Segregation and Urban Form: Towards an Understanding of Dynamics Between Race, Population Movement, and the Built Environment of American Cities

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Abstract

There has been increased attention to urban form in the recent segregation literature, showing population density and changes in housing structure as having crucial influence on segregation patterns (Spielman and Harrison 2013; Rothwell and Massey 2010; Watson 2006). However, there has been little work examining areas with newly constructed housing, looking at what kinds of people move to these places, and the consequences of this movement for residential segregation across the built environment of the United States. This project addresses this gap, using 2000 and 2010 decennial Census data to isolate areas of population growth, and understand their racial compositions in context with urban form. Three theoretical perspectives on segregation are used to understand these dynamics with previous understandings of segregation dynamics: Spatial Assimilation, Place Stratification, and Group Threat. It is found that growing areas are generally less segregated than older comparable areas. The implications of the results are discussed, and future avenues of research into segregation and urban form are identified.

Keywords: residential segregation, built environment, urban growth, American cities

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Introduction

In 1993, Douglas Massey and Nancy Denton published *American Apartheid*, and completely changed the way scholars understood the social causes and effects of residential segregation. They claimed that, since the passage of the Civil Rights Act in 1964, mainstream discourse had ignored the extreme separation of black and white neighborhoods, considering it "an unfortunate holdover from a racist past, one that is fading progressively over time" (p. 1). Massey and Denton instead argued that the isolation of blacks in central city areas is manufactured by contemporary white-dominated power structures, and that the associated troubles of these neighborhoods (high crime rate, poverty, etc.) and their consequences on individuals are a direct result of this social alienation. What was once the goal of overt racism had quietly become the result of structural violence and covert discrimination aimed to maintain a racial social order. Suddenly, the Civil Rights Act looked much less effective at creating equality for blacks than had been assumed. To quote the authors:

> "A racially segregated society cannot be a race-blind society; as long as U.S. cities remain segregated—indeed, hypersegregated—the United States cannot claim to have equalized opportunities for blacks and whites. In a segregated world, the deck is stacked against black socioeconomic progress, political empowerment, and full participation in the mainstream of American life" (p. 148).

In the following two decades, much research has been published that shows increasing integration between white and black populations in U.S. cities, as well as with the rapidly growing populations of Hispanics and Asians (Charles 2003). However, despite marked improvements in race relations, covert racism and discrimination is still rampant in American society, particularly against blacks. In his book *Racism Without Racists*, Eduardo Bonilla-Silva identifies a new social ideology that he calls "color-blind racism." He claims that despite new ideals and rhetoric that decry racism and promote acceptance, whites still cling to their social

privilege and exclude minority groups. Bonilla-Silva puts much of the blame for this phenomenon on segregation. Whites experience the highest levels of segregation and isolation of any racial group, and this "promotes a sense of group belonging (a white culture of solidarity) and negative views about nonwhites" (p. 152). Bonilla-Silva exposes the huge social distance remaining between white people and the black people in their lives, and that most whites "do not interpret their racial isolation and segregation from blacks as racial" (p. 171). His work shows that these divisions have deep roots in where people live, with physical distance maintaining social distance across race. American society is still very racialized, and it seems unlikely to change as long as this segregation persists in our cities.

In the wake of suburbanization, urban decay, and "white flight" out of major American cities in the mid-to-late 20th century, patterns of residential segregation have been mainly understood two ways: as a result of racial discrimination in the housing market and other structural barriers (Place Stratification), or as a pattern necessitated by socioeconomic and cultural differences of immigrant groups to mainstream society (Spatial Assimilation). However, older ideas about how segregation changes over time have become complicated, as American cities have undergone much change over the past two decades. An explosion in population growth coincided with a massive increase in American housing stock. Suburbs have continued to sprawl, and construction in central city areas has brought new populations to previously shrinking and depressed neighborhoods. Hispanic and Asian immigrants continue to flock to the United States at high rates, radically affecting the urban social landscape.

Considering the defining history of racism and racial segregation in the U.S., recent diversification, and the concurrent booms in housing construction and population, the question must be asked: who is moving to these new areas? Will the processes that excluded minorities in

the past still have sway over this new growth? Do new neighborhoods have less segregation than older neighborhoods that have those historical legacies? There has been little research on how changes in the urban environments of cities affect segregation patterns. My work aims to fill this gap by isolating growing and shrinking parts of American metropolitan areas in context with their built environment, and analyzing their populations, and determining their significance to overall patterns of segregation in cities and the country as a whole.

This thesis contains five chapters. In the first chapter, I provide a review of the literature that connects recent segregation trends to various social and economic dynamics that shape housing outcomes and population movements. This section contains background into current patterns (growth and migration, spatial contexts, income dynamics), and gives examples of evidenced connections between the built environment of cities and segregation. It also has overviews and evidence for three main theoretical models that explain segregation dynamics. In the second chapter, I review my data specifications and methods for the project, and introduce key concepts for my analysis. In the third chapter, I provide results of my analysis, interpret them into patterns of population change and segregation, and connect them to previous work in the literature. In the fourth chapter, I reflect on my research process and address shortcomings present in my project, as well as expose future avenues of research. In the final chapter, I summarize my conclusions and the relevance of my work to the segregation literature.

Chapter I – Literature Review

Background on Segregation

Since white flight from central city neighborhoods and discriminatory housing policies created an apex of black-white segregation in 1970, the situation has slowly, but steadily improved. Metropolitan-level statistical indices show decreasing segregation between the groups for each decade, starting at 1980 (Logan and Stults 2011). This decrease coincides with an improvement in the attitudes of whites towards having blacks in their neighborhoods (Farley et al 1993; Farley and Frey 1994); however, whites still generally preferred to live in neighborhoods comprised mostly of other whites, and on average remain the most segregated race group in the United States (Logan and Stults 2011). The large-scale immigration of Asians and Hispanics has complicated the pattern of inclusion for minorities in predominately white neighborhoods. Since 1980, these two groups' percentage share of the total U.S. population has more than tripled (Lee et al 2013). This pattern has both created new ethnic-dominated neighborhoods, segregating minority groups from the general population (Logan et al 2002), and increased diversity in 97-98% of cities and towns nationwide (Lee et al 2013). Compared to blacks, Asians and Hispanics face significantly lower rates of segregation. However, quantitative measures show that segregation for those groups is increasing; this has been attributed to their rapidly growing immigrant populations, who tend to settle with co-ethnics in enclave neighborhoods (Charles 2003; Logan et al 2004). The number of highly diverse neighborhoods in the country has increased (though they are still exceedingly rare), and the diversity of neighborhoods dominated by a single racial group increased significantly in metropolitan areas across the country between 2000 and 2010 (Halloway et al 2012).

These trends differ greatly by region and metropolitan area, and much work has gone into detailing this variation. Cities in the Western and Southern areas of the country have experienced the largest decreases in residential segregation over the past few decades (Farley and Frey 1994; Iceland et al 2013). These are the fastest growing metropolitan areas in the country, and contain the bulk of recent housing construction, suggesting that new residential developments might be less segregated than older ones (Farley and Frey 1994). However, this trend does not affect all racial groups in the same way. Iceland and colleagues (2013) show that migration of blacks from the Midwest and Northeast regions of the U.S. to the South explains very little of this decrease in segregation, and none in the West, where there was very little net change in black population for those cities.

Nonetheless, the racial composition of metropolitan areas is very important in determining their segregation levels. South and colleagues (2011) find that blacks face greater segregation from whites in cities with large minority population shares, and will have more white neighbors in metros with small black populations. Local factors are also important; whites on average have more black neighbors in metropolitan areas with high rates of government employment and new housing construction, and fewer black neighbors in metropolitan areas with high levels of municipal fragmentation[1] (South et al 2011). Levels of immigration also vary greatly across metro area, which also affects segregation. Metropolitan areas that experienced the most immigrant settlement saw the most increases in diversity and populations mixing (Lee et al 2013).

A major historical aspect to racial segregation in the U.S. has been the city-suburb divide. Since mass suburbanization started in the 1940s and 1950s, blacks and other minorities have

[1] Municipal fragmentation refers to the division of suburbs into multiple city governments, which geographically divides public services and the tax bases that maintain them.

dominated central cities, while the more affluent white population dominated the suburbs. However, more and more minorities have been moving into suburban neighborhoods. It had been previously theorized that this movement would drastically reduce segregation levels. However, it seems increasingly likely that increased suburban moves for minorities do not necessarily imply increased integration. Charles (2003) notes that suburban segregation patterns mirror those of the metropolitan area as a whole, meaning that minorities are most likely to move to suburban neighborhoods where their racial group is already dominant. These minority suburbs are generally less affluent than suburbs dominated by whites (Charles 2003), but Logan and colleagues (2002) provide evidence that living in these neighborhoods is not merely an economic outcome, but can be motivated by a desire to live with in-group members, particularly for recent, affluent immigrants. However, suburban segregation is still a function of economics and race. Fischer (2008) shows that while blacks that move to the suburbs generally experience less segregation, this dynamic has little to do with the overall decrease in black segregation. In most regions, changes in central cities are responsible for this shift, except for the West, where suburbs and cities see similar levels of segregation change (Fischer 2008). In fact, many suburban municipalities are now facing the same problems of minority segregation and urban decay that central cities have for decades, often in older "inner-ring" suburbs closest to the urban core (Orfield 1997).

A final important structural aspect to segregation in the U.S. is the well-documented income disparity across racial groups. While the theory that this disparity is completely responsible for racial segregation has been disproven (Charles 2003), income has significant impact on the dynamics that form segregation patterns. In fact, segregation by income itself has been increasing over the past few decades, and especially since 2000 (Reardon and Bischoff

2011). This pattern has occurred simultaneously with quickly growing income inequality and a shrinking middle class, and there is much scholarly work showing that income inequality actually encourages residential sorting by income (Watson et al 2006; Bjorvatn and Cappelen 2001). Watson (2009) finds that this type of residential sorting occurs within racial groups, and blacks experience the highest within-group income segregation due to an explosion of distance between the richest and poorest of the population. She even goes so far as to suggest that income may be replacing race as the dominant form of segregation.

But ultimately, race is still crucial, and there is much evidence suggesting that racial income inequality is actually a product of racial segregation (Massey and Denton 1993). Minority dominated neighborhoods are consistently less affluent than white-majority areas, and affluent black and Hispanic households on average reside in poorer neighborhoods than white households of the same income (Logan 2011). Hispanics also face greater segregation in metropolitan areas with greater income inequality between Hispanics and whites (Logan et al 2004). However, blacks face the strongest obstacles to integration when income is considered. Fischer (2003) shows that low-income blacks face the highest segregation of any group, and that their levels of segregation decline at the slowest rate.

Evidence on the Built Environment

Changes in the built environment have an important place in the history of racial segregation in the United States. As American suburbs exploded in the 1950s and 1960s, the mass retreat of the white population to these areas (and related economic processes) caused black ghettos to grow enormously in central cities, resulting in extreme black-white segregation, the legacies of which are still visible (Massey and Denton 1993). The construction of public housing projects also played an important role, as poor blacks became extremely clustered in large

complexes. Often, historically black neighborhoods were demolished, displacing residents of stable neighborhoods into new areas of concentrated poverty, and resulting in a net loss of available housing for blacks to live in (Massey and Denton 1993). Unfortunately, there has been little research into how changes in the built environment over the previous two decades have affected segregation by race. Instead, there has been considerable work tying recent construction to increases in income segregation, with economic issues increasingly dominating the segregation literature since the Great Recession, and the concurrent rise in income inequality.

Watson (2006) examines how market demand for income segregation affects housing construction patterns across the country. She theorizes that rapidly growing metropolitan areas can adapt to new housing preferences easily, while the slow rate of construction in stagnant metropolitan areas makes adapting to dynamic preferences far more expensive (Watson 2006). This would mean that construction in those areas would only be available to the very affluent, and that that demographic would want a certain number of amenities in their residence. If those houses are constructed in the same area, the affluent that move there become segregated from other income groups. Indeed, Watson found that increasing segregation by income in slow growth cities also saw greater than expected housing construction. This was coupled with the finding that segregation persists more strongly in cities with older housing stock, as poorer households become trapped in neighborhoods left behind by the wealthy. Dwyer (2007) further explores this theory that poorer groups are restricted to older housing stock, and that wealthy people dominate newly constructed areas. She shows that the percentage of houses sold with more than 2000 sq ft skyrockets in the late 1980s, and that the percentage of homebuyers that were affluent also started increasing. Metropolitan areas with concentrated development also have greater segregation of the affluent population (Dwyer 2007).

This sort of evidence has created a policy focus towards fostering socially mixed neighborhoods by mixing housing types and tenure[2]. Bergsten and Holmqvist (2013) examine the results of this trend in Swedish cities, where public housing projects have led to the concentration of poor households. Their work identifies several barriers to the implementation of mixed housing policies, as homeowners often do not want rental units constructed nearby, and builders do not want to build houses to sell in rental-dominated areas. However, there was some success implementing the policies, and new construction lead to increased social mixing in 75% of Swedish cities, lending some credence to the theory despite the missing work on the links between housing structures and population structures (Bergsten and Holmqvist 2013).

Conversely, Rothwell and Massey (2010) show how municipal control of the built environment can cause increases in income segregation, particularly through maximum density zoning. The authors address the price inflations that these regulations create, severely restricting who can afford to move to those areas. Their models show huge discrepancies in income across density regulations, and even tie the history of density zoning to the desire of suburban dwellers to maintain the social character of their exclusive towns. In a 2009 paper, Rothwell and Massey also explore the effects of density zoning on racial segregation, concluding that these policies restrict minorities from those areas, especially blacks. This relationship exists on a gradient: as an area allows greater population density, the level of racial segregation declines (Rothwell and Massey 2009). Similarly, Huie and Frisbee (2000) find that the density of housing structures help explain variations of indices measuring various dimensions of racial segregation across metropolitan areas.

[2] Housing tenure refers to the financial arrangements of residence, e.g. renting vs. owning.

Spielman and Harrison (2013) provide additional evidence into the relationship between population density and segregation within metropolitan areas. The authors use a high-resolution historical spatial dataset of Newark, NJ in 1880 (capturing 100% of the city's population) to identify sorting dynamics, and build a framework for an agent-based Schelling model. Then, over multiple simulations, they change the amount space allowed for the agents to arrange themselves in a landscape, emulating various population densities metropolitan areas can exhibit. They find that, while maintaining social tendencies, reducing population density greatly magnifies patterns of ethnic segregation (the authors examine German, Irish, and "Yankee" populations). They admit that their model does not establish causation, but their work establishes some possible effects that urban form can have on segregation patterns and social tendencies.

Theoretical Models of Segregation

It should be noted that these theories are not intended to be all-encompassing or mutually exclusive definitions of behavior. Populations are really just aggregated individuals, and no single theory could ever succeed in explaining the choices and needs of every household. The following ideas are attempts to link segregation patterns with important, universal social forces and tendencies. Such theories are needed to explain the continued segregation by race, "despite the passage of antidiscrimination legislation, more favorable racial attitudes among whites, and the dramatic expansion of the black middle class" (Charles 2003). In fact, these models complement each other quite well, and can work together in interesting ways.

Spatial Assimilation is a theory that prioritizes socioeconomic differences across racial groups, with particular relevance to recent immigrant groups, as it is grounded in the sociologic literature of immigrant assimilation as a whole. It proposes that housing affordability is a major motivation for residential location. This means that living in a poorer, dense ethnic enclave might

actually be a benefit to many minority members, and with improvement their socioeconomic status, they will eventually move into better quality housing historically dominated by whites. Immigrant context is important, because people who are unfamiliar with a new culture and environment will tend to live with co-ethnics (language nativity is a major motivator). As these immigrants become more acculturated to the United States, eventually these people (or their children) will leave those ethnic neighborhoods for better opportunities.

Iceland and Scopilliti (2008) show broad support for spatial assimilation among immigrant populations. They separate blacks, Asians and Hispanics by nativity, and find that foreign-born members of these groups are more segregated from the non-Hispanic white population than U.S-born minorities. They also find that immigrants who have been in the U.S. longer are less segregated from whites. Much of this difference in segregation of minorities by nativity and U.S. experience is explained by various socioeconomic characteristics, like income, homeownership, and English language ability (Iceland and Scopilliti 2008). However, black immigrants are segregated at higher rates than other minority groups, something that socioeconomics cannot explain.

Alba and colleagues (2000) use locational attainment models to predict how socioeconomic variables affect outcomes of residential movement across racial groups. They link socioeconomic status, assimilation level, and suburban location to residence in affluent, white-dominated neighborhoods. True to spatial assimilation, this difference is greatly reduced for Asians and Hispanics of higher income residing in the suburbs (Alba et al 2000). Once again, however, blacks face the highest disadvantage in housing attainment, something that cannot be explained by any other variable. These dynamics for individuals are upheld by South and colleagues (2008) when looking at longitudinal data.

While the bulk of the literature finds that spatial assimilation does not explain segregation dynamics for blacks, there are some exceptions. Clark and Ware (1997) provide an important counterexample in their analysis of black integration and socioeconomic status for Southern California, reinforcing the importance of regional context for population patterns. They find that increases in income and education are crucial to explain black residential gains, and their work is an important reminder that even though national levels of black integration are lagging behind other racial groups, socioeconomic forces are still central in predicting residential gains for black households.

Still, there remains a stark racial divide in segregation dynamics that income and education cannot explain. The literature is very aware of the uniquely disadvantaged situation black Americans find themselves in, a discrimination that can only be chalked up to outright racism. As we will see, blacks have faced numerous structural barriers to economic prosperity and housing access (in addition to hostility from white-dominated areas and police) for decades. Most spatial assimilation papers acknowledge that the theory is too often inadequate to explain the continued segregation of blacks, as most of the black population is native born. There must be other factors causing this isolation.

Place Stratification (or Ethnic Stratification) holds that "the emergence of racially separate neighborhoods resulted from a combination of individual and institutional level actions" (Charles 2003). It "describes how powerful groups manipulate space to maintain their physical and social separation from groups they view as undesirable" (Pais et al 2012). Place stratification emphasizes that minorities are segregated against their will; the only way to integrate them with whites is to remove structural barriers that prevent them from turning socioeconomic improvement into housing improvement.

Pais, South, and Crowder (2012) find near-universal evidence for the "weak" version of the place stratification hypothesis in U.S. cities, where minorities are forced to pay more for residential gains than whites are. They find that the neighborhoods blacks and Hispanics move into are consistently "less white" than whites of similar income, even at the highest earnings levels. When the socioeconomic characteristics of destination neighborhoods are examined, the relationship becomes a little more complex, where outcomes vary by metropolitan area. For slightly more than half of U.S. cities, the "strong" version of place stratification is evidenced, where blacks and Hispanics are less able than whites to turn income into improved neighborhood socioeconomic status (Pais et al 2012). Additionally, some cities exhibited spatial assimilation in regards to socioeconomic trends, but these gains might still be racially segregated. Logan, Stults, and Farley (2004) also identify patterns consistent with place stratification for blacks. Their analysis of metropolitan level change showed that several population changes hypothesized to improve black segregation had no effect. The black population had no net movement toward less-segregated areas in 2000, metropolitan areas with a smaller income gap between blacks and whites did not see increased integration, and emerging multiethnic diversity also had no effect (Logan et al 2004).

However, the most compelling evidence for place stratification is found when looking at the structural barriers themselves. In his lit review on the causes of black segregation, Dawkins (2004) details many studies investigating five major hypotheses. Consistent with place stratification, he finds that differences in socioeconomics do not explain nearly enough of the discrepancy in housing, and he points to racial prejudice from whites and discrimination in the housing market as the main forces preventing blacks from realizing housing gains with income (Dawkins 2004).

Ross and Turner (2005) find that there have been improvements in the pervasiveness of racial discrimination by real estate agents and rental offices; however, some concerning trends have not changed. Blacks still face racial steering in the housing market, where agents restrict the types and locations of housing they show black clients based solely on their race, severely limiting the places they even know are available. Very recent scholarship has shown that this pattern is still continuing. Hanson and Hawley (2014) ran an experiment involving emailing landlords about available properties in a range of cities and neighborhoods. The researchers sent each landlord two emails: one from a commonly white-associated name, and one from a commonly black-associated name. They found that blacks face increased discrimination compared to whites in a variety of neighborhoods: mixed race neighborhoods, neighborhoods with very high or very low vacancy rates, neighborhoods with rents near or above the city median, or neighborhoods located near the city center or in inner suburban areas (Hanson and Hawley 2014). Hispanics also face harsh discrimination in the housing market, particularly in their access to rental housing and receiving financial assistance. (Ross and Turner 2005).

White acceptance and neighborhood preference also help determine the kinds of neighborhoods available to minorities, and Farley and colleagues (1993) provide detailed insight into how those attitudes are changing. Their work revisits a classic 1978 Detroit survey quantifying whites' ideal neighborhood racial compositions, examining how those preferences had changed in the past fifteen years. Unsurprisingly, there was extreme prejudice against blacks in 1978. These tensions have since improved, and whites are generally more accepting of blacks moving into their neighborhood (Farley et al 1993). However, racial bias still exists in these attitudes. Krysan (2002) does her own analysis of multi-city survey data, and finds that whites who hold negative racial stereotypes are the most likely to claim they would move out of their

neighborhood if its black percentage suddenly rose. Krysan also identifies that region is paramount in determining overall racial attitudes and tendencies to stereotype. Whites in the Los Angeles area are "about twice as likely to make disparaging stereotypical comments about the characteristics of Latinos than about Asians or African Americans" (Krysan 2002).

As previously mentioned, these two theories are both well supported in the literature, and can work together. In fact, the clear trend of enhanced discrimination for blacks in terms of housing outcome has led to a variant of spatial assimilation that allows for differences in assimilation rates based on skin color, called "segmented assimilation" (Iceland and Scopilliti 2008). However, analyses in both spatial assimilation and place stratification ignore dynamics that are crucial in determining regional distributions: patterns of movement for non-Hispanic white populations. It is especially perplexing, considering the role that "white flight" (the tendency for whites to leave integrating neighborhoods and self-segregate) plays in the place stratification literature (Farley et al 1993; Krysan 2002; Dawkins 2004). Research focusing on whites as an independent racial group has only surfaced recently; previously, whites had only been used as a reference group to measure integration levels for minorities. This new development has resulted in a new theoretical explanation for continued segregation patterns, one that can actually explain previous discrepancies in theory and empirical trends.

Group Threat proposes that whites self-segregate as a means of protecting their racial privilege. In this understanding, segregation by race is an important tool for non-Hispanic whites to maintain its dominant social position. White residential isolation allows them to retain privileges like well-funded schools and safer neighborhoods, reinforcing historical patterns of socioeconomic attainment, and perpetuating the pattern of segregation. A key pattern in the theory is the emptying of white populations from neighborhoods with in-migrating minorities.

This perspective is the only one that considers the population dynamics of the ruling racial class, and as such is very relevant to changes in the built environment, as the affluent tend to settle those new areas (Watson 2006; Dwyer 2007).

DeFina and Hannon (2009) provide compelling evidence for the validity of group threat by quantifying such "threat" through metropolitan-level racial diversity. They find that white segregation levels are highest in metropolitan areas with a larger presence of a single minority group. This effect decays as metropolitan diversity increases (DeFina and Hannon 2009). These results manifest the white group identity proposed by Bonilla-Silva, and the consequences such behaviors and attitudes have on the greater social environment of U.S. cities. This pattern is consistent with one identified by Logan, Alba, and Leung in 1996, before group threat theory had been formulated. Iceland and Sharp (2013) find similar patterns, especially in metropolitan areas with larger black populations. Still, white integration with minority groups has been increasing steadily over the past few decades, and these results may be more indicative of historical patterns rather than current ones, as economic constraints have reduced move rates for the past two decades (Stoll 2013).

Group threat also helps explain previous inconsistencies in the literature. For example, Alba and colleagues (2000) found that their work with cross-sectional data predicting minority residential attainment supported spatial assimilation, but when they extended their analysis to longitudinal data, the models do not match their predictions. Minority groups were moving to neighborhoods that were less white-dominated than expected. If we look at this from the group threat perspective, we would predict the white populations in these minority destination neighborhoods to want to leave, reducing integration, and maintaining segregation patterns despite the spatial expansion of minorities. This process would also help explain the recent

prevalence of minority-dominated suburbs, and when the central city proximity common to these neighborhoods is considered (Orfield 1997), it suggests that new residential construction might be a main factor in this story of constantly retreating white populations.

Gaps in Research

The literature on segregation is filled with discussion and debate of trends, patterns, causes, and consequences of mass residential separation by race. These patterns have important interactions with income and other economic factors, spatial considerations, and social contexts. However, understanding these trends of change in context with the built environment of urban areas remains a major hole in the segregation literature. Galster and Cutsinger (2007) examine black-white segregation in context with land-use patterns, and make an important contribution to understanding sprawl patterns of development effect racial inequalities and access to housing. However, no research has tried to understand the social character of new, growing places and their populations in context with urban form and older parts of cities. My work attempts to fill this gap, and show how much there is yet to be uncovered in this area of research.

CHAPTER II – Data and Methods

Measuring Segregation

In their comprehensive review of segregation indices, Massey and Denton identified five different "dimensions" of segregation, i.e. ways to interpret residential distance across racial groups (1988). These dimensions are: (1) *evenness*, the representation of different groups across areas of the city (e.g. Census areal units); (2) *exposure*, the likelihood that different groups will encounter each other based on residential locations; (3) c*oncentration*, where minorities occupy less space to live relative to the majority group; (4) *centralization*, where minorities reside in or near the core of an urban area; and (5) *clustering*, which describes the overall distribution of a minority group across an urban area (Massey and Denton 1988). The paper analyses twenty different indices for measuring segregation, relating each of them to one of their five dimensions,

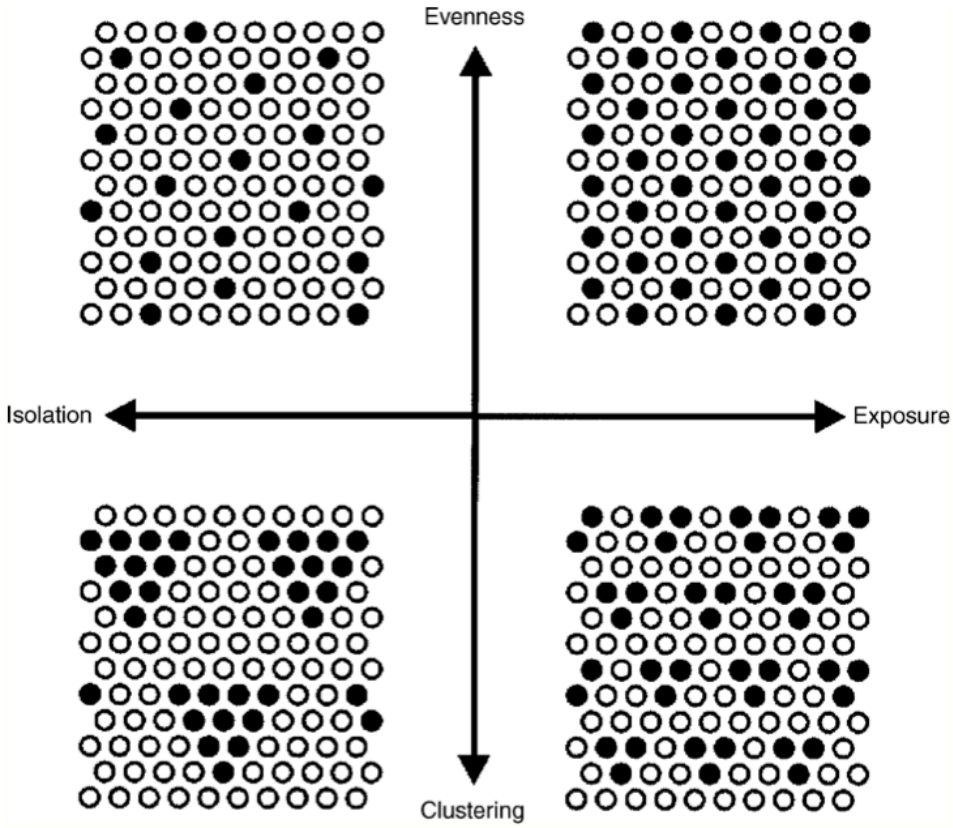


Figure 1: Visualization of the dimensions of spatial segregation, from Reardon and O'Sullivan (2004)

and then deciding on which is the most appropriate to represent that concept. Like Fischer (2003), my analysis focuses on the evenness of racial groups and their spatial representation across metropolitan areas. I use the entropy-based index first used by Theil (Thiel and Finizza 1971) to measure segregation of public schools, as it allows for the comparison of multiple groups. Reardon and Firebaugh (2002) conclude that the entropy index is ideal for these comparisons, due to its ease of decomposition and obedience of the principle of transfers[3].

Entropy and the Theil Index

The Theil Index is based a branch of mathematics called Information Theory (which is an alternate name for the index), which measures the amount of information given by the outcome of an event based on its probability (Theil 1972). Theil took this concept, and applied it to public school in Chicago, using the formula to compare the probable outcomes of an "event": a student in a given school being white or non-white (Theil 1972). This measure is called *Entropy*, and over the years has become interpreted as a measure of diversity within an area of a city (Massey and Denton 1988), as well as developed to allow for the analysis of more than two groups (Reardon and Firebaugh 2002). The entropy of a given area is calculated with the equation (Reardon and O'Sullivan 2004):

$$E = \sum_{m}^{M} \pi_m \log_M (\pi_m)$$

where $m \in M$ denotes the set of racial groups and π_m is the proportion of group m to the total population of the area. E has a minimum of 0 and a maximum value of log(M). The Census Bureau used seven different racial categories for respondents to identify themselves: White,

[3] "If an individual of group m is moved from organizational unit i to unit j, where the proportion of persons of group m is greater in unit i than in j ($\pi_{im} > \pi_{jm}$) then segregation is reduced" (Reardon and Firebaugh 2002).

Black or African American, American Indian and Native Alaskan, Asian, Native Hawaiian and Other Pacific Islander, Some Other Race[4], and Two or More Races. Additionally, the Census form allowed respondents to identify with a Hispanic ethnicity along with their racial classification. Clearly though, the segregation literature has frequently treated Hispanics as a segregated group with significant patterns of discrimination. Thus, I aggregate Hispanic origin across all races to create an additional category, making M=8 for this analysis. Thus, E has a theoretical range of 0 to log(8), or 0.903. A value of 0 occurs when the entire population consists of a single group (monoracial), and a maximum value means each group has the same number of people, representing perfect diversity. This index can be calculated for any kind of area or subarea, such as an entire metropolitan area or smaller units like Census Tracts and Census Blocks.

In fact, the Theil Index is calculated by comparing the entropy of an aggregate region with the entropies of its subregions. H represents the average difference in diversity of localities from the regional diversity (Massey and Denton 1988):

$$H = \sum_{r}^{R} \frac{t_r(E - E_r)}{ET}$$

where $r \in R$ is a set of subareas in region R, t_r and E_r are the total population and entropy of r respectively, and T and E are the total population and entropy of the region respectively. If the region being measure is the same as the reference region (and hence the same racial composition), H has a minimum of 0 and a maximum of 1. A result of H=0 means that the racial proportions of every subarea mirror the racial proportions of the region: perfect racial evenness. A result of H=1 means that every subarea is monoracial: absolute racial segregation. If the

[4] Some Other Race is a category for people who do not identify as any of the categories provided by the Census Bureau.

measured area is different than its reference (e.g. a subregion), then *H* has a theoretical minimum of -1 and maximum of 1. A negative result for *H* means that the subregion has a more diverse racial composition than its region as a whole, and can be considered "hyper-integrated" relative to its greater region (Reardon and O'Sullivan 2004).

H is a global index, meaning it represents an aggregate level of segregation across a region, like a metropolitan area. It does nothing to tell us about the distribution of local entropy measures. A major advantage of the Theil index is its decomposability across both areas and groups (Fischer 2003). This allows for the calculation of each subarea's contribution to the overall level of segregation in the region. The formula for calculating the local Theil decomposition is (Thiel and Finizza 1971):

$$I_r = \sum_{m}^{M} \pi_{rm} \log_M \left(\frac{\pi_{rm}}{\pi_m}\right)$$

where π_{rm} is the proportion of group *m* in subarea *r*, and π_m is the proportion of group *m* for the entire region. The larger a subarea's *I* value, the more it differs from the population composition of the greater region, and the more it contributes to regional segregation. My analysis interprets *I* as a direct measure of segregation for area *r*, with a larger value indicating that it is "more segregated."

It should be noted that the Theil Index and its local decomposition are relative measures dependant on the region being analyzed. Changing the region definition will also change the racial composition that subareas are compared to, returning different values and a different interpretation. This aspect of the Theil Index is useful, as one can understand the racial composition of localities in multiple geographic contexts.

Data

My analysis uses racial population data from the 2000 and 2010 US Censuses. I use one table from the 2010 Summary File 1a (Hispanic or Latino Origin by Race) and three tables from the 2000 Summary File 1b (Total Population, Not Hispanic or Latino Population of One Race by Race, and Total Hispanic or Latino Population). My analysis focuses on 2010; segregation indices are calculated on 2010 data. The 2000 data is used to find local population change and isolate urban growth, as well as breakdown changes in population by racial group. I will review this process in the following section.

For my study area, I analyze the fifty most populous Metropolitan Statistical Areas (MSAs) in 2010 according to Census data. This geographic extent covers about 166 million people, representing: 53.8% of the total US population, 46.9% of the non-Hispanic white US population, 64.2% of the black US population, 78.8% of the Asian US population, and 66.6% of the Hispanic US population. It is also important to know the overall racial composition of the study area: 55.7% White, 20.2% Hispanic, 14.5% Black, 6.8% Asian, 2% Two or More Races, 0.3% American Indian, 0.2% Other Race, and 0.1% Hawaiian or Other Pacific Islander. It is possible that this urban-centric view of the United States will ignore specific racial patterns of growth that might only happen in rural-dominated or resource-dependant areas (e.g. the recent rise of population in North Dakota). However, big cities have been ground zero for the racial segregation of the past fifty years, and this study attempts to understand the social character of new and growing areas in relation to neighborhoods with legacies of segregation, especially if those places are only a short distance apart.

Reconciling Census Boundaries

A major challenge of my analysis was identifying population growth in the 2010 data. The Census Bureau does not provide any data describing changes in population between Censuses, and Census boundaries are changed every decade, making one-to-one geographic comparisons across Censuses impossible at any scale smaller than counties (assuming there were no changes in counties, e.g. Broomfield County in Colorado[5]). However, the Census Bureau released Relationship Files detailing how boundaries changed between the 2000 and 2010 Censuses. These files connect unique identifying codes for units in 2010 and the units they were made from in 2000, essentially telling which units overlap spatially between the two decades.

To solve this problem, I used the "NetworkX" package in Python (Hagberg et al 2008) to create graphs to plot connections between 2000 and 2010 Census Blocks that share area, with each block represented as a node. This process yielded connected components, which are self-contained subgraphs that do not connect to any other nodes in the graph. I interpret these components as contiguous areas that can be directly compared across Censuses, and aggregate the block data into these new units. From there, I calculate total population change, as well as calculate change by racial group[6]. Because I can only measure population changes accurately for components, they are my main unit of analysis.

My study area consists of N=1,514,398 total populated components, removing any unit that doesn't have any people from the dataset. This representation of the data is actually rather similar to the original block data, with 1,166,466 components (~77%) consisting of only one block in 2010. Additionally, 177,718 components (~12%) consist of two combined blocks in

[5] Between 2000 and 2010, Broomfield, CO was turned into a new county, taking land from Adams, Boulder, Jefferson, and Weld Counties.
[6] "Two Races" was not an available racial identifier for the 2000 Census, so calculating changes in this category for 2010 is impossible.

2010, and only 63,501 components (~4%) are composed of three 2010 blocks. This leaves around 7% of components that combine more than four 2010 blocks, with a maximum of 717 blocks aggregating to a single component. A possible cause for this sort of occurrence in the data is the construction of an entire development of houses or condominiums in a previously unused spot of land. This is because, apart from county boundaries, Census Blocks are drawn along physical boundaries, like streets, railroad tracks, and water bodies like rivers and lakes (*Geographic Areas Reference Manual* 1994). This means newly constructed streets will always result in new blocks being drawn.

Qualitative Categories

Much of my analysis uses qualitative assignments for components based on population change and population density. Using classifications along these continuous variables allows for an effective descriptive analysis that contextually understands segregation as a function of both simultaneously. This strategy also allows for easy comparisons of different "kinds" of places based on population change and density, though there is surely significant variation of social and economic conditions within these categories.

I group components into three growth categories: growing, shrinking, and stable. Components that gained 50 or more people between 2000 and 2010 are growing, components that lost 50 or more people between 2000 and 2010 are shrinking, and any other component is considered stable. These thresholds are ultimately arbitrary; however, I use them for two reasons. First, it is large enough to ensure that a significant number of families have moved into or left an area. Almost every component fluctuated in population between 2000 and 2010, so it is necessary to exclude those whose net change was small in comparison to their overall population. Additionally, the thresholds are small enough to include a wide variety of growing

places, from rural developments and exurbs to central city neighborhoods and high-rise apartments. N=83,684 (~5.5% of study area) components are classified as growing, and N=44,642 (~3% of study area) are components classified as shrinking.

I analyze these growth categories across fifteen equal bins defined by population density, where Bin 1 consists of the least dense fifteenth of components, and Bin 15 consists of the densest fifteenth of components. Because population density is a direct product of the amount and variety of housing stock available in an area (e.g. a development of spread-out, large single-family homes vs. a cluster of condominium buildings), it can serve as a proxy for urban form. Population density at the block/component scale is particularly powerful, because it describes structures within areas defined by the street layout, picking up small-scale variation in housing types (e.g. an higher density apartment complex built next to single-family homes).

The scope of development these density bins represent is very broad. MSAs are collections of counties that contain a concentration of a metropolitan area's population or fit another definition, such as commuting patterns (*Geographic Areas Reference Manual* 1994). Because counties often contain rural land far beyond urbanized areas, this allows us to conceive these density bins as a qualitative "rural-to-urban" gradient, with Bin 1 representing farm land and Bin 15 representing the most urban settings, like high-rise apartments and densely-constructed townhouse rows. Large and spread out "McMansion" developments can be found in Bins 2 and 3, a wide range of single-family, "suburban" developments are found in Bins 4 through 12, and apartment and condominium complexes generally fall in Bins 10-15. These are not definitive descriptions, however, and there is a range of housing structures present in each of these bins. It should also be noted that, while the central parts of cities are the densest as a whole, it is a mistake to think of population density as an exact proxy for distance to the urban core.

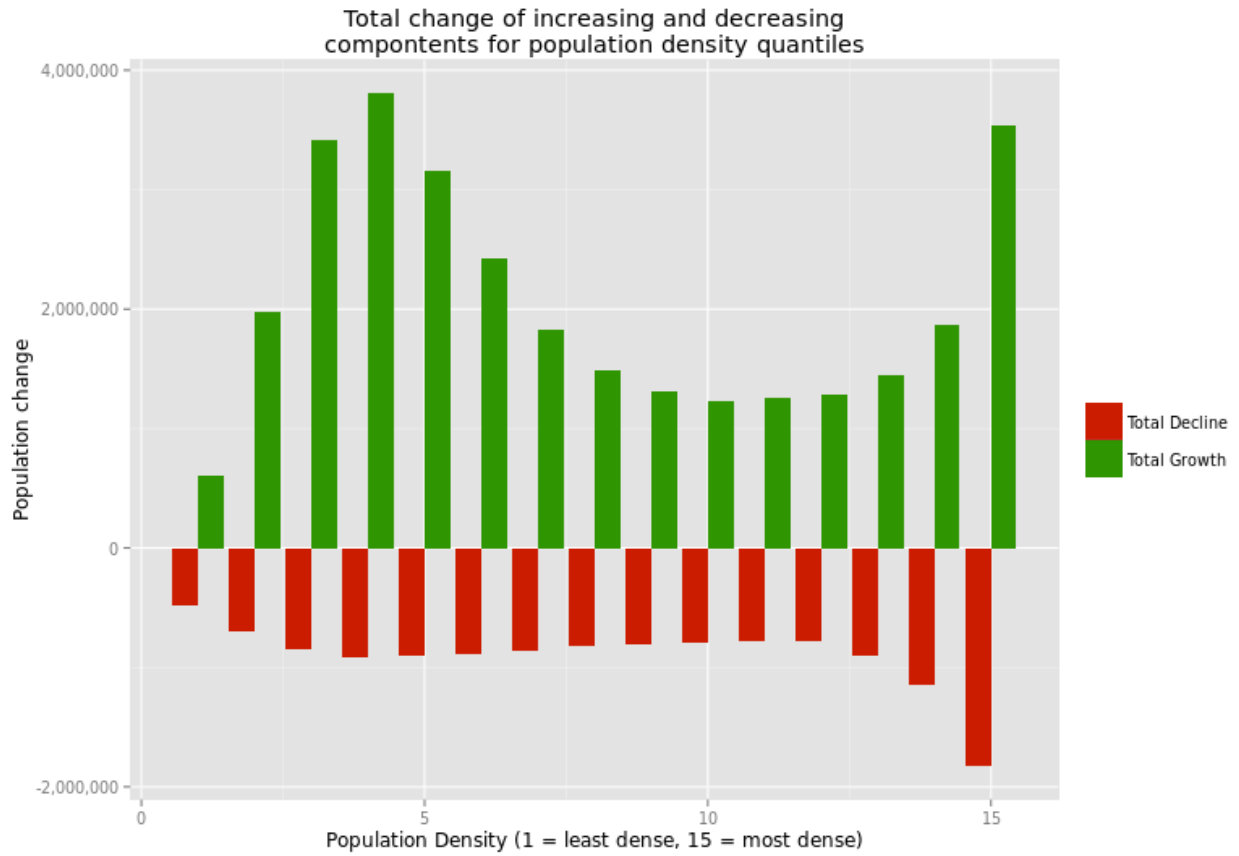
Many high-density developments have been built far from downtown areas since 2000. On the other hand, low-density housing can only be built in suburban and exurban areas, where there is no housing stock that needs to first be removed. Construction in highly dense and regulated central city areas has a huge associated cost (Watson 2006), and low-density housing would not generate the needed revenue to make development there financially viable.

CHAPTER III – Results and Discussion

Tracking Population Change

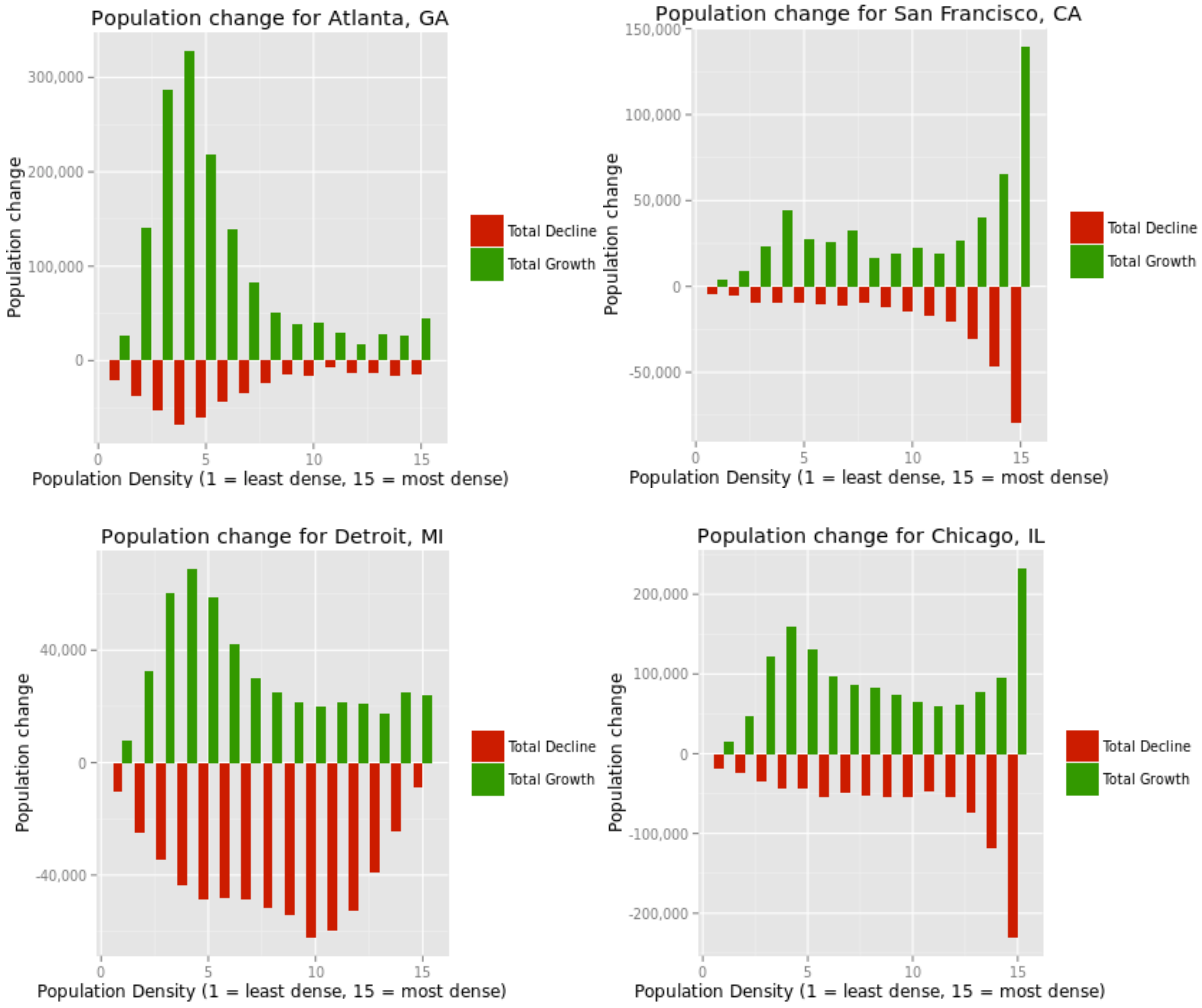
In order to understand how segregation is changing across urban form, we must first understand how the population is moving across it. Density bins are useful for conceptualizing this; there are places that are gaining and losing population in every single one, and aggregating this loss or decline can expose trends in certain kinds of development and movement. Figure 2 is a bar chart aggregating components to find the absolute population gain and loss in each Bin. It shows that two kinds of growth that dominated the years between 2000 and 2010: new construction in the densest parts of the city, and lots of new suburban developments in low- to mid-densities, with a lull in development activity in the densities between the two. There is also

Figure 2



a large amount of population loss occurring in Bin 15, creating a contradictory group where parts are under going a transformation of construction and population boom, while others are rapidly decaying. This makes us wonder if these phenomena are happening near each other in the same city, or if some cities account for the growth while others are in decline. Figure 3 helps show the variety patterns that cities can exhibit when growth is contextualized with the built environment. Chicago is particularly interesting, as it shows that cities can have stark divides in such close proximity, where some dense areas are thriving, while others are rapidly losing their population.

Figure 3



Racial Changes Across the Urban Environment

In order to meaningfully interpret a segregation index that compares eight different groups, it is helpful to understand how those groups are distributed across urban densities. Table 1 contains the percent of each racial group's population that lives in each density bin. The relative concentration of *every* minority group in the densest parts of cities is immediately visible. In contrast, the white population is distributed fairly evenly across the categories, with a slight bump in the lower densities. Considering how much larger the white population is compared to each minority, this means that whites retain majority status in the suburbs and exurbs (Bins 1-11) by a wide margin. This general result is not surprising, as the literature has detailed white dominance of less dense development at great length, and every theoretical framework for segregation predicts this sort of pattern.

However, a similar examination of population change since 2000 yields very interesting results. Table 2 contains each racial group's net change as a percentage of that group's

Table 1: Percentage of racial group's population in each density bin

Density Bin	White	Black	Am. Indian	Asian	Pac. Islander	Other Race	Two Races	Hispanic
1	3.2	0.7	4.5	0.2	0.9	0.7	1.3	0.7
2	7.5	1.8	7.8	1.4	2.1	2.4	3.7	1.9
3	9.5	4.1	7.1	4.0	3.5	4.6	6.0	3.2
4	9.7	5.9	6.7	5.8	4.8	5.6	7.1	3.9
5	8.8	6.0	6.3	6.1	5.0	5.2	6.9	4.2
6	7.6	5.5	5.4	5.5	4.8	4.9	6.3	3.9
7	6.6	5.1	5.2	5.0	4.6	4.6	5.7	3.9
8	6.1	5.0	5.3	4.6	5.0	4.3	5.5	3.9
9	5.8	5.2	5.4	4.7	5.5	4.3	5.5	4.2
10	5.6	5.4	5.8	5.2	6.2	4.6	5.8	4.7
11	5.4	5.9	5.9	5.7	6.9	4.7	6.3	5.8
12	5.3	6.7	6.2	6.7	8.3	5.6	6.9	7.4
13	5.1	8.4	7.3	8.7	11.4	7.3	7.8	10.2
14	5.4	11.8	9.0	11.7	15.5	11.0	9.6	14.4
15	8.4	22.5	12.0	24.7	15.4	30.2	15.5	27.9

population in that bin in 2000. The first thing to notice is that white population has been moving out of mid- to high-density parts of cities (Bins 7-15), and subsequently into low- to mid-density developments (Bins 1-6). This indicates that the Group Threat theory may be particularly relevant to these dynamics. Meanwhile, blacks, Asians, and Hispanics all made significant gains

Table 2: Percent change by race from 2000 across density bins

Density Bin	White	Black	Am. Indian	Asian	Pac. Islander	Other Race	Hispanic
1	3.0	-20.0	4.7	35.5	37.5	9.3	38.2
2	13.0	15.7	21.3	96.1	46.1	33.9	82.5
3	17.8	48.5	24.7	114.1	75.9	71.1	108.4
4	15.7	51.3	25.5	118.6	91.1	73.7	111.7
5	8.6	40.9	24.3	104.4	93.2	60.0	104.6
6	3.5	28.8	16.7	83.5	69.8	43.4	87.4
7	-1.7	22.0	12.4	65.2	58.1	38.8	74.7
8	-4.7	16.0	12.3	53.7	54.2	36.2	68.8
9	-6.8	13.7	7.0	43.7	49.4	33.2	59.5
10	-8.4	11.2	5.7	41.1	47.0	32.3	54.6
11	-9.6	9.5	2.0	39.3	47.2	29.1	51.3
12	-11.0	8.1	-4.3	33.9	35.4	28.3	44.1
13	-13.0	5.0	-4.1	26.5	26.7	28.6	36.4
14	-12.8	3.9	-7.0	26.1	24.8	22.6	27.9
15	-1.4	1.8	-2.9	27.5	6.5	12.8	14.8

Table 3: Net population change by race across density bins

Density Bin	White	Black	Am. Indian	Asian	Pac. Islander	Other Race	Hispanic
1	85350	-39838	1152	7166	553	247	63473
2	798874	60782	7769	77877	1545	2590	285071
3	1330887	328464	8055	242587	3529	8244	553565
4	1230120	481736	7788	359677	5372	10142	694814
5	649605	426083	6954	354577	5646	8395	717702
6	238452	299074	4415	286201	4600	6415	613970
7	-108842	225196	3270	224261	3994	5532	559621
8	-279450	166703	3295	183121	4157	4968	532284
9	-393503	150975	2022	162640	4283	4577	522102
10	-479229	131267	1782	171538	4617	4836	559500
11	-536082	123757	656	184435	5223	4593	662879
12	-603445	122605	-1600	193314	5123	5355	759710
13	-709588	96051	-1798	209194	5646	6992	915391
14	-735136	107789	-3836	277257	7212	8740	1061950
15	-108840	96159	-2029	608916	2208	14765	1215916

in lower density areas relative to 2000, with Asians and Hispanics both more than doubling their populations in Bins 3-5 in those ten years. While it appears from Table 2 that blacks might be moving to low-density suburbs at a slower rate than both Hispanics and Asians, Table 3 shows that the magnitude of population growth in those areas is very comparable to those groups: less than Hispanics, but greater than Asians. While these tables doesn't tell us anything about how those racial groups are sorted across growing components in those density bins, it encourages the idea that segregation is indeed lower in new, growing areas.

Table 3 also shows how dramatic Asian and Hispanic growth really is in the densest components, with Hispanics alone having a net gain of more than three million in Bins 13-15. Based on the work by Iceland and Scopilliti (2008) and the rates at which Hispanics are immigration to the U.S. (Charles 2003), it follows that these increases are the result of international migration, which fits Spatial Assimilation theory. However, this would mean that more Hispanic immigrants are moving into these neighborhoods than "assimilated" Hispanics are moving out, a possible indication that Hispanics face significant barriers to gaining housing in those suburbs. The stagnation of the black population in the highest densities relative to other races (white loss; Hispanic and Asian growth) despite continued suburban expansion is also important to note, providing evidence for the Place Stratification theory. Finally, the large net decrease in whites in Bins 8-14 correspond with significant increases in minority (particularly Hispanic) populations, providing even more evidence for dynamics described by the Group Threat theory.

These tables paint a general picture of how the social and urban landscape of U.S. cities changed between 2000 and 2010. However, some issues need to be addressed. First, there is some uncertainty in these interpretations, as my data has nothing to show how much of these

population increases are due to migration or natural birth rates. I address this further in Chapter 4. Additionally, calculating net change over geographically and racially diverse metropolitan areas hides local and regional patterns in these dynamics. To address this, Tables 4-11 show versions of Tables 2 and 3 for each of the four Census Bureau Regions: Northeast, Midwest, South, and West. Each region has its own racial patterns for population dynamics, and even these calculations mask patterns happening in each individual metro area.

The Northeast paints a bleaker picture for integration than the nation as a whole. Tables 4 and 5 show very similar findings. Whites are leaving the region as a whole, with only Bins 2-4 showing net increases. Hispanics and Asians are increasing their representation in the suburbs, but that growth is dwarfed by the populations moving into the densest parts of northeastern cities. Blacks are also moving into the suburbs, but at a much slower rate than both Hispanics and Asians (again highlighting racial differences in housing attainment). These tables suggest national patterns of growth might be making the Northeast more segregated, as whites tend to leave the region, and new minority populations flood the densest neighborhoods.

The Midwest (Tables 6 and 7) yields similar results to the Northeast, but with some important distinctions. First, low-density suburbs see much more white growth than in the Northeast, and there is even a net gain of whites in Bin 15, despite being very small. Blacks, Hispanics, and Asians are moving to the suburbs at comparable rates to each other and to the Northeast, thought this has a much smaller effect on black representation there. Most importantly, there is far less minority growth in the densest parts of these cities (though a significant number of Hispanics do appear). It's hard to infer large changes in segregation based on these tables. At the very least, minority representation in the suburbs is increasing, though patterns of white movement are larger, and probably contribute more to changes in segregation.

Table 4: Percent change by race from 2000 across density bins for the Northeast

Density Bin	White	Black	Am. Indian	Asian	Pac. Islander	Other Race	Hispanic
1	-7.2	-39.5	-14.2	16.4	18.0	-29.9	25.2
2	2.1	-13.5	2.5	65.4	-6.6	18.0	55.1
3	4.1	19.3	4.6	82.6	-0.9	42.3	72.8
4	1.1	22.6	11.3	71.9	1.6	36.2	72.2
5	-1.5	19.3	-1.8	66.3	-0.6	40.0	71.4
6	-4.0	15.2	10.4	53.3	5.2	7.3	68.3
7	-6.0	18.1	9.6	51.9	-0.4	9.1	67.0
8	-6.9	11.5	11.3	55.7	-14.9	19.3	63.0
9	-7.4	10.5	6.4	45.0	-23.8	60.1	63.5
10	-8.1	10.9	4.6	54.8	43.0	43.1	59.4
11	-8.1	10.2	8.1	48.7	2.3	50.9	64.4
12	-9.5	9.4	0.3	46.9	-16.8	45.9	59.0
13	-11.1	7.9	15.7	46.5	-13.3	57.1	59.3
14	-12.5	5.9	2.1	44.7	-19.7	35.5	49.5
15	-4.3	-0.4	2.2	33.9	-3.3	9.5	15.4

Table 5: Net population change by race across density bins for the Northeast

Density Bin	White	Black	Am. Indian	Asian	Pac. Islander	Other Race	Hispanic
1	-23420	-3170	-312	417	16	-109	1661
2	31924	-5337	84	12700	-22	361	17810
3	89770	14249	151	49176	-4	1659	41809
4	21595	20064	305	49308	7	1358	48370
5	-23629	17109	-42	41057	-2	1279	43298
6	-55149	13022	183	32652	18	283	41044
7	-71856	15203	168	26882	-1	330	39209
8	-74006	9717	181	25273	-46	620	35461
9	-77819	10401	111	22399	-76	1493	39885
10	-81820	10796	80	25205	99	1330	40933
11	-82473	11752	148	24191	6	1425	49234
12	-106073	14491	7	28933	-63	1914	62138
13	-146596	19481	492	41864	-66	3764	100036
14	-212822	35271	130	72926	-187	5648	181544
15	-176066	-12127	557	333565	-132	8139	481629

Note: Metro areas represented in the Northeast are Boston, Buffalo, Hartford, New York, Philadelphia, Pittsburgh, and Providence.

Table 6: Percent change by race from 2000 across density bins for the Midwest

Density Bin	White	Black	Am. Indian	Asian	Pac. Islander	Other Race	Hispanic
1	0.5	-50.6	2.4	53.7	43.6	16.4	43.4
2	11.7	-5.9	17.4	78.0	52.7	30.6	72.5
3	18.3	17.8	14.2	100.6	40.6	48.8	88.2
4	15.3	24.9	17.2	96.4	49.9	54.2	89.9
5	6.6	21.2	7.7	89.0	66.9	34.0	75.8
6	1.3	13.6	4.8	72.0	48.1	24.5	73.7
7	-3.7	9.1	3.8	57.6	41.2	22.8	70.2
8	-6.4	7.0	2.1	48.1	19.9	19.4	75.6
9	-8.4	6.8	2.7	39.8	41.2	0.7	67.7
10	-10.1	6.5	-3.5	33.5	29.9	4.4	72.4
11	-10.8	2.9	-7.1	34.2	39.3	8.3	74.1
12	-12.9	3.1	-5.3	23.9	23.3	4.7	63.8
13	-14.7	0.9	-9.6	25.1	-3.1	2.4	52.7
14	-15.9	0.7	-8.9	18.3	-3.9	-9.5	39.6
15	0.5	3.4	-10.9	20.9	-25.3	1.9	8.1

Table 7: Net population change by race across density bins for the Midwest

Density Bin	White	Black	Am. Indian	Asian	Pac. Islander	Other Race	Hispanic
1	4236	-7891	65	1790	92	79	5533
2	169840	-2313	693	8229	158	287	19160
3	314221	20176	674	31049	241	846	46011
4	318187	47935	962	50566	395	1252	65245
5	142191	46760	447	52244	479	896	62804
6	24381	31939	259	41099	346	639	55957
7	-62288	21634	174	30420	221	498	50143
8	-100199	18386	94	23615	119	432	55103
9	-127334	19458	122	20370	239	19	56325
10	-149923	21660	-176	18347	173	119	63565
11	-145087	11530	-378	17761	199	212	71096
12	-150361	14989	-314	12738	111	128	76107
13	-150032	5194	-629	15762	-20	72	89631
14	-163840	5325	-739	15274	-32	-387	133018
15	4699	23320	-967	34283	-314	103	66594

Note: Metro areas represented in the Midwest are Chicago, Cincinnati, Cleveland, Columbus, Detroit, Indianapolis, Kansas City, Milwaukee, Minneapolis, and St. Louis.

Table 8: Percent change by race from 2000 across density bins for the South

Density Bin	White	Black	Am. Indian	Asian	Pac. Islander	Other Race	Hispanic
1	6.9	-13.9	10.4	42.5	44.1	34.6	55.7
2	19.3	22.4	28.1	139.3	51.1	82.1	103.2
3	27.3	60.8	41.0	164.7	119.2	123.3	137.6
4	21.8	62.0	36.8	171.7	116.2	122.1	134.4
5	11.8	47.7	35.8	137.2	104.7	86.1	122.9
6	5.1	33.3	19.3	114.9	63.6	78.2	97.8
7	-1.9	25.0	15.4	77.6	77.2	64.4	81.1
8	-6.4	16.8	12.4	52.4	43.3	47.6	68.7
9	-8.7	15.5	10.3	50.6	33.2	43.6	61.6
10	-10.9	11.3	7.1	42.3	24.2	50.0	52.0
11	-12.9	12.2	4.4	39.9	28.2	38.4	49.9
12	-14.3	11.6	-2.5	32.0	6.8	39.0	44.0
13	-15.9	10.2	0.9	22.6	25.5	32.9	37.7
14	-13.0	9.8	2.6	25.8	6.2	29.0	34.1
15	8.9	13.3	9.8	33.6	24.6	25.2	33.9

Table 9: Net population change by race across density bins for the South

Density Bin	White	Black	Am. Indian	Asian	Pac. Islander	Other Race	Hispanic
1	88559	-22519	993	2894	175	358	46535
2	468589	64747	4189	33278	520	2190	192407
3	721720	277501	5456	98381	1392	4832	343556
4	600615	379131	4580	162561	1686	6276	404157
5	318856	324289	4243	159507	1513	4875	419124
6	116754	220951	2096	126887	933	4240	333234
7	-40639	159938	1604	86716	1115	3550	303017
8	-126124	103774	1290	55209	599	2475	257666
9	-155092	97652	1067	52774	548	2184	248121
10	-174891	70967	773	45127	374	2433	235438
11	-185482	78252	439	41891	404	1972	275993
12	-181112	77012	-247	34322	108	2073	303261
13	-176083	75367	79	25590	398	1912	318389
14	-134619	88304	207	31388	100	1911	293992
15	83281	131137	785	45812	383	1887	328839

Note: Metro areas represented in the South are: Atlanta, Austin, Baltimore, Birmingham, Charlotte, Dallas, Houston, Jacksonville, Louisville, Memphis, Miami, Nashville, New Orleans, Oklahoma City, Orlando, Raleigh, Richmond, San Antonio, Tampa, Virginia Beach, and Washington, DC.

Table 10: Percent change by race from 2000 across density bins for the West

Density Bin	White	Black	Am. Indian	Asian	Pac. Islander	Other Race	Hispanic
1	4.8	-44.4	4.0	27.6	34.8	-10.6	15.4
2	17.9	18.3	19.7	87.2	52.1	-12.3	55.5
3	22.3	49.6	15.8	102.3	78.4	44.9	80.8
4	27.7	76.5	19.7	111.0	102.0	49.1	97.4
5	19.0	73.0	26.5	99.1	103.1	54.1	95.4
6	12.9	61.2	22.1	75.0	81.3	43.7	81.4
7	5.3	47.0	13.8	62.9	57.5	39.3	68.1
8	1.6	46.3	16.7	56.0	64.8	47.0	68.4
9	-2.3	26.8	5.8	40.2	58.3	24.3	54.2
10	-4.5	25.1	8.0	39.5	53.2	22.1	53.0
11	-6.8	14.6	2.9	38.4	52.0	18.6	47.2
12	-8.5	7.8	-5.4	33.6	41.3	18.5	39.3
13	-11.8	-1.2	-6.8	24.1	28.9	13.7	30.5
14	-11.4	-4.2	-10.5	22.8	28.5	12.9	20.2
15	-1.1	-6.9	-8.8	20.9	8.4	28.7	10.3

Table 11: Net population change by race across density bins for the West

Density Bin	White	Black	Am. Indian	Asian	Pac. Islander	Other Race	Hispanic
1	15975	-6258	406	2065	270	-81	9744
2	128521	3685	2803	23670	889	-248	55694
3	205176	16538	1774	63981	1900	907	122189
4	289723	34606	1941	97242	3284	1256	177042
5	212187	37925	2306	101769	3656	1345	192476
6	152466	33162	1877	85563	3303	1253	183735
7	65941	28421	1324	80243	2659	1154	167252
8	20879	34826	1730	79024	3485	1441	184054
9	-33258	23464	722	67097	3572	881	177771
10	-72595	27844	1105	82859	3971	954	219564
11	-123040	22223	447	100592	4614	984	266556
12	-165899	16113	-1046	117321	4967	1240	318204
13	-236877	-3991	-1740	125978	5334	1244	407335
14	-223855	-21111	-3434	157669	7331	1568	453396
15	-20754	-46171	-2404	195256	2271	4636	338854

Note: Metro areas represented in the West are Denver, Las Vegas, Los Angeles, Phoenix, Portland, Riverside, Sacramento, Salt Lake City, San Diego, San Francisco, San Jose, and Seattle.

The South (Tables 8 and 9) contains the largest number of metro areas, including cities with large proportions of blacks (Atlanta, New Orleans) and Hispanics (all of Texas, Miami). This also means that these tables are probably obscuring the most local variation of any region. However, we can still glean interesting results. Most importantly, the South gained far more people than the Northeast and Midwest between 2000 and 2010. White population patterns are similar to those regions, but with far more growth at low densities. The real differences lie in the Hispanic and black growth patterns. First, Hispanic growth is absolutely massive at all densities, and more than doubles the group's numbers in Bins 2-5. Blacks also find their way into Southern suburbs in huge numbers, and even Asians increase their numbers in the suburbs far more than in the Northeast and Midwest.

The West (Tables 10 and 11) is most similar to the South, but differs in key ways. The white population appears to be moving out of denser areas for new suburbs and exurbs, making the trend of "white flight" basically ubiquitous across all regions. Like the South, the West saw a large increase in the number of Hispanics, but this growth was concentrated in higher density areas. The West also saw a large increase of Asians, and while this growth was more evenly distributed across population density than in the Northeast, it is still concentrated in higher densities. Interestingly, blacks saw the opposite effects, where they had net loss in the densest areas, and significant gains in low- to mid-density suburbs.

The West and South, by far the fastest growing of the four regions, exhibit the greatest suburban attainment for the three largest minority groups: blacks, Asians, and Hispanics. These results are very suggestive that new, growing places are less segregated than older neighborhoods, as rapidly growing cities receive the most new housing construction (Watson 2006). However, this form of analysis is very broad in terms of segregation. The fact that many

racial groups are moving into areas of similar densities does not mean that they are moving into the same neighborhoods. It is possible that blacks and whites moving to the Atlanta area could settle in completely separate suburban areas. We can only start to understand how these new populations might be mixing by using the Theil Index.

Segregation Results

Figures 4 and 5 both display the Theil Index for all growing, shrinking, and stable components in the study area across each population density bin. However, there is an important different between the two graphs. In Figure 4, every index uses the whole study area as its reference region, and uses the global racial composition as the benchmark for diversity. This means that systematic differences in racial composition across the growth-density bins will translate into differences in Theil score. Since we have seen that denser places tend to have more diverse populations, we should expect to see the higher-density bins have lower Theil scores. This allows us to compare different kinds of places, and see which is more or less "segregated." On the other hand, Figure 5 scales each qualitative area (e.g. growing components in Bin 5) to itself, meaning that there is no comparison of racial composition across kinds of places. Instead, Figure 5 only measures how evenly distributed populations are within the qualitative areas, something that can get lost in Figure 4. Using these two graphs together, we can gain a full understanding of how these different places are segregated.

We can see in Figure 4 that, compared with all other densities, Bin 1 is the most segregated. Shrinking places are especially segregated, scoring above 0.75, the highest score on the plot. As the bins get denser, Theil scores for all types of change decrease, but growing places quickly outpace everywhere else. They are by far the least segregated at all densities outside of the most rural places in the whole study area. Shrinking places are the most segregated at all

Figure 4

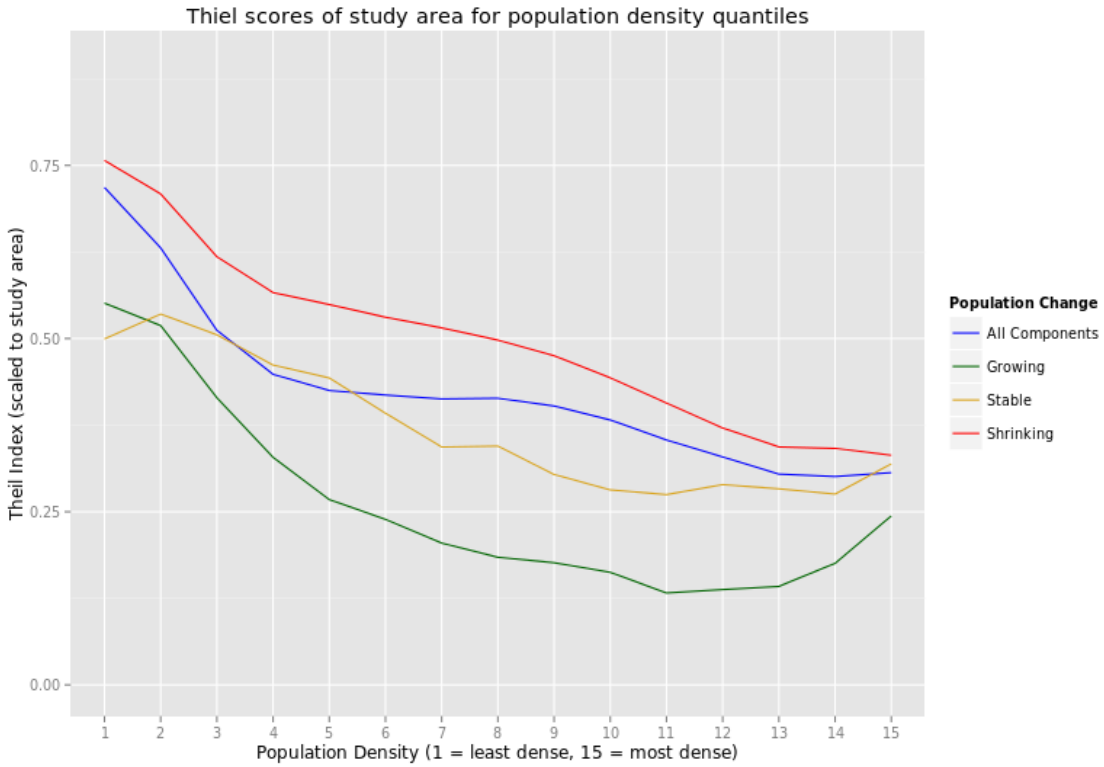
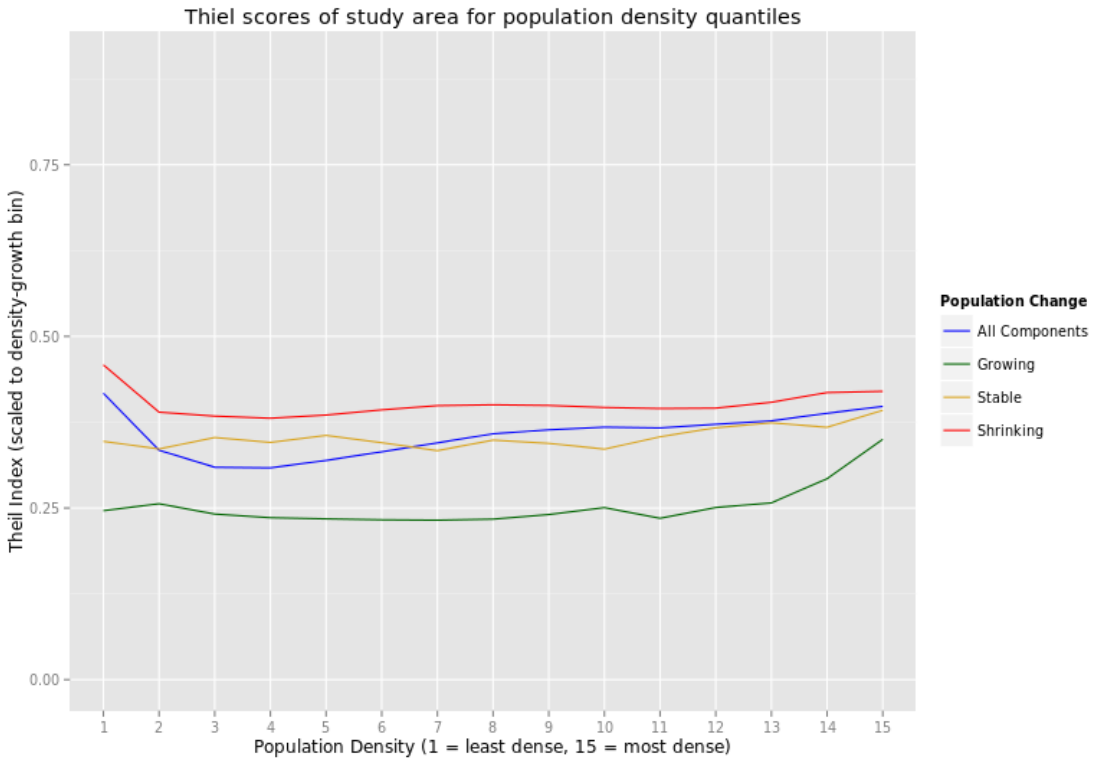


Figure 5



densities as well, although the lines start to converge at the highest densities. This response is especially interesting for growing places; in Bin 13, growing places are at near-minimum segregation, but in Bin 15, they are at similar levels of segregation as growing places in suburban locations (Bins 5 and 6). Since we know from Table 1 that Bin 15 is the most diverse bin, it seems likely that racial groups are less mixed (and more segregated from each other) in these highly dense places. Figure 4 confirms this suspicion. For Bins 1-13, growing components consistently score around 0.25, well below stable and shrinking components for all bins. Figure 5 has the same increase in Theil for growing places in Bins 14 and 15, just as in Figure 4. This confirms that growing places in the most urban areas of U.S. cities are more segregated than other densities.

However, one should stop short of claiming that the people moving there choose to live in neighborhoods dominated by their racial group. This may be the case for whites moving to new central city developments, but according to Spatial Assimilation, new immigrants often have little choice but to move into co-ethnic enclaves. Additionally, since high densities concentrate many more people together than a suburban block, these places may exhibit lower scores when an index that analyzes a different spatial dimension of segregation than evenness. For example, three blocks dominated by different races in close proximity would score low for an Isolation index. A spatial variant of the Theil index that incorporates a unit's neighbors into its calculations would also yield lower segregation.

While the four regions follow growth-density-segregation patterns that are very similar to the overall trend, there are a couple discrepancies that are worth examining. Figure 6 shows Theil indices for the Northeast scaled to the total racial composition of the Northeast. Shrinking places in Bins 6-12 are significantly more segregated than stable and growing places of similar

Figure 6

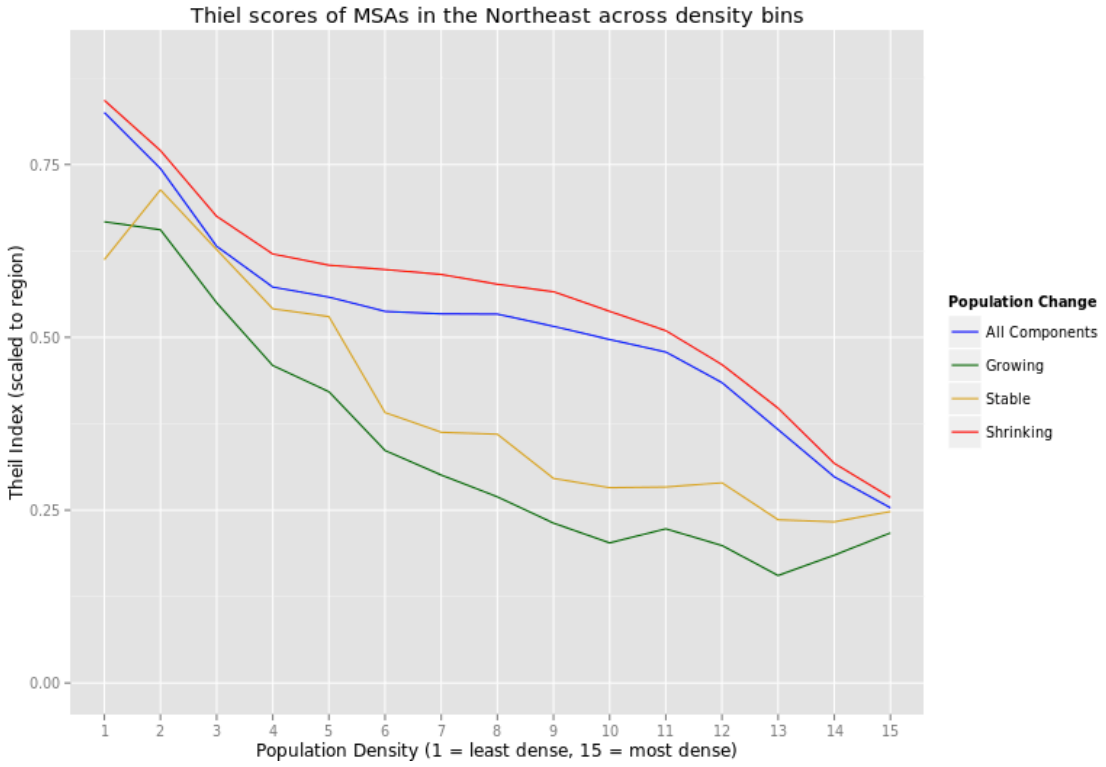
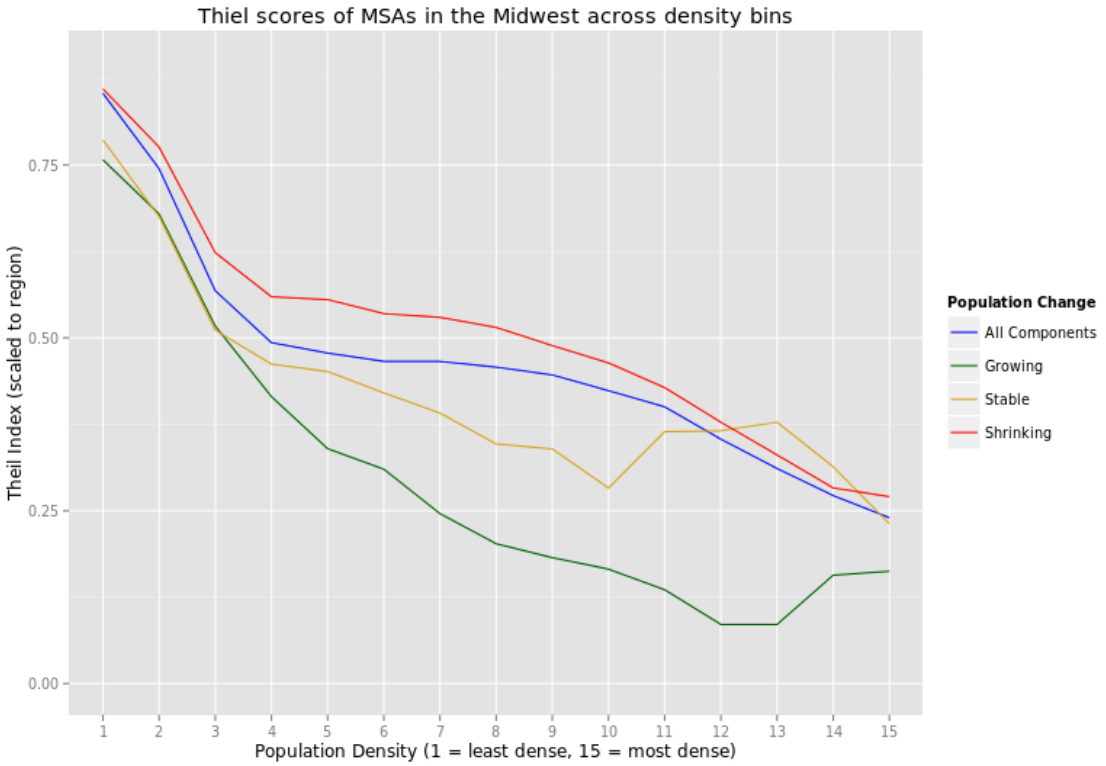


Figure 7

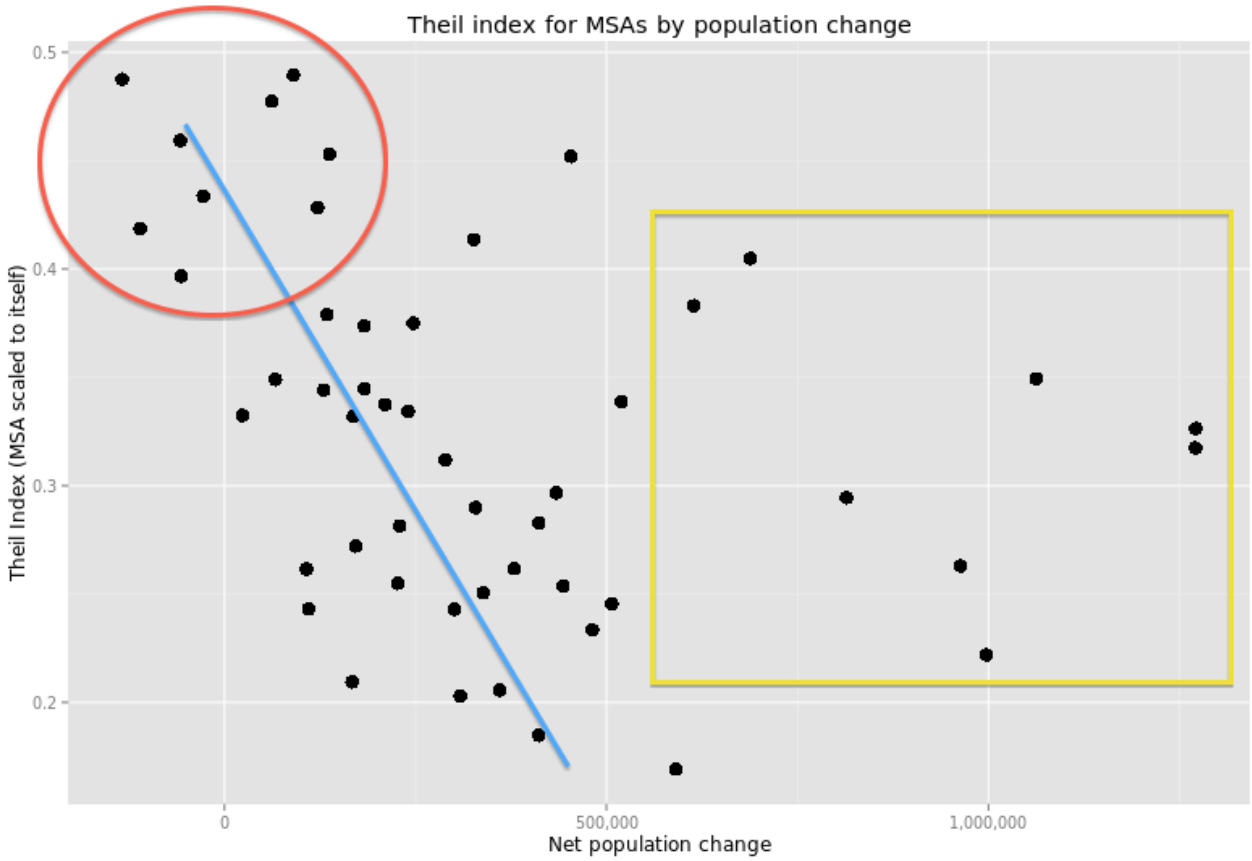


density. This is a little difficult to interpret. From Tables 4 and 5, we can see a large number of whites moving out of those densities. Presumably, large concentrations of minorities are left to dominate these neighborhoods, but there is no way to be sure without a more in-depth analysis of those cities. Figure 7 the shows Theil indices for the Midwest scaled to the total racial composition of the Midwest. Here, growing places in low densities have surprisingly high segregation scores, basically identical to stable areas. Then, from Bin 5 and denser, growing areas become much less segregated than stable or shrinking areas. This is slightly easier to interpret, as Tables 6 and 7 show that whites dominate low-density growth in the Midwest. As the developments become denser, the populations moving there become more diverse, lowering their segregation.

These plots analyzing Theil scores across growth and population density allow us to draw two general conclusions: growing areas are generally less segregated than stable and shrinking areas (through both racial composition and mixing), and higher-density urban areas tend to be less segregated than lower-density suburban or rural, except for the very densest places, which have high diversity, but also greater separation by race. These patterns exist across the entire study area, and within each region of the United States. Population growth in the West and South has now been occurring for decades, as have the Northeast and Midwest been fairly stagnant in their growth (Farley and Frey 1994). If population dynamics really have an effect on segregation, we would expect to see metropolitan level responses to those changes

Figure 8 shows a scatterplot of all 50 MSAs: their net population change is plotted on the x-axis, and their Theil statistic, each one scaled to its own MSA, is plotted on the y-axis. This plot shows very strong results with careful interpretation. First, one should notice that cities with the least net growth between 2000 and 2010, or net loss, are the most overall segregated cities in

Figure 8



the study area (red circle). From there, it is easy to see that a majority of MSAs follow a pattern: the more growth that occurred in a city, the less segregated it will be (blue line). There are several outliers to this pattern, however, and all of them have the most net population gain of all MSAs (yellow box). This sort of pattern in outliers merits a closer examination. These cities, starting with the greatest net growth (right to left along the x-axis) are: Houston, Dallas, Atlanta, Riverside, Phoenix, Washington, New York, and Miami. All of these metro areas are characterized by very large non-white population shares, with Houston, Riverside, Washington, New York, and Miami actually being minority-majority (whites are not the majority group, or make up less than 50% of population). The Group Threat theory predicts this sort of effect in places where white majorities are threatened, so higher than expected segregation for these

MSAs is very strong support for Group Threat. Additionally, most of these MSAs actually exhibit low to moderate segregation. They are only outliers to the pattern because having extreme levels of growth does not make them have extremely low levels of segregation. We must be cautious while interpreting these results, as it would be foolish to claim that ten years of population change has had a huge effect on segregation patterns with decades to centuries of history behind them. Even so, we can conclude from this plot that consistent national patterns of growth have had an effect on metropolitan-level segregation, mixing racial populations in newer cities, and leaving them separated in declining ones.

So far, this analysis can only give us general ideas about how components within our defined qualitative areas are segregated. Remember, the Theil Index is a global index; it uses one number to describe cumulative segregation for a whole region of localities. In order to understand how dynamics of growth and urban form affect the segregation of individual places, we need to change the scale of our analysis.

While there are common patterns of segregation across the metropolitan areas, there will always be huge variation in how these patterns play out in each individual metropolitan area. These local factors, such as metropolitan level racial composition and location within a city, are far more important to determining the segregation of a small local area than any national trend. Hence, when analyzing the Theil decompositions of each component, one should only be looking a single, contiguous metropolitan area at a time. Because of the wide range of MSAs included in my study area, I select two examples based on their patterns of population growth to see if that context results in different expressions of segregation at the local level. These examples are not meant to be representative for similarly changing cities, but to show how monumental of a task it is to comprehensively understand local segregation dynamics across the entire country.

Figures 9 and 10 are local regression curves (or Loess curves) showing the detailed relationships between Theil decomposition and population density for each growing, shrinking, and stable component in Atlanta, GA and San Francisco, CA. Loess curves are not like standard regression techniques, which take a designed model based on one or more variables, and try to predict values from those measured relationships. Instead, they computationally fit curves to show detailed, non-linear relationships between two variables by only using values that are close together to find an expected value rather than the whole dataset. The grey areas surrounding the trend lines are confidence intervals based on the number of data points present around the line in that area. I use Atlanta as an example because of its massive low-density growth, and I use San Francisco because of its concentration of high-density growth. It should be noted that both curves have some outliers removed from the visualization to focus on parts that can be interpreted.

Despite their vastly different urban structures and patterns of growth, Atlanta and San Francisco show similar patterns for local segregation based on growth and population density. Both Figures 9 and 10 show growing components have consistently smaller contributions to segregation until about 20,000 people per km^2, a density that falls within Bin 15. Both curves also show an immediate drop in local segregation beyond the smallest population densities regardless of growth, followed by a steady increase in segregation until about 10,000 people per km^2. Interestingly, both curves show that growing components experience reduced segregation as their population density goes above 10,000 people per km^2, which is contrary to the overall pattern I found for those areas using the global Theil index. The curves for San Francisco go well beyond the 20,000 people per km^2 limit I put on Atlanta due to the dense character of the city; however, results for those densities are more difficult to interpret because of the small number of

Figure 9

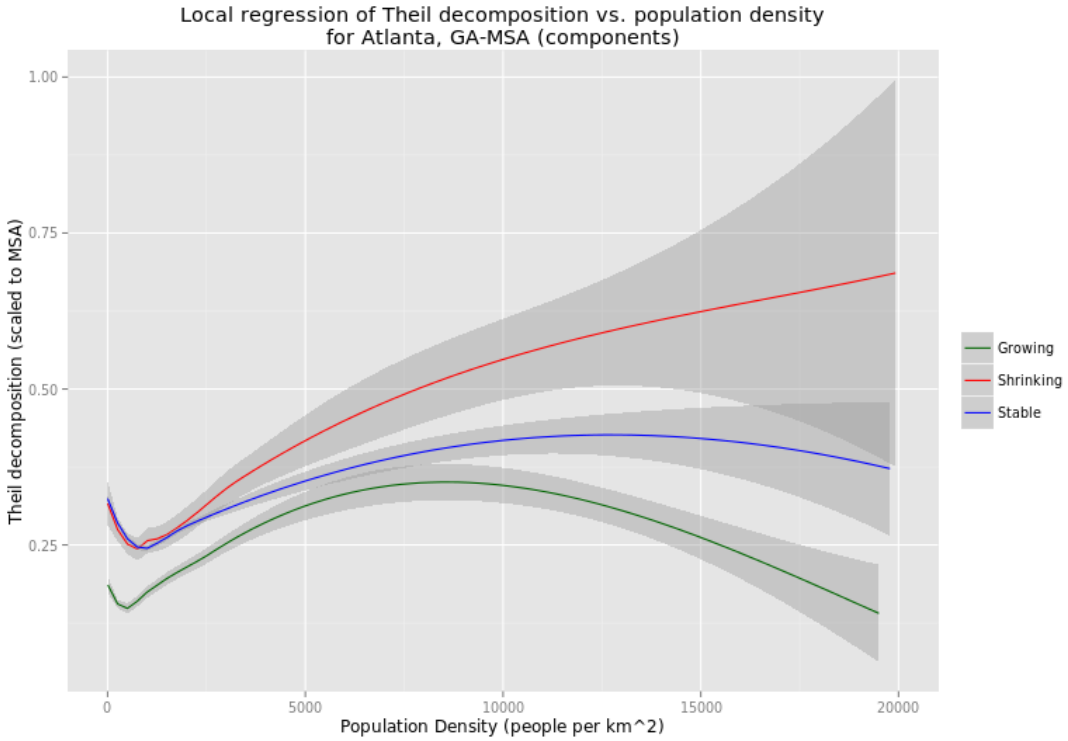
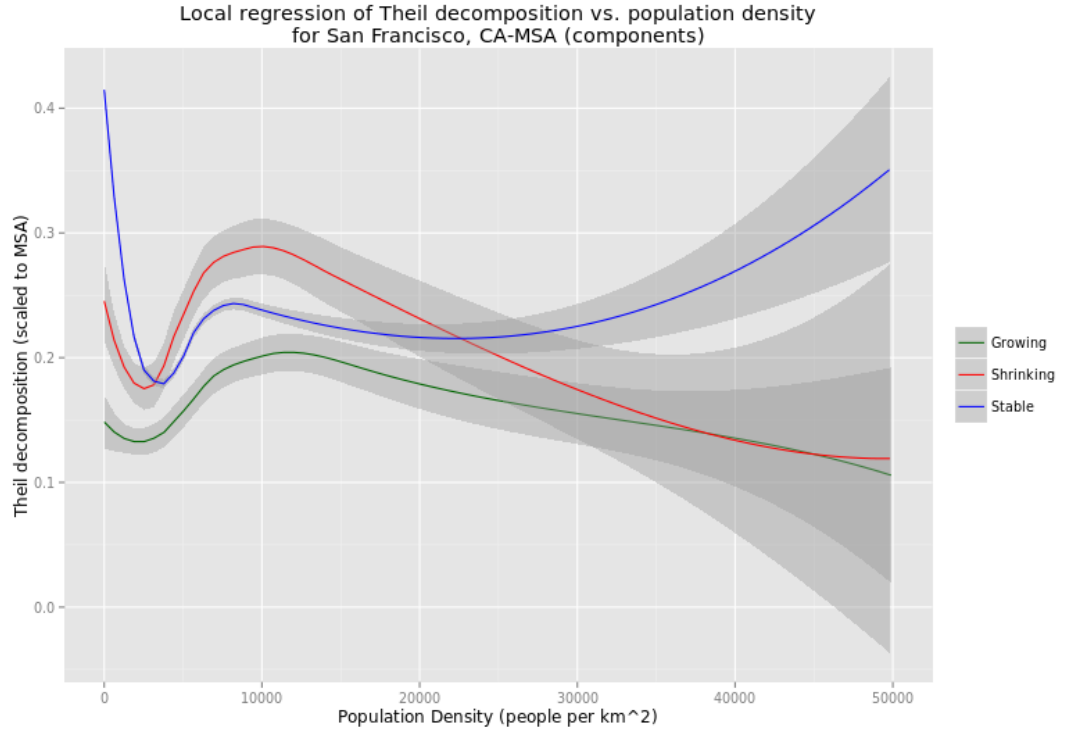


Figure 10



cases available. It appears that growing components are still generally less segregated than stable components of the same density, but due to the higher levels of uncertainty, that conclusion is far weaker at those extreme densities than other parts of the city. While basic relationships can be found in global indices that connect disparate localities through their qualities, it is clear that patterns across these localities are far more complicated. Further research will be needed to be able to connect local instances of growth in the urban environment to the large-scale patterns exposed in this analysis.

Chapter IV – Reflection

One of the priorities of my work has been to conceptualize social space in numbers with as little uncertainty as possible. While it is impossible for a government survey to ever capture a perfect representation of what it's measuring, the United States Census Bureau spends billions of dollars minimizing the error and uncertainty in decennial Census data. Each unit's composition is considered an exact count. My strategy creates a simple framework that is easily interpreted, and lends itself well to adaptation for future study.

There are several limitations to what I have done in this thesis, and all must be addressed before any conclusions can be considered definitive. This project is exploratory at heart, trying to find empirical answers to a question that has not yet been explored in the segregation literature. While my data and methods lend themselves well to these goals, they also put constraints on how strong their conclusions really are.

Data

Block-level data is incredibly detailed; as the smallest geographic unit available, it is ideal for maximizing certainty when trying to track changes in population and identifying specific areas of growth. However, block data also has the fewest released variables of any geographic level. There are only two variables available for blocks: housing occupancy and tenure, neither of which I have yet incorporated into my analysis. Income data is not available at the block level for respondent confidentiality reasons; government statistical agencies can only release aggregate counts of confidential information, and there are thousands blocks with only one household living in them. Most, if not all, common socioeconomic variables are simply not released for blocks. Drawing conclusions from data aggregated at two different geographic scales is a crippling statistical fallacy, making it impossible for me to connect my findings with a

large portion of the segregation literature. This keeps my conclusions stuck in an abstract world where social and economic effects and consequences can't be quantified. It is especially frustrating considering the contemporary importance of income segregation in population sorting. Future research in segregation dynamics should make synthesis with income patterns and other socioeconomic characteristics a priority.

My analysis also cannot tell if population increase is a results from fertility of the unit's population or from migration into the unit. Estimating birthrates might allow for an expected value of migration contribution to growth, removing even more uncertainty about how the U.S. population is moving. However, this would be much more beneficial for a local analysis interested in the dynamics of a specific region. My analysis frequently deals with population increases in the hundreds of thousands, numbers that suggest patterns too big for natural birthrates to explain alone.

Apart from reclassifying the Hispanic ethnic identity, my analysis does not address ethnicity's role in residential segregation patterns. Much of Asian segregation is because of ethnic enclaves of common emigrant groups, such as Chinese, Vietnamese, and Koreans. Hispanics are also comprised of ethnic groups that face segregation, like Mexicans and Dominicans. This consideration also lends itself well to an analysis of a defined region interested in a specific set of local dynamics.

Methods

While descriptive methods allowed me to build a concise narrative that tied together multiple ways of looking at the data, their conclusions are not strong enough to stand on their own. I offer no test statistics for any of my results, and apart from my Loess curves, I use no regression techniques to bring these relationships into one cohesive theory. There are many

fertile avenues of research for using regression models, especially spatial models. Segregation is an inherently spatial phenomenon, and a place's spatial position within a metropolitan area is crucial in determining who lives there. The local Theil decomposition lends itself well to this sort of local spatial analysis. Once these relationships are understood in better detail, it might be possible to use spatial regression models for predicting where someone might move based on factors like their race, income level, family structure, etc. That being said, my methods are well suited for describing and generalizing patterns across a large, disparate area at such a fine scale.

Finally, I must discuss a possible confounder in my results. As mentioned in Chapter 2, because new developments often involve new street construction (particularly in lower densities), new, growing places are more likely to be combined into large components of several different blocks because of boundary changes. This makes these units represent larger areas and populations, creating uncertainty in how the population is racially sorted within the component. My analysis interprets a diverse large component like this as "mixed," even when there could be stark separation of race in that part of the urban landscape. This is especially concerning, because this issue overwhelmingly affects low-density growing areas, the vast majority of growth that occurred between 2000 and 2010. The average growing component is composed of 5.7 Census blocks, while the average shrinking component consists of 3, and the average stable component consists of 1.5. Even more worrying, 8.7 blocks make average growing component in Bin 5, and the number goes to 11.9 in Bin 1. Unfortunately, I do not know how much this issue affects my results. Further investigation is necessary to fully determine if growing areas really are less segregated than older parts of cities. However, it bears repeating that I used components as a unit of analysis because it is the smallest possible unit of one-to-one comparison to find changes in population between 2000 and 2010. Analyzing blocks within growing components as growing is

a fraught assumption, and could be more problematic to my results than not knowing the distribution of populations within those components. Additionally, given the wide geographic extent of these basic patterns, and wide variety of evidence uncovered, I believe that this issue does not detract much from my findings.

Chapter VI – Conclusions

This project finds that growing areas are generally less segregated than other parts of American Cities. They are likely to be more diverse racially than older places of a similar population density, and growing places are better mixed within those neighborhoods, except at the highest densities. Additionally, there is a strong gradient of segregation along population density, where whites tend to dominate low-density areas, and minorities are concentrated in the densest parts of American cities. This is changing, however, and in the West and South, the fastest growing regions of the U.S., there is lots of minority growth in suburban areas. This pattern also exists in the Midwest and Northeast, but is much less dramatic.

My results also find evidence for each of the three theoretical perspectives from the literature. Continued white migration out of denser suburban areas and higher than expected segregation in large-minority metro areas support Group Threat. Higher segregation in lower density areas supports Place Stratification. Large concentrations of growth of Hispanics and Asians in the densest parts of Immigrant regions like the West and Northeast, coupled with increased minority representation in the suburbs, supports Spatial Assimilation.

These conclusions are abstract, and do nothing to connect these changes to the social and economic conditions that mediate population movements and form and maintain segregation patterns. However, investigating social characteristics of growing places and relating them to racial patterns should help make these findings incredibly relevant to the overall segregation literature. Additionally, these findings reinforce the notion from the literature that segregation is changing. That new, growing neighborhoods are among the least segregated in the country gives hope for future societies in the United States. If this trend continues, changes in urban structure will result in racial groups coming together, helping remove social boundaries maintained

residential segregation. Perhaps these changes in new areas are an indicator that racial tolerance and acceptance is becoming more prevalent in our society, and we can only hope that it serves as a catalyst for new social transformations.

References

Alba, RA, Logan, JR, and Stults, BJ. (2000). The changing contexts of the immigrant metropolis. *Social Forces, 79(2).* 587-621. DOI: 10.1093/sf/79.2.587.

Bergsten, Z, and Holmqvist, E. (2013). Possibilities of building a mixed city: Evidence from Swedish cities. *International Journal of Housing Policy, 13(3).* 288-311. DOI: 10.1080/14616718.2013.809211.

Bjorvatn, K, and Cappelen, AW. (2001). Inequality, segregation, and redistripution. *Journal of Public Economics, 87(2003)*. 657-1679. DOI: 10.1016/S0047-2727(01)00202-X.

Bonilla-Silva, Eduardo. (2014). *Racism Without Racists: Color-blind racism and the persistence of racial inequality in America* (4th ed.). Lanham, MD: Rowman & Littlefield Publishers, Inc.

Charles, Camille. (2003). The dynamics of residential segregation. *Annual Review of Sociology, 29.* 197-207. DOI: 10.1146/annurev.soc.29.010202.100002.

Clark, WAV, and Ware, J. (1997). Trends in residential integration by socioeconomic status in Southern California. *Urban Affairs Review, 32(6).* 825-843. DOI: 10.1177/1078087497032006.

Dawkins, Casey J. (2004). Recent evidence on the continuing causes of black-white residential segregation. *Journal of Urban Affairs, 26(3)*. 379-400. DOI: 10.1111/j.0735-2166.2004.00205.x.

DeFina, R, and Hannon, L. (2009). Diversity, racial threat and metropolitan housing segregation. *Social Forces, 88(1).* 373-394. DOI: 10.1353/sof.0.0234.

Dwyer, Rachel E. (2007). Expanding homes and increasing inequalities: U.S. housing development and the residential segregation of the affluent. *Social Problems, 54(1).* 23-46. DOI: 10.1525/sp.2007.54.1.23.

Farley, R, and Frey, WH. (1994). Changes in the segregation of whites from black during the 1980s: Small steps toward a more integrated society. *American Sociological Review, 59(1).* 23-45. http://www.jstor.org/stable/2096131.

Farley, R, Steeh, C, Jackson, T, Krysan, M, and Reeves, K. (1993). Continued racial residential segregation in Detroit: "Chocolate City, Vanilla Suburbs" revisited. *Journal of Housing Research, 4(1)*. 1-38. http://content.knowledgeplex.org/kp2/img/cache/documents/1230.pdf.

Fischer, Mary J. (2003). The relative importance of income and race in determining residential outcomes in U.S. urban areas, 1970-2000. *Urban Affairs Review, 38(5).* 669-696. DOI: 10.1177/1078087403038005003.

Fischer, Mary J. (2008). Shifting geographies: Examining the role of suburbanization in blacks' declining segregation. *Urban Affairs Review, 43(4)*. 475-496. DOI: 10.1177/1078087407305499.

Galster, G, and Cutsinger, J. (2007). Racial settlement and metropolitan land-use patterns: Does sprawl abet black-white segregation? *Urban Geography, 28(6)*. 516-553. DOI: 10.2747/0272-3638.28.6.516.

Hagberg, AA, Schult, DA, and Swart, PJ. (2008). Exploring network structure, dynamics and function using NetworkX. *Procedings of the 7th Python in Science Conference (SciPy2008)*. G Varoquaux, T Vaught, and J Millman (Eds.). 11-15. Pasadena, CA.

Hanson, A, and Hawley, Z. (2014). Where does racial discrimination occur? An experimental analysis across neighborhood and housing unit characteristics. *Regional Science and Urban Economics, 44*. 94-106. DOI: 10.1016/j.regsciurbeco.2013.12.001.

Holloway, ST, Wright, R, and Ellis, M. (2011). The racially fragmented city? Neighborhood racial segregation and diversity jointly considered. *The Professional Geographer, 64(1)*. 63-82. DOI: 10.1080/00330124.2011585080.

Huie, SAB, and Frisbee, WP. (2000). The components of density and the dimensions of residential segregation. *Population Research and Policy Review, 19(6)*. 505-524. DOI: 10.1023/A:1010611901602.

Iceland, J, and Scopilliti, M. (2008). Immigrant residential segregation in U.S. metropolitan areas, 1990-2000. *Demography, 45(1)*. 79-94. http://www.jstor.org/stable/30053082.

Iceland, J, and Sharp, G. (2013). White residential segregation in U.S. metropolitan areas: Conceptual Issues, patterns, and tends from the U.S. Census, 1980 to 2010. *Population Research and Policy Review, 32*. 663-686. DOI: 10.1007/s11113-013-9277-6.

Iceland, J, Sharp, G, and Timberlake, JM. (2013). Sun Belt rising: Regional population change and the decline in black residential segregation, 1970-2009. *Demography, 50(1)*. 97-123. DOI: 10.1007/s13524-012-0136-6.

Krysan, Maria. (2002). Whites who say they'd flee: Who are they, and why would they leave? *Demography, 39(4)*. 675-696. DOI: 10.1353/dem.2002.0037.

Lee, BA, Iceland, J, and Farrell, CR. (2013). Is ethnoracial residential integration on the rise?: Evidence from metropolitan and micropolitan America since 1980. *US2010 Project*. http://www.s4.brown.edu/us2010/Data/Report/report10022013.pdf.

Lee, BA, Reardon, SF, Firebaugh, G, Farrell, CR, Matthews, SA, and O'Sullivan, D. (2008). Beyond the census tract: Patters and determinants of racial segregation at multiple geographic scales. *American Sociological Review, 73(5)*. 766-791. DOI: 10.1177/000312240807300504.

Logan, John R. (2011). Separate and unequal: The neighborhood gap for Blacks, Hispanics, and Asians in metropolitan America. *US2010 Project*. http://www.s4.brown.edu/us2010/Data/Report/report0727.pdf.

Logan, JR, Alba, RD, Leung, S. (1996). Minority access to white suburbs: A multiregional comparison. *Social Forces, 74(3).* 851-881. DOI: 10.1093/sf/74.3.851.

Logan, JR, Alba, RD, McNulty, T, and Fisher, B. (1996). Making a place in the metropolis: Locational attainment in cities and suburbs. *Demography, 33(4).* 443-453. DOI: 10.2307/2061779.

Logan, JR, and Stults, BJ. (2011). The persistence of segregation in the metropolis: New findings form the 2010 Census. *US2010 Project*. http://www.s4.brown.edu/us2010/Data/Report/report2.pdf.

Logan, JR, Stults, BJ, and Farely, R. (2004). Segregation of minorities in the metropolis: Two decades of change. *Demography, 41(1).* 1-22. DOI: 10.1353/dem.2004.0007.

Logan, JR, Zhang, W, and Alba, RD. (2002). Immigrant enclaves and ethnic communities in New York and Los Angeles. *American Sociological Review, 67(2).* 299-322. http://www.jstor.org/stable/3088897.

Massey, DS, and Denton, NA. (1988). The dimensions of residential segregation. *Social Forces, 67(2).* 288-315. http://www.jstor.org/stable/2579183.

Massey, DS, and Denton, NA. (1993). *American Apartheid: Segregation and the making of the underclass*. Cambridge, MA: Harvard University Press.

Massey, DS, Rothwell, J, and Domina, T. (2009). The changing bases of segregation in the United States. *The ANNALS of the American Academy of Political and Social Science, 626.* 74-90. DOI: 10.1177/0002716209343558.

Minnesota Population Center. National Historical Geographic Information System: Version 2.0. Minneapolis, MN: University of Minnesota 2011. https://www.nhgis.org/.

Orfield, Myron. (1997). *Metropolitics: A regional agenda for community and stability.* Washington, DC: Bookings Institution Press.

Pias, K, South, SJ, and Crowder, K. (2012). Metropolitan heterogeneity and minority neighborhood attainment: Spatial assimilation or place stratification? *Social Problems, 59(2).* 258-281. DOI: http://www.jstor.org/stable/10.1525/sp.2012.59.2.258.

Reardon, SF, and Bischoff, K. (2011). More separate and more unequal: Growth in the residential segregation of families by income, 1970-2009. *US2010 Project*. http://www.s4.brown.edu/us2010/Data/Report/report111111.pdf.

Reardon, SF, and Firebaugh, G. (2002). Measures of multigroup segregation. *Sociological Methodoogy, 32(1).* 33-67. DOI: 10.1111/1467-9531.00110.

Reardon, SF, and O'Sullivan, D. (2004). Measures of spatial segregation. *Sociological Methodology, 34(1).* 121-162. DOI: 10.1111/j.0081-1750.2004.00150.x.

Ross, SL, and Turner, MA. (2005). Housing discrimination in metropolitan America: Explaining changes between 1989 and 2000. *Social Problems, 52(5).* 152-180. 10.1007/s13524-011-0062-z.

Rothwell, J, and Massey, DS. (2009). The effect of density zoning on racial segregation in U.S. urban areas. *Urban Affairs Review, 44(6).* 779-806. DOI: 10.1177/1078087409334163.

Rothwell, J, and Massey, DS. (2010). Density zoning and class segregation in U.S. metropolitan areas. *Social Science Quarterly, 91(5).* 1123-1143.

South, SJ, Crowder, K, and Pais, J. (2008). Inter-neighborhood migration and spatial assimilation in a multi-ethnic world: Comparing Latinos, Blacks, and Anglos. *Social Forces, 87(1).* 415-443. http://www.jstor.org/stable/20430862.

South, SJ, Crowder, K, and Pais, J. (2011). Metropolitan structure and neighborhood attainment: Exploring intermetropolitan variation in racial residential segregation. *Demography, 48(4).* 1263-1292. 10.1007/s13524-011-0062-z.

Spielman, S, and Harrison, P. (2013). The co-evolution of residential segregation and the built environment at the turn of the 20th century: A Schelling model. *Transactions in GIS,*

Stoll, Michael A. (2013). Residential mobility in the U.S and the Great Recession: A shift to local moves. *US2010 Project*. http://www.s4.brown.edu/us2010/Data/Report/report09232013.pdf.

Theil, H. (1972). *Statistical decomposition analysis in the social and administrative sciences*. Center for Mathematical Studies in Business and Economics, University of Chicago.

Theil, H, and Finizza, AJ. (1971). A note on the measurement of racial integration of schools by means of informational concepts. *Journal of Mathematical Sociology, 1 (2)*. 187-194. 0.1080/0022250X.1971.9989795.

United States Department of Commerce Economics and Statistics Administration (1994). *Geographic Areas Reference Manual*. https://www.census.gov/geo/reference/garm.html.

Watson, Tara. (2009). Inequality and the measurement of residential segregation by income in American neighborhoods. *The Review of Income and Wealth, 55(3)*. 820-844. DOI: 10.1111/j.1475-4991.2009.00346.x.

Watson, T, Carlino, G, and Ellen, IG. (2006). Metropolitan growth, inequality, and neighborhood segregation by income. *Brookings-Wharton Papers on Urban Affairs*. 1-52.