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An Examination of the Geography of Population Composition and Change in the United States, 2000-2010: Insights from Geographical Indices and a Shift-Share Analysis

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Introduction

The phrase “population change” conjures associations both numerical and compositional. Populations of places change by growing or shrinking, but also through the evolution of the type of individuals who live there. Conceptually, the two processes are often treated separately. Of course, in reality, both types of change are inextricably linked; numerical outcomes have their origin in group-level dynamics. In spite of macro-level population growth, individual groups may themselves be experiencing decline or geographic areas may be experiencing considerable turnover in composition with or without any discernible effect on total numbers. Sub-areas of a region may show similar outcomes in terms of population increase (decrease) but very different demographic sources of that change.

As a whole, the United States population is undergoing a significant transition from majority white, non-Hispanic to a majority composed of racial and ethnic minorities. The geographical variation in population composition remains extensive, however. Some areas of the country are still relatively homogeneous, while others exhibit much more racial and ethnic diversity. At the national level, the majority-minority transition advances because of differential growth trends across racial and ethnic groups and national population growth is the result of increases in just a few groups. As Johnson and Lichter (2010) make clear, the minority share of the population is increasing not only because of actual minority increases (in particular, Hispanics) but also because of declines in young, white non-Hispanics. Together, racial and ethnic growth rates play out at the sub-national level, leading to differential geographical patterns not only in numerical growth but also population composition. And as Rogerson and Plane (2012) astutely note, observed changes in population distribution at various sub-national scales represent the combined effect of not only internal migration but also the other demographic components of change: international migration, fertility, and mortality.

The goals of this paper are twofold. The first is to offer an assessment of the recent geography of population composition and change in the United States, to show how concentrated different racial and ethnic groups are, and to investigate a new approach to measuring which parts of the country can be considered “typical” in terms of their population composition. In addition, state-level population change between 2000-2010 is decomposed by age and race/ethnicity to identify the sources of growth or decline. The secondary purpose of the paper is more methodological and seeks to show how relatively simple – both in terms of computation and data requirements – geographical indices and methods can offer new insights into population change in the U.S. Descriptive measures include the coefficients of specialization and localization, siblings of the dissimilarity index and the Hoover index of concentration, as well as a variation of shift-share analysis, a tool most often encountered in assessments of regional employment change. The next section of the paper provides context and background information. After that, the following sections outline the data and methods, respectively. The descriptive analysis results are then discussed, followed by the shift-share analysis and concluding remarks.

Background

The United States population increased by ten percent between 2000 and 2010, but of course growth varied regionally (Table 1). Some states, particularly those in the West, grew by over 20 percent during this decade. Others, especially in the Midwest or on the East Coast, experienced very little growth. While often population growth is linked to economic base or economic growth, or migration trends, it is less common to link growth – or the lack thereof – to compositional changes. However, whether fast-growing (Nevada or Arizona) or slow (Rhode Island or Ohio), numerical change can be decomposed by sub-group to better understand the contribution made by each group and the outcome of the change in terms of overall mix of population in particular locations.

The United States' inexorable march towards minority-majority status has been well documented (Dougherty, 2010; Johnson and Lichter, 2010; U.S. Census Bureau, 2011d; Yen, 2010). Table 2 provides a sense of the compositional change that has occurred at the national level in just ten years. In 2000, almost 70 percent of the U.S. population was white, non-Hispanic and Hispanics and blacks both had approximately the same share of population, at 12.55 and 12.06 percent, respectively. By 2010, Hispanics were clearly the second largest group in the U.S., after white, non-Hispanics, and all other groups had increased their share of the total population, at the expense of white, non-Hispanics (with the exception of the American Indian category). At the state level, the picture is more nuanced. Figure 1, which orders states by population growth rate between 2000 and 2010 in descending order, shows the contribution each racial and ethnic subgroup made to a state's population change between 2000 and 2010. Bars on the left indicate the magnitude of population decrease for a group, while bars on the right hand side indicate increase. Subtracting the width of the decline bar from the increase bar gives a sense of overall population increase during the period. With few exceptions, the states with the highest growth rates were those that experienced smaller declines in their white youth populations. The figure's most important message is that virtually every state experienced decline in at least one subgroup, *even in an environment of overall growth*. For example, although all

states experienced gains in their youth and adult Hispanic populations, not all states experienced declines in their white, non-Hispanic populations. The District of Columbia, the Carolinas, and Utah, for example, each saw increases in their white populations. North Carolina, in fact, experienced increases across all race/ethnicity groups, youth and adult. Rhode Island, which had a mixture of growth and decline within cohorts, actually experienced very little net change in terms of total population (but a great deal in terms of composition). Michigan, the only state to see population decrease in the last decade, still experienced increases across many groups (and total decline can be mostly attributed to decreases in numbers of white and black non-Hispanics under age 18).

A wealth of research exists in demography and sociology on the changing racial and ethnic composition of the United States. More recent research has tended to focus on the contribution to change made by Hispanics, since this is extensive, and has considered the relative impact of immigration, internal migration, and natural increase. Where Hispanic immigration tends to occupy the limelight, this research shows that while immigration indeed contributes to increases, both directly and indirectly, natural increase is also very important (Johnson and Lichter, 2010; Lichter and Johnson, 2009). Other relevant research has addressed the geographic outcomes of the demographic processes above (Frey, 1996; Massey, 2008; Johnson and Lichter, 2010; Singer, 2004) to show how traditional gateway cities and large metropolitan areas are no longer the sole focal point of minority population concentration and growth. While geography is integral to the research above, the range of tools employed to describe compositional characteristics is fairly narrow. In contrast, although geographers have not tended to make quantitative contributions to this dialogue, they have at their disposal a wide range of spatial measures (admittedly generally applied more frequently in economic than population geography) that can help elucidate the geographical patterns and changes in population composition. Moreover, while both geography and composition go hand-in-hand in the research above, less attention is given to the fact that sub-group dynamics will vary across space and that these dynamics will play into overall numerical change for sub-national areas.

This paper therefore builds on previous research by extending analysis of the geography of population composition to include not only diversity – that is, how the mix of different racial/ethnic groups varies across the U.S. – but also measures of concentration and specialization that provide a sense of how different groups are distributed across the country. Johnson and Lichter (2010) touch on several of the topics addressed in this paper, using county-level population estimates data. They not only offer a thorough assessment of population composition at the U.S. county level, but emphasize the driving force behind the shift to a majority-minority population: youth population composition. Their use of a diversity index to measure the mix of population shows a positive relationship between diversity and age cohort and maps of youth diversity show extensive geographical variation.

In addition, this paper offers a different approach to the “sources of change” question by using shift-share analysis to look at the contributions made by individual groups to overall change at the state level. At its most basic, fundamental level, shift-share analysis parses regional change – in employment, population, or births – between two time periods into a national effect, an industry mix effect, and a competitive effect. That is, change due to

national circumstances; change due to regional emphasis on fast-growing sectors; and change that can be attributed to regional competitiveness. Shift-share has traditionally been employed to understand the sources of regional economic growth in a region relative to some larger, benchmark area and in the years since its introduction has been the subject of innumerable tweaking and extensions (Arcelus, 1984; Barff and Knight, 1988; Haynes and Dinc, 1997; Knudsen and Barff, 1991). Although it has been criticized for its lack of predictive ability, among other weaknesses (see e.g. Knudsen, 2000), it remains a commonly used regional analysis tool. In more recent decades, its application has been expanded to include migration (Ishikawa, 1992; Ishikawa, 1999; Plane, 1987; Plane, 1989), and fertility change (Franklin and Plane, 2004) over time.

Data

This paper uses national, state, and county level data for 2000 and 2010 on race and ethnicity, as well as age. One of the first sets of data to be released following each decennial census in the U.S. is the redistricting data file, which provides population counts at various levels of geography by not only race and ethnicity, but also for two age cohorts: those under 18 and those above (US Census Bureau, 2011a; US Census Bureau 2011b; US Census Bureau 2011c). For these two age cohorts, the population is classified by ethnicity, Hispanic and non-Hispanic, and then, for non-Hispanics into different race categories. The race classification used here is for non-Hispanics reporting only one race alone. Those reporting two or more races are placed into one category together, giving eight race/ethnicity categories: Hispanic; white, non-Hispanic; black, non-Hispanic; Asian, non-Hispanic; American Indian and Alaska Native, non-Hispanic; Native Hawaiian and Other Pacific Islander, non-Hispanic; some other race, non-Hispanic; and two or more races, non-Hispanic. For the remainder of the paper, all non-Hispanic groups are referred to by race only, so that “white, non-Hispanic”, for example, becomes simply “white”. “black” and “African American” are used interchangeably to refer to the black, non-Hispanic population.

The eight categories above are each further subdivided into two age cohorts, resulting in sixteen mutually exclusive and exhaustive categories. Although most race/ethnicity-specific population change recorded between two time periods will be the result of migration and natural increase, since census respondents self-select into race/ethnicity categories and may opt for different categories over time, it is possible for some population change to be the result of evolving subgroup identities. More specifically, a population subgroup – such as two or more races – may experience an increase over time through actual natural increase or net in-migration, but also due to individuals changing the label they apply to themselves across census periods. In fact, a recent report on Census 2010 findings from the U.S. Census Bureau (Humes et al., 2011) notes that, although actual race and ethnicity categories remained the same between 2000 and 2010, some portion of population change across groups during this period is likely attributable not only to self-selection but also to basic changes in the wording of the race and ethnicity questions across the two census questionnaires.

Methods

As noted above, the analysis is conducted in two parts. First, indices are calculated at the state and county level to assess, first, how diversity varies across the country, as well as how the distribution of different race and ethnic groups can be characterized vis à vis the nation as a whole. Second, population change at the state level is decomposed, to show state-level variation in the sources of population growth between 2000-2010.

Capturing Population Composition

Three basic measures are employed to characterize the distribution of race/ethnic groups in the United States. The first is a measure of diversity, which quantifies the amount of heterogeneity in an area's population and allows for easy comparison across areas. The interaction index is calculated as below (following Plane and Rogerson, 1994):

$$I_j = 1 - \sum_{i=1}^n (P_i - P)^2$$

where an area j 's population (P) can be sub-divided into i categories, and the index value I ranges from zero when the entire population belongs to only one group to $(n-1)/n$ or in this case 0.875. I is interpreted as the probability that two members of the group selected at random will belong to different population subgroups. The interaction index is often encountered in demographic studies, such as in Johnson and Lichter (2010), discussed above, or Franklin (2011) as it provides a one-number summary of the diversity of an area that is easily interpreted and easily compared to the value for other sub-areas.

The second measure computed is an index of localization, which compares the distribution of a race/ethnic/age group at the state or county level to the overall population distribution across those areas to show how geographically concentrated the population of any one subgroup is. The index of localization is a common tool of regional analysis and variations of it are described in both Smith (1977) and Isard (1960). In structure, it is fundamentally the same as the Hoover index of concentration (Hoover, 1941), which relates regional shares of population to shares of land area and which occupies its own niche in American population geography (e.g. Rogerson and Plane, 2012; Long and Nucci, 1997; and Vining and Strauss, 1977). The index of localization has typically been used to measure the concentration (or localization) of industries or employment in economic sectors across a set of geographic areas, but it lends itself well to the present task of describing, with one number, the distribution of different race/ethnicity category across the United States. It is calculated:

$$L_i = \frac{1}{2} \sum_{j=1}^N i X_j - Y_j \vee i$$

where j is the state, X_j is the state's share of population in a race/ethnicity/age category, and Y_j is the state's share of total U.S. population. The resulting statistic ranges between zero and 100, with zero indicating that the distribution of a subgroup's population across a set of areas matches the distribution of the total population across those areas. Said in other words, the lower the value, the more uniformly distributed the population subgroup, given the distribution of the total population.

The final measure used, the index of specialization, is very similar to the index of localization in that it is built upon the sum of the absolute differences between two distributions. It is calculated:

$$S_j = \frac{1}{2} \sum_{i=1}^N |X_i - Y_i|$$

where X_i is the percent of total regional population in demographic category i and Y_i is the percent of national, or benchmark, population in category i . As with the localization coefficient, the specialization index has been more traditionally found in regional economic studies (see Mulligan and Schmidt, 2005 for a review of localization and specialization coefficients). Here, rather than comparing the economic structure of an area to that of a benchmark region, the demographic structure – in terms of race/ethnicity and age – of a state or county is compared to that of the nation as a whole. The lower the value, the more a state or county's population structure matches the nation's; the higher the value, the more the smaller area's population structure deviates from that of the country as a whole. In some ways, this measure is a more attractive gauge of regional population diversity than the interaction index, above, in that its point of reference is concrete: current national population composition.

Decomposing Population Change

To complement the descriptive picture of population composition in 2010 provided by the measures above, shift-share analysis is employed to identify the sources of state-level population change between 2000 and 2010. Shift-share offers a useful tool for decomposing change between two time periods into components that can be linked to national, cohort, and regional change. Most typically, shift-share analysis compares sector-level employment change between two time periods to change that occurred during the same time period for a benchmark region. This analysis uses the 16 population categories described in the data section in place of economic sectors for the years 2000 and 2010 for the fifty U.S. states plus the District of Columbia and takes the nation as the benchmark region. The method disaggregates the change experienced between the two time periods into three effects: a national, a cohort mix, and a competitive effect, such that total change between the two periods is the sum of the three effects:

$$\Delta P_i^r = N_i^r + M_i^r + C_i^r$$

The National Effect (N_i^r) isolates the increase in cohort i 's population in state r that would have been expected had it grown at the same rate as the nation as a whole (a rising tide that lifts all boats). The Cohort Mix Effect (M_i^r) captures cohort population change attributable to a state's "specialization" in cohorts that are growing fast at the national level. So, for example, the adult Hispanic population in the United States grew by 45 percent between 2000 and 2010, while the white youth population declined by 10 percent. States with larger shares of adult Hispanics would benefit, while states with more young whites would see declines. States with fewer young whites would still experience a decline in that cohort for the Cohort Mix Effect, but the impact would be lessened. The Competitive Effect (C_i^r) is intended to measure the contribution state-specific characteristics make to overall population change. Suppose cohort growth is higher at the state level than at the national level; this suggests there are regional particularities that make this area stand out.

As Arcelus (1984) notes, the Competitive Effect in this traditional specification conflates growth due to overall population increase at the state level and the actual competitive portion that would be the result of state-level cohorts growing faster than their national level counterparts. To mitigate this weakness, the following analysis further disaggregates the Competitive Effect into two additional components, as suggested by Arcelus (1984):

$$C_i^r = R_i^r + RM_i^r$$

where R_i^r is a Regional Effect that measures growth due to overall population growth at the state level and RM_i^r is a Regional Cohort Mix Effect, which measures growth/decline in cohort population due to cohort growth rates at the national and regional levels.

The shift-share calculations are structured such that population change within a cohort (for example, whites under 18) between the two time periods is the sum of the components above, and overall population change within the state is the sum of the components across all cohorts.

An additional extension proposed by Arcelus (1984) allows each component to be subdivided into what he terms the "expected" and the "regional specialization" portions of each component, so that each Effect is, in turn, the sum of these two sub-components. The "expected" portion is the population increase (or decrease) that would have been expected had the state the same population composition as the nation. The "regional specialization" portion is that share of change that can be attributed to the state's deviation from the nation, thus the idea of specialization. This sub-division is accomplished through the estimation of a state cohort's "homothetic population", HP_i^r , which represents state r 's hypothetical population in cohort i if the state's population structure were the same as the nation's population structure – with structure being a combination of race/ethnicity and age – and it is calculated thus:

$$HP_i^r = P^r * P_i^n / P^n$$

where P^r is the total state population, P_i^n is the cohort's national population, and P^n is the total national population, all for the first time period.

The shift-share components are calculated as follows:

$$\begin{aligned} N_i^r &= HP_i^r * p^n + (P_i^r - HP_i^r) * p^n \\ M_i^r &= HP_i^r * (p_i^n - p^n) + (P_i^r - HP_i^r) * (p_i^n - p^n) \\ C_i^r &= HP_i^r * (p_i^r - p_i^n) + (P_i^r - HP_i^r) * (p_i^r - p_i^n) \end{aligned}$$

and C_i^r is furthermore the sum of R_i^r and RM_i^r , which are calculated thus:

$$\begin{aligned} R_i^r &= HP_i^r * (p^r - p^n) + (P_i^r - HP_i^r) * (p^r - p^n) \\ RM_i^r &= HP_i^r * (p_i^r - p^r) + (P_i^r - HP_i^r) * [(p_i^r - p^r) - (p_i^n - p^n)] \end{aligned}$$

where:

P_i^r = State j 's cohort population in 2000

p^n = National population growth rate, 2000-2010

p_i^n = National cohort growth rate, 2000-2010

p^r = State population growth rate, 2000-2010

p_i^r = State cohort growth rate, 2000-2010

For the Regional Effect (R_i^r), the $HP_i^r * (p^r - p^n)$ portion captures expected cohort growth due to the state's population growth (relative to the nation's) and $(P_i^r - HP_i^r) * (p^r - p^n)$ measures the impact of regional growth given the region's specialization in that cohort.

Population Composition

The population distributions shown in Table 2 above indicate the very definite reallocation of population shares that has occurred over just one ten year period. At the sub-national level, varying patterns of immigrant settlement, internal migration, and fertility mean that the mix of groups seen at the national level is an average that is found in few places in the U.S. Racial and ethnic diversity at the county level (captured with the interaction index), for example, is higher on the coasts and in the southern portions of the country. In these locations, the probability that two randomly selected individuals will come from different subgroups is considerably higher than in the Upper Midwest or parts of New England. Much of the evolution in overall population composition is driven by change in younger age cohorts, and a similar diversity pattern for those under 18 in 2010 is seen at the county level (Figure 2a). As can be seen in Figure 2a, the lowest levels of youth diversity are found in counties stretching from New England in the northeast, through the Midwest, and into the

upper Plains states. These areas are predominantly white, non-Hispanic. Higher levels of diversity are apparent on both coasts and in a band through the South to Texas.

Figure 2b shows the results of a local indicator of spatial association, or LISA, cluster map that shows clear evidence of spatial clustering of high and low levels of racial and ethnic diversity of the under-18 population at the county level (Anselin, 1995). In fact, in terms of youth diversity, two Americas clearly emerge from the map: one, red, in a band from coast to coast through the South, is an almost continuous cluster of high-diversity counties. The other, blue, New England through the Midwest, is a cluster of low diversity. One interesting anomaly is that of the Texas border counties, which form a statistically significant and independent cluster of low diversity counties (but this time, predominantly Hispanic). Along the periphery of both large clusters are outlier counties – counties with especially high or low diversity juxtaposed against contrasting areas of low or high diversity. These can be thought of as areas in demographic transition, either precursors to higher diversity (pink counties) or last vestiges of low diversity (light blue counties).

Finally, Figure 2c compares diversity at the county level for the adult population to that for the population under 18. Counties in blue are those in which diversity for the adult population exceeds that measured for the youth population. These places are fairly rare and tend to be concentrated in places with a longer history of significant minority populations (e.g. California, southern Texas, and the Mississippi Delta), but there are also a few counties located in the relatively un-diverse New England/Midwestern belt. In those locations, the blue color is likely indicative of the low numbers of minority youth present. Red counties, on the other hand, are those in which youth diversity exceeds diversity for the total population. Here, the younger generation exhibits more racial and ethnic diversity than the adult cohort. These are places undergoing a great deal of population composition transition.

Diversity is the result of the mix of several groups. These groups do not tend to be uniformly distributed across the country, however, which is why overall diversity varies. Table 3 uses the index of localization described above to measure how uniformly distributed each race/ethnicity/age category is across U.S. states and counties¹. The lower the index value, the more uniformly distributed the group is, relative to the benchmark population. Several conclusions may be drawn from the table. First, for every group and each age, populations are more uniformly distributed at the state level than at the county level. This is quite normal for indices of this type, which display more extreme value for smaller units. That said, this result is consistent with the supposition that subgroup populations are fairly evenly distributed across states but that, within states, they are more concentrated. Second, variations in concentration exist across groups. Whites are the most uniformly distributed group, but the trend over the past decade was towards increased geographic concentration for young and adult whites at both state and county levels. Young whites are more concentrated than adult whites, in contrast to Hispanics, blacks, and Asians, who tend have more uniformly distributed youth than adult populations. Native Hawaiians and American Indians are the most concentrated subgroup at both the state and county levels but are also

¹Table 2 uses the total population as the benchmark. Adjusting the benchmark population to the under-18 or adult population age cohort did not result in appreciable differences in the values of the index.

small groups. In terms of the Hispanic population, both age cohorts are less concentrated in 2010 than in 2000, but the under-18 cohort saw a larger decline in concentration than the adult population. Asians and blacks are both less spatially concentrated than Hispanics, and the trend over time has been towards deconcentration. Taken all together, the results suggest that, along with increasing shares of the overall population, minority subgroup populations are also becoming more geographically diffused, while the white population, while starting from a very low level of concentration, is slowly becoming more spatially condensed.

A complement to the diversity measure is to ask the question: which places are most demographically representative of the U.S. as a whole? The specialization index, because it compares the race/ethnicity/age distribution at a local level to that at the national level, provides a one-number measure of how much a state or county “looks” like the nation as a whole. The specialization index is first calculated for states and then again for counties in 2010. With the exception of Illinois, which is the state with a demographic structure most like the U.S. ($S = 2.2$), the lowest coefficient values are found mainly on the East Coast of the U.S.; these are the areas of the country most like the U.S. as a whole. Harking back to the diversity discussion above, this result drives home the conclusion that to be demographically “normal” in the U.S. today is to be diverse. Some higher values, such as those seen for West Virginia ($S=29.4$) and Vermont ($S=30.6$), are the outcome of local population that are *more* white, non-Hispanic than the country as a whole, while other higher values, such as California indicate those states are more diverse (read: *less* white, non-Hispanic) than the country as a whole. The vast majority of states became more demographically specialized – that is, their state populations became even more unlike the nation's – between 2000 and 2010.

At the county level (Figure 3), areas with population structures similar to the U.S. can be found throughout the country, but especially along the East Coast, through the South, and up through Mountain and western states. As at the state level, large deviations from the national norm are found in non-diverse counties of the Midwest or interior New England, as well as in the more minority-dominated areas of southern Texas, New Mexico, and California. These results are starkly different from the traditional view of the American Heartland as somehow representative of the country as a whole. Politically and culturally, this assumption has been questioned for years; demographically, it clearly does not hold.

Shift-Share Analysis

The descriptive picture presented in the tables and figures above shows how numerical and compositional change over time can result in redistribution of population subgroups and geographical variations in diversity. This section of the paper further investigates the numerical outcome, with special attention to subgroup contributions and growth trends at the national, regional, and cohort levels. Although there are other ways in which this could be accomplished, for example by focusing on contributions of demographic components of change for each group and location, one goal of the present analysis is to explore the value of applying standard geographical analysis tools to the topic of demographic change. Subsequently shift-share is employed to allocate population change at the state level to the

National Effect, the National Cohort Mix Effect, and Competitive Effect described in the methodology section.

The Homothetic Population

As discussed above, this shift-share analysis uses a “homothetic population” – the population the state would have in each subgroup were its distribution the same as the nation's – to show the contribution made to each effect that results from the state's specialization in particular cohorts. Information gleaned from the homothetic cohort population figures is similar to that elicited from the specialization index above, except that the homothetic population is able to show cohort-level differences from the national norm rather than a one-number summary of the deviation. Table 4 provides a comparison of the actual population distribution to the homothetic distribution for Michigan, the only state that lost population between 2000 and 2010. As the table shows, Michigan had fewer Hispanics and Asians, both youth and adult, than it would have if its population distribution were the same as the nation's. In contrast, Michigan's population distribution is more white and African American than the national distribution. Illinois, the state whose population distribution was most like the overall nation, according to the specialization index, shows an overrepresentation of blacks in both age cohorts, but underrepresentation of adult whites – while the share of youth Hispanics is just about exactly the same as the U.S. as a whole. Across all states (and DC), in fact, many states with an overrepresentation of youth whites also show an *underrepresentation* of under-18 Hispanics. Some areas, like Hawaii or the District of Columbia, come out with an underrepresentation in both cohorts (Figure 4). Not unexpectedly, New Mexico, California, and Texas, traditional centers of the U.S. Hispanic population, have a higher share of Hispanics in both age groups than they would if their population distribution were the same as the U.S. as a whole, but also a lower share of whites in both age cohorts. Colorado stands out as the lone state with overrepresentation of both whites and Hispanics. In the shift-share analysis, these figures – both actual and homothetic – matter because states which seem to specialize in a particular cohort (e.g. youth Hispanics or adult whites) will either accrue a demographic premium or pay a penalty depending on whether that cohort is growing or shrinking at the national and state levels.

Shift-Share Results: A State Example

The homothetic population and the difference between actual and homothetic are then used in the shift-share analysis to capture the share of population change that would accrue to the state for each effect if its population distribution matched the country's distribution (“expected” effects), as well as the advantage (disadvantage) it gains (suffers) by “specializing” in particular groups, relative to the nation. The result is twelve calculated values for each cohort in each state, rendering any meaningful discussion of all individual state results impossible. Instead, the approach here is to continue the focus on Michigan that commenced above. This permits a thorough discussion of one state and a comparison of cohort level results. Following the evaluation of results for Michigan, discussion of results then continues at the state level.

Table 5 shows the full results for the state of Michigan. Here, each component is the sum of the expected and specialization calculations and the Competitive Effect is the sum of the

Regional and Regional Cohort Mix Effects. For all cohorts, the total National Effect is positive – and, indeed, is positive for all cohorts in all states – as this component measures solely the potential growth attributable to national population growth. The specialization element of the National Effect may be positive or negative, however, and the sign is dependent on whether Michigan's share of population in a particular cohort is larger or smaller than the share at the national level. In this case, Michigan gains an extra boost in both young and adult cohorts of whites and blacks, but has a much smaller boost from the positive National Effect for Hispanics because the homothetic population in those cohorts was larger than the actual, observed population in those groups in Michigan and the resulting difference between the two is negative. That is, the small positive values for Hispanics under the National Effect occur *in spite of* Michigan's population distribution and not because of it, whereas the growth due to this effect for whites and blacks can be traced in part to population distribution.

Of course, population figures attached to any one shift-share component do not reflect actual population change, but rather hypothetical change that can be linked to each shift-share effect. And these effects, in turn, are based on collections of differences in growth rates. This means that although Michigan would have added 182,446 whites under age 18 between 2000 and 2010 had this cohort grown at the national pace of growth, in fact the cohort lost 269,881 during this time period. The difference in outcomes can be traced to the Cohort Mix Effect, although the Competitive Effect is also negative. Together, these two latter components more than wipe out the potential increase in population that might be expected from the National Effect. In sum, the decline in the youth white population in Michigan can be explained mostly by that state's demographic mix, but also by its demographic emphasis on a group – white youth – that is in decline at the national level and in an even starker state of decline at the state level.

The shift-share results provide particular insights in the case of white and black adult cohorts, which both experienced increases in population during this period. Table 5 shows that, in the case of adult whites, the small positive increase in numbers during this period is wholly attributable to the positive National Effect, whereas the increase in the black adult population comes partly from the positive Cohort Mix Effect: this cohort grew faster at the national level than the overall national pace of growth. The black adult cohort is not seen as competitive, though, because national level growth for this cohort was much higher than it was in Michigan.

State-Level Shift-Share Results

Summary state-level results are shown in Table 6, where the total population change between 2000 and 2010 is presented in the far right column, with the three shift-share effects shown to the left and summing to the total population change. The sub-components of the Competitive Effect, the Regional and Regional Cohort Mix Effects, are also shown in the table and their sum equals the total Competitive Effect. Figure 5 echoes Figure 1 by framing the results in terms of contributions to overall population change. As with Figure 1, the states have been ranked by population growth between 2000 and 2010, with negative contributions to population change arrayed on the left and positive contributions on the

right. As discussed above, the National Effect is positive for all cohorts and states, since the country as a whole grew during this period. States that experienced higher rates of population growth during this period tended to have positive values for the Competitive Effect, while those states that experienced lower levels of growth, or decline as in the case of Michigan, have negative values – if population growth were a business, these states would, indeed, be viewed as less successful. In terms of the Cohort Mix Effect, which rewards states that “specialize” in cohorts growing faster than the national average, some states are allocated a positive effect and other a negative. There appears to be a geographic pattern to the Cohort Mix, with states in the Midwest, New England, and much of the South performing poorly in this category, while western and gateway (e.g. Florida and New York) show gains from this component (Figure 6). In fact, as Figure 6 shows, there appears to be a clear geographical aspect to the interplay between values for the Cohort Mix and Competitive Mix Effects. Those states with population growth attributable to both shift-share components tended to be in the south of the country, as were those displaying a positive Cohort Mix combined with a negative Competitive Effect (with New York and New Jersey proving the exception to the rule). Gold-colored states are those with projected negative values for both effects. Figure 6 makes clear another aspect of geography not easily gleaned from the table: the bulk of U.S. states during this period have negative scores for the Cohort Mix, but positive values for the Competitive Effect. In general, positive values for the Cohort Mix are due primarily to cohort-level increases in the Hispanic adult category. Negative values, such as those seen in Louisiana or Massachusetts are the result of population distributions that favor cohorts with slower growth rates than the nation – that is, both white cohorts and the youth black cohort.

In traditional shift-share applications, the Competitive Effect is the element of the analysis that highlights regional competitiveness in particular industries, the logic being that regional industries performing better than their national-level peers must have some edge on others in their field. In demographic terms, of course, a state is hardly going to “invest” in cohorts that appear to be competitive, however the explanation is the same: states with positive values for the Competitive Effect have, on the whole, more individuals in cohorts that are growing faster at the state than the national level. For example, California, for all its population growth (about 3.4 million), actually experienced slower growth in every single cohort than cohorts at the national level, and this while the state as a whole was growing (see positive value for Regional subcomponent of Competitive Effect). Illinois, on the other hand, also had negative values for virtually every cohort for the competitive effect, but much of this can be attributed to the fact that the state as a whole was growing much more slowly than the nation. Arizona, which can attribute almost half its population growth during this period to the Competitive Effect, shows increases in almost every cohort for this effect, but was particularly “competitive” where adult whites were concerned. In fact, about half of Arizona's population increase from the Competitive Effect is due just to growth in this cohort.

Comparison of component values for each state suggests that some states' increases can be primarily allocated to overall national growth, others' to all three effects, and others' to some combination of the three. States like Mississippi, Connecticut, or Pennsylvania, for example, owe all their population growth to national momentum. They neither specialize in expanding

cohorts nor have a competitive edge big enough to propel them into positive values for that component. Other states, such as Arizona, Texas, or Florida have the weight of demography behind them on all fronts: positive values for all three shift-share effects. These are states buoyed not only by national growth trends, but also benefitting from large shares of population in cohorts that are both growing fast at the national level but also outstripping national growth at the state level.

Concluding Thoughts

This paper considers a range of descriptive geographical measures to assess population composition, distribution, and change in the United States. Several conclusions may be drawn by pooling insights from the diversity and specialization measures, as well as the coefficient of localization to measure concentration, discussed above. First, racial and ethnic diversity has been increasing and is now the norm, but values vary considerably across the country at both the state and county levels. The macro-level national population statistics in Table 2 make clear this increasing diversity, but the specialization index values drive home the fact that places that are representative of the nation as a whole are actually quite diverse. Furthermore, subnational differences in population composition and growth rates mean that some cohorts – such as Hispanics in both age cohorts – are becoming more uniformly distributed across the country, while the white population becomes more spatially concentrated.

This paper also echoes Johnson and Lichter (2010) in highlighting the importance of considering youth and adult cohorts for each race and ethnic group. Doing so allows for a more nuanced view of local population transition, as, in many locations, a less heterogeneous population is succeeded a more diverse youth population. This transition is seen in particular in Figure 2c, which shows areas of the country evolving towards higher levels of diversity as well as those areas in which the under-18 population is less diverse than the adult. The shift-share analysis distinguishes between youth and adult cohorts, as well, and shows how outcomes within race/ethnicity groups can vary by age cohort across states. It is beyond the scope of this paper to address what factors would lead some areas to see increases in adult Hispanics and others youth Hispanics, but clearly the impacts of these different growth trends could be vastly important for both policy and demographic research.

The shift-share application to population change presented above is novel, although the full potential of the technique to describe demographic change remains untapped; future research efforts that emphasize the age cohort connections between youth and adults could be quite elucidating. In spite of the fact that the numbers produced here can be difficult to interpret, one advantage of the technique is the spotlight it shines on differential growth rates for cohorts and geographic units. The fact that some cohorts are growing and others shrinking at the national level is almost self-evident; where shift-share analysis is helpful is in forcing a comparison of those growth rates to both the national growth rate and state level rates for each cohort. Thus we are able to perceive that, for example, Arizona's gains in the adult white cohort stem not only from the cohort's growth at the national level, but also the fact that that cohort was growing even faster in Arizona than across the nation, on average. Furthermore, the shift-share analysis allows us to state categorically that, yes, some states

(e.g. Illinois or Mississippi) appear to be growing simply because the U.S. is growing. Other states, such as California or Hawaii, appear to benefit from a “demographic advantage” and a good portion of their growth can be attributed to the extent to which their populations are already in cohorts (e.g. Hispanics or adult Asians) that are growing fast. Finally, there are the states like Florida or Texas that are all-round winners, or demographic powerhouses, in the sense that their population composition is distributed in such a way as to allow them to benefit from national and cohort growth trends, as well as region-specific cohort growth factors.

There are three final, broader points that the analysis above suggests. First, given their population make-up, there are states that are, for now, on the wrong side of demographic trends. These states, located in the Midwest, South, or New England, have been racially and ethnically homogeneous and now find a sizeable portion of their populations in cohorts that have ceased growing rapidly or at all. For these states to grow, they will likely need to attract more members from growing cohorts, particularly Hispanics. Not every state can hope to be Arizona or Nevada and propel growth by attracting white, non-Hispanics. Second, the enormous Hispanic population increases in recent years were driven in part by immigration. Impacts of the economic recession and increasing anti-immigration sentiment are now being felt and it will be interesting to observe the geographic and demographic impacts of an immigration slowdown. Third and finally, demographic analysis has become habituated to equating minority population change with increases in diversity. Now that some areas become minority white, it becomes apparent that diversity really must refer to the mix of groups in an area – a lack of white population can also be a lack of diversity. The typical U.S. state or county is not white, but rather quite diverse.

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Figure 1.
Sources of Population Change, U.S. States, 2000-2010

Figure 2.

Diversity in the Under-18 Population (a), Youth Diversity Hotspots (b), and (c), Comparison of Youth and Adult Diversity, Counties, 2010

Source: United States Census, 2010.

Figure 3.
Coefficient of Specialization, U.S. Counties, 2010
Source: United States Census, 2010.

Figure 4.

Selected Cross-Comparisons of Differenced Homothetic and Actual Populations

$$(P_i^r - HP_i^r)$$

Homothetic and actual population are normalized by total 2000 population to allow comparability across states.

Figure 5.
Shift-Share Component Contributions to Population Change, U.S. States, 2000-2010

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Table 1

State Population Change, 2000-2010

State	Population Change, number	Population Change, percent	State	Population Change, number	Population Change, percent
Alabama	332,636	7.48	Missouri	393,716	7.04
Alaska	83,299	13.29	Montana	87,220	9.67
Arizona	1,261,385	24.59	Nebraska	115,078	6.72
Arkansas	242,518	9.07	Nevada	702,294	35.15
California	3,382,308	9.99	New Hampshire	80,684	6.53
Colorado	727,935	16.92	New Jersey	377,544	4.49
Connecticut	168,532	4.95	New Mexico	240,133	13.20
Delaware	114,334	14.59	New York	401,645	2.12
District of Columbia	29,664	5.19	North Carolina	1,486,170	18.46
Florida	2,818,932	17.64	North Dakota	30,391	4.73
Georgia	1,501,200	18.34	Ohio	183,364	1.62
Hawaii	148,764	12.28	Oklahoma	300,697	8.71
Idaho	273,629	21.15	Oregon	409,675	11.97
Illinois	411,339	3.31	Pennsylvania	421,325	3.43
Indiana	403,317	6.63	Rhode Island	4,248	0.41
Iowa	120,031	4.10	South Carolina	613,352	15.29
Kansas	164,700	6.13	South Dakota	59,336	7.86
Kentucky	297,598	7.36	Tennessee	656,822	11.54
Louisiana	64,396	1.44	Texas	4,293,741	20.59
Maine	53,438	4.19	Utah	530,716	23.77
Maryland	477,066	9.01	Vermont	16,914	2.78
Massachusetts	198,532	3.13	Virginia	922,509	13.03
Michigan	-54,804	-0.55	Washington	830,419	14.09
Minnesota	384,446	7.81	West Virginia	44,650	2.47
Mississippi	122,639	4.31	Wisconsin	323,311	6.03
			Wyoming	69,844	14.14

Source: U.S. Census Bureau.

Table 2
The U.S. Population by Race/Ethnic Category, 2000 and 2010

	2000		2010	
	Total	Percent	Total	Percent
Total Population	281,421,906		308,745,538	
Hispanic	35,305,818	12.55	50,477,594	16.35
White	194,552,774	69.13	196,817,552	63.75
Black/African-American	33,947,837	12.06	37,685,848	12.21
American Indian or Alaska Native	2,068,883	0.74	2,247,098	0.73
Asian	10,123,169	3.60	14,465,124	4.69
Native Hawaiian or Pacific Islander	353,509	0.13	481,576	0.16
Some Other Race	467,770	0.17	604,265	0.20
Two or More Races	4,602,146	1.64	5,966,481	1.93

Source: U.S. Census Bureau. Aside from the "Two or More Races" category, all others are for one race alone. Apart from the Hispanic category, all other groups are non-Hispanic.

Table 3
Coefficient of Localization

	2000		2010	
	State	County	State	County
Hispanic	38.31	45.55	33.18	39.24
Under 18	37.95	45.73	31.69	37.97
18 and Up	38.67	45.59	34.36	40.18
White	8.54	13.02	9.87	14.58
Under 18	10.49	16.41	12.23	18.50
18 and Up	8.00	12.25	9.29	13.87
Black/African-American	25.05	40.65	24.52	39.43
Under 18	24.99	41.29	24.39	40.40
18 and Up	25.08	40.43	24.61	39.28
American Indian or Alaska Native	46.04	53.92	46.44	54.72
Under 18	52.12	60.93	52.21	61.83
18 and Up	43.04	50.73	44.10	52.04
Asian	35.24	44.21	32.24	41.38
Under 18	33.41	43.05	28.84	39.60
18 and Up	35.96	44.83	33.30	42.19
Native Hawaiian or Pacific Islander	58.34	60.42	56.17	59.94
Under 18	61.56	64.27	57.95	63.20
18 and Up	56.90	58.85	55.51	58.86
Some Other Race	24.24	29.37	23.22	28.16
Under 18	16.53	23.83	16.95	23.16
18 and Up	30.63	35.72	28.51	33.21
Two or More Races	18.35	22.62	14.76	18.11
Under 18	17.72	22.04	13.37	18.88
18 and Up	19.92	24.34	17.00	20.42

Aside from the "Two or More Races" category, all others are for one race alone. Apart from the Hispanic category, all other groups are non-Hispanic.

Table 4
“Homothetic” versus Actual Population Distribution, Michigan

	Actual Population Distribution	Homothetic Distribution	Difference
Hispanic			
Under 18	123,381	435,868	-312,487
18 and Up	200,496	810,960	-610,464
White			
Under 18	1,879,122	1,554,821	324,301
18 and Up	5,927,569	5,315,830	611,739
Black			
Under 18	449,091	374,703	74,388
18 and Up	952,956	824,169	128,787
American Indian or Alaska Native			
Under 18	16,571	24,223	-7,652
18 and Up	36,850	48,840	-11,990
Asian			
Under 18	47,432	85,472	-38,040
18 and Up	127,879	272,029	-144,150
Native Hawaiian/Pacific Islander			
Under 18	574	3,867	-3,293
18 and Up	1,571	8,617	-7,046
Some Other Race			
Under 18	5,915	6,792	-877
18 and Up	5,550	9,727	-4,177
Two or More Races			
Under 18	73,681	67,317	6,364
18 and Up	89,806	95,208	-5,402
Total	9,938,444	9,938,444	0

Aside from the “Two or More Races” category, all others are for one race alone. Apart from the Hispanic category, all other groups are non-Hispanic.

Table 5

Detailed Shift-Share Results, Michigan, 2000-2010

Cohort	National Effect			Cohort Mix Effect			Regional Effect			Regional Cohort Mix Effect			Total Pop. Change
	Expected	Specialization	Total	Expected	Specialization	Total	Expected	Specialization	Total	Expected	Specialization	Total	
Hispanic													
Under 18	42,319	-30,340	11,979	126,792	-90,901	35,891	-44,723	32,063	-12,660	46,827	-33,572	13,255	48,466
18 and Up	78,737	-59,271	19,466	287,945	-216,755	71,189	-83,209	62,637	-20,572	-24,547	18,478	-6,069	64,015
White													
Under 18	150,960	31,487	182,446	-303,186	-63,238	-366,424	-159,534	-33,275	-192,809	88,455	18,450	106,905	-269,881
18 and Up	516,121	59,395	575,516	-283,914	-32,672	-316,586	-545,434	-62,768	-608,202	342,937	39,465	382,402	33,129
Black/African-American													
Under 18	36,380	7,222	43,603	-45,141	-8,962	-54,103	-38,447	-7,633	-46,079	-5,894	-1,170	-7,064	-63,644
18 and Up	80,020	12,504	92,524	60,750	9,493	70,243	-84,564	-13,214	-97,779	-16,981	-2,654	-19,635	45,353
American Indian or Alaska Native													
Under 18	2,352	-743	1,609	-3,715	1,173	-2,541	-2,485	785	-1,700	958	-303	656	-1,977
18 and Up	4,742	-1,164	3,578	2,915	-716	2,199	-5,011	1,230	-3,781	1,624	-399	1,225	3,221
Asian													
Under 18	8,299	-3,693	4,605	18,394	-8,187	10,208	-8,770	3,903	-4,867	6,957	-3,096	3,861	13,807
18 and Up	26,412	-13,996	12,416	100,232	-53,113	47,118	-27,912	14,791	-13,121	2,040	-1,081	959	47,372
Native Hawaiian/Pacific Islander													
Under 18	375	-320	56	546	-465	81	-397	338	-59	-1,178	1,003	-175	-97
18 and Up	837	-684	153	2,765	-2,261	504	-884	723	-161	-2,048	1,675	-373	122
Some Other Race													
Under 18	659	-85	574	432	-56	376	-697	90	-607	-1,968	254	-1,714	-1,371

Cohort	National Effect			Cohort Mix Effect			Regional Effect			Regional Cohort Mix Effect			Total Pop. Change
	Expected	Specialization	Total	Expected	Specialization	Total	Expected	Specialization	Total	Expected	Specialization	Total	
18 and Up	944	-406	539	2,785	-1,196	1,589	-998	429	-569	-3,131	1,345	-1,786	-228
Two or More Races													
Under 18	6,536	618	7,154	24,661	2,331	26,992	-6,907	-653	-7,560	-3,278	-310	-3,588	22,998
18 and Up	9,244	-524	8,719	7,741	-439	7,302	-9,769	554	-9,215	-3,070	174	-2,896	3,911
Total	964,937	0	964,937	0	-465,963	-465,963	-1,019,741	0	-1,019,741	427,704	38,259	465,963	-54,804

Aside from the "Two or More Races" category, all others are for one race alone. Apart from the Hispanic category, all other groups are non-Hispanic.

Table 6

Shift-Share Results, U.S. States

State	National Effect	Cohort Mix Effect	Competitive Effect			Total Population Change 2000-2010
			Total	Regional Effect	Regional Cohort Mix Effect	
Alabama	431,775	-208,630	109,491	-99,139	208,630	332,636
Alaska	60,870	-15,685	38,114	22,429	15,685	83,299
Arizona	498,140	202,512	560,733	763,245	-202,512	1,261,385
Arkansas	259,564	-135,677	118,631	-17,046	135,677	242,518
California	3,288,644	3,799,197	-3,705,533	93,664	-3,799,197	3,382,308
Colorado	417,615	20,824	289,496	310,320	-20,824	727,935
Connecticut	330,651	-74,709	-87,410	-162,119	74,709	168,532
Delaware	76,081	-25,842	64,095	38,253	25,842	114,334
District of Columbia	55,542	20,459	-46,337	-25,878	-20,459	29,664
Florida	1,551,751	222,422	1,044,759	1,267,181	-222,422	2,818,932
Georgia	794,834	-193,435	899,801	706,366	193,435	1,501,200
Hawaii	117,630	249,145	-218,011	31,134	-249,145	148,764
Idaho	125,632	-62,948	210,946	147,997	62,948	273,629
Illinois	1,205,806	-19,562	-774,905	-794,467	19,562	411,339
Indiana	590,362	-349,406	162,360	-187,045	349,406	403,317
Iowa	284,121	-191,275	27,186	-164,090	191,275	120,031
Kansas	261,022	-108,269	11,947	-96,322	108,269	164,700
Kentucky	392,421	-270,996	176,174	-94,823	270,996	297,598
Louisiana	433,899	-168,596	-200,907	-369,503	168,596	64,396
Maine	123,784	-97,466	27,120	-70,346	97,466	53,438
Maryland	514,243	-93,462	56,285	-37,177	93,462	477,066
Massachusetts	616,442	-181,882	-236,028	-417,910	181,882	198,532
Michigan	964,937	-465,963	-553,778	-1,019,741	465,963	-54,804
Minnesota	477,639	-273,047	179,854	-93,193	273,047	384,446
Mississippi	276,192	-117,565	-35,987	-153,553	117,565	122,639
Missouri	543,247	-327,218	177,688	-149,531	327,218	393,716
Montana	87,595	-61,244	60,869	-375	61,244	87,220

State	National Effect	Cohort Mix Effect	Competitive Effect			Total Population Change 2000-2010
			Total	Regional Effect	Regional Cohort Mix Effect	
Nebraska	166,149	-89,141	38,071	-51,071	89,141	115,078
Nevada	194,013	66,040	442,241	508,281	-66,040	702,294
New Hampshire	119,984	-88,919	49,619	-39,300	88,919	80,684
New Jersey	816,961	106,412	-545,828	-439,417	-106,412	377,544
New Mexico	176,614	197,944	-134,425	63,519	-197,944	240,133
New York	1,842,450	442,430	-1,883,235	-1,440,805	-442,430	401,645
North Carolina	781,519	-266,121	970,772	704,651	266,121	1,486,170
North Dakota	62,352	-46,644	14,683	-31,961	46,644	30,391
Ohio	1,102,292	-669,291	-249,637	-918,928	669,291	183,364
Oklahoma	335,029	-116,941	82,609	-34,332	116,941	300,697
Oregon	332,188	-99,866	177,353	77,487	99,866	409,675
Pennsylvania	1,192,384	-628,875	-142,184	-771,059	628,875	421,325
Rhode Island	101,783	-27,465	-70,070	-97,535	27,465	4,248
South Carolina	389,532	-157,465	381,285	223,820	157,465	613,352
South Dakota	73,289	-53,532	39,579	-13,953	53,532	59,336
Tennessee	552,380	-301,728	406,170	104,442	301,728	656,822
Texas	2,024,531	1,543,072	726,138	2,269,210	-1,543,072	4,293,741
Utah	216,821	-96,152	410,046	313,895	96,152	530,716
Vermont	59,112	-46,071	3,873	-42,198	46,071	16,914
Virginia	687,263	-175,835	411,081	235,246	175,835	922,509
Washington	572,268	-102,164	360,315	258,151	102,164	830,419
West Virginia	175,575	-132,407	1,482	-130,925	132,407	44,650
Wisconsin	520,766	-302,744	105,288	-197,455	302,744	323,311
Wyoming	47,942	-26,219	48,121	21,902	26,219	69,844