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The Spatial Diffusion of Racial and Ethnic Diversity Across U.S. Counties

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Abstract Although increasing racial and ethnic diversity is a demographic trend with society-wide implications, it has advanced farther in some parts of the United States than others. Our research seeks to understand this unevenness at the local level. Drawing on 1980–2010 census data, we use an innovative spatial analytic approach to examine the spread or diffusion of diversity across counties in the 48 contiguous states. Three perspectives—locational persistence, spatial assimilation, and institutional hub—offer different expectations about the nature of the diffusion process. The perspectives are evaluated by mapping changes in the magnitude and structure of diversity and by tracing county transitions between types of diversity clusters. We document considerable stability in diversity patterns over a 30-year period, consistent with the logic of locational persistence. But support is also found for the spatial assimilation and institutional hub models in the form of cluster-type transitions that reflect contagious diffusion and hierarchical diffusion, respectively.

Keywords Racial-ethnic diversity · Counties · Contagious diffusion · Hierarchical diffusion · Spatial assimilation · Entropy index

1 Introduction

The steep rise of ethnoracial diversity in the United States constitutes a transformative demographic trend. Minority populations have grown rapidly during recent decades, fueled not only by immigrant flows from Latin America and Asia but also by natural increase, youthful age structures, and other dynamics. As a result, the nation's compositional profile will soon look fundamentally different,

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with people of color expected to exceed whites in number before mid-century (Colby and Ortman 2015). This changing racial-ethnic mix has the potential to influence a range of life domains, from education and politics to intergroup relations and social trust among neighbors (Frey 2015; Lee and Bean 2010; Lichter 2013; Putnam 2007; Stolle et al. 2008). While the jury is still out concerning the overall effects of diversity, there can be no doubt about the direction of diversity change in the decades to come.

However, diversification on the national scale is only part of the story. The growth and spatial redistribution of panethnic groups has led to significant variation in the magnitude and structure of diversity at the local level (Lee et al. 2014; Logan and Zhang 2010; Parisi et al. 2015; Wright et al. 2014). Hispanics in particular have established footholds in new destinations that may be distant from traditional immigrant gateways (Fischer and Tienda 2006; Hall 2013; Lichter and Johnson 2009; Massey 2008). These recent shifts, coupled with the tendency toward minority geographic clustering, have created an uneven diversity landscape across the country. Many communities are experiencing an increase in ethnoracial diversity, but they differ markedly in initial composition and subsequent group-specific growth rates (Hall et al. 2016). For some places, the ascendance of one group to numerical majority status has actually produced a diversity decline (Lee and Hughes 2015).

Our investigation treats counties as appropriately local units with which to capture the full range of changes. Counties often approximate housing and labor markets and they are formal governmental jurisdictions in most states. As devolution has proceeded from the federal level downward, county governments have assumed greater responsibility for regional planning, economic development, and social service delivery (Lobao et al. 2007; Lobao and Kraybill 2005). In addition to their functional importance, counties represent significant symbolic entities. Residents and outsiders recognize them by name and perceive cultural and institutional differences among them relevant to ethnoracial diversity, such as whether the communities within a county are reputed to offer a favorable context of reception for immigrants and minorities. On practical grounds, county boundaries remain quite stable compared to those of other units, facilitating longitudinal research.

The feature of counties that we regard as most essential from an analytic standpoint is their spatial continuity. Unlike metropolitan or micropolitan areas or census-defined places, which do not provide exhaustive territorial coverage of the nation, virtually every county in the continental U.S. borders at least one other county.[1] Existing studies that document diversity trends in areas or places typically ignore the spatial contexts within which such units are embedded (see, e.g., Frey 2006; Lee et al. 2012). Consequently, little is known about how diversity has spread across locations over time. This lacuna provides the focal point for our research. By utilizing counties as cases, we can employ an innovative methodological strategy to address an overarching question: has ethnoracial diversity diffused throughout the

[1] The two exceptions are Nantucket County, MA and San Juan County, WA, both of which are islands.

national settlement system in a proximity-dependent fashion, or are the patterns of diversity change consistent with other spatial dynamics?

Before turning to this question, we briefly define the concept of diversity in the next section of the paper. We then summarize three perspectives—locational persistence, spatial assimilation, and institutional hub—that provide different expectations about the spatial diffusion of diversity. The perspectives are evaluated with 1980–2010 decennial census data for over 3100 counties in the 48 contiguous states. As a first empirical aim, we rely on the entropy index to map broad trends in the magnitude of diversity over time. Our second aim is to describe the evolving racial-ethnic structures that underlie such trends. A 'majority rule' typology proves helpful here, both for mapping compositional changes and for constructing transition matrices that capture shifts of counties from one type of ethnoracial structure to another. Third, we examine how ethnoracial diversity migrates across space. Applying Anselin's (1995) LISA statistic, we determine whether diversity moves from high-diversity counties to adjacent lower-diversity counties, following a contagious diffusion pattern, or whether it emerges 'out of the blue' in new locations that previously had been rather homogeneous, consistent with a hierarchical diffusion process.

2 Background

2.1 Clarifying the Concept

Despite a range of meanings, diversity is most often employed in the social sciences to refer to the ethnoracial richness or variety exhibited by a population (Allen and Turner 1988; Lindsay and Singer 2003; Lichter 2013). Demographers emphasize two aspects of population composition when defining the concept: the number of groups that make up the population and their relative sizes. To see how these two components contribute to the *magnitude* of diversity, visualize a county population in pie-chart terms, with each slice representing a different panethnic group (e.g., Hispanics and non-Hispanic whites, blacks, and Asians). Intuitively, the greater the number of equal-sized group slices, the more diverse the county would be. Thus, a county comprising four equal slices is more diverse than one consisting of just two equal slices. At the opposite extreme, a single-slice county reflects maximum homogeneity: all residents belong to the same group. In essence, the magnitude or level of diversity tells us how evenly persons are distributed across a set of ethnoracial categories that cover the population of interest (White 1986).

Magnitude, though important, is not the only dimension of diversity worth considering. One must also assess the *racial-ethnic structure* or composition of a population, i.e., the specific groups that are present (Franklin 2014; Wright et al. 2014). Comparing a couple of hypothetical counties illustrates the significance of the structural dimension. In the first county, half of the residents are white and half are Asian. The population of the second county is divided 50–50 between blacks and Hispanics. These counties would be judged equally diverse on the magnitude dimension of diversity. However, given aggregate differences among the four groups in the real world, the two counties would likely diverge to a non-trivial extent in socioeconomic status, intergroup relations, and other respects.

2.2 Perspectives on Diffusion

Due to the dearth of research on the spatial diffusion of ethnoracial diversity, a ready-made framework for understanding the phenomenon does not exist. However, studies that examine patterns of geographic concentration and dispersion among minority groups, especially immigrant-rich ones, are germane to our purpose. Because most of these studies stress 'group-centric' dynamics—why members of a particular group tend to be disproportionately selected into certain locations—we have translated them into 'geocentric' terms, identifying their implications for changes in the magnitude, structure, and diffusion of diversity across U.S. counties. The translation exercise, admittedly imprecise, yields three broad perspectives.

The first perspective, which we label *locational persistence*, stresses the tendency for groups such as Hispanics and Asians to remain spatially concentrated rather than to disperse. Although much of the work relevant to this perspective focuses on enclaves and neighborhood-level segregation, the persistence phenomenon can be observed at higher scales as well, ranging from cities to regions. According to Portes and Rumbaut (2006), the uneven territorial distribution of racial and ethnic groups is partly a reflection of historical circumstance (also see Lieberson and Waters 1988). Group-specific concentrations are rooted in proximity to the country of origin and the geography of labor demand when a group first arrived in the U.S. These concentrations endure because of the gradual expansion of ethnic social networks, institutions, and economies, which have the power not only to attract but to retain group members (Frey and Liaw 2005; Kritz et al. 2011). As the sites of initial settlement become adept at incorporating immigrants and other newcomers, they develop into ethnic 'comfort zones', reducing the propensity of later generations to move elsewhere (Ellis and White 2006).

Some counties in our study are heterogeneous gateways that serve as comfort zones for multiple minority groups. At the opposite extreme, many counties are still heavily white. However, the locational persistence model has less to say about the absolute differences in diversity between these two types of counties than about their standing in relation to each other over time and across space. The model's underlying logic of path dependence—that the past continues to shape the present—suggests that diverse counties in the West (with historical concentrations of Hispanics and Asians) and the South (with concentrations of blacks and Hispanics) will exhibit distinctive diversity levels and racial-ethnic structures throughout the three-decade period when compared to counties in the Midwest and Northeast. The relative stability implied by locational persistence can thus be envisioned as parallel but not identical trajectories. This leads us to anticipate little spatial diffusion of diversity, with most counties and county clusters retaining their time 1 (t_1) diversity classifications at time 2 (t_2).

The second perspective, *spatial assimilation*, offers an alternative to the null hypothesis of locational persistence, predicting changing rather than stable patterns of diversity. It holds that as racial and ethnic minorities become more integrated in

American society, they will settle in a wider range of locations (Alba and Logan 1991; Hall 2009; Massey 1985; South et al. 2008). With upward social mobility and (for immigrants) acculturation, minority group members are expected to pursue economic and quality-of-life opportunities beyond their traditional areas of concentration. Driving this process are the gains in education, occupational status, earnings, citizenship, English language proficiency, and other indicators of intra- and intergenerational advancement that most groups experience (Alba and Nee 2003; Clark 2003; White and Glick 2009; Xie and Goyette 2005). The spatial dimension of assimilation is further facilitated by modern communication and transportation technologies, which can heighten awareness of locational options while sustaining ethnic ties over longer distances (Zelinsky and Lee 1998).

At our scale of analysis, immigrants and native-born minorities may move from central counties of gateway metropolises to the suburban periphery or to nearby micropolitan or rural settings. Inter-county relocation of this sort highlights a key tenet of the assimilation model: that the spread of panethnic groups to new destinations is often proximity-dependent, taking the form of a *contagious diffusion* process. Moreover, as the groups disperse across counties, they can be expected to enhance the diversity of all destinations but especially of the most homogeneous (whiter) ones. Thus, from 1980 through 2010 pre-existing gaps between gateway and non-traditional locations should narrow, with counties shifting toward similar diversity magnitudes and racial-ethnic structures. Reinforcing the convergence trend are floor and ceiling effects, or the statistical likelihood that the least diverse counties will become more diverse and the most diverse counties less so.

Unlike assimilation, the *institutional hub* perspective emphasizes the possibility that ethnoracial diversity can spread in a spatially disconnected or ‘leap-frog’ manner. Central to this perspective are various types of institutions capable of concentrating minority panethnic groups in places far from their traditional areas of settlement. Some institutions, such as government, higher education, and the armed forces, attract minority groups through a shared commitment to the principle of equal opportunity. Less abstractly, these institutions are encouraged by law or organizational mandate to engage in affirmative recruiting. Thus, counties that contain seats of government, have a college or university presence, or host military installations should be relatively diverse irrespective of the racial-ethnic composition of neighboring counties (Allen and Turner 1989; Lee et al. 2012).

Economic enterprises, another kind of institution, may address labor needs by hiring members of an ethnoracial group not well represented in nearby populations. The ability of meat and poultry processing plants, which rely on Hispanic and immigrant-heavy workforces, to transform nonmetropolitan communities in the Midwest is perhaps the most striking example of this phenomenon, but carpet manufacturing, oil extraction and refining, and the seafood industry can also have a diversifying impact (Kandel and Parrado 2005; Murphy et al. 2001; Zuniga and Hernandez-Leon 2005). So can correctional facilities, particularly in the rural counties at the forefront of the prison industry boom (Glasmeier and Farrigan 2007). The opening of a prison often produces a sudden change in local ethnoracial composition even though the change does not always ‘color’ residents’ daily lives to a visible degree. American Indian reservations may have a similar diversifying effect on their host counties. In all of these instances, the spatial and demographic scenario anticipated by the institutional hub model is more consistent with *hierarchical diffusion* than contagious diffusion.

We do not regard the two kinds of diffusion—or the three guiding perspectives—as free from overlap. For example, it is easy to imagine Los Angeles, New York, and Miami retaining their diverse gateway standing (in line with locational persistence) at the same time that some minority residents of these metropolises disperse to communities in the same vicinity or region (spatial assimilation) while others pursue socioeconomic advancement in newer, more far-flung and homogeneous destinations (institutional hub). An added wrinkle is that these dynamics are likely to vary in strength despite their simultaneous operation. Spatial heterogeneity seems inevitable, the forces of persistence and diffusion shaping ethnoracial diversity within and across counties in different ways contingent on location. The implication here is that the three perspectives should be seen as complementary instead of pitted against each other. With this caveat in mind, the locational persistence, spatial assimilation, and institutional hub models provide a helpful framework for addressing our research aims.

3 Methodology

3.1 Diversity Measurement

We use 1980 through 2010 decennial census data to measure diversity for 3109 counties in the 48 contiguous states. Summary File 1 (SF1) includes the total population living in each county, and SF1 (1990–2010) and SF3 (1980) provide a cross-tabulation of race by Hispanic origin. With some modest recoding, the crosstab yields counts of five exhaustive and mutually exclusive panethnic categories: Hispanics of any race and non-Hispanic whites, blacks, Asians and Pacific Islanders (hereafter referred to as Asians), and a residual non-Hispanic 'other' category. The 'other' category encompasses Native Americans (American Indians and Alaska Natives) and people who report belonging to more than once race (an option first available in the 2000 census) or to a race not recognized by the U. S. Census Bureau.

We tap diversity magnitude—emphasized in our first research aim—with the *entropy index*, symbolized by E (Reardon and Firebaugh 2002; White 1986). The index reveals the degree of evenness or equality in size among the ethnoracial categories that comprise a county population. Formally,

$$E = \sum_{r-1}^{R} P_r \ln\left(\frac{1}{P_r}\right)$$

where p_r refers to ethnoracial category r's proportion of the population in a given county and R signifies the number of such categories. The entropy index reaches its maximum (the natural log of R) only when all ethnoracial categories are exactly the same size. We standardize E, dividing it by its maximum (1.609 in the case of five panethnic populations) then multiplying by 100. The extremes of E serve as a guide to interpretation. A score of 100 would indicate complete heterogeneity, with each of the five panethnic groups representing one-fifth of the residents of a hypothetical county. Alternatively, an E of 0 indicates complete homogeneity, when all of the residents belong to a single group. For the nation as a whole, E climbed from 44.5 to 67.6 during the 1980–2010 period.

To address the second aim of our study, we characterize the racial-ethnic structure of every county via Farrell and Lee's (2011) *majority rule* typology (for a similar typological effort, see Holloway et al. 2012). The categories in the typology reflect (1) which ethnoracial group, if any, constitutes a numerical majority of the population in a county and (2) the extent to which that group shares the county with one or more other groups. Counties with a majority group are broken down into three subtypes, labeled *group-dominant*, *group-shared*, and *group-other*. In group-dominant counties, the majority group accounts for at least 90 % of the total population. Group-shared counties have a smaller majority group (less than 90 %) and somewhat larger numerical minority groups, but none of the minority groups makes up as much as 10 % of the county population. In group-other counties, the majority group is joined by at least one minority group that reaches or exceeds the 10 % mark.[2] Our final type, *no-majority*, refers to counties where none of the groups surpasses 50 % of the population.

3.2 Capturing Contagious and Hierarchical Diffusion

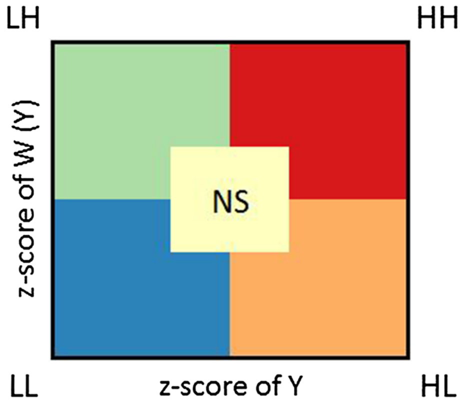
For the third aim of the study, we use Anselin's (1995) *local indicator of spatial association* (or LISA) to map ethnoracial diversity clustering in individual census years and to examine how such clustering has changed over time. LISA measures compare the standardized level (z-score) of a variable such as diversity in a local spatial unit (e.g., a county) and the standardized value of the same variable in all connected spatial units (e.g., nearby counties), where 'connected' is defined by a spatial weights matrix based on adjacency, distance, or N nearest neighbors. We rely on a Queen's 1 adjacency matrix, which determines that all counties that share a border or corner with a focal county are connected to it.[3]

The stylized LISA scatterplot in Fig. 1 facilitates visualization of the z-score of diversity in a focal county (aligned with the horizontal axis) and the weighted z-score of diversity in surrounding counties (aligned with the vertical axis). Specifically, LISA clusters allow us to identify counties that have significantly High (H) or Low (L) diversity relative to the distribution of diversity values in their neighboring counties. We see that some counties may fall within the HH (High–High, signified by dark red shading), LL (Low–Low, dark blue), HL (High-Low, light red), or LH (Low–High, light blue) quadrants of a LISA scatterplot, while

[2] This group-other type can span a range of racial-ethnic structures. For example, group-other counties might be rather evenly split between two groups (55 % ofresidents belonging to group A, 40 % to group B), have even representationfrom a number of groups (51 % from A, 15 % each from B, C, and D), or onlyminor representation from a group other than the majority (80 % from A, 15 % from B).

[3] Sensitivity tests were performed using both nearest k neighbors and a Queen's 2 matrix as adjacency matrices. In both cases, LISA cluster results were similar to those obtained using a Queen's 1 matrix.

Fig. 1 LISA Scatterplot Typology. HH, Counties with relatively high values surrounded by counties with relatively high values; HL, Counties with relatively high values surrounded by counties with relatively low values; NS, Not significant; LH, Counties with relatively low values surrounded by counties with relatively high values; LL, Counties with relatively low values surrounded by counties with relatively low values



others are not significantly (NS, white) different from the average of their neighbors.[4] A data point in the HH quadrant represents a county with, for example, a high diversity value surrounded by counties with a standardized diversity value that is also high. If a county is below the mean on diversity and the standardized diversity value in surrounding counties is also below the mean, then the point falls in the LL quadrant. A county in the HL quadrant has a high diversity value but is surrounded on average by counties with low diversity values; a county in the LH quadrant has low diversity but is surrounded by counties that are, on average, high in diversity.

To date, most applications of LISA measures and maps have been cross-sectional. Our research extends an emerging body of work across the social sciences that highlights dynamic aspects of change in spatial dependencies (see, e.g., Han et al. 2016; Porter 2011; Porter and Howell 2012). Adapting Tita and Cohen (2004), we employ LISA to classify ethnoracial diversity in 1980 and 2010 and then use the resulting maps and transition matrices to identify contagious and hierarchical diffusion processes. For a set of counties to be identified as part of a significant cluster, values for both the spatially weighted average and focal county diversity must exceed a 95 % significance threshold. This threshold is determined through 10,000 permutations which test the assumption that diversity levels are not randomly distributed across space.[5] In essence, our approach involves tracking county transitions between types of diversity clusters over time.

A hypothetical example of how LISA year-specific maps can help us see changes in diversity and generate transition matrices is shown in Fig. 2. (The color shading scheme is the same as in Fig. 1.) In the example, three cells are classified as LH at t_1 but two have transitioned to HH by t_2 (row 6, column 2 and row 7, column 6). Consistent with the spatial assimilation perspective, this pattern would be indicative

[4] With LISA abbreviations, the first term always refers to the focal county and the second to the average value of that county's neighbors.

[5] Despite an already rigorous threshold, we have run 20 additional significance tests (of 10,000 permutations each) to verify our inference that the clusters reported here are not due to chance. More than 96% of all counties retain their cluster identification across tests, indicating a sufficient level of significance for present purposes. Further information regarding the test results is available upon request.

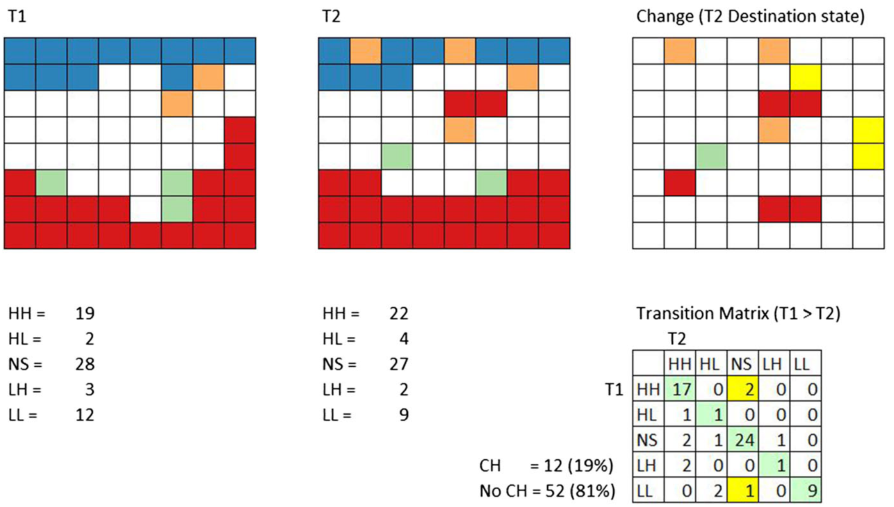


Fig. 2 Calculating ethnoracial diversity change with LISA clusters

of a contagious diffusion process (transition of a county from LH to HH) where the level of diversity in the focal county at t_2 is associated with higher levels of diversity in adjacent counties at t_1. Similar instances of contagious diffusion associated with higher diversity could be reflected in the transition from NS to HH. (Two cells make this transition: row 3, column 5 and row 7, column 5.) On the other hand, a hierarchical diffusion process is implied when an isolated county transitions from LL to HL, presumably due to the net in-migration of minority residents. (Two cells make this transition: row 1, column 2 and row 1, column 5.) Such a transition adheres most closely to the logic of the institutional hub model.

Numerous other kinds of transitions are possible based on the cross-classification of HH, LL, HL, LH and non-significant clusters at two points in time. We should note, however, that there need not be any change in the diversity of a focal county relative to diversity in surrounding counties. The Fig. 2 example confirms this: 81 % of all cells do not change LISA typology category between t_1 and t_2. A stable pattern of this sort would support the locational persistence perspective.

4 Results

4.1 Trends in Diversity Magnitude

The maps contained in Fig. 3 convey the unevenness of the ethnoracial diversity landscape in 1980 and 2010. Both maps differentiate among counties with *E* scores of 20 or less (low diversity), between 20 and 60 (medium), and 60 or above (high). What stands out about 1980 (top map) is that only 30 counties fell in the high diversity category. Medium magnitudes of diversity can be seen in California and throughout the Southwest and South. By contrast, the Midwest and Northeast

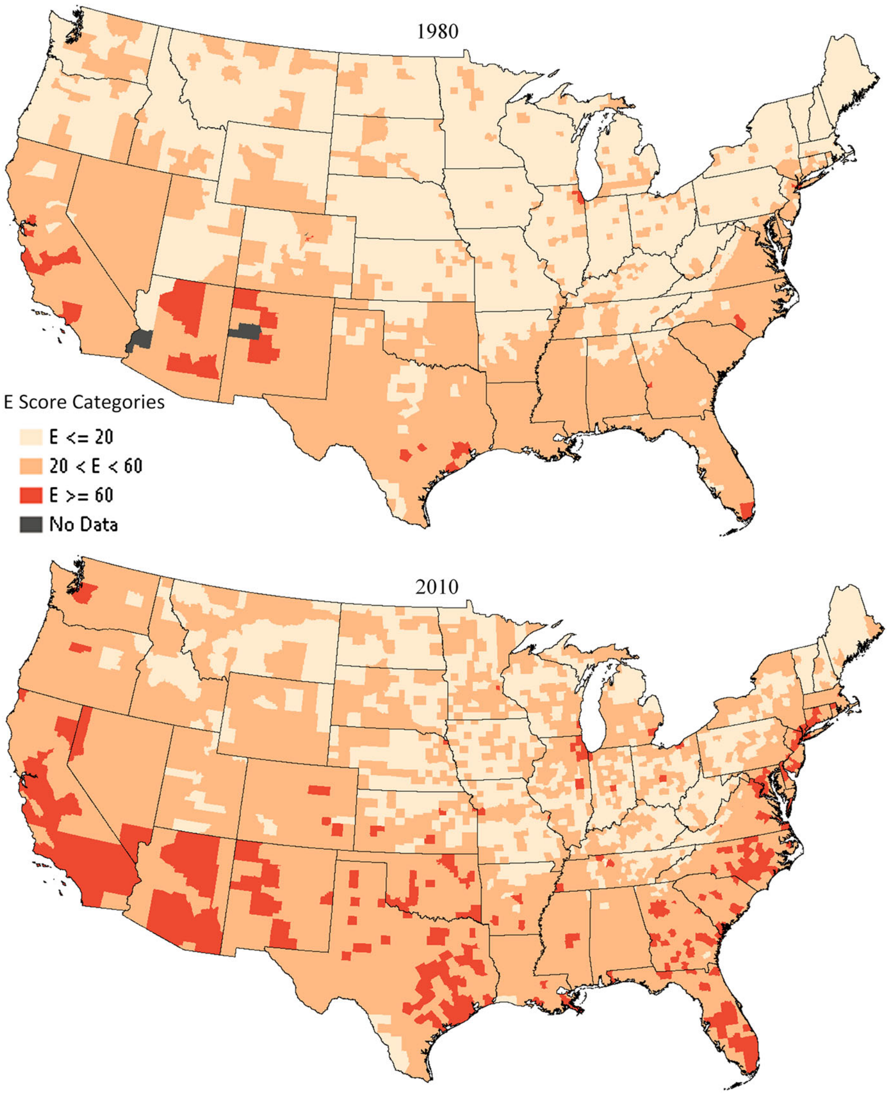


Fig. 3 County diversity, 1980 and 2010

contained many homogeneous, low-diversity counties ($E < 20$), with the exception of those counties comprising large metropolitan areas such as New York and Chicago. Major metro areas across the Sunbelt (from Los Angeles to Miami) also exhibited high levels of diversity.

At first glance, roughly similar patterns appear when we turn to the 2010 diversity map in the lower half of the figure. The West Coast, Southwest, and South remain home to many of the highest-diversity counties in the U.S., suggestive of locational persistence. Yet pockets of high and medium diversity now dot parts of the nation where, 30 years earlier, diversity was uniformly low. Some of this diversity expansion has been centered in areas where high levels of diversity existed previously (such as metropolitan New York), but high diversity has also emerged in the counties of states with medium or low diversity in 1980 (such as North Carolina and Oklahoma). However, focusing just on the high-diversity category obscures a key finding: increases in diversity occurred in over nine-tenths of all counties from 1980 through 2010, with nearly three-fifths experiencing a gain in *E* of 10 points or more. The widespread nature of these diversity shifts seems most consistent with the spatial assimilation perspective, although institutional hubs may have anchored cases of localized change as well.

Diversity increases in some counties have been much larger than elsewhere in the nation. In Fig. 4 we divide the 1980–2010 gains in *E* (positive difference scores) into quartiles and also identify the handful of counties registering a net decline in diversity over the three-decade period. Many parts of the Midwest and Northeast remain at relatively low levels of diversity; nevertheless, counties in these regions have undergone some of the fastest diversity growth. This is due in part to where the counties started, at minimal diversity magnitudes in 1980. Florida and portions of the Pacific Northwest have recorded major gains in *E* despite initially higher levels of diversity. Finally, a departure from the generally upward trend in ethnoracial diversity is evident in the counties sharing a border with Mexico—particularly those along the Rio Grande in Texas—as well as those lining the east bank of the Mississippi River in the state of Mississippi. These counties all experienced post-1980 diversity decreases.

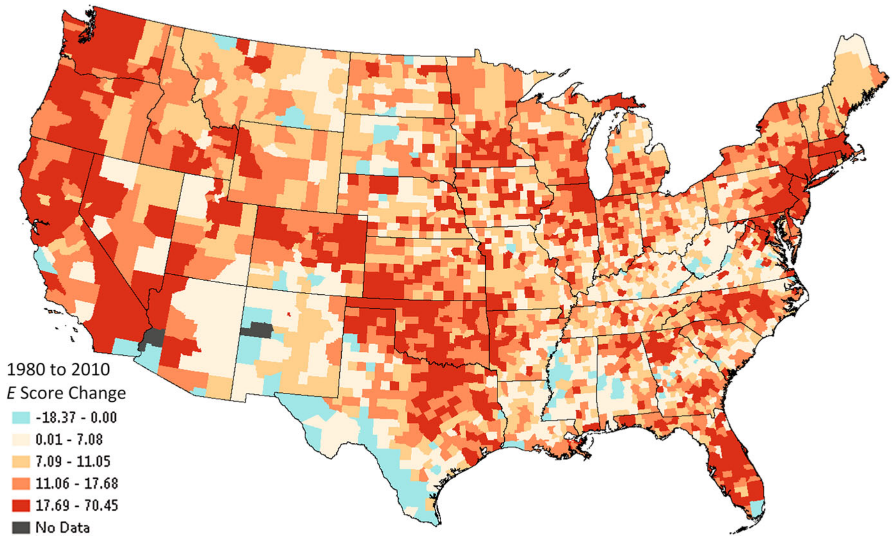


Fig. 4 Change in county diversity by quartile, 1980–2010

4.2 Evolving Racial-Ethnic Structures

Figure 5 classifies counties by their racial-ethnic structure in 1980 and 2010 based on the majority rule typology introduced earlier. Both maps have a blue hue, indicating that whites make up a numerical majority of most county populations. Darker shades represent a higher percentage of whites, with (1) the darkest shade (white-dominant) depicting a county 90 % or more white, (2) the middle shade

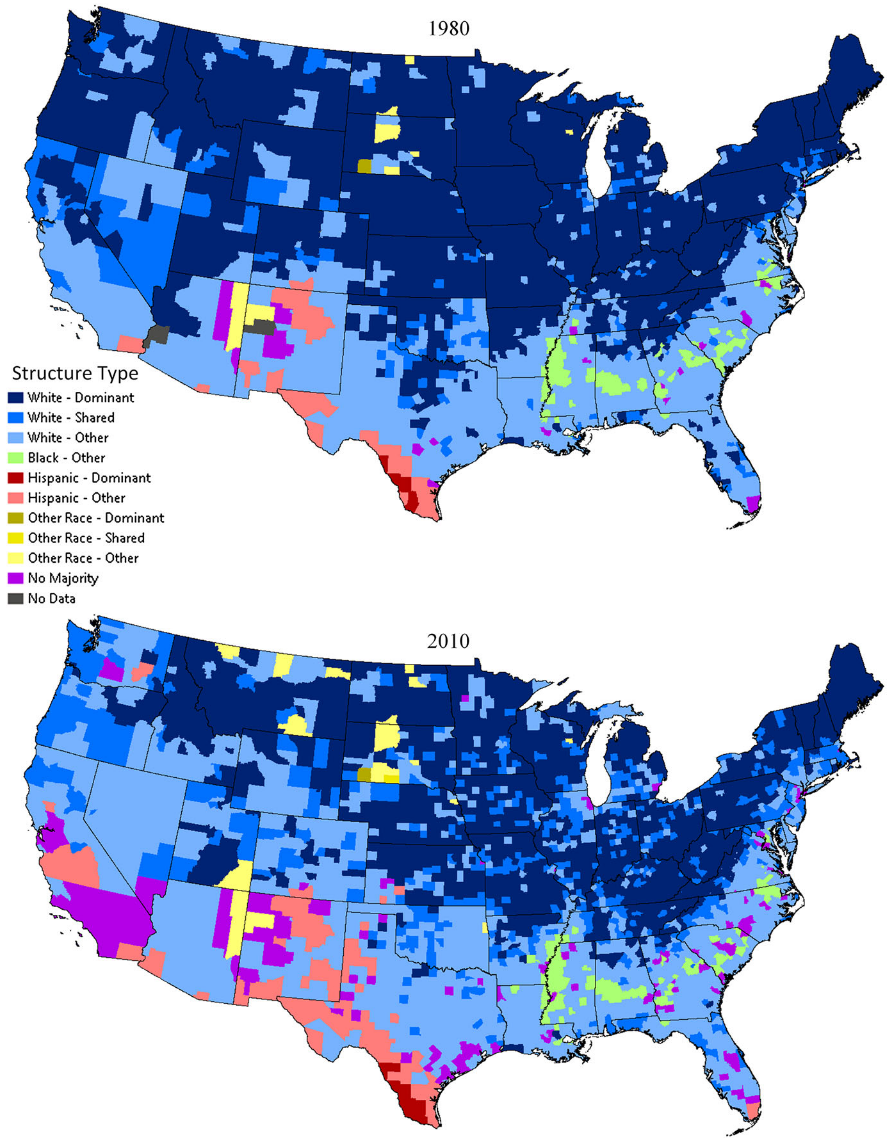


Fig. 5 Racial-ethnic structure of counties, 1980 and 2010

(white-shared) depicting a county less than 90 % white but with no other group making up 10 % or more of the population, and (3) the lightest shade (white-other) depicting a county more than 50 % white but with at least one other group at or above 10 %. Red counties provide a similar scheme for Hispanics, green for blacks, and yellow for other races. Counties in purple reflect those areas where no racial group comprises a numerical majority.[6]

In 1980 a preponderance of counties qualified as white majority in one sense or another (top map). There are, however, some significant exceptions. Most notable are the Hispanic-majority counties along the Texas-Mexico border, many of which have declined in diversity magnitude over subsequent decades. By 2010 (bottom map), a number of neighboring counties have also transitioned away from white-majority to Hispanic-majority status. A few of the Texas counties have become Hispanic-dominant, exhibiting Hispanic shares above 90 %. A second exception occurs in the 'Black Belt' stretching from the Mississippi River to South Carolina, where a number of counties were home to black majorities in 1980 that fell short of dominance. These counties featured a shared racial-ethnic structure in which blacks outnumbered whites but both groups had substantial representation. Such a structure makes sense given the intertwined history of the two groups in the region. It also aligns with aspects of the locational persistence model.

The racial composition of counties changes substantially by 2010 (bottom map). White-majority counties are still plentiful in the Northeast and Midwest, but these regions no longer constitute an uninterrupted swath of territory where white dominance (90 %+) is the norm. Rather, they are now sprinkled with counties in which whites are increasingly joined by larger populations of non-whites. This is also apparent in the South and West, in a different form. A few counties in those regions had no-majority populations in 1980; many more have transitioned from white-majority to no-majority status over the last 30 years. The pattern is most evident in Southern California and the San Francisco Bay Area, where geographically sizeable and/or heavily populated counties have made the transition. No-majority counties have also emerged in parts of the South as increasing Hispanic populations have bumped white or black populations (which were not far above the 50 % mark to begin with) out of the majority.

These compositional transitions are explored more fully in Table 1. The table classifies all counties by their 1980 and 2010 types of racial-ethnic structures. Due to the small number of counties with minority-majority or no-majority structures in 1980 (only 157 out of 3106), we focus on those locations that had some kind of white-majority composition at that time. White-dominant counties made up more than half of all counties in 1980 (top panel), yet a third of them have subsequently transitioned to different racial-ethnic structures that include larger populations of color. White-shared counties in 1980 (second panel) turned out to be the least stable, with only about 20 % retaining their same composition in 2010. These counties overwhelmingly shifted to the white-other type that includes more than 10 % of some other group, most often Hispanics. The level of diversity also rose in these counties, as reflected in an average E score increase of over 20 points

[6] These maps are best viewed online in full color given the number of types required.

Table 1 County transitions in racial-ethnic structure, 1980–2010

1980 type		*E* Score		% Black		% Hispanic	
2010 type	N	2010 mean	Change	2010 mean	Change	2010 mean	Change
White-dominant							
White-dominant	1244	15.94	9.25	1.01	0.26	2.09	1.45
White-shared	372	33.69	18.91	3.49	1.10	5.42	4.08
White-other	246	41.78	25.41	2.84	1.41	13.65	11.00
Black-other	1	65.72	42.36	65.15	58.23	13.66	12.59
Hispanic-other	1	56.09	33.39	1.79	0.35	51.17	44.77
No majority	4	75.73	56.99	20.82	16.32	26.63	25.32
White-shared							
White-dominant	2	24.36	−0.67	3.82	−3.99	2.57	1.22
White-shared	33	39.87	13.44	6.59	−1.08	5.73	3.75
White-other	124	52.45	22.22	6.38	1.23	12.99	8.66
Hispanic-other	1	59.79	24.36	2.99	−1.60	56.60	47.42
No majority	9	76.08	39.07	14.74	7.35	24.48	19.07
White-other							
White-dominant	3	24.95	−3.73	4.88	−7.00	1.92	0.89
White-shared	47	35.54	6.37	8.05	−5.24	3.99	3.02
White-other	702	52.66	12.63	19.10	−0.95	10.15	5.72
Black-other	22	56.91	8.98	54.58	12.54	3.90	2.73
Hispanic-other	39	54.43	5.02	2.35	−0.27	56.30	23.29
Other race-other	12	48.74	3.94	0.14	0.10	2.47	1.46
No majority	87	67.55	16.24	22.57	2.34	25.15	12.84
Black-other							
White-other	7	53.22	6.50	41.62	−13.53	2.45	1.29
Black-other	71	48.85	2.74	63.84	4.22	2.22	0.89
No majority	9	61.17	13.49	47.24	9.55	7.14	5.95
Hispanic-dominant							
Hispanic-dominant	4	14.33	−3.39	0.17	0.15	94.92	2.59
Hispanic-other							
Hispanic-dominant	4	19.03	−10.01	0.25	0.15	92.27	9.18
Hispanic-other	28	40.75	−1.41	1.12	0.27	75.23	6.16
No majority	1	51.95	4.47	0.63	0.18	48.29	−3.05
Other race-dominant							
Other race-dominant	1	15.19	−4.72	0.03	−0.01	2.19	0.64
Other race-other							
Other race-shared	1	27.89	−7.03	0.17	0.03	2.36	1.92
Other race-other	8	38.38	−4.52	0.24	0.09	4.12	1.41
No majority							
White other	5	54.34	6.53	36.84	−12.44	3.88	2.58
Black other	2	53.98	4.16	55.52	7.47	1.54	0.73
Hispanic other	5	61.21	−3.29	11.74	0.08	59.24	17.41

Table 1 continued

1980 type		*E* Score		% Black		% Hispanic	
2010 type	N	2010 mean	Change	2010 mean	Change	2010 mean	Change
No majority	11	68.59	6.05	18.90	−2.35	23.75	4.80

to 52.4. White-dominant counties that transitioned to the white-other type experienced comparable gains in diversity (average increase of 25 points) but reached lower diversity levels in 2010 than those transitioning from the white-shared type due in part to a lower starting magnitude. Expanding Hispanic representation is largely behind these transitions.

Conspicuously absent from Table 1 are transitions in racial–ethnic structure driven by marked increases in the proportion of African American residents. Apart from counties that transitioned to black-majority status, black representational gains were outpaced by those of Hispanics. This is true for counties transitioning to no-majority, white-shared, and white-other contexts. No-majority counties have become much more common between 1980 and 2010, with the vast majority of new counties in this category originating from white-other contexts. Counties with Asian-majority populations are not observed at either time point.

4.3 The Spatial Diffusion of Diversity

Our final empirical aim is to better understand the process through which ethnoracial diversity spreads from location to location. For this purpose we turn to the LISA statistic, which identifies (1) significant clusters of counties with either high or low levels of diversity (e.g., HH or LL) and (2) clusters where the focal county and its neighbors differ significantly, one having a high level of diversity and the other low (e.g., HL or LH). Even though we refer to clusters of counties, each county is embedded in its own cluster. Thus, the number of counties equals the number of clusters.

Mapping the location of LISA clusters produces similar patterns to those displayed by the *E* scores in Fig. 3.[7] Figure 6 shows these patterns for 1980 and 2010. Low-diversity clusters concentrate in the Northeast and Midwest in 1980 (upper map), with only a few in the South and West. Conversely, high-diversity clusters are found throughout the South and West, although a handful of high-diversity clusters appear in the New York metropolitan area. Diversity clusters are similarly distributed in 2010 (lower map). High-diversity clusters populate the South, while low-diversity clusters predominate in the North.

In addition to these compositionally uniform clusters, HL clusters identify a focal county where diversity is significantly higher than in adjacent counties; the opposite is true for LH clusters. Many counties are part of non-significant (NS) clusters, for a

[7] A high degree of spatial autocorrelation exists in the county diversity data at each time point, based on Moran's I values of .77 in 1980 and .70 in 2010. The Moran's I statistic, which ranges from 0 to 1, provides a global measure of spatial structure. However, it cannot tell us where clusters are located within that structure.

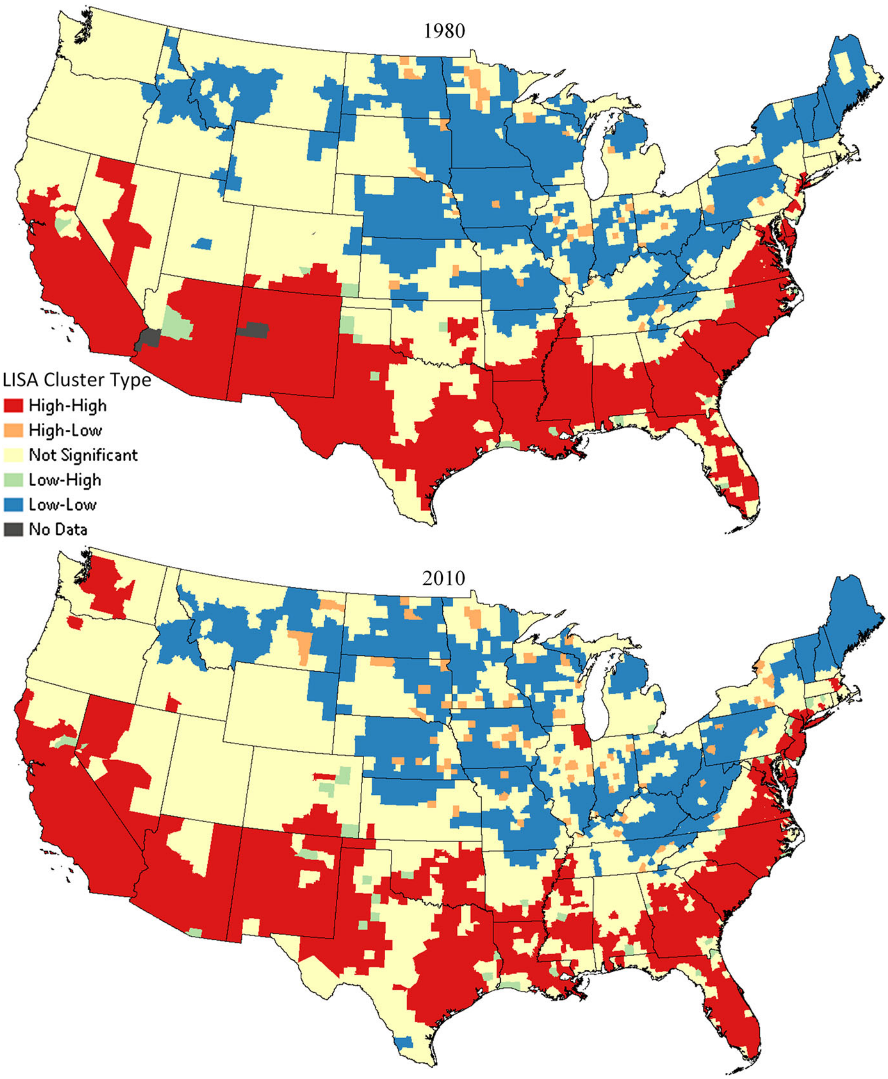


Fig. 6 Spatial clustering of diversity, 1980 and 2010

variety of reasons. First, every county in a local cluster might have a level of diversity that is neither high nor low when compared to all other counties (close to the mean diversity score across all counties), resulting in a non-significant classification. Second, a NS cluster could include a mix of counties—some significantly diverse and others significantly homogeneous—such that the average diversity score for the cluster is not significant. Counties in this second type of NS cluster (neighbors with a mix of high and low diversity) may be of interest if they are positioned between high- and low-diversity areas. To the extent that diversity spreads outward from higher-diversity counties, as anticipated by the spatial assimilation perspective, these mixed counties may transition over time to clusters with significantly high diversity levels.

We use the different cluster types to document diversity transitions consistent with hierarchical or contagious diffusion. However, the first lesson learned from the transition matrix in Table 2 conforms to locational persistence expectations: 77 % of all counties remained in their original cluster type throughout the 1980–2010 period, with HH counties slightly more likely to be stable than LL counties (80 vs. 76 %). Other counties saw relative decreases in diversity: 143 counties were part of HH clusters in 1980 that transitioned to NS, while 108 transitioned from NS to LL. Considering that very few counties experienced absolute decreases in diversity, these shifts are likely due to stable levels of local diversity as the nation as a whole has become more diverse. In some cases, Hispanic growth may drive absolute diversity declines. Rapidly growing populations along the Texas-Mexico border, for instance, have resulted in strong Hispanic majorities in counties that previously were ethnoracially diverse.

4.3.1 Hierarchical Diffusion

Alongside instances of stable or declining diversity, Table 2 reveals a number of transitions consistent with hierarchical diffusion. We detect 34 counties that have experienced hierarchical growth in diversity based on their shift from a LL cluster in 1980 to a HL cluster in 2010. These counties are located mainly in the Midwest. Their racial-ethnic composition has changed to include a greater non-white share while neighboring counties remain largely homogeneous. While most counties that were part of LL clusters in both 1980 and 2010 were classified as rural (59 %), roughly one-fourth of those that shifted to HL clusters were rural, with the rest fairly evenly split between metropolitan and micropolitan settings. According to the institutional hub model, this process could be driven by the introduction of a new industrial establishment, such as a meat processing plant that attracts a substantial number of Hispanics. Such plants are often sited in smaller metropolitan or micropolitan contexts as well as rural ones. LL to HL transitions may also reflect the

Table 2 LISA cluster transitions, 1980–2010

	2010					
	High–high	High-low	Not significant	Low–high	Low–low	Total
1980						
High–high	649		143	13		805
High-low		21	7		4	32
Not significant	155	10	1015	17	108	1305
Low–high	10		3	6		19
Low–low		34	191		718	943
Total	814	65	1359	36	830	3104

opening of a facility that houses a racially diverse population, such as a military base or prison.

An illustration of the institutional hub model can be found in Dawson County, Nebraska, where the diversity level (E score) was roughly 10 in 1980 but skyrocketed to 52 by 2010. No county adjacent to Dawson has a 2010 E higher than 27, and four of its six neighbors have scores of 15 or below. Dawson stands out from its heavily white neighbors because of a beef processing plant that opened there in the early 1990s (Gouveia and Stull 1995). The plant has attracted a large Hispanic workforce and a growing number of Somalis. In the city of Lexington, which lies at the center of this change in Dawson County, Hispanics now make up more than 60 % of the population. As they continue to grow as a group, white residents have relocated to other places. At the county level the shift in ethnoracial structure is less pronounced but still substantial, with Hispanics comprising nearly a third of all residents. Dawson is not alone in this type of transition, as labor market opportunities have increasingly drawn Hispanic migrants to rural Midwest counties such as Buena Vista County, Iowa, and Nobles County, Minnesota (Lichter 2012). Like Dawson, the average Hispanic population share in other counties experiencing LL to HL transitions jumped from less than one percent in 1980 to over 10 % in 2010. By comparison, Hispanic shares in stable LL county clusters mostly remained stable.

4.3.2 Contagious Diffusion

Contagious diffusion is most apparent in the 10 counties in Table 2 that transitioned from LH to HH during the study period. These counties recorded low levels of diversity in 1980 but were embedded in contexts where the average level of diversity was significantly high. While the data do not allow us to determine definitively if their transitions are due to minority residents relocating from adjacent areas with higher-than-average diversity, it seems plausible that the presence of such diverse locations nearby plays an important role. In line with the spatial assimilation perspective, a surrounding context of highly diverse counties might facilitate the use of cross-county co-ethnic networks. And if adjacent counties are part of the same metropolitan area, such transitions may indicate the movement of people of color to suburban communities within the same labor market.

A county making the transition from LH to HH is Fayette County, Georgia. Fayette is one of the 28 counties that constitute the Atlanta-Sandy Springs-Marietta metropolitan area. The Atlanta area has a rich African American history, a growing black middle class, and an increasingly diverse population, and it is among the largest of the new immigrant gateways (Liu 2012; Sjoquist 2000). The population of Fayette County increased from 29,000 in 1980 to over 106,000 in 2010. Mirroring trends across the wider metro area, the number of whites in Fayette increased but their proportion declined. During the same three-decade period, every other panethnic group grew more rapidly and hence became a larger proportion of the county population. Fayette's growth and compositional changes are reflected in higher E scores at each successive census, from a low of 16 in 1980 to a high of 60 by 2010. This upward trend in E is not surprising, given the diverse, dynamic character of the four counties that surround Fayette: Fulton and Clayton in the heart of metro Atlanta and Coweta and Spaulding farther out. Despite their somewhat different trajectories since 1980, all four witnessed a shrinking or stable share of white residents, an expanding black population, and varying degrees of Hispanic growth. Fulton, the largest of the counties adjacent to Fayette, experienced dramatic Asian as well as Hispanic increases.

4.3.3 *Weak Diffusion Processes*

Figure 7 maps the counties that were HH in both 1980 and 2010 as well as the 155 counties that transitioned from NS to HH. Non-significance occurs when the *E* score for the focal county relative to the spatially weighted average *E* of surrounding counties is in the middle of the standardized distribution of all counties. Thus, the transition from NS to HH denotes a shift in ethnoracial diversity either within the focal county or in the set of neighboring counties that pushes the spatially weighted average of diversity toward the high end of the distribution. We consider this a weaker form of the contagious diffusion process observed in counties shifting from LH to HH. The counties making this kind of transition frequently border a county in a stable HH diversity cluster, suggesting—as envisioned by the spatial assimilation model—the contagious spread of diversity from counties with high *E* scores to nearby, less diverse ones.

Where NS to HH transitions occur in relative isolation, away from stable high-diversity clusters, they may signal a broader area that has increased markedly in ethnoracial diversity. Metropolitan Chicago is one such area. Though Cook County had a high level of diversity in 1980, the counties adjacent to it exhibited much

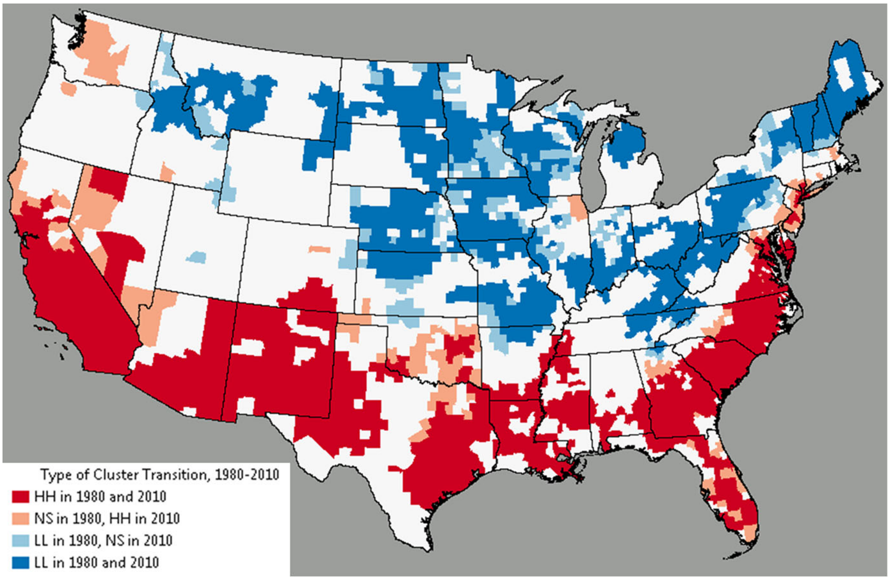


Fig. 7 Selected LISA cluster transitions, 1980–2010

lower diversity, yielding a non-significant cluster designation. Many of these surrounding counties underwent compositional shifts during the next 30 years that resulted in a much higher diversity magnitude in 2010 for the area overall. Other metropolitan areas undergoing similar transitions include Boston and the portion of western Washington anchored by the Seattle-Tacoma metropolitan region.

Finally, Table 2 reveals that 191 counties transitioned from LL to NS between 1980 and 2010. Transitions of this sort represent a weak hierarchical diffusion process (compared to LL to HL transitions), where the focal county does not reach a significantly high level of diversity, or the change in diversity affects more than one county but leaves others at a low level of diversity. Though some counties that make the transition from LL to NS are located on the edge of low-diversity pockets, others spring up in areas that previously had been entirely embedded in significant low-diversity contexts (see Fig. 7). These 'out-of-the-blue' hierarchical shifts toward greater diversity could affect more than one county. Alternatively, they may not yet have reached a level that we would consider significantly high, but they still represent a substantial deviation from the racial compositions of surrounding counties.

Hennepin County, Minnesota provides a useful example of this sort of transition, which is consistent with institutional hub logic. During the three decades of interest, Hennepin's E score rose 39 points (from 21 to 60). Its steep rise in diversity was not an isolated phenomenon: four of the seven counties adjacent to Hennepin experienced diversity increases of at least 30 points, and all seven had E values of 30 or greater by 2010. Hennepin and neighboring Ramsey County form the heart of metropolitan Minneapolis-St. Paul. Despite an inland location, the greater Minneapolis area has traditionally been receptive to the sponsored resettlement of refugees, including sizeable Hmong, Somali, and Liberian populations (Fennelly and Orfield 2008). The Hispanic population has also grown since 1980 in response to the pull of labor market opportunities. After gaining initial footholds in the metropolitan core, these minority groups have moved outward to diversify the suburban hinterlands. With its partner Ramsey County, Hennepin has served as a magnet, attracting ethnoracial newcomers to a predominantly white area and rendering the entire metropolis increasingly diverse over time.

5 Conclusion

Despite our focus on the spatial diffusion of diversity, one key conclusion from the results is about the relative stability of the ethnoracial landscape across counties. Mapping methods and an analysis of LISA-based cluster transitions reveal that the geography of diversity in 2010 looks much like it did in 1980. At both time points, counties in coastal states or that are part of major metropolitan areas have been home to larger shares of residents from non-white panethnic populations. Similarly, Hispanic representation in the West and South and black representation in the South have contributed to higher levels of diversity in those regions than in the Midwest or Northeast. A stable picture is also conveyed by the concentration of cases along the diagonal in Table 2, indicating few shifts in county cluster type over time. Any semblance of stability may seem paradoxical, given that the vast majority of counties experienced diversity gains during the study period. What must be remembered, however, is that they began the period with a range of different diversity magnitudes and racial-ethnic structures. Subsequent trajectories have often run roughly parallel, not only for the focal counties but for the larger contexts surrounding them.

The locational persistence perspective offers a plausible historical account of this pattern of stability amid change. It proposes that conditions upon arrival in America—such as proximity to the country of origin and labor needs—shaped the initial spatial distributions of panethnic groups, which in turn created momentum for communities to follow particular paths. The gateways where the groups congregated gradually cemented their reputations as desirable destinations, thanks to an accumulation of ethnic networks, organizations, and other resources capable of attracting and retaining members of one group or many. The outcome has been an enduring diversity hierarchy in which counties maintain their standing in relation to each other even as diversity increases across the board. The strong rank-order correlation between county E scores in 1980 and 2010 (Spearman's $r = 0.89$) lends further weight to the persistence perspective.

At the same time, we draw modest support for the spatial assimilation and institutional hub models from cluster-type transitions that reflect contagious and hierarchical diffusion processes, respectively. Contagious diffusion is apparent in some counties with low or non-significant diversity that were embedded in high-diversity contexts in 1980 and that transitioned to higher diversity themselves by 2010. These counties may have been the recipients of a diversity 'transfusion' from their neighbors as minority populations relocated within the same labor markets or metropolitan areas. Likewise, a number of low-diversity counties surrounded by equally homogeneous contexts in 1980 have transitioned to substantially higher diversity levels since then. As the illustrative cases described above suggest, the expansion of a new labor market sector or of an institution with an ethnoracially diverse clientele could partially drive this kind of hierarchical diversity change.

The work reported here is the first phase of a larger project devoted to understanding spatio-temporal patterns of ethnoracial diversity at the local level. Obviously, much remains to be done. For example, in the present analysis we do not identify the demographic mechanisms through which the diffusion of diversity takes place. It is often assumed that the phenomenon is fueled by immigration and domestic migration flows, which distribute panethnic groups across counties in a more even fashion. However, group- and county-specific differences in natural increase (the excess of births over deaths) can also contribute to the spread of diversity as aging white populations are replaced by youthful minority populations (Johnson and Lichter 2008). To assess these mechanisms, a follow-up analysis is underway in which overall county diversity change will be decomposed into its net-migration and natural increase components.

Members of our project team have begun to tackle another relevant but under-researched issue: the characteristics of communities—including counties—associated with variation in diversity magnitude and structure (see, e.g., Sharp and Lee 1990). Specifically, how does ethnoracial diversity change over time in response to changes in institutions (e.g., college growth), economic opportunities (as implied by spatial assimilation), or other features of a community and its neighbors? Future studies should first identify the correlates of diversity aspatially. Doing so would serve to build a basic understanding of the forces that encourage racially diverse population composition and growth at the local level. These aspatial relationships will provide a statistical baseline against which a number of spatially sensitive models can then be tested to determine the role that space and proximity play in diversity change. It is clear from the present paper that diversity and diversity growth have a spatial structure. Models sensitive to this spatial structure, such as spatial lag or error models, that also include the aspatial correlates of diversity would allow us to more stringently test our theoretical frameworks.

Our evidence on counties along the Rio Grande and the lower Mississippi River hints that the potential for diversity decline should also be examined more fully (also see Lee and Hughes 2015). Consider the future of a high-diversity county with approximately equal proportions of whites, blacks, Hispanics, and Asians. The growth rates of these panethnic groups are unlikely to remain identical for an extended period; one or perhaps two groups can be anticipated to outpace the others. When that happens, an inflection point is reached beyond which the slices of the population pie start to become less equal, signifying a diversity decline. Local employment shocks (e.g., the opening of a large meat-processing plant that recruits Hispanic laborers), housing market conditions, the strength of residential preferences (own-group affinity and out-group aversion), and white flight from perceived minority threats are among the factors that could influence the onset and pace of the decline. This change, essentially a form of succession, might even spill over into adjacent counties, creating local clusters of diminished diversity.

Finally, the probability of a decline or of any type of significant shift in diversity will be greater during a longer time span than the 30 years we have observed. It should also be greater for community units smaller than counties. No county studied here undergoes a transition from a LL cluster to a HH cluster, as this would reflect drastic and rapid compositional change. But we fully expect that dramatic shifts will become more common with the extension of the analysis over additional decades and to census-defined places (e.g., cities, suburbs, small towns). As ethnoracial diversity spreads throughout the United States, more localized and heterogeneous types of change are likely to occur in its wake.

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