

Neighborhood Change in Metropolitan America

Fang Wei

Dissertation submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
in
Planning, Governance, and Globalization

Paul L. Knox, Committee Chair

Pang Du

Sonia A. Hirt

Thomas W. Sanchez

December 10, 2012

Blacksburg, Virginia

Keyword: Neighborhood change, diversity, job accessibility

© 2012 by Fang Wei

Neighborhood Change in Metropolitan America

Fang Wei

Abstract

This dissertation presents an integrated framework that was developed to examine trajectories of neighborhood change, mechanisms of suburban diversity, and the relationships between neighborhood change and employment accessibility. First, this dissertation extends the study of neighborhood change to a greater time and spatial span, systematically examining the trajectories of neighborhood change at the census tract level. The results show that neighborhood change is complicated and exhibits various trajectories. The dominant patterns do not always conform to classical models of neighborhood change, providing counterpoints to some long-established assumptions. This dissertation also provides evidence of the mechanisms through which metropolitan and suburban characteristics influence suburban diversity. Most importantly, it highlights a remarkable increase in suburban diversity with respect to neighborhood composition. Finally, this dissertation investigates the relationships between neighborhood change, spatial transformation, and employment accessibility in the North Carolina Piedmont region during the last three decades. Spatial patterns of the neighborhood distributions suggest that job accessibility varies by neighborhood typology. A detailed analysis of the trajectories of neighborhood change shows interesting patterns in both central city and suburban ecological succession and transformation. These geographical shifts of neighborhoods were shown to be associated with changes in job accessibility to a certain extent. In sum, by introducing an integrated framework including social, spatial, and employment factors, this dissertation develops a more balanced understanding of neighborhood change in the United States.

Acknowledgements

Many persons have helped me during the course of my studies and the completion of this dissertation. Above all, I would like to offer thanks to my advisor Dr. Paul Knox for his continued guidance, support, and understanding throughout this entire journey. Thank you for supporting me with encouragement and patience during my both exciting and stressful times at Virginia Tech. I would like to express my gratitude to each of the current committee members, Dr. Pang Du, Dr. Sonia Hirt, and Dr. Thomas Sanchez, for offering invaluable advice and assistance. I also wish to thank Dr. Gerard Kearns, and Dr. Casey Dawkins for their assistance when they were at Virginia Tech as my committee members. In addition, I would like to thank Dr. David Bieri for giving generously of his time and talent while we worked together in the office at Burrus Hall. I would also like to thank everyone in PGG and EDP who supported me along the way. Thank you to all of my best friends for being there for me and for your genuine concern. I also benefited from being part of the research team on “Global Suburbanisms,” a project funded by the Canadian SSHRC through the CITY Institute at York University, Canada. Finally, I would like to thank my family for their past and continuing love and support. Thank you to my wonderful husband for loving me all of the time, standing up for me, and taking care of me in every way possible. I also thank my son for bringing me joy, pride, and faith each day, and for being the reason that I live and stay strong.

Table of Contents

I. Chapter 1 Introduction and Overview.....	1
1 Toward a multidimensional research object	2
2 Toward a quantitative visualization of neighborhood typology	3
3 Toward a geography of spatial transformation	4
4 Toward an integrated framework of neighborhood change	5
5 Research questions.....	7
6 Organization.....	8
Reference	9
II. Chapter 2 Neighborhood Change in Metropolitan America	13
1 Introduction.....	13
2 Data.....	16
3 Methodology	17
3.1 K-means cluster analysis.....	17
3.2 Clustergram.....	18
3.3 Discriminant analysis.....	19
4 Results.....	19
4.1 Cluster Identification.....	19
4.2 Neighborhood Typology	23
4.3 Trajectories of neighborhood change.....	25
4.3.1 Temporal changes across typologies.....	25
4.3.2 Sequences of neighborhood change	26
4.3.3 Trajectories of neighborhood change.....	28
(1) Neighborhood stability.....	29
(2) Neighborhood succession	30
(3) Neighborhood upgrading	32
(4) Other neighborhood changes	33
5 Discussions and conclusions.....	35
References.....	40
III. Chapter 3 Suburban Diversity in Metropolitan America	46

1 Introduction.....	46
2 Research Background	48
3 Data and Methods	52
3.1 K-means cluster analysis.....	52
3.2 Entropy index.....	53
3.3 A multiple linear regression.....	54
4 Theoretical Framework and Hypotheses.....	55
5 Results.....	58
6 Discussion and Conclusions	66
References.....	70
IV. Chapter 4 Neighborhood Change, Spatial Transformation and Job Accessibility	76
1 Introduction.....	76
2 Research Context	78
3 Socio-Economic Change in the North Carolina Piedmont Metropolitan Region	81
4 Data and Methods	86
5 Results.....	89
5.1 Changing social ecology: empirical analysis	89
5.2 Changing spatial patterns of neighborhood distribution	91
5.3 Neighborhood distribution and job accessibility across typologies	94
5.4 Changing spatial patterns of neighborhood transition	99
5.4.1 Neighborhood succession	99
5.4.2 Neighborhood growth	102
5.5 Neighborhood transition and job accessibility change.....	105
6 Conclusions.....	109
References.....	113
V. Chapter 5 Conclusion	121
1 Neighborhood change from a dialectical perspective	123
2 Neighborhood change from a totality perspective	124
3 Neighborhood change from a historical perspective.....	124
4 Policy implications.....	125
5 Research limitations and future research	127
VI. Appendix A.....	129

List of tables

Table II-1 Calinski/Harabasz index	21
Table II-2 Eigenvalues and measures of importance	23
Table II-3 Standardized canonical discriminant function coefficients	24
Table II-4 Z-score means across clusters.....	25
Table II-5 The numbers and percentages of tracts across clusters over time	26
Table II-6 The first 39 sequences of neighborhood transitions	27
Table II-7 Neighborhood transitions from 1990 to 2010.....	28
Table III-1 List of variables and descriptions.....	54
Table III-2 Z-score means across clusters.....	59
Table III-3 Multiple linear regression results	62
Table IV-1 Z-score means across clusters	91
Table IV-2 Distributional changes across clusters.....	92
Table IV-3 Inflow/Outflow Job Counts.....	95
Table VI-1 Neighborhood change across metropolitan statistical areas	129
Table VI-2 Suburban diversity across metropolitan statistical areas.....	133

List of figures

Figure I-1 An integrated framework of neighborhood change	6
Figure II-1 Visualization of clusters via Clustergram	21
Figure II-2 Biplot of the tracts and clusters in the first two principal components	22
Figure II-3 Biplot of the points and clusters in the first three principal components.....	22
Figure III-1 Conditional effect plot (Foreign-born population %)	63
Figure III-2 Conditional effect plot (Non-white population %)	64
Figure III-3 Conditional effect plot (Metropolitan population).....	65
Figure IV-1 Visualization of clusters via Clustergram.....	90
Figure IV-2 Spatial pattern of clusters in CGR MSA in 2010	92
Figure IV-3 Spatial pattern of clusters in RDC CSA in 2010	93
Figure IV-4 Job density in CGR MSA (2010).....	97
Figure IV-5 Job density in RDC CSA (2010).....	97
Figure IV-6 Job accessibility by wage across clusters in Charlotte-Gastonia-Rock Hill MSA 2010	98
Figure IV-7 Job accessibility by wage across clusters in Raleigh-Durham-Chapel Hill CSA 2010	98
Figure IV-8 Succession patterns of the five typologies of tracts in the Piedmont region.....	100
Figure IV-9 Growth patterns of the five typologies of tracts in the Piedmont region.....	103
Figure IV-10 A simplified neighborhood-job changing relationship	106
Figure IV-11 Percentage of change in job accessibility (L10 - L10 θ) by wage across clusters in CGR MSA	108
Figure IV-12 Percentage change in job accessibility (L10 - L10 θ) by wage across clusters in RDC Hill CSA	108

I. Chapter 1 Introduction and Overview

Neighborhood change has been a major concern of urban planners, geographers, and regional economists for several decades. Urban planners are interested in the relationship between neighborhood change and urban issues such as urban policy (Newman and Ashton, 2004; Temkin and Rohe, 1996), land use and the environment (Liu, 1997), residential mobility (Coulton et al., 2009; Freeman, 2005), segregation (Charles, 2003; Dawkins, 2004; Freeman, 2009), poverty (Fong and Shibuya, 2003; Galster et al., 2003), and quality of life (Hollander, 2010), to name a few. Some studies on geography are focused on the spatial patterns of neighborhood change and distribution (Kitchen and Williams, 2009; Mikelbank, 2011). Regional economists model population and employment change by investigating the density or developing advanced parametric or non-parametric models (McDonald and Prather, 1994; McMillen, 2001; Muniz et al., 2003; Roca Cladera et al., 2009). While these studies contribute to theorizing and modeling neighborhood change from unique perspectives, the mechanics of neighborhood change contain key elements that permit a more nuanced understanding of the realities of metropolitan America from an integrated perspective.

Factors behind the evolving metropolitan areas and suburbs in the United States include the restructuring of the global economy, increase in demographic diversity, suburbanization of population and employment et al. However, the social ecologies that have developed within and around these landscapes have not, until now, been systematically and comprehensively mapped. How does neighborhood change shape the landscape of metropolitan America both socially and spatially? Centered on a framework integrating social, spatial, and employment aspects of neighborhood change, the essays presented in this dissertation systematically evaluate the dynamics of neighborhood change, mechanisms of suburban diversity, and relationships between

spatial patterns of neighborhood change and employment accessibility. The integrated framework suggests that the scope of this dissertation is multidimensionally-, longitudinally-, and spatially-focused. This work provides systematic insights, chronically and geographically, into American metropolitan areas and a chance to test metropolitan realities, both past and present. Specifically, this dissertation makes several theoretical and empirical contributions to the literature on neighborhood change.

1 Toward a multidimensional research object

The overarching theme of this dissertation is neighborhood change with an emphasis on social, spatial, and employment dimensions. This dissertation contributes to the body of neighborhood change literature by introducing a multidimensional research object—neighborhoods. In theoretical and empirical studies, class, race/ethnicity or housing price variables have been used individually to study multiple issues related to neighborhood change. However, as argued in the current study, a neighborhood is a geographic unit with multiple attributes such as race or income, and these variables must be studied simultaneously. First, the racial landscape has become more complex with the dichotomy of black and white diminished, giving way to black-other racial/ethnic groups and white. The concentration of immigration also affects society socioeconomically, demographically, and spatially (Rephann and Holm, 2004), with immigrants coming from different races as well as from developed and developing countries, and may influence the composition and distribution of the population (Champion, 1994). Newbold and Spindler (2001) found that the suburbanization of immigration is visible among many groups. An increase in the number of racial minorities has made the “white majority” the minority.

Next, the racial complexity is accompanied by changing and even more involved differences in socioeconomic status within groups of African Americans, whites, or immigrants. African American is no longer synonymous with poor due to the increasing size of the African American middle class (Fischer, 2003), and immigration has contributed to the growing socioeconomic heterogeneity. The traditional spatial assimilation model assumes a low socioeconomic status of immigrants (Freeman, 2002). On the one hand, new immigrants are substantially poorer than earlier immigrants and the native born population (Clark, 1998), and Simpson et al. (2008) pointed out that immigration is traditionally associated with poverty. On the other hand, the “circulation of elites” model posits that those migrating from longer distances may be from a higher income, more educated population (Frey, 1995). In addition, the white population is not as homogeneous as it once was, and the “suburbia” of the traditional middle class and “struggling” white neighborhoods coexist in metropolitan areas (Mikelbank, 2011). It would be futile to use a single dimension of either race or income to capture the increasing diversity of the population and neighborhood compositions. The theoretical meaningfulness and sophistication of the typologies of neighborhoods can thus be better identified using multiple attributes. Therefore, this study introduces a multidimensional unit—neighborhoods—as the research object.

2 Toward a quantitative visualization of neighborhood typology

One theoretical consideration in the study of neighborhoods is the construction of typologies (Reibel, 2011). Neighborhood typologies are generally defined using multivariate classification techniques such as hierarchical clustering methods or partitional clustering techniques (including k-means clustering). A great number of studies have constructed theoretically meaningful typologies of neighborhoods through k-means cluster analysis. An important aspect of cluster analysis is cluster stability. In k-means clustering, the same data set

may yield different cluster results when acted upon by different clustering algorithms. Some cluster results may be very stable and some may not. Nevertheless, the issue of cluster stability is often ignored in studies of neighborhood typologies. This dissertation adds to the study of neighborhood typology, introducing a visualization clustergram technique to guide the choice of the number of clusters. The clustergram was plotted multiple times based on various clustering algorithms. The resulting graphs were then compared to each other in order to observe the stability of the cluster formation and identify the most stable cluster solution.

3 Toward a geography of spatial transformation

One important contribution of this dissertation is the examination of not only the spatial patterns of neighborhood distribution but also the spatial patterns of neighborhood succession and transformation. The spatial structure of cities has been theoretically and empirically investigated in planning, geography, and regional economics. Many theories and models contribute to a comprehensive understanding of how different types of people and businesses are located within urban settings, including the classic models of the Chicago School, the social space concept of Bourdieu (1985), Kearsley's (1983) model of urban structure, and the quartered city of Marcuse (1989), to name a few. Rather than simply focusing on the cross-sectional patterns of cities and metropolitan areas, some models focus on the spatial dynamics of neighborhood change, such as the invasion-succession model (Burgess, 1925; Park, 1952) and neighborhood life cycle model (Hoover and Vernon, 1959). Several empirical studies of neighborhood change have investigated the spatial patterns of neighborhood distribution (Hanlon et al., 2006; Kitchen and Williams, 2009). Many studies in regional science and human geography have explored the history of the population distribution in order to explore the determinants of change (Chi, 2011). Among these studies, few have examined the transition

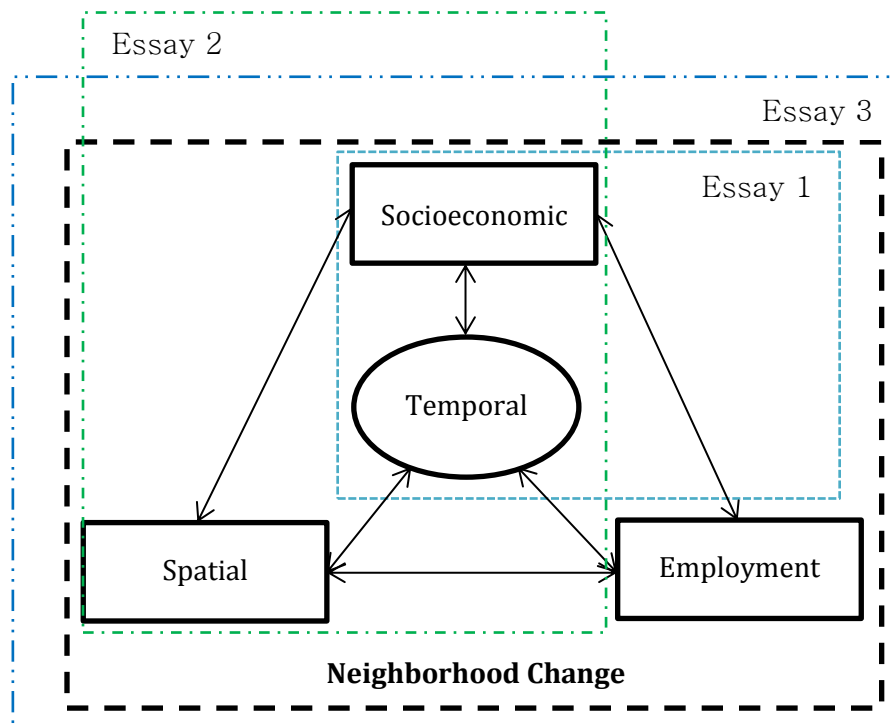
patterns of neighborhood change, such as one study indicating that traditional suburban neighborhoods are disappearing and migrating farther away from urban cores (Mikelbank, 2011). Over the past few decades, urban economists have been trying to demonstrate the transition from mono-centric forms to a polycentric structure of employment and population in U.S. metropolitan areas (Cervero, 1989; McMillen, 2001; Musterd and Zelm, 2001; Roca Cladera et al., 2009). Researchers have conducted empirical studies of these changes in metropolitan structures through the identification of polycentric urban structures using density peak, cut-offs, and parametric or non-parametric models (Roca Cladera et al., 2009). This decentralization process demonstrates various categories of forms, including scattered patterns, clusters, corridors (Pivo, 1993), edge cities (Garreau, 1988), edgeless cities (Lang, 2003), and those with a more hierarchical structure (Cervero and Wu, 1997). These studies have focused on spatial patterns of the population or employment distribution; however, studies on the spatial patterns of transformation are rare in the literature. The present dissertation fills this research gap by investigating the changing spatial structure of neighborhood succession and transformation in order to gain a deep understanding of the dynamics of neighborhood change.

4 Toward an integrated framework of neighborhood change

The essays in this dissertation introduce an integrated framework to investigate neighborhood change (Fig.I-1). This integrated framework includes three components—socioeconomic, spatial, and employment—that incorporate temporal trends. Neighborhood change includes changes in socioeconomic attributes, spatial structure, employment accessibility, and so on. Socioeconomic changes impose a spatial effect on neighborhood distributions, and the spatial patterns of the neighborhood distribution may affect employment accessibility. Meanwhile, changes in residential location choice may occur in response to changes in

employment accessibility, which may then result in changes in the population and employment distribution. Spatial changes in the neighborhood distribution may lead to changes in the socioeconomic characteristics of neighborhoods to a certain extent. These three components are analyzed across the temporal dimension, providing us with a better understanding of neighborhood change. This dissertation aims to complement the existing literature by examining not only the relationships between neighborhood composition, spatial distribution, and employment accessibility, but also the relationships between neighborhood change, spatial transformation, and corresponding changes in employment accessibility.

Figure I-1 An integrated framework of neighborhood change



5 Research questions

The objective of this research is to contribute to the ongoing theoretical and policy debates regarding trends in neighborhood change across the United States, the extent of the changes in suburban diversity, and the high-resolution changes of socio-spatial structure and their relationships with employment accessibility.

The primary questions to be examined in this research are:

- (1) How has neighborhood change evolved over time and across regions in metropolitan America?
- (2) Has suburban diversity increased over time in terms of neighborhood typologies?
- (3) How do the spatial patterns of neighborhood distribution and transformation influence employment accessibility?

This study is also designed to answer the following related queries:

- (1) What are the dominant types of neighborhood change in metropolitan America?
- (2) Which types of neighborhoods are more likely to experience upward or downward movement, or remain stable over time?
- (3) What implications does neighborhood change portend for specific demographic groups?
- (4) Which factors are correlated with changes in suburban diversity and to what extent?
- (5) What are the spatial patterns of neighborhood distribution and transformation?
- (6) How do employment accessibility and its associated changes vary by neighborhood typology?

6 Organization

Centered on the overarching theme of neighborhood change, the essays presented in this dissertation are organized into five chapters. Focusing on socioeconomic and temporal dimensions, the first essay (presented in Chapter 2) systematically examines trajectories of neighborhood change for all metropolitan areas in the United States during the last two decades. The second essay (presented in Chapter 3) explores the mechanisms by which metropolitan and suburban characteristics influence suburban diversity in terms of the typologies of neighborhoods. This essay mainly focuses on socioeconomic and temporal dimensions, and briefly discusses regional differences in suburban diversity. The third essay (presented in Chapter 4) introduces an integrated framework to explore not only the spatial patterns of neighborhood distribution and transformation across neighborhood typologies, but also their relationships with employment accessibility over the last three decades in the North Carolina Piedmont region. The final chapter summarizes the findings of the dissertation and suggests several key elements of a further research agenda.

Reference

- Bourdieu P, 1985, "The social space and the genesis of groups" *Social Science Information* **24**
195-220
- Burgess E W, 1925, "The growth of the city: An introduction to a research project. In R. LeGates
& F. Stouts (Eds.), *The inner city reader*. New York: Routledge."
- Cervero R, 1989 *America's Suburban Centers: The Land Use-Transportation Link* (Unwin
Hyman, Boston, MA)
- Cervero R, Wu K-L, 1997, "Polycentrism, commuting, and residential location in the San
Francisco Bay area" *Environment and Planning* **29** 865 – 886
- Champion A G, 1994, "International Migration and Demographic Change in the Developed
World" *Urban Studies* **31** 653-677
- Charles C Z, 2003, "The dynamics of racial residential segregation" *Annual Review of Sociology*
29 167-207
- Chi G, 2011, "An Integrated Framework of Population Change: Influential Factors, Spatial
Dynamics, and Temporal Variationmore" *Growth and Change* **42** 549-570
- Clark W A V, 1998, "Mass Migration and Local Outcomes: Is International Migration to the
United States Creating a New Urban Underclass?" *Urban Studies* **35** 371- 383
- Coulton C, Theodos B, Turner M A, 2009, "Family mobility and neighborhood change", (The
Urban Institute)
- Dawkins C, 2004, "Measuring the spatial pattern of residential segregation" *Urban Studies* **41**
833-851
- Fischer M J, 2003, "The relative importance of income and race in determining residential
outcomes in U.S. urban areas, 1970-2000" *Urban Affairs Review* **38** 669-696

- Fong E, Shibuya K, 2003, "Economic changes in Canadian neighborhoods" *Population Research and Policy Review* **22** 147–170
- Freeman L, 2002, "Does Spatial Assimilation Work for Black Immigrants in the US?" *Urban Studies* **39** 1983-2003
- Freeman L, 2005, "Displacement or Succession?: Residential Mobility in Gentrifying Neighborhoods" *Urban Affairs Review* **40** 463-491
- Freeman L, 2009, "Neighbourhood Diversity, Metropolitan Segregation and Gentrification: What Are the Links in the US?" *Urban Studies* **46** 2079-2101
- Frey W H, 1995, "Immigration and Internal Migration 'Flight' from US Metropolitan Areas: Toward a New Demographic Balkanisation" *Urban Studies* **32** 733-757
- Galster G C, Quercia R G, Cortes A, Malega R, 2003, "The Fortunes of Poor Neighborhoods" *Urban Affairs Review* **39** 205-227
- Garreau, 1988, "Edge cities" *Landscape Architecture* **78** 48-55
- Hanlon B, Vicino T, Short J R, 2006, "The New Metropolitan Reality in the US: Rethinking the Traditional Model" *Urban Studies* **43** 2129 - 2143
- Hollander J B, 2010, "Can a City Successfully Shrink? Evidence from Survey Data on Neighborhood Quality" *Urban Affairs Review* **47** 129-141
- Hoover E M, Vernon R, 1959 *Anatomy of a metropolis* (Harvard University Press, Cambridge, MA)
- Kearsley G W, 1983, "Teaching Urban Geography: The Burgess Model" *New Zealand Journal of Geography* **75** 10-13
- Kitchen P, Williams A, 2009, "Measuring Neighborhood Social Change in Saskatoon, Canada: A Geographic Analysis" *Urban Geography* **30** 261-288

- Lang R E, 2003, "Edgeless cities : exploring the elusive metropolis " *Washington, D.C. :*
Brookings Institution
- Liu F, 1997, "Dynamics and causation of environmental equity, locally unwanted land uses, and neighborhood changes" *Environmental Management* **21** 643-656
- Marcuse P, 1989, "'Dual City': a muddy metaphor for a quartered city" *International Journal of Urban and Regional Research* **13** 697-708
- McDonald J, Prather P, 1994, "Suburban Employment Centres: The Case of Chicago" *Urban Studies* **31** 201-218
- McMillen D P, 2001, "Nonparametric Employment Subcenter Identification" *Journal of Urban Economics* **50** 448-473
- Mikelbank B A, 2011, "Neighborhood D é à Vu: Classification in Metropolitan Cleveland, 1970-2000" *Urban Geography* **32** 317-333
- Mun̄eiz I, Galindo A, Garc ía M A, 2003, "Cubic spline population density functions and satellite city delimitation: the case of Barcelona" *Urban Studies* **40** 1303-1321
- Musterd S, Zelm I v, 2001, "Polycentricity, Households and the Identity of Places" *Urban Studies* **38** 679-696
- Newbold K B, Spindler J, 2001, "Immigrant Settlement Patterns in Metropolitan Chicago" *Urban Studies* **38** 1903-1919
- Newman K, Ashton P, 2004, "Neoliberal urban policy and new paths of neighborhood change in the American inner city" *Environment and Planning A* **36** 1151 - 1172
- Park R A, 1952, "Human communities" *Glencoe, IL: Free Press*
- Pivo G, 1993, "A Taxonomy of Suburban Office Clusters: The Case of Toronto" *Urban Studies* **30** 31-49

- Reibel M, 2011, "Classification Approaches in Neighborhood Research: Introduction and Review" *Urban Geography* **32** 305-316
- Rephann T J, Holm E, 2004, "Economic-Demographic Effects of Immigration: Results from a Dynamic Spatial Microsimulation Model" *International regional science review* **27** 379-410
- Roca Cladera J, Marmolejo Duarte C R, Moix M, 2009, "Urban Structure and Polycentrism: Towards a Redefinition of the Sub-centre Concept" *Urban Studies* **46** 2841-2868
- Simpson L, Gavalas V, Finney N, 2008, "Population Dynamics in Ethnically Diverse Towns: The Long-term Implications of Immigration" *Urban Studies* **45** 163-183
- Temkin K, Rohe W, 1996, "Neighborhood Change and Urban Policy" *Journal of Planning Education and Research* **15** 159-170

II. Chapter 2 Neighborhood Change in Metropolitan America

1 Introduction

Neighborhood change has been a major concern of urban planners and policy makers for several decades. The theories of neighborhood change, such as invasion-succession model (Burgess, 1925), filtering model (Hoyt 1939), and neighborhood life-cycle model (Downs, 1981; Hoover and Vernon, 1959), have emphasized downward movement as the dominant component of neighborhood change. Neighborhoods change as higher-income residents are replaced by lower-income residents. Residents begin to move when a neighborhood is perceived to have deteriorated to a certain degree, and the housing chain finally ends in concentrated abandonment and permanent vacancies (Bier, 2001; Megbolugbe, 1996). In these classic models, neighborhood change occurs along a predictable downward succession in terms of income or racial composition. Decades ago, the realities of neighborhood transition could be captured using these models. However, these models may overlook the current and emerging issues surrounding the complexity of neighborhood change in metropolitan America.

The orthodox view of the inevitability of neighborhood succession has been challenged by some more recent studies of neighborhood change. Gentrification, specifically, suggests a process in which higher-income residents displace lower-income households in a neighborhood. This process has the potential to revitalize distressed cities, though the threat of displacement as a result of gentrification has become a major concern (Freeman, 2005; Lees et al., 2008; Ley and Dobson, 2008). During the 1990s and early 2000s, certain types of neighborhoods in many revitalizing cities experienced gentrification (Coulton et al., 2009; Hudson, 1980; Newman and

Ashton, 2004). In addition to the gentrification observed in central cities, suburbs, especially older, inner-ring suburbs, have also experienced the class-based processes of neighborhood upgrading (Charles, 2011).

The transformation of the demographic and economic structure of metropolitan areas has led to a growing heterogeneity of metropolitan America. Gentrification and the increased heterogeneity of metropolitan America may suggest a corresponding increase in the types of neighborhood change. Thus, neighborhoods may go beyond the simple downgrading movement that has been identified by the classic models. Neighborhoods may change in a more complex way that is difficult to anticipate or predict (Coulton et al., 2009). Yet we know relatively little about these new patterns of neighborhood change in metropolitan America.

In the literature, neighborhood transition generally refers to one of several specific changes in household /family income, poverty rate, or racial/ethnic composition, and, to a lesser degree, shifts in owner-occupied housing price, occupation, or unemployment rate (Denton and Massey, 1991; Galster et al., 2003; Hanlon et al., 2006; Morrow-Jones and Wenning, 2005; Schwab, 1987; Williams and Kitchen, 2009). In reality, however, a neighborhood is a geographic unit with a bundle of spatially-based attributes (Galster, 2001). Using the change of a single indicator as a proxy for neighborhood transition may neglect other important factors that crucially shape the trajectories of neighborhood change. Although some studies have investigated the increased diversity of neighborhoods across a multidimensional array of indicators, these studies have merely constructed neighborhood typologies without exploring the changes that accompany those typologies.

A few studies have examined multidimensional attributes to explore the longitudinal changes of neighborhoods. For example, employing a cluster analysis on 825 census tracts from

1970 to 1990 in Chicago, Morenoff and Tienda (1997) developed a multidimensional typology of neighborhoods with a set of ten variables. The typology consists of four ecological categories: stable middle-class, gentrifying yuppie, transitional working-class, and ghetto underclass. Based on the four typologies, this study examined the path of neighborhood change and documented the increasing spatial polarization and emergence of Hispanic neighborhoods in Chicago. Performing a cluster analysis using tract-level demographic, socioeconomic and housing data across four decades, Mikelbank (2011) created a combined taxonomy of neighborhood conditions in metropolitan Cleveland. He revealed five types of neighborhoods: struggling, struggling African American, stability, new starts, and suburbia. He also investigated the ways in which these neighborhoods changed through time and across space. Though these studies do suggest a gradually increased interest in the multidimensional neighborhood transition, existing research has focused largely on a single metropolitan area. Generalizing the results of these studies to places in other geographic locations is difficult.

In this study, I assume that trajectories of neighborhood change will go beyond the simple downward or upward process, in which lower-income and higher-income households replace each other; they will also go beyond a linear, evolutionary process involving predictable neighborhood stages. By analyzing decennial tract-level data between 1990 and 2010 for all metropolitan and micropolitan areas in the United States, this study will address the following research questions: (1) What are the typologies of neighborhoods with multidimensional attributes? (2) Other than succession and gentrification, what other patterns of neighborhood change can be observed? (3) Does neighborhood change vary across regions? (4) What implications does neighborhood change have for neighborhood theories and practices? By answering these questions, this work will provide chronologically and geographically systematic

insight into American metropolitan regions, and a chance to test the realities of neighborhood change over the last two decades.

2 Data

The data used in this analysis are derived from Longitudinal Tract Data Base (LTDB) and prepared by Spatial Structures in the Social Sciences (S4). The LTDB data include two standard data sets. One is the data drawn from the full-count census, including the key variables from the 2010 Census and comparable variables from the 1970 to 2000 censuses. The other set contains data based on sample counts, which are available through the American Community Survey (2006-2010), and one-in-six decennial census samples (1970-2000). The LTDB data set has been standardized to 2010 boundaries. The variables used in this analysis are calculated based on these two data sets.

This study focuses on neighborhood change in Metropolitan and Micropolitan Statistical Areas in the US from 1990 to 2010. For each census year during this period, there are 65,535 tracts in the original data set. I have deleted 4,730 tracts from each census year because these tracts do not belong to any metropolitan or micropolitan area according to the Office of Management and Budget's (OMB) 2009 definitions of these terms. In addition, those tracts with a population less than 500 in the full-count data set have been excluded from the analysis. The reason for eliminating these tracts was to avoid estimates based on a small amount of data (Bench, 2003). After excluding these tracts, the data in this study include 58,801, 59,837, and 60,078 tracts for 1990, 2000 and 2010, respectively. The study areas contained over 209.57 million people in 1990, 237.68 million in 2000, and 255.99 million in 2010. All tracts in each

census year were entered into one clustering procedure. Thus, the total number of observations considered in the cluster analysis is 178,716.

According to the literature, many variables are utilized to develop neighborhood typologies. These variables are related to race and ethnicity, age structure, family structure, household/family income, educational attainment, unemployment, immigrant status, and housing characteristics (Hanlon, 2009; Mikelbank, 2004, 2011; Morenoff and Tienda, 1997; Williams and Kitchen, 2009). All these variables are powerful indicators that differentiate categories of neighborhoods. In this study, sixteen variables that related to these dimensions were divided into three major categories: demographic, socioeconomic, and housing characteristics. I followed the pooled sample and z-score procedures introduced by Mikelbank (2011). Each of these variables for each tract was standardized as a z-score relative to all the other tracts in the same census year. A positive z-score reflects a level higher than the national average, and a negative score reflects a lower-than-average level.

3 Methodology

3.1 K-means cluster analysis

K-means cluster analysis was chosen to identify neighborhood typologies over the time period of 1990 to 2010. Facing the task of classifying all census tracts into certain types of groups, we generally have two options using cluster analysis: the single-tier methods typified by k-means partitioning, and the hierarchical methods. The algorithm of k-means is completely different from that of the hierarchical method. Instead of merging (or dividing) one of the observations into (or from) established clusters stepwise, the k-means method first identifies k observations as starting points and starting groups, assigning each observation in the sample to

these k clusters in an exclusive and exhaustible way. Centroids of these initial k clusters are calculated in terms of, for example, Euclidean distance, and all observations are clustered once again around the new centroids observations. The process is carried out iteratively until the dissimilarity between each pair of k clusters is maximized.

Hierarchical methods are usually preferred to single-tier methods in that all grouping possibilities, i.e., from 1 to n (the number of observations), are exhaustively tried from the closest pair, merging one observation with each step. The optimal grouping is ‘endogenously’ decided and judged by the large break in the percentage change in the dissimilarities when the number of groups is extended or decreased. Conversely, in k -means clustering, the number of groups is ‘exogenously’ decided (to be k , as the name suggests). Furthermore, in k -means analysis, failure to locate the appropriate starting points could lead to a poor performance.

Nevertheless, k -means clustering is not without value. Firstly, the idea behind hierarchical clustering fits better with biology, in which clusters are formulated gradually. This is not necessarily the case in the field neighborhood research. Secondly, clusters formed in previous steps can never be corrected in hierarchical clustering, so any faulty decisions cannot be undone. The k -means method, on the other hand, iterates the grouping process and adjusts grouping until a satisfactory dissimilarity coefficient is achieved, ensuring that mistakes may be overcome. Finally, the k -means method is good for large sample calculation (Gan et al., 2007), as in this research. The k -means method, therefore, serves as a good alternative to hierarchical clustering in neighborhood research.

3.2 Clustergram

Given that most large datasets may contain masking outliers and other deviations, non-hierarchical clustering methods rarely yield a clear partitioning structure of the data on a first

pass. This complicates the identification and selection of a stable number of clusters. One way to overcome the cluster selection problem is by relying on data visualization, using clustergrams that guide the choice of the number of clusters. I adopted this strategy and followed the visualization procedure introduced by Henning and Chrislieb (2002) and Schonlau (2004). The clustergram is used to examine how the members of these clusters are formed as the number of clusters increases. The width of the line segments indicates the number of observations that are assigned to a cluster.

3.3 Discriminant analysis

As one of many multivariate techniques, the basic objective of discriminant analysis is to build rules or classification schemes that can classify observations into appropriate populations (Johnson, 1998). It can also be used to describe or reveal major differences among groups (Stevens, 2001). In this study, discriminant analysis was used to test the internal validity of the cluster analysis (Hill et al., 1998) and to explore the relative importance of variables in differentiating neighborhood typologies.

4 Results

4.1 Cluster Identification

Before jumping to the task of analyzing neighborhood change, I needed to specify the number of neighborhood clusters using a k-means cluster analysis. No single algorithm used in k-means cluster analysis is perfect for any one clustering task. Usually, several algorithms are applicable, and academic insights and experiences play an important role in producing satisfactory results.

In k-means cluster analysis, an important task is to pre-specify the number of clusters. Although this would seem irrational, the purpose of the study and my prior knowledge of American neighborhoods, as well as my tentative anticipated results, helped us to surmount this difficulty. Previous empirical studies have produced classifications of between four and ten distinct types of neighborhoods (Hanlon, 2009, 2010; Hanlon et al., 2006; Mikelbank, 2004; Orfield, 2002). In seeking to delineate the neighborhood change in US metropolitan areas over time, I therefore anticipated a similar degree of differentiation.

A k-means cluster analysis partitioned the pooled tract-level data of 178,716 observations into 2 to 10 groups by selecting different initial groups in STATA. A clustergram was plotted multiple times based on various clustering algorithms. These graphs were then compared to each other in order to observe the stability of the cluster formation. By examining the Calinski/Harabasz index, the clustergram, the meaning of each cluster selection, and the cross-validation in JMP for all those tentative results, a seven-cluster solution, with the first k observations as the initial group centers, was confirmed as the optimal model.

Here, I only report the results of clustering process with the first k observations as the initial group centers. First, based on the Calinski/Harabasz pseudo-F test, the two-, three-, four- and seven-group solutions had the largest values (Table II-1), so they were selected as the candidates for the final choice of clusters. For k-means clustering, a graph like the dendrogram, which is used in hierarchical cluster analysis, does not exist. Following a visualization technique introduced by Schonlau (2004), a clustergram (Figure II-1) was computed for the pooled data of the 16 variables. The clustergram indicated the relative stability of the seven-cluster choice even at the higher-order specifications. Then, the means and standard deviations of the initial two-, three-, four-, and seven-cluster models were compared, and the seven-group solution provided

more detailed and accurate descriptions of neighborhood characteristics in the US. Finally, cross-validation in JMP confirmed this seven-cluster solution. Figure II-2 shows a biplot of the tracts and clusters in the first two principal components of the data. Biplots are useful procedures in exploratory data analysis and allow the visualization of points (tracts in this study) depending on clusters. A circle with an area proportional to the number of points in the cluster was drawn around the cluster centers. Figure II-3 illustrates a three-dimensional biplot of the data. The two figures illustrate how these clusters are distributed, and their relative distances in both two and three dimensions.

Table II-1 Calinski/Harabasz index

umber of Clusters	Calinski/Harabasz pseudo-F
2	38098.97
3	35550.98
4	29755.40
5	27152.59
6	25455.20
7	27801.44
8	25041.71
9	23895.98
10	22661.29

Figure II-1 Visualization of clusters via Clustergram

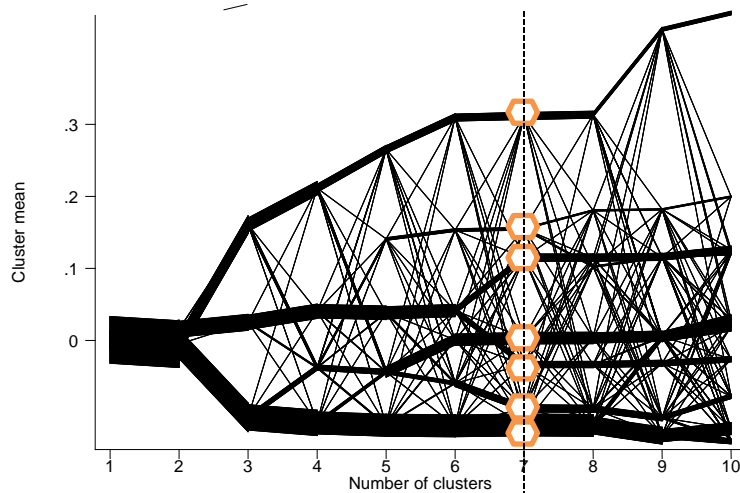


Figure II-2 Biplot of the tracts and clusters in the first two principal components

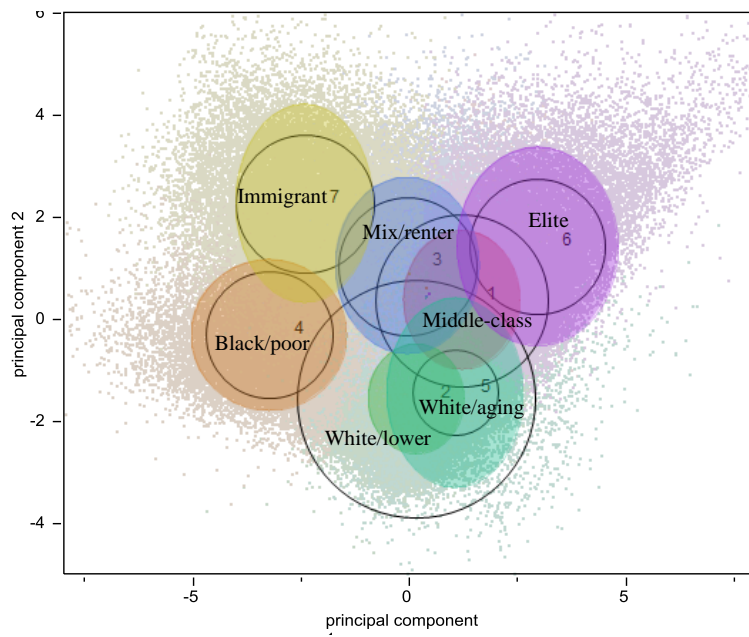
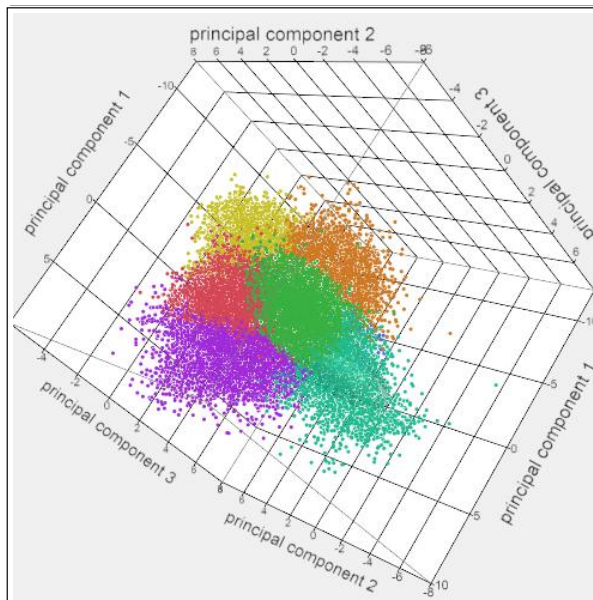


Figure II-3 Biplot of the points and clusters in the first three principal components



4.2 Neighborhood Typology

The important questions following the cluster analysis were: (1) how well are the neighborhoods classified? and (2) which variables used in the k-means cluster analysis best explain the neighborhood differentiation? In order to answer these questions, discriminant analysis was employed to study the differences between groups of neighborhoods with respect to multiple variables simultaneously. The percent of misclassified neighborhoods was 7.2, which meant that more than 92 percent of neighborhoods were appropriately classified. A canonical discriminant function is a linear combination of the variables, which is used to study the nature of group differences. Functions with larger eigenvalues are more powerful discriminators. Table II-2 shows the eigenvalues of each function, and thus indicates the importance of each function. The first four discriminant functions, which had the largest eigenvalues, explained more than 85 percent of total variances, and significantly contributed to our understanding of group differences (Wilks' Lambda=0.0037). The last two functions with small eigenvalues and relative percentages were weak relative to the first four functions. Thus, we used the first four functions to investigate the relative importance of the variables.

Table II-2 Eigenvalues and measures of importance

Canonical Discriminant Function	Eigenvalue	Relative Percentage	Cumulative Percentage	Canonical Correlation
1	3.373	33.129	33.129	0.878
2	2.568	25.224	58.353	0.848
3	1.427	14.016	72.370	0.767
4	1.289	12.655	85.025	0.750
5	0.841	8.264	93.289	0.676
6	0.683	6.711	100	0.637

The relative importance of the variables can be determined by examining the magnitude of the standardized score coefficients of each function (Table II-3): the larger the magnitude (ignoring the sign), the greater the variable's contribution. For Functions 1 and 2, the percentage of black and Hispanic residents made the greatest contribution. Educational attainment had the

highest standardized coefficient in Function 3. Other variables, such as housing values, rent, household income, and immigrant percentage, made somewhat similar contributions to this discriminant function. For Function 4, the percentage of vacant housing units was most important, and the percentage of persons age 60 years is the second most significant variable. As expected, race and ethnicity, immigrant percentage, socioeconomic status, and housing characteristics played important roles in the differentiation of neighborhood typologies, which is consistent with findings in the literature of neighborhood typologies (Hanlon, 2009; Hanlon et al., 2006; Orfield, 2002; Shevky and Bell, 1955). According to the importance of variables (Table II-3) and the z-score means of the variables in each cluster (Table II-4), the seven clusters are labeled as “*middle-class*,” “*white/lower*,” “*mix/renter*,” “*black/poor*,” “*white/aging*,” “*elite*,” and “*immigrant*.”

Table II-3 Standardized canonical discriminant function coefficients

variables	Function1	Function2	Function3	Function4
percentage of persons age 17 years and under	-0.123	0.002	0.098	-0.027
percentage of persons age 60 years and over	0.057	0.172	-0.255	0.571
percentage of persons of white race, not Hispanic origin	0.243	0.076	-0.223	-0.123
percentage of persons of black race, not Hispanic origin	-0.536	0.500	0.143	0.070
percentage of persons of Hispanic origin	-0.334	-0.578	-0.243	0.129
percentage of owner-occupied housing units	0.167	0.129	-0.120	0.041
percentage of vacant housing units	0.065	0.177	-0.318	0.719
Median monthly contract rent	0.085	-0.026	0.266	0.244
Median home value	0.071	0.011	0.246	0.141
percentage of foreign-born	-0.080	-0.229	-0.216	0.101
percentage of persons with at least a four-year college degree	-0.046	-0.123	0.371	0.150
percent unemployed	-0.194	0.109	0.131	0.081
percentage of manufacturing employees (by industries)	-0.031	0.046	-0.158	-0.160
Median household income	0.067	-0.099	0.243	0.122
percentage of structures built more than 30 years ago	-0.175	0.025	-0.022	-0.094
percentage of household heads moved into unit less than 10 years ago	0.046	-0.044	-0.038	0.120

Table II-4 Z-score means across clusters

Variable	Middle-class	White/lower	Mix/renter	Black-poor	White/aging	Elite	Immigrant
Demographic							
percentage of persons age 17 years and under	0.50	-0.04	-1.16	0.65	-1.34	-0.36	0.85
percentage of persons age 60 years and over	-0.60	0.27	-0.26	-0.22	2.41	0.29	-0.61
percentage of persons of white race, not Hispanic	0.34	0.62	-0.05	-1.68	0.67	0.35	-1.50
percentage of persons of black race, not Hispanic	-0.29	-0.31	-0.05	2.57	-0.47	-0.44	-0.14
percentage of persons of Hispanic origin	-0.20	-0.43	-0.05	-0.31	-0.33	-0.28	2.29
percentage of foreign-born	-0.25	-0.55	0.36	-0.32	-0.25	0.27	1.78
Socioeconomic Status							
percentage of persons with at least a four-year college	0.45	-0.45	0.66	-0.76	-0.02	1.43	-0.75
percent unemployed	-0.50	-0.17	-0.07	1.60	-0.17	-0.60	0.65
percentage of manufacturing employees (by industries)	-0.21	0.56	-0.67	-0.19	-0.73	-0.35	0.14
Median household income	0.67	-0.28	-0.40	-0.92	-0.23	1.69	-0.57
Housing characteristics							
percentage of owner-occupied housing units	0.53	0.41	-1.32	-0.75	0.55	0.57	-0.84
percentage of vacant housing units	-0.32	-0.11	-0.01	0.52	2.86	-0.52	-0.18
Median monthly contract rent	0.35	-0.57	0.16	-0.60	0.08	1.52	0.02
Median home value	0.06	-0.50	0.18	-0.60	0.02	1.78	0.01
percentage of structures built more than 30 years ago	-1.19	0.24	0.20	0.71	-0.78	0.31	0.37
percentage of household heads moved into unit less	0.70	-0.55	0.96	-0.23	0.21	-0.67	0.32

4.3 Trajectories of neighborhood change

This section turns to describe the trajectories of neighborhood change. It will first examine the temporal changes across the seven neighborhood clusters from 1990 to 2010. Sequences of neighborhood change will then be identified based on the types of clusters in three continuous census years. Finally, this section will describe the trajectories of neighborhood change from 1990 to 2010.

4.3.1 Temporal changes across typologies

Table II-5 highlights the changes in the numbers and percentages of tracts for the seven clusters in 1990, 2000 and 2010. At the beginning as well as by the end of the study period, the *white/lower* and *middle-class* neighborhoods outnumbered the other clusters, while *white/aging* accounted for the smallest number of the tracts. The *immigrant* and *black/poor* neighborhoods, featuring the two lowest household incomes among the seven clusters, grew steadily over time. In particular, America has witnessed a dramatic increase of *immigrant* neighborhoods, especially

in the South and West. *Immigrant* neighborhoods accounted for 9.47 percent of all tracts in 1990, and by 2010 they represented more than 13 percent. While the share of *elite* neighborhoods declined moderately from 1990 to 2000, it began to rise after 2000, reaching its peak in 2010. The data show a shrinking of the middle layers in terms of household income. The *middle-class* neighborhoods accounted for almost 20 percent of all tracts in 1990, but by 2010 they represented only 15.5 percent. Increases in the size and shares of neighborhoods on the two extremes, the top and the bottom, were paralleled by the simultaneous decline of the middle layers. Thus, neighborhoods in metropolitan America have become more polarized over time.

Table II-5 The numbers and percentages of tracts across clusters over time

		middle-class	white/lower	mix/renter	black/poor	white/aging	elite	immigrant
1990	Tracts	11749	20505	6473	5358	2656	6435	5570
	Share	19.98%	34.87%	11.01%	9.11%	4.52%	10.94%	9.47%
2000	Tracts	10950	20332	6837	5841	2569	6210	7038
	Share	18.30%	33.98%	11.43%	9.76%	4.29%	10.38%	11.76%
2010	Tracts	9323	20070	7164	6004	2468	7064	7852
	Share	15.52%	33.41%	11.92%	9.99%	4.11%	11.76%	13.07%

4.3.2 Sequences of neighborhood change

In this study, neighborhood change is defined as the socioeconomic transition of a neighborhood from one cluster to another between census years. Thus, a sequence of neighborhood change could be identified based on the cluster in each subsequent census year. There are 280 different sequences of neighborhood change. Table II-6 shows the first 39 sequences, which explain more than 90 percent of the total tracts. Each three-digit number represents a neighborhood type in each census year from 1990 to 2010. For example, the sequence “227” specifies those type 2 tracts (*white/lower*) in 1990 which remained the same in 2000, and changed to type 7 (*immigrant*) in 2010.

Table II-6 The first 39 sequences of neighborhood transitions

Cluster Change 90-00-10	Tracts	Tracts%
222	15666	26.868
111	5689	9.757
666	4727	8.107
777	4605	7.898
444	4193	7.191
333	4036	6.922
555	1748	2.998
112	1279	2.194
122	998	1.712
211	718	1.231
116	635	1.089
221	593	1.017
224	499	0.856
377	499	0.856
177	427	0.732
223	401	0.688
166	397	0.681
244	389	0.667
277	384	0.659
133	347	0.595
227	341	0.585
212	335	0.575
113	329	0.564
117	309	0.530
233	290	0.497
337	264	0.453
773	247	0.424
662	234	0.401
443	215	0.369
622	215	0.369
121	207	0.355
336	203	0.348
477	202	0.346
633	195	0.334
636	178	0.305
447	172	0.295
552	150	0.257
344	148	0.254
733	145	0.249

1: middle-class; 2: white/lower; 3: mix/renter; 4: black/poor; 5: white/aging; 6: elite; 7:

The most striking finding of Table II-6 is that metropolitan America is dominated by neighborhoods that are relatively stable in their socioeconomic attributes. This neighborhood stability may challenge the long established assumptions of neighborhood succession. The first seven sequences (222, 111, 666, 777, 444, 333 and 555), or neighborhoods that remained stable for all three census years, accounted for 69.74 percent of the total tracts. Another aspect of neighborhood stability is highlighted in Table II-6: neighborhoods tended to remain the same over at least two successive census years. This includes two scenarios. The first scenario is that a neighborhood had the same type in 1990 and 2000, and a different type in 2010. The other

scenario is that a neighborhood had the same type in 2000 and 2010, and a different type in 1990. Three sequences (212, 121, and 636) in Table II-6 reflect neighborhoods that reverted to their original state; in other words, they are another form of stable neighborhood. In sum, the sequences of neighborhood change reveal a tendency of most neighborhoods to remaining in one stage of the life cycle over at least two successive census years.

4.3.3 Trajectories of neighborhood change

The large-scale stability of neighborhoods raises concerns about the trajectories of change among the seven clusters. Table II-7 displays a total of 49 types of neighborhood change among the 7 clusters. Table IV-1 in Appendix A shows neighborhood change across metropolitan statistical areas. The main diagonal reveals that the stable neighborhoods dominate metropolitan America, which further confirms the results of the sequences of neighborhood change. But which types of neighborhoods are more likely than others to remain stable over time? What are the patterns of neighborhood change? Are there regional differences among these changes? Before these questions can be answered, I first must define several concepts. Upward movement, or upgrading, is defined as a lower class neighborhood moving upward into an upper class neighborhood in terms of household income, and downward movement, or downgrading, is when an upper class neighborhood moves downward into a lower class neighborhoods.

Table II-7 Neighborhood transitions from 1990 to 2010

From cluster state: neighborhood type in 1990	To cluster state: neighborhood type in 2010								Pct. Of neighborhoods remaining in same cluster
	middle-class	white/lower	mix/renter	black/poor	white/aging	elite	immigrants	total	
middle-class	6123	2421	752	279	142	1108	845	11670	52.47
white/lower	1336	16225	731	932	203	160	797	20384	79.60
mix/renter	266	253	4360	305	58	357	801	6400	68.13
black/poor	50	233	327	4286	19	22	378	5315	80.64
white/aging	231	302	152	19	1835	45	55	2639	69.53
elite	190	481	314	37	40	5218	144	6424	81.23
immigrants	92	78	416	133	20	82	4698	5519	85.12
total	8288	19993	7052	5991	2317	6992	7718	58351	

(1) *Neighborhood stability*

The last column of Table II-7 shows that the tendency of neighborhoods to remain in the same cluster is particularly pronounced along the two extremes: the *immigrant* and *black/poor* neighborhoods on one extreme, and the *elite* neighborhoods on the other. Compared to the two extremes, the *middle-class* neighborhoods were the least likely to remain the same over time, with more than 47 percent of them transitioning out of that category in either 2000 or 2010. This finding is consistent with some studies that examined the neighborhoods that remained stable during a certain period of time. Morenoff and Tienda (1997) found that the ghetto underclass and gentrified neighborhoods in Chicago were more stable and experienced less transition than other types of neighborhoods. As Galster et al. (2007) have pointed out, the neighborhood change that has been observed in history, especially explosive racial transition, may simply be an exception. The higher stability of *black/poor* and *immigrant* neighborhoods reflects the enduring concentration of poverty and racial minorities in metropolitan areas (Megbolugbe et al., 1996; Quercia and Galster, 2000).

Today, large differences among racial and ethnic minorities continue to exist in many areas (Blank et al., 2004). Discrimination in the housing market or exclusionary zoning may still play a significant role in the enduring *black/poor* neighborhoods (Price-Spratlen and Guest, 2002). Furthermore, once an immigration gateway is established, that area will continue to attract higher proportions of immigrants (Frey, 1995a), although a large number of immigrants gravitate to new areas (Painter and Yu, 2008). Factors such as the effect of pioneer immigration, chain immigration and family building (Frey, 1995b; Simpson et al., 2008) may lead to high stability of *immigrant* neighborhoods. The high stability of *elite* neighborhoods could be due to the higher-status households' security and satisfaction with their homes and neighborhoods (Coulton

et al., 2009). It may also reflect the “enchanted spaces” created by American intellectuals and design professionals (Knox, 2008).

(2) *Neighborhood succession*

Despite the stability of most neighborhoods, other neighborhoods have changed their attributes in the last two decades. The *middle-class* and *elite* neighborhoods have been dominated primarily by downward movements. More than 20.7 percent of *middle-class* neighborhoods have changed to *white/lower* neighborhoods. Some neighborhoods, first developed for the *elites*, became either *middle-class* or *white/lower* neighborhoods over time. The Midwest and Northeast regions have undergone downward movements that are considerably higher than the national average. These neighborhoods were highly concentrated in the Rust Belt areas, such as New York, Chicago, and Detroit. These once-prosperous metropolitan areas have been affected by deindustrialization, and the problems associated with the Rust Belt may lead to the downward movements of neighborhoods in those areas.

Other types of neighborhood succession include the changes from *middle-class* and *elite* to *white/aging* and *mix/renter* neighborhoods. This study shows that most neighborhoods that shifted from *middle-class* and *elite* to *white/aging* neighborhoods are located in Miami, FL, Tampa, FL, Phoenix, AZ, Tucson, AZ, and New York. In addition, more than 75 percent of the changes from *middle-class* to *mix/renter* neighborhoods are found in the South and West, such as the metropolitan areas of Las Vegas, Sacramento, Dallas, and Phoenix. Another 16.5 percent of these changes are located in the Midwest, such as in Chicago. In contrast to the transitions from *middle-class* to *mix/renter*, most of the changes from *elite* to *mix/renter* neighborhoods are found in the Northeast and West regions. They were predominantly located in large metropolitan areas such as New York, Los Angeles, Boston, and San Francisco. Some of them can be found in the

South and Northeast, such as in the Washington DC, Chicago, and Philadelphia Metropolitan areas.

Most of the neighborhood successions listed above confirms the classic theories of neighborhood change, in which the socioeconomic status of inhabitants becomes successively lower (Liu, 1997). However, many of the downgrading movements skip the stages of relatively lower socioeconomic status by switching directly to the later stages of the neighborhood life cycle, stages that are dominated by underclass neighborhoods. For example, about 2.4 percent of *middle-class* neighborhoods changed directly into *black/poor* neighborhoods, which were predominantly located in the South. Most of these changes were in the suburbs of Atlanta, Memphis, and Washington DC. The concentration of a large black population in east Washington DC (Knox, 1987) and the emergence of black suburbs around Washington DC (Vicino et al., 2007) have been identified in the literature. In this study, I found that except for the stable *black/poor* neighborhoods, two thirds of the other *black/poor* neighborhoods in Washington DC were changed from either *middle-class* or *elite* neighborhoods (the other one third is *from mix/renter*). These changes varied in other metro areas; most of the *black/poor* neighborhoods were changed from *middle-class* in Atlanta, and from *mix/renter* and *elite* in New York. Furthermore, the downward movement to *immigrant* neighborhoods is located mostly in immigration gateways such as New York, Miami, Dallas, Washington DC, Los Angeles, Phoenix, or San Diego. The established and emerging gateways (Painter and Yu, 2008) may help to explain why changes to immigrant neighborhoods are mostly located in those metropolitan areas.

Examining new construction over the last two decades may help place these trends of downgrading in context. From 1990 to 2010, the overwhelming majority of new housing units

(about 70%) were located in the South and West, with development in the Midwest and Northeast lagging behind. Most of the metropolitan areas that have witnessed dramatic downward movements from higher-income to *mix/renter*, *white/aging*, *black/poor* or *immigrant* neighborhoods gained a large number of new residential constructions during the period under study. Downgrading movements are possible when new housing units on the periphery of cities attract the higher-income population, which creates new housing opportunities in the urban core, as well as in the suburban areas (Price-Spratlen and Guest, 2002). The higher number of new housing units in those metro areas explains these downgrading trends to a certain extent.

(3) *Neighborhood upgrading*

The last two decades have witnessed dramatic neighborhood stability and succession to a lesser extent. However, there still has a trend of “neighborhood upgrading,” with lower class neighborhoods upgrading into upper class neighborhoods. *White/lower* neighborhoods, in particular, are more likely to attract higher income households to a certain critical point in order to upgrade into *middle-class* neighborhoods. This kind of change is mostly located in the South and Midwest, such as in Atlanta, Charlotte, Chicago, and St. Louis, as well as in some of the large metropolitan areas of the Northeast and West, such as Philadelphia and Portland. These large metro areas provide more opportunities for the *middle-class* to upgrade into *elite* neighborhoods. *Mix/renter* and *white/aging* neighborhoods, mostly located in the South, have moved upward either to *middle-class* or *elite* neighborhoods.

Upgrading did occur among most types of neighborhoods, but the upward social ladder seems to become steeper for households in the underclass: *black/poor* and *immigrant* neighborhoods. However, small segments of some big metro areas have seen upgrading for the underclass neighborhoods, especially in central cities. In particular, underclass neighborhoods

upgrading into *middle-class* or *elite* neighborhoods are more often found in large metro areas such as New York, San Diego, Chicago, San Francisco, Los Angeles, and Atlanta.

According to the U.S. Environmental Protection Agency (2010), the share of new residential construction in central cities and old suburbs has increased strikingly in those metro areas. This trend toward more redevelopment in central cities and old suburbs may suggest heavy investment in those areas. In this situation, some underclass residential districts, as well as some *white/lower*, *mix/renter*, and *white/aging* neighborhoods, may remain, and have attracted gentrifiers in significant numbers, while others may have been razed, a block at a time, to provide single-family homes, townhomes, or condominiums for upper income households. Both scenarios may result in the neighborhood upgrading in the central cities and old suburbs of those metropolitan areas.

(4) Other neighborhood changes

Neighborhood change occurs across clusters over time. But what is the magnitude of the underlying changes that accompany those categorical shifts? By investigating the changes in z-score means, I found that most neighborhoods were undergoing significant and dramatic changes in at least one key indicator, and small to modest changes in other indicators, which barely pushed them over the border from one category to another. Therefore, neighborhoods may experience remarkable changes in some attributes, but a minor change in household income. These types of neighborhood change are difficult to classify into categories of either upgrading or downgrading. For example, *black/poor* neighborhoods are more likely to change into *immigrant* neighborhoods, and many *immigrant* neighborhoods will change to *black/poor*. These mutual transitions among underclass neighborhoods with similar social status can be identified as

the “neighborhood transition trap,” which is similar to the “poverty cycle” of families or “development trap” of countries in economics (Collier, 2007).

Other examples may include the changes between *white/lower* and *white/aging*, or between *mix/renter* and *immigrant* neighborhoods. *White/aging* neighborhoods generally emerge from neighborhoods that were previously *white/lower*. More than half of these changes are located in Sun Belt metropolitan areas in Florida, Arizona, South Carolina, North Carolina, etc. The other 47.5 percent of neighborhoods that changed in this way are located in the other three regions. The number of older residents varies considerably by state, with some states experiencing much greater growth than others. According to the US Census Bureau, the states of California, Florida, New York, and Texas have attracted large elderly populations in recent decades. The older population is growing most rapidly in the West, such as in the state of Arizona. Not surprisingly, neighborhoods in these states have changed more rapidly to *white/aging*. Since this study does not follow movers, these changes could be due to the influx of residents with entirely different socio-economic attributes, or could be the result of “aging in place” (Fitzpatrick and Logan, 1985; Frey, 2006; Lagory et al., 1980). No matter what the situation, an increased number of seniors, or an influx of seniors to an existing *white/lower* neighborhood, may result in considerable change to the age structure, family composition, educational attainment, vacancy rate or unemployment rate of the neighborhood. Although these kinds of changes only have a minor impact on the average household/family income in the neighborhoods, they may have substantially different repercussions for local services and facilities.

The mutual transitions among neighborhoods with similar household income also exist between *immigrant* and *mix/renter* neighborhoods. Most of the shifts between these two

classifications are located in immigrant gateways and big metro areas, especially in the West. However, central cities differ from suburbs in the patterns of these changes. Specifically, changes from *mix/renter* to *immigrant* neighborhoods occurred equally in both central cities and suburbs. However, neighborhoods that changed from *immigrant* to *mix/renter* are located predominantly in central cities (more than 86 percent). The city/suburb difference in the mutual transitions between *immigrant* and *mix/renter* neighborhoods is consistent with the findings that traditional influx patterns of immigration have changed since suburbs became the new destination of immigrants who “bypass the cities and settled directly in the suburbs” (Hanlon et al., 2010). In contrast, *mix/renters* are more likely to make their homes in central cities than are *immigrants*. Generally speaking, both clusters share similar features in many indicators, especially in housing characteristics and household income, but demographic compositions, educational attainment and unemployment rates differ widely, and these changes may challenge the existing policies or services in these communities.

5 Discussions and conclusions

Using the pooled tract-level data from 1990 to 2010, this research describes the typologies and trajectories of neighborhood transition in US metropolitan areas. It identifies a total of 280 actual sequences and 49 types of neighborhood change for the last two decades. Neighborhood change is not always a simple transition along a single indicator, nor is it always a predictable transition following the directions of either downgrading or upgrading. Neighborhood change is complicated and may include various trajectories and transitions. Although transformations that overcome wide gaps in race and income seem very difficult, all 49 types of changes do occur in metropolitan America to a certain extent. Understanding those

changes that do not fall under the frame of either downgrading or upgrading—for example, the changes between *mix/renter* and *immigrant* or between *white/lower* and *white/aging* neighborhoods—is very important for policymakers and practitioners in providing appropriate local services, support, or opportunities for the residents.

The trajectories of neighborhood change in this study reinforce some findings from prior research, and also offer some new insights into the patterns of neighborhood change. Specifically, this study makes several contributions to the existing literature and to our understanding of neighborhood change. First, the visualization technique of the clustergram is used to identify the best cluster choice. An important aspect of cluster analysis is cluster stability (note: cluster stability is different from neighborhood stability). Usually, the same data set may yield different cluster results when acted upon by different clustering algorithms. Some cluster results may be very stable and some may not. Nevertheless, the issue of cluster stability is generally ignored in the studies of neighborhood typologies. Based on the stability of cluster formation and other statistical tests in k-means cluster analysis and discriminant analysis, an intuitive and reliable set of seven neighborhood typologies in the US has been identified. The profiles of these seven clusters largely echo and also extend the findings of the existing literature on social class (Beeghly, 2004; Gilbert, 1998; Thompson and Hickey, 2005) and neighborhood typologies (Hanlon, 2009, 2010; Hanlon et al., 2006; Mikelbank, 2004; Orfield, 2002).

Second, this study investigates multidimensional neighborhood typologies using national data. Explanations and interpretations of neighborhood change only concerning a single indicator are not sufficient, as they explain only one aspect of this process. If a single indicator, for instance household income, is the only criteria we use to assess neighborhood transition, neighborhood changes that are not necessarily associated with changes in that indicator will be

ignored. Thus, a multidimensional approach is important in identifying the trajectories of neighborhood change. Additionally, this analysis at the national level captures the full landscape of neighborhood change in metropolitan America, which provides a chance to test classic theories and the realities of neighborhood change.

By examining the trajectories of multidimensional neighborhood change, this research reveals the trends of shrinking *middle-class* neighborhoods and the polarization of inequality in neighborhood distributions. Most *middle-class* neighborhoods are gradually either sinking to *white/lower* groups or rising into *elite* enclaves. The result of these transformations is the polarization of neighborhood inequality at both extremes of the social stratum. This confirms that the middle class has shrunk dramatically both in metropolitan areas and in the suburbs (Swanstrom et al., 2004) and the fact that there is a growing income inequality in metropolitan America (Booza et al., 2006; Swanstrom et al., 2004).

Broadly speaking, downward changes are usually interpreted under the general rubric of traditional models of neighborhood change. The findings in this study, however, reveal the primarily stable nature of neighborhoods during the study period. Neighborhoods tend to remain stable for at least two successive census years when passing through their life cycles. The higher stability of underclass neighborhoods reflects the enduring concentration of poverty and racial minorities in metropolitan areas (Megbolugbe et al., 1996; Quercia and Galster, 2000).

Despite the relative stability of neighborhoods, the last two decades have witnessed a somewhat dramatic neighborhood succession. In the traditional neighborhood life cycle model or filtering model, neighborhood changes move along a predictable downward succession. This study, however, demonstrates that the socioeconomic status of inhabitants in a neighborhood does not necessarily become successively lower. Many of the downgrading movements skip the

stages of the next lower socioeconomic status by switching directly to the later stages of the neighborhood life cycle, stages that are dominated by underclass neighborhoods. However, it could be possible that neighborhoods quickly change into the next stage in only a few years before finally switching to underclass neighborhoods, a shift which cannot be identified by the census data. This suggests that the neighborhood life cycle could be decades-long or last only for a few years. With the data at hand, it is difficult to investigate the length of neighborhood life cycle, or to examine whether neighborhood change follows a predictable downward succession. These questions might be explicitly considered in future research.

There was, in fact, a substantial counter trend toward neighborhood upgrading, and the changes tended to follow a cluster-specific pattern. For instance, moving up the social ladder was difficult for underclass neighborhoods, but small segments of the central cities of some big metropolitan areas displayed this change. The upgrading change, from lower class to upper class neighborhoods, may reflect the notion of the third and fourth wave of gentrification identified by Lees et al (2008), a change which is characterized by large-scale capital and the collaboration of government and private sectors.

Finally, the same type of neighborhoods in different regions may experience substantially different outcomes, which may strongly correlate to the social, economic, and cultural contexts of regions. Neighborhood typologies do not occur with equal likelihood throughout every region, which portends a pattern of uneven distribution in the trajectories of neighborhood change. It is hardly a novel observation that the studies of neighborhood change need to take into account regional differences. However, this has received surprisingly little attention in the literature on neighborhood change. Some factors, such as federal policy, investment climate, racial/ethnic discrimination, exclusionary zoning, economic recessions or emerging new gateways, may play

significant roles in explaining the patterns of neighborhood changes. However, evaluating the total 49 types of neighborhood changes based on all the census tracts in the US may provide less detail than could be achieved by studying a single area. Within the limited space of this paper and with the data at hand, it is difficult to investigate the roles played by various forces on the total 49 types of neighborhood changes using statistic models. One of the most pressing questions to address in the future work would be to focus on a certain type of neighborhood change within a single jurisdictions and to answer more precise questions, such as how different forces and regional differences may determine the directions that neighborhood trajectories will take, and to what extent these neighborhoods will change.

References

- Beeghley L, 2004 *The Structure of Social Stratification in the United States* (Pearson, New York, NY)
- Bench K, 2003, "Comparing Quality Measures: The American Community Survey's Three-year Averages and Census 2000's Long Form Sample Estimates", (Planning, Research, and Evaluation Division, American Community Survey)
- Bier T, 2001, "Moving up, filetering down: metropolitan housing dynamics and public policy" A *Discussion Paper Prepared for The Brookings Institution*
- Blank R M, Dabady M, Citro C F, 2004 *Measuring racial discrimination* (National Academies Press, Washington, D.C)
- Booza J C, Cutsinger J, Galster1 G, 2006, "Where Did They Go? The Decline of Middle-Income Neighborhoods in Metropolitan America" *Metropolitan Policy Program, The Brookings Institution • Living Cities Census Series*
- Burgess E W, 1925, "The growth of the city: An introduction to a research project. In R.LeGates & F. Stouts (Eds.), *The inner city reader*. New York: Routledge."
- Charles S L, 2011, "Suburban Gentrification: Understanding the Determinants of Single-family Residential Redevelopment, A Case Study of the Inner-Ring Suburbs of Chicago, IL, 2000-2010", (Joint Center for Housing Studies Harvard University)
- Collier P, 2007 *The Bottom Billion: Why the Poorest Countries Are Failing and What Can Be Done About It* (Oxford University Press, New York, NY)
- Coulton C, Theodos B, Turner M A, 2009, "Family mobility and neighborhood change", (The Urban Institute)

- Denton N A, Massey D S, 1991, "Patterns of Neighborhood Transition in a Multiethnic World: U.S. Metropolitan Areas, 1970-1980" *Demography* **28** 41-63
- Downs A, 1981, "Neighborhoods and urban development " *Washington, D.C. : Brookings Institution*
- EPA, 2010, "Residential Construction Trends in America's Metropolitan Regions", (U.S. Environmental Protection Agency)
- Fitzpatrick K M, Logan J R, 1985, "The aging of the suburbs, 1960-1980" *American Sociological Review* **50** 106-117
- Freeman L, 2005, "Displacement or Succession?: Residential Mobility in Gentrifying Neighborhoods" *Urban Affairs Review* **40** 463-491
- Frey W, 1995a, "Immigration and Internal Migration 'Flight' from US Metropolitan Areas: Toward a New Demographic Balkanisation" *Urban Studies* **32** 733-757
- Frey W H, 1995b, "Immigration and Internal Migration 'Flight' from US Metropolitan Areas: Toward a New Demographic Balkanisation" *Urban Studies* **32** 733-757
- Frey W H, 2006, "America's regional demographics in the'00s decade: the role of seniors, boomers and new minorities", (The Brookings Institution)
- Galster G, 2001, "On the Nature of Neighbourhood" *Urban Studies* **38** 2111-2124
- Galster G, Cutsinger J, Lim U, 2007, "Are Neighbourhoods Self-stabilising? Exploring Endogenous Dynamics" *Urban Studies* **44** 167-185
- Galster G C, Quercia R G, Cortes A, Malega R, 2003, "The Fortunes of Poor Neighborhoods" *Urban Affairs Review* **39** 205-227
- Gilbert D, 1998 *The American Class Structure*. (Wadsworth Publishing, New York, NY)

- Hanlon B, 2009, "A Typology of Inner-Ring Suburbs: Class, Race, and Ethnicity in U.S. Suburbia." *City & Community* **8** 221-246
- Hanlon B, Short J R, Vicino T J, 2010, "Cities and Suburbs: New Metropolitan Realities in the US" *Routledge, London and New York*
- Hanlon B, Vicino T, Short J R, 2006, "The New Metropolitan Reality in the US: Rethinking the Traditional Model" *Urban Studies* **43** 2129 - 2143
- Hennig C, Christlieb N, 2002, "Validating visual clusters in large datasets: fixed-point clusters of spectral features" *Computational Statistics and Data Analysis* **40** 723-739
- Hill E W, Brennan J F, Wolman H L, 1998, "What is a Central City in the United States? Applying a Statistical Technique for Developing Taxonomies" *Urban Studies* **35** 1935-1969
- Hoover E M, Vernon R, 1959, "Anatomy of a Metropolis" *Cambridge, MA: Harvard University Press*
- Hoyt H, 1939, "the structure and growth of residential neighborhoods in American cities" *Washington, D.C. :Federal Housing Administration*
- Hudson J R, 1980, "Revitalization of inner-city neighborhoods : an ecological approach" *Urban Affairs Review* **15** 397-408
- Johnson D E, 1998, "Applied multivariate methods for data analysts" *Pacific Grove, Calif. : Duxbury Press*
- Knox P L, 1987, "City Profile: the Washington Metropolitan Area" *Cities* **4** 90-98
- Knox P L, 2008 *Metroburbia, USA* (Rutgers University Press, New Brunswick, NJ)
- Lagory M, Ward R, Juravich T, 1980, "The age segregation process: explanation for American cities" *Urban Affairs Review* **16** 59-80
- Lees L, Slater T, Wyly E K, 2008 *Gentrification* (Routledge/Taylor & Francis Group, New York)

- Ley D, Dobson C, 2008, "Are There Limits to Gentrification? The Contexts of Impeded Gentrification in Vancouver" *Urban Studies* **45** 2471-2498
- Liu F, 1997, "Dynamics and causation of environmental equity, locally unwanted land uses, and neighborhood changes" *Environmental Management* **21** 643-656
- Madden J, 2003, "The Changing Spatial Concentration of Income and Poverty among Suburbs of Large US Metropolitan Areas" *Urban Studies* **40** 481-503
- Megbolugbe I, 1996, "Understanding Neighbourhood Dynamics: A Review of the Contributions of William G. Grigsby" *Urban Studies* **33** 1779-1795
- Megbolugbe I F, Hoek-Smit M C, Linneman P D, 1996, "Understanding Neighbourhood Dynamics: A Review of the Contributions of William G. Grigsby" *Urban Studies* **33** 1779-1795
- Mikelbank B A, 2004, "A Typology of U.S. Suburban Places" *Housing Policy Debate* **15** 935-964
- Mikelbank B A, 2011, "Neighborhood D     Vu: Classification in Metropolitan Cleveland, 1970-2000" *Urban Geography* **32** 317-333
- Morenoff J D, Tienda M, 1997, "Underclass Neighborhoods in Temporal and Ecological Perspective" *The ANNALS of the American Academy of Political and Social Science* **551** 59-72
- Morrow-Jones H, Wenning M, 2005, "The housing ladder, the housing life-cycle and the housing life-course: Upward and downward movement among repeat home-buyers in a US metropolitan housing market" *Urban Studies* **42** 1739-1754
- Newman K, Ashton P, 2004, "Neoliberal urban policy and new paths of neighborhood change in the American inner city" *Environment and Planning A* **36** 1151 - 1172

- Orfield M, 2002 *American metropolitics: the new suburban reality* (Brookings Institution Press, Washington, D.C.)
- Painter G, Yu Z, 2008, "Leaving Gateway Metropolitan Areas in the United States: Immigrants and the Housing Market" *Urban Studies* **45** 1163-1191
- Price-Spratlen T, Guest A M, 2002, "Race and population change: a longitudinal look at Cleveland neighborhoods" *Sociological Forum* **17**
- Quercia R G, Galster G C, 2000, "Threshold Effects and Neighborhood Change" *Journal of Planning Education and Research* **20** 146-162
- Schonlau M, 2004, "Visualizing hierarchical and non-hierarchical cluster analyses with clustergram" *Computational Statistics* **19** 95-111
- Schwab W A, 1987, "The predictive value of three ecological models a test of the life-cycle, arbitrage, and composition models of neighborhood change" *Urban Affairs Quarterly* **23** 295-308
- Schwirian K P, 1983, "Models of neighborhood change" *Annual Review of Sociology* **9** 83-102
- Shevky E, Bell W, 1955, "Social Area Analysis: Theory, Illustrative Applications and Computational Procedure" *Stanford, CA: Stanford University Press*
- Simpson L, Gavalas V, Finney N, 2008, "Population Dynamics in Ethnically Diverse Towns: The Long-term Implications of Immigration" *Urban Studies* **45** 163-183
- Stevens J P, 2001, "Applied multivariate statistics for the social sciences " *Mahwah, N.J. : Lawrence Erlbaum Associates*
- Swanstrom T, Casey C, Flack R, Dreier P, 2004, "Pulling Apart: Economic Segregation among Suburbs and Central Cities in Major Metropolitan Areas" *Metropolitan Policy Program, The Brookings Institution*

Thompson W, Hickey J, 2005 *Society in Focus* (Pearson, Boston, MA)

Vicino T J, Hanlon B, Short J R, 2007, "Megalopolis 50 Years on: The Transformation of a Globalizing City Region" *International Journal of Urban and Regional Research* **31** 344–367

Williams A, Kitchen P, 2009, "Measuring Neighborhood Social Change in Saskatoon, Canada: A Geographic Analysis" *Urban Geography* **30** 261-288

III. Chapter 3 Suburban Diversity in Metropolitan America

1 Introduction

Traditional metropolitan models assume that suburbs and central cities are simple dichotomous categories (Farley, 1964; Hall and Lee, 2009; Hanlon et al., 2006). In these models, suburbs are essentially homogenous, dominated by white middle-class homeowners with children. Since Farley's (1964) prediction of a long lasting classical socio-economic structure of cities and suburbs, most of the characteristics of suburbs still hold as he presented. However, changes are still taking place. Global economic restructuring and transferring of manufacturing jobs to new, emerging economies underlie the evolving suburbs. A growing income inequality (Booza et al., 2006; Swanstrom et al., 2004) confirms that the middle class has shrunk dramatically, both in metropolitan areas and in suburbs (Swanstrom et al., 2004). The shrinking of the middle class (Booza et al., 2006) in suburbs is being replaced by the growth of the upper and lower classes. An increase in the numbers of affluent singles, divorcees, and retirees on the metropolitan periphery has made the "typical" middle class a socio-demographic minority. Over the last three decades, immigrants from Latin America, Asia, and elsewhere have increased the racial and ethnic diversity of the United States, both in the principal cities and their suburbs (Lee et al., 2012). Recently, new streams of immigrants have left their mark on suburban housing markets by settling down directly in suburbs (Hanlon et al., 2010). All of these changes have left an imprint on the suburban fabric to a certain extent, and the once white-dominant suburbs have become more diverse.

The socio-economic landscape of suburbia is shaped by the composition of their populations. Nevertheless, the composition of neighborhoods may determine the suburban landscape more profoundly and significantly. Current empirical analyses have confirmed the diversity of contemporary U.S. suburbia in terms of neighborhood composition. It is clear from the literature that the classic “sitcom suburbs” (Hayden, 2001) of the mid-twentieth century metropolitan United States have been increasingly overshadowed by a splintering suburbanism of exurbs, boomburbs, manufacturing suburbs, aging suburbs, immigrant suburbs, African American suburbs, or struggling suburbs (Berube et al., 2006; Hanlon, 2009; Hanlon et al., 2006; Lang et al., 2008; Mikelbank, 2004, 2006; Orfield, 2002b). The diversity in terms of neighborhood composition signals a more tolerant suburbia, which is a sign of openness to different groups of populations.

While certain aspects of suburban diversity of neighborhood composition have been highlighted in the literature, there has been little systematic research, within a comprehensive framework, that can provide grounded generalizations about the diversity and, most importantly, the changes of suburban diversity over time, with respect to neighborhood composition. Thus, we cannot fully understand whether the suburban diversity of neighborhood composition has significantly increased or decreased. This study attempts to fill the research gap by addressing the following research questions: (1) Has the suburban diversity of neighborhood composition significantly increased or decreased over time? (2) How does the increased diversity of population composition affect the suburban diversity of neighborhood composition? (3) How do metropolitan and suburban characteristics affect suburban diversity of neighborhood composition, and to what extent? (4) Does suburban diversity vary across regions?

By analyzing the data collected on the decennial census tracts between 1990 and 2010 for all metropolitan areas in the United States, I investigated suburban diversity in terms of neighborhood composition and its determinants over the last two decades. In particular, I have focused on the extent to which suburban diversity of neighborhood composition has changed over time. The remainder of this paper is structured as follows. The next section provides an overview of previous research. Then I discuss the data set and the methodology used in this study. Next is the study's theoretical framework and hypotheses; a detailed examination of the empirical results is given in the following section. The final section includes discussion of these results and conclusions, with some suggestions for future work.

2 Research Background

Generally speaking, the U.S. is becoming more diverse in terms of race and other demographic attributes (Roberts, 1993). The transformation in the demographic structure of metropolitan areas has led to the growing heterogeneity of central cities, as well as their suburbs.

First, the suburbs have not been non-Hispanic white for quite some years. Fischer (2008) gives a detailed account of the historical relationship between African Americans and suburbs. Low birth rates of non-Hispanic whites suggests that population growth mainly comes from racial minorities. The nation's population growth and increasing diversity, especially among younger residents, are driven by racial and ethnic minorities (Frey et al., 2009). Traditional influx patterns of immigration have also changed since suburbs have become the new destination for immigrants who bypass the cities and settle directly in the suburbs (Hanlon et al., 2010). In other words, non-white Hispanic and other minorities have entered suburbs directly (Alba and Logan, 1991; Clark, 2007; Massey and Denton, 1987).

In addition, according to Hayden (2003), the dominant households of married-couples with children in suburbs have been outnumbered by young singles and the elderly. Lucy and Phillips (2006) showed that, contrary to the popular image of suburbia as solidly white, upper-middle-class, and family-oriented, the suburbs contain significant and increasing numbers of ethnic minorities, including many immigrants, along with significant concentrations of poverty and a growing share of the nation's single-person households and seniors.

Furthermore, while the national income level has increased dramatically, poverty is also increasing, and has invaded the suburbs (Frey et al., 2009). In this situation, some older, inner suburbs actually see deteriorating income levels (Jargowsky, 2003; Short et al., 2007). Vicino (2008) investigates the first-tier suburban decline in Baltimore County, MD. His study targets 21 first-tier suburban communities and finds evidence of a decline with respect to sluggish population growth, lower income levels, aging housing stock, and loss of employment. In addition to the decline of inner suburbs, in general, poverty has extended beyond, to the outer suburbs (Frey et al., 2009).

Economic restructuring, demographic shifts, digital telecommunications technologies, and neoliberal impulses have given rise to a stereotypical "New Metropolis" (Lang and Knox, 2009) that is characterized by the disjointed and fragmented post-suburban landscapes (Phelps et al., 2010), of edge-cities, off-ramp subdivisions, office parks, commercial corridors, and edgeless cities (Lang, 2003a) of low-density office development. Professional employees, minorities, immigrants, and renters have all left their marks on suburbia. These demographics may be located around the mixed land-use nodes of edge-cities and boomburbs, or appear in other places in peripheral districts. As a result, suburbia is no longer synonymous with the upwardly-mobile,

white, nuclear family, and suburbia as a whole has become more diverse in terms of population composition.

There is a great deal of socio-economic diversity across the entire body of suburbs that surround metropolitan areas in the U.S. The increased diversity of population composition is reflected in urban space, and affects the landscape of suburbia through the formation of the spatial foundations of the urban area – the neighborhoods. Current empirical analyses have confirmed the diversity of contemporary U.S. suburbia by recognizing different neighborhood typologies (Berube et al., 2006; Hanlon, 2009; Hanlon et al., 2006; Mikelbank, 2004, 2006; Orfield, 2002b). Hanlon et al (2006) identified poor, manufacturing, African American, and immigrant suburbs. The results show that only half of the suburbs are in accordance with the stereotypical white, wealthy population. Orfield (2002a) has established a 6-cluster model based on a clustering analysis of 4711 suburban places. Mikelbank (2004) analyzed 3,567 suburban places and identified 10 distinct types of suburbs by including the dimensions of population, place, economy, and government. Based on the 2000 Census data, Hanlon, Short et al. (2010) identified five types of places: the affluent, underclass, black middle, middle America, and immigrant gateway. In other research based on 13 MSAs, Hanlon et al (2006) suggested five types of suburbs: rich, poor, manufacturing, black, and immigrant suburbs. Thus, American suburbia includes not only white affluent communities, but also African American, Chinese American, Hispanics, and immigrant suburbs etc. (Hayden, 2001). Most of these cross-sectional studies have investigated the diversity of contemporary U.S. suburbs by constructing suburban typologies. As a result, they concluded that neighborhood typologies demonstrated that suburbia is no longer homogenous, and is becoming increasingly diverse.

Suburban typologies may capture diversity to a certain extent. However, these conclusions are premature for several reasons. First, it is not enough to conclude that suburbia has become increasingly diverse merely by constructing suburban typologies without exploring the changes in diversity over time. American suburbia has always been physically and socially diverse. Working-class, lower middle-class families and racial minorities have been found in suburbs from about 1870 to the present (Hayden, 2003). A few studies have investigated longitudinal changes in suburban typologies (Mikelbank, 2011; Morenoff and Tienda, 1997). Despite the detection of an increasing spatial polarization, and a decrease in certain types of suburban neighborhoods, these studies do not investigate diversity and its changes over time.

In addition, most studies do not quantify suburban diversity with respect to neighborhood typologies. A few have probed the levels of diversity quantitatively in suburbs or metropolitan areas (Hall and Lee, 2009; Lee et al., 2012), but these studies are mainly focused on several aspects of population composition, such as income, education, and/or race, rather than neighborhood composition. Particularly, the analyses are usually based on simple city-suburban categories without considering the changes of diversity within suburbs.

Finally, despite a gradually increasing interest in suburban diversity, the existing research generally selects only a small number of metropolitan areas for study. Generalizing the results of these studies to other geographic locations is difficult. In general, the literature on suburban diversity provides surprisingly little information about diversity in terms of neighborhood composition. The body of work reflects primarily a population-composition focus, and has a descriptive tendency in the study of suburban diversity. The limitations of current research and inquiry into changes in suburban diversity reveal that the issue has continued to be under-studied.

3 Data and Methods

The data used in this analysis are from the Longitudinal Tract Data Base (LTDB) prepared by Spatial Structures in the Social Sciences (S4). Since the primary focus of this article is to analyze the changes in suburban diversity in terms of neighborhood composition, it is important to identify suburbs in metropolitan areas. The boundaries of central cities change from one census year to the next. In order to make the suburban areas comparable from 1990 to 2010, I used the central city boundaries of the year 2000 provided by the US census. In GIS, I selected those 2010 census tracts having their centroid in the 2000 central city boundaries. These census tracts based on 2010 boundaries are identified as central cities, and suburbs as those tracts outside central city boundary.

3.1 K-means cluster analysis

K-means cluster analysis was chosen to identify suburban typologies over the time period of 1990 to 2010. The suburban tracts with populations equal to or greater than 500 were entered into one clustering procedure in order to avoid estimates based on a small amount of data. The total number of observations considered in the cluster analysis is 116,887 tracts. According to the literature, variables related to race and ethnicity, age structure, family structure, household/family income, educational attainment, unemployment, immigrants, and housing characteristics (Hanlon, 2009; Mikelbank, 2004, 2011; Morenoff and Tienda, 1997; Williams and Kitchen, 2009) are powerful indicators that differentiate categories of neighborhoods. In this study, eighteen variables that related to those dimensions were divided into three major categories, including demographic, socioeconomic status, and housing characteristics. Each of these variables for each tract was standardized as a z-score relative to all the other tracts in the

same census year. A positive z-score reflects a level higher than the national average, and a negative score reflects a lower level.

3.2 Entropy index

The first important step in the analysis of suburban diversity is to select appropriate measurements. White (1986) produced two diversity measurements: the entropy or Shannon index, and the interaction or Simpson index. Entropy is favored by many authors as a principal measure of diversity, evenness, or segregation (Bishop and Gripaios, 2007; Fischer, 2003, 2008), which allows for comparisons among more than two groups (Fischer, 2003) and avoids the problem of subjectivity.

Before entering into the discussion of suburban diversity, I will first distinguish between two similar concepts: diversity with respect to population composition, and diversity with respect to neighborhood composition. The former refers to the size of the different groups of population relative to each other within a certain area. The latter reflects the extent to which the sizes of different types of neighborhoods are relative to each other. In this study, Entropy (E) is used to measure suburban diversity in terms of neighborhood composition, which is defined as follows:

$$E = \sum_{i=1}^n P_i \ln\left(\frac{1}{P_i}\right)$$

Where, in this study, n is the number of neighborhood typologies, and P_i is the share of the tracts belonging to certain types of neighborhoods i in a metropolitan area.

In this study, k-means cluster analysis yields six categories of neighborhoods that are comparable from 1990 through 2010. Suburbs in each of the 366 metropolitan areas in the US consist of different combinations of these six groups of neighborhoods. For suburban diversity Entropy consisting of six typologies of neighborhoods, the minimum value is zero and the maximum value is 1.79. Then, Entropy is standardized by dividing its maximum value, and then

the standardized value is multiplied by 100. After this transformation, the Entropy index value of 0 signifies complete homogeneity and 100 indicates maximum heterogeneity when these six groups have equal representation in suburbs of a metropolitan area.

3.3 A multiple linear regression

I conducted a multiple regression model of suburban diversity as a function of regional and suburban determinants, which can be expressed as:

$$E_{index} = \alpha + \beta_1 \ln(Metro_Pop) + \beta_2 Sub_HousingSupply + \beta_3 Sub_Poverty + \beta_4 Sub_Elderly + \beta_5 Sub_NonMarried + \beta_6 \ln(Sub_ForBorn) + \beta_7 Sub_Minorities + \beta_8 Sq(Sub_Minorities) + \sum_i^2 Y_i Year_i + \sum_j^4 \Theta_j Region_j + \varepsilon$$

Where E_{index} is the standardized suburban diversity Entropy (0-100) with respect to neighborhood composition; Metropolitan population, suburban housing supply, suburban poverty rate, the share of elderly, non-married persons, foreign-born population and minorities are included as regressors. I also include two fixed-effects for census years and census regions. The reference categories for the dummy variables are 1990 and Northeast, and the error term ε is assumed as meeting the basic assumption of multiple linear regression. Table III-1 provides the definitions and descriptive statistics for the variables used in the multiple regression analysis.

Table III-1 List of variables and descriptions

Variables	Description	1990	2010	Total	
		Mean	Mean	Mean	SD
Year	Census year (1990=0, 2010=1)				
Region	Census region (Northeast=0, Midwest=1, South=2, West=3)				
Metro_Pop	Metropolitan population (1000)	558.00	705.69	631.84	1459.67
Sub_HousingSupply	Percentage of structures built within 30 years in suburbia	67.90	49.54	58.72	16.31
Sub_Poverty	Percentage of persons in poverty in suburbia	11.69	11.90	11.79	5.13
Sub_Elderly	Percentage of population age 60 years and over in suburbia	16.31	19.66	17.98	4.79
Sub_NonMarried	Percentage of population currently not married	39.34	44.69	42.02	4.91
Sub_ForBorn	Percentage of foreign-born	3.91	6.88	5.39	6.06
Sub_Minorities	Percentage of persons that is not non-Hispanic white in suburbia	15.01	23.50	19.25	16.81
Dependent Variable	Suburban diversity (Entropy index)	59.88	63.66	61.77	20.04

4 Theoretical Framework and Hypotheses

Changes in the shares of different populations will lead to the corresponding changes in suburban diversity in terms of neighborhood composition for several reasons. First, residential preferences of non-white and white populations are deciding factors for whether or not these populations have a tendency to live with their peers. Different residential preferences exist among different racial groups, tempered by income and education, which jointly determine how people of different races and ethnicities are distributed in metropolitan areas (Clark, 2009). With Farley et al.'s seminal work (Farley et al., 1978), a series of studies have confirmed that African Americans (as well as other races and ethnicities such as Hispanic and Asian) prefer integrated neighborhoods more than white people and also tend to live with their peers (Clark, 1992; Farley et al., 1997). The American dream from its origin is a tri-part construction, of house plus land plus community (Hayden, 2003). White populations prefer peaceful, small-scale residential neighborhoods with similar socioeconomic backgrounds.

Thus, if certain types of populations prefer to live in integrated neighborhoods with their peers, the changes of different types of populations will result in changes in neighborhood composition to a certain extent, and may lead to changes in the diversity of neighborhood composition. Given a simple case, there is a population consisting of two groups (A and B) of equal size in a metropolitan area, and the members of these two groups reside in two different neighborhoods. When the same numbers of A and B move into this metropolitan area, the diversity in terms of population composition will remain the same, but the diversity of neighborhood composition may not. If households of B population prefer a high density community or have larger numbers of family members than A population, B population may form, for example, only one neighborhood, but A population will form two neighborhoods. In

this scenario, the diversity in terms of neighborhood composition will change to a certain extent, but not in the same way as population diversity.

In addition, the socio-economic landscape of metroburbia is not only decided by the aggregation of individual choices, but also by competitive consumption, government, developers, mortgage providers, as well as other economic agents who jointly affect people's residential choices (Chaves et al., 2009). These and some other factors on a more detailed level, such as housing discrimination and zoning, may contribute to the formation and increase of homogeneous communities. Thus, the increase of different groups of populations in the suburbs is expected to increase the numbers of different types of neighborhoods, which may influence suburban diversity in terms of neighborhood composition to a certain extent.

Therefore, the shares of different groups of population in suburbs are included in the model. I expected to discover that suburbs have become more diverse than they were decades ago, with significant and increasing numbers of ethnic minorities, along with significant concentrations of poverty and a growing share of seniors, non-married, and foreign-born populations.

The following variables are included in this model as the control variables. Geographic region (*Region*) is associated with suburban demographic composition, which is generally used as a control for historical differences in residential patterns (Frey, 1995; Huie and Frisbie, 2000). In this study, the dummy variable region is measured as census-defined Northeast, Midwest, South and West, with the Northeast serving as the base group. Older metro areas are more likely to have mixed population and housing types (Pendall and Carruthers, 2003). As a metropolitan area matures, suburbia is expected to become more diverse (Hall and Lee, 2009). Most metropolitan areas in the Northeast and Midwest have developed over a longer period of time,

relative to newer metropolitan areas in the South and West. Thus I anticipated a significant regional difference in suburban diversity.

Metropolitan size ($\ln(\text{Metro_Pop})$) reflects the population composition of metropolitan areas (Boustan, 2007). Bigger metropolitan areas have more internal differentiation and are traditionally much more diverse than smaller ones (Pendall and Carruthers, 2003). Certain dimensions of suburban diversity are found to increase with the size of their constituent metropolitan areas (Hall and Lee, 2009). Thus, larger metropolitan areas are expected to have greater levels of suburban diversity. Metropolitan size is measured as the natural log of the total population in metropolitan areas.

Suburban housing supply is measured as the percentage of structures built within 30 years in suburbia. Larger amounts of suburban housing supply (*Sub_HousingSupply*) are anticipated to be associated with higher suburban diversity. A significant amount of residential construction is continuing to take place in suburbs, especially on previously undeveloped land at the periphery of cities (EPA, 2010; Timberlake et al., 2010). In quickly growing suburbs, new housing units on the periphery of cities attract a higher-income population, creating more housing opportunities both in urban cores and suburban areas (Price-Spratlen and Guest, 2002). According to the filtering model, the old housing units abandoned by higher-income households may be occupied by lower-income households, renters, or minorities. Certain groups of households may move directly into suburbs with newer housing stocks. Thus, types of households are expected to increase in quickly growing suburbs and influence suburban diversity to a certain extent.

Suburbia is traditionally perceived as homogeneous places dominated by middle-class, white households, but currently, U.S. suburbia has become increasingly diverse in terms of

population composition. Different typologies of neighborhoods in suburbs have also been identified in the literature (Berube et al., 2006; Hanlon, 2009; Hanlon et al., 2006; Mikelbank, 2004, 2006; Orfield, 2002b). Thus, this study will attempt to test the following hypotheses. The first hypothesis is that changes in the shares of different populations will lead to corresponding changes in suburban diversity in terms of neighborhood composition. The second hypothesis is that suburban diversity with respect to neighborhood composition has significantly increased from 1990 to 2010.

5 Results

The first part of this section describes suburban typologies. According to the Calinski/Harabasz pseudo-F test and z-score means of the variables in each cluster (Table III-2), a six-group solution was selected as the final choice of the cluster, and includes *immigrant*, *mix/renter*, *elite*, *white/lower*, *middle-class*, and *black/poor* neighborhoods.

Constituting 9.53 and 11.75 percent of tracts in 1990 and 2000, respectively, are the *elite* neighborhoods. They represent the enclaves of the very wealthy households of highly educated professionals distinguished by exceptionally high household income, homeownership rate, median rent, and home value. They also have above average shares of a foreign-born population, and seniors. In particular, the *elite* neighborhoods have the lowest vacancy rate and residential mobility (percentages of household heads moved into unit less than 10 years ago).

Table III-2 Z-score means across clusters

	Immigrant	Mix/rent	Elite	White/lower	Middle-class	Black/poor
Demography						
percentage of persons age 17 years and under	0.78	-1.20	-0.21	-0.17	0.33	0.58
percentage of persons age 60 years and over	-0.56	-0.16	0.36	0.51	-0.31	-0.19
percentage of persons of white race, not Hispanic origin	-1.43	-0.01	0.49	0.59	0.43	-1.63
percentage of persons of black race, not Hispanic origin	-0.13	-0.05	-0.46	-0.30	-0.31	2.48
percentage of persons of Hispanic origin	2.15	-0.10	-0.39	-0.40	-0.26	-0.28
Percentage of persons currently married, not separated	-0.41	-1.03	0.78	0.25	0.68	-1.51
percentage of foreign-born	1.72	0.33	0.08	-0.50	-0.29	-0.37
Socioeconomic Status						
Per capita income ratio to suburban per capita income	-0.51	-0.42	1.39	-0.28	0.59	-1.02
percentage of persons with at least a four-year college degree	-0.79	0.72	1.69	-0.57	0.31	-0.85
percent unemployed	0.57	-0.19	-0.67	-0.07	-0.49	1.72
percentage of manufacturing employees (by industries)	0.19	-0.66	-0.34	0.48	-0.08	-0.14
Percentage of professional employees (by occupations)	-0.97	0.55	1.64	-0.48	0.41	-0.87
Median household income	-0.60	-0.35	1.87	-0.38	0.54	-1.03
Percent of persons in poverty	0.79	0.25	-0.79	-0.14	-0.63	1.57
Housing characteristics						
percentage of owner-occupied housing units	-0.80	-1.22	0.75	0.36	0.59	-0.84
percentage of vacant housing units	-0.11	0.19	-0.33	0.13	-0.37	0.65
Median home value	0.02	0.32	1.66	-0.53	0.03	-0.68
percentage of household heads moved into unit less than 10 years ago	0.28	0.90	-0.45	-0.45	0.13	-0.14

White/lower neighborhoods, constituting roughly one third in 1990 and 27.43 in 2010 of tracts, consist of mostly white households in relation to the production of goods and services. They are racially more homogenous than the elite neighborhoods with the lowest shares of foreign born and Hispanic populations. White/lower neighborhoods have household incomes, educational attainments and median home values that are below the national averages.

Middle-class neighborhoods represent a half-way point between elite and white/lower neighborhoods, occupying roughly one quarter of tracts over each of the last two census years. They are constituted mostly of white-collar professionals with higher educational attainments

and household incomes than white/lower neighborhoods. The income thresholds used follow Beeghley's (2004) definition for middle class using a combined household income. In particular, middle-class neighborhoods are family-oriented with higher percentages of persons age 17 years and under, and higher homeownership rates. They also have the lowest vacancy rates, and the median home values are well above the national average.

The lowest homeownership rate and highest mobility serve as the main distinguishing features of the mix/renter neighborhoods. The median household income of this cluster is lower than the elite and middle-class. This is consistent with the concept that mobility rates are higher among lower-income households and renters (Coulton et al., 2009). This cluster is also characterized by the lowest percentage of persons of age 17 years and under. Households in this cluster also have higher educational attainment and foreign-born populations. More than 12 percent of tracts in each census year can be classified into this cluster.

The last two clusters have come to be known as underclass, based on the model formulated by Thompson & Hickey (2005). These clusters comprise socially and economically disadvantaged households, consisting mainly of the frequently unemployed population. In particular, black/poor neighborhoods, constituting 9.43 and 10.06 percent of tracts in 1990 and 2000, are characterized by the highest percentages of the black population and unemployment rate. Households in this cluster also have the lowest household incomes, educational attainments, and median home values. In this study, the immigrant neighborhoods constitute 9.96 and 14.31 percent of tracts in each census year. The most distinctive characteristic of immigrant neighborhoods is that they have both the highest share of Hispanics and foreign-born populations. This cluster also encompasses census tracts that have much lower than average household

income. This is consistent with the findings of Simpson et al (2008), that immigration concentration is traditionally associated with poverty.

Based on the Entropy index, the more equally represented the six groups are, the higher the suburban diversity. Therefore, the evidence that the suburban share of different types of neighborhoods is more evenly distributed than it once was may indicate an increased suburban diversity.

Then, I conducted a multiple regression model of suburban diversity (consisting of six types of neighborhoods) as a function of the nine variables. The results of the multiple linear regressions model are summarized in Table III-3. The errors of this model are not identically distributed based on the Breusch-Pagan / Cook-Weisberg test for heteroskedasticity, and thus standard errors of OLS estimators and statistical inferences are estimated by a robust method. Coefficients (unstandardized), standardized coefficients (Beta), and robust standard errors are reported in Table III-3. The robust model does not change the direction and significance characteristics of a regular model. The R square value equals 0.6128, indicating that the metropolitan and suburban characteristics account for relatively high percentages of variations in suburban diversity.

In Table III-3, I found that most of the parameter estimates are significant, which means most of the variables are highly associated with suburban diversity. The hypothesis that suburbia becomes more diverse in terms of neighborhood composition receives support from the results in Table III-3, by showing the significance of the *Year* dummy variable. Suburban diversity in 2010 is 4.256 higher than that in 1990 when controls are provided for the other variables. This increase is statistically significant at a 1% level. In other words, the data provide the evidence to support that suburbia as a whole has become more diverse over time.

Table III-3 Multiple linear regression results

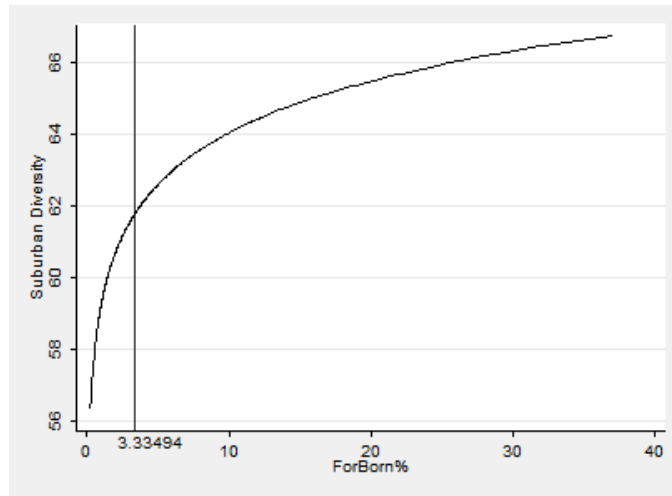
	Coefficients	Standard Error	Robust Standard Error	Beta
Year (2010)	4.256***	1.5205	1.542	
Midwest	-6.004***	1.778	1.758	
South	-9.582***	2.309	2.460	
West	-11.090***	2.168	2.178	
Ln(Metro_Pop)	7.483***	0.545	0.504	0.397
Sub_HousingSupply	0.315***	0.053	0.055	0.256
Sub_Elderly	-0.854***	0.117	0.133	-0.204
Sub_Poverty	-0.509**	0.150	0.170	-0.130
Sub_NonMarried	0.115	0.146	0.145	0.028
Ln(Sub_ForBorn)	2.083**	0.821	0.893	0.101
Sub_Minorities	1.403***	0.107	0.110	
Sq(Sub_Minorities)	-0.019***	0.001	0.001	
_cons	-45.953***	10.413	10.420	
n	732			
R_Square	0.6128			
Adj. R_Square	0.6063			

p<=0.1 (*); p<=0.05(**); p<=0.01 (***)

The findings yield mixed support for the hypothesis that the changes in population composition are related to suburban diversity in terms of neighborhood composition. Consistent with this hypothesis is the finding that the percentage of the foreign-born population is positively related to suburban diversity. Figure III-1 illustrates the conditional effect plot of the transformed variables ($\ln(\text{Sub_ForBorn})$), which traces the predicted value of suburban diversity as a function of the percentage of the foreign-born population, with other variables held constant at their means. A one percent increase in the foreign-born population, on average, leads to about a 0.0208 increase in suburban diversity. The relationships of poverty and an elderly population to suburban diversity are exactly the opposite. The poverty rate and the percentage of persons age 60 and over are negatively and significantly related to suburban diversity. Increases in the percentages of poverty and the elderly are associated with decreases in suburban diversity.

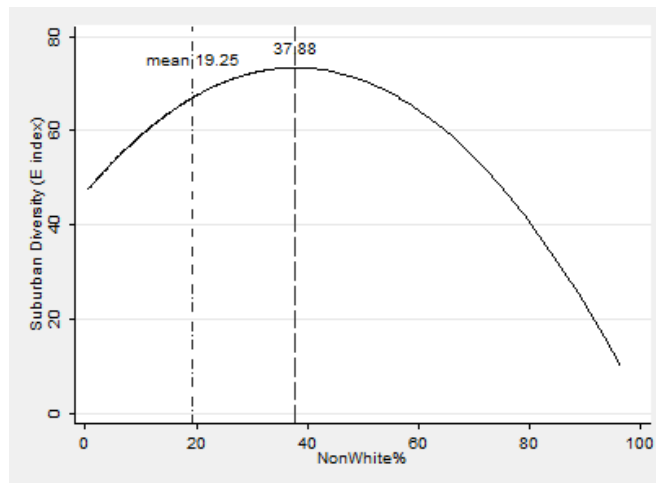
Relative to the significant effects of these three variables, the percentage of persons who are not married is not significant even at the 0.1 level.

Figure III-1 Conditional effect plot (Foreign-born population %)



In contrast to the linear relationships, suburban diversity is subject to the influence of the percentage of minorities in a nonlinear relationship. This is indicated by the statistically significant quadratic term of the percentage of minorities. Figure III-2 shows the predicted value of suburban diversity as a function of the percentage of minorities, with other variables held constant at their means. In a parabolic-shape relationship, the percentage of minorities has a positive effect on suburban diversity. After the percentage exceeds 37.88, it will have a negative effect. There are about 12.16% metropolitan areas where the percentages of minorities are beyond the turning point.

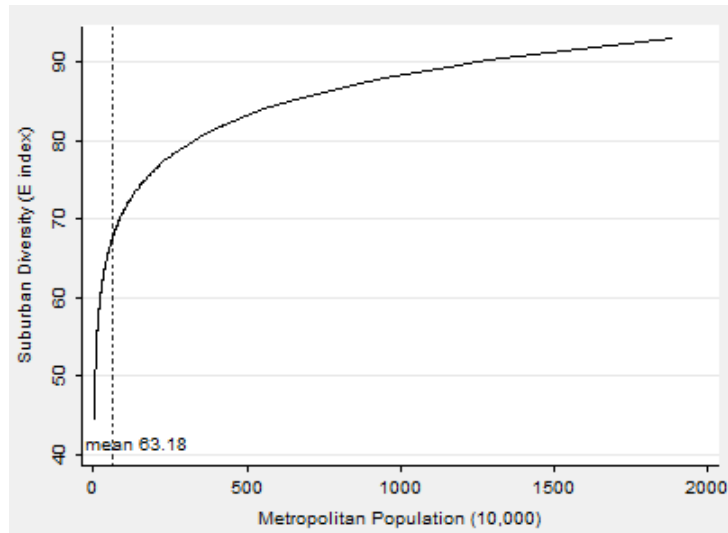
Figure III-2 Conditional effect plot (Non-white population %)



The relationships of control variables and suburban diversity are consistent with expectations. Significant regional effects are found for suburban diversity. The dummy variable—*Region*—is statistically significant with the expected sign. All of the significant coefficients take negative signs, implying that suburbs in the Northeast metropolitan areas have the highest diversity among regions. Suburbs in the West have the lowest diversity.

In Table III-3, I found that the size of metropolitan areas is highly correlated with suburban diversity, and the coefficients were in the expected direction. The findings indicate that suburban diversity increases with the size of the corresponding metropolitan population. Figure III-3 shows the predicted value of suburban diversity as a function of the metropolitan population, with other variables held constant at their means. This finding supports the concept that diversity is related to the scale of metropolitan areas.

Figure III-3 Conditional effect plot (Metropolitan population)



In suburbs with a higher level of housing supply within 30 years, suburban diversity tends to be greater. A one percent increase in a suburban housing supply leads to an increase in suburban diversity by about 0.315. This finding suggests that housing supply positively affects suburban diversity.

Table III-3 also provides standardized regression coefficients (beta), where the variables have been transformed into standard scores (means 0, standard deviations 1). For those variables having significant linear relationships with suburban diversity, the natural log of metropolitan size has the largest influence on suburban diversity. With a one-standard-deviation increase in the log of metropolitan size, the predicted Entropy index increases by 0.397, holding the other variables constant.

In sum, the hypothesis that suburbia becomes more diverse over time in terms of neighborhood composition receives support from the results. The findings yield mixed support for the hypothesis that changes in percentages of population composition are related to suburban

diversity. Suburban diversity tends to be greater in metropolitan areas with large populations and located in the Northeast. More diverse suburbs are also featured by higher suburban housing supplies and a substantial foreign-born presence. An increasing percentage of minorities (before the turning points) is also significantly associated with an increased suburban diversity. The relationships between suburban diversity and the percentages of poverty and elderly are negative, and marital status falls short of significance in the regression model.

6 Discussion and Conclusions

The stereotypes of traditional models assume that suburbs and central cities are simple dichotomous categories (Hanlon et al., 2006). Recent studies have identified that the dichotomy of black, poor cities and white wealthy suburbs has been, slowly, and now more rapidly, and steadily, changing. Many scholars have found that suburbs are becoming more diversified in certain dimensions (Hall and Lee, 2010; Hanlon et al., 2006; Lang, 2003b; Mikelbank, 2004). Despite the fact that suburban diversity has been identified in the literature, few studies, to my knowledge, have focused on how suburban diversity in terms of neighborhood composition has changed over time, nor have studies identified with precision the influences of metropolitan and suburban characteristics on suburban diversity. Given the dearth of attention paid to suburban diversity in terms of neighborhood composition, this study provides a starting point for further research.

Based on the census tract level data of 1990 and 2010, this study identified six typologies of suburbs. In particular, by conducting a linear regression model, this study has provided evidence for the mechanisms by which suburban diversity in terms of these six neighborhood compositions has been affected by metropolitan and suburban characteristics. Most importantly,

this study highlights a remarkable increase in suburban diversity with respect to neighborhood composition, which has been shaping the landscape of suburban America during the last two decades.

While suburbia as a whole has been changing significantly, changes have been highly uneven from suburb to suburb, and metropolis to metropolis. Table VI-2 in Appendix A shows suburban diversity across metropolitan statistical areas. Most metropolitan areas in the Northeast and Midwest have developed over a longer period and have more established residential patterns. Thus, these metropolitan areas may feature higher suburban diversity relative to those newer metropolitan areas in the South and West. In addition, the size of metropolitan areas also has implications for suburban diversity. Large metropolitan areas, especially those with strong ties to the global economy, also have higher suburban diversity, such as metropolitan areas of Chicago, New York, Miami, and Boston. Many metropolitan areas with fast growth in population (immigrants, single-person households, and senior households) have higher suburban diversity such as the Sunbelt metropolitan areas of Charlotte, Durham, and Phoenix MSAs. The metropolitan areas with a higher suburban housing supply are also marked by higher suburban diversity, for example, the San Francisco MSA, San Diego MSA, and Washington DC MSA.

Suburban diversity also has key implications for smart growth. Many metropolitan areas with higher suburban diversity are located in those regions often cited as leaders in promoting growth management and redevelopment, such as Denver, CO MSA, Portland, OR MSA, Sacramento, CA MSA, and Atlanta, GA MSA. The shift inward and redevelopment in these medium sized metropolitan areas are dramatic, which may increase suburban diversity to a certain extent.

Residential diversity, in the forms of the distribution of different races, incomes, and other backgrounds, has been extensively studied (Emeka, 2009; Freeman, 2009; Kato, 2006; Lee et al., 2012; Talen, 2009). The attention paid by scholars to population patterns may be a factor of the value placed on the welfare of individuals, regardless of their backgrounds. Equal opportunities and treatment are desirable, despite the unavoidable, vast, differences in socio-economic status. A more diverse population pattern is preferred, because diversity increases the potentials for equal opportunities, increases the human capital of the native-born, and increases the array of available consumer goods. (Galster et al., 2001; Sarkissian, 1976).

An increased diversity signals a more tolerant suburbia, which is a sign of openness to different groups of populations. However, statistically diverse regions are often quite segregated at the neighborhood or even the block level (Storper and Manville, 2006). This indicates that increased diversity of neighborhood composition at the suburban level may be associated with a corresponding increase in segregation at the neighborhood level. Recalling the definition of diversity, the increase of suburban diversity with respect to neighborhood composition is, to a certain extent, due to an increase in evenly distributed homogenous neighborhoods in suburbs. If diversity is a positive goal, then policy-makers need to give attention to the increased diversity of neighborhood composition, and the possibility of an increase in segregation within neighborhoods in suburbia. Understanding the mechanisms of suburban diversity is central to gaining greater insight into the metropolitan realities and how policy can be used to create positive directions. From this point of departure, future research should focus on investigating various dimensions of suburban diversity, the relationship between suburban diversity of neighborhood composition in suburbs or metropolitan areas, the segregation within

neighborhoods, and the consequences of increased suburban diversity for cultural conflict and merger, community development, and the formulation and implementation of urban policies.

References

- Alba R D, Logan J R, 1991, "Variations on Two Themes: Racial and Ethnic Patterns in the Attainment of Suburban Residence" *Demography* **28** 431-453
- Beeghley L, 2004 *The Structure of Social Stratification in the United States* (Pearson, New York, NY)
- Berube A, Katz B, Lang R E, 2006, "Redefining urban and suburban America : evidence from Census 2000. Vol. 3 " *Washington, D.C. : Brookings Institution ; Bristol : University Presses Marketing*
- Bishop P, Gripaios P, 2007, "Explaining Spatial Patterns of Industrial Diversity: An Analysis of Sub-regions in Great Britain" *Urban Studies* **44** 1739–1757
- Booza J C, Cutsinger J, Galster G, 2006, "Where Did They Go? The Decline of Middle-Income Neighborhoods in Metropolitan America" *Metropolitan Policy Program, The Brookings Institution • Living Cities Census Series*
- Boustan L P, 2007, "Was Postwar Suburbanization "White Flight"? Evidence From the Black Migration" *NBER Working Paper Series, Working Paper 13543*,
<http://www.nber.org/papers/w13543>
- Chaves E, Knox P L, Bieri D, 2009, "The Restless Landscape Of Metroburbia (Draft)", (Virginia Polytechnic Institute and State University, Blacksburg, Virginia) p 25
- Clark W A V, 1992, "Residential preferences and residential choices in a multi-ethnic context" *Demography* **29**
- Clark W A V, 2007, "Race, Class, and Place: Evaluating Mobility Outcomes for African Americans " *Urban Affairs Review* **42** 20

- Clark W A V, 2009, "Changing Residential Preferences across Income, Education, and Age: Findings from the Multi-City Study of Urban Inequality " *Urban Affairs Review* **44** 22
- Coulton C, Theodos B, Turner M A, 2009, "Family mobility and neighborhood change", (The Urban Institute)
- Emeka A, 2009, "Race and Unemployment Amidst the New Diversity: More Evidence of a Black/Non-Black Divide" *Race and Social Problems* **1** 157-170
- EPA, 2010, "Residential Construction Trends in America's Metropolitan Regions", (U.S. Environmental Protection Agency)
- Farley R, 1964, "Suburban Persistence" *American Sociological Review* **29** 10
- Farley R, Fielding E L, Krysan M, 1997, "The Residential Preferences of Blacks and Whites: A Four-Metropolis Analysis" *Housing Policy Debate* **8**
- Farley R, Schuman H, Bianchi S, Colasanto D, Hatchett S, 1978, "'Chocolate city, vanilla suburbs: Will the trend toward racially separate communities continue?" *Social Science Research* **7**
- Fischer M J, 2003, "the Relative Importance of Income and Race in Determining Residential Outcomes in U.S. Urban Areas 1970-2000" *Urban Affairs Review* **38** 669-696
- Fischer M J, 2008, "Shifting Geographies: Examining the Role of Suburbanization in Blacks' Declining Segregation" *Urban Affairs Review* **43** 475
- Freeman L, 2009, "Neighbourhood Diversity, Metropolitan Segregation and Gentrification: What Are the Links in the US?" *Urban Studies* **46** 2079-2101
- Frey W H, 1995, "Immigration and Internal Migration 'Flight' from US Metropolitan Areas: Toward a New Demographic Balkanisation" *Urban Studies* **32** 733-757

- Frey W H, Berube A, Singer A, 2009, "Getting Current: Recent Demographic Trends in Metropolitan America" *Metropolitan Policy Program, The Brookings Institution*
- Galster G, Hanson R, Ratcliffe M R, Wolman H, Coleman S, Freihage J, 2001, "Wrestling Sprawl to the Ground: Defining and Measuring an Elusive Concept" *Housing Policy Debate* **12** 681-717
- Hall M, Lee B, 2009, "How Diverse Are US Suburbs?" *Urban Studies* **47** 3-28
- Hall M, Lee B, 2010, "How Diverse Are US Suburbs?" *Urban Studies* **47** 3-28
- Hanlon B, 2009, "A Typology of Inner-Ring Suburbs: Class, Race, and Ethnicity in U.S. Suburbia." *City & Community* **8** 221-246
- Hanlon B, Short J R, Vicino T J, 2010, "Cities and Suburbs: New Metropolitan Realities in the US" *Routledge, London and New York*
- Hanlon B, Vicino T, Short J R, 2006, "The New Metropolitan Reality in the US: Rethinking the Traditional Model" *Urban Studies* **43** 2129 - 2143
- Hayden D, 2001, "Revisiting the Sitcom suburbs" *Land Lines* **13**
- Hayden D, 2003 *Green fields and urban growth, 1820-2000* (Pantheon Books, New York, NY)
- Huie S A B, Frisbie W P, 2000, "The components of density and the dimensions of residential segregation" *Population Research and Policy Review* **19** 505-524
- Jargowsky P A, 2003, "Stunning progress, hidden problems: the dramatic decline of concentrated poverty in the 1990s" *Research Brief, Metropolitan Policy Program, Brookings Institution, Washington, DC.*
- Kato Y, 2006, "Planning and Social Diversity: Residential Segregation in American New Towns" *Urban Studies* **43** 2285-2300

- Lang R, Knox P K, 2009, "The New Metropolis: Rethinking Megalopolis" *Regional Studies* **43** 789-802
- Lang R E, 2003a, "Edgeless cities : exploring the elusive metropolis " *Washington, D.C. : Brookings Institution*
- Lang R E, 2003b *Edgeless cities: Exploring the elusive metropolis*. (Brookings Institution Press, Washington, D.C.)
- Lang R E, Nelson A C, Sohmer R R, 2008, "Boomburb downtowns: the next generation of urban centers" *Journal of Urbanism* **1** 77–90
- Lee B A, Iceland J, Sharp G, 2012, "Racial and Ethnic Diversity Goes Local: Charting Change in American Communities Over Three Decades", (Department of Sociology and Population Research Institute, The Pennsylvania State University)
- Lucy W, Phillips D, 2006 *Tomorrow's Cities, Tomorrow's Suburbs* (Planners Press, Chicago)
- Massey D S, Denton N A, 1987, "Trends in the Residential Segregation of Blacks, Hispanics, and Asians: 1970-1980" *American Sociological Review* **52** 802-825
- Mikelbank B A, 2004, "A Typology of U.S. Suburban Places" *Housing Policy Debate* **15** 935-964
- Mikelbank B A, 2006, "Local Growth Suburbs: Investigating Change within the Metropolitan Context" *Opolis: An International Journal of Suburban and Metropolitan Studies* **2** 1-15
- Mikelbank B A, 2011, "Neighborhood D é à Vu: Classification in Metropolitan Cleveland, 1970-2000" *Urban Geography* **32** 317-333
- Morenoff J D, Tienda M, 1997, "Underclass Neighborhoods in Temporal and Ecological Perspective" *The ANNALS of the American Academy of Political and Social Science* **551** 59-72

- Orfield M, 2002a *American Metropolitcs The New Suburban Reality* (Brookings Institution Press, Washington, DC)
- Orfield M, 2002b *American metropolitcs: the new suburban reality* (Brookings Institution Press, Washington, D.C.)
- Pendall R, Carruthers J I, 2003, "Does Density Exacerbate Income Segregation? Evidence from U.S. Metropolitan Areas, 1980 to 2000" *Housing Policy Debate* **14** 541-589
- Phelps N A, Wood A M, Valler D C, 2010, "A postsuburban world? An outline of a research agenda" *Environment and Planning A* **42** 366-383
- Price-Spratlen T, Guest A M, 2002, "Race and population change: a longitudinal look at Cleveland neighborhoods" *Sociological Forum* **17**
- Roberts S, 1993, "Who We Are: A Portrait of America based on the Latest US Census " *New York: Times Books.*
- Sarkissian W, 1976, "The Idea of Social Mix in Town Planning: An Historical Review" *Urban Studies* (*),* , **13** 23 21-246
- Short J R, Hanlon B, Vicino T J, 2007, "The Decline of Inner Suburbs: The New Suburban Gothic in the United States" *Geography Compass* **1** 641–656
- Simpson L, Gavalas V, Finney N, 2008, "Population Dynamics in Ethnically Diverse Towns: The Long-term Implications of Immigration" *Urban Studies* **45** 163-183
- Storper M, Manville M, 2006, "Behaviour, Preferences and Cities: Urban Theory and Urban Resurgence" *Urban Studies* **43** 1247-1274
- Swanstrom T, Casey C, Flack R, Dreier P, 2004, "Pulling Apart: Economic Segregation among Suburbs and Central Cities in Major Metropolitan Areas" *Metropolitan Policy Program, The Brookings Institution*

- Talen E, 2009, "The Context of Diversity: A Study of Six Chicago Neighbourhoods" *Urban Studies* **47** 486-513
- Thompson W, Hickey J, 2005 *Society in Focus* (Pearson, Boston, MA)
- Timberlake J M, Howell A J, Staight A J, 2010, "Trends in the Suburbanization of Racial/Ethnic Groups in U.S. Metropolitan Areas, 1970 to 2000" *Urban Affairs Review* **47** 218-255
- Vicino T J, 2008 *Transforming Race and Class in Suburbia: Decline in Metropolitan Baltimore* (Palgrave Macmillan, New York)
- White M J, 1986, "Segregation and Diversity Measures in Population Distribution" *Population Index* **52** 198-221
- Williams A, Kitchen P, 2009, "Measuring Neighborhood Social Change in Saskatoon, Canada: A Geographic Analysis" *Urban Geography* **30** 261-288

IV. Chapter 4 Neighborhood Change, Spatial Transformation and Job Accessibility

With Paul L. Knox

1 Introduction

Until the middle of the twentieth century, the social ecologies of metropolitan America could be conceptualized accurately by the textbook models of Alonso (1964), Burgess (1925) and Hoyt (1939), in terms of processes of congregation, segregation, bid-rent, and sequent occupancy—all of which pivoted tightly around a dominant central business district and transportation hub. Since the middle decades of the twentieth century, however, remarkable changes have transformed metropolitan America. These changes are being transcribed into settlement patterns of cities and metropolitan areas. The traditional social ecology of the stereotypical sectors and zones of Murdie's famous model (1969) of factorial ecology has shown signs of giving way to a more complex social spatial structure.

Just how have the socioeconomic changes played out across U.S. metropolitan areas? Many empirical analyses have investigated certain dimensions of socioeconomic distribution (Fan, 2010; Hanlon et al., 2006; Lucy and Phillips, 2001; Mikelbank, 2011; Nelson and Lang, 2011), and the proximity of employment to central cities (Glaeser et al., 2001; Kneebone, 2009) or populated areas (Weitz and Crawford, 2012). In spite of the significant progress those studies have made in achieving better understanding of neighborhood change across cities and metropolitan areas, they may either focus on cross-sectional socioeconomic distribution at a certain time without considering changes in distribution, or they may address the changing issues but ignore the spatial patterns of those transformations; they may also examine spatial structure

and its effects on employment accessibility, but fail to capture the proximity to jobs that accompanied socioeconomic distribution and transformation. In one words, the relationships between concomitant changes in socioeconomic profiles, changing metropolitan spatial structure, and the proximity of employment to locations of different typologies of neighborhoods remains unclear.

Why is the relationship between social and spatial factors and employment so important? Because specific patterns of socioeconomic compositions and their changes affect the configuration of spatial structure, and the form of spatial structure contributes to explanations of job accessibility and employment outcomes (Chapple, 2006; Naude, 2008). The literature provides much of the rationale for the accessibility of employment (Cervero, 1989; Kain, 2004; Stoll, 2005; Weitz, 2003), especially to low income families, as lower job accessibility may affect the residents' labor market outcome (Cooke, 1997), employment rate (Ihlanfeldt and Sjoquist, 1998 ; Raphael, 1998), and commuting time (Kawabata and Shen, 2007).

Recognizing these important interactions, this study will introduce a socially and spatially integrated framework to investigate neighborhood transformation, its spatial change over time, and the effect on employment accessibility. The aim is to contribute to the literature on neighborhood change and spatial mismatch by introducing employment accessibility across typologies of neighborhoods; further, we will examine not only the relationship between the spatial patterns of neighborhood distribution and employment accessibility, but also that between spatial patterns of neighborhood transformation and corresponding changes in employment accessibility.

In this study, a set of cluster analysis and GIS-based spatial analyses have been developed to capture the spatiotemporal patterns of high-resolution changes of socioeconomic

development in the North Carolina Piedmont region from 1980 to 2010. This study will address the following issues: (1) the spatial patterns of neighborhood distribution (2) how job accessibility varies across neighborhood typologies (3) the spatial patterns of neighborhood transformation over the past three decades and (4) the relationships between spatial patterns of neighborhood transformation and changes in job accessibility across neighborhood typologies.

2 Research Context

An enormous body of theories contributes to a comprehensive understanding of how different types of people and businesses are located within the urban setting. These theories can be traced back to the Chicago School's concentric zonal model (Burgess, 1925), the sectoral model (Hoyt, 1939), the multiple nuclei model of Harris and Ullman (1945), and the social space concept of Bourdieu's (1985) model. Unlike earlier models that emphasized single diagnostic variables, social area analysis (Shevky and Bell, 1955) discovered both common characteristics and their variations within cities by constructing a composite index of variables, including social rank, urbanization and segregation. Since the 1960s, using factor analysis to uncover underlying dimensions, factorial ecology has offered idealized three-factor models across Western cities: the sectoral pattern of socioeconomic status, the zonal gradient of family status, and a clustered pattern of ethnicity (Davies, 1984). Generalizations about urban structure have been made from comparative analyses of factorial ecologies, which show that the spatial expression of the major dimensions tends to persist over decades (Knox, 1982). Due to the social and economic changes in the United States, a number of criticisms have been raised against the classical models of the Chicago School. Kearsley's (1983) model of urban structure, for example, updated Burgess's (1925) model by including contemporary urban processes, such as inner city decline,

gentrification and decentralization. Marcuse (1989) suggested a “quartered city” model with exclusionary and ethnic enclaves, gentrified areas, suburbs and tenement areas.

Rather than simply focusing on cross-sectional patterns of cities and metropolitan areas, some models have investigated changes in population composition, land use or activities in neighborhoods. The fundamental assumption of the Chicago School’s invasion-succession model (Burgess, 1925; Park, 1952) is that neighborhood change is an inevitable result of residence competition for space, and that neighborhoods will change as higher-income residents in outer rings are invaded and finally replaced by lower-income residents from inner rings. The filtering model developed by Hoyt (1939) explains this neighborhood decline as a function of aging properties and new construction on the periphery of cities. It is the attraction of new neighborhoods on the periphery, rather than the push from inner cities that resulted in the outward expansion of urban areas (Pitkin, 2001). These models, although they examine the mechanisms of a range of changes in demographic, socioeconomic and physical conditions of neighborhoods, rarely examine the spatial dimension of those changes.

In recent decades, contemporary development has challenged those traditional models, which has resulted in flourishing theoretical and empirical research on the significant changes in social, spatial and employment structures in metropolitan areas. First, the transformation of the demographic and economic structure of metropolitan areas has led to a growing heterogeneity in an increasingly decentralized metropolitan America. Several empirical analyses have confirmed the diversity of contemporary U.S. metropolitan areas, especially in suburbia, providing typologies of samples of suburban municipalities and census designated places, such as poor cities and suburbs (Kneebone and Berube, 2008), declining suburbs (Jargowsky, 2003; Short et al., 2007; Vicino, 2008), African American and immigrant suburbs (Hanlon et al., 2006), and

manufacturing suburbs (Mikelbank, 2004), to name a few. Distinctive typologies were identified by race, age or socioeconomic status. These studies challenge the traditional metropolitan models of urban core and homogeneous suburbs, but only focus on socioeconomic dimensions without considering their spatial dimensions and the relationship to employment accessibility.

Second, specific patterns of socioeconomic compositions and changes are likely to influence the configuration of spatial structure. As Knox (2008) suggests, socioeconomic realignments have given rise to new urban, suburban, and extra-urban landscapes. These new landscapes are characterized by the dispersed spatial structure of “urban realms” (Lang and Knox, 2009) and the disjointed and decentralized urban landscapes of the “galactic metropolis” (Lewis, 1983), “post-suburban” (Phelps et al., 2010), “edge cities” (Garreau, 1988), “edgeless cities” (Lang, 2003) of low-density office development, the interspersed landscape of “metroburbia” (Knox, 2008), and “cosmoberbs” of wealthy suburbs that are also diverse (Lang and LeFurgy, 2007). Those dispersed and polycentric urban forms are characterized by the emergence of employment centers in suburbs (Anas et al., 1998; Coffey and Shearmur, 2001). More recently, a megapolitan spatial model (Nelson and Lang, 2011) was proposed to capture the notion of super, multi-metropolitan regions with a strong economic interdependency. This body of literature has examined the spatial expression of contemporary population and employment structure and recognized the overall trend of de-centralization and suburbanization. However, patterns of spatial change are less well understood. Most importantly, these studies have paid much less attention to how spatial patterns and their changes are related to employment accessibility and its changes.

Finally, the suburbanization of both populations and employment has led to a more diversified demographic composition as well as a more dispersed and polycentric urban form.

These transformations may increase the proximity between suburban residents—both minorities and majorities—and employment opportunities. Despite the increasing diversity of the population in U.S. metropolitan areas, the lower job accessibility for inner-city minorities, such as low-income African Americans or immigrant populations (Liu and Painter, 2012; Martin, 2001; Parks, 2004; Raphael and Stoll, 2002; Stoll, 2005), is still an important concern. The spatial mismatch hypothesis (Ihlanfeldt, 1998; Kain, 1968) emphasizes that, due to the spatial isolation from low-wage, low-skill suburban employment opportunities, low-income populations in inner-city neighborhoods suffer from high unemployment rates and commuting time. Some studies offer information about whether residents are close to central business districts or to other job centers, and may look at the issue of spatial mismatch from either a monocentric or polycentric perspective.

While neighborhood typology, spatial structure or employment accessibility has been investigated in the literature individually, the proximity of employment to locations of different neighborhood typologies identified by multiple attributes has been under studied. Most importantly, the relationships between patterns of neighborhood transformation and changes in job accessibility across typologies of neighborhoods have received much less attention.

3 Socio-Economic Change in the North Carolina Piedmont Metropolitan Region

The fast-growing development in the North Carolina Piedmont region is somewhat typical of the U.S. The Piedmont metropolitan region, including Charlotte-Gastonia-Rock Hill (CGR), Raleigh-Cary (RC), and Durham-Chapel Hill (DC) MSA (Metropolitan Statistical Areas), refers mainly to the hilly plateau between coastal plains and mountains in North Carolina. For over a hundred years this vast rural area that formerly produced cotton and tobacco has

developed textile, processing and other related industries. The Piedmont has been the most populated region in North Carolina (NC) for nearly a century (Meade, 2008) and for decades has been the top metropolitan area, showing continued significant growth, strong competitiveness, a strong economy, and one of the best living areas in the state (Brookings, 2000a, 2010; Frey, 2005, 2010; Hughes, 1990; Institute, 2004; Meade, 2008; Wial and Friedhoff, 2010).

The Charlotte-Gastonia-Rock Hill MSA is anchored by the city of Charlotte. Hanchett (1998) has described how the city's early development involved a "sorting out" along racial and class lines. Initially driven by economics, an original, ante-bellum "salt and pepper" ecology of spatially-intermixed African American and white populations gave way to a "patchwork quilt" of racial segregation in the 1880s. A booming textile economy at the turn of the 20th century produced new wealth that quickly found expression in streetcar suburbs that were sharply segregated through restrictive covenants. After the Great Depression, the city's social ecology changed again in response to modernization and the advent of the automobile, developing—like many other North American Cities—a sectoral pattern in terms of income and race. By the mid-twentieth century, the basic layout of modern Charlotte had been formed, with wealthy and upper-middle class white families dominating the south and southeast of the city, while the north and west sides were dominated by the more modest homes of the city's large African American and working-class white populations.

Raleigh's socio-spatial development followed a similar chronological pattern, but with a different geography. Here the locus of affluent white neighborhoods was in the north of the city, while poor African American neighborhoods were concentrated in the south. While Charlotte and Raleigh both presented a clear demarcation between rich white and poor African American populations, with each occupying one end of the city, Durham developed a distinctively different

social ecology. African-American business thrived in Durham, a unique phenomenon in the early South. The hub of African American businesses was Parrish Street, widely known as “Black Wall Street,” adjacent to the town’s tobacco warehouses. The early streetcar suburbs in Durham, in contrast to those in Charlotte and Raleigh, were largely established to serve African American communities such as Trinity Park, Morehead Hills, Club Boulevard, and Needmore (Turner, 2002).

Since the mid-1970s, the population of the Piedmont region has grown rapidly (Berube et al., 2006; Brookings, 2000b). The population of Charlotte-Gastonia-Rock Hill MSA was 829,824 in 1980, and by 2010, it reached 1,758,038. The population of Raleigh-Durham-Cary CSA (Combined Statistical Area) reached 1,634,847 by 2010 from just over 635,131 in 1980. Central city Charlotte, for example, topped the American core cities list with a 70% population growth rate (Landis, 2009). Migrants and immigrants, drawn first by manufacturing jobs relocated from the deindustrializing northeast and then—and in much greater numbers—by the growth of ‘new economy’ jobs in banking, advanced business services, digital technologies, and biotechnology, contributed to rapid growth.

One aspect of this growth in the Piedmont has been the changing family structure, including a growth in the numbers of married couples with children, single-person households, and senior households. The Piedmont metro areas also became an immigration gateway in the 1990s, resulting in a marked increase in foreign-born populations, especially Hispanics and Asians (Kasarda and Johnson, 2006; Singer, 2004; Smith and Furuseth, 2004, 2008). Meanwhile, racial segregation and its attendant inequalities have persisted within the Piedmont metro areas, despite an overall increase in affluence (Brookings, 2000b).

Another aspect of this growth has included changing employment structure. As those regions have grown, the spatial locations of some sources of employment have become more decentralized, such as in Charlotte MSA; some may have experienced small changes in the spatial locations of employment, such as in Durham MSA (Kneebone, 2009). With respect to job creation and job sprawl, Weitz and Crawford (2012) used 2001-06 data to show that Raleigh MSA and Charlotte MSA gained in job creation but decreased in job accessibility. In another study, Stoll (2005) showed that Charlotte and Raleigh MSAs experienced relatively higher job sprawl but lower job mismatch for African Americans among 300 metropolitan areas based on year 2000 data.

An important factor in the growth of the Piedmont metros has been the “Research Triangle” anchored by the University of North Carolina (Chapel Hill), Duke University (Durham) and North Carolina State University (Raleigh). The Triangle has been listed among the nation’s top high-tech regions in terms of labor force quality (Koo, 2005), top competence (Institute, 2004) and top population gains since the 1990s (Landis, 2009). Centered on Research Triangle Park, this area has fostered the growth of the region’s new economic industries. Just as in other metropolitan regions, these employers have sought new settings well away from congested central city areas. The result has been the emergence of a “metroburban” metropolitan form (Knox, 2008), with a polycentric structure that incorporates urban realms and corridors, “edge cities,” “edgeless cities,” “exurbs,” “micropolitan” centers and “boomburbs.” Cary, for example, is a “boomburb” with a total office space market of over 5.5 million square feet, a retail space market of almost 6 million square feet, and a flex-space market approaching 1 million square feet. It is home to many new economy corporations, scattered throughout the district in small office parks and commercial corridors. They include the SAS Institute (the largest privately-held

software company in the world and Cary's single largest employer), Geotek Mapping, 3D Learning Solutions (simulation software for the military), Deutsche Bank Global Technologies, R.H. Donnelley (publisher), Infineon Technologies, Research in Motion (smartphone manufacturer), and Epic Games (video game developer). Cary's new-economy corporations have attracted an influx of employees from across the country. A much-recited witticism among North Carolinians is that the district's name is an acronym, standing for **C**ontainment **A**rea for **R**elocated **Y**ankees. Not all are Yankees, of course, but the great majority is "relos": affluent middle class households that have had to relocate as a result of the increasing fluidity and flexibility of corporate location strategies within the new economy.

Meanwhile, both Charlotte and Raleigh have invested heavily in their downtowns. In the 1980s and 1990s Charlotte had one of the healthiest downtown office markets in the United States (Hughes, 1990), and it remains the country's second largest financial center (after New York City) in terms of the financial assets that it controls (Charlotte Chamber of Commerce). Raleigh, as the state capital, has developed a significant amount of office employment in its downtown area, though it has almost none of the glassy office towers that characterize Charlotte's business district. Both city centers are surrounded by a transitional mixture of land uses. Some older residential districts remain, while others have been razed, a block at a time, to provide daily parking lots or sites for small business. Others still have been redeveloped as condominiums. In both cities, older single-family homes and town homes in leafy inner-city districts have attracted "gentrifiers" in significant numbers.

Both Charlotte and the Triangle were caught in the so-called Great Recession of the 2000s. According to the North Carolina Department of Commerce, in Charlotte MSA, employment dropped from a historical high of 861.2 thousands in 2008 to 807.5 thousands in

2010, and remained at a modest 820.4 thousands in 2012. In the Research Triangle Region, employment dropped by more than 35 thousands in 2009 before slowly regaining ground in 2011 after a two-year decline. To illustrate this significant job loss, consider Charlotte's banking industry, which was hardest hit in the financial crisis. Based on the 2011 Bank of America Annual Report, Bank of America lost 2.2 billion dollars in 2010. Another major event was Wachovia's merger with Wells Fargo in 2008 after a massive \$8.9 billion loss in the year.

The Piedmont was historically a rural agricultural region but has now urbanized so much that it is swarming with the largest and fastest-growing cities. Now what characterizes the Piedmont region, especially the cities of Charlotte, Raleigh and Durham, are fast-growing, vibrant job centers for financing and hi-tech, top population growth and its racial diversification.

4 Data and Methods

The primary source of the data used in this study at the census tract level from 1980 to 2010 is derived from the Longitudinal Tract Data Base (LTDB) and prepared by Spatial Structures in the Social Sciences (S4). In order to track neighborhood changes directly over time, we used the LTDB data that have been standardized to 2010 boundaries. Employment data at the five-digit zip code and census tract level in 2010 are from the Longitudinal Employer-Household Dynamics (LEHD). Central cities of 1980 are identified based on the indicator in the Neighborhood Change Database (NCDB) produced by the Urban Institute and GeoLytics. The boundaries of the 2010 census used in GIS analysis are from the National Historical Geographic Information System (NHGIS).

In this study, those census tracts with populations lower than 200 in each census year have been excluded from the analysis in order to avoid estimations based on a small number of

data (Bench, 2003). After excluding these tracts and tracts with missing data, the pooled data in this study included a total of 2,874 tracts. All variables for each tract were standardized as z-scores relative to all the other tracts in the same census year. The major advantage of our study is that it allows direct comparisons of the relative importance and spatial organization of each major tract type from one census year to another. When analyzing the spatial changes of socioeconomic distribution from 1980 to 2010, only those tracts that have specific typologies in both census years (629 tracts for 1980 and 2010) were included in the analysis.

In seeking to delineate the socio-spatial transformation of these Piedmont metros, we have pooled the standardized tract-level data from 1980 to 2010 for the three MSAs and employed a k-means cluster analysis to develop the overall typologies. K-means is a method of cluster analysis that partitions N observations into k clusters. In this process, each observation belongs to the cluster with the nearest mean. In order to identify the number of clusters that are relatively stable, we relied on a data visualization technique—clustergrams—to guide the choice of the number of clusters. The clustergram is used to examine how the members of these clusters are formed as the number of clusters increases. The width of the line segments indicates the number of observations that are assigned to a cluster.

The job accessibility of a given zip code area is measured using a gravity model (Geertmana and Eck, 1995; Pooler, 1987; Raphael, 1998; Weitz and Crawford, 2012). It is calculated using the following equation:

$$L_i = \sum_j \frac{P_j}{d_{ij}^b}$$

where, L_i is the accessibility for zip code i . P_j is the population in tract j within a given distance threshold to zip code i . The Euclid distances between zip code i and tracts j are denoted d_{ij} . The exponent b is a distance decay exponent.

Generally, a 30-minute travel time or a 30-mile travel distance by car is selected as the threshold (Cervero and Murakami, 2010; Matsuo, 2011; Parsons Brinckerhoff Quade & Douglas Inc., 1996; Weitz and Crawford, 2012). Here, following the procedure of Weitz and Crawford (2012), we defined the distance threshold as 30 miles and employed the simplest value of 1 as the distance decay exponent b .

The LEHD employment data include 174 zip codes within the three metropolitan areas. Total primary jobs are used to calculate the highest paying job for an employee in 2010 for each zip code area. Three categories of primary jobs by earnings are available from the LEHD data: more than \$3,333 per month, \$1,250 to \$3,333 per month, and less than \$1,250 per month. For the sake of simplicity, these three categories will be labeled as high-, mid- and low-wage jobs, respectively.

In order to calculate the Euclid distances between zip code i and tracts j , we created two point features based on the centroids of zip code and tract polygons in GIS. The point features of census tracts contain the attributes of population, and the point features of zip code contain the attributes of employment. By performing spatial analysis of point distance calculations in GIS, we measured the Euclid distance from the point of every zip code to all points in the nearest census tracts within a defined radius of 30 miles. This calculation includes all zip code-to-tract linkages within a 30-mile threshold without limiting those linkages across metropolitan boundaries. Since Raleigh-Cary MSA and Durham-Chapel Hill MSA are physically connected to each other, the report about job accessibility will include Charlotte-Gastonia-Rock Hill (CGR) MSA and Raleigh-Durham-Chapel Hill (RDC) CSA.

The job accessibility at region m is the sum of the L_i weighted by zip code i's share of employment within the region m:

$$L_m = \sum_i L_i * \frac{w_i}{W_m}$$

where, L_m is job accessibility at region m (MSA or CSA), L_i is the accessibility for zip code i, and w_i is the employment in zip code i. W_m is the total number of jobs contained in region m.

5 Results

5.1 Changing social ecology: empirical analysis

In this study, ten variables related to demographics, socioeconomic status, and housing characteristics were selected based on the literature of neighborhood typologies (Hanlon, 2009; Kitchen and Williams, 2009; Mikelbank, 2004, 2011; Morenoff and Tienda, 1997). In order to determine just how the spatial patterns of Piedmont metros have changed since 1980, we have drawn on tract-level decennial census data on this standard set of ten socio-economic variables.

We first divided the pooled data into two to eight clusters using k-means algorithms. The three to five group solutions have the relatively larger values based on the Calinski/Harabasz pseudo-F test. Then, a clustergram indicates the relative stability of the five-cluster choices (Fig.IV-1). Thus, our analysis will be based on the five-fold classification of census tracts in the Piedmont metros.

Figure IV-1 Visualization of clusters via Clustergram

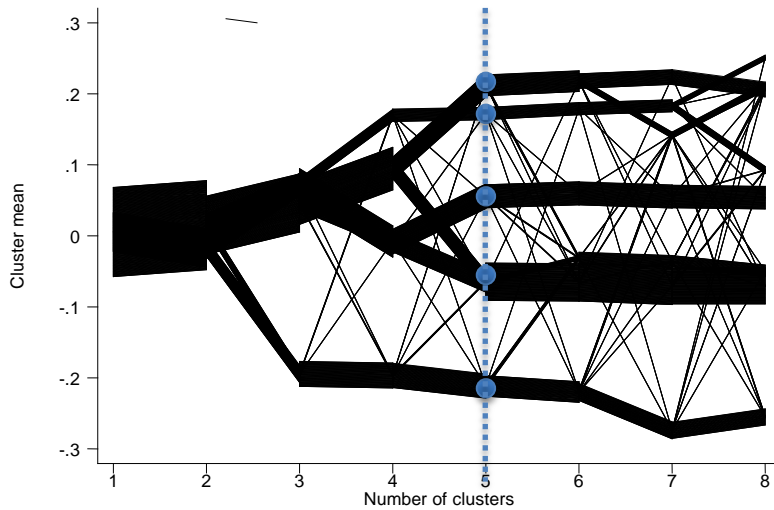


Table IV-1 lists the means of the ten variables for the five clusters. A significant group of tracts were dominated by *middle-class* households, the classic demographic of America’s “sitcom suburbs” (Hayden, 2003): family-oriented, white and relatively stable home-owning households. In comparison, *lower/aging* tracts had lower homeownership and median household incomes with a relatively higher proportion of seniors. *Black/poor* tracts were characterized by the highest percentages of African American populations and the lowest median household incomes. We described the fourth group of tracts as *upper-income*: households with significantly higher than average median household incomes, as well as the highest proportion of persons with a higher education. *Immigrant/renter* described those tracts with the lowest homeownership and the highest proportions of foreign-born populations. It should be emphasized that these results reflected the dominant general patterns among the pooled tract data for the period 1980-2010.

Table IV-1 Z-score means across clusters

Variable	Middle -class	Lower/ aging	Black /poor	Upper- income	Immigrant /renter
Demographic					
percentage of persons age 17 years and under	0.29	0.10	0.51	0.49	-1.09
percentage of persons age 60 years and over	0.04	0.73	0.17	-0.40	-0.33
percentage of persons of black race, not Hispanic origin	-0.22	-0.14	2.42	-0.69	-0.03
percentage of foreign-born	-0.38	-0.61	-0.24	0.35	1.07
Socioeconomic Status					
percentage of persons with at least a four-year college degree	-0.25	-0.91	-0.93	1.27	0.61
percent unemployed	-0.32	0.27	1.77	-0.59	-0.07
percentage of manufacturing employees (by industries)	-0.17	1.46	-0.20	-0.34	-0.77
Median household income	0.11	-0.62	-1.23	1.53	-0.44
Housing characteristics					
percentage of owner-occupied housing units	0.58	0.19	-1.11	0.65	-1.24
percentage of vacant housing units	-0.33	0.10	0.54	-0.14	0.18

5.2 Changing spatial patterns of neighborhood distribution

This section of the paper revolves around the question of what spatial patterns of neighborhood distribution may be discerned in the Piedmont region. Given the nature and extent of changes in metropolitan form and social and demographic structure, it is reasonable to expect that the remarkably consistent social ecology of mid-twentieth century North American cities—with socio-economic status expressed in wedge-shaped sectors, household demographics in zonal rings, and ethnicity in clusters—has evolved in significant ways. The contemporary urban social fabric might be fragmented at the fine-grained level but integrated at the macro level (Marcinczak and Sagan, 2011). Thus, we expected a consistent pattern in the spatial expression of neighborhood distribution.

Plotting the spatial distribution of each tract type over the three decades reveals some interesting patterns in segmentation, diversification, and evolution of different socio-ecological settings in the North Carolina Piedmont region. Given the overall growth of MSAs over the period, the general trend for most tract types is towards an increase in aggregate numbers. Table

IV-2 summarizes the distributional changes across clusters. Figs. IV-2 and IV-3 show the spatial patterns of the five types of neighborhoods in CGR MSA and RDC CSA in 2010.

Table IV-2 Distributional changes across clusters

Location	Year	Total tracts	Middle-class%	Lower/aging%	Black/poor%	Upper-income%	Immigrant/renter%
Suburbs	1980	509	38.90	22.00	6.09	21.02	11.98
Suburbs	1990	618	39.00	23.14	4.37	18.77	14.72
Suburbs	2000	627	36.52	24.88	4.31	20.41	13.88
Suburbs	2010	631	37.40	20.44	7.45	19.02	15.69
Cities	1980	123	13.01	5.69	30.08	16.26	34.96
Cities	1990	122	9.02	2.46	32.79	10.66	45.08
Cities	2000	122	8.20	3.28	31.15	9.02	48.36
Cities	2010	122	5.74	4.92	31.97	12.3	45.08

Figure IV-2 Spatial pattern of clusters in CGR MSA in 2010

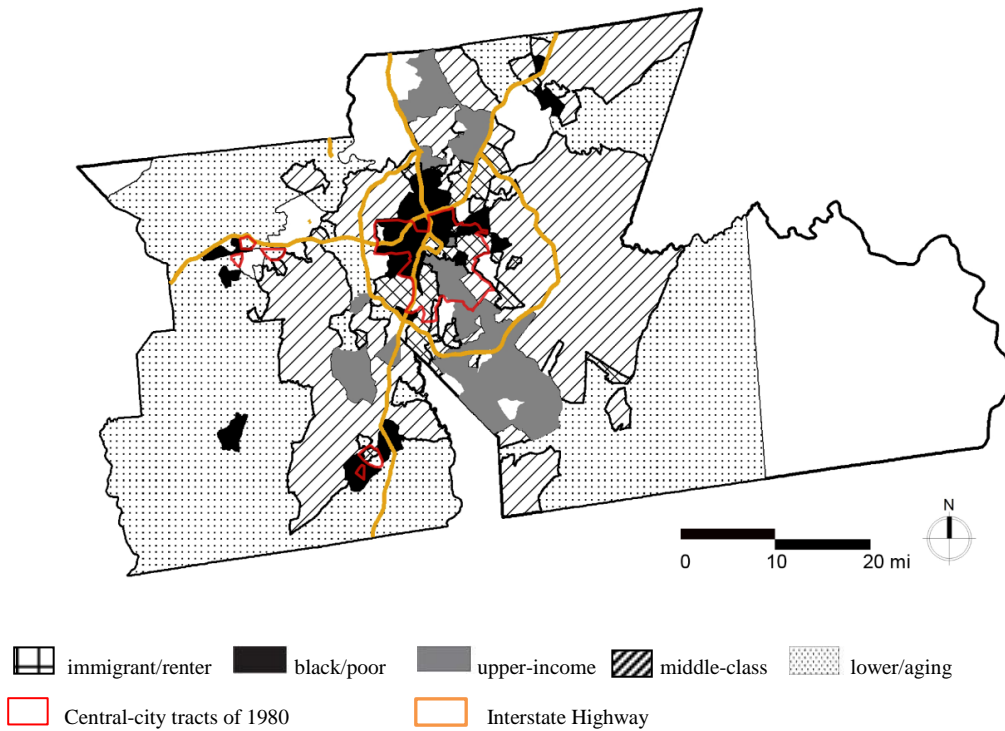
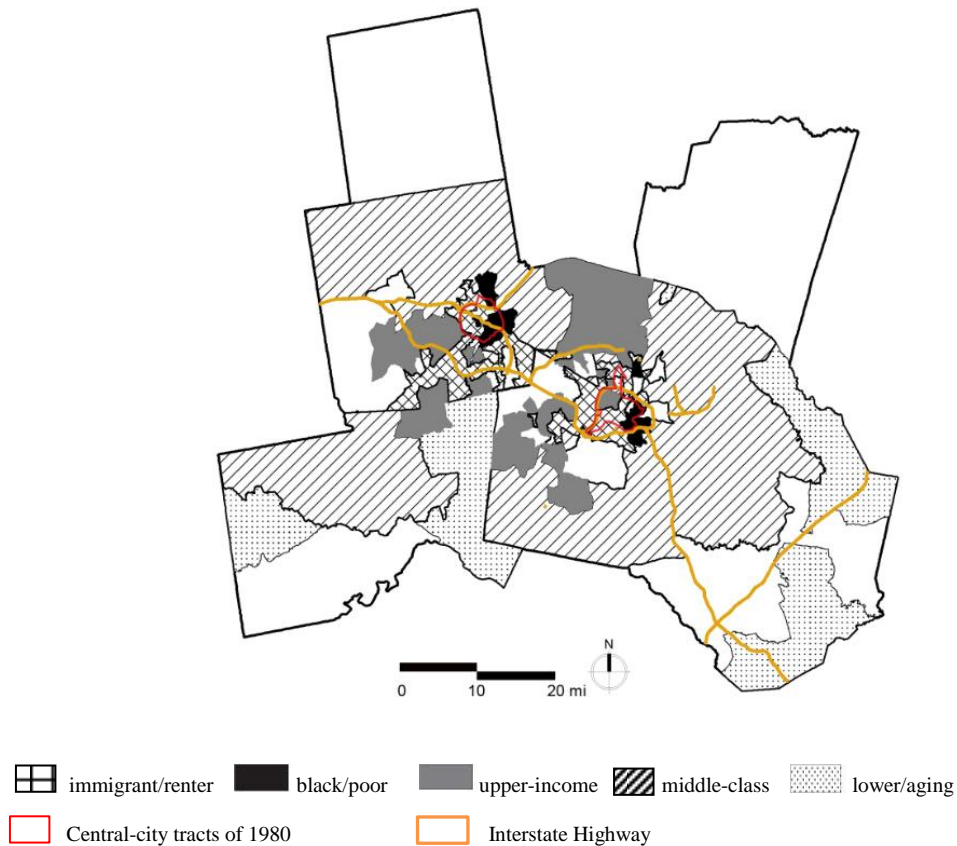


Figure IV-3 Spatial pattern of clusters in RDC CSA in 2010



The first point to make here is that, in contrast to our expectations, cities are still organized with “zones” and “sectors,” as described in the classic urban models. At a more detailed scale, much of the socio-spatial differentiation exhibits a sectoral pattern. As in most of metropolitan America, and indeed as established in the early development of the Piedmont metros, affluent white and low-income African American neighborhoods are not only spatially segregated but located at some distance from each other. Households with incompatible social, cultural and economic backgrounds tend to avoid living together (Clark, 2009), which may explain why *black/poor* and *upper-income* neighborhoods rarely exist in the same areas. The exception, as in its own early development, is Durham, where *black/poor* tracts are in close

propinquity to *upper-income* white tracts. In many cases, *immigrant/renter* tracts occupy the sectors between *black/poor* and *upper-income* neighborhoods.

A second observation is that the *middle-class* dominance in suburbs, and the *immigrant/renter* and *black/poor* dominance in city centers have been maintained numerically and spatially throughout these decades; further, most *immigrant/renter* tracts are located near university areas in the Piedmont region. The North Carolina Piedmont region is home to a large number of colleges and universities (Brookings, 2000a). These characteristics suggest that these areas have a higher education rate but lower homeownership rate. The finding that universities may attract well-educated immigrants and renters is consistent with certain aspects of the multiple nuclei model of Harris and Ullman (1945).

Another broad observation, then, is that the socio-spatial ecology of the Piedmont metros is characterized by a juxtaposition of a relatively stable structure with a growing fragmentation and diversification at a finer-grained level. Since the 1980s, the Piedmont metros have become substantially post-suburban (Phelps et al., 2010). Despite the dominance of the *middle-class* in suburbia, the Piedmont region has shown an increasingly diverse and fragmented mosaic. The spatial patterns have become more diversified due to socio-spatial restructuring, but the basic, traditional patterns and relative locations of neighborhood types have remained largely stable over time. Thus, socio-spatial trajectories in the Piedmont are both an extension of historical trends and a consequence of new forces, such as new streams of migration and immigration, social polarization and gentrification.

5.3 Neighborhood distribution and job accessibility across typologies

Figs.IV-2 and IV-3 show that *immigrant/renter* and *black/poor* tracts were generally located near urban cores. The *upper-income* neighborhoods occupied one or several sectors that

were not far away from those suburban tracts with a higher density of jobs. The *lower/aging* tracts are located generally in outer suburbs and exurbs where jobs are less accessible. Generally speaking, *middle-class* socioecologies formed rings in the suburbs of the region. We asked, what is the relationship between those neighborhood distributions and job accessibility? Which typologies of neighborhoods have higher job accessibility, and which ones suffer from lower accessibility to available jobs? In order to answer these questions, we focused in this section on the relationship between neighborhood distribution and job accessibility across neighborhood typologies.

A notable result of job accessibility analysis in the Piedmont region is that RDC (Raleigh-Durham-Chapel Hill) CSA suffers from lower job accessibility (78.94) compared with CGR (Charlotte-Gastonia-Rock Hill) MSA (86.46) in 2010. CGR MSA had the highest number of primary jobs (723,549) in 2010, with fewer in Raleigh-Cary (514,307) and Durham-Chapel Hill (247,746) MSA. According to the inflow/outflow analysis in 2010 (by all jobs) provided by the U.S. Census Bureau (Table IV-3), 38.7% of employees living in the city of Charlotte were employed elsewhere (52.5% in the city of Raleigh, 56.0% in the city of Durham), while 59.2% of employees in Charlotte lived outside the city (76.5% in the city of Raleigh, 70.8% in the city of Durham).

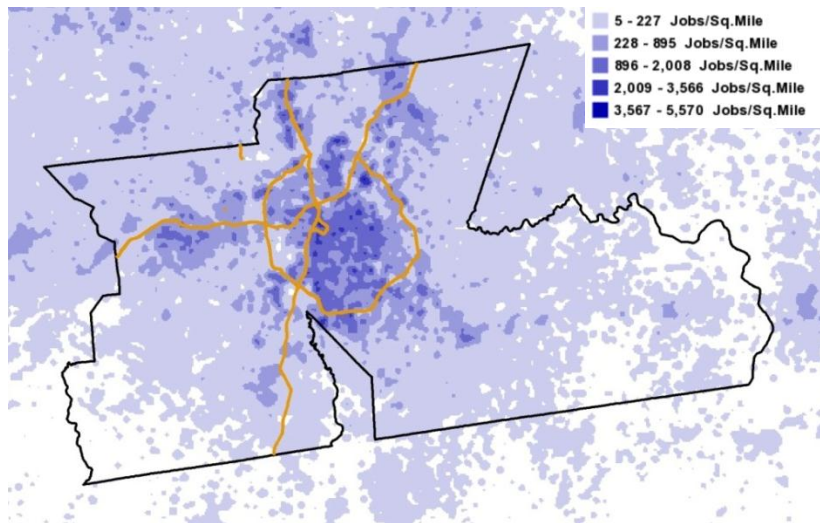
Table IV-3 Inflow/Outflow Job Counts

		Employed in the selected area	Employed in the selected area but Living Outside	Employed and Living in the selected area	Living in the selected area	Living in the selected area but Employed Outside	Living and Employed in the selected area
City of Charlotte	Count	433,424	256,408	177,016	288,743	111,727	177,016
	Share	100%	59.20%	40.80%	100%	38.70%	61.30%
City of Raleigh	Count	329,492	252,125	77,367	162,707	85,340	77,367
	Share	100%	76.50%	23.50%	100%	52.50%	47.50%
City of Durham	Count	140,421	99,396	41,025	93,222	52,197	41,025
	Share	100%	70.80%	29.20%	100%	56.00%	44.00%

Source: Longitudinal Employer-Household Dynamics

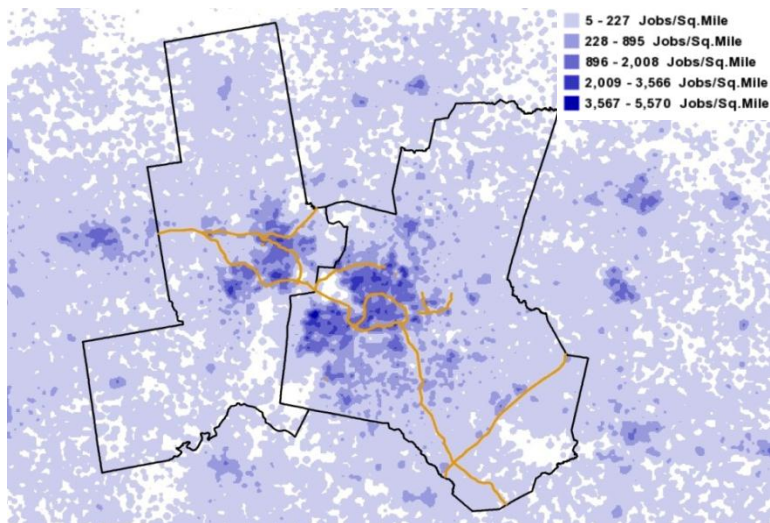
Comparing the distribution of neighborhood typologies and their spatial relationships with job density (Figs.IV-4 and IV-5) suggests that job accessibility may vary by neighborhood typologies. Figs. IV-6 and IV-7 show job accessibility by the five neighborhood typologies in CGR MSA and RDC CSA in 2010, respectively. In general, *lower/aging* and *black/poor* neighborhoods were less accessible to job opportunities than others were. The *lower/aging* neighborhoods had the lowest job accessibility, because *lower/aging* tracts were generally located in outer suburbs and exurbs that were farther from both urban cores and suburban employment centers. Similar to *lower/aging* neighborhoods, the *black/poor* neighborhoods did not enjoy high accessibility to jobs. This is consistent with the literature that African Americans are the most spatially isolated from jobs and show the highest spatial mismatch (Stoll, 2005). Different from other low-income neighborhoods with poor accessibility to jobs, *immigrant/renter* neighborhoods have a strong advantage in job accessibility; in RDC it is even higher than that of their suburban white counterparts. This might be because those residents in *immigrant/renter* neighborhoods tend to live near their job locations. Further, the *middle-class* neighborhoods, and to a lesser extent, *upper-income* neighborhoods, have high job accessibility. One possible reason for the high job accessibility of *middle-class* neighborhoods may be that they tended to form rings in suburbs that were adjacent to most job opportunities. The job accessibility of *upper-income* neighborhoods is lower than that of *middle-class*, which is probably because high-income workers may prefer spacious housing and amenities over short commuting distances (Hu, 2010).

Figure IV-4 Job density in CGR MSA (2010)



Source: Longitudinal Employer-Household Dynamics

Figure IV-5 Job density in RDC CSA (2010)



Source: Longitudinal Employer-Household Dynamics

Figure IV-6 Job accessibility by wage across clusters in Charlotte-Gastonia-Rock Hill MSA 2010

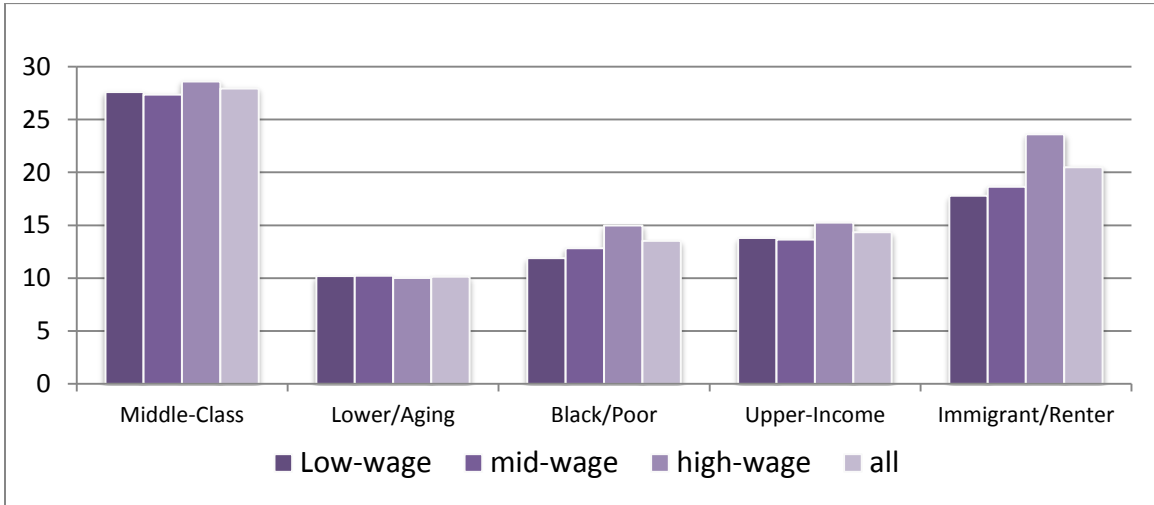
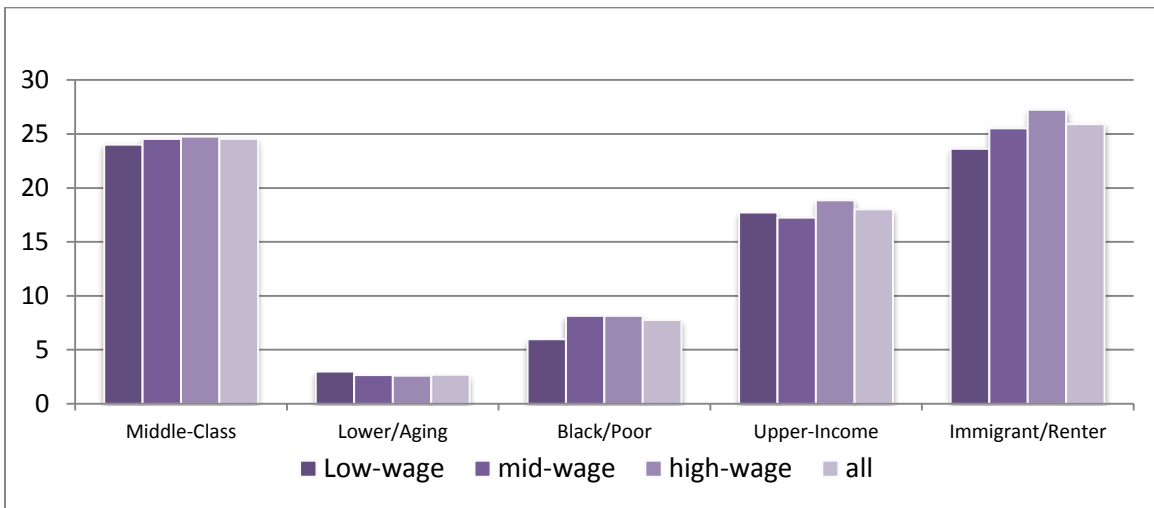


Figure IV-7 Job accessibility by wage across clusters in Raleigh-Durham-Chapel Hill CSA 2010



Enormous differences in job accessibility by neighborhood typologies raise another question with respect to the availability of jobs across neighborhoods, because living close to CBD or job centers does not necessarily mean that those employees are close to the jobs available to them. Results of job accessibility by wage across clusters (Figs.IV-6 and IV-7) show that low-wage jobs are less accessible to *black/poor* and *immigrant/renter* neighborhoods than

are high-wage jobs. In this situation, most residents in those neighborhoods, although generally located near urban cores, may be far away from available job opportunities. For *middle-class* and *upper-income* neighborhoods, the high-wage employment opportunities are more available to them than mid- and low-wage jobs. In sum, neighborhoods in the NC Piedmont region with lower incomes are more accessible to high-wage jobs than to low- and mid-wage jobs, which may suggest a problem of spatial mismatch between certain types of low-income neighborhoods and the jobs available to them.

5.4 Changing spatial patterns of neighborhood transition

5.4.1 Neighborhood succession

In this section, we looked in more detail at specific trajectories of neighborhood change from 1980 to 2010 in order to investigate how socioeconomic changes are reflected in urban landscapes. Several further observations emerged. Stability is the single greatest dimension of metropolitan change, while for those neighborhoods that have changed their attributes, the succession and growth of each type of neighborhood reveal some interesting patterns.

First, we focused on the succession process, defined as the sequences of neighborhood change where typologies of neighborhoods come to occupy a territory formerly dominated by another typology. Specifically, we examined the different evolutionary trajectories of ecological change across the Piedmont metro region. Fig.IV-8 illustrates succession patterns of neighborhood change in CGR MSA and RDC CSA. In looking at the overall succession patterns of the five types of tracts in the entire Piedmont region, we found that succession patterns differ by clusters:

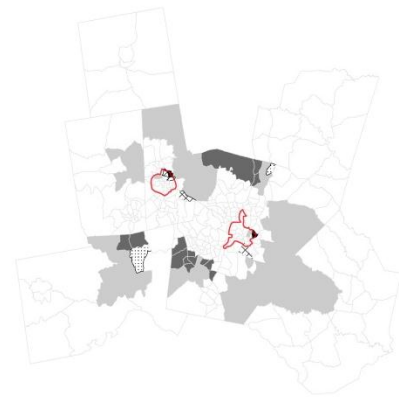
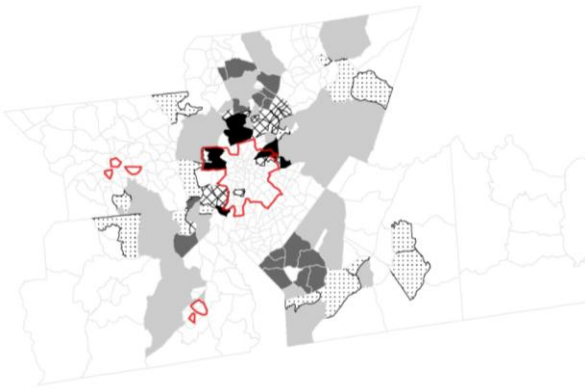
(1) *Immigrant/renter* and *black/poor* neighborhoods: a few *immigrant/renter* and *black/poor* neighborhoods have been upgraded into *middle-class* or *upper-income* neighborhoods, especially

in suburbs. Several *immigrant/renter* neighborhoods in inner cities that are adjacent to *upper-income* neighborhoods have been gentrified into *upper-income* neighborhoods, especially in the Charlotte MSA. In addition, transitions occurred from *black/poor* to *immigrant/renter* neighborhoods in central cities.

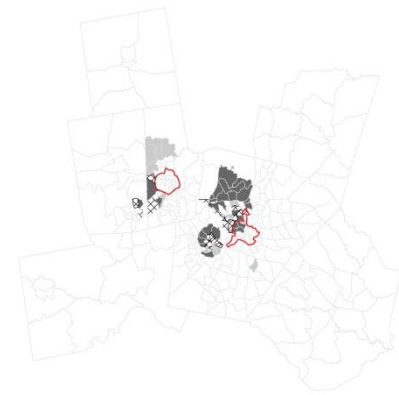
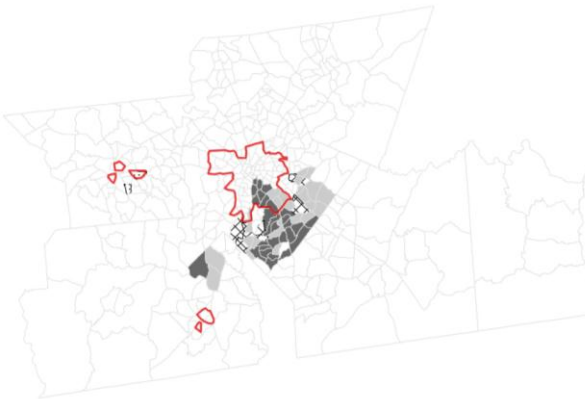
Figure IV-8 Succession patterns of the five typologies of tracts in the Piedmont region

Charlotte-Gastonia-Rock Hill MSA

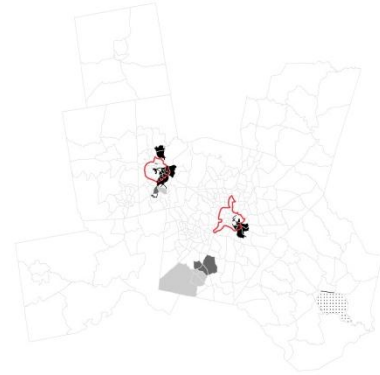
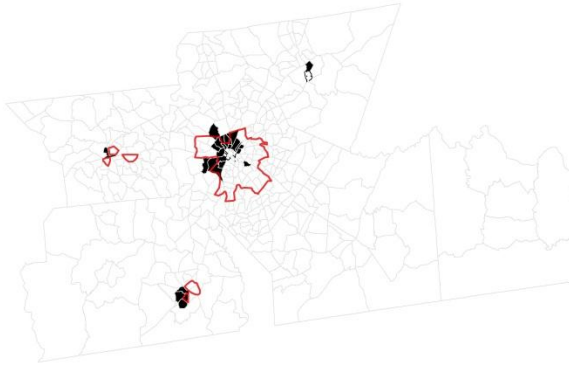
Raleigh-Durham-Chapel Hill CSA



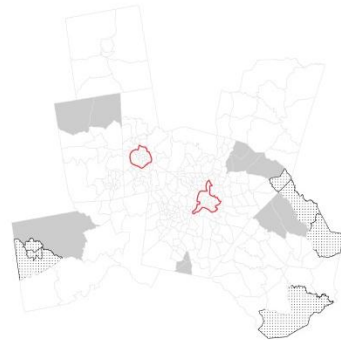
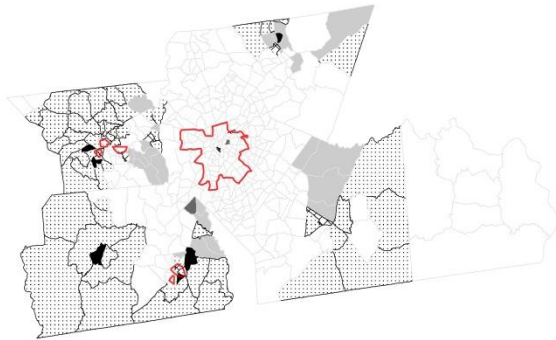
Succession patterns of *middle-class* neighborhoods



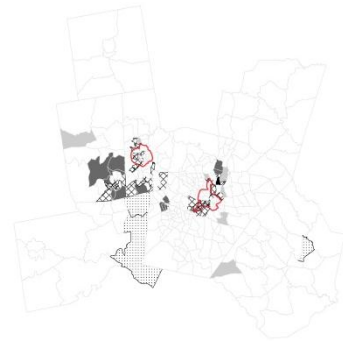
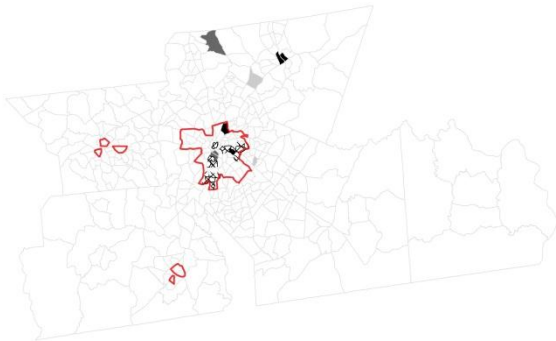
Succession patterns of *upper-income* neighborhoods



Succession patterns of *black/poor* neighborhoods

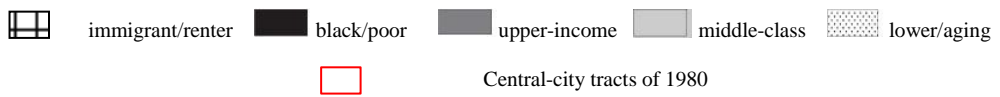


Succession patterns of *lower/aging* neighborhoods



Succession patterns of *immigrant/renter* neighborhoods

Legend for Other tracts



(2) *Upper-income* neighborhoods: the fringes of sectors of *upper-income* neighborhoods, especially those close to inner-ring suburbs, have generally been superseded by *middle-class* tracts and, to a lesser extent, *immigrant/renter* tracts. However, those *upper-income* neighborhoods located in central cities are relatively stable.

(3) *Lower/aging* neighborhoods: most *lower/aging* sectors in suburban and some in exurban settings have been upgraded into *middle-class* neighborhoods. Several *lower/aging* neighborhoods in the central city of Charlotte have changed into *black/poor* or been upgraded into *upper-income* neighborhoods.

(4) *Middle-class* neighborhoods: elsewhere within the background of *middle-class* suburbia it is possible to discern two broad trajectories of change: deteriorating *middle-class* tracts and strong and rising *middle-class* tracts. Generally speaking, *middle-class* ecologies formed rings in the suburbs of the region; the interior perimeter of these *middle-class* rings was adjacent to neighborhoods that were previously *middle-class*, but have shifted to *immigrant/renter* and *black/poor* neighborhoods; the outer suburban exterior perimeter of the *middle-class* rings, in particular in CGR MSA, tended to consist of neighborhoods that were previously *middle-class* but have emerged as *lower/aging* tracts. This result confirms invasion-succession model (Burgess, 1925; Park, 1952) to a certain extent, where neighborhoods will change as higher-income residents in outer rings are invaded and finally replaced by lower-income residents from inner rings. Finally, certain sectors of the *middle-class* rings have changed into *upper-income* tracts.

5.4.2 Neighborhood growth

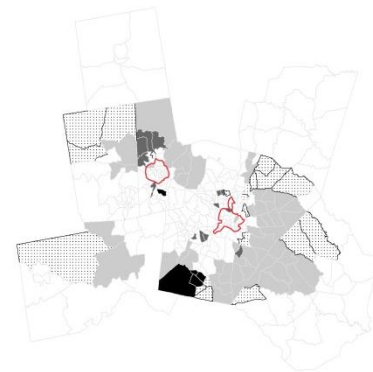
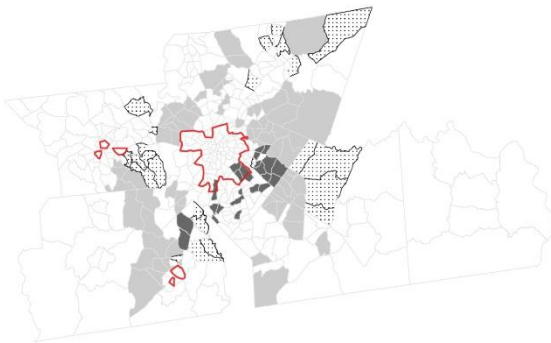
In addition to these patterns of ecological succession, it was possible to identify another aspect of metropolitan change by looking at patterns of ecological transformation: the growth of

a neighborhood typology through occupation of a territory that was formerly dominated by other typologies. Fig.IV-9 illustrates such patterns in the Piedmont region. This growth process can be categorized into four patterns: clustering, sectoral growth, border accretion, and greenfield expansion. The ecological changes of each typology of tracts in the Piedmont region follow one or a mix of the four patterns.

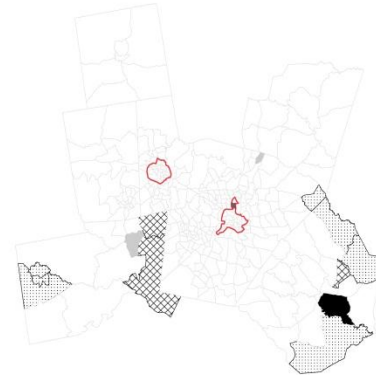
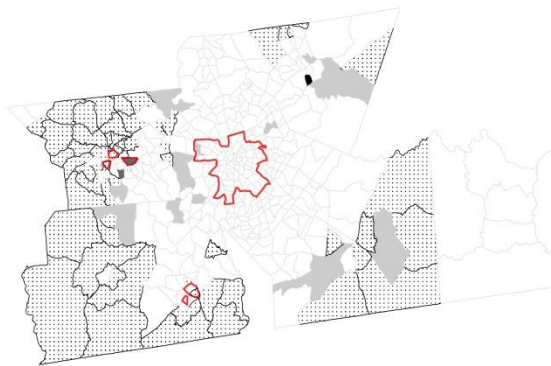
Figure IV-9 Growth patterns of the five typologies of tracts in the Piedmont region

Charlotte-Gastonia-Rock Hill MSA

Raleigh-Durham-Chapel Hill CSA



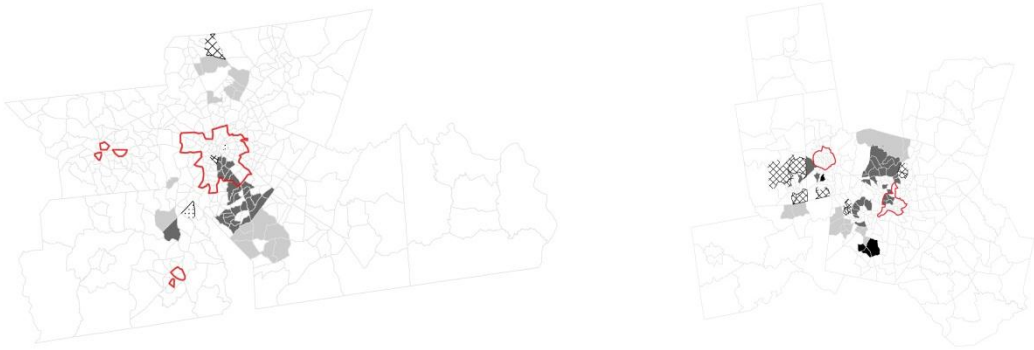
The growth pattern of *middle-class* neighborhoods



The growth pattern of *lower/aging* neighborhoods



The growth pattern of *black/poor* neighborhoods

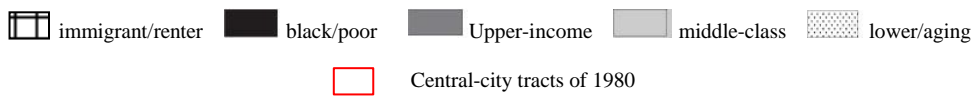


The growth pattern of *upper-income* neighborhoods



The growth pattern of *immigrant/renter* neighborhoods

Legend for Other tracts



(1) Clustering: The *immigrant/renter* tracts that are a distinctive feature of the 2010 maps generally emerged from neighborhood social ecologies that were previously dominated by white populations or, in a few small patches, by *black/poor* populations. By 2010, these newly-emerged *immigrant/renter* tracts had generally developed a cluster pattern within the central cities as well as in the suburbs.

(2) Border accretion: Most new *black/poor* areas emerged from *middle-class* tracts on the border of stable *black/poor* districts. Many new *upper-income* areas have evolved from formerly *middle-class* tracts on the suburban border of stable *upper-income* tracts.

(3) Sectoral growth: The expansion of *upper-income* ecologies has tended to occur along the outer border of the original *upper-income* tracts, but many of them are due to the transformation of outlying *middle-class* and *lower/aging* districts through upscale new developments in sectoral patterns.

(4) Greenfield expansion: Most new *middle-class* districts have evolved from formerly *lower/aging* tracts, or, to a lesser extent, *upper-income* tracts in under-developed suburban areas. Several *middle-class* tracts have evolved from *immigrant/renter* and *black/poor* suburban tracts. In addition, tracts that became *lower/aging* also exhibited a pattern of greenfield expansion. Most of these areas transitioned from former *middle-class* tracts in outer suburbs, and several from the other types of tracts.

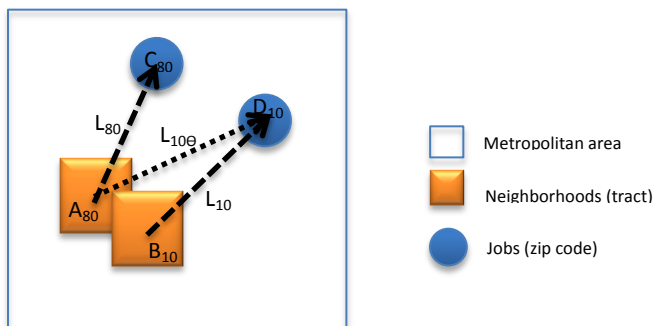
5.5 Neighborhood transition and job accessibility change

When comparing the growth patterns with employment density, we found that *upper-income* neighborhoods were growing far from available jobs, while new *immigrant-renter* neighborhoods were located mainly in those areas accessible to jobs. Is the growth of neighborhoods randomly distributed or do they tend to follow jobs? Is there any relationship

between neighborhood transition and changes in job accessibility across neighborhood typologies? The literature suggests that, due to less well-developed social networks, immigrants are more likely than African Americans to follow jobs (Baird et al., 2008). Therefore, it is expected that the growth of *immigrant/renter* neighborhoods will be located in those areas with higher job accessibility, while the growth of *black/poor* neighborhoods may not. Do residents in other types of neighborhoods tend to follow jobs as do immigrants? Will this trend be reflected in the spatial patterns of neighborhood growth? Will changing spatial patterns of neighborhoods lead to corresponding changes in job accessibility?

In order to answer these questions, we compared two types of job accessibility of neighborhoods. Fig.IV-10 translates the concept using a simplified graph that represents the spatial relationships of neighborhood-job changes. In this simplified case, jobs moved from location C in 1980 to location D in 2010, while neighborhoods moved from location A in 1980 to location B in 2010. L_{80} is job accessibility in 1980, and L_{10} is job accessibility in 2010. $L_{10\theta}$ is the job accessibility of those neighborhoods if they remained in the same location as in 1980. The difference between L_{10} and $L_{10\theta}$ is the change in job accessibility due to the movement of neighborhoods from location A to location B.

Figure IV-10 A simplified neighborhood-job changing relationship



In this part of the study, we examined the changes in job accessibility due to the movement of neighborhoods from location A to location B ($L_{10} - L_{10\Theta}$). Our measurement can be interpreted as the effect of neighborhood spatial shifts on job accessibility. The purpose of this measurement is to investigate whether the new neighborhood growth areas have higher or lower accessibility to those jobs in 2010. It is not designed to compare the job accessibility of neighborhoods in 1980 to that of neighborhoods in 2010. Therefore, we will not use population and employment specific to those two years, but instead, we will use the 2010 zip code employment and 2010 tract population. The benefits of using 2010 data are to control for the effects of population and employment changes on job accessibility, and to evaluate the pure effect of neighborhood location change on job accessibility.

If a neighborhood typology followed jobs in 2010, residents would move to those areas with higher job accessibility, thereby increasing overall job accessibility of that neighborhood typology. Figs.IV-11 and IV-12 illustrate the percentage of changes in job accessibility ($L_{10} - L_{10\Theta}$) by wage across the five types of neighborhoods. A positive value indicates that the growth of neighborhoods was associated with a corresponding increase in job accessibility, while a negative value indicates a decrease in accessibility.

Findings of this analysis suggested that the effects of neighborhood growth on changes in job accessibility varied by neighborhoods. The changes were particularly significant in *black/poor* and *immigrant/renter* neighborhoods in CGR MSA. We found that *immigrant-renter* neighborhoods tended to move closer to jobs, while *upper-income* neighborhoods tended to move farther away. Further, the growth of *lower/aging* neighborhoods was generally associated with a decrease in job accessibility, but in RDC CSA we saw an increase in low-wage job

accessibility. The effects on employment accessibility due to the growth in *middle-class* and *black/poor* neighborhoods are different in these two regions.

Figure IV-11 Percentage of change in job accessibility (L10 - L100) by wage across clusters in CGR MSA

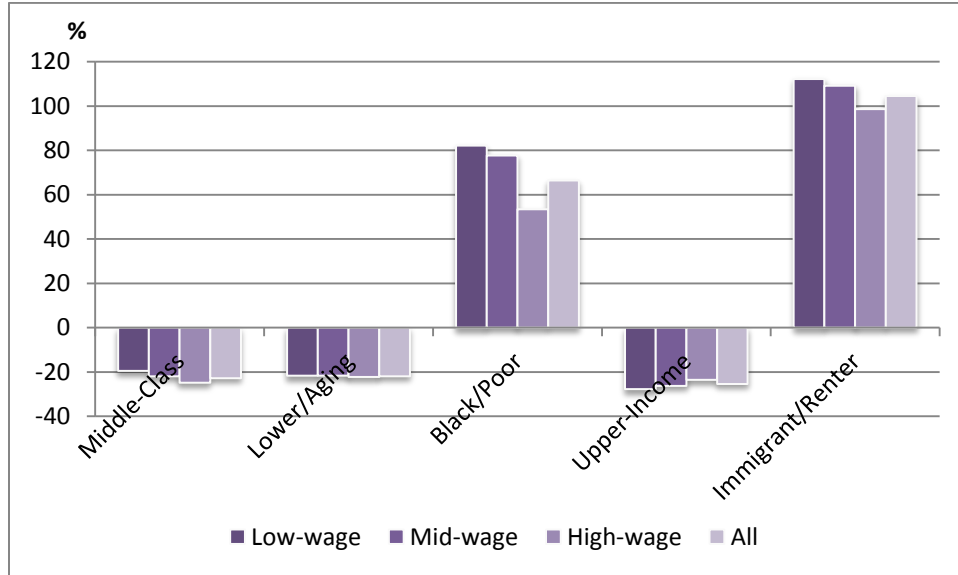
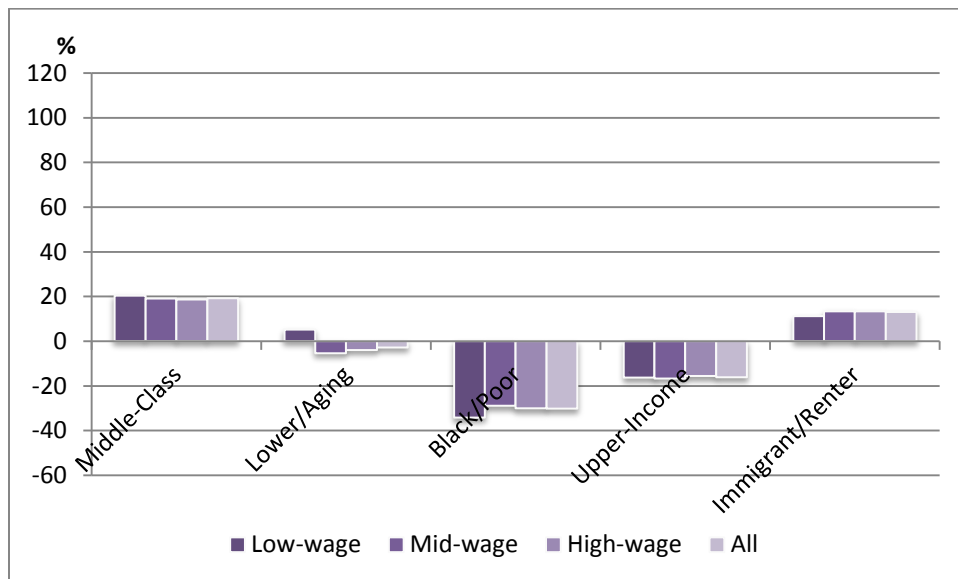


Figure IV-12 Percentage change in job accessibility (L10 - L100) by wage across clusters in RDC Hill CSA



6 Conclusions

In the Piedmont region, as in other U.S. metropolitan regions, external forces such as structural economic change, secular changes in social organization and demographic structure, as well as immigration, have clearly had a significant influence in shaping trajectories of ecological change (Kitchen and Williams, 2009). The Piedmont region has morphed rapidly into polycentric metropolitan regions with traditional city centers and suburban employment centers, and has become an exemplar of contemporary Sunbelt suburbanization. Thus, we hope that our investigation of the dominant metropolitan areas of the NC Piedmont region—Charlotte-Gastonia-Rock Hill, Raleigh-Cary, and Durham-Chapel Hill—will make a contribution to understanding social ecological changes in metropolitan areas in the U.S.

Given the joint action of post-war external forces and historical concentration of poverty and racial minorities, the Piedmont has evolved rapidly into segmented, diversified and polarized socio-ecological settings and a more pronounced polycentric metropolitan form. Across the Piedmont metro region, relatively stable spatial patterns of historical trends at the macro scale have been shown to be juxtaposed with growing fragmentation and diversification at a finer-grained level.

Investigation of neighborhood distribution revealed something similar to the spatial patterns of the Chicago school (Burgess, 1925; Park, 1952) and the typical patterns of Murdie's Factorial Ecology models (1969). Framed by core cities whose social ecology still bears some resemblance to the textbook factorial ecology model of North American cities, the social ecology of Piedmont has demonstrated that, in certain cases, urban phenomena do match those of classic models. It reminds us to re-evaluate the contemporary importance of traditional theories.

However, it may also question the Los Angeles School's fundamental claim that Los Angeles should be considered the paradigmatic postmodern American city. Urban development in the Piedmont region suggests that similar processes might shape spatial patterns in the way that they have in other parts of the U.S., such as Los Angeles. However, just as Hanchett (1998) has pointed out, the particular historical context and racial background in the Piedmont will more likely give this process a distinctive Southern flavor.

The spatial distribution of different neighborhood typologies also has important implications for job accessibility. Neighborhood distribution affects not only accessibility to all jobs, but also accessibility to jobs that match their incomes. Our findings suggested that job accessibility varies across neighborhood typologies. Both *lower/aging* and *black/poor* neighborhoods suffer from low job accessibility. In contrast, *immigrant/renter* neighborhoods have relatively higher job accessibility. In addition, lower-wage jobs are less accessible to those neighborhoods with relatively lower incomes. With suburbanization of population and jobs, jobs are moving closer to white populations, but the white-dominated *lower/aging* neighborhoods do not have an equal opportunity to share in the increased job accessibility. The differences in job accessibility among neighborhood typologies and the fact that low-wage jobs are less spatially accessible for certain typologies of low-income neighborhoods may raise questions about the possibility of spatial mismatch and social inequality in the NC Piedmont region.

Further, examination of the changing patterns of metropolitan transformation revealed factors that have generally been ignored by any School. By investigating the structural dimensions of metropolitan change—succession and growth patterns over the past three decades—our study showed some interesting patterns. Despite the variations in patterns of ecological succession among the five types of tracts, a commonality exists. Overall, urban-side

tracts (near city centers or inner-ring suburbs) are more likely to have experienced a downward socioeconomic transition, while suburb-side tracts tended to experience an upward socioeconomic transformation. This may reflect certain aspects of central-city and inner-ring suburban decline and the prevailing process of suburbanization. Meanwhile, this study also identified four types of patterns resulting from ecological growth: clustering, border accretion, sectoral growth and greenfield expansion. This implies the selective operation of a variety of socio-spatial processes, including segregation/congregation, filtering, invasion/succession, redevelopment and gentrification, and greenfield development.

Geographical shifts in neighborhoods are associated with changes in job accessibility. In general, the growth of most *immigrant/renter* neighborhoods tended to be in closer proximity to employment opportunities, both in central cities and suburbs. This result substantiates Baird et al.'s (2008) perspective that immigrants with higher residential mobility are able to adjust their residential locations to employment opportunities. The growth of *upper-income* and most *lower/aging* neighborhoods tended to be located in suburban areas that were farther from jobs. Patterns in other neighborhoods were inconsistent. The decreased job accessibility could be due to the fact that growth of those neighborhoods tended to occur in areas having lower job accessibility. However, it is possible that those neighborhoods also tended to follow jobs, but jobs moved faster than did the neighborhoods.

These results offer planners a rare opportunity to better understand the spatial/temporal patterns of neighborhood changes in order either to ameliorate urban problems efficiently or implement urban policies in communities and metropolitan areas more effectively. It is also important for urban planners and policy makers to recognize the relationships among neighborhood change, social spatial transformation and employment accessibility in order to

address issues such as spatial mismatch and social inequality.

Without comparing the changing spatial patterns of neighborhood distribution and transformation in other metropolitan areas, it is difficult to generalize these patterns to other regions in the U.S. Thus, future research is needed to compare the patterns we found across regions in order to discover what similarities or differences may exist. Future research could also investigate more closely the mechanisms behind the patterns we found in order to reveal the factors that may influence the likelihood of changes in neighborhood typologies or of neighborhood shifts to locations with high/low job accessibility. Finally, propinquity is important in overcoming the problem of spatial mismatch, although in some cases, other types of mismatch, such as transportation mode accessibility, may be more important than location accessibility (Shen, 2001). Thus, future research could examine the relationships of neighborhood change, spatial transformation and job accessibility with respect to automobile or other forms of transportation.

References

- Alonso W, 1964 *Location and Land Use: Toward a General Theory of Land Rent* (Harvard University Press, Cambridge, MA)
- Anas A, Arnott R, Small K A, 1998, "Urban spatial structure" *Journal of Economic Literature* **36** 1426-1464
- Baird J, Adelman R, Reid L W, Jaret C, 2008, "Immigrant settlement patterns: the role of metropolitan characteristics" *Sociological Inquiry* **78** 310–334
- Bench K, 2003, "Comparing Quality Measures: The American Community Survey's Three-year Averages and Census 2000's Long Form Sample Estimates", (Planning, Research, and Evaluation Division, American Community Survey)
- Berube A, Katz B, Lang R E, 2006 *Redefining urban and suburban America : evidence from Census 2000* (The Brookings Institution, Washington, D.C.)
- Bourdieu P, 1985, "The social space and the genesis of groups" *Social Science Information* **24** 195-220
- Brookings, 2000a, "Adding It Up: Growth Trends And Policies In North Carolina", in *Center on Urban and Metropolitan Policy-Brookings Institution*
- Brookings, 2000b, "Adding it up: growth trends and policies in North Carolina", (The Brookings Institution, Center on Urban and Metropolitan Policy)
- Brookings, 2010, "State of Metropolitan America-On The Front Lines Of Demography Transformation", in *State of Metropolitan America-On The Front Lines Of Demography Transformation* (Metropolitatan policy program-The brookings insttitution)

- Burgess E W, 1925, "The growth of the city: An introduction to a research project. In R. LeGates & F. Stouts (Eds.), *The inner city reader*. New York: Routledge."
- Cervero R, 1989, "Jobs–housing balancing and regional mobility" *Journal of the American Planning Association* **55** 136–150
- Cervero R, Murakami J, 2010, "Effects of built environments on vehicle miles traveled: Evidence from 370 US urbanized areas" *Environment and Planning A* **42** 400–418
- Chapple K, 2006, "Overcoming Mismatch: Beyond Dispersal, Mobility, and Development Strategies" *Journal of the American Planning Association* **72** 322-336
- Charlotte Chamber of Commerce, "Leading financial center",
<http://charlottechamber.com/business-profile/leading-financial-center/>
- Clark W A V, 2009, "Changing Residential Preferences across Income, Education, and Age: Findings from the Multi-City Study of Urban Inequality " *Urban Affairs Review* **44** 22
- Coffey W J, Shearmur R G, 2001, "The identification of employment centers in Canadian metropolitan areas: The example of Montreal, 1996" *Canadian Geographer* **45** 371-386
- Cooke T J, 1997, "Geographic access to job opportunities and labor-force participation among women and African Americans in the greater Boston metropolitan area" *Urban Geography* **18** 213-227
- Davies W K D, 1984, "Factorial Ecology " *Grower, Aldershot, England*
- Fan Y, 2010, "Reexamining contemporary urbanism in the United States: convenient mix of the old and new" *Environment and Planning A* **42** 2897- 2913
- Frey W H, 2005, "Metro America in the New Century: Metropolitan and Central City Demographic Shifts Since 2000" *Living Cities Census Series-The Brookings Institution*

- Frey W H, 2010, "A Demographic Lull at Census Time" *Metropolitan Policy Program-The Brookings Institution*
- Garreau, 1988, "Edge cities" *Landscape Architecture* **78** 48-55
- Geertmana S C M, Eck J R R V, 1995, "GIS and models of accessibility potential: an application in planning" *International Journal of Geographical Information Systems* **9**
- Glaeser E, Chu C, Kahn M, 2001 *Job sprawl: Employment location in U.S. metropolitan areas* (Brookings Institution, Washington, DC)
- Hanchett T W, 1998 *Sorting out the New South city-race, class and urban development in Charlotte, 1875-1975* (The University of North Carolina Press, Chapel Hill, NC)
- Hanlon B, 2009, "A Typology of Inner-Ring Suburbs: Class, Race, and Ethnicity in U.S. Suburbia." *City & Community* **8** 221-246
- Hanlon B, Vicino T, Short J R, 2006, "The New Metropolitan Reality in the US: Rethinking the Traditional Model" *Urban Studies* **43** 2129 - 2143
- Harris C D, Ullman E L, 1945, "The Nature of Cities" *The ANNALS of the American Academy of Political and Social Science* **242** 7-17
- Hayden D, 2003 *Building suburbia : green fields and urban growth, 1820-2000* (Pantheon Books, New York)
- Hoyt H, 1939, "the structure and growth of residential neighborhoods in American cities" *Washington, D.C. :Federal Housing Administration*
- Hu L, 2010 *Urban spatial transformation and job accessibility: spatial mismatch hypothesis revisited*, Policy, planning and development, University of Southern California
- Hughes J, 1990, "City review: North Carolina" *National Real Estate Investor* **32** 131-134

- Ihlanfeldt K R, 1998, "The spatial mismatch hypothesis: a review of recent studies and their implications for welfare reform" *Housing Policy Debate* **9** 849–892
- Ihlanfeldt K R, Sjoquist D L, 1998 "The spatial mismatch hypothesis: A review of recent studies and their implications for welfare reform" *Housing Policy Debate* **9** 849-892
- Institute T B H, 2004, "Metro Area and State Competitiveness Report 2004", in *The Beacon Hill Institute for Public Policy Research* (Suffolk University)
- Jargowsky P A, 2003, "Stunning progress, hidden problems: the dramatic decline of concentrated poverty in the 1990s" *Research Brief, Metropolitan Policy Program, Brookings Institution, Washington, DC.*
- Kain J, 2004, "A pioneer's perspective on the spatial mismatch literature" *Urban Studies* **41** 7-7
- Kain J F, 1968, "Housing Segregation, Negro Employment, and Metropolitan Decentralization" *Quarterly Journal of Economics* **82** 175-197
- Kasarda J D, Johnson J H, 2006 *The economic impact of the Hispanic population on the state of North Carolina* (Frank Hawkins Kenan Institute Of Private Enterprise-UNC, Chapel Hill, NC)
- Kawabata M, Shen Q, 2007, "Commuting inequality between cars and public transit: the case of the San Francisco Bay Area, 1990-2000" *Urban Studies* **44** 1759-1780
- Kearsley G W, 1983, "Teaching Urban Geography: The Burgess Model" *New Zealand Journal of Geography* **75** 10-13
- Kitchen P, Williams A, 2009, "Measuring Neighborhood Social Change in Saskatoon, Canada: A Geographic Analysis" *Urban Geography* **30** 261-288
- Kneebone E, 2009 *Job sprawl revisited: The changing geography of metropolitan employment* (Metropolitan Policy Program at Brookings, Washington, DC)

- Kneebone E, Berube A, 2008, "Reversal of Fortune: A New Look at Concentrated Poverty in the 2000s" *The Brookings Institution* 28
- Knox P L, 1982 *Urban social geography : an introduction* (Longman, London ; New York)
- Knox P L, 2008 *Metroburbia USA* (Rutgers University Press, New Brunswick, NJ)
- Koo J, 2005, "How to Analyze the Regional Economy With Occupation Data" *Economic Development Quarterly* **19** 356-372
- Landis J, 2009, "The Changing Shape of Metropolitan America" *The ANNALS of the American Academy of Political and Social Science* **626** 154
- Lang R, Knox P K, 2009, "The New Metropolis: Rethinking Megalopolis" *Regional Studies* **43** 789-802
- Lang R E, 2003, "Edgeless cities : exploring the elusive metropolis " *Washington, D.C. : Brookings Institution*
- Lang R E, LeFurgy J B, 2007 *Boomburbs : the rise of America's accidental cities* (Brookings Institution Press, Washington, D.C.)
- Lewis P, 1983, "The galactic metropolis", in *Beyond the urban fringe* Eds R H Platt, G Mackinder (University of Minnesota Press, Minneapolis, MN)
- Liu C Y, Painter G, 2012, "Immigrant Settlement and Employment Suburbanisation in the US- Is There a Spatial Mismatch?" *Urban Studies* **49** 979-1002
- Lucy W H, Phillips D L, 2001, "Suburbs and the Census: patterns of growth and decline." *Washington, DC: Brookings Institution, Center on Urban and Metropolitan Policy*
- Marcinczak S, Sagan I, 2011, "The Socio-spatial Restructuring of Lodz, Poland" *Urban Studies* 48 1789-1809

- Marcuse P, 1989, "'Dual City': a muddy metaphor for a quartered city" *International Journal of Urban and Regional Research* **13** 697-708
- Martin R W, 2001, "The adjustment of black residents to metropolitan employment shifts: how persistent is spatial mismatch?" *Journal of Urban Economics* **50** 52–76
- Matsuo M, 2011, "US metropolitan spatial structure and labour accessibility" *Urban Studies* **48** 2283-2302
- Meade M, 2008, "The Population of the Carolinas", in *A geography of the Carolinas* Eds D G Bennett, J C Patton (Parkway Publishers, Inc, Boone, NC)
- Mikelbank B A, 2004, "A Typology of U.S. Suburban Places" *Housing Policy Debate* **15** 935-964
- Mikelbank B A, 2011, "Neighborhood D é à Vu: Classification in Metropolitan Cleveland, 1970-2000" *Urban Geography* **32** 317-333
- Morenoff J D, Tienda M, 1997, "Underclass Neighborhoods in Temporal and Ecological Perspective" *The ANNALS of the American Academy of Political and Social Science* **551** 59-72
- Murdie R, 1969 *Factorial ecology of metropolitan Toronto, 1951-1961: An essay on the social geography of the city* (University of Chicago Chicago, IL)
- Naude W, 2008, "Is there a spatial mismatch in South Africa's metropolitan labour market?" *Cities* **25** 268-276
- Nelson A C, Lang R E, 2011 *Megapolitan America: a new vision for understanding America's metropolitan geography* (APA Planners Press Chicago, Washington, D.C.)
- Park R A, 1952, "Human communities" *Glencoe, IL: Free Press*

- Parks V, 2004, "Access to work: the effects of spatial and social accessibility on unemployment for native-born black and immigrant women in Los Angeles" *Economic Geography* **80** 141–172
- Parsons Brinckerhoff Quade & Douglas Inc., 1996, "Commuter and Light Rail Transit Corridors: The Land Use Connection", (Transit Cooperative Research Program)
- Phelps N A, Wood A M, Valler D C, 2010, "A postsuburban world? An outline of a research agenda" *Environment and Planning A* **42** 366-383
- Pitkin B, 2001, "Theories of neighborhood change: implications for community development policy and practice", (UCLA Advanced Policy Institute)
- Pooler J, 1987, "Measuring geographical accessibility: A review of current approaches and problems in the use of population potentials " *Geoform* **18** 269–289
- Raphael S, 1998, "The spatial mismatch hypothesis and black youth joblessness, evidence from the San Francisco Bay Area" *Journal of Urban Economics* **43** 79-111
- Raphael S, Stoll M A, 2002, "Modest progress: the narrowing spatial mismatch between blacks and jobs in the 1990s", (Living Cities Census Series, The Brookings Institution, Washington, DC.)
- Shen Q, 2001, "A spatial analysis of job openings and access in a US metropolitan area" *Journal of the American Planning Association* **67** 53-68
- Shevky E, Bell W, 1955, "Social Area Analysis: Theory, Illustrative Applications and Computational Procedure" *Stanford, CA: Stanford University Press*
- Short J R, Hanlon B, Vicino T J, 2007, "The Decline of Inner Suburbs: The New Suburban Gothic in the United States" *Geography Compass* **1** 641–656
- Singer A, 2004, "The rise of new immigrant gateways", (The Brookings Institution)

- Smith H A, Furuseth O J, 2004, "Housing, Hispanics and transitioning geographies in Charlotte, North Carolina" *Southeastern Geographer* **44** 216–235
- Smith H A, Furuseth O J, 2008, "Transitioning suburban landscapes in the “Nuevo South”: Latino place making and community building in the middle ring suburbs of Charlotte, North Carolina", in *Suburban immigrant gateways: immigration and incorporation in new U.S. metropolitan destinations* Eds A Singer, C Brettell, S Hardwick (The Brookings Institution, Washington, D.C.) pp 279-305
- Stoll M A, 2005 *Job sprawl and the spatial mismatch between blacks and jobs* (Metropolitan Policy Program, Brookings, Washington, DC)
- Turner W R, 2002, "Development of streetcar systems in North Carolina",
<http://www.cmhpf.org/development%20of%20streetcar%20systems.htm>
- Vicino T J, 2008, "Transforming Race and Class in Suburbia: Decline in Metropolitan Baltimore."
" *New York, Palgrave Macmillan.*
- Weitz J, 2003 *Jobs-housing balance* (American Planning Association, Chicago, IL)
- Weitz J, Crawford T, 2012, "Where the Jobs Are Going: Job Sprawl in U.S. Metropolitan Regions, 2001–2006" *Journal of the American Planning Association* **78** 53-69
- Wial H, Friedhoff A, 2010, "MetroMonitor-Tracking Economic Recession and Recovery in America's 100 Largest Metropolitan Areas" *Metropolitatan policy program, The brookings inststtution*

V. Chapter 5 Conclusion

By introducing an integrated framework, this dissertation examines the trajectories of neighborhood change, mechanisms of suburban diversity, and relationships between neighborhood change and employment accessibility. The first essay in this dissertation systematically examines the trajectories of neighborhood change at the census tract level between 1990 and 2010 for all metropolitan and micropolitan areas of the United States, utilizing k-means cluster analysis and discriminant analysis. The typologies of neighborhoods are identified using a visualization clustergram technique and other statistical tests. This study of neighborhood change reveals that neighborhood inequality is polarized at both extremes of the social stratum. It also shows that neighborhoods remained primarily stable during the study period. Neighborhood change is complicated and exhibits various trajectories. The dominant patterns do not always conform to classical models of neighborhood change and provide counterpoints to some long-established assumptions.

Although suburbia is shaped by the composition of its population, the composition of neighborhoods determines the distribution of the population and thus the socio-economic landscape. By conducting a linear regression model, the second essay provides evidence for the mechanisms by which metropolitan and suburban characteristics influence suburban diversity in terms of neighborhood composition. Most importantly, these results highlight a remarkable increase in suburban diversity with respect to neighborhood composition, which has shaped the landscape of suburban America during the last two decades. While suburbia as a whole has been changing significantly, the changes have been uneven across regions. Metropolitan areas with a longer history feature higher suburban diversity relative to newer metropolitan areas. In addition,

large, rapidly growing metropolitan areas and metros with a higher suburban housing supply have greater suburban diversity. Suburban diversity also has key implications for smart growth.

Macro-level analyses of metropolitan areas and suburbs are helpful in uncovering the dynamics of neighborhood change and mechanisms of suburban diversity, while micro-level analyses reveal more detailed patterns of neighborhood change. The final essay in this dissertation investigates the relationships between neighborhood change, spatial transformation, and employment accessibility in the North Carolina Piedmont region between 1980 and 2010. The dominant patterns of neighborhood change, on the one hand, conform to some classical models of metropolitan structure, and on the other hand, provide new insights on what has been ignored by those models. Trajectories of neighborhood change reflect both persistent segregation and increasing diversification. Spatial patterns of neighborhood distributions suggest that job accessibility varies by neighborhood typology, and a spatial mismatch exists in certain types of low-income neighborhoods. A detailed analysis of trajectories of neighborhood change points to interesting patterns in both central city and suburban ecological succession and transformation. These geographical neighborhood shifts are associated with changes in job accessibility, and those living in *immigrant/renter* neighborhoods are more likely to follow jobs to other regions than those in other types of neighborhoods.

The three essays on neighborhood change outlined above vary by scale, dimension, and geography, and these variations provide a better understanding of neighborhood change. This dissertation answers several research questions and bridges various dimensions, providing a holistic framework in order to develop a more balanced understanding of neighborhood change from multiple perspectives.

1 Neighborhood change from a dialectical perspective

Contemporary socioeconomic changes have led to a more nuanced and complex urban landscape, and today's cities and metropolitan areas do not necessarily follow traditional models of neighborhood change. Have traditional models of neighborhood change been completely outdated? Should we shift the perspective from traditional models to postmodern models of neighborhood change?

On the one hand, the spatial pattern in the North Carolina Piedmont region fits the traditional factorial ecology model of North American cities to a certain extent. This dissertation shows that: (1) cities are still organized with “zones” and “sectors” of the traditional social ecology, as described in classic urban models; and (2) urban-side tracts are more likely to have experienced a downward socioeconomic transition, while suburb-side tracts tended to experience an upward socioeconomic transformation. This dissertation also extends the invasion-succession patterns by including four growth patterns: clustering, sectoral growth, border accretion, and greenfield expansion. These two findings demonstrate the explanatory power of the traditional sectorial and invasion-succession models. It may be worth reminding to re-evaluate the importance of traditional theories.

On the other hand, this dissertation challenges the traditional models by demonstrating various trajectories of neighborhood change that differ from the assumption of a linear trajectory in traditional ecological models. Thus, this dissertation demonstrates that a dialectical perspective—constructing a bridge between traditional models and emerging new models—may be an appropriate approach to examine the process of clash and struggle between new and traditional models of neighborhood change.

2 Neighborhood change from a totality perspective

Neighborhood change is a complex process involving multiple dimensions in social, spatial, and economic activities. This dissertation demonstrates various trajectories in neighborhood change and shows that suburbs have become increasingly diverse in terms of neighborhood composition. It also shows that the spatial distributions of different neighborhood typologies have important implications for job accessibility, and geographical shifts in neighborhoods are associated with changes in job accessibility. Simple interpretations of each dimension may be helpful in explaining certain aspects of neighborhood change, but a “totality” perspective could preserve as much inter-related elements of neighborhood change as possible and provide a balanced view of neighborhood change as a whole. In addition, neighborhood change is a dynamic process involving changes in socioeconomic composition, spatial patterns, and economic activities. Using the population distribution tends to be effective in uncovering the urban spatial structure of cities. However, a better understanding of neighborhood change is difficult without linking the spatial patterns of neighborhood change to shifts in socioeconomic conditions. In this dissertation, a balanced theory of neighborhood change is proposed by including multi-dimensional attributes and covering not only cross-sectional but also dynamic patterns of neighborhood change.

3 Neighborhood change from a historical perspective

The results of this dissertation demonstrate that an understanding of history is indispensable for understanding neighborhood change today. The changing context of cities affects neighborhood change everywhere. This dissertation shows that suburban diversity is influenced by external forces such as housing investment, demographic changes, and urban policies; and the Piedmont region has also evolved into segmented, diversified, and polarized

socio-ecological settings due to changing urban contexts. The external and internal forces of recent decades matter, but urban history also plays an important role that should not be ignored in the study of neighborhood change, as this dissertation suggests. The present patterns of neighborhood distribution in the North Carolina Piedmont region have been largely shaped by past urban development. Moreover, metropolitan areas with a longer history and more established residential patterns seem to present higher suburban diversity relative to newer metropolitan areas. Thus, a better understanding of neighborhood change should investigate current forces as well as historical urban development. In sum, this dissertation contributes to the literature by developing a more holistic view of neighborhood change from dialectical, totality, and historical perspectives.

4 Policy implications

An understanding of neighborhood change from social, spatial, and employment dimensions is crucial to our understanding of neighborhood change, the formulation of appropriate public policies, and the assessment of related policies. It is also important for policymakers and practitioners in providing appropriate local services, support, and opportunities for residents.

First, identifying a neighborhood typology and choosing targeted neighborhoods are key to successful neighborhood programs. The composition and extent of attributes vary dramatically across neighborhoods, and it is possible that an urban policy that works well in one neighborhood may exhibit little impact in another. Therefore, it is important to target neighborhoods based on their specific needs before making decisions on neighborhood development.

Furthermore, an in-depth understanding of neighborhood change could assist policy makers in applying limited resources or leveraging private resources more efficiently. A lack of awareness of the inevitable neighborhood deterioration makes it difficult to develop effective policies for coping with neighborhood decline, but an overemphasis on gentrification may ignore other channels of upward development of cities. By pointing out the diverse trajectories of neighborhood change, this study provides planners and policy makers with a comprehensive view on neighborhood transition. Therefore, if a certain kind of neighborhood transition never or rarely happens, investments to encourage this change may be a waste. However, if some neighborhood changes are ubiquitous and easily occurring, a substantive investment might be worthwhile.

The diversity of neighborhood change is important for policymakers and practitioners in providing appropriate local services, support, and opportunities for residents. Only by understanding the determinants of change in neighborhood diversity can policy makers develop predictions about future diversity trends in terms of neighborhood composition. Some forces may be more effective than others in affecting the diversity in certain metropolitan areas. If we are able to identify a series of factors that contribute significantly to a specific metropolitan diversity transition, policy makers may find it easier to focus on the major factors rather than waste resources on the minor factors.

Finally, policy makers or urban planners may face two major challenges when making decisions to move jobs or workers closer to each other and to provide affordable housing in order to promote job accessibility. Understanding the relation between neighborhood typologies and job accessibility may help policy makers and urban planners target neighborhoods that are in great need of employment improvement. In addition, residents in low-income neighborhoods,

such as those in *black/poor* or *lower/aging* neighborhoods may have less location choices. At the same time, due to economic restructuring, low-wage jobs have decreased and suburbanized faster than low-income job seekers. Under these situations, the job accessibility of such disadvantaged neighborhoods will decline. Understanding the increasing mismatch among specific typologies of neighborhoods may help policy makers in deciding where, to whom, and to what extent affordable housing should be provided in order to improve the job-housing balance.

5 Research limitations and future research

This section points out the limitations of the study presented in this dissertation and presents future research directions. First, neighborhood change and the changing spatial patterns in the United States are much more complex than those presented in any single model. Changes in scale and scope may result in changes in the resulting clusters in a cluster analysis (Reibel, 2011). This could be seen that drawing conclusions of one region based on cluster analyses of another is inappropriate. Thus we cannot safely generalize those patterns in the NC Piedmont metropolitan areas and apply them to other regions in the U.S without comparing the changing spatial patterns of neighborhood distribution and transformation in other metropolitan areas. In addition, interpreting findings from national scale to local level are also inappropriate. Future research is therefore needed to compare spatial patterns and their relationships with economic activities in order to discover what similarities and differences may exist across cities and metros.

Second, this dissertation investigates the spatial patterns of neighborhood distribution or trajectories of neighborhood change without examining the underlying mechanisms. One of the most pressing questions to address in the future would be to focus on a certain type of neighborhood change and to answer more precise questions such as how different forces and regional differences may determine the directions that neighborhood trajectories will take, why

neighborhoods decline, improve or remain stable, and why and to what extent neighborhoods will change. Future research could also investigate more closely the mechanisms behind the spatial patterns of neighborhood change in order to reveal the factors that may influence the likelihood of changes in neighborhood typologies or the likelihood of neighborhood shifts to locations with high/low job accessibility.

Third, while the standardization of boundaries across time avoids the problem of historical boundary shifts, it can also cause some problems. According to the Census Bureau, MSAs are divided into tracts that are “homogeneous with respect to population characteristic, economic status, and living conditions” in order to obtain “pure” basic observation units. Standardizing tract boundaries means that the tracts may well be heterogeneous. In addition, when metropolitan areas expand by annexing surrounding areas, the former rural areas can become suburbs, and former suburbs can become central cities. This dissertation assumes a level of homogeneity within neighborhoods, but variances in socioeconomic characteristics may exist within a neighborhood. The heterogeneity within a neighborhood may influence the results to a certain extent, which should be considered when evaluating the results of this dissertation.

Finally, propinquity is important in overcoming the problem of spatial mismatch, but in some cases other types of mismatch, such as transportation mode accessibility, may be more important than location accessibility. Thus, future research could examine the relationships of neighborhood change, spatial transformation and job accessibility with respect to automobile or other forms of transportation.

VI. Appendix A

Table VI-1 Neighborhood change across metropolitan statistical areas

MSA Code	Tracts	Metropolitan Statistical Areas
Middle-class to white/lower		
16980	117	Chicago-Joliet-Naperville, IL-IN-WI Metropolitan Statistical Area
19820	112	Detroit-Warren-Livonia, MI Metropolitan Statistical Area
33460	91	Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area
37980	67	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metropolitan Statistical Area
41180	44	St. Louis, MO-IL Metropolitan Statistical Area
38060	43	Phoenix-Mesa-Glendale, AZ Metropolitan Statistical Area
28140	42	Kansas City, MO-KS Metropolitan Statistical Area
Elite to white/lower		
35620	82	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area
25540	46	Hartford-West Hartford-East Hartford, CT Metropolitan Statistical Area
37980	42	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metropolitan Statistical Area
19820	34	Detroit-Warren-Livonia, MI Metropolitan Statistical Area
Elite to middle-class		
35620	23	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area
37980	16	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metropolitan Statistical Area
16980	11	Chicago-Joliet-Naperville, IL-IN-WI Metropolitan Statistical Area
14460	11	Boston-Cambridge-Quincy, MA-NH Metropolitan Statistical Area
19820	10	Detroit-Warren-Livonia, MI Metropolitan Statistical Area
31100	10	Los Angeles-Long Beach-Santa Ana, CA Metropolitan Statistical Area
Middle-class to white/aging		
33100	14	Miami-Fort Lauderdale-Pompano Beach, FL Metropolitan Statistical Area
45300	9	Tampa-St. Petersburg-Clearwater, FL Metropolitan Statistical Area
38060	9	Phoenix-Mesa-Glendale, AZ Metropolitan Statistical Area
46060	9	Tucson, AZ Metropolitan Statistical Area
29820	8	Las Vegas-Paradise, NV Metropolitan Statistical Area
15980	8	Cape Coral-Fort Myers, FL Metropolitan Statistical Area
Elite to white/aging		
35620	6	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area
45860	4	Torrington, CT Metropolitan Statistical Area
38060	3	Phoenix-Mesa-Glendale, AZ Metropolitan Statistical Area
Middle-class to mix/renter		
29820	26	Las Vegas-Paradise, NV Metropolitan Statistical Area
40900	22	Sacramento—Arden-Arcade—Roseville, CA Metropolitan Statistical Area
19100	21	Dallas-Fort Worth-Arlington, TX Metropolitan Statistical Area
38060	20	Phoenix-Mesa-Glendale, AZ Metropolitan Statistical Area
16980	20	Chicago-Joliet-Naperville, IL-IN-WI Metropolitan Statistical Area

Elite to mix/renter		
35620	93	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area
31100	60	Los Angeles-Long Beach-Santa Ana, CA Metropolitan Statistical Area
14460	20	Boston-Cambridge-Quincy, MA-NH Metropolitan Statistical Area
41860	16	San Francisco-Oakland-Fremont, CA Metropolitan Statistical Area
47900	15	Washington-Arlington-Alexandria, DC-VA-MD-WV Metropolitan Statistical Area
16980	14	Chicago-Joliet-Naperville, IL-IN-WI Metropolitan Statistical Area
37980	8	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metropolitan Statistical Area

Middle-class to black/poor		
12060	57	Atlanta-Sandy Springs-Marietta, GA Metropolitan Statistical Area
32820	19	Memphis, TN-MS-AR Metropolitan Statistical Area
47900	16	Washington-Arlington-Alexandria, DC-VA-MD-WV Metropolitan Statistical Area
16980	15	Chicago-Joliet-Naperville, IL-IN-WI Metropolitan Statistical Area
37980	13	Columbus, GA-AL Metropolitan Statistical Area
19100	12	Dallas-Fort Worth-Arlington, TX Metropolitan Statistical Area
35380	10	New Orleans-Metairie-Kenner, LA Metropolitan Statistical Area
36740	10	Orlando-Kissimmee-Sanford, FL Metropolitan Statistical Area

Elite to black/poor		
35620	20	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area
47900	8	Washington-Arlington-Alexandria, DC-VA-MD-WV Metropolitan Statistical Area
19820	3	Detroit-Warren-Livonia, MI Metropolitan Statistical Area
16980	2	Chicago-Joliet-Naperville, IL-IN-WI Metropolitan Statistical Area
37980	1	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metropolitan Statistical Area
31100	1	Los Angeles-Long Beach-Santa Ana, CA Metropolitan Statistical Area
17460	1	Cleveland-Elyria-Mentor, OH Metropolitan Statistical Area

Middle-class to immigrant		
40140	120	Riverside-San Bernardino-Ontario, CA Metropolitan Statistical Area
26420	85	Houston-Sugar Land-Baytown, TX Metropolitan Statistical Area
33100	62	Miami-Fort Lauderdale-Pompano Beach, FL Metropolitan Statistical Area
19100	55	Dallas-Fort Worth-Arlington, TX Metropolitan Statistical Area
29820	53	Las Vegas-Paradise, NV Metropolitan Statistical Area
31100	53	Los Angeles-Long Beach-Santa Ana, CA Metropolitan Statistical Area
38060	46	Phoenix-Mesa-Glendale, AZ Metropolitan Statistical Area

Elite to immigrant		
31100	65	Los Angeles-Long Beach-Santa Ana, CA Metropolitan Statistical Area
35620	43	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area
47900	13	Washington-Arlington-Alexandria, DC-VA-MD-WV Metropolitan Statistical Area
41860	8	San Francisco-Oakland-Fremont, CA Metropolitan Statistical Area
41940	5	San Jose-Sunnyvale-Santa Clara, CA Metropolitan Statistical Area
41740	2	San Diego-Carlsbad-San Marcos, CA Metropolitan Statistical Area

Black/poor to middle-class		
12060	5	Atlanta-Sandy Springs-Marietta, GA Metropolitan Statistical Area
16700	5	Charleston-North Charleston-Summerville, SC Metropolitan Statistical Area

28660	4	Killeen-Temple-Fort Hood, TX Metropolitan Statistical Area
35620	3	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area
45300	3	Tampa-St. Petersburg-Clearwater, FL Metropolitan Statistical Area
Immigrant to middle-class		
35620	11	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area
40140	7	Riverside-San Bernardino-Ontario, CA Metropolitan Statistical Area
38060	6	Phoenix-Mesa-Glendale, AZ Metropolitan Statistical Area
31100	6	Los Angeles-Long Beach-Santa Ana, CA Metropolitan Statistical Area
41740	6	San Diego-Carlsbad-San Marcos, CA Metropolitan Statistical Area
41860	4	San Francisco-Oakland-Fremont, CA Metropolitan Statistical Area
Black/poor to elite		
35620	9	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area
47900	8	Washington-Arlington-Alexandria, DC-VA-MD-WV Metropolitan Statistical Area
31100	2	Los Angeles-Long Beach-Santa Ana, CA Metropolitan Statistical Area
41860	1	San Francisco-Oakland-Fremont, CA Metropolitan Statistical Area
Immigrant to elite		
31100	24	Los Angeles-Long Beach-Santa Ana, CA Metropolitan Statistical Area
41860	22	San Francisco-Oakland-Fremont, CA Metropolitan Statistical Area
35620	17	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area
16980	5	Chicago-Joliet-Naperville, IL-IN-WI Metropolitan Statistical Area
26180	4	Honolulu, HI Metropolitan Statistical Area
41740	3	San Diego-Carlsbad-San Marcos, CA Metropolitan Statistical Area
White/lower to middle-class		
12060	67	Atlanta-Sandy Springs-Marietta, GA Metropolitan Statistical Area
37980	61	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metropolitan Statistical Area
16740	42	Charlotte-Gastonia-Rock Hill, NC-SC Metropolitan Statistical Area
16980	40	Chicago-Joliet-Naperville, IL-IN-WI Metropolitan Statistical Area
34980	38	Nashville-Davidson—Murfreesboro—Franklin, TN Metropolitan Statistical Area
38900	32	Portland-Vancouver-Hillsboro, OR-WA Metropolitan Statistical Area
19820	30	Detroit-Warren-Livonia, MI Metropolitan Statistical Area
41180	30	St. Louis, MO-IL Metropolitan Statistical Area
22220	30	Fayetteville-Springdale-Rogers, AR-MO Metropolitan Statistical Area
Middle-class to elite		
35620	74	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area
16980	70	Chicago-Joliet-Naperville, IL-IN-WI Metropolitan Statistical Area
41740	56	San Diego-Carlsbad-San Marcos, CA Metropolitan Statistical Area
19740	52	Denver-Aurora-Broomfield, CO Metropolitan Statistical Area
47900	48	Washington-Arlington-Alexandria, DC-VA-MD-WV Metropolitan Statistical Area
31100	47	Los Angeles-Long Beach-Santa Ana, CA Metropolitan Statistical Area
12580	42	Baltimore-Towson, MD Metropolitan Statistical Area
37980	42	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metropolitan Statistical Area
40900	38	Sacramento—Arden-Arcade—Roseville, CA Metropolitan Statistical Area
40140	36	Riverside-San Bernardino-Ontario, CA Metropolitan Statistical Area
41860	34	San Francisco-Oakland-Fremont, CA Metropolitan Statistical Area
33100	33	Miami-Fort Lauderdale-Pompano Beach, FL Metropolitan Statistical Area

White/lower to white/aging

11700	8	Asheville, NC Metropolitan Statistical Area
33980	8	Morehead City, NC Micropolitan Statistical Area
45300	6	Tampa-St. Petersburg-Clearwater, FL Metropolitan Statistical Area
42940	6	Sevierville, TN Micropolitan Statistical Area
36740	5	Orlando-Kissimmee-Sanford, FL Metropolitan Statistical Area
27260	4	Jacksonville, FL Metropolitan Statistical Area
24860	4	Greenville-Mauldin-Easley, SC Metropolitan Statistical Area
29460	4	Lakeland-Winter Haven, FL Metropolitan Statistical Area
16980	3	Chicago-Joliet-Naperville, IL-IN-WI Metropolitan Statistical Area
28940	3	Knoxville, TN Metropolitan Statistical
19660	3	Deltona-Daytona Beach-Ormond Beach, FL
37340	3	Palm Bay-Melbourne-Titusville, FL Metropolitan Statistical Area
43420	3	Sierra Vista-Douglas, AZ Micropolitan Statistical Area

Mix/renter to immigrant

35620	133	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area
31100	65	Los Angeles-Long Beach-Santa Ana, CA Metropolitan Statistical Area
26420	53	Houston-Sugar Land-Baytown, TX
33100	38	Miami-Fort Lauderdale-Pompano Beach, FL Metropolitan Statistical Area
38060	36	Phoenix-Mesa-Glendale, AZ Metropolitan Statistical Area
19100	36	Dallas-Fort Worth-Arlington, TX Metropolitan Statistical Area
29820	32	Las Vegas-Paradise, NV Metropolitan Statistical Area
12060	31	Atlanta-Sandy Springs-Marietta, GA
41860	28	San Francisco-Oakland-Fremont, CA Metropolitan Statistical Area
47900	26	Washington-Arlington-Alexandria, DC-VA-MD-WV Metropolitan Statistical Area
40140	21	Riverside-San Bernardino-Ontario, CA Metropolitan Statistical Area
16980	20	Chicago-Joliet-Naperville, IL-IN-WI Metropolitan Statistical Area

Immigrant to mix/renter

35620	120	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area
31100	67	Los Angeles-Long Beach-Santa Ana, CA Metropolitan Statistical Area
16980	66	Chicago-Joliet-Naperville, IL-IN-WI Metropolitan Statistical Area
33100	22	Miami-Fort Lauderdale-Pompano Beach, FL Metropolitan Statistical Area
41860	18	San Francisco-Oakland-Fremont, CA Metropolitan Statistical Area
26420	14	Houston-Sugar Land-Baytown, TX
14460	11	Boston-Cambridge-Quincy, MA-NH Metropolitan Statistical Area
41740	8	San Diego-Carlsbad-San Marcos, CA

Table VI-2 Suburban diversity across metropolitan statistical areas

The first 60 MSAs with largest Entropy values in 2010

MSA code	Metropolitan Statistical Areas	Entropy90	Entropy10	E10-E90
16980	Chicago-Joliet-Naperville, IL-IN-WI Metropolitan Statistical Area	1.723	1.763	0.039
45940	Trenton-Ewing, NJ Metropolitan Statistical Area	1.551	1.699	0.148
35300	New Haven-Milford, CT Metropolitan Statistical Area	1.612	1.690	0.079
35620	New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area	1.773	1.686	-0.087
36740	Orlando-Kissimmee-Sanford, FL Metropolitan Statistical Area	1.393	1.685	0.292
12060	Atlanta-Sandy Springs-Marietta, GA	1.486	1.683	0.197
33100	Miami-Fort Lauderdale-Pompano Beach, FL	1.729	1.677	-0.052
25540	Hartford-West Hartford-East Hartford, CT Metropolitan Statistical Area	1.625	1.667	0.042
19100	Dallas-Fort Worth-Arlington, TX Metropolitan Statistical Area	1.627	1.666	0.038
40900	Sacramento—Arden-Arcade—Roseville, CA Metropolitan Statistical Area	1.518	1.649	0.131
12100	Atlantic City-Hammonton, NJ	1.493	1.648	0.155
26420	Houston-Sugar Land-Baytown, TX	1.706	1.638	-0.068
37980	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metropolitan Statistical Area	1.517	1.634	0.117
14460	Boston-Cambridge-Quincy, MA-NH Metropolitan Statistical Area	1.640	1.634	-0.007
46060	Tucson, AZ Metropolitan Statistical Area	1.603	1.624	0.021
26620	Huntsville, AL	1.479	1.623	0.145
16740	Charlotte-Gastonia-Rock Hill, NC-SC (part)	1.406	1.616	0.210
40060	Richmond, VA	1.470	1.616	0.146
33340	Milwaukee-Waukesha-West Allis, WI	1.458	1.611	0.152
20500	Durham-Chapel Hill, NC Metropolitan Statistical Area	1.560	1.608	0.048
12580	Baltimore-Towson, MD Metropolitan Statistical Area	1.556	1.600	0.044
28140	Kansas City, MO-KS Metropolitan Statistical Area	1.427	1.594	0.167
42140	Santa Fe, NM Metropolitan Statistical Area	1.299	1.593	0.294
36420	Oklahoma City, OK	1.365	1.592	0.227
31180	Lubbock, TX	1.617	1.592	-0.025
19740	Denver-Aurora-Broomfield, CO Metropolitan Statistical Area	1.557	1.588	0.031
34980	Nashville-Davidson—Murfreesboro—Franklin, TN Metropolitan Statistical Area	1.419	1.581	0.162
10740	Albuquerque, NM Metropolitan Statistical Area	1.454	1.581	0.127
39900	Reno-Sparks, NV Metropolitan Statistical Area	1.341	1.581	0.239
45220	Tallahassee, FL Metropolitan Statistical Area	1.576	1.572	-0.004
38060	Phoenix-Mesa-Glendale, AZ Metropolitan Statistical Area	1.573	1.570	-0.003
12420	Austin-Round Rock-San Marcos, TX	1.566	1.569	0.003
47900	Washington-Arlington-Alexandria, DC-VA-MD-WV (part)	1.512	1.567	0.055
16700	Charleston-North Charleston-Summerville, SC Metropolitan Statistical Area	1.448	1.563	0.115
26900	Indianapolis-Carmel, IN Metropolitan Statistical Area	1.415	1.552	0.137
42660	Seattle-Tacoma-Bellevue, WA Metropolitan Statistical Area	1.418	1.545	0.127
39580	Raleigh-Cary, NC Metropolitan Statistical Area	1.361	1.539	0.178
47260	Virginia Beach-Norfolk-Newport News, VA-NC Metropolitan Statistical Area	1.408	1.539	0.131
18140	Columbus, OH	1.459	1.538	0.079
47380	Waco, TX Metropolitan Statistical Area	1.425	1.538	0.113
42220	Santa Rosa-Petaluma, CA Metropolitan Statistical Area	1.218	1.535	0.317

33460	Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area	1.312	1.526	0.214
35380	New Orleans-Metairie-Kenner, LA	1.470	1.525	0.055
35980	Norwich-New London, CT Metropolitan Statistical Area	1.232	1.516	0.284
14860	Bridgeport-Stamford-Norwalk, CT Metropolitan Statistical Area	1.537	1.513	-0.023
46700	Vallejo-Fairfield, CA Metropolitan Statistical Area	1.208	1.511	0.302
42340	Savannah, GA Metropolitan Statistical Area	1.460	1.508	0.048
39300	Providence-New Bedford-Fall River, RI-MA Metropolitan Statistical Area	1.269	1.505	0.236
17900	Columbia, SC Metropolitan Statistical Area	1.445	1.505	0.060
17820	Colorado Springs, CO Metropolitan Statistical Area	1.348	1.504	0.156
42060	Santa Barbara-Santa Maria-Goleta, CA Metropolitan Statistical Area	1.506	1.501	-0.006
12020	Athens-Clarke County, GA Metropolitan Statistical Area	1.295	1.498	0.203
17780	College Station-Bryan, TX Metropolitan Statistical Area	1.417	1.497	0.080
34900	Napa, CA Metropolitan Statistical Area	1.234	1.487	0.254
11460	Ann Arbor, MI Metropolitan Statistical Area	1.369	1.487	0.118
41740	San Diego-Carlsbad-San Marcos, CA Metropolitan Statistical Area	1.538	1.484	-0.054
27260	Jacksonville, FL Metropolitan Statistical Area	1.389	1.483	0.094
24660	Greensboro-High Point, NC Metropolitan Statistical Area	1.279	1.480	0.200
29820	Las Vegas-Paradise, NV Metropolitan Statistical Area	1.194	1.475	0.282
34940	Naples-Marco Island, FL Metropolitan Statistical Area	1.574	1.474	-0.101