UNIVERSITY OF CALIFORNIA, SAN DIEGO

Introducing "Clustering:" Redistricting in Geographic Perspective

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Political Science

by

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This Dissertation of Justin Mark Levitt is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

Chair

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DEDICATION

This dissertation is dedicated to the memory of my grandfather, Nissel "Sol" Levitt.

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ABSTRACT OF THE DISSERTATION

Introducing "Clustering:" Redistricting in Geographic Perspective

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Previous research in redistricting has treated geography and institutions as two separate, disconnected questions. Geographic variation in partisanship and race has mostly been treated as a structural question best suited for long-term, big picture discussion (e.g. Rodden 2009, Bishop 2005). As a result, scholars looking at institutional variation between redistricting systems have normally treating geography as control variable distributed randomly throughout the jurisdiction (Masket 2012, McDonald 2006). I bring these two dimensions into dialogue with each other first by looking at how spatial autocorrelation—

clustering—shapes tradeoffs within a single geography and second, how legislatures and commissions make different choices when faced with similar levels of clustering. I test the former by simulating plans that maximize each of competitiveness, compactness, and the number of majority-minority seats in two states using the Better Automated ReDistricting (BARD) tool. I show that the more highly clustered a state is by race, the more majority-minority seats can be drawn. Conversely, states highly clustered by party produce fewer competitive seats. I also show that the tradeoffs between compactness and competitiveness are larger in a state more highly clustered by party while the tradeoff between compactness and number of majority-minority seats is smaller in a state more heavily clustered by race. In addition to the direct impacts of clustering, I show that once we control for the level of clustering in a state, redistricting commissions in 2011 produced more compact and competitive maps than their legislative counterparts. However, commissions are more sensitive to the degree of clustering than legislatures and consistently refuse to trade compactness for either competitiveness or more majority-minority seats under extreme levels of clustering. What this demonstrates is that commissions can produce plans that are more compact, competitive, and contain more majority-minority districts—as long as it doesn't interfere too much with the general appearance of the district. Ultimately, this project shows the danger of studying a geographic phenomenon without thinking about the underlying geography in a systematic way.

Chapter 1

Making Decisions in San Diego

It was a long, hot July day in the City of San Diego. The city's Redistricting Commission was under a deadline to approve a draft map by the end of the day. Most of the issues had been resolved, if only preliminarily, but Golden Hill was turning out to be a sticking point.

Proposition A, passed the previous year, had increased the size of the City Council from eight to nine members, but adding a new district had required taking population away from the old majority-Latino Eighth District. Golden Hill, always ethnically mixed, in the process of gentrifying, and now bordering the Third District on three sides, seemed like a good choice to move from the heavily Latino Eighth to the LGBT-dominated Third. The neighborhood was home to many Latino politicians, including the city councilmember.

The one Latino member of the Redistricting Commission wasn't budging on this point. It was important that this neighborhood historically linked to the Latino community was not moved. The other six members expressed their sympathies with his position—but what could they do? The proposed Eighth District consisted of the San Ysidro-Otay Mesa area, only connected to the city by a fifty-foot wide corridor in the middle of San Diego Bay. At the north end of this strip were the historic Latino neighborhoods including Barrio Logan, designated as the Latino area in the days of racial covenants. Together, these comprised 100% of the population of a district.

Making the situation trickier, the Eighth District, though 75% Latino by total population, was only 57% Latino by eligible voter population. Golden Hill was only 30% Latino by the eligible voting population, and would bring down the Latino population

further. Not to mention that if Golden Hill—or even part of it—were added to the Eighth, part of the 80% Latino Barrio Logan would be removed from the district.

As the minutes ticked by, the commissioner requested tests involving swaps between Districts 3 and 8, three-way swaps between Districts 3, 8, and 9 or 3, 8, and 4, underpopulating District 3 and overpopulating District 8. It was all to no avail; each of these proposals ended up increasing the number of neighborhoods split, in most cases across freeways. Eventually the chair spoke up. "I think we're all sympathetic to putting Golden Hill, or part of it in District 8, but I just don't see a way to do it without dividing a lot of neighborhoods. Neighborhoods that want to stay together."

Eventually, the plan kept Golden Hill together in a single district—District 3. The commission had faced a clear tradeoff: they could draw districts around incumbents or around neighborhoods. They had chosen neighborhoods.

Twenty years earlier, the city had made a different choice. In 1988, voters had switched San Diego's "from district" election system, in which a primary was held in a district, but the general election for the seat was held citywide, to a "by district" system, where both the primary and the general were held in the same district.

As a consequence, the current District 8 incumbent (and future mayor) Bob Filner worried that if he had too many Latinos in his district, he might lose his seat. Fewer than 600 votes had separated the top three in the district primary, and his margin of victory had come in the citywide general election, not in his heavily Latino home district.

So he convinced others on the council to help "crack" the Latino neighborhoods. The twenty five-foot wide, ten-mile long corridor between San Ysidro and Barrio Logan would be divided in two, and San Ysidro would be split. Barrio Logan would also be

divided, and a "finger" reaching up from—no surprise—Golden Hill would reach into mostly White South Park would grab Filner's home. The rest of San Ysidro and Barrio Logan were added to the Second District, a conservative district dominated by the military and downtown. Filner won his new district in 1991 against only token opposition.

While this "Filner finger" did not prevent Latinos from coordinating with the Democratic Party to lock out serious non-Latino contenders after Filner's election to Congress in 1992, the bad taste of the 1991 redistricting led to the adoption of an independent redistricting commission in 2001—whose first public statement was that all of San Ysidro was a community of interest that needed to be kept together.

Overview of the argument

Incumbency or neighborhoods? Redistricting often demands making this sort of tradeoff. Indeed, the political nature of redistricting stems from the fact that these sorts of tradeoffs have to be made. While the courts, Congress, the Constitution, and even city charters constrain these tradeoffs, at the same time, they enable them—districts that must be population-balanced cannot perfectly align seat to neighborhood. It is up to the strategic actors—the institutions charged with drawing these lines—to decide between potential criteria.

Redistricting often begins at this stage. The politics of redistricting—tradeoffs, bargaining, rule setting, and institutional inertia—have been part and parcel of this. Stories and anecdotal evidence from individual states and cities point to the significant consequences of who draws the lines (Winburn 2006; MacDonald 2012). Yet larger studies often struggle to find significance (Masket et al 2012; Jacobson 2005; McDonald 2006).

Even when effects are found, they tend to be marginal compared to alternative explanations such as the national swing. What's missing?

Geography is the link. Politics happen, yes, but the context in which they happen is not random but systematically constrained. So it is essential to understand that not only do different jurisdictions n have different geography, but that this geography results in different tradeoffs as well. By excluding geography from the model, studies have treated geography essentially as a random process. Whatever differences there are between North Carolina and Indiana will washed out given a large enough sample. What I argue, essentially, is that *geography is not random.*

Many studies have controlled for demography—percent African-American, for example—but analyses of redistricting have typically missed the fact that the distribution of a state's African-American population is not random. In other words, a state or city that is 5% African-American where all the African-American population is concentrated in a single area will present very different tradeoffs from one where they are in pockets throughout the jurisdiction.

Geography, because it helps us look at how people are distributed across the jurisdiction and what consequences it may have, shows why the politics of redistricting alone are not enough to have a full picture of the process. Indeed, treating geography as random leads to a specific conclusion: the assertion that all jurisdictions face the same tradeoff. What I show is that geography not only shapes the scale of the tradeoffs, but even *whether tradeoffs exist at all.* The infamous tradeoff in *Shaw v Reno* (1993) between compactness and majority-Black districts that defines North Carolina redistricting simply does not exist in New York.

This in turn must impact how scholars study the effects of institutions. Previous research on redistricting commissions has focused on changes to individual districts (e.g. Masket et al 2012, Winburn 2008) following Gelman and King (1994) without controlling for the different potential for outcomes in different states—when the conclusion is that Ohio's legislature produces more competitiveness than Hawaii's commission, the result should be expected *because of* the geographic distribution of voters: while Ohio has large areas of heavily Republican and Democratic precincts, Hawaii has no precinct in which Republicans make up more than 40% of the vote share in the 2008 election, for example. It is literally impossible to create competitive districts in Hawaii without going street-by-street selecting blocks.

This project is a starting point for a systematic analysis of geography in redistricting. There are many potential links between geography and districts and a single study cannot pretend to trace all the ways geography systematically connects to redistricting, this study opens the book by looking at a particularly important dimension for understanding and predicting when tradeoffs should occur: spatial autocorrelation, or clustering. Spatial autocorrelation is a measure of how well neighboring units predict the value in a given unit. Jurisdictions with high levels of clustering tend to have large, homogenous regions, while lower levels tend to reflect greater heterogeneity between neighbors.

I argue that clustering by race and by party create situations in which the tradeoffs faced by each jurisdiction is different. Structural factors like the Voting Rights Act and "One person one vote" create situations where jurisdictions are potentially forced to make tradeoffs, but some will have a larger tradeoff to make than others. Washington, for

example, has a much more substantial drop in compactness than Arizona if it wants to draw majority-non-White districts.

Institutions operate, then, within the bounds of these necessary tradeoffs. And what I will demonstrate is that Commissions are indeed making different tradeoffs from Legislatures. At certain levels of clustering, however, Commissions may come to the same conclusion as a Legislature, or even produce fewer competitive or majority-non-White seats. Results like Arizona producing fewer competitive seats (McDonald 2006) are not surprising given the degree of clustering by party. By seeing how the geographic structure—spatial autocorrelation—changes the possible outcome space, we are better able to predict how changing redistricting institutions will lead to different results.

Connecting Geography and Representation

Redistricting Institutions in Geographic Context

The answer this project advances is grounded in the larger question of what is most important in redistricting: politics or geography? In other words, is it the strategic choices made by individual actors or small bodies of individuals, or the structural factors like demographic change that are more important for redistricting? Of course, this has never been an either-or question. But it is important to begin with setting up the problem in this way to look at the problems inherent in the question.

From the Athenians' division of the polis into zones that contained both urban and rural areas (Manin 1997) to modern election reform groups' push for independent commissions, most have come down on the side of politics. Even if geographic factors are present, they are dealt with by political organizations. Institutions can be—and are—used to

transform how people see themselves, and mitigate concerns about localized, parochial interests or simply imbalance between various interests within society (such as Madison's argument in *Federalist 10*).

This notion that citizens should focus on political institutions rather than social context is found not only in the *Federalist,* but assumed throughout the processes in use in the United States today, where courts, legislatures, and voters have looked toward institutional reform to transform representation. The US inherited from the British an emphasis on geographic-based representation, in which places formed the interests in the legislature. This gave rise to apportionment systems that guaranteed each county or township a minimum number of representatives. For adjusting the boundaries of representative districts, the authority was vested in the legislature. The general custom was for each House to take the lead on drawing districts for itself: the lower house would draw House (or Assembly) districts, the upper house Senate districts, and each would defer to each other.

The Governor, of course, could veto the plan, but could be overridden. The state courts by and large followed the Supreme Court's guidance that redistricting was a purely political matter and not an issue for the judiciary. There was no limit to how often a state could adjust its boundaries. After the Civil War, legislatures might redraw if a party had been swept into power. This reached a crescendo in the 1880s, when Ohio redrew its legislative districts four times in the decade.

Redistricting Reform and its Contexts

Yet despite the fading appeal of constant redrawing by 1900, no real call for reform developed until the 1970s. Until the reapportionment revolution in the 1960s, many states

redistricted infrequently because neither party was willing to pay the cost of changing district lines, which would have meant a large transfer of power from rural to urban areas (Katz and Cox 2002).

The reapportionment revolution recast the representative link from a legislature of places to a legislature of people—"one man, one vote." As a result of cases such as *Reynolds v Sims* (1964), which forced states to reapportion state legislatures, dramatic shifts of power from rural to urban and urban to suburban areas happened across the country. This led to the first calls for reform. Scholars in the hard sciences focused on outcomes, arguing that if we could define an optimal outcome, then all we will need is an algorithm that implements it. For example, Reock (of compactness fame) hoped that computers could eventually develop an automated districting system (1961). Modern versions of this thesis appear regularly in physics, economics, and mathematics journals (to give just a sampling: Rincon Garcia 2013; Guo and Jin 2011; George et al 1997).

However, social scientists in political science, law, and sociology, as well as political reform groups have long distrusted this approach. The "one size fits all" approach of optimization algorithms has particularly come under scrutiny (Altman 1997; Altman and McDonald 2009). In particular, Butler and Cain (1992) point out the sheer variety of potential criteria to be maximized and the potential for loss along another criterion if a single one is selected. While it is not clear that there is *always* a tradeoff between majority-minority districts and competitive ones, some evidence suggests that the push for more majority-Black districts in 1991 led to more safe Republican seats, particularly in the South (Cameron et al 1996, Canon 1999).

Political reform groups, then have turned away from outcome-based approaches in favor of procedural reforms. This school of thought argued that "bad" outcomes (such as preservation of incumbents) stemmed from the self-interest of legislators drawing their own districts. Therefore what was needed was a non-partisan board or commission imbued with the authority to draw district boundaries independently. While they claimed this would undo the effects of legislative gerrymandering, the crux of the argument focused on increasing public engagement, education, participation, and oversight—goals redistricting commissions have certainly met (MacDonald 2013).

The notion of commission redistricting was new in the US in the 1980s—the decade when Hawaii and Washington adopted the system—but not new elsewhere. Other single-member district systems based on the British model had long taken control of those lines out of the hands of the legislature. Australia had put control of its redrawing in the hands of the civil service agency, the Australian Electoral Commission, in 1902, the UK itself from 1944. Even Canada transferred this authority to their Electoral Commissions in the 1970s and required each province to do to the same for its provincial assemblies. While it is not certain why interest in redistricting reform remained minimal in the United States before the 80s, institutional factors such as decentralized state control over the process and the multiple veto players as well as implications for ethnic and racial representation, and strength of incumbency and party in different parts of the country imposed steep costs on adoption (Butler and Cain 1992; Katz and Cox 2002). Those states that have adopted redistricting commissions in the US overlap those in which progressive politics were strongest (Bridges 1999), both in the far West and Northeast—areas with strong traditions of non-partisan or independent politicians.

Now if we accept that tradeoffs vary from area to area—that we cannot simply measure the success of a redistricting by looking only at a single competitiveness or compactness measure—we return to the original state: however institutions try to capture the interests that make up a society, a district-based system will necessarily return to the question of how those interests are structured geographically. Thus it is important to consider three ways in which societal change in the 20th century altered the nature of geographic representation: urbanization, sorting, and technological advancement. While these structural answers are not purely geography, each connects to the underlying role geography plays in representation.

Urbanization and the "Long Shadow of the Industrial Revolution"

In 1920, the Census recorded that for the first time, a majority of Americans lived in cities. By 2000, a majority of Americans were living in suburban areas around central cities—a number that did not even include the suburban style of many parts of newer cities from San Diego to Miami—and only about one in five live in rural areas. This is the heart of Rodden's (2009) hypothesis that argues the demographic transition caused by the Industrial Revolution and structural shift toward urbanization to explain why districts are increasingly safe.

Essentially, urbanization created larger, more homogenous areas within cities, so where pre-modern districts were forced to include a more diverse set of neighborhoods, now districts often are entirely within an area with a similar socio-economic and partisan profile. This is reflected in a greater level of homogeneity within neighborhoods, counties, and states today than in previous eras. The partisan dimension is particularly telling: where the average pre-Industrial Democrat lived in a geographic unit that was only about 65% Democratic, the

average contemporary Democrat lives in an area that is on average 80% Democratic. The comparative figure for Republicans has stayed steady at 60%, because Republicans do better among non-urban voters in either rural or suburban areas where residential patterns continue to have more heterogeneity because neighborhoods are not as large.

The lower levels of Republican clustering leads to a structural advantage toward the Republican Party—especially when Republicans and Democrats are nearly evenly matched at the state level (Rodden 2010; Chen and Rodden 2013). Just look at Missouri, Florida, and Virginia—states that are competitive nationally in Presidential elections but have disproportionately Republican Congressional delegations. Missouri is particularly telling. Of its eight Congressional districts, Obama received over 85% of the vote in 2008 in two of them, while in the remaining six, McCain received about 60% in each—and won the state by less than 0.5 percentage points.

Rodden argues that geography creates this structural advantage and the implication is that erasing this structural advantage necessarily entails joining areas with different socioeconomic profiles. There are also drawbacks to doing so—artificially linking neighborhoods with little in common may not serve either community well, even if it results in more partisan proportionality. The theory also offers little in terms of an explanation of redistricting behavior. It does not predict when jurisdictions draw more proportionate plans by party and or choose more compact districts. Nevertheless, Rodden's use of spatial autocorrelation to measure impacts of geography for representation is telling; it functions well as a way of getting at the real issue that those drawing districts cannot merely ignore what neighboring units look like when placing lines.

Sorting

While Rodden offers a descriptive picture of how increases in clustering lead to structural advantage, theories of sorting (Tiebout 1956; Bishop 2009) offer a causal process. Sorting connects systemic factors with individual behavior: how partisanship maps on to identity is systematic, but the behavior leading to change is ultimately a decision by the individual or individual family unit.

The thesis posited in the Sorting Hypothesis (Bishop 2009) is straightforward: geographic areas (e.g. counties, districts) have become increasingly homogenous because people are choosing to live in more socially, economically, and politically homogenous areas. People who go to church regularly find neighborhoods where others go to church regularly and so forth. While Bishop acknowledges factors like segregation and ethnic enclaves, he argues that ethnic separation does not produce the same level of similar thinking because there is more likely to be a diversity of opinion among Italian-Americans than there are people who are deliberately choosing a particular lifestyle.

This argument draws on the insights of Tiebout (1956) in offering a scenario in which the costs to Tiebout sorting were dramatically reduced. Tiebout argued that people have specific preferences in the tradeoff between government services and taxation, a situation in which individuals seek an optimal location given their preferences. Communities then offer different sets of services and tax levels in order to attract residents, and engage in competition for residents by offering more services or cutting taxes.

Though Tiebout's model depends on quite a number of assumptions, it does help explain the long term trends identified by Bishop. As legal barriers to desegregation have fallen, the suburbs have become increasingly heterogeneous (Frey 2006), and even central

cities have turned toward neighborhood-based planning (Peterman 2000). These trends increase the individual's ability to find a community with the right mix of policies. Furthermore, increased amount and accessibility of real estate data allows individuals to make a more informed choice. It has become increasingly easy to identify and choose to live near those with similar political beliefs.

What this means for social interaction, combined with the increasing size of these communities, is that sorting makes areas more uniform. It becomes increasingly likely that the Hillcrest resident never meets a Republican voter nor the Poway resident a Democrat. However, there is no direct link between sorting and districting. While sorting may alter the tradeoff between keeping neighbor-hoods intact and other aims, with the possible exception of areas where the Voting Rights Act comes into play, nothing prevents districts from being drawn to divide communities.

Technological Advancement

In fact, drawing districts that do divide communities has become increasingly easy to do. Before 1940, the county was the only geographic unit of analysis for most of the country. There were townships in some northeastern states and a few large cities like Boston had wards, but very little precise local data existed. By the time courts mandated the lines be redrawn according to population in the 1960s, only around 100 cities were delineated into "Census Blocks"—literally a city block—and only in those counties that contained one of these cities would there be tract data collected.

The necessity of better information following the Supreme Court's decisions in *Wesberry v Sanders* and *Reynolds v Sims* (1964) resulted in the expansion of Census Tracts nationally in the 1970 Census and then Census Blocks in 1990. Over the next two decades,

the Census doubled the number of Census blocks from the original 1990 scheme. These new blocks added an immense degree of precision, because information on population, housing, employment, family structure, and even education was now available at a small unit of geography.

Thus a large factor leading to the first wave of modern gerrymanders has been in the increasing complexity and sophistication in redistricting (Altman 2005). With the assistance of computers to keep tabs on the addition, it was now easy to connect this block-level information to registration and voting patterns, to where incumbents lived. Better computers, including the development of GIS software by 1991 and stronger enforcement of the Voting Rights Act following the 1982 reauthorization exacerbated these problems. Elbridge Gerry had to use whole townships in 1815; Jerry Brown was able to stretch a one-block wide finger into the San Fernando Valley to pit two Republican incumbents against each other in 1981.

This factor thus contains a measurement issue as well as a substantive component. It is not merely that society has changed, but our capacity to measure and divide people has been drastically expanded. Where gerrymandering once relied on politicians' instincts (as Fenno (1978) described), today redistricting uses a whole host of tools that have increased the accuracy and precision—and thereby the predictability of the results.

Nevertheless, while the technical changes have expanded the potential for extreme gerrymandering, they have also allowed for experimenting with a broader array of redistricting options. For example, working with Census Blocks allows states like North Carolina to draw reliable African-American districts today where they couldn't in the 1970s. Furthermore, expanded precision has only strengthened the role of geography in drawing

districts by allowing us to describe not only communities in general but specific parts of a community individually.

The demographic transitions of urbanizations and sorting, the mass movement of people into self-selected communities, only exacerbates the underlying natural phenomenon of clustering. Certainly it makes the measurement and analysis of it more important. But so far we have studied these phenomena such that the impact on redistricting and representation detached and secondary. We have seen that changes in society and technology have an impact on redistricting, but we have not studied the relationship between greater degrees of clustering and outcomes directly. Further, we have not studied the particular role institutions have in shaping this relationship. While this dissertation is not historical, it nevertheless shows why clustering matters at the micro level, and thus has important connections to the institutional processes by which districts are drawn.

Plan of the Work

This project is a starting point for a systematic analysis of geography in redistricting. There are many potential links between geography and districts and a single study cannot pretend to trace all the ways geography systematically connects to redistricting. This study opens the book by looking at a particularly important dimension for understanding and predicting when tradeoffs should occur.

Ultimately, this is a study about the role of geography in redistricting, and how different redistricting institutions approach making tradeoffs in redistricting given that their tradeoff space is limited by clustering. Clustering sets the stage for these most brutal of

political fights, but it has remained relatively underdeveloped as a mediating factor on what tradeoffs are available and what sort of outcomes might result.

The main thrust of the project analyzes how clustering impacts the potential for tradeoffs in redistricting. Chapter 2 delves into the nature of clustering, arguing that clustering should change how we look at and evaluate redistricting criteria. Using toy models and illustrations of states, I argue that the level of clustering has implications for the degree of a tradeoff that exists between two potential criteria. This chapter also introduces the three criteria most commonly cited as redistricting aims: compactness, competitiveness, and communities of interest.

Chapter 3 continues the analysis of clustering on drawing districts. This chapter compares two states with similar institutions, but widely varying results. Using districts drawn to maximize different potential redistricting criteria using the Better Automated ReDistricting program (Altman and McDonald 2009), I argue that the difference in degree of clustering produces the difference in results between these two states.

Returning to the question that inspired this study, whether redistricting institutions matter, Chapter 4 asks whether clustering can help explain the lack of findings about redistricting commissions. I show that redistricting commissions are making different choices than legislatures. However, the tradeoff commissions make is not constant across all levels of clustering. When clustering is low, commissions often behave in a different way vis-à-vis legislatures than when clustering is high. Finally, Chapter 5 explores the implications of how institutions respond to geographic clustering.

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Chapter 2

Evaluating Clustering and Redistricting Criteria

Spatial autocorrelation—clustering—is an important tool in understanding how people are distributed in space. By measuring the degree to which knowing one's neighbors can predict one's characteristics, we improve our predictions as to what sorts of districts are likely to occur if a specific criterion is used. Further, it allows us to predict the potential impacts on tradeoffs between standard redistricting criteria. This may include even whether a tradeoff exists at all, and if so, to what degree. Thi

s is considered through a geographic analysis of the states. In addition, the measurement of standard redistricting criteria is compared and evaluated in light of its theoretical and empirical utility.

A Political Windfall?

In 2010, African-American activists felt they had a significant windfall: South Carolina had unexpectedly picked up a seventh Congressional District. Surely in a state 28% African-American, there was a strong possibility that the new district could be a second majority non-White district. While the state had a single majority-Black 6th District since 1992, it only contained the most heavily Black areas in Columbus and Charleston. Nearly three quarters of the state's African-American population lived outside the district.

The NAACP felt a second majority-Black district was possible (South Carolina House of Representatives 2011). Black communities in Myrtle Beach on the coast and Spartanburg in the piedmont were in majority-White districts. Yet when it came to select a plan, the only African-American Congressman, Jim Clyburn, persuaded the NAACP to

support keeping his district above 55% African-American rather than risk two districts barely 50% African-American from not performing.

800 miles north, Illinois had lost one of its 19 Congressional districts. Unlike South Carolina, Illinois already had three majority African-American districts. But unlike South Carolina, however, there was no question of eliminating any of these seats. Each district had to grow, of course, but keeping the three districts above 55% African-American was no challenge. Despite the fact that African-Americans make up just 14% of the state's population, they make up a larger share of Illinois' Congressional delegation.

We might be tempted to say that Illinois is simply politically different from South Carolina—it is more liberal, more Democratic. When faced with a tradeoff between safe Democratic seats and likely Republican ones, Illinois chooses the former instead of the latter. Or perhaps we blame the Voting Rights Act: if South Carolina did not have to avoid retrogression for preclearance, it would produce more majority-Black districts.

But while South Carolina does face a different political climate and different constraints, this point does not seem to explain why South Carolina—even despite a series of court decisions over Black representation—continues to struggle in a way Illinois seems to be able to avoid. What makes South Carolina so different from Illinois is not just culture, not just the legal environment.

This is because South Carolina faces a different set of conditions than Illinois stemming from its geography. *Even if* the Illinois legislature wanted to behave in the same way as South Carolina, they would still produce a different map. That is to say, the Illinois legislature never faces the tradeoff between compactness and majority-minority districts South Carolina's struggles with each year.

This chapter explores this phenomenon. I argue that clustering is specifically key to understanding the role of geography in redistricting: geographic clustering shapes the map in systematic and predictable ways.. The first part of the chapter defines and explores clustering itself. It looks at how clustering is measured and why it is essential. It suggests how the degree of clustering can result in different tradeoffs.

The second part of the chapter discusses the main criteria used in redistricting: compactness, competitiveness, and communities of interest (including ethnicity). It also includes constraints on redistricting such as population equality and contiguity. The final section tackles the question of making these tradeoffs. It argues that different types of institutions have interests that lead them to prioritize particular criteria.

Clustering: Theory and Definition

Spatial autocorrelation, or clustering[1], is a measure of similarity over space (Getis and Ord 1992). That is, it is used to determine the degree to which a particular variable or measure is randomly distributed in space. It provides the degree of similarity between any given unit and its neighbors, by indicating how well the surrounding values predict the value for the unit itself.

Like temporal lag, spatial autocorrelation tries to capture the fact that the degree of difference between two units—points in time, points in space—become increasingly different as they become farther apart. This is best expressed in Tobler's First Law of Geography (1970), which states, "Everything is related to everything else, but near things are more related than distant things." Just as one might more accurately predict 2002 GDP from

[1] Throughout this paper, I use "clustering" and "spatial autocorrelation" interchangeably. "Spatial autocorrelation" is the more technical term, because "clustering" can have alternative meanings. However, ArcGIS refers to the Moran's I tools as "Cluster analysis."

2001 and 2003 than from 1987 and 2012 data, one can predict the share of voters registered Republican in a precinct more accurately knowing adjacent precincts than knowing results from randomly chosen precincts.

To go through a basic example, we can look at Figures 2.1 and 2.2, which show race and partisanship in South Carolina and Illinois. What we can see is that even though both states are a similar proportion non-Hispanic White, the distribution of the non-White population within the state is much different. In Illinois, the non-White population is largely located in metropolitan Chicago. All three African-American-majority districts and the majority-Latino district are in the area. Almost all the area outside of Chicago is over 90% non-Hispanic White. A similar pattern appears with respect to election results.

Contrast this to South Carolina. Even in the state's largest cities, African-American and White, Democratic and Republican neighborhoods fade into each other—only in the Appalachian foothills in the northwest of the state does one find larger areas that are predominantly made of a single ethnicity. And though small towns and cities continue to face segregation at the block level, this gets washed out by the precincts and Census Tracts because the scale is too small.

(Figure 2.1 about here)

(Figure 2.2 about here)

Measuring Clustering

While Figures 2.1 and 2.2 show simple raw percentages, they hint at how clustering is measured. One begins with the raw geographic percentages—or frequencies—and

calculates a measure of similarity between one unit and its neighbors, which produces a local indicator not too different from a spatial lag variable.

Unlike spatial lag, clustering also determines whether the pattern of values across the jurisdiction is random or not. Given the hypothesis that we are equally likely to find a similar or dissimilar value for each adjacent precinct, can we reject the possibility that the actual distribution is random?

These individual values for each unit are aggregated together across the entire geographic area and becomes a global indicator of the distribution of some criterion of interest through the space. As South Carolina and Illinois illustrate, the more closely related adjacent values are, the higher the degree of clustering—Illinois has a level of Non-Hispanic White clustering at 0.8, while South Carolina has a level of 0.4.

The potential values of Moran's I run from -1 to +1, with the measure essentially indicating the correlation between a randomly chosen unit of geography and its neighbors. So if we picked a random geographic unit in an area with a Moran's I of -0.3, we would reduce our chance of being wrong about its neighbors if we assumed they were different 30% of the time. South Carolina's score indicates there is only a 40% chance that a precinct's neighbors have a similar demographic profile, while Illinois' score of 0.8 shows a much greater degree of similarity.

Moran's I can be run in ArcGIS using a standard implementation (ESRI 2016). Other programs, including R and GeoDA, offer implementations as well, but they often use non-standard formulae or are based on other GIS packages that lead down a rabbit hole. ArcGIS also has an advantage that it returns a confidence level alongside each test. Moran's I is also well-represented not only in political science (Rodden 2010, of course, which inspired

this project. Also Chen 2013 on distributive benefits, Gilardi 2015 on women in politics) but also as a marker of clustering in public health (Zhang et al 2008 on disease incidence, Baltagi and Moscone 2010 on health economics), economics (Arbia 2001 on employment concentration), sociology (Baller and Richardson 2002 on suicide rates, Alba et al 2014 on Latino residential patterns).

Why Clustering?

Why clustering? Of the many available measures of geographic patterns in the data, why do I focus on the global Moran's I as my variable of choice? The simple answer is that it is the best geographic measurement of the components of districts.

In order to be the best possible measurement of geography for studying redistricting, the choice of measures has to satisfy two criteria. First, it must be a global measure. Second, however, it must be able to tell us something about local conditions. Third, it must also provide information on extent. That is, it must be able to tell us something about the relationships between individual units of geography. The strengths and weaknesses of each possible measurement are summarized on Table 2.1.

(Table 2.1 about here)

Each criterion is important in its own way. First, it must be a global measure rather than a local measure in order to tell us something about the overall capacity to draw districts. Local measures, such as Anselin's Local Moran's I (Anselin 1995) or the Getis-Ord G_i, indicate "hot spots"—individual precincts or sectors with a significantly higher or lower than predicted value (Getis and Ord 1992).

In essence, they can provide individual estimates of spatial autocorrelation for each geography. Because each value has its own level of significance, we can tell if a region is a good place to draw a single district or not, but we get very little picture of the situation as a whole. For this project, the global measure is more important because we are looking at overall capacity to draw districts. However, future work should be done looking at local clustering and using "hot spots" to identify potential areas where a single district might be drawn.

Second, it is important that a measure must tell us something about local conditions. Virtually all studies of redistricting include global measures such as overall percent Republican or Latino. However, this assumes that the demographic variable is spread randomly throughout the population—in essence, treating geography as a simple control. In this study, I seek to treat geography as a variable, something that looks different depending on which state one is looking at.

Third, the measure must tell us something about extent—that is, the relationship between any two geographic units in the system. This is where a metric like a basic spatial lag falls. A spatial lag might be able to tell us whether the value in a single geography is a function of its neighbors, it says nothing about the distribution across all neighbors.

This criteria also eliminates measures of segregation. The relationship between segregation and clustering is, as Massey and Denton (1988) say, "empirically associated" but "conceptually distinct" (293). The difference is that measures of segregation start with a null hypothesis that the variable of interest is distributed evenly throughout the geography. Each

unit of geography is compared to the ideal distribution if each population was distributed evenly.

To illustrate this difference, compare Illinois and South Carolina again. Both have similar degrees of segregation—at the individual precinct level, most are either solidly African-American or White. There is a high degree of segregation in both states. However, the degree of clustering is substantially lower in South Carolina—that precinct may be entirely Black, but if it is surrounded by a mix of White and Black precincts, its clustering is not as high.

Ultimately, segregation is at heart about homogeneity and isolation. We look at segregation when we want to know if a unit or area is different from the whole. Douzet (2007), for example, uses a measure of segregation, the Thiel H, to compare racial composition of a given tract to the county as a whole. Another major difference is that segregation is more directly about non-geographic factors. For example, a common index of segregation uses 20 different criteria (Massey and Denton 1988, Massey, White and Phua 1996), including measures of exposure and centralization.

Now, clustering can be limited by the fact that it cannot distinguish between areas in which a single group is dominant and areas where every geographic unit is simply identical to its neighbors. Nevertheless, in this particular study, I argue that clustering better suits the purpose. Clustering ensures that we can see the extensiveness of the pattern—we can see if segregation produces more easily defined zones or simply an anomalous unit surrounded by areas unlike it.

Clustering in the American States

General Observations

Clustering in the United States is not uniform, but there are some general trends. Table 2.2 and Figures 2.3 through 2.7 show the level of clustering by each of the major four racial groups in the US by the Citizen Voting Age Population (CVAP) from the 2005-2009 American Community Survey. As I discuss later, I use CVAP because the courts have generally settled on this measure for judging majority-minority districts, particularly where Asians or Latinos are involved. Figure 2.3 shows clustering for the non-Hispanic White by quartile, Figure 2.4 does the same for African-Americans, Figure 2.5 for Latinos and Figure 2.6 for Asian Americans. Table 2.3 and Figure 2.7 show the level of clustering for the 2008 Presidential election, as calculated at the precinct level. Data comes from Ansolabehere and Rodden 2011 for election results by precinct and Census 2010 for race/ethnicity.

(Table 2.2 about here)

(Figure 2.3 about here)

(Figure 2.4 about here)

(Figure 2.5 about here)

(Figure 2.6 about here)

(Table 2.3 about here)

(Figure 2.7 about here)

-As predicted by Tobler's Law, every single result is greater than zero. That is, for every statistically significant result, ethnicity and partisanship are somewhat geographically concentrated. The degree of clustering ranges, however, quite a bit. While Blacks and Whites are more heavily clustered throughout the entire country, Asian Americans in particular are less heavily clustered.

Table 2.2 also indicates an important limit to clustering or simply to natural geography. States with low populations of a particular ethnic group (or conversely, overwhelmingly dominated by a particular group) often appear to have lower levels of clustering that we might expect. In these cases, we should be more careful about interpreting the Moran's I statistic. This phenomenon is apparent when we look at states like Maine, which has a Non-Hispanic White CVAP of 95%. Its p value is only significant at the 0.05 level, while most states' significance are well below the $p<0.001$ level.

This is also true for many states with small populations of specific ethnic groups. This is because as the variance within a geography decreases, the denominator of Moran's I approaches zero—undefined. This means that Moran's I's utility is greatest when there is a good deal of diversity within the geography as a whole.

Patterns of Clustering

Race presents two clear trends. First, on a global level clustering correlates with the size of the racial group. States with insignificant populations of a particular racial group (or conversely, overwhelmingly dominated by a group) are more likely to have clustering closer to random. In some states with very small numbers for a particular group (such as Asians in

Maine, the *p* value is not even statistically significant, indicating that even assuming a "random" distribution is suspicious.

More importantly, we see regional patterns in the data. With respect to the non-Hispanic White population, the industrial Northeast and Midwest (with the exception of Maine and Iowa, which have extremely low non-White populations) is heavily clustered. The Deep South and West, with the exception of California, have much lower levels of clustering. This corresponds to historical patterns of migration, particularly of the African-American population.

This pattern is reinforced by the trends we see in the Black clustering data. Among states that are over 5% African-American, South Carolina, Louisiana, and Mississippi have the lowest level of clustering and Wisconsin, Missouri, and Michigan have the highest rates (among Western states, only California is greater than 5% Black). Again history serves as a good predictor of how states fall with respect to clustering. States with the highest degree of clustering, particularly by race, tend to correspond to states where migration of racial/ethnic groups was a predominantly urban phenomenon. Low levels of clustering correspond to states where Blacks were historically enslaved or kept in subsistence labor until the mid 20th century.

It should be noted that we do not see the same regional patterns with respect to partisan clustering. While some Midwestern states—particularly Ohio, Michigan, and Illinois—continue to top the list of most clustered states, other states heavily clustered by race, such as California and New York, are among the lowest clustered by party.

These results begin to put existing findings into context. For example, Goedert's (2012) conclusion that Black-maximizing districts in the Deep South are statistically

indistinguishable from partisan gerrymanders is a product of the low levels of both party and racial clustering in the South. Most notably, his finding does not apply to Border States like Texas and Tennessee, where the levels of clustering are substantially higher than in Deep South states like Alabama and South Carolina.

Similarly McDonald's (2010) finding that compact Midwestern districts tend to produce Republican majorities despite Democratic registration advantages corresponds to clustering as well—Midwestern states tend to be very heavily clustered by both race and party and if Rodden's (2010) Industrial Revolution story holds, that would lead to high levels of clustering, empowering Republicans when compactness is prioritized.

Measurement in Redistricting

Measurement and Representation Theory

The first step in understanding how geography impacts redistricting is thinking through the major ways of measuring the goodness of districts. In general, what I will do here is narrow the broad, abstract categories of measures into specific, concrete variables. Then in Chapter 3, I will explore the relationship between each measure and outcomes in redistricting. Thus, in this section, I cover the variation in the forms of measurements used in redistricting and discuss why we care about each type of measurement, why it should matter, and finally, what can has been theorized about its interactions with other measures before accounting for geography.

Now before delving into a discussion of each measure, I want to discuss the problem of measuring districts more generally. The question of measuring districts is not new. Dozens of measures of districts have been used, often tailored to a specific study or purpose.

Just as a taste of the problem, Niemi et al (2009) list over 36 measures of compactness that had been proposed prior to the 2001 redistricting cycle. However, one of the redeeming qualities of this multitude of measures is that they are often designed not for the purpose of evaluating districts *qua* districts, but rather districts as they relate to electoral or policy outcomes.

Furthermore, the challenge of representation theory is that there is no single variable of interest that magically produces the "best" districts. Indeed, one can find arguments for the most competitive districts possible (Manin, Przworski, and Stokes 1999) and arguments that single-party homogenous districts will maximize voter satisfaction with their representatives (Brunell 2008). On one hand, we have a concern about wasted votes, and on the other a lack of accountability. Perhaps the only true point of agreement is that the problem lies with the choice to use districts itself.

Even there we run into issues. Abandoning an electoral system based on single-member district representation doesn't *eliminate* concerns, but changes their nature. Single member districts allow for a clear tie between representative and represented, which is important for not only accountability but for bringing government closer to people (Rehfield 2002). Furthermore, simply assuming that all African-Americans or other communities would be better served by small parties that only represent that community further marginalizes these communities (e.g. Carroll 2001, Gay 2009).

The conclusion should not be that good representation is impossible, but rather that it can be analyzed in multiple ways. Representation theory gives some possible goals—including but not limited to minimizing wasted votes, maximizing competitiveness, obtaining

a legislature that is "the population in miniature," keeping communities intact, and reflecting the physical and socioeconomic divisions of the population.

Recognizing that some of the goals are contradictory, the potential subjectivity of others presents a serious challenge—how does one decide whether two census blocks (or even two people) are sufficiently similar to be placed in the same district? As Altman (1995) notes, this is one of the primary difficulties in developing algorithms for automated districting. The motivation for a particular scheme requires obtaining qualitative feedback that colors the objective data.

Nevertheless, from an empirical standpoint, we do see certain criteria reappearing in laws, court decisions, academic studies, interest and "good government" group pamphlets, as well as public testimony at redistricting hearings. The most commonly discussed criteria form a subset generally referred to as "traditional redistricting criteria," particularly since *Shaw v Reno* in 1993 (American Civil Liberties Union 2010). Traditional redistricting criteria normally include compactness, contiguity, respect for political subdivisions (particularly counties/townships and cities), and reflecting communities of interest[2] (Altman 1998). Most of these today serve as constraints on the process (see "Constraints" below) but Compactness and Communities of Interest merit special discussion, as does Competitiveness because of its centrality to democratic theory. Table 2.4 summarizes the key points concerning measurement

(Table 2.4 about here)

Compactness

[2] Some include incumbent protection as a traditional criterion, but since this is generally omitted both in court decisions and by "good government" groups, I exclude it from this list.

While Altman (1998) disagrees with calling compactness a "traditional" criterion, it has been a frequent member of most lists since the early 20th century. Altman records its inclusion in a Congressional districting statute of 1901, while the Supreme Court has cited it in cases as far back as *Wesberry v Sanders* in 1964. The advantages of compactness are that it is rather simple to understand and apply. Compactness is about the shape of the district, and can be measured in the same way no matter where one is.

Thus the attractiveness of compactness as a criteria stems from the perception that it is an objective measure. That is, that while other measures are either intrinsically biased (using partisan measures) or subject to artificiality (political subdivisions like city boundaries) or popular opinion (communities of interest), compactness is a pure mathematical formula. In addition, compactness is often seen as the solution to the challenge of automated districting; if we could identify the right compactness formula, then we could simply have the computer draw the "best" districts.

This, at least, was the hope of those who proposed the major measurements we use to get at compactness, including Roeck (1961), Stern (1974), and Polsby and Popper (1991). Even Altman's specific problem with treating compactness as traditional—its lack of enforcement—seems to point to the idealism in compactness as an objective, arbitrary measurement.

And although analyses of compactness, most notably Niemi et al's (2009) survey of over ninety proposals for measuring the concept, argue that the precise metric doesn't seem to matter because districts that are compact under one measure tend to be compact under other measures as well, there are some important distinctions.

Most importantly, compactness can measure either (a) the geographic extent or (b) population of the district within an ideal figure. Roeck's measure, illustrated in Figure 3.8, demonstrates the most common way of simply drawing the smallest circle encompassing the entire district. The value is then the percent of either area or population contained by the circle within the district. Other methods used include ellipses, squares, triangles, and convex polygons, but the circle is often preferred because it rewards districts that are "thick" in both the horizontal and vertical axes. Other tests, such as Polsby-Popper use a ratio between inscribed and encompassing circles (1991), perimeter tests ratios of perimeter to ideal figures, or shortest internal splits.

However, compactness suffers from regular flaws, because natural geography may not lend itself well to being measured by compactness scores or perimeter measures. A district with a coastline or islands will necessarily have a "worse" compactness score under perimeter tests because of the added length. Indeed, Niemi et. al. (2009) note that every single proposal for compactness measurements has the potential to produce counter-intuitive results under the appropriate circumstances. For example, the Roeck-compact Louisiana's 3rd district in the bayou as shown in Figure 3.8 (lower) has the lowest area-to-perimeter ratio in the country simply because it is comprised of hundreds of islands.

Despite the need to recognize that compactness does vary based on where it is measured, it remains one of the few objectively measured criteria in redistricting, and it is a decent measure of some sense of community because it punishes high levels of dispersion. Throughout this study, I will be using the Roeck measure as illustrated in Figure 3.8 for two main reasons. First is its simplicity—as Niemi et al (2009) show, there's no need to over

complicate this measure—and second because it punishes for both dispersion and perimeter, but not to the degree other measures do.

Finally, the major limitation on compactness is that it may come into conflict with other criteria when communities are aligned along linear features. For example, Latinos in the San Gabriel Valley share a community that runs along the I-10 corridor that may not look compact. Coastal residents in states like Florida may face very different issues from the people living just two or three miles inland. Furthermore, if a protected class is dispersed across a rural region, states may be required to divide the area in order to draw a district.

Competitiveness

If the theory behind compactness is nitpicky, competitiveness is by comparison straightforward. Fundamentally, competitiveness is tied into the model of political accountability that defines democracy as alternation in power (Manin, Przworski, and Stokes 1999). The theory is that more competition leads either to more alternation in power or representatives moving toward the center (the median voter), thereby producing more opportunity for accountability. As McDonald and Samples (2006) put it, "competition militates against shirking, fosters accountability, and informs voters" (11). Given the US' two-party system, we can think of competitiveness primarily in partisan terms, even allowing for times when the party primary is more competitive than the general election.

While in theory this is not problematic in the broad sense as long as we recognize that competitiveness is not the only way to ensure accountability. However, taking the step

from theory to practice is a bit more challenging. How do we decide whether a district is safe? Whether the representative is accountable?

The difficulty lies in two criteria that must be true for this measurement to work effectively. First, it must be comparable across states. This rules out measures such as partisan registration because not all states have partisan registration at all, or even in the same way. Similarly, measures like competitiveness in state house races (as used in Holbrook and Van Dunk 1993) would assume that intradistrict politics, including incumbent advantage, work the same in each state and each district. Second, it must be calculable at all levels of geography. This rules out self-reported metrics of ideology such as those from surveys or interviews.

The measure I use is election results—specifically the 2008 Presidential Election. Following Kousser (1996), most studies of redistricting comparing across states use election results (Jacobson 2003, McGhee and Krimm 2009, Brunell 2005). Election results meet both criteria I laid out above. First, except for any home state boost, results reflect national trends and issues rather than extremely local ones. They also are available at the precinct level nationwide.

Following Jacobson (2006) and McGhee and Krimm (2009), I use a simple 10 percentage point margin as my "competitive zone". That is, a district falling ±5% points of exactly equal numbers of votes for each candidate would be considered competitive. While I recognize the possibility of incumbent effects on whether districts are in practice competitive, the focus of this dissertation is on theoretical competitiveness, so the question of interest is not "who won?" but "who would win if the election were being held in an

empty seat?" While the use of a single election also might raise this concern, I think the Obama vote share is a good metric for partisanship, at least at the present.

That last point points to competitiveness' biggest drawback, which is its strong correlation to measures of race in particular. A state may be very competitive statewide, but locally not very competitive at all. Missouri is the best example of this—the most competitive state in 2008, but locally, Obama won 80% of the vote in many precincts and received fewer than 30% of the vote in most other—and most of the precincts he won by that margin were African-American. And like with compactness, a state like Missouri may be required to draw that district even if it reduces the chance for competitive districts elsewhere.

Communities of Interest and Race

Twice in this section already I mentioned "protected classes," and to many in the public, "communities of interest" is code for "protected classes." These terms are not equivalent, though they may be related. The trickiness of defining and using "communities of interest"—one of the "traditional redistricting criteria"—goes back long before the Supreme Court held that "legislators do not represent acres or trees" in throwing out unequally populated districts.

Indeed, since *Shaw v Reno*, communities of interest have been a sort of Holy Grail in redistricting. Yet in contrast to the purported objectivity of compactness, "communities of interest" seems to be the most subjective criterion. Indeed, looking at its use only furthers this perception. At the Redistricting and the New Demographics conference in 2002, for

example, the keynote address talked about a "community of memory," linked by shared tragedy, and definition of community of interest included such categories as "community of shared opportunity" (Hum 2002). Commissioner Kosmo on the City of San Diego Redistricting Commission referred to the concept as "shared problems."

Part of this trouble is that naturally the level of districting matters; school attendance areas are highly relevant for public school district elections, but are less significant for city council districts, where groups such as neighborhood associations and local businesses matter more. In addition, there is a clear substantive component to the concept of Communities of Interest, but each layer of government has a different mandate.

How, then, do we begin to figure out how to implement some measure of Communities of Interest? While this criterion can be subjective, there is one dimension that plays a disproportionately large role. I am speaking, of course, about race. While, broadly speaking, communities of interest can encompass any group of people linked by common bonds, in the United States, it almost always refers to race, and the use of race as a criteria in districting.

Race plays a unique role in American history, to the point that there are laws specifically singling it out in the redistricting process. In particular, the Federal Voting Rights Act of 1965, and especially the 1986 reauthorization, laid out a clear and definite role for race in the redistricting process, to the extent that the courts refuse to hear challenges brought for other reasons (except equal population).

The Voting Rights Act does not speak about race directly; it speaks in terms of "protected classes"—groups that have historically faced barriers to voting or political

participation, including not being able to get ballots in a particular language or having to pay special taxes or pass a certain test.

Some states, particularly in the South, found themselves covered by Section 5, the part of the law dealing with preclearance—needing to have the Department of Justice sign off on their redistricting plans before they could take effect. This burden requires states to satisfy Federal administrators who look directly at race. And while *Shelby County v Holder* (2015) "clears the slate" of jurisdictions covered by this requirement, all states still have to deal with Section 2.

Section 2 covers the entire country, and requires states to look at their protected class populations to assess their risks. In *Thornburg v Gingles* (1986), the courts laid out a "totality of the circumstances" test for considering challenges that includes whether members of protected classes have run for office and won or lost as well as the geographic compactness and community formed by the community. Even later rulings like *Shaw v Reno* (1993) do not diminish the requirement to pay attention to race—they just set limits on how non-compact a state can go or whether crossover districts are required (*Bartlett v Strickland* 2009).

Other Potential Measures and Constraints

Constraints

Before discussing two measures that will not be considered, I want to note first some measures that will serve as constraints as opposed to not be taken into account. First, I will be treating **contiguousness** as a constraint. Contiguousness is the principle that a person should be able to travel from one part of a district to every other part of that district without

leaving the district, and in the case of natural discontinuity, any remote area should be connected by the most commonly used transportation route (ACLU 2010). The first part includes bridges and regularly operating ferries, while the latter concerns the case of remote islands like Hawaii.

The second constraint is **population equality**. While there are strong theoretical arguments for and against population equality, the Supreme Court requires that deviations be small, and, in the case of Congress, within one individual. There is little doubt that such a strict metric of population equality has in no small part led to necessitating tradeoffs, even though it has also reduced disproportionality (Mann and Cain 2005). Specifically, for the purposes here, population equality serves as an equal constraint for all tradeoffs—indeed, with less equal populations, some tradeoffs may not exist while others may be possible. It would be another dimension that does not reflect how redistricting works in the United States today.

Political Subdivisions

Going all the way back to English institutions underlying the American electoral system, keeping political subdivisions such as counties intact has long been considered one of the most natural ways of measuring the goodness of a districting (Altman 1998, Adams 2005). Altman shows that for most of the country's history, political subdivisions were kept together, with massive increases only starting in the reapportionment revolution of the 1960s and 70s—also corresponding to the expansion of the Census Block program.

While these sorts of concerns are often grouped with communities of interest, they reflect a slightly different set of principles. Communities of interest as we have seen here are fundamentally concerned with the subjective perceptions of groups that name themselves

similar. Here, shared political jurisdictions are theoretically objective. While there is often a mutually reinforcing relationship between community of interest and political subdivision (e.g. the presence of colleges in Claremont creating a community of interest around being a "college town"), the city of Claremont ultimately has semi-permanent boundaries while the "college town" parts of Claremont do not.

I do not include political subdivision splits as a measure in my analysis, though they will be discussed. I avoid them for several reasons. First, though commissions in particular tend to cite keeping political subdivisions intact, as far as the courts are concerned, political subdivisions are secondary. If there is a choice between keeping an ethnically divided city together of splitting it up to create a majority-Black or Latino seat, the courts will require the latter.

Secondly, the size and number of subdivisions varies extensively between states. Arizona has a few large cities that often annex unpopulated territory for future growth. Massachusetts has small townships that cannot expand. While comparing within-state may be feasible, they cannot be compared across state.

Finally, there is no agreement on how to measure splits—precisely because some jurisdictions *have* to be split, given their populations. San Francisco has population for 1.43 Congressional districts. Would its best representation be one district entirely in the city or two districts with a majority of their population in the city? This also plays against the equal population constraint—if a city is 105% of ideal population, is it more representative for the people in the city to have one representative, even though their vote-to-seat ratio would be slightly larger than elsewhere?

Substantive Representation

Finally, I will not be including measures of substantive representation. While I agree with Pitkin (1968) and Rehfield (2009) on the importance of substantive representation in good representation, it is a difficult measure to quantify. Indeed, many studies looking at how representatives substantively support policies favored by constituents often admit to making assumptions. Gay (2009), for example, looks at who introduces civil rights legislation—assuming that African-Americans care about civil rights more than other policies. Carroll (1993) simply asked legislators if they thought their bills were representative of the people they represented.

Contemporary research by Maske (2012) in Ohio suggests that one answer might lie in using initiative results to create a factor analysis using local level data that would help sort precincts by their substantive preferences. College town Democrats, for example, have a very different attitude toward pot than Native Americans, for example, that comes out in initiative results. However, not all states have a vibrant initiative process—and even initiatives are limited in their scope to state and local issues.

Table 2.1: Clustering vs Other Measures

	Strengths	Drawbacks
Global Moran's I	• Global measure that provides significance of finding • Is based on local, individual unit level calculations • Gets at the relationship between each unit of geography and its neighbors	• Does not provide information on local significance • Clustering may be high if neighbors are similar, even if no concentration of a particular group of people
Local Moran's I/ hot spot analysis	• Provides information on local significance of clustering	• Cannot be directly extended into a global measure • Highly localized measure cannot provide information on extent of effect
Spatial Lag	• Directly gets at the impact of relationships between neighboring geographic areas.	• No independent information on the significance of the lag term • Only good as control term; no context for aggregating to the system as a whole
Demographic Controls	• Already included in most models and shown to have effect •	• Does not provide information on the local distribution of population or relationship between neighboring
Segregation	• Widely used to look at effects similar to clustering • Provides both global and local indicators	• Global measures are based on highly localized effects and cannot provide information on extent of effect

Table 2.2: Clustering by Race by State

STATE	WHITE	BLACK	LATINO	ASIAN
Alabama	0.68	0.69	0.18	0.28
Arkansas	0.67	0.70	0.48	0.36
Arizona	0.72	0.45	0.75	0.25
California	0.82	0.77	0.79	0.75
Colorado	0.63	0.66	0.67	0.35
Connecticut	0.74	0.71	0.71	0.24
Florida	0.75	0.65	0.86	0.31
Georgia	0.72	0.73	0.41	0.57
Hawaii	0.44	0.17	0.24	0.50
Iowa	0.48	0.58	0.37	0.31
Idaho	0.28	0.16	0.48	0.23
Illinois	0.86	0.83	0.79	0.66
Indiana	0.80	0.79	0.70	0.24
Kansas	0.66	0.73	0.51	0.27
Louisiana	0.57	0.56	0.44	0.39
Massachusetts	0.69	0.77	0.67	0.50
Maryland	0.79	0.82	0.58	0.61
Maine	0.12	0.35	0.15	0.24
Michigan	0.83	0.85	0.49	0.49
Minnesota	0.66	0.68	0.38	0.55
Missouri	0.85	0.86	0.40	0.34
Mississippi	0.56	0.59	0.19	0.33
North Carolina	0.65	0.65	0.33	0.35
New Jersey	0.79	0.77	0.79	0.58
New Mexico	0.56	0.31	0.63	0.35
Nevada	0.54	0.70	0.57	0.53
New York	0.84	0.84	0.79	0.74
Ohio	0.80	0.80	0.68	0.35
Oregon	0.40	0.68	0.43	0.62
Pennsylvania	0.79	0.78	0.75	0.42
Rhode Island	0.68	0.61	0.70	0.32
South Carolina	0.52	0.54	0.16	0.25
Tennessee	0.77	0.79	0.33	0.28
Texas	0.78	0.70	0.84	0.56
Virginia	0.64	0.69	0.53	0.68
Washington	0.63	0.65	0.61	0.70
Wisconsin	0.83	0.89	0.84	0.31

Source: American Community Survey Special Tabulation (2011), values are Moran's I, run in ArcGIS 10.2.

Table 2.3: Clustering by 2008 Election by State

STATE	PERCENT DEMOCRATIC (2 PARTY VOTE)	CLUSTERING BY 2008 ELECTION
Alabama	39.1%	0.62
Arizona	45.7%	0.76
California	62.3%	0.35
Colorado	54.6%	0.85
Connecticut	61.3%	0.73
Florida	51.4%	0.60
Georgia	47.4%	0.75
Hawaii	73.0%	0.64
Iowa	54.8%	0.64
Idaho	37.0%	0.76
Illinois	62.7%	0.89
Indiana	50.5%	0.73
Kansas	42.4%	0.31
Louisiana	40.5%	0.61
Massachusetts	63.2%	0.76
Maryland	62.9%	0.81
Michigan	58.4%	0.81
Minnesota	55.2%	0.63
Missouri	49.9%	0.82
Mississippi	43.4%	0.52
North Carolina	50.2%	0.68
New Jersey	57.9%	0.82
New Mexico	57.7%	0.77
Nevada	56.4%	0.36
New York	63.6%	0.67
Ohio	52.3%	0.86
Pennsylvania	55.2%	0.90
South Carolina	45.5%	0.52
Tennessee	42.4%	0.57
Texas	44.1%	0.68
Virginia	53.2%	0.63
Washington	58.8%	0.65
Wisconsin	57.1%	0.78

Source: Ansolabehere et al (2011), values are Moran's I, run in ArcGIS 10.2.

Table 2.4: Redistricting Measurements

	Competitive-ness	**Communities/ Race**	**Population Equality**	**Political Subdivisions**
Compactness	*Traditionally*: no necessary tradeoff. *However*, under high clustering by party, there would be a necessary tradeoff that doesn't exist when clustering is low	*Traditionally*: no necessary tradeoff. *However*, under high clustering by race, it would be easier to draw compact majority-minority districts	*Traditionally*: Population equality necessitates tradeoff *Here used* as a constraint on the system	*Traditionally*: Political subdivisions are only somewhat compact *This stands* even when clustering is included.
Competitiveness		*Traditionally*: only if race and party are closely tied together *However*, no necessary new relationship from a clustering perspective	*Traditionally*: Population equality limits ability to pack partisans *Here used* as a constraint on the system	*Traditionally*: Political subdivisions not necessarily competitive *However*, lower levels of clustering increase ability to keep towns together
Communities of Interest/Race			*Traditionally:* Population equality may constrain lawmakers from disenfranchising non-Whites *Here used* as a constraint on the system	*Traditionally:* Political boundaries may not correspond to minority communities *However,* greater tradeoff under lower levels of clustering
Population Equality				*Traditionally:* Political subdivisions not precisely divisible by district populations *Relaxing* equality would allow one to keep more areas together.

Source: Adapted from Butler and Cain (1992).

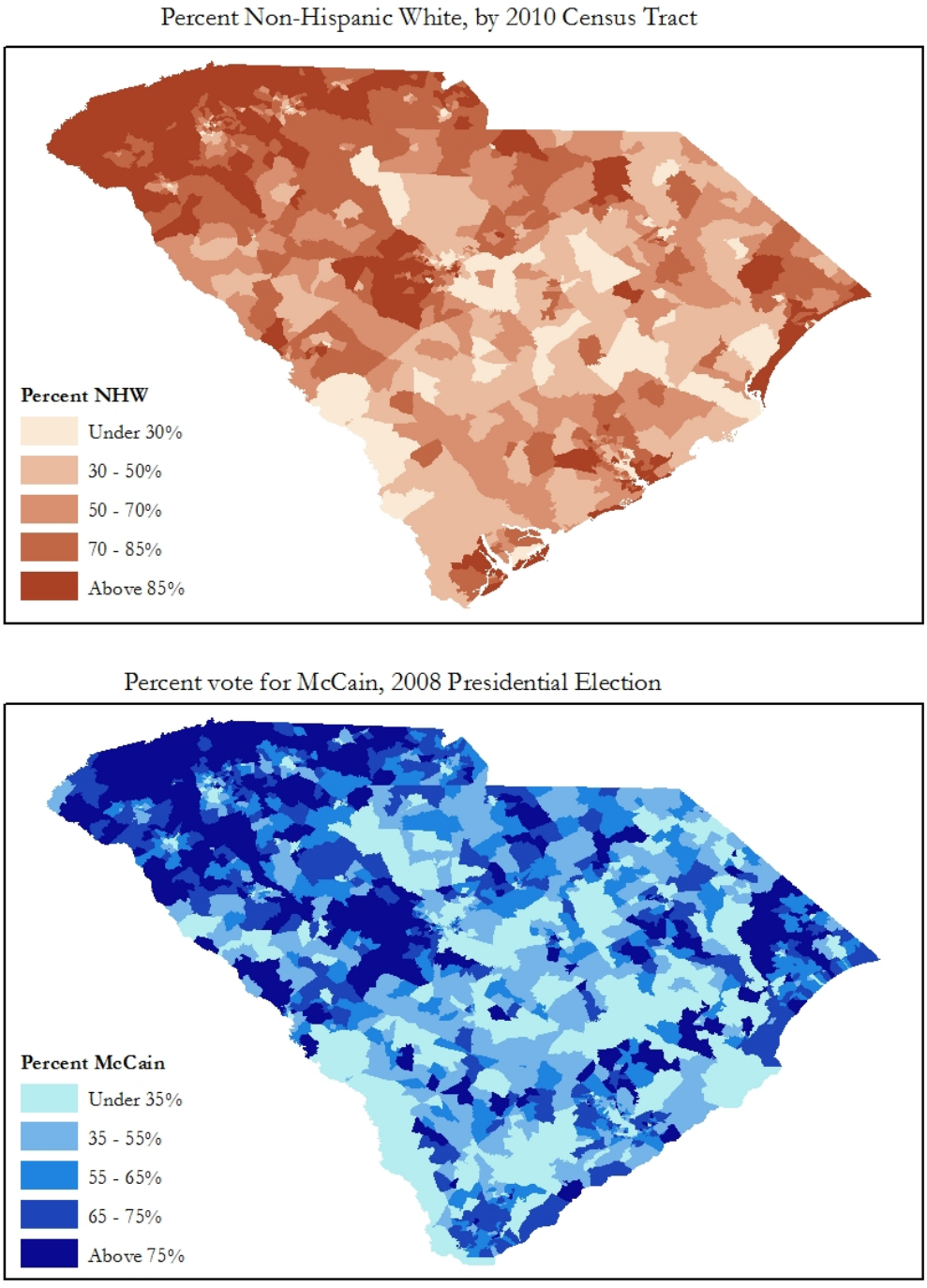

Figure 2.1: South Carolina by Percent Non-Hispanic White and Percent Vote for McCain

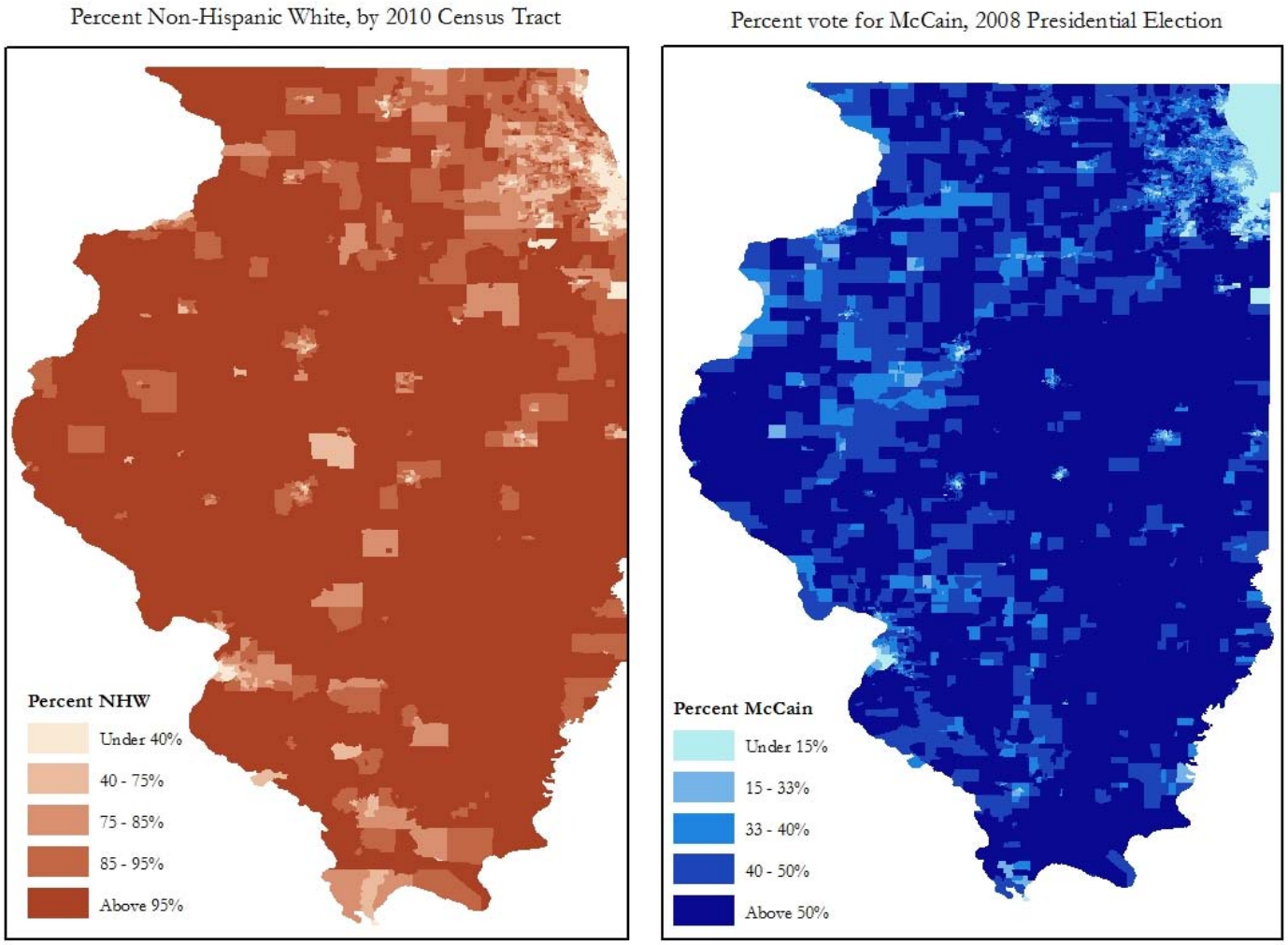

Figure 2.2: Illinois by Percent Non-Hispanic White and Percent Vote for McCain

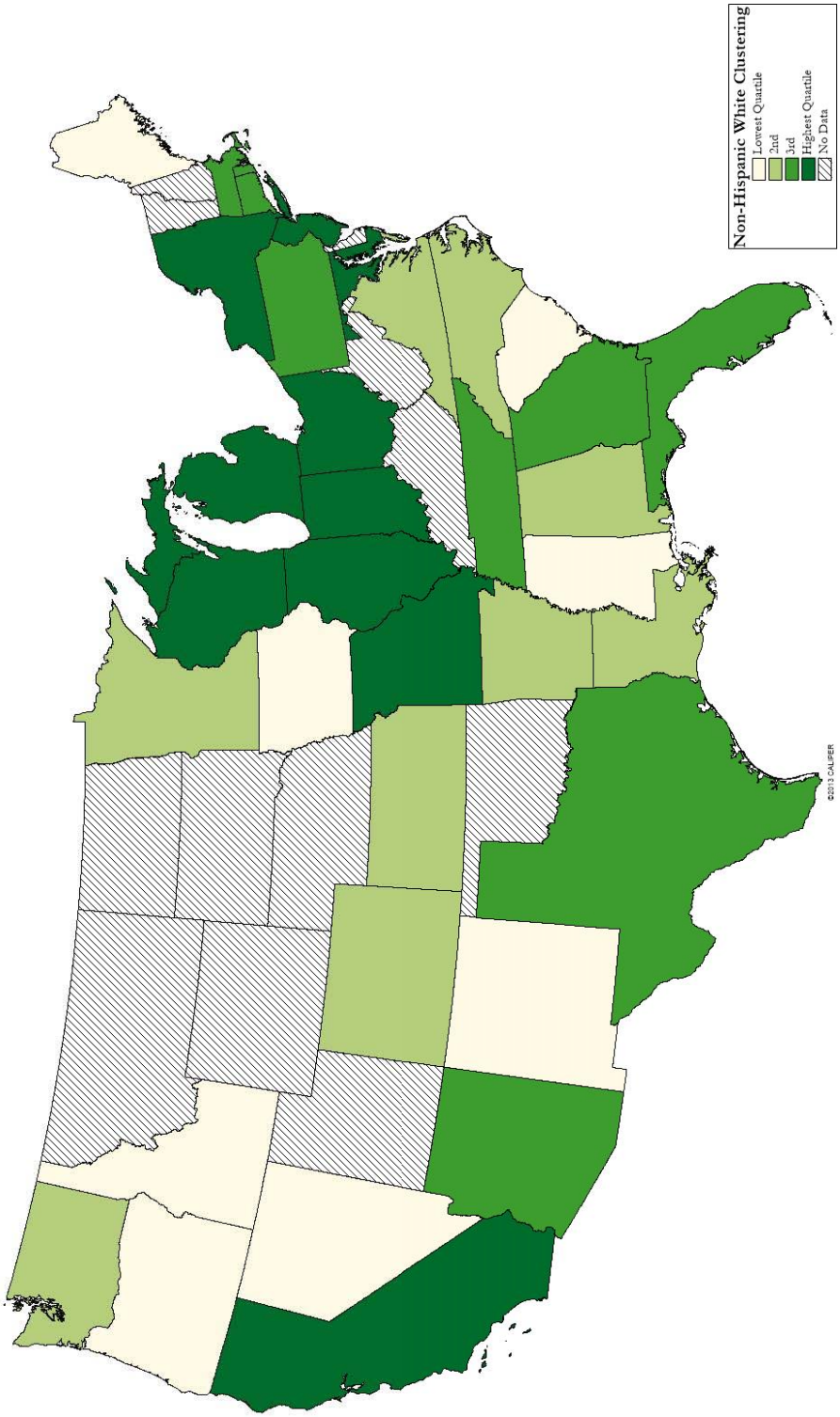

Figure 2.3: Non-Hispanic White Clustering by State

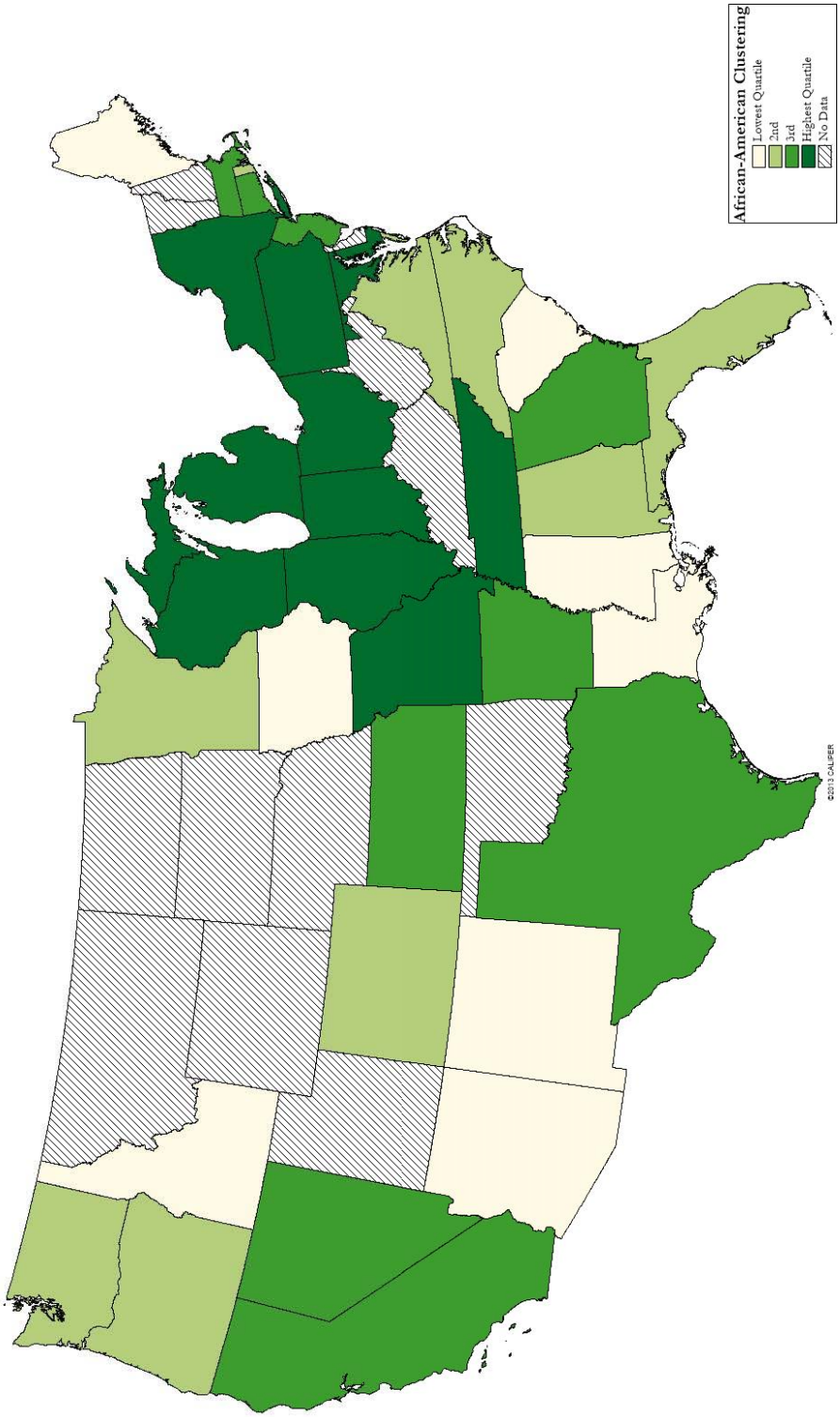

Figure 2.4: African-American Clustering by State

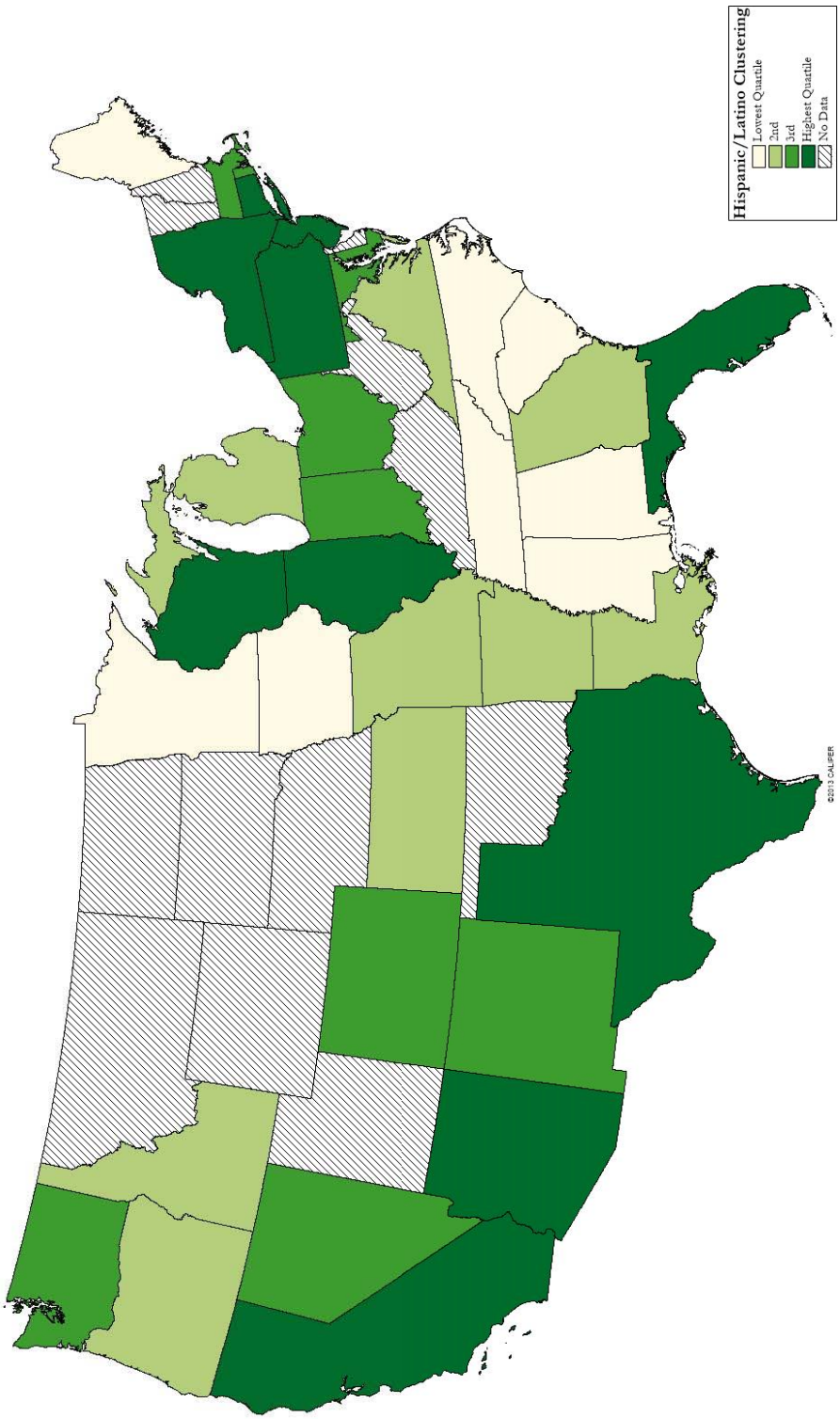

Figure 2.5: Latino Clustering by State

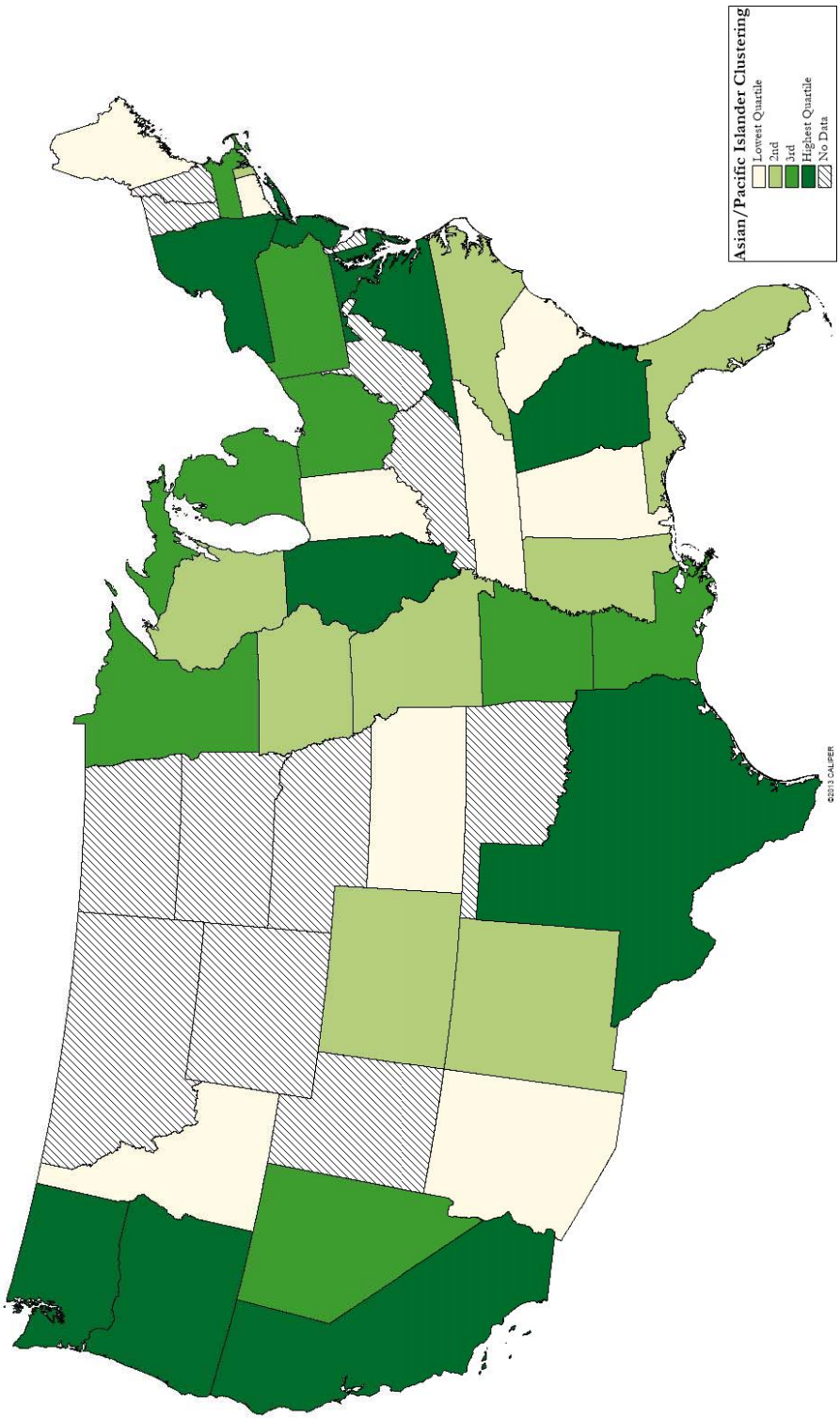

Figure 2.6: Asian-American Clustering by State

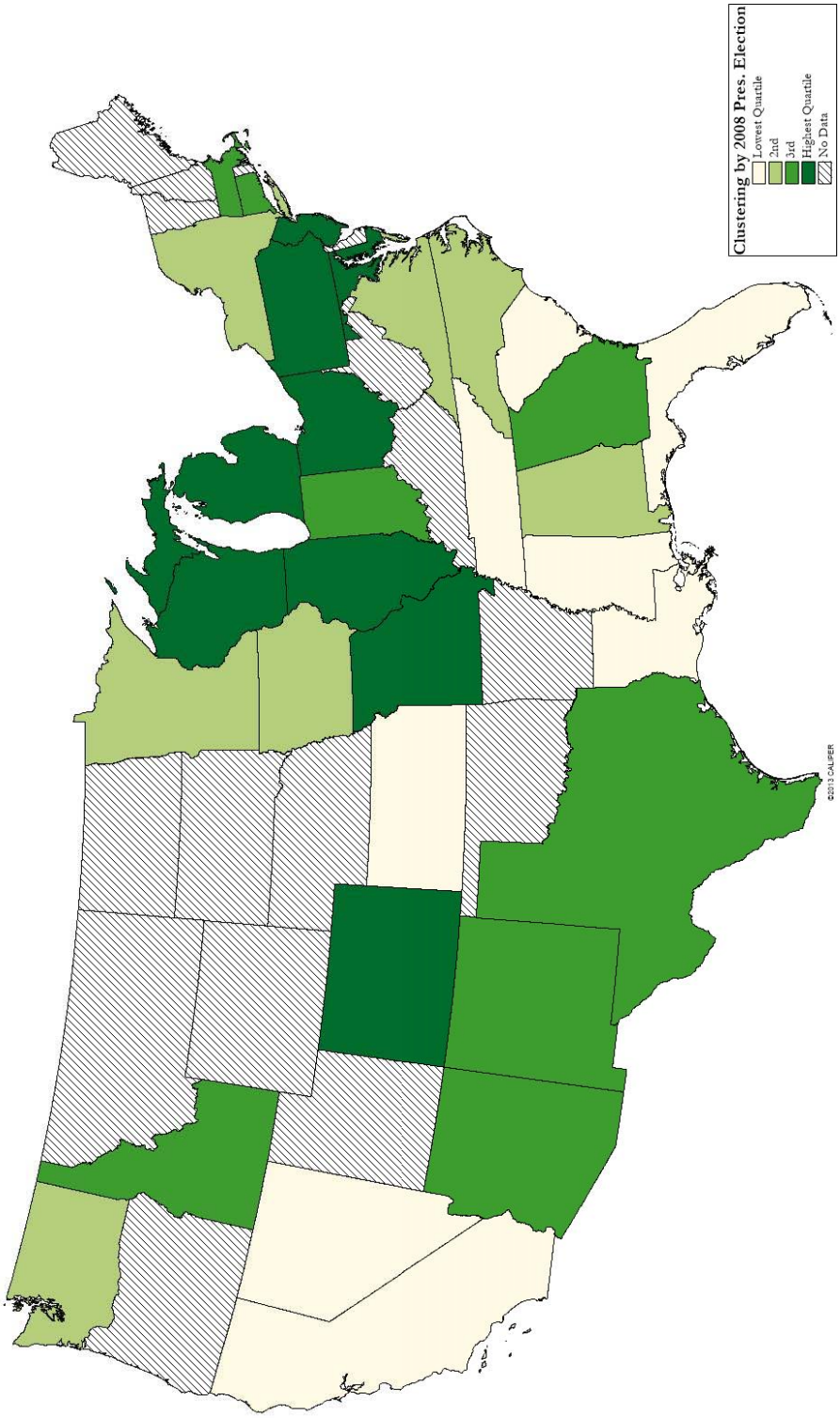

Figure 2.7: Clustering by 2008 Election by State

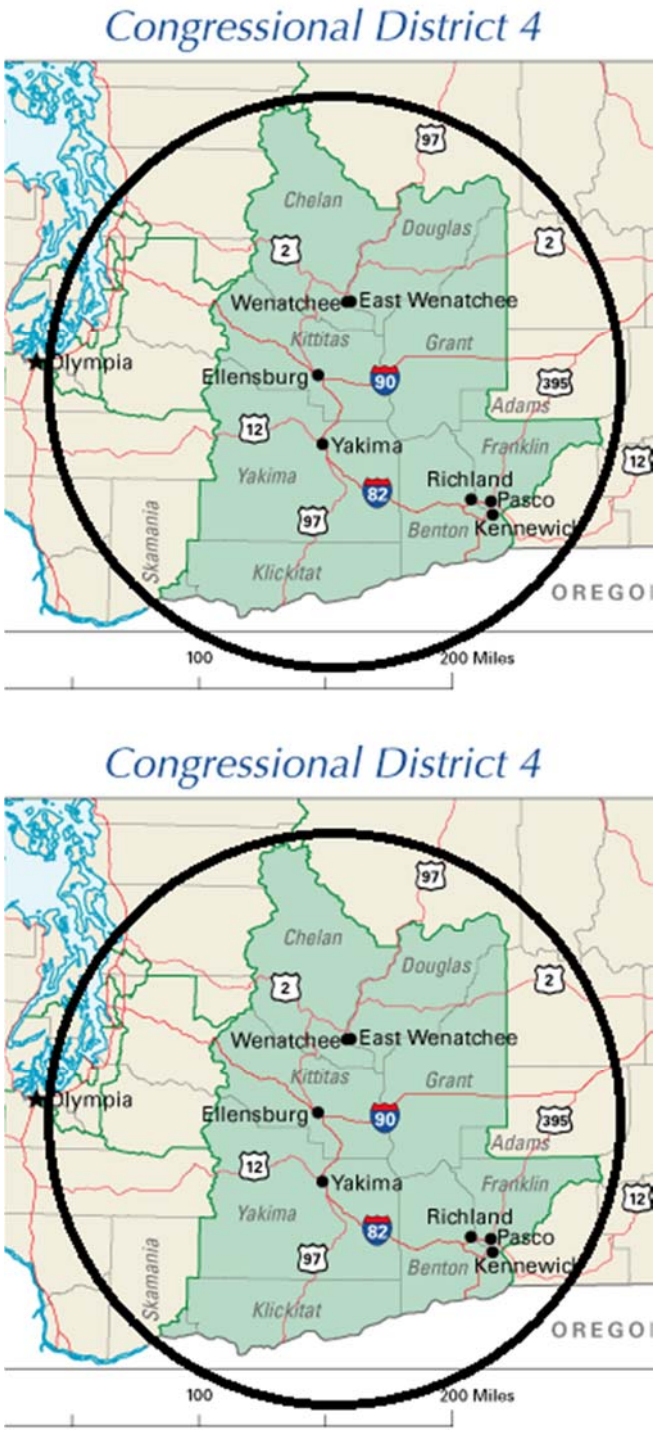

Figure 2.8: Illustrations of Roeck Compactness

Source: Nationalatlas.gov

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Chapter 3

How Clustering Shapes Redistricting Tradeoffs

Theories of tradeoffs between different redistricting criteria have long emphasized the geographic dimension (Butler and Cain 1992, Canon 1999, Chen and Rodden 2009). Indeed, discussions of voting rights and communities of interest, particularly in the aftermath of Shaw v Reno (1993), often focus on the degree that compactness and keeping political subdivisions intact is at odds with competitiveness or increasing non-White representation. Yet while some states are confronted with these tradeoffs every decade, other states seem to avoid this rancor. In this paper, I use clustering to quantify how one state may be forced make tradeoffs neighboring states do not. This paper asks two specific questions. First, given the degree of clustering, what is the direct effect of prioritizing particular redistricting criterion that that outcome? Second, given the degree of clustering, what is the tradeoff between two criteria when drawing plans that favor a different criterion? Using an automated redistricting software program, BARD (Altman and McDonald 2009), I create a total of 600 maps: 100 each that prioritize compactness, competitiveness, and percent non-White in two states that have significantly different levels of clustering: Arizona, a highly clustered state by both race and partisanship, and Washington, which has low levels of clustering. I show that the degree of clustering has a very substantial impact on the potential for majority non-White districts, and in particular, there is less of a tradeoff between compactness and the number of majority non-White districts in a highly clustered environment. Higher degrees of clustering likewise diminish the potential for competitive districts, and there is more of a tradeoff between compactness and the number of competitive districts.

Arizona and Washington: A Tale of Two Commissions

At the Democrat's election night bash in Bellevue in 2006, Patty Murray, the Senior Senator was thrilled, telling the Seattle Times that "we got our country back tonight". While she was mainly talking about the national Democratic tide in Washington, D.C, Democrats in Washington state also had something to celebrate. Eight seats had switched from Republican to Democratic in the State House and seven in the State Senate, ending Republican control of the latter body and giving Democrats a veto-proof majority in the former.

2000 miles away in the warmer and drier city of Phoenix, Republicans were counting their blessings. Despite the national tide, only two seats in the state's House of Representatives had changed party control—and both of them seats that had been held by Democrats in the past. Republicans continued to retain their solid majority in the state legislature, and even the leftward swing on initiative voting did not challenge the status quo in state government.

Arizona and Washington in the 2010 Republican wave tells a similar story. In Washington, Republicans picked up nine seats—and not all of the seven lost in 2006 changed back. In Arizona, Republicans gained just four—the two they had lost in 2006 and two from a district on the edge of Phoenix that had grown 200% from its 2001 population—a district where the share of rural voters declined since 2001 as farmland became tract homes.

Indeed, looking back over the past twenty years tells the story. After the 1994 elections, Washington's Republicans had the same margin in the House in 1994 as

Democrats did in 2008—nearly half of the legislative districts had experienced a change in party control. In Arizona, only a quarter of seats changed party control—and some of them were term-limits induced trades between the House and Senate.

Similarly, after the 2011 redistricting, Washington has predictably continued to swing. After good Republican years like 2014, Republicans make up a majority in Washington's Senate and nearly so in the House—even though they are a minority party statewide. In Arizona, the composition remains nearly flat, with only two competitive districts shifting between parties.

What explains this difference? Why do Arizona's districts tend to stay in one column while Washington's are more responsive to change? One explanation is race—Arizona has to draw majority-Latino districts while Washington does not (McDonald 2006). This limits Arizona's ability to create competitive seats.

However, while Washington may not have many majority-minority seats, this answer assumes that Washington couldn't draw any in the first place. And while Arizona certainly has more non-White residents—43% of the state's population to barely 24% of Washington's, the difference shrinks when accounting for citizenship rates. Washington drops just five percentage points to 19% non-White among citizens of voting age, while Arizona drops 18 points to 31%. Yet this cannot explain the situation. States whiter than Washington—Wisconsin, Minnesota, and Indiana, to name three—have more majority-minority districts.

Similarly, Arizona and Washington have virtually identical redistricting institutions, commissions given prioritization to particular criteria through statute. Both have redistricting commissions established by initiative and little legislative oversight of the

process—even the Arizona lawsuits came after the commission finished its work rather than in its process. So what's happening differently in these states?

Demographic Transition on the Ground

This comparison asks two distinct questions:

1. What is the impact of changing the level of clustering on each redistricting criterion individually?
2. To what extent does the level of clustering shape tradeoffs between criteria?

The interaction between clustering and redistricting is clear when we work through the implications of big picture "macro" theories like sorting and industrialization for "micro" processes like redistricting.

To illustrate, we can look at Rodden's (2010) urbanization narrative. Rodden argues that as cities grew, a naturally competitive network of small cities mixed with rural areas was replaced by large swathes of increasingly homogenous urban districts. So where a district in 1850 would contain a city as well as countryside, and in the early 1900s would include both wealthy and poor districts within a city, late 20th century cities were large enough that neighborhoods outsized districts.

This means that non-White and Democratic voters are poorly distributed after urbanization. While Republicans can take advantage of their rural—and thus more heterogeneous—parts of the state, working class and minority residents of cities find themselves in regions too large to easily divide. For Rodden, this explains the structural inequality in the system. The average Republican lives in an area about 60% Republican, while the average Democrat lives in an area where registration tends to be around 80%

Democratic. This gap produces a structural bias toward Republicans as evident in continued Republican control of states houses like Michigan and Wisconsin, where Democrats outnumber Republicans statewide, but Republicans represent more seats.

While Rodden's analysis ends with questioning the sorting hypothesis—the question his work is actually grappling with—the theory has enormous implications for drawing individual districts. High levels of regional homogeneity in a system with overall heterogeneity, regardless of the cause, make it easy to draw majority-minority districts because the minority population is geographically concentrated and thus is easy to keep together.

Illinois illustrates this. Illinois' large African-American and Latino populations are concentrated in Chicago while the majority of the state is overwhelmingly non-Hispanic White. When drawing districts in Illinois, it is not hard to draw majority-minority districts. Indeed, the concern in Illinois is drawing majority-African American districts that avoid *packing* because the high concentration of African-Americans in a single region of the state may mean their voice is diluted elsewhere. Figure 3.1 shows the consequences of needing to reduce packing—long necks reaching from a concentrated African-American population toward less concentrated regions.

(Figure 3.1 about here)

The situation in Illinois may be a result of urbanization, certainly, but in terms of its practical implications for drawing districts, it doesn't really matter. The most important point is that the effect of the process is that it produces a high degree of clustering. As seen in Chapter 2, the Midwest in particular tends to be a highly clustered region by race, and Illinois itself is the most clustered state by race in the country. A consequence of history, to

be sure, but more importantly, a feature that makes this region of the country face some unique challenges when drawing districts.

Predicting the Effect of Clustering on Redistricting Criteria

In other words, theories like sorting and urbanization explain why clustering exists—they may even be able to predict the amount or degree. They point to places where clustering can explain the potential for redistricting outcomes. Furthermore, in addition to delineating the direct effects of clustering, this logic can refine where I expect to see tradeoffs between specific criteria.

Direct Effects

Competition. The clearest example of how clustering effects redistricting criteria is from Rodden's own argument—the more densely clustered populations are, as in cities after the Industrial Revolution, the more large areas of a city are socially homogeneous. So unless the particular issue is a cross-cutting cleavage, it is likely that each area will be politically homogeneous as well—at least in terms of partisanship.

Thus it seems logical to expect that if clustering is high, people of the same party are more likely to live next to each other—exactly as Rodden (2010) finds. Conversely, if clustering by party is lower, we will be able to draw more competitive districts.

Majority-Minority. Rodden's argument holds for the direct effects of clustering by race as well. If people of the same race live nearer each other, it is logically easier to draw a district that keeps that community together. Thus I would expect that as the clustering by race increases, so will the number of majority-minority seats. Conversely, low clustering will

often mean fewer majority-minority precincts in the first place, making it harder to draw those seats.

Now, if the region they reach a point where it might be considered "packing" minorities in a single district, as Figure 3.1 shows in the Chicago area, the community may be divided between two neighborhoods. This would only happen if the group could form a majority or plurality in two seats. I will discuss this point further under "Tradeoffs" below.

Tradeoffs

Though scholars have been well aware of tradeoffs, or at least the potential for tradeoffs, as far back as politics goes (Manin 1997 discusses this with reference to Athenian politics in ancient Greece, for example), the literature on tradeoffs is rather conjectural. The most thorough treatment of redistricting tradeoffs, in Butler and Cain (1992), admits that many tradeoffs, such as compactness vs. competitiveness, have never been properly studied.

This study, then, offers an opportunity to begin to look at tradeoffs in a more systematic way, particularly because clustering so obviously affects the capacity to trade between criteria, especially compactness. With regards to Arizona and Washington, how can the level of clustering by both party and race help explain why nearly identical redistricting commissions produced plans with such different consequences? Table 3.1 summarizes the key points, building on Butler and Cain's analysis.

(Table 3.1 about here)

For example, look at the relationship between compactness and majority-minority districting. Butler and Cain argue there is no necessary tradeoff unless the "ethic population

is dispersed" (83). Yet when we compare African-American majority districts in Illinois and California (Figures 3.1 and 3.2), we see that California, with a moderately high degree of clustering produces districts that are far more compact than Illinois with its extremely high degree of clustering.

Yet it is also important to acknowledge just how rare it is to find areas like South Los Angeles where there is less of a tradeoff. That district demonstrates just the incredible coincidences that had to occur to create that district. Firstly, the district is not majority African-American, even by eligible voters. It has no majority—it is barely an African-American plurality district by eligible voters. It also takes advantage of a divided non-African-American population (33% White, 25% Latino). And there are few partisan considerations considering the area has long been together in the same district.

(Figure 3.2 about here)

In general, we should expect a greater degree of tradeoff when two things are very heavily correlated with each other. When race and partisanship are heavily correlated, we should expect a greater tradeoff between them, as McDonald shows in Arizona (2006). Clustering is a way of expressing this correlation where geographic distribution is what ethnicity/partisanship is being compared to:

Compactness vs Competitiveness. If clustering by party is high, there will be more of a tradeoff between compactness and competitiveness. This is due to heavily clustered areas producing more homogeneous (i.e. single-party) districts. In low clustered environment, more competitive districts will occur naturally, all else being equal.

Compactness vs. Majority-Minority. If clustering by race is high, there will be less of a tradeoff between compactness and majority-minority districts. This is due to heavily clustered areas producing more homogeneous (ethnically-clustered) districts. At an extremely high level of clustering, there may be pressure to divide the community into multiple districts, which would require sacrificing compactness.

Research Design

Hypotheses

Stemming from the argument above as to why clustering should effect tradeoffs, my first set of hypotheses test the direct impact of going from one level of spatial clustering in one state to another. The first hypothesis argues that the number of compact districts is a direct consequence of partisan clustering and the second hypothesis predicts the relationship between clustering by race and number of majority-minority seats. These districts are institution-blind since we are not taking into account who drew the lines.

Direct Effects

Competitiveness

H_1. As clustering by party increases, plans will contain fewer competitive districts.

Number of Majority-Minority Seats

H_2. As clustering by race increases, plans will contain more majority-minority districts.

In addition to direct effects of clustering, we also want to test predictions about the relationships between the potential redistricting criteria. Hypotheses in this section are particularly concerned with the tradeoff between compactness and clustering, because

clustering by its nature interacts with the shape of the district. Table 3.1 lays out the predicted effects between the level of clustering and these criteria.

Tradeoffs from Clustering

Compactness

H_3. As clustering by party increases, the tradeoff between compactness and competitiveness is sharper.

H_4. As clustering by race increases, the tradeoff between compactness and number of majority-minority seats will be less sharp.

Competitiveness vs Majority-Minority Seats

H_5. In states with a higher degree of correlation between race and partisanship, there will be a sharper tradeoff between majority-minority districts and competitive districts.

Overview of Approach

In order to get at clustering directly, I compare computer-drawn plans that maximize (1) compactness, (2) competitiveness, and (3) the number of majority-minority districts for two states, Arizona and Washington, using Altman and McDonald's (2009) Better Automated ReDistricting (BARD) extension for R.

For each state, I used BARD to draw 100 plans that see to maximize each of three criteria—compactness, competitiveness, and the number of majority-minority districts—for each state, producing a total of 600 plans:

- 200 plans maximize compactness (100 in Arizona, 100 in Washington)
- 200 plans maximize the number of majority-minority seats

- 200 plans maximize the number of competitive seats.

For each plan, I automatically calculate descriptive statistics on each of our three variables of interest:

(a) Number of districts where party is within 10% (5% of equal)

(b) Number of districts where CVAP is under 50% non-Hispanic White

(c) Average compactness using the smallest inscribed polygon (Roeck 1960)

Because the starting point for each plan is chosen randomly by the program, and the plans are drawn mechanically, I will then use descriptive and inferential statistics and hypothesis testing to analyze the results. I will look both at (a) the direct effects of clustering using the Student's T, and (b) a difference-in-differences approach to look at the tradeoffs between criteria.

Automated Districting Procedure

Compactness-maximizing plans. The 200 plans that maximize competitiveness are done with a weighted *k*-means algorithm. A *k*-means algorithm begins by randomly assigning 100 points as centers of districts and expands each district out from that center until it hits another center or meets its maximum threshold. The weights used in these plans are population, so districts in large population areas will grow more slowly and be denser (start with more points) than in areas with small population.

Competitive/Majority-Minority. BARD's algorithm for maximizing a particular criterion uses a "random walk" approach in line with Cirincione et al (2000). This means that the program randomly chooses a starting point for each iteration and calculates a "next best"

probability for each adjacent geography. The one with the highest score is added to the district and so forth, until a population threshold is reached.

For all 600 automatically-drawn plans, an equivalency file—a file that lists assignments of precincts to districts—was produced. These equivalency files were then used to aggregate precincts and calculate (a)-(c) above.

Using Automated Districting. While automated redistricting has been considered by some a solution to the political costs of redistricting outlined in Cox and Katz (2002), Altman (2005) does rightly warn of its limitations. The mess of criteria that go into a redistricting plan runs at odds with the single criterion maximization algorithms used in a program. More importantly, it is probable that the important criteria in one jurisdiction will be different from any other jurisdiction—making it difficult to account for all the differences.

Nevertheless, automated districting has some important advantages. Most importantly, by removing the line-drawer from the process, it removes bias from the process. Altman and McDonald (2010) particularly points to its importance in studying districting. They argue that automated districting gives researchers the chance to be objective about the criteria they use since the criteria have to be defined. This is the reason I use it here.

The "random walk" approach does contain drawbacks. Unlike split-line algorithms that simply divide by half or wedges (Imai 2015), the random walk may leave a single precinct unassigned surrounded by other districts. This can lead to substantial population deviations, beyond any acceptable levels by the courts. In an attempt to minimize this, BARD's programmers assign additional weight to unassigned precincts that touch more than

one precinct already in the district. This does create a bias toward more compact districts than, for example, the random walk algorithm used by Kimbrough and Miller (2015). This weighting, however, biases the study against a finding rather than for one.

Case Selection

With respect to case selection, I use Arizona and Washington principally because the two have comparable redistricting processes. Even more significantly, both of their commissions have talked about the tradeoffs they were forced into—Arizona on trading competition for majority-Latino seats (McDonald 2006) and Washington on trading compactness and keeping cities intact for an attempt at a majority-non-White district (Washington State Redistricting Commission 2011).

Geography. For both Arizona and Washington, I used 2008 precincts as my base layer. These precincts were eventually drawn into the 2010 Census Block geography, so there is a direct lineup between precincts and block boundaries. Citizen Voting Age Population (CVAP) was calculated at the block level before -being aggregated into precincts.

Each state has a different degree in clustering. Washington has relatively low clustering by both party and race, while Arizona has relatively high clustering. Neither state is extreme on either measure.

Redistricting Criteria

Compactness. Compactness was measured in BARD using the Roeck measure. Roeck measures the percentage of the smallest circumscribed circle made up of the district. Niemi

(2009) notes that regardless of the measure chosen, most measures seem to get at the same underlying concept. Roeck is the default BARD uses, and is also a robust measurement. As each plan was drawn, each district received a separate score (ranging from 0 to 1, with 1 being a perfectly circular district). These individual district scores were averaged to create a single average for each plan.

Competitiveness. Competitiveness was measured using results for the 2008 Presidential election. The specific data, including shapefiles, came from the Harvard Election Data Archive (Ansolabehere and Rodden 2011, Ansolabehere 2015). As each map was drawn, I aggregated vote totals for McCain and Obama in each district. From this, I was able to get an estimate of the 2008 Presidential Election result in each district. I then used a cut off of ±5% to count the number of competitive districts in each plan.

Race/Ethnicity ("Communities"). Though the concept of "communities of interest" lacks a quantifiable definition, I have used race/ethnicity as a proxy because of its importance in the Voting Rights Act. While the Voting Rights Act speaks in terms of "protected classes" rather than specific racial/ethnic groups, for the purposes of redistricting, it does requires us to consider race and ethnicity. No other demographic criterion is so explicitly required.

There is substantial debate on the best way to determine what makes an effective minority district. However, in replicating the circumstances of actual redistricting to the extent practical, I follow the Ninth Circuit, which covers both Arizona and Washington, and use Citizen Voting Age Population (CVAP). The CVAP estimates used in this paper come from the 2008-2012 Special Tabulation of the American Community Survey, prepared at the direction of the Department of Justice (U.S. Census Bureau, "Citizen Voting Age Population

(CVAP) Special Tabulation" 2014). While this was not the dataset used in the 2011 redistricting, it is the dataset that is most accurate for 2010 itself and the most recent data available in late 2014.

For race/ethnicity, I generally use "percent non-majority White" as the metric. This is in line with evidence from state debates, such as the decision made by Washington's Redistricting Commission. In Washington, many areas have large non-White populations split between Latinos and Asians or African-Americans and Asians. Given that both the Asian and Latino communities are generally newer arrivals, the focus has been on White/non-White as the major division.

Arizona is more complicated. While it is not substantially more diverse, it does have large Native American reservations. However, in no cases are Latinos and Native Americans competing over seats in Arizona. Therefore, a White/non-White divide seems to capture the population split most accurately in both states.

Cluster Analysis

To measure spatial autocorrelation (clustering), I use the Global Moran's I tool included in ArcGIS 10.2 (ESRI 2016). Global Moran's I is a standard tool for calculating the total degree of spatial autocorrelation across all units in a system. Unlike several R implementations, the tool in ArcGIS has the advantage of making no hidden assumptions about the formula and calculation used.

Global Moran's I is measured on a scale ranging from -1 to 1, with -1 being perfectly dispersed, 1 being perfectly correlated, and 0 being random. One might understand this as the probability two adjacent units are identical, with values greater than 0 indicating

neighboring units are likely to be more similar, while values less than 0 indicate higher probability the two items are opposite.

In addition to the degree of clustering, each test produces a p-value indicating the degree of certainty of that finding. Clustering by both race and party was significant in both Arizona and Washington.

Clustering by Party. For each state, clustering by party was calculated based on the 2008 precinct-level election results (Ansolabehere and Rodden 2011). Based on the 2008 election results, Arizona has a Moran's I of 0.75 while Washington has a value of 0.65. The total variation between the largest and smallest among all states is 0.30 (Kansas) – 0.90 (Pennsylvania).

Clustering by Race. For each state, clustering by race/ethnicity was calculated using the Special Tabulation of CVAP 2008-2012. Based on the Special Tabulation, Arizona has a Moran's I of 0.72 while Washington's is 0.63. The total variation between the largest and smallest among all states is 0.11(Maine) – 0.90 (Illinois), though Maine's value is heavily influenced by its low non-White population.

Analysis

Individual Criteria

Competitiveness. As Table 3.2 shows, Arizona produced an average of 21 competitive districts (out of 100) across 300 plans, while Washington produced an average of 27.6 districts. This difference is statistically significant (t=-39.3, p<0.001), even after taking into account the difference in statewide competition.

(Table 3.2 about here)

This result is especially significant because Washington produces an average of six more competitive districts than Arizona, despite the state being less competitive as a whole. This means that despite the fact that we would have, *a priori* expected fewer competitive districts in Washington, where the margin between Obama and McCain was 16 percentage points than in Arizona, where the margin was 12, Washington managed to produce more competitive districts.

Figures 3.5 and 3.6 highlight the clustering story when we look at the Phoenix and Seattle areas. In Figure 3.6 we see that large competitive areas in the Seattle suburbs make it easy to rack up competitive districts quickly, while the highly clustered, homogeneous sections north and south of Grand Boulevard in Phoenix make it difficult to achieve those numbers.

Majority-Minority. In Table 3.3, I find similar results for the number of majority-minority districts. Arizona produced an average of 19.2 competitive districts across 300 plans, while Washington produced 2.3 (t=34.8, p<0.001), even after taking into account the difference in minority population.

(Table 3.3 about here)

The difference in non-White share between Washington and Arizona matters because we would expect more majority non-White districts in Arizona, which is 31% non-White by CVAP compared to Washington, which is only 19% non-White. However, the mean difference between the two states is not 12 fewer seats, which we might expect based on raw percentages, but a larger 17 seat difference. This may be attributed to clustering.

This result is important because even though Washington is almost 20% non-White (by CVAP), its low level of racial clustering gives it an average of just 2.3 districts that are majority non-White. In other words, minorities are evenly distributed throughout Washington state, making it more difficult to produce majority-minority districts. We can see this in both Figure 3.7 and Figure 3.3, which shows the lengths the Redistricting Commission went through in the 2011 redistricting. District 37 (shown) is the only majority-non-White seat in the state.

Tradeoffs

In addition to direct effects, I also looked at the effects of drawing plans that maximize each of the three criteria of interest: compactness, competitiveness, and majority-minority districts. Each column of the table corresponds to one of the three criteria that have been maximized, while each row refers to one redistricting criterion. Table 3.4 reports the means (total number of majority-minority and competitive seats, statewide average of Roeck value) in each row given each maximization condition.

(Table 3.4 about here)

Tables 3.4 and 3.5 compare across plans. Table 3.5 looks at the difference in means between each set of maximization criteria, such as between competitiveness and compactness. This table also reports the results of T-tests between plans within a state drawn to maximize different criteria. Table 3.6 shows the difference in differences, how much greater a tradeoff there is in one state compared to the other.

(Table 3.5 about here)

(Table 3.6 about here)

Compactness vs Competitiveness.

Compactness. When switching from plans that maximize compactness to plans that maximize competitiveness, the Roeck score in Arizona goes from 0.49 to 0.42—a 7 percentage point decrease. In Washington, the change goes from 0.42 to 0.38, a net decrease of 4 percentage points. In both cases, the change is significant (in Arizona, t=-54.5, p<0.001; in Washington, t=-27.9, p<0.001). As Hypothesis 3 suggested, the tradeoff is less in Washington than in Arizona

Competitiveness. When switching from plans that maximize compactness to plans that maximize competitiveness, the mean number of competitive districts in Arizona goes from 17.03 to 22.72—a 6.3 district increase. In Washington, the change goes from 30.1 competitive seats to 26.61, a net *decrease* of 3.5 districts. In both cases, the change is significant (in Arizona, t=18.0, p<0.001; in Washington, t=-9.2, p<0.001). Overall, as Hypothesis 3 suggested, the scale of the tradeoff is far smaller in Washington than in Arizona, even noting the surprising reverse sign on the tradeoff.

Causes. In no small part, this is for the same reason as Figures 3.5 and 3.6 demonstrated. Because partisans are more evenly distributed in Washington, compact districts tend to be more competitive than their Arizona equivalents. Even when drawing districts that maximize compactness, then, competitive districts can be the result in Washington, where Arizona really forces that tradeoff be made.

Compactness vs Race.

Compactness. When switching from plans that maximize compactness to plans that maximize the number of majority-minority districts, the Roeck score in Arizona goes from 0.49 to 0.42—a 7 percentage point decrease. In Washington, the change goes from 0.42 to

0.38, a net decrease of 4 percentage points. In both cases, the change is significant (in Arizona, t=57.7, p<0.001; in Washington, t=26.7, p<0.001). This presents evidence contrary to Hypothesis 4, because the tradeoff was supposed to be greater in Washington than Arizona given the level of clustering.

Race. When switching from plans that maximize compactness to plans that maximize the number of majority-minority districts, the mean number of majority-minority districts in Arizona goes from 20.5 to 18.6—a 2 district decrease. In Arizona, the change is significant (t=-7.3, p<0.001). In Washington, the mean is unchanged at 2.2 districts, a difference that is not significant. Again this runs contrary to Hypothesis 4, although this may be driven by Arizona's counterintuitive result.

Causes. Just as in Washington on competitiveness, these counterintuitive findings most likely relate to the limitations of BARD itself. As the State of Washington demonstrates in Figure 3.3 and Arizona in 3.4, Washington's attempt at majority-minority districts requires a good deal more tradeoff in practice (and Arizona requires a lot less) than we see in the models.

Race vs Competitiveness.

Race. When switching from plans that maximize competitiveness to plans that maximize the number of majority-minority districts, the mean number of majority-minority districts in Arizona goes from 18.49 to 18.6—a 0.1 district increase. In Washington, the mean is unchanged at 2.2 districts. The tradeoff in Arizona is barely significant (t=-1.6, p<0.1) in a one tailed test. Washington in not significant. Though slight, as Hypothesis 5 suggested, there is a tiny bit more of a tradeoff between race and competitiveness in Arizona than Washington

Competitiveness. When switching from plans that maximize competitiveness to plans that maximize the number of majority-minority districts, the mean number of competitive districts in Arizona goes from 23.3 to 22.7—a 0.5 district decrease. In Washington, the mean goes from 22.6 to 22.2. Neither difference is significant. Again, though slight, as Hypothesis 5 suggested, there is a tiny bit more of a tradeoff between race and competitiveness in Arizona.

Causes. Like the Compactness/Race tradeoffs, the slightness of this finding most likely relates to the limitations of BARD itself. Race is strongly correlated with partisanship in Arizona (White and Democrat are correlated at $r = -0.8$), while in Washington, the two are less linked (White and Democrat are correlated at $r = 0.1$). Perhaps this effect is also conditioned by local conditions; drawing more majority-non-White districts in Seattle may not have an effect on competition because the competitive parts of the state are elsewhere and less affected by this tradeoff.

Discussion

While the Arizona is more diverse and more competitive statewide, demography alone does not fully explain the differences between these two states. To understand that, we have to take into account their relative levels of clustering. Arizona is a heavily clustered state, where the non-White population lives in clearly defined neighborhoods and Native American lands. As race correlates strongly with partisanship, these heavily non-White areas are also heavily Democratic. Washington is less clustered, where the non-White population

lives throughout the state, often in areas 25 – 40% non-White. Not only does this produce different abilities to maximize criteria based on the degree of clustering, but also the degree of tradeoff between potential criteria.

Thus it is not surprising that the most significant findings are in the direct effects of switching from a state with a high degree of clustering to a lower degree, as in Hypotheses 1 and 2. Arizona was able to draw more majority-minority districts, but fewer competitive ones—despite Arizona being more competitive at the state level than Washington. This holds, even adjusting the null hypotheses to account for the demographic differences.

When it comes to tradeoffs, I come to findings that are less substantial. Encouragingly, I do find that Hypothesis 3 has some support in that Arizona had a statistically significant difference between plans drawn to maximize compactness and those drawn to maximize competitiveness, while in Washington the difference was not statistically significant.

Looking toward Hypotheses 4 and 5, however, shows the limits of the program. BARD seems unwilling to trade compactness for non-White districts after a point and maintains some kind of higher weighting to geographic units bounded by more than one already assigned unit in its random walk algorithm. This is most clearly demonstrated by the lack of support for Hypothesis 5, although a very weak finding that Arizona has more of a tradeoff at the 10% confidence level between competiveness and majority-minority districts suggests it might be worth further investigation.

The logical place to extend this work is to states with varying levels of clustering. While Washington and Arizona share institutional setups that helped narrow the scope down to clustering, I can imagine that working with states where the difference in clustering is

more substantial—between Illinois and South Carolina for example—may produce more clear-cut findings.

The results also suggest getting under the hood of BARD, so to speak, would be useful. While I discuss this more in Chapter 5, I think improving the coding and methodology—particularly figuring out a post-assignment automated process for balancing district populations would be an improvement over this methodology.

Table 3.1: Hypothesized Effects between Clustering and Criteria

	As Clustering increases by	
	2008 Election	Non-Hispanic White
Compactness	Sharper tradeoff between compactness and competitiveness	Less sharp tradeoff between compactness and majority-non-White districts
Competitiveness	Direct effect will be fewer competitive districts possible.	If White and partisanship are highly correlated, could lead to fewer competitive districts
Majority-Minority Districts	If White and partisanship are highly correlated, could lead to more majority-minority districts	Direct effect will be more majority-minority districts

Table 3.2: Mean number of competitive districts by state

	Arizona	*Washington*
Number of competitive districts	21.0***	27.6
	(3.7)	*(3.2)*
95% Confidence Interval	±0.7	±0.6
Upper Bound	21.8	28.2
Lower Bound	20.3	27.0
n	300	300
Obama 2008 % (statewide two party share)	45.7	58.7
Hypothesized Mean Difference	*-4.39*	
df	387	
t Stat	-39.30	
P(T<=t) two-tail	0.000***	

Note. *** = $p < .001$, two-tailed test. Standard Deviations appear in parentheses below means. Unequal variances assumed.

Table 3.3: Mean number of majority-minority districts by state

	Arizona	*Washington*
Number of majority-minority districts	19.2***	2.3
	(2.1)	*(0.8)*
95% Confidence Interval	±0.4	±0.2
Upper Bound	19.6	2.4
Lower Bound	18.8	2.1
n	300	300
Percent non-White (CVAP)	31.5	19.0
Hypothesized Mean Difference	*12.53*	
df	387	
t Stat	34.75	
P(T<=*t*) two-tail	0.000	

Note. *** = $p < .001$, two-tailed test. Standard Deviations appear in parentheses below means. Unequal variances assumed.

Table 3.4: Mean Values for Plans Maximizing Different Redistricting Criteria

		Arizona Plans Maximizing			Washington Plans Maximizing		
		Majority-non-White	Competitiveness	Compactness	Majority-non-White	Competitiveness	Compactness
Mean	Non-White	18.6	18.49	20.51	2.23	2.22	2.31
		(1.57)	*(1.84)*	*(2.04)*	*(0.87)*	*(0.83)*	*(0.66)*
	Competitive	22.72	23.28	17.03	26.17	26.61	30.06
		(2.43)	*(2.6)*	*(2.27)*	*(2.86)*	*(2.49)*	*(2.79)*
	Compactness	0.42	0.42	0.49	0.38	0.38	0.42
		(0.01)	*(0.01)*	*(0.01)*	*(0.01)*	*(0.01)*	*(0.01)*

Table 3.5: Tradeoffs between Plans Maximizing Redistricting Criteria

		Tradeoff Between Maximizing			Tradeoff Between Maximizing		
		Competitive to Maj. Min.	Compact to Maj. Min.	Compact to Competitive	Competitive to Maj. Min.	Compact to Maj. Min.	Compact to Competitive
Change in Mean	Non-White	0.11	-1.91***	-2.02***	0.01	-0.08	-0.09
	Competitive	-0.56#*	5.69***	6.25***	-0.44	-3.89***	-3.45***
	Compactness	-0.002	-0.067***	-0.066***	0.002	-0.038***	-0.040***

Table 3.6 Difference in Differences between Plans Maximizing Redistricting Criteria

	Difference in Differences (Arizona to Washington)		
	Race-Compete	Race-Compact	Compete-Compact
Non-White	0.1	-1.83	-1.93
Competitive	-0.12	9.58	9.7
Compactness	-0.004	-0.029	-0.026

Note. *** = $p < .001$, two-tailed test. Standard Deviations appear in parentheses below means. Unequal variances assumed.
#*=$p<.1$, one tailed test.

Figure 3.1: Unpacking African-Americans in Chicago

(Source: Illinois House of Representatives 2016)

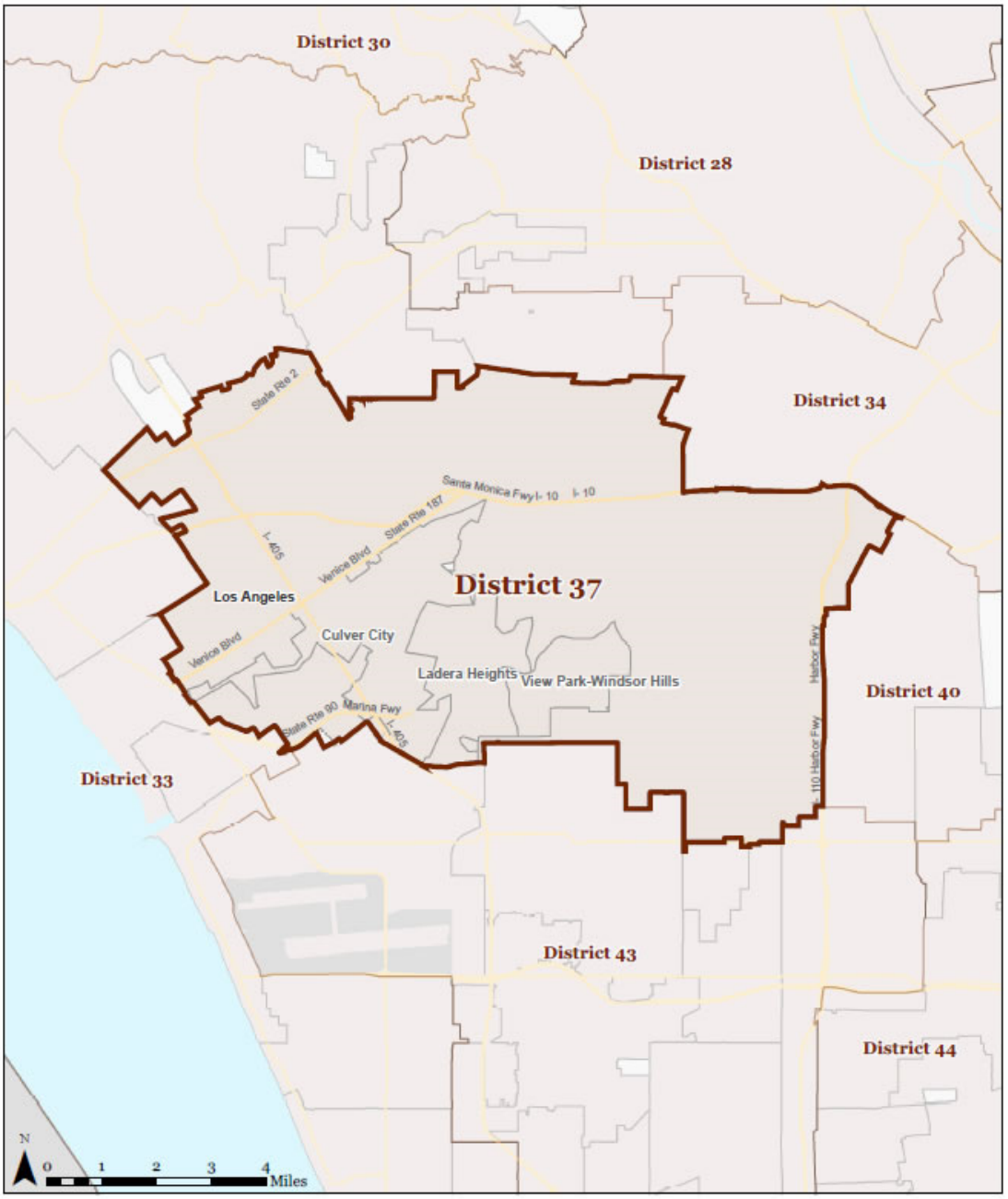

Figure 3.2: Congressional District 37 in Mid-City Los Angeles

(Source: Website of Representative Karen Bass 2016)

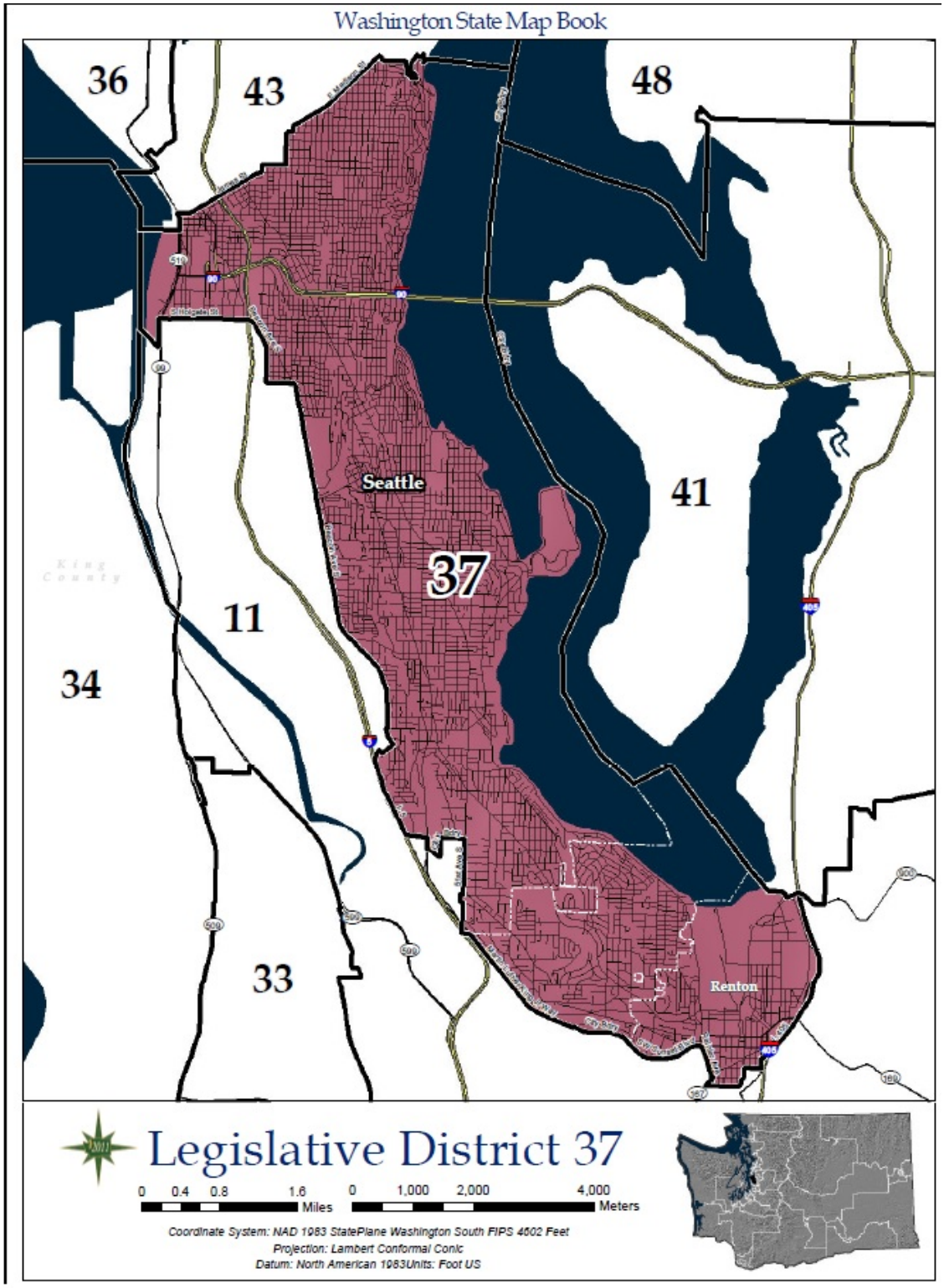

Figure 3.3: Majority-Minority District in Washington

(Source: Washington State Redistricting Commission 2016)

Figure 3.4: Majority-Minority Districts in Arizona

(Source: Arizona Independent Redistricting Commission 2016)

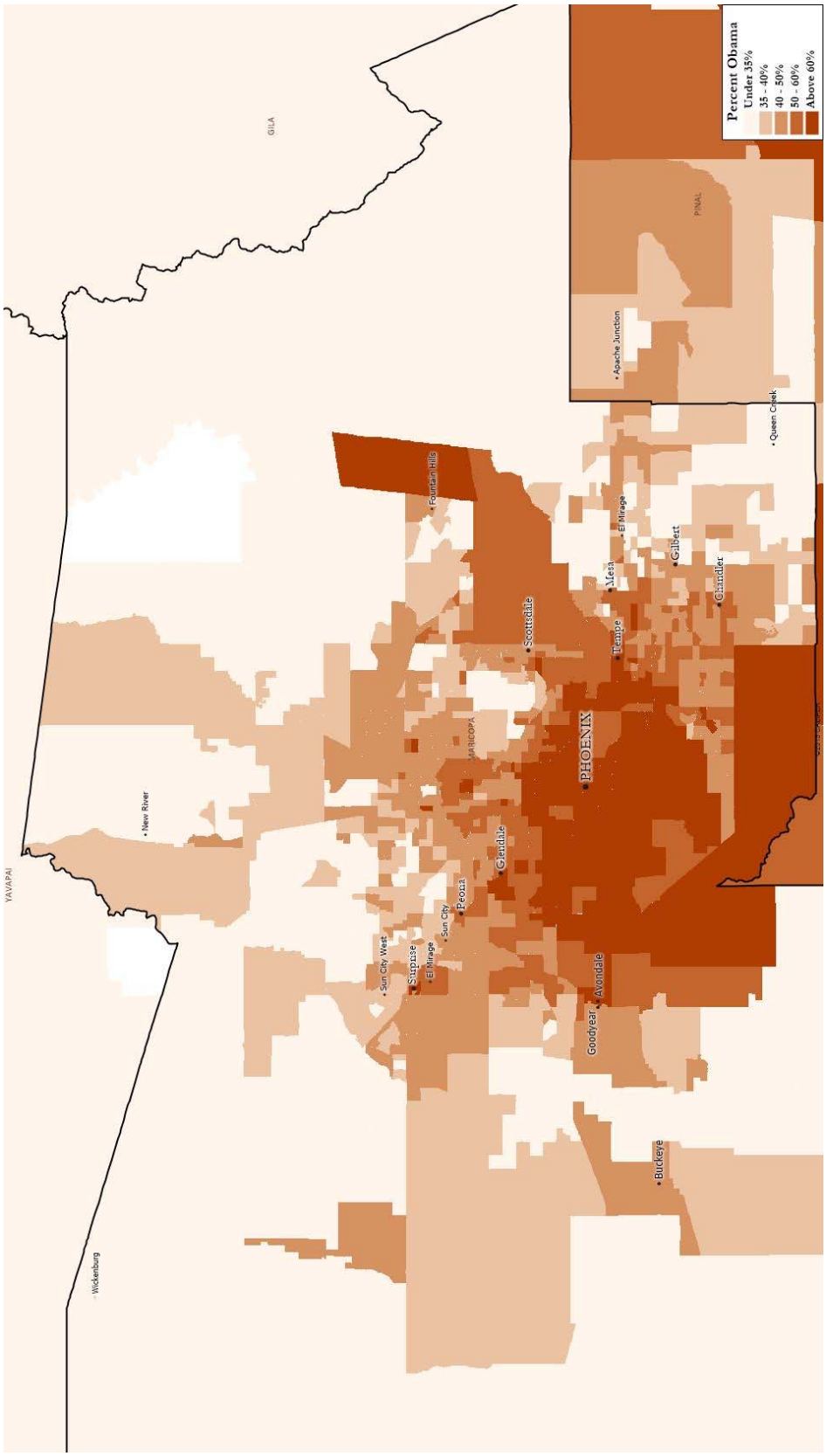

Figure 3.5: High Clustering by 2008 Election Results in Arizona, Phoenix detail

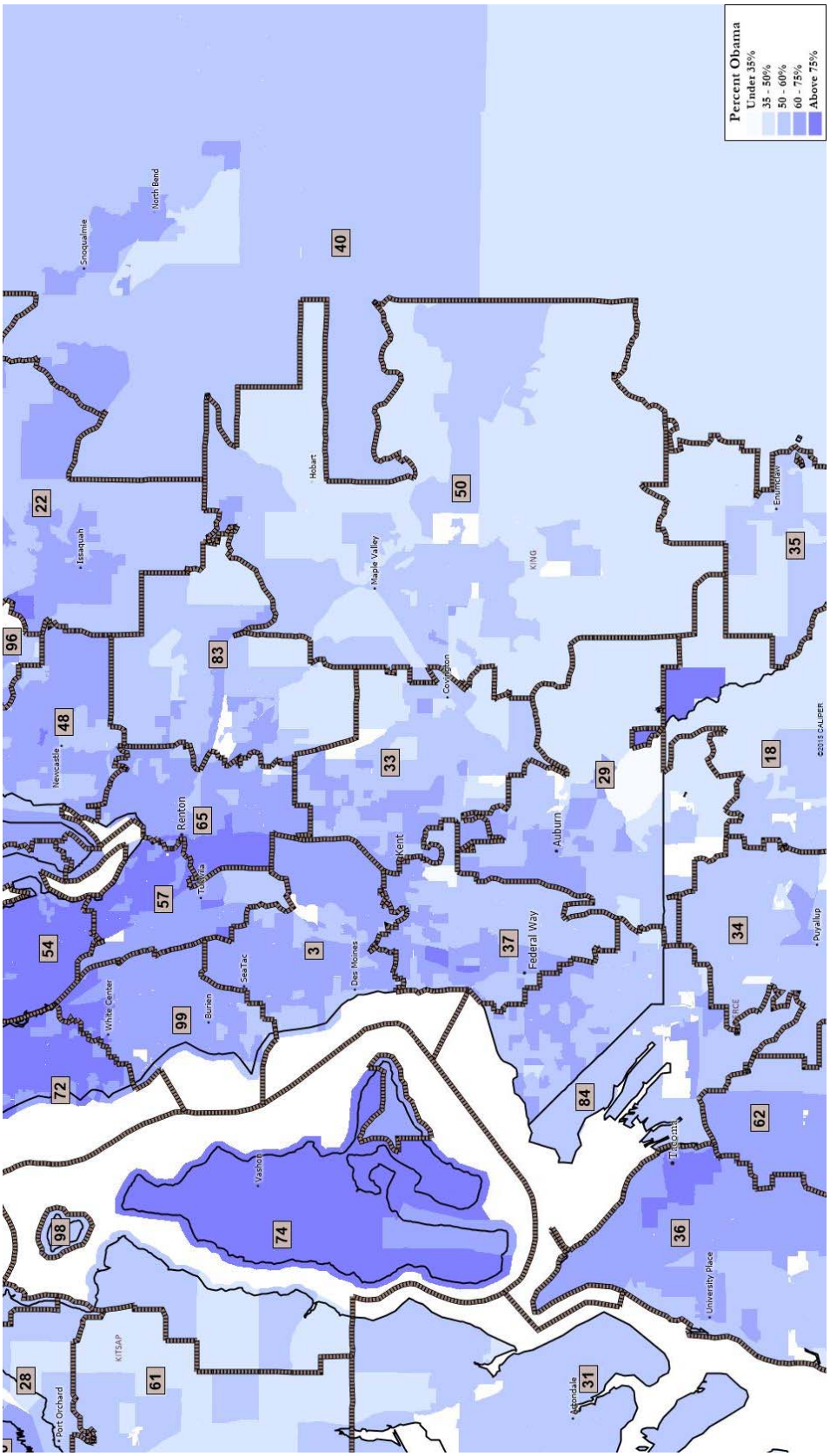

Figure 3.6: Compactness-Maximizing Plan and Percent Obama for Washington State, Seattle Detail

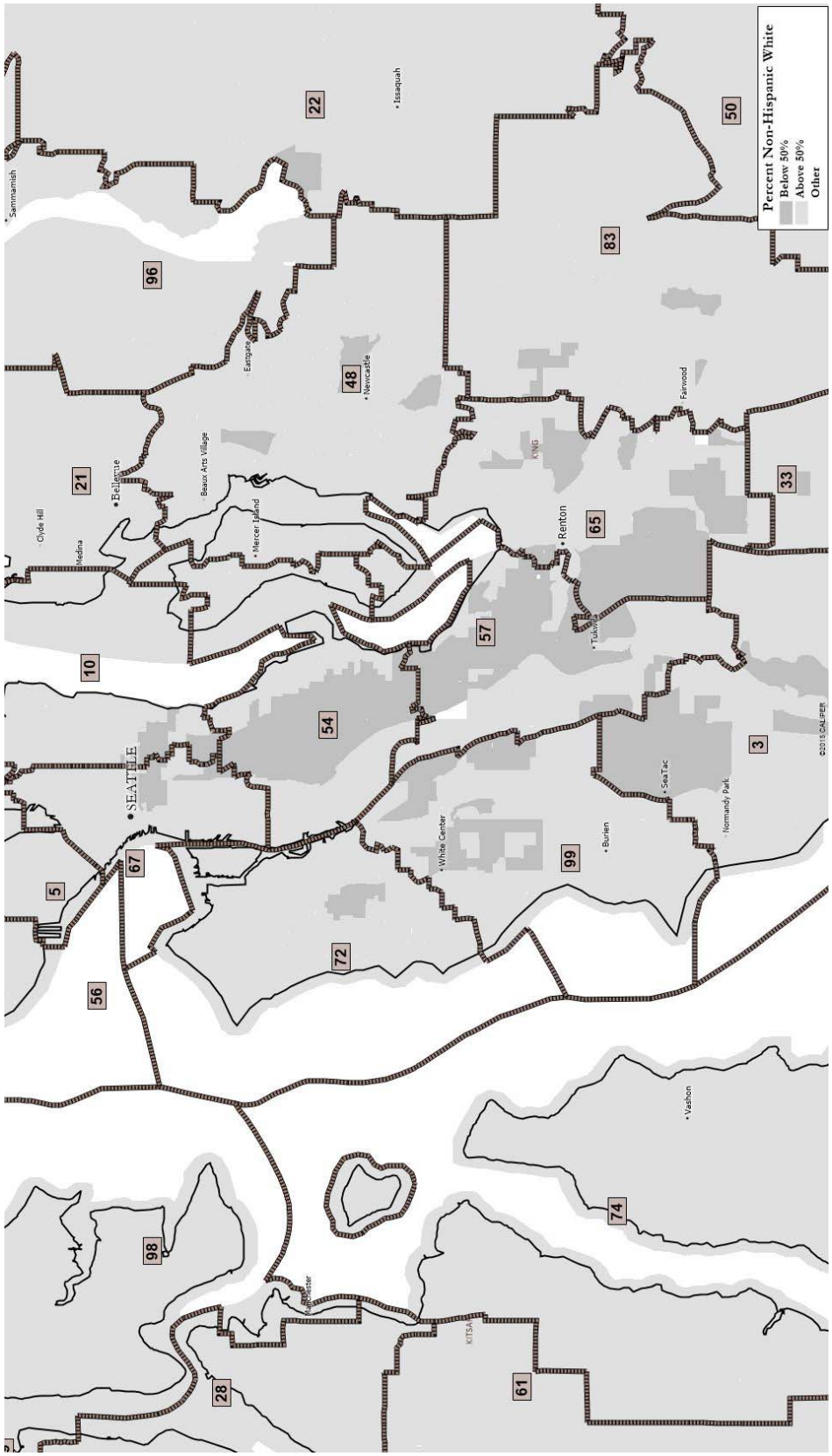

Figure 3.7: Low Clustering by Race in Washington State, Seattle detail

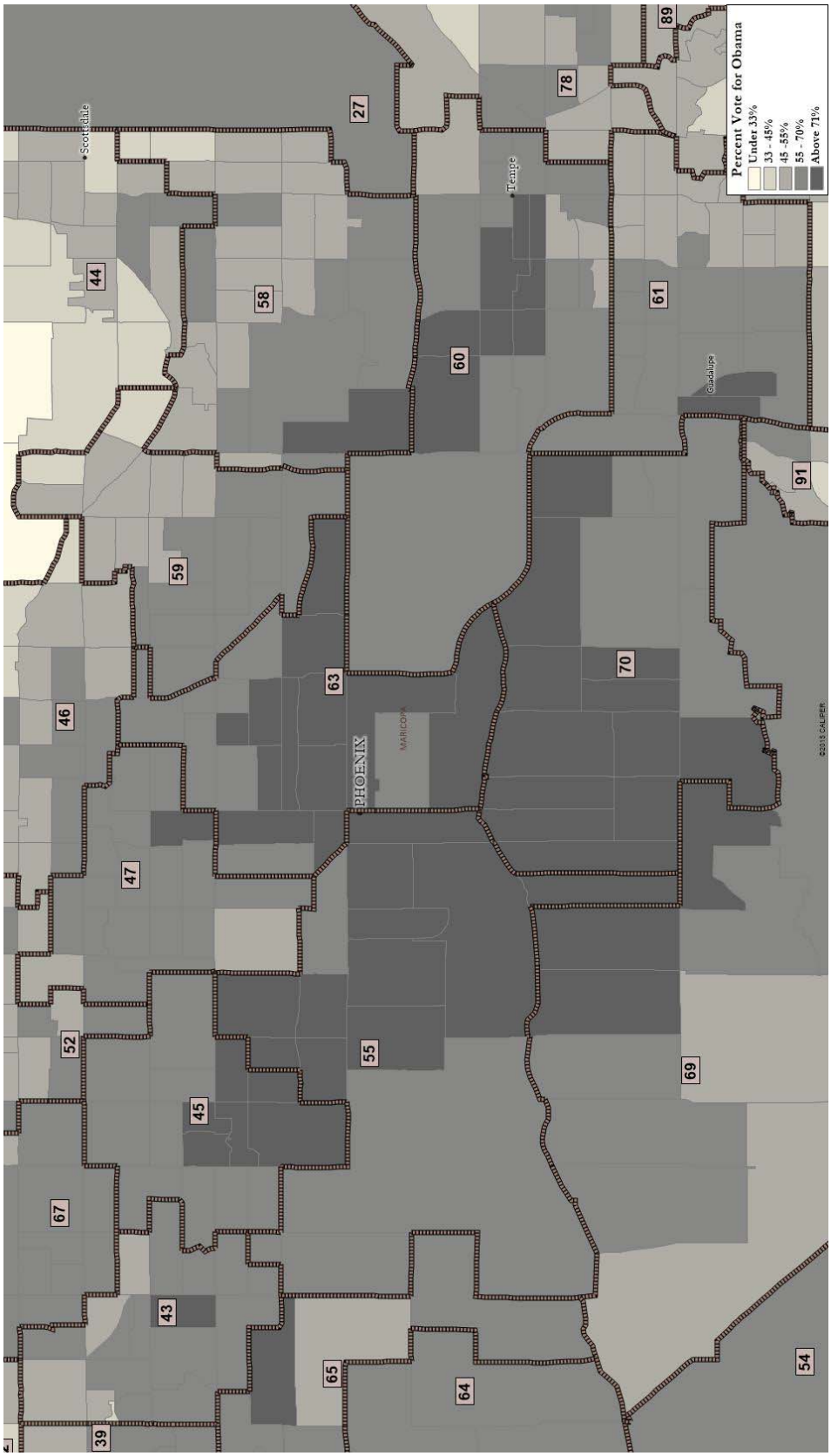

Figure 3.8: Majority-Minority Maximizing Plan and Percent Obama for Arizona, Phoenix detail

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Chapter 4

The Impact of Clustering on Redistricting Institutions

Though conventional wisdom and reform groups have argued that switching from legislative to commission redistricting results in fairer districts, academic research has either not found an effect (e.g. McDonald 2006) or found a minimal role for institutions (Winburn 2008). However, I show that institutions are necessarily constrained by the political and geographic context in which redistricting occurs. That is, if we want to see the impact of redistricting commissions, we must look at the underlying geography that line drawers must take into account. Geographic clustering by factors such as party and race constrain the redistricting process at the state level because each state faces a different tradeoff between standard redistricting criteria. Using state legislative data from 37 states during the 2011 redistricting, I find that commissions are more likely to draw competitive districts at low levels of clustering by party, but actually less likely to draw competitive districts when party clustering is high. Similarly, commissions are more likely to draw majority-minority districts than legislatures when clustering by race is high, but less likely to draw them when clustering by race is low. I also show that higher levels of clustering by party and/or race lead to commissions drawing more compact districts. These results indicate that Commissions do make different tradeoffs, but are less willing to trade compactness for other criteria than legislatures.

Introduction

In 2008, California was the poster child for the evils of the bipartisan gerrymander. Despite national swings in 2002 and 2006, "the tide stopped at the Pacific." The story went

that in 2001, the national Republican Party, wanting to focus on redistricting elsewhere, struck a corrupt bargain with state Democrats, who wanted to lock in their gains from a better-than-expected gain in 2000. Since then, California's legislative makeup stubbornly refused to react to national sentiment.

Out of this came several attempts to reform the system, such as Proposition 77. And even though Prop 77 suffered the fate of several previous intents to reform California's districting process, losing by 20 points, California's failure to produce competitive elections continued. In light of this, in 2008 Californians did approve of Proposition 11, which established a Citizens Redistricting Commission first used in 2011.

While voters may have opted for it because of the unpopularity of the legislature and reformers were optimistic that the commission would bring about sweeping change, the conventional wisdom among political advisors was that the effect would be minimal. After all, states like Idaho, Hawaii, Missouri, and Arizona—commission states all—have seen little to no effect. After a turbulent decade in the 1990s, even Washington's commission-drawn districts seemed to settle into an incumbent-friendly routine. Leading scholars following Butler and Cain (1992) expressed skepticism that commissions had results above and beyond the standard metrics such as incumbency and demography.

Much to the surprise of many in both politics and political science, it worked. After a decade where the only change came in the aftermath of scandal, the 113th Congress opened with six seats that had changed party hands, Democrats picking up five and Republicans one. Another ten had the top two candidates within 10% of each other in the general election, a trend that continued into 2014. So much for the commonly made argument in the 2000s that there simply were no more competitive areas in California—some of these districts just

simply restored the famously competitive boundaries of the 1990s that had been carefully broken up in 2001.

But what had really happened in California? 30% of the seats were now competitive (California Secretary of State 2012), not all of them, and many incumbents were more at risk from the new top-two primary that might pit two Democrats or two Republicans against each other than they were from their margin of safety. Certainly nothing challenged the Democratic Party's position statewide. Still, the commission clearly had some effect—more than in Idaho or Hawaii.

As the question of California's experiment with redistricting reform shows, scholars have a difficult time answering the question of whether redistricting institutions ultimately matter for outcomes. While there is some evidence that different redistricting institutions approach the process differently (Winburn 2008), even explicitly making different decisions, it has proven trickier to show that institutional change ultimately affects the end result. Why?

Geography Reconsidered

The answer lies on the drawing board—literally. Depending on the geography, in one state, two paths will lead to the same outcome, while in the second, they will produce very different consequences. However, without accounting for the effects of geography, the theoretical expectation is that any difference in geography is *random*. That is, if we want to determine the impact of redistricting instructions on tradeoffs and we compare plans across states without controlling for the geography of the state, we are assuming that the difference between them is due to institutions alone.

Yet since the geographic makeup of each state is non-random, this amounts to comparing apples and oranges. What we need to do is compare apples to apples: holding the underlying geography constant, would commissions and legislatures produce different maps?

This paper brings geography into the discussion of how these geographic districts are drawn. By measuring the degree of spatial autocorrelation—clustering on both the partisan dimension and on race—in each state, we are able to see how institutions choose given the tradeoffs they encounter. By comparing multiple states with similar levels of clustering and different redistricting institutions, we will be able to see whether actual political institutions make different tradeoffs given the real circumstances they face.

There is good reason to expect clustering to matter. Imagine if most African-Americans in one state lived in adjacent precincts—there is a clear African-American neighborhood, and racial clustering is high. In a nearby state, African-Americans are the majority in one precinct but a minority in the surrounding ones. Here, clustering is low on the dimension of race. Redistricting the first state makes it easy to create a majority-African-American district, but the second makes it far trickier. This is not merely hypothetical; it is the extension of Goedert's (2012) evidence that Voting Rights Act-compliant plans are often statistically indistinguishable from Republican gerrymanders in Southern states, but not Northern ones. Southern states have less clustering than Northern ones when it comes to the African-American population because rural areas tend to have less clustering than urban ones.

There is a similar story with clustering by party, but the extension of the logic is clear: depending on the level of clustering, the potential for tradeoffs change. This paper

begins by working through the consequences of this idea. First, it considers the criteria used in redistricting, with particular emphasis on understanding which are most important to legislatures and commissions, respectively. Then I look at how variation in clustering and redistricting institutions across 37 states in the 2011 redistricting affected the choices states made. I show that controlling for the level of clustering allows us to see that commissions are making different tradeoffs from legislatures. I also point to one reason why the literature may have missed this effect by showing that at specific levels of clustering, commissions and legislatures may produce similar results, even if they do so for different reasons.

Rules of the Game

To understand how clustering translates into tradeoffs, I begin by reviewing the principle decisions and limitations redistricting institutions face. Since *Baker v Carr* (1962), the Supreme Court has taken the lead in demanding that all plans must follow certain basic rules. The key one is **population equality**, often called "one person, one vote." This has mandated increasingly narrow restrictions on population deviations—when it comes to Congress a deviation of one person is allowed.

In addition, the Court has recognized "traditional redistricting criteria," which include **contiguity** (the principle that all parts of a district must touch or be connected), **use of natural boundaries**, and **keeping communities of interest intact**. While this last criterion, notably affirmed in *Shaw v Reno* (1993), is the vaguest, it is nonetheless the biggest check the courts have relied on when making decisions about the other legal constraint.

This constraint is Voting Rights Act of 1965, or more specifically Section 2, which mandates that "protected classes"—groups that have historically faced discrimination in

registration or voting as a result of their race or language group—have the "opportunity to elect candidates of their choice." Further, Section 5 required states and counties that did not meet certain thresholds for registration or turnout in 1974 to have their districts "precleared" by the Department of Justice or the District Court for Washington DC. Until *Shelby County* (2014), nine states were entirely covered and parts of seven more were covered, mainly in the South and areas with large Native American populations.

Section 2 of the Voting Rights Act, which applies everywhere in the country, requires states to look at and use race, drawing districts to represent non-White populations when there is a history of racially polarized voting (Kousser 1999, Grofman 1990). Sometimes, this may even require states to divide communities, or sacrifice other redistricting aims. It is also important to note that the Voting Rights Act may not be the only reason for drawing majority-minority districts. There has been a fear that such districts might be drawn to "pack" Democrats into a smaller number of districts, further exacerbating the Republicans' structural advantage (Canon 1999, Brace et al 2009). Or many members of the groups may feel they are a community of interest with different challenges than their non-coethnics (e.g. Epstein and O'Halleran 1996; Gay 2009).

Beyond the Voting Rights Act, political scientists have often sought an objective measure of district goodness. For example, a long line of researchers starting with Roeck (1961) have advocated for the use of **compactness,** a measure of a district when compared to an ideal shape. Niemi et al's (2009) paper shows over 90 different measures of compactness that have been proposed. The challenge here is that while compactness is widely seen as an "objective" measurement, it ignores race, natural and mad-made features

that divide communities and can impede contiguity or keeping political subdivisions intact (Altman 1997, Altman and McDonald 2010)

Theorists, politicians and good government groups often talk in terms of the partisan composition of the district as well. Much of the literature on accountability (e.g. Manin, Przevorski, and Stokes 1999, McDonald and Samples 2006) stresses the need for a **competitiveness** criterion. Can voters hold their leaders accountable? Is it possible the incumbent might lose? The exact standard for competitiveness varies, and can include such subjective elements as candidate quality, challenger quality, and previous election results, or simply partisan registration being within a small margin (Jacobson 2006).

Finally, there is the question of **keeping existing political subdivisions intact**. Commissions in particular often explicitly reference this idea when evaluating maps (Winburn 2008), but many local and state officials prefer to have clear lines of authority between levels of government. Many groups have claimed in hearings to find that division of their area serves to minimize their ability to influence policy.

Now as Butler and Cain (1992) point out, it is often impossible to satisfy all of these criteria at once. Redistricting inherently involves tradeoffs between these potential criteria. However, they do not go so far as to predict when tradeoffs may or may not exist—they only can speculate about what tradeoffs might be more probable (majority-minority vs competitiveness) than others (compactness vs keeping existing subdivisions intact). Some state-specific (Altman and McDonald 2012, Chen and Rodden 2013) and regional (Goedert 2012, McDonald 2010) studies have been done that suggest that tradeoffs do vary from state to state, but there are regional patterns.

Institutional Preferences

Even if the existence of these tradeoffs is somewhat hypothetical, what is more apparent is that different kinds of institutions believe themselves to be making different tradeoffs. Winburn (2008) analyzes the process in eight states with different forms of redistricting institutions and finds that when states reference a criterion explicitly in their state laws, they are more likely to debate it and it is more likely to impact their final product. This is confirmed in analyses of commissions, such as Arizona (McDonald 2006) and California (MacDonald 2012). Communities of interest—political subdivisions, neighborhoods with similar issues, natural features—all factor prominently into commission decision making processes. In contrast, Winburn's states that use legislatures often reference explicitly partisan criteria, pointing out the desire to hold or increase seat share.

Perhaps, then, it is surprising that existing literature has found that institutions seem to have little impact or even a negative result—commissions seem to produce fewer competitive districts than their legislative counterparts (McDonald 2012, 2006). Knowing, however, that commissions at the very least seem to explicitly reference different criteria than legislatures does allow us to see how institutions might respond when faced with specific tradeoffs.

The starting point for understanding the tradeoff institutions are willing to make stems from Cox and Katz (2002). Because changes to electoral boundaries have to be made, institutions face costs associated with moving lines—representatives may have to lose some of their core voters, incumbents may have to be placed together, communities may have to be divided. Many of these are essentially fixed costs, set by the constraints of equal population and the Voting Rights Act that individual states have little control over. These

costs, however, may pay dividends later, and each kind of institution is attempting to pay the smallest cost for the greatest future benefit.

Legislatures. A legislative party can get the most benefit out of consolidating that party's gains. This may be a bipartisan gerrymander or simply a partisan one—but either way, it is a play designed to keep the current party in power. Since the courts have consistently refused to rule that partisan gerrymandering is unconstitutional (*Davis v Bandemer* (1986), *Vieth v Jubelirer* (2004)), state legislators are generally only limited by their party's overall strength in the state and the federal constraints of equal population and the Voting Rights Act.

In terms of tradeoffs, legislatures are generally willing to give away compactness and even increasing minority group representation if it helps keep their party in power (for example, Southern Democrats in the 1970s and 80s—see Canon 1999). If the party's power is tenuous, they might opt for more competitive districts—particularly where the minority party seems a bit vulnerable. Overall, Republicans have a large structural advantage over Democrats due to their lack of concentration in urban centers and non-White populations (Rodden 2010). This would lead the Republican costs of trading off to be lower than those of Democrats.

Commissions. In contrast to legislatures, commissions generally work under explicit criteria given in their enabling acts (Winburn 2008). Many of these statutes explicitly call out competitive districts as a desirable objective (e.g. Arizona, "To the extent practicable, competitive districts should be favored where to do so would create no significant detriment to the other goals," Ariz. Const., Article VI, part 2, §1(16)).). However, competitiveness is below other criteria, including keeping political subdivisions intact, following natural

boundaries, and compactness. Like most Commission states, Arizona conducts a series of hearings throughout the state in which they solicit testimony about communities of interest—a nearly-universal feature of commissions that remains rare among legislatures (Cain 2011).

In terms of tradeoffs, commissions are generally willing to lose competitiveness in favor of keeping communities of interest together. In fact, commissions generally see the strength of their approach as their ability to keep neighborhoods and communities together. In some states such as Iowa, where the non-partisan board is charged with only considering competitiveness and there are no VRA issues, it is feasible that they will have more competitive districts. However, this is specifically because of the rules there (see Winburn 2008); in general commission states will see partisanship as one of many factors that play into defining communities.

Research Design and Hypotheses

Overview of Approach. In order to get at the role of clustering in shaping tradeoffs, I use plans—or really states—as a unit of analysis. I compare models without clustering to models with clustering. I use ordinary least squares (OLS) regression to test my hypotheses. Because the level of clustering exists prior to any districts drawn, states are an appropriate unit of analysis and all variables are calculated at or aggregated to the state level. I also exclusively use lower House plans. This paper uses only real plans and does not consider draft proposals, subsequent modifications, etc. In order to distinguish the effects of clustering from simply being in a more competitive or diverse state, I also include summary variables at the state level to control for this.

While this is in line with much early work on redistricting (e.g. Grofman and Handley 1991, Lublin 1997), much work since the mid-1990s has focused on district-level analyses following the approach of Gelman and King (1994). However, while individual contexts continue to be important for comparing plans within a given state (such as Rodden 2008, Altman and McDonald 2012, Forthcoming), it is less useful for comparing plans across states.

In particular, previous studies such as Masket et al (2012) have compared states such as Idaho where there are few precincts in which Obama won over 45% of the vote with non-commission states such as Nevada, where competition is fierce, can lead one to conclude that the commission system produced fewer competitive districts. Thus it can miss the fact that there may be less potential for competitive districts at the state level, which goes beyond controlling for state level effects.

No Clustering. The model used for the relationship between the three redistricting criteria I use (compactness, competiveness, and race/ethnicity) and the use of a commission can be modeled as:

(a) $$Compactness = \beta(Institution\ type) + \beta(controls) + \varepsilon$$

Note that though compactness is used here to illustrate, it can be replaced by the other dependent variables. This serves as the basis for the first set of hypotheses, which conform to our expectation that commissions as a general rule seek to draw more compact and more competitive districts as well as districts that reflect the race/ethnic demographics of the states:

H_1. Compared to legislative-drawn plans, commission-drawn plans will draw more compact districts.

H_2. Compared to legislative-drawn plans, commission-drawn plans will draw more competitive districts.

H_{3i}. Compared to legislative-drawn plans, commission-drawn plans will draw more majority-minority districts. This effect will be magnified in states covered by Section 5 of the Voting Rights Act.

H_{3ii}. Compared to Democratic legislative-drawn plans, Republican legislative and commission-drawn plans will draw more majority-minority districts. This effect will be magnified in states covered by Section 5 of the Voting Rights Act.

With race, it is essential to pay attention to the structural constraints imposed by the Voting Rights Act in particular. States that must submit their plan for review may be particularly conscious of race in districting. Hypothesis 3ii stems from evidence from Chen and Rodden (2013) and Goedert (2012), among others, who demonstrate that Republicans are more efficiently distributed in space than Democrats, so a Republican legislature may be able to produce more compact districts while maintaining a majority of seats.

Interaction with clustering. Adding clustering does not change the expected differences in how legislatures and commissions make tradeoffs, but it can either lead to either:

1. A magnification of the expected pattern, or
2. A functionally equivalent outcome for two different reasons.

This can be illustrated in the equation:

(b) $Compactness = \beta(Clustering) + \beta(Institution\ type) + \beta(\ Clustering \times Institution\ type) + \beta(controls) + \ \varepsilon$

That is to say, the clustering environment, however, leads to a different set of tradeoffs between criteria for high and low levels of clustering. So as a state moves from a low

clustering environment to a high one, the natural tradeoffs institutions already make will be magnified:

> **H_4.** In states with low clustering by party, moving from legislative-drawn to commission-drawn plans has an accelerated influence on the ability to draw competitive districts.
>
> **H_5.** In states with high clustering by party, moving from legislative-drawn to commission-drawn plans has little influence on the ability to draw competitive districts.
>
> **H_6**. In states with low clustering by race, moving from legislative-drawn to commission-drawn plans will have little influence on the ability to draw majority-minority districts.
>
> **H_{7a}.** In states with high clustering by race, moving from legislative-drawn to commission-drawn plans will have an accelerated influence on the ability to draw majority-minority districts.
>
> **H_{7b}.** In states with high clustering by race, moving from Democratic legislative-drawn to Republican legislative and commission-drawn plans will have an accelerated influence on the ability to draw majority-minority districts.

We have four potential states here, as seen in Table 1: high and low clustering by party and race. These hypotheses highlight how the degree of clustering can affect tradeoffs—Hypotheses 4, for example, predicts that low clustering by party will lead to increase competitiveness, because there is no tradeoff between compactness and competitiveness in that case. As the clustering by party increases, however, commissions will be unlikely to make the tradeoff of losing compactness to achieve more competitiveness.

(Table 1 about here)

Method and Data

States, Plans, and Institutions

States Included. Table 2.3 lists the 37 states are included in the initial data calculation. Several states either do have precinct-level election results for 2008 available (such as Delaware and Oregon) or do not meet the non-White population threshold necessary for statistically significant clustering (including New Hampshire and West Virginia; see discussion below under *"Cluster Analysis"*). Additionally, Nebraska was not included because it is a unicameral legislature.

Plan Year. This study includes the plans used in each state's 2012 General Election[3]. Some states (Texas) redrew maps after that election, but only plans drawn in 2011 are included in this study. This helps keep the data available to redistricters as consistent as possible.

Seats vs Districts. Four included states have different numbers of seats—positions in the legislature—and districts—geographic constituencies in which elections occur. For example, Washington has 49 districts and 98 seats, two representatives coming from each district. For the purposes of this study, I use the number of districts unless number of seats is specified.

Commission. Each state has a unique process for drawing districts, and a few states even have distinct processes for drawing Congressional and Legislative lines. The line between commission and legislature is not clear. One comprehensive survey (Johnson et al

[3] For New Jersey and Virginia, which hold odd-year elections, I used the plans first enacted for 2013

2010) distinguishes nine institutional arrangements on a scale of 1-9, with 1 meaning standard legislative process and 9 being the independent commissions of California and Arizona. Intermediate values represent limits on legislative control (3 includes states with backup processes specified in their constitutions. 4 and 5 include states where the process is led by the executive branch) or partisan commissions (6-8 are commissions that all require final legislature approval, sometimes with authority to modify the plan).

For this study, I treat values of 5 or higher as Commission and 4 or lower as non-Commission. This includes 14 states as commission states, including Iowa, which scores a 5 but is generally thought of as a commission state. The states considered as commission states are shown in Figure 4.3.

Redistricting Criteria

Compactness. Compactness was measured in Maptitude for Redistricting using the Roeck measure. Roeck measures the percentage of the smallest circumscribed circle made up of the district. Each district receives a separate score (ranging from 0 to 1, with 1 being a perfectly circular district). These individual district scores were averaged to create a single value for each state. These values range from 0.33 (Hawaii) to 0.46 (Kansas).

Competitiveness. Competitiveness was measured using results for the 2008 Presidential election. For the state-level competitiveness, the formula can be presented as:

(c) $$Competitiveness = 1 - \left|\%\, Obama_{State,2008} - \%McCain_{State,2008}\right|$$

Where each candidate's vote share is simply their overall state value. Since a state that is 55% Republican is just as competitive as a state that is 55% Democratic, I calculated

the absolute value, then subtracted from 1 so that a value of 1 means that a state is exactly evenly balanced and a score of 0 would be a single-party state. Values range from 0.77 (Hawaii) to 0.999 (Missouri).

For district-level competitiveness, I aggregated 2008 precinct-level data using the data and GIS shapefiles from the Harvard Election Data Archive (Ansolabehere and Rodden 2011, Ansolabehere 2015) to the districts drawn in 2011. From this, I was able to get an estimate of the 2008 Presidential Election result in each district. I then used a cut off of ±5% to count the number of competitive districts in each state. These values range from 0% in Hawaii and Massachusetts to 50% of districts competitive in Iowa.

Race/Ethnicity ("Communities"). Though the concept of "communities of interest" lacks a quantifiable definition, I have used race/ethnicity as a proxy because of its importance in the Voting Rights Act. While the Voting Rights Act speaks in terms of "protected classes" rather than specific racial/ethnic groups, for the purposes of redistricting, it does requires us to consider race and ethnicity. No other demographic criterion is so explicitly required.

There is substantial debate on the best way to determine what makes an effective minority district. However, in replicating the circumstances of the 2011 redistricting to the extent practical, I follow four Circuit Court opinions and use Citizen Voting Age Population (CVAP). The CVAP estimates used in this paper come from the 2005-2009 Special Tabulation of the American Community Survey, prepared at the direction of the Department of Justice (U.S. Census Bureau, "Citizen Voting Age Population (CVAP) Special

Tabulation" 2011). This was the data set released in early 2011 as the most recent data during the process[4].

For race/ethnicity, I generally use "percent non-majority White" as the metric. This is in line with evidence from state debates, such as the decision made by Washington's Redistricting Commission. While states such as California and Florida have often struggled with interethnic conflict, representatives of the ethnic groups often use a percent non-Hispanic White as a test for ability to elect. With the exception of Hawaii, estimates for the proportion of non-majority White districts vary considerably between 0% and 50%. Four included states (Idaho, Iowa, Maine, and Oregon) have no districts that do not have a non-Hispanic White majority. Again excepting Hawaii, non-Hispanic Whites make up a plurality of the population by CVAP in every state, and a majority in all states but Hawaii and New Mexico (49% non-Hispanic White). Hawaii is plurality Asian (47%), keeping in line with its exceptionality elsewhere.

Cluster Analysis

To measure spatial autocorrelation (clustering), I use the Global Moran's I tool included in ArcGIS 10.2. Global Moran's I is a standard tool for calculating the total degree of spatial autocorrelation across all units in a system. Unlike several R implementations, the tool in ArcGIS has the advantage of making no hidden assumptions about the formula and calculation used.

Global Moran's I is measured on a scale ranging from -1 to 1, with -1 being perfectly dispersed, 1 being perfectly correlated, and 0 being random. One might understand this as

[4] This dataset updates annually; redistricting professionals are currently using 2010-2014 data.

the probability two adjacent units are identical, with values greater than 0 indicating neighboring units are likely to be more similar, while values less than 0 indicate higher probability the two items are opposite.

In addition to the degree of clustering, each test produces a p-value indicating the degree of certainty of that finding. All results for included states are under $p<0.001$, with the exception of the non-Hispanic White clustering for Maine ($p<0.04$). One of the principle limitations of cluster analysis is that the level of uncertainty increases as variation decreases. That is, if every geographic unit has the same composition, the model is uncertain whether this is because people are perfectly dispersed or perfectly correlated, and the function is undefined. This is the reason some states with low levels of variation had to be excluded.

Clustering by Party. For each state, clustering by party was calculated based on the 2008 precinct-level election results (Ansolabehere and Rodden 2011). Global Moran's I was run for each state separately, with resulted in a range of 0.31-0.90. Figure 4.1 shows these results by state, showing regional variation with more clustering in the Midwest and less in the Deep South.

Clustering by Race. For each state, clustering by race/ethnicity was calculated using the Special Tabulation of CVAP 2005-2009. Global Moran's I was run for each state separately for non-Hispanic White, Black or African-American, Hispanic or Latino, and Asian. Variation in the range for non-Hispanic White ranges from 0.12-0.86, for Black from 0.17-0.89, for Latino 0.15-0.86, and for Asian 0.23-0.75. Figure 4.2 illustrates this, showing more clustering in the Midwest, and less in the Deep South, just as for clustering by party.

Overall, in the models I generally use non-Hispanic White clustering for the same reason I use a state's percentage non-Hispanic White for the same reason as above. It is the White-non-White dichotomy that best captures states' debates nationally.

Results

Competitiveness

(Table 2 about here)

Table 2 shows the impact of switching from legislature to commission redistricting given the level of clustering by party. Models 1-4 confirm the strong effect of state-level competitiveness for the percent of districts that are competitive in each state. On average, for every one additional percentage point competitive the state is as a whole, there is a corresponding 1.4 point increase in the number of competitive districts.

Model 5, the interaction between commission and clustering by party, is one of the most important models. It shows that simply switching from legislative to commission at a random distribution of geography would produce a 0.53 increase in competitive districts, significant to the 1% level. Similarly, as clustering increases, the percent of competitive districts increases, with each unit increase in clustering producing 0.29 unit increase in the percentage of competitive districts, significant to the 5% level. With the interaction, which is also significant at the 1% level, shows that as clustering increases, it actually is in the reverse direction. That is, as level of clustering increases, switching from legislature to commission has a negative effect. This interaction was robust to the inclusion of the Voting Rights Act, partisan composition of the legislature, and other variables.

Race/Ethnicity

(Table 3 about here)

Table 3 shows how commissions make tradeoffs with respect to majority-minority districts based on clustering by party. Models 1-3 again show that commissions have no independent effect, with the main variable standing out being percent Non-Hispanic White CVAP. This is logical—as the percent Non-Hispanic White by CVAP increases, the percent of districts that are majority White decreases. Model 4 shows that increasing clustering by percent Non-Hispanic White has a slight but significant decrease in the percent non-majority White districts. At too-high levels of clustering, it may be increasingly difficult to draw districts that are not overwhelmingly of one race—such as California's heavily (80%+) Latino districts in central Los Angeles—there's no way to avoid drawing them.

Model 5 uses an interaction term to see how clustering results in tradeoffs when in conjunction with clustering by race. As with competitiveness, it shows that when clustering is random, a commission would produce more majority-non-White districts, significant at the 1% level. However, as clustering increases, the percentage of majority-non-White districts declines faster among commission states than in non-commission states. At the range of clustering present in the states, this would indicate that commissions are refusing to increase the number of majority-non-White districts if it means less compactness. These findings are robust to the inclusion of the Voting Rights Act, the partisanship of the legislature, and other variables.

Compactness

Compactness by Party

(Table 4 about here)

Table 4 looks at how compactness can be predicted from clustering by party. Model 1 confirms the results of Rodden (2011). Being covered by the Voting Rights Act decreases compactness by 3%, while being a state with a Republican-controlled redistricting process increase compactness by 2.6%, as we would expect. Models 2 and 3 shows that just adding a commission dummy has little impact on compactness.

Model 4 shows the impact of adding clustering by party without an interaction term. Simply controlling for the degree of clustering shows the direct impact of clustering, which is significant at the 5% level. Controlling for who draws the lines, as the level of clustering increases, compactness decreases, by about 6.6%. Since high levels of clustering by party mean that lots of similar partisans live nearby, we would expect legislators, ceteris paribus, to want to break these clusters up. Thus, as we expect, commissions now lead to a slight increase in competitiveness, 1.5%, which is significant at the 10% level. With interaction, as in Model 5, commission is not significant on its own, and neither is the interaction, but clustering is still negatively correlated.

Compactness by Race

(Table 5 about here)

Table 5 looks at how compactness can be predicted from clustering by race. Just as above, Commission alone has no relationship with or without demographic variables. Compared to the above model, `adding the overall percent Non-Hispanic White by CVAP leads to slightly more compact districts—as states are less likely to have potential VRA challenges, they can draw more compact districts. In Model 3, which includes both

commission and demographic variables, Percent Non-Hispanic White is the only significant variable.

Even adding clustering in Model 4 has limited impact. As we saw with clustering by party, adding clustering clarifies the other variables, especially the positive correlation between percent Non-Hispanic White and compactness. However, Model 5 demonstrates the importance of the interaction term. With the interaction term, commissions have a slightly negative impact on compactness (significant at the 10% level) when clustering is random. However, as clustering by race increases, commission states increase their average level of compactness faster than Democratic-controlled legislatures, so at high levels of clustering, commission states will produce more compact districts. This is greater than the increase for switching from Republican to Democratic-controlled legislatures as well. This continues to be conditional on whether the state is covered by the Voting Rights Act.

Discussion

Previous literature presented a puzzle: political science concludes that institutions scarcely matter for the final redistricting outcome. But if that is true, why have reformers and incumbents alike fought tooth and nail over these reforms? Geography helps resolves the puzzle. Given a particular level of clustering, legislators and commissions not only face different choices, but they make different decisions.

In terms of both the competitiveness and number of majority-minority districts, commissions would produce more competitive and majority-minority districts—if clustering was random. However, as the level of clustering increases, we see that commissions are not willing to make the same tradeoffs legislatures make. This may be because under high levels

of clustering, achieving either more competitive or majority-minority districts would require dividing political subdivisions or communities of interest. This is something we see in the compactness models as well, where commissions are more likely than commissions to make the compact choice as clustering increases.

Importantly, the interactions also show that legislators and commission may produce the same results under certain levels of clustering. For example, we would expect little difference between commission and legislative plans with respect to competitiveness when clustering by party is low. This is in line with what my hypotheses would suggest.

By using actual plans, we are able to see how legislatures and commissions have made tradeoffs. In the future, we would want to see in particular what happens when states switch their redistricting institutions. Comparing plans across decades would be an important confirmation of these findings. We could also evaluate what happens if states are forced to draw multiple plans in a single decade, contrasting court-drawn plans with legislative- or commission-produced ones, for example.

The results may also suggest that the impact of clustering may not be as linear as I expected. The logic of what happens at when clustering is extremely high may not have the same impacts as clustering at more moderate levels. Nevertheless, the introduction of clustering as an explanatory variable has helped get to the heart of Rodden's (2008) finding that legislatures and commissions have different intentions going into the process, thereby representing is a significant advance over previous uncertainty over whether commissions have any impact in redistricting outcomes.

Table 4.1: Hypothesized Interaction Effects between Clustering and Institutions

	By Party	By Race
Low Clustering	• Increased competitiveness	• No effect on majority-minority districts (subject to VRA)
High Clustering	• No effect on competitiveness	• Increased number of majority-minority districts (subject to VRA)

Table 4.2: Competitiveness Models

	(1)	(2)	(3)	(4)	(5)
	Only Commission	Only Race	Race and commission	With Cluster by 2008 Election	With Interaction
VARIABLES	Percent Competitive Districts	Percent Competitive Districts	Percent Competitive Districts	Percent Competitive Districts	Percent Competitive Districts
PRESIDENTIAL COMPETITIVENESS	1.396**	1.122*	1.111*	1.115*	1.378**
	(0.404)	(0.424)	(0.438)	(0.442)	(0.401)
PERCENT NON-HISPANIC WHITE		0.227	0.230	0.212	0.276#
		(0.147)	(0.152)	(0.155)	(0.139)
PRESIDENTIAL CLUSTERING				0.0897	0.292*
				(0.131)	(0.135)
COMMISSION	0.00372		-0.00683	-0.0115	0.531**
	(0.0457)		(0.0453)	(0.0462)	(0.190)
COMMISSION X PRESIDENTIAL CLUSTERING					-0.785**
					(0.269)
NUMBER OF DISTRICTS	-0.000608	-0.000701	-0.000733	-0.000781	-0.000999*
	(0.000497)	(0.000438)	(0.000493)	(0.000502)	(0.000451)
CONSTANT	-0.999**	-0.901**	-0.887**	-0.933**	-1.335**
	(0.372)	(0.354)	(0.371)	(0.380)	(0.364)
OBSERVATIONS	33	33	33	33	33
R-SQUARED	0.298	0.351	0.351	0.362	0.520

Standard errors in parentheses ** *p<0.01, * p<0.05, # p<0.1*

Table 4.3: Majority-Minority Models

	(1)	(2)	(3)	(4)	(5)
	Commission Only	Presidential Competitiveness Only	Commission + Pres. Comp.	With Cluster by Race	With Interaction
VARIABLES	Percent Majority Non-White Districts	Percent Majority Non-White Districts	Percent Majority Non- White Districts	Percent Majority Non- White Districts	Percent Majority Non- White Districts
PRESIDENTIAL COMPETITIVENESS		0.115	0.113	0.0539	0.102
		(0.205)	(0.207)	(0.184)	(0.172)
PERCENT NON-HISPANIC WHITE	-1.124**	-1.118**	-1.118**	-1.167**	-1.121**
	(0.0785)	(0.0793)	(0.0801)	(0.0730)	(0.0705)
NON-HISPANIC WHITE CLUSTERING				-0.233**	-0.149#
				(0.0793)	(0.0819)
COMMISSION	0.0133		0.0131	0.0212	0.382**
	(0.0200)		(0.0203)	(0.0182)	(0.157)
COMMISSION X NON-HISPANIC WHITE CLUSTERING					-0.491*
					(0.212)
CONSTANT	-0.0290	-0.129	-0.130	0.0530	-0.0166
	(0.0591)	(0.192)	(0.194)	(0.183)	(0.172)
OBSERVATIONS	32	32	32	32	32
R-SQUARED	0.876	0.876	0.878	0.907	0.923

Standard errors in parentheses ** *p<0.01*, * *p<0.05*, # *p<0.1*

Table 4.4: Compactness by Party Models

VARIABLES	(1) Demographics Only Roeck	(2) Commission Only Roeck	(3) Demographics and Institutions Roeck	(4) Clustering Only Roeck	(5) Clustering with Interaction Roeck
COMMISSION		0.00823	0.0132	0.0153#	-0.0226
		(0.0111)	(0.00929)	(0.00849)	(0.0429)
REPUBLICAN HOUSE	0.0257*		0.0267*	0.0298**	0.0292**
	(0.0113)		(0.0111)	(0.0102)	(0.0102)
VRA: §5 COVERAGE (WHOLE STATE)	-0.0320**		-0.0295**	-0.0341**	-0.0349**
	(0.00995)		(0.00992)	(0.00919)	(0.00928)
PRESIDENTIAL COMPETITIVENESS	0.0273		0.0274	0.0282	0.00988
	(0.130)		(0.128)	(0.116)	(0.118)
PRESIDENTIAL CLUSTERING				-0.0661*	-0.0802*
				(0.0256)	(0.0302)
COMMISSION X PRESIDENTIAL CLUSTERING					0.0537
					(0.0596)
HAWAII CONTROL	-0.0438		-0.0520*	-0.0549*	-0.0556#
	(0.0296)		(0.0296)	(0.0270)	(0.0271)
CONSTANT	0.358***	0.388***	0.352***	0.395***	0.423***
	(0.117)	(0.00610)	(0.115)	(0.106)	(0.110)
OBSERVATIONS	33	33	33	33	33
R-SQUARED	0.429	0.017	0.469	0.577	0.590

Standard errors in parentheses ** *p<0.01,* * *p<0.05,* # *p<0.1*

Table 4.5: Compactness by Race Models

VARIABLES	(1) Demographics Only Roeck	(2) Commission Only Roeck	(3) Demographics and Institutions Roeck	(4) Clustering Only Roeck	(5) Clustering with Interaction Roeck
COMMISSION		0.00823	0.00847	0.00489	-0.0796#
		(0.0111)	(0.00891)	(0.00914)	(0.0445)
REPUBLICAN HOUSE	0.0167		0.0178	0.0171	0.0221*
	(0.0106)		(0.0107)	(0.0106)	(0.0104)
PERCENT NON-HISPANIC WHITE	0.0831**		0.0832*	0.0880*	0.0845*
	(0.0373)		(0.0373)	(0.0369)	(0.0352)
NON-HISPANIC WHITE CLUSTERING				-0.0426	-0.115*
				(0.0309)	(0.0475)
VRA: §5 COVERAGE (WHOLE STATE)	-0.0194*		-0.0177	-0.0200#	-0.0286*
	(0.0110)		(0.0112)	(0.0111)	(0.0115)
COMMISSION X NON-HISPANIC WHITE CLUSTERING					0.123#
					(0.0637)
CONSTANT	0.323***	0.388***	0.319***	0.347***	0.400***
	(0.0255)	(0.00610)	(0.0259)	(0.0325)	(0.0413)
OBSERVATIONS	33	33	33	33	33
R-SQUARED	0.447	0.017	0.464	0.500	0.563

Standard errors in parentheses ** *p<0.01,* * *p<0.05,* # *p<0.1*

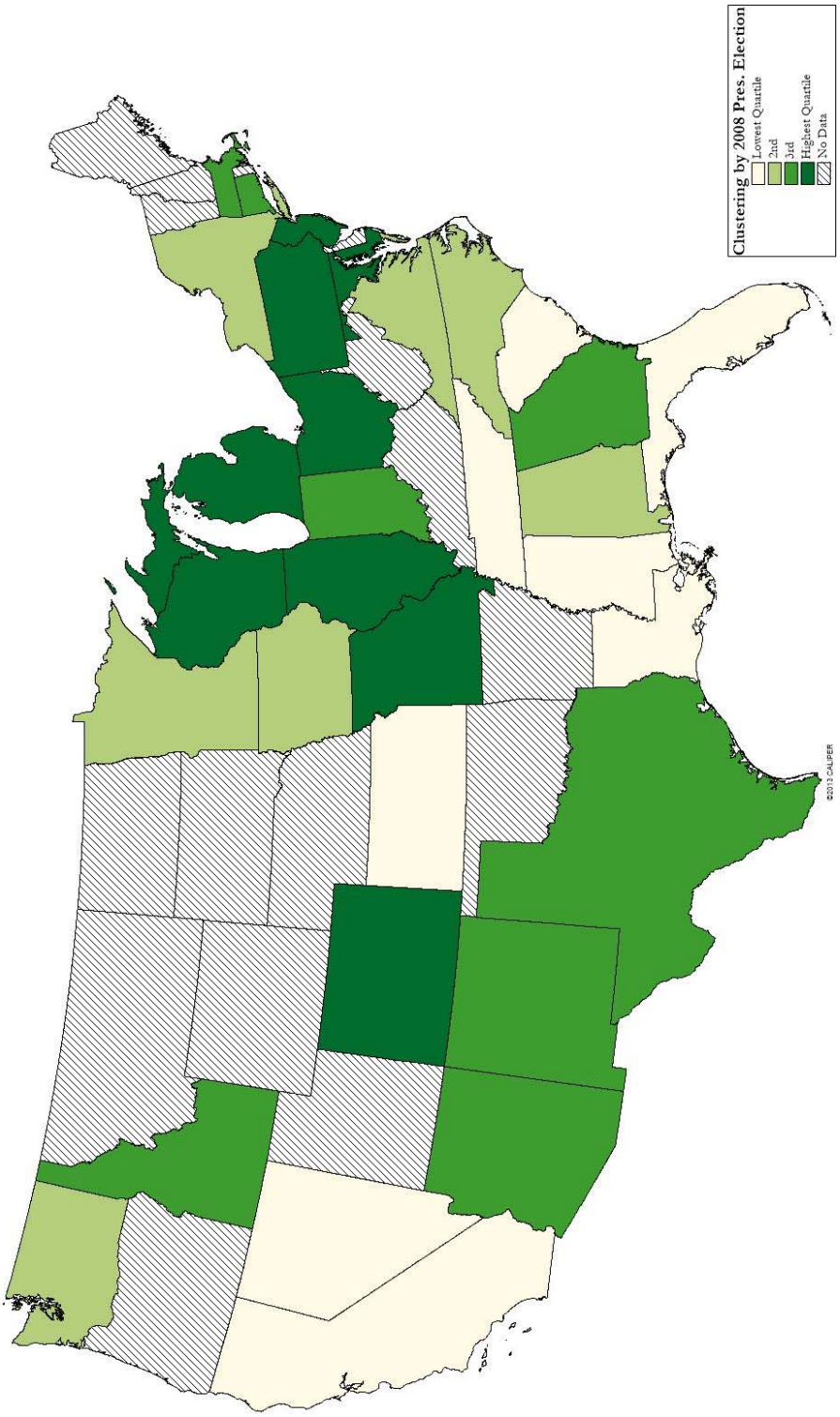

Figure 4.1. Clustering by 2008 Presidential Election by State

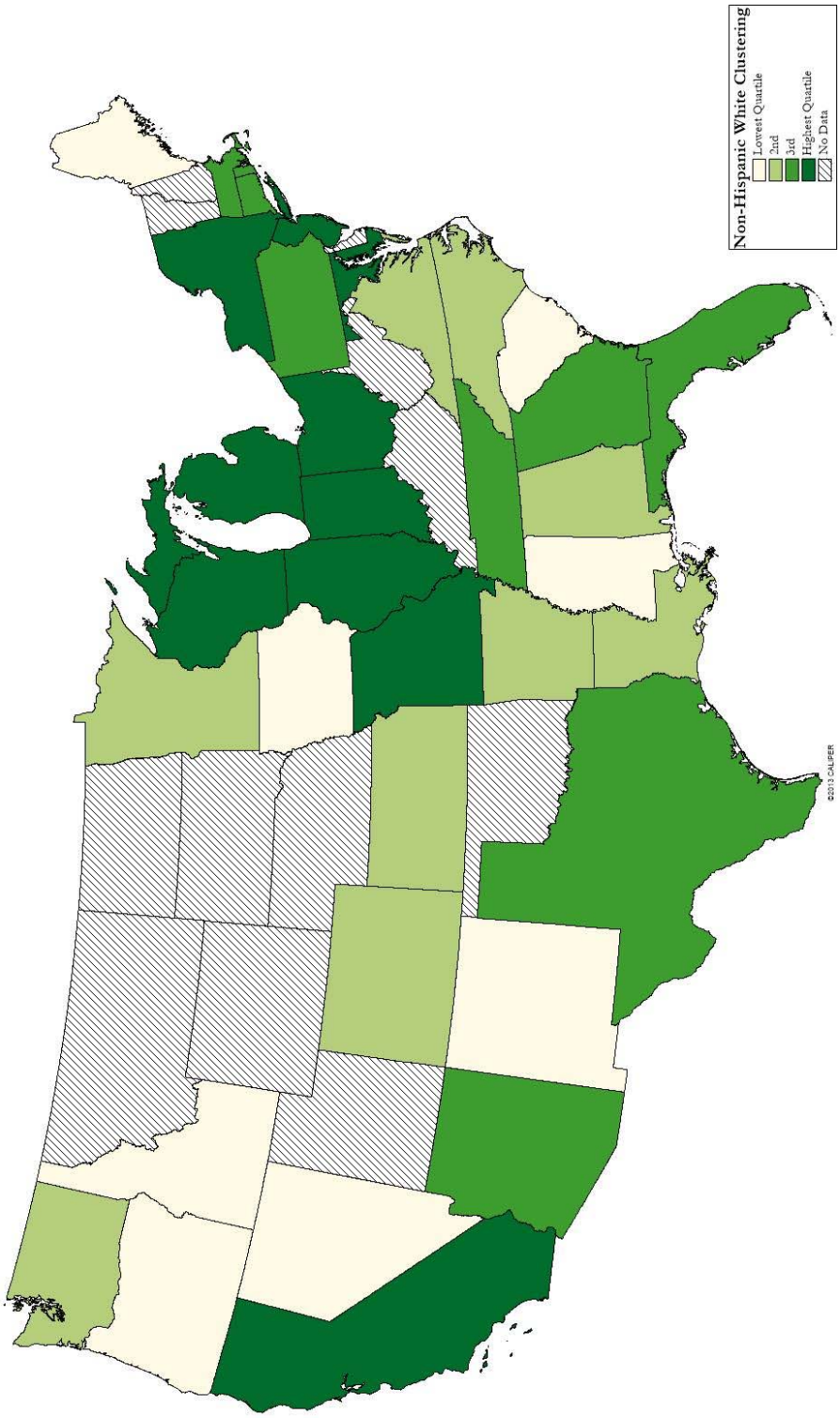

Figure 4.2. Clustering by Non-Hispanic White by State

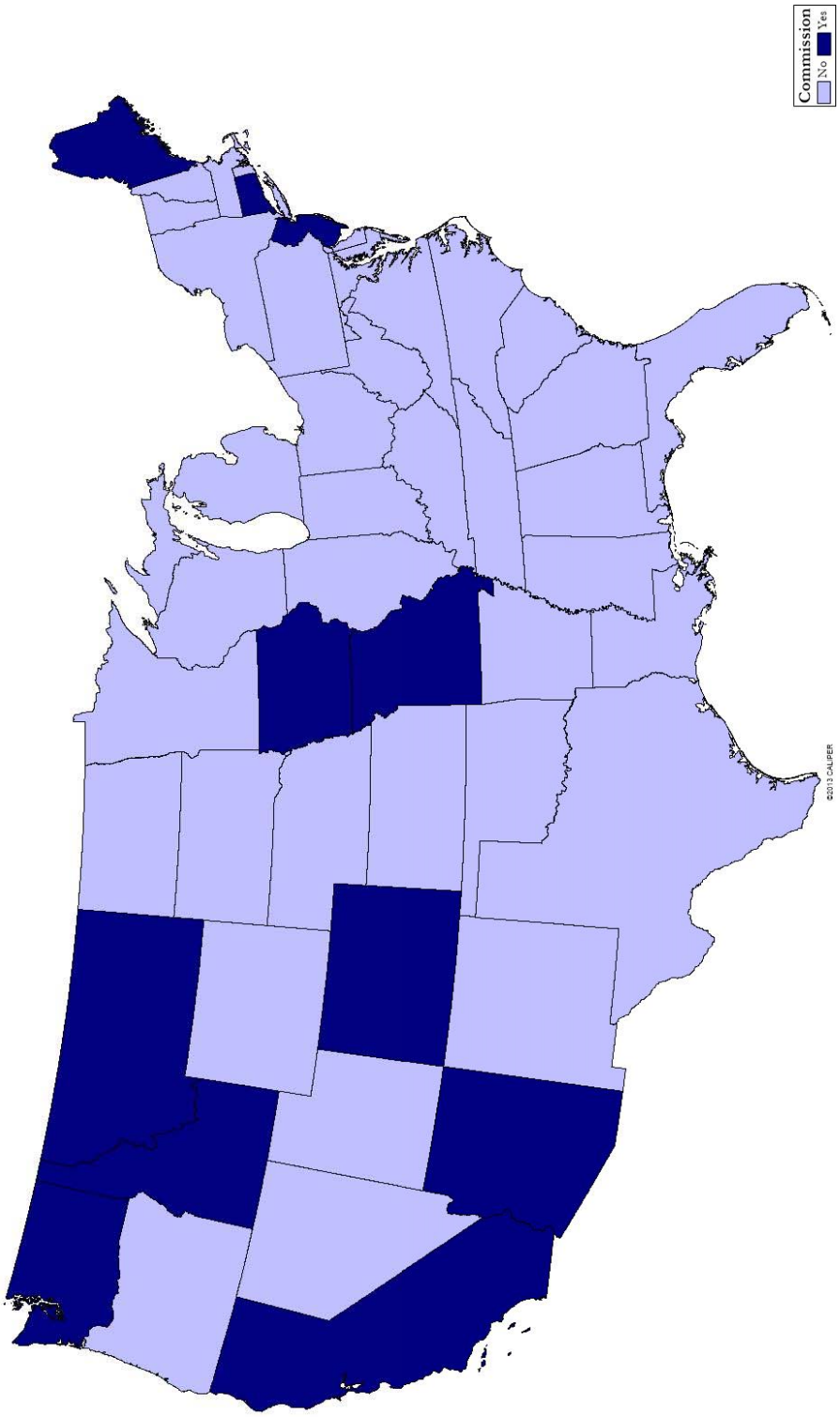

Figure 4.3. State by Redistricting System used for State Legislative Districts, 2011-2

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Chapter 5:

Conclusion: Clustering on the Drawing Board

Putting Geography under the Microscope

In *Shaw v Reno* (1993), Justice O'Connor compared North Carolina's 12th congressional district to "political apartheid." The district's joining of two urban African-American communities separated by 150 miles of freeways could not be justified on any basis other than race. In the subsequent ruling, *Shaw v Hunt* (1996), Chief Justice Rehnquist applies the *Gingles* test, noting that simply because some might suffer from voting dilution did not give the state the right to draw a district that was so non-compact that the only possible justification was race.

If the *Shaw* cases and their aftermath had been the end of struggles over the Voting Rights Act, we might be able to write it off to a one-year fluke of renewal. However, the cases kept coming—*Georgia v Ashcroft* in 2003, *LULAC v Perry* in 2006, *Northwest Austin v Holder* in 2009 and just since 2010, there have been *Backus v South Carolina, Shelby County v Holder, Harris v Arizona Independent Redistricting Commission,* several suits in state courts, and this year *McCrory v Harris* out of North Carolina again—all pointing to the continuing struggle between the courts and states over drawing districts.

However, with the exception of *Harris*, all these cases have another feature in common—they are all Southern states with majority-Black (and Latino in some cases) districts protected under the Federal Voting Rights Act (VRA). They are not the only states subject to the VRA, but we don't see the same kinds of suits coming out of covered states in other parts of the country. As pointed out by David Canon (1999), in summarizing the effects of the 1986 reauthorization of the Voting Rights Act on the 1992 redistricting, the

biggest and most durable consequences of the stricter mandates to create majority-Black districts were felt in the South—arguably the only part of the country where the VRA hurt Democrats long term.

The difficulties faced by Southern states like North Carolina highlight the consequences of ignoring geographic patterns. It is frustrating not only to interest groups but also to the states themselves when there is an honest attempt at creating a good plan, but the standard held up to meet requires major tradeoffs that run contrary to districting principles both traditional and partisan.

When looking at the potential for geography, global-level clustering specifically makes for the best measurement compared to other candidates. It provides a global measure based on local data, and incorporates regional patterns. Clustering does not only provide system data like "percent Latino;" it provides information on how likely Latinos are to live near other Latinos. It does not provide only local data like where each Tract is diverse; it shows how that tract fits with its neighbors and how those tracts then fit with their neighbors and so on across the jurisdiction as a whole.

Without taking clustering into account, we might get frustrated that states with similar demographics have very different results. North Carolina's White population composes about the same percentage of the state as New York, but the latter comes under the microscope far less often than the former—because New York's majority-Black and Latino districts compose existing, clearly bounded areas that are easy to spot on the map. African-Americans in North Carolina, in contrast, make up a majority in only "Five of 100 counties," as O'Connor notes in *Shaw*, and none of those counties has more than 50,000 residents.

The degree of clustering, then, is immensely relevant to evaluating plans. Further, clustering does not contradict single-state or regional analyses like Chen and Rodden's work on Florida (2013) or McDonald's work on the Upper Midwest (2010). Rather, clustering provides the framework for grounding all of these individual studies, explaining why the results in the Upper Midwest look different from Goedert's (2013) analysis of the Southern states. The low levels of clustering by both race and party predict Goedert's finding in the South, while the high levels of clustering in the Midwest predict McDonald's results in that region.

Varied Clustering, Varied Results

Furthermore, clustering provides the basis for contextualizing the limits of redistricting. In terms of direct effects, I show that in a state with a higher degree of clustering by party you do produce fewer competitive districts—even when that state is less competitive overall. I also show that a state with a higher degree of clustering by race does produce more majority-minority district, even accounting for the difference in share of the non-White population.

This analysis thus not only confirms the regional analyses, but extends them more broadly. Knowing the level of clustering allows us to get a sense of whether we should expect more competitive or majority-minority districts. Thus it explains in part why so many redistricting cases begin with in the Southern states. It is not only that they draw fewer majority-minority seats, but also that we would expect them to draw relatively fewer majority-minority seats in the first place given their level of clustering.

While the disappointing evidence for tradeoffs tends to reflect some of the difficulties of the method used, we do see relatively strong tradeoffs between compactness and the other criteria that point to a phenomenon we understand well from cases like *Shaw v Reno*. In order to satisfy the courts, states like North Carolina produce "ugly" districts full of necks and jogs to get more population. While Chen and Rodden (2013) may have found less of a need to tradeoff in Florida, the state is not as dispersed as the Carolinas.

Clustering thus can help serve as a guideline for determining which of Butler and Cain's (1992) tradeoffs exist in a particular jurisdiction. If we know there is a high level of partisan clustering, we can go into the districting process with a more limited expectation of how many competitive districts will be produced. In other words, we change the *a priori* assumption of where the mean is. Thus clustering gives us the tools for understanding not only what makes the tradeoffs to draw majority-non-White districts so extreme in North Carolina and also so minimal in states like Missouri, but also why states like Florida and Virginia seem to go against the grain.

Rescuing Commissions

The issue of whether redistricting institutions "fail" at producing desired outcomes begs two questions: What do we want redistricting commissions to do (especially do differently from legislatures), and are they capable of doing those things?

While the first question has been widely debated both normatively and in empirical political science, the second question comes up less often. Even studies that nominally mention that tradeoffs must exist, rarely postulate beyond partisanship or the Voting Rights Act when judging why they occur (e.g. Butler and Cain 1992, McDonald 2006). These

tradeoffs occur on the margins, a single district here or pair of districts there. A legacy of Gelman and King (1994), most studies focus on these edge cases.

Even more problematic, when studies have looked at the role institutions might play in shaping these tradeoffs, studies have compared states that look very different geographically (McGhee and Krimm 2009). The best analyses are work like Kogan and McGhee (2012) that compares a single state before and after a major institutional shift or Winburn's (2008) study of how the rules governing redistricting constrain policy makers. Perhaps in light of Winburn's findings it is no surprise that many of the focus of the study of commissions have shifted toward participation and process (MacDonald 2012, Cain 2011).

The crux of the problem existing studies have is their search for a magic bullet. Scholars know what they expect of redistricting commissions: better districts, as defined by more competition (Kogan and McGhee 2012, McGhee and Krimm 2009) and more compactness (Winburn 2008). And, depending on the state, more majority-minority districts as well (Chen and Rodden 2009).

Other states' commissions are often compared to those of Iowa, where low non-White population and statewide partisanship produce a distinctive starting point for drawing districts. A state, however, in which all four of the state's congressional district and more than half of its legislative districts are competitive. Iowa is also one of the least clustered states by party in the country.

That last sentence begins to get at where my analysis differs from what has come before. Rather than focus on the first question, I get at the second question. I show that all redistricting institutions are limited by the geography they have to deal with, whether

legislatures or commissions. Pennsylvania simply has different decisions to make from Georgia.

Once we control for clustering, I do find that commissions behave differently from legislatures. In particular, Commissions are behaving differently from legislatures in different ways when clustering is low than when clustering is high. For example, when clustering by race is low, Commissions are less likely to draw the majority-minority seat than legislatures, but when clustering by race is high, the Commission is more likely to draw the seat. Or when clustering by party is low, a Commission is more likely to draw the competitive district than a legislature is, but if clustering by party is high, the Commission is actually *less* likely to draw that seat than a legislature would have been.

Ultimately, this study begins to rehabilitate commission from the scrapheap to which they have been relegated since the 1990s. It is not purely that rules matter (though they may contribute to the Commission's sense of purpose) or the increase in public engagement and community participation (though oversight certainly helps keep commissions honest). Commissions can draw plans that are more compact, competitive, and have more majority-non-White seats—but only under particular circumstances. A Washington commission may be less likely to trade compactness for more majority-non-White seats because clustering by race is so low. On the other hand, given low levels of partisan clustering but high levels of racial clustering, a commission in California should produce more competitive districts than a legislature—just as Kogan and McGhee (2012) find.

Time and Technology

There are two major ways in which this project could be extended: expanding the time frame for comparing institutional variation and improving the technological capacity to model districting.

Time

The biggest way in which this project could be extended would be adding a time-series dimension to complement the cross-sectional analysis. Looking at a cross-section allows the project to focus on a constant legal situation rather than having to deal with different Supreme Court environments or implementations of the Voting Rights Act. However, a time-series analysis would allow for holding geography constant, more or less.

This would emphasize the institutional dimension, especially since this would allow us to look at states that changed who districts. If I could look at data as far back as 1980, I would be able to compare several states before and after redistricting reform, including Washington (first used in 1991), Arizona (2001) and California (2011). This would also allow a comparison over time between several commission-produced redistricting plans.

However, to do this nationally would require a massive data collection effort. As recently as 2000, most states did not collect precinct-level election information in a single, state-wide repository. In addition, some states—mainly in the South—still reported sub-county election data in paper only. Mississippi still allowed counties to provide hand-written tabulations!

This could be a feasible project if the scope of the project was narrowed to a subset of states. This might be the same eight states in Winburn's analysis of districting rules (2008), or include California or other states of particular interest. A single state analysis comparing

legislative and non-legislative plans in California (judicial imposed maps) or New York (which has a "first pass" commissions that can be rejected) would be one idea because this would really get at that question of comparing commission and legislatively produced plans within each Census era.

Technology

Furthermore, the project could be improved—and likely will be improved—by advances in automated districting technology. While BARD is a major advancement over automated districting programs of the 1990s and 2000s, it comes with some uncertainty about whether it functions as advertised—as illustrated in Chapter 3.

BARD works best with a small number of geographic units placed into a small number of districts. When you give BARD a large number of districts and units, the computation power required increases substantially. The program defaults to hard-wired predetermined decisions, such as maintaining a level of compactness or giving higher priority to geographies bounded by more than geography already assigned to that district.

This is frustrating because BARD's major advantage over other automated districting programs is that it can prioritize criteria other than total population. Even the most recent advances, such as a recent extension by Imai (2015) to use Markov Chains to create "most linked" areas, can only equalize one variable at a time. It would be worth it to develop a reliable program that includes some kind of "post" adjustment to clean up plans in a transparent way.

As Micah Altman (2005) points out in his critique of automated districting, no automated system will ever be perfect. However, with the rapidly improving computing

picture, it is likely that systems will become more sophisticated and perhaps even easier to use. Even if a system cannot balance all the factors that go into real-world redistricting, a more sophisticated model would allow us to develop better intuitions about the potential for tradeoffs given geography, as McDonald and Altman (2009) hope.

Redistricting in Geographic Perspective

In the 20th century, three forces combined to change the way we draw districts. First, urbanization created large imbalances between rural and urban populations, as well as creating larger homogeneous areas within urban areas. Second, people increasingly sorted themselves into like-minded areas, first in central cities, and then in suburbs as well. Finally, as technology responded to legal requests by growing increasingly sophisticated, it became easier to obtain detailed information about specific smaller units of geography. From a macro-level context, the situation for drawing districting had undergone incredible change.

These changes clashed with a growing belief in political science that fundamentally all choices in redistricting stem from politics and that the decision to increase or not to increase the number of competitive districts, for example, is a deliberate choice of the body conducting the redistricting. Even when states adopted redistricting reform, the literature seemed to suggest that the effects of reform were minimal at best.

The argument here is not that either is wrong *per se*. Rather, I argue that both are insufficiently constrained. A major change in the capacity to draw districts did happen, *but it was constrained* by the distribution of people. Similarly, institutions can make political choices, but *they too are constrained* by the geography they have to work with.

In other words, without understanding the role that clustering plays in connecting the possible to the practicable, all we have are guesses about what might be feasible. These guesses often lead us down rabbit holes, down paths that suggest that a diverse, highly clustered state like California might be able to achieve the same outcomes as a homogenous state with low clustering like Iowa. That ge*ography need not limit one's options when drawing districts.*

By including clustering, I set up a framework for understanding what is possible in redistricting. This framework demonstrates that each state has a different set of potential redistricting outcomes, and potentially a different space in which tradeoffs occur. Because it provides information about the shape of the global and local situation, it does not merely highlight places where a single district could be drawn nor only provide general demographic information. Rather, it helps us relate the demography to the distribution on the ground.

Furthermore, politics continues to be important. By defining the space in which redistricting occurs, I show that institutions can make a difference in terms of which plan is selected. Commissions do have to work within the framework of their geography, which is not the same as the space of all potential outcomes. However, commissions do pick different priorities than legislatures, as demonstrated by the plan they pick when we take clustering into account.

As stories like San Diego, Illinois, South Carolina, Washington, Arizona, and California show, redistricting is not a homogeneous phenomenon. The space in which the process takes place shapes not only the politics involved, but also the potential for different outcomes.

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