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Title of Dissertation: Justice and Opportunity: Spatial Justice and Changing Access to Employment Opportunities in Metropolitan Baltimore, 1990-2000.

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ABSTRACT

Title of Document:	JUSTICE AND OPPORTUNITY: SPATIAL JUSTICE AND CHANGING ACCESS TO EMPLOYMENT OPPORTUNITIES IN METROPOLITAN BALTIMORE, 1990-2000.
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Since the 1970s, economic restructuring and urban expansion have re-drawn the map of economic opportunity in metropolitan Baltimore. These transformations had different impacts on neighborhoods across the region. Research has typically focused on the labor market outcomes of socio-demographic groups that are disproportionately disadvantaged by these urban transformations, or linked residential

location with group identity in a specific socio-demographic group. This research focuses on the impacts of economic restructuring and urban expansion on the economic opportunities, specifically, employment access on different spatial groups across metropolitan Baltimore.

This study also presents the idea that spatial justice is lens though which to view employment accessibility. In doing so, differences in access to opportunity shift from issues purely in the realm of public policy to something which residents of communities can become actively involved in transforming. This paradigm considers both the social and the spatial aspects of access, and in addition, this shift allows for the inclusion of a greater number of actors and concerns within an integrated spatial area.

The goal of this research was to obtain a better understanding of how economic restructuring and employment decentralization impacted job access for residents living and working within metropolitan Baltimore from 1990 to 2000. I present an overview of the demographic changes that occurred within residential areas of metropolitan Baltimore, and the shifting patterns of employment within the major industrial categories from 1970 to 2000, with a focus on neighborhood-level change between 1990 and 2000. Then, using Google Maps to calculate travel costs, I measured employment access with two separate accessibility measures. The results suggest that centers of employment play an important role in determining accessibility within the metropolitan region. Residential neighborhoods located in and around centers of employment have access to a higher number of employment opportunities and faster commuting times However, access was not equal among socio-spatial demographic groups residing in different areas of the metropolitan region. The findings suggest that access is related to spatial location and that different neighborhoods have experienced changes to that access over time in distinct ways.

JUSTICE AND OPPORTUNITY: SPATIAL JUSTICE AND CHANGING ACCESS TO EMPLOYMENT OPPORTUNITIES IN METROPOLITAN BALTIMORE, 1990-2000.

By

Amanda Mary Roberts Davis

Dissertation submitted to the Faculty of the Graduate School of the University of Maryland, Baltimore County, in partial fulfillment of the requirements for the degree of
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Dedication

To Adrian Thatcher and Aiden Davis.

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*This document contains demographic data from GeoLytics, E. Brunswick, NJ.

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Chapter 1: Introduction

1.1 Introduction

In a speech given to the NAACP on July 14, 2015, President Barak Obama stated that "justice is not only the absence of oppression; it's the presence of opportunity." From 1970 to 2000, economic restructuring "re[drew] the map of economic opportunity in metropolitan America" (Kneebone & Holmes, 2015, p. 2), metropolitan Baltimore included. This economic restructuring, coupled with urban expansion, created new patterns of opportunity, and neighborhoods experienced these transformations in very different ways, particularly with relation to their access to economic opportunities.

Research shows that the above-described urban transformations, including the reorganization of workplace location opportunities relative to where people live, and shifting labor market demand for workers in different industries, disproportionately disadvantages particular groups of people living within metropolitan areas. A historical look at the social distribution of labor shows that similar groups suffer labor market disadvantages, including women, minorities, and the poor (Kain, 1968; Ihlanfeldt & Sjoquist, 1989; England, 1993; Chapple & Weinberger, 2001; Horner & Mefford, 2007). There is also evidence that residents of particular spatial locations, most notably inner-city residents, are also disproportionately disadvantaged (Soja et al., 1983; Soja, 2010; Wilson, 1996). Frequently, research ties the physical location of residents to group identity in race, gender, and socioeconomic status. For example, much of the research related to justice and opportunity in the Baltimore metropolitan area has focused on Baltimore City, which has a long history of discrimination towards, and segregation of, its African-American community. There has been less focus on the role that space plays in shaping place than on the identities of residents living within those spaces. Space plays a critical role in determining the relationship between land use and commuting behavior (Horner, 2004a), and this role goes beyond the distribution of land uses.

Focusing on group identities in relation to opportunities frames issues of access as a social issue. An alternative way to frame these issues are through the lens of spatial justice. I argue that in doing so, differences in access to opportunity shift from issues purely in the realm of public policy to something which residents of communities can become actively involved in transforming. This paradigm considers both the social and the spatial aspects of access, and in addition, this shift allows for the inclusion of a greater number of actors and the uniting of various social justice movements and causes within an integrated spatial area where the social forces of everyday lived and shared experiences take place (Dikec, 2001).

The concept of place is integral to justice. As Mitchell (2007) stated,

> Starting from the simplest of ideas—that our actions, our lives, or relationships, our struggles must take *place*—requires us to immediately ask about what kinds of places (or spaces) those are, who does and does not have access to them, and who can and cannot exercise power over or within them (and under what conditions). It also makes us think immediately about what

happens when someone does *not* have access to the spaces that make life possible, much less good? (p.7)

Answering these questions necessitates further evaluation of these ideas, including the issue of access. This dissertation seeks to address some of these questions about who has access to space and opportunity in regards to employment access within metropolitan Baltimore.

1.2 Research Goals

The central goal of this research is to obtain a better understanding of how economic restructuring and employment decentralization impacted job access for residents living and working within metropolitan Baltimore from 1990 to 2000. Countless variables impact job access, operating at many scales from the individual to the global. Because it is not possible to address all of these variables with the limits of this dissertation, I have selected to focus on accessibility measures, which are a first exploratory step in understanding people's needs (Reggiani, Bucci, & Russo, 2011) and evaluating social inequalities, including which residential areas of a city are less accessible to job opportunities, and also how that access has changed over time.

Accessibility is a concrete measure of commuting costs that can be evaluated for different sociodemographic, socioeconomic, or spatial groups. Although it is expected that commuting costs will differ across spatial locations, this research will investigate the change in commuting costs over time. A 2015 study by Harvard University found that one of the strongest factors that affect the chances of escaping poverty was commuting time (Chetty & Hendren, 2015). In addition, the Baltimore Neighborhood Indicators Alliance found a strong correlation between areas where a high percentage of workers have commutes more than 45 minutes, and issues such as high employment levels and poverty, and population decline. They found that when faced with long commutes, people will either move away, or become unemployed (BNIA-JFI, 2015). Not all neighborhood in the metropolitan area need to have employment opportunities, but residents of all communities should have access to opportunity.

To meet the goals of this research, I present three main objectives: (1) describing the demographic changes that occurred within residential areas of the Baltimore region; (2) describing shifting employment patterns, including (a) the demand for workers in major industrial categories and (b) the spatial distribution of employment locations; and (3) examining changes in employment accessibility for residents living within different areas of the metropolitan region. I include a broader discussion of residential and workplace change from 1970 to 2000 to provide some historic context to the study years. Integrated within my examination and discussion of these changes, I will highlight the concept of spatial justice. In the case of access to employment opportunities, this means making explicit the role that space has played in producing just and unjust geographies within metropolitan Baltimore, what Soja (2009) referred to as the spatiality of justice.

As I will discuss in greater detail in Chapter 4, studies measuring the job accessibility and employment outcomes of various individuals or groups have often concentrated on the accessibility of 'low-skilled'[1] workers and/or African-American workers, particularly since Kain's 1968 publication, *Housing Segregation, Negro*

[1] As discussed in Chapter 3, the term "low-skill" is problematic, because many occupations and industries given this label are in fact jobs that demand a great deal of skill. However, the term is often applied in the literature.

Employment, and Metropolitan Decentralization, which introduced the concept of spatial mismatch. Accessibility studies related to social justice typically consider race and/or ethnicity, identifying the commuting patterns and options among those various worker groups. Other studies such as Tomer et al., 2011 have focused on only the transit-dependent population of a metropolitan area in measuring job accessibility. I seek to fill a gap in the literature, which is lacking in empirical analyses of spatial justice issues, and more specifically analyses that do not focus solely on the central city or one group identity, as is the case with the spatial mismatch literature. I seek to identify areas that may include multiple group identities who are similarly impacted by spatial shifts in employment and labor market changes. This relates to the focus on spatial justice as adding a spatial component to social justice issues.

My focus on the metropolitan area is not meant to diminish issues unique to and experienced by inner-city residents, or specific demographic groups such as African-Americans or women. Rather, I seek to explore the changing geographies of opportunity and issues of justice as they relate to employment access over the entire region, which includes different demographic groups and different kinds of spaces. Although there are demographically homogenous neighborhoods in metropolitan areas, neither the entire city nor the entirety of the suburbs are demographically homogenous units, and it is my attempt to move beyond discussing intra-regional inequalities along these or other dichotomous variables, while still acknowledging their existence.

An exploratory analysis of residential and employment change is necessary not only to describe patterns of change across space and time, but to situate the more detailed examination of employment access and seek to identify areas within the region where residents may have been uniquely impacted by the labor market transformations that occurred in recent history. This allows me to describe whom access has changed for, to what kind of employment opportunities, and what role space has played producing or reproducing justice in terms of accessibility.

1.3 Organization of the Study

The organization of this dissertation contains three separate analyses, each including a brief literature review on the topic under analysis. Each of those three chapters also includes some discussion in regards to contributions to the literature and suggested future research in the subject matter of the chapter. In the next sections of this chapter, I introduce the concept of spatial justice in relation to employment access and transportation, drawing on examples of spatial justice movements in Los Angeles and Baltimore, and noting the role that transit planning has had in shaping current access to employment. The remainder of this study is structured as follows.

Chapter 2 provides an assessment of residential change in metropolitan Baltimore from 1970 to 2000. I develop typologies of residential neighborhoods in order to reveal how sociodemographic groups have both moved and remained stationed in different areas of the region. In addition, I describe some of the historic processes that played a role in shaping the patterns of space where different sociodemographic groups reside. The purpose of the chapter is to use the residential typologies in determining how employment access has varied over time for different socio-spatial demographic groups in the metropolitan area.

In Chapter 3, I describe shifts in the labor market demand for workers in different industrial categories from 1970 to 2000 and how this, coupled with increasing employment decentralization, impacted the spatial locations where workers in different industries were employed. I also discuss the broader concerns related to these changes due to their potential impact on earnings distributions. First, I describe changing levels of employment within the region from 1970 to 2000, with a separate description of change within each of the regions counties. Next, I examine these changes at a smaller spatial resolution, closer to the neighborhood level, for the years 1990 and 2000. In addition, I identify and characterize major centers of employment present in the region in 1990 and 2000. These areas are important spaces of employment, drawing workers from various parts of the region, changing the spatial character of the area's employment, and impacting job access. I discuss the changes that took place in metropolitan Baltimore in relation to the spatial mismatch literature, to distinguish my research from that body of work.

Chapter 4 presents an empirical analysis of commuting times and distances within the metro area, with particular focus on the residential clusters developed in Chapter 2 and the employment centers identified in Chapter 3. I review measures of accessibility and calculate both an average commuting time and cumulative opportunity measures to assess the change in employment accessibility in metropolitan Baltimore. I also present an innovative way of calculating travel costs for use in transportation analyses, which have the potential to be used by non-technical experts and community groups as an alternative to current transportation software and/or GIS.

In the final chapter, I summarize important findings from the study, highlighting implications of my findings with regards to employment accessibility from different neighborhoods within metropolitan Baltimore. I conclude with a suggestion of areas for future research.

1.4 Metropolitan Baltimore, a Brief Introduction to the Study Area.

Metropolitan Baltimore is located north of Washington, DC, on the eastern seaboard of the United States. The metropolitan area is made up of Baltimore City, an older, post-industrial city, surrounded by Anne Arundel, Baltimore, Carroll, Harford, and Howard counties.

Maryland's economy was originally based around tobacco farming, and later other. By the 1820s, manufacturing overtook agriculture as the primary industry (DiLisio, 2014), with shipbuilding and steel as two of the primary manufacturing activities. Today manufacturing has given way to high-tech and knowledge-based industries. Between 1970 and 2000, the region lost many living-wage jobs in industries requiring lower levels of education, such as manufacturing. These jobs have been mostly replaced by employment opportunities in two categories: service jobs that require little education and training that do not pay a living wage, and high paying jobs that require greater education and/or skills training. Middle wage jobs have declined significantly in the region (Baltimore Metropolitan Council, 2015).

Despite an overall increase in racial and ethnic diversity, the Baltimore region has historically been segregated by race and income, a trend that has persisted to the present day. During the second half of the 20th century, the city experienced a large exodus of its white, middle-class households, and later, middle-class, African

Americans, moving into the surrounding suburban counties. This left many central-city, predominantly African-American neighborhoods, depopulated and disinvested (Baltimore Metropolitan Council, 2015).

The number of jobs in the region followed a similar pattern to the population trends, growing in the counties and declining in the city. Baltimore's development pattern can be described as polycentric in nature, having several employment centers spread throughout the region's suburbs. Despite this trend, Baltimore City has retained the highest density of jobs and still serves as the economic center of the region.

The metro region has an extensive transit system that includes light rail, commuter rail, subway, and busses; but the area is heavily automobile-dependent. An analysis of the D.C-Baltimore metropolitan region revealed that the highway system is "built out," and there is "little space or political appetite for new roads or highway" and "the transit system, however, continues to expand" (Knapp & Ding 2014: 13), this is much more true for the D.C. metropolitan area than Baltimore. Certainly, looking back to 1970, there has been quite a bit of highway and transit development. Since 1990, there was some decline in highway construction and some expansion of the transit system, but in 2016, highway construction appears to once again be prioritized over transit development.

1.5 What is Spatial Justice? What Makes Justice Spatial?

The next few paragraphs outline some of the major components related to the concept of spatial justice and discuss how it relates to broader theories of space, justice, and opportunity. Spatial justice is not meant to be a substitute for other forms of justice, such as social, economic, or environmental justice, but rather a different way of framing justice issues. It is an analytical framework (Soja, 2009), or an approach that researchers can implement to understand specific research questions, generate ideas, or explanations. It can also be used to engage different sociodemographic groups and/or activists around issues affecting spatially integrated areas. However, spatial justice is "polysemic, [and often includes very] contradictory and conflicting conceptions" of justice (Gervais-Lambony & Dufaux, 2009, p. 4). Thus, it has some different interpretations. I have selected spatial justice as a framework to move forward an understanding of the concept by drawing on real world examples of spatial justice issue and presenting this research as a measure of a spatial justice issue.

Beginning from a more general concept of justice, Gough (2010) argued that people's actions are not governed by human nature or abstract ideals about good and evil, but rather, societies develop notions of justice through social theory. He stated that "individual needs are pursued through social relations" and through these, social relations notions of justice are developed, "which in turn enter into the material reproduction or disruption of society" (p. 132).

Over the past few decades, demands for 'a just society,' rather than simply 'economic equality,' has been a focal point for several social justice movements. These movements have been "framed in both material (re-distributive policies) *and* non-material terms (liberty, happiness, opportunity, security, etc.)" (Bromberg et al. 2007, p. 1). This paradigm was initially illustrated through Rawls's (1971) presentation of the two principals of justice:

> First: each person is to have an equal right to the most extensive scheme of equal basic liberties compatible with a similar scheme of liberties for others. Second: social and economic inequalities are to be arranged so that they are both (a) reasonably expected to be to everyone's advantage, and (b) attached to positions and offices open to all (as cited in Brown et al. 2007, p. 53).

Rawls's conception of justice hinges on two principles: equality of rights and distribution. The second and most discussed principle, referred to as *distributive justice,* suggests a redistribution of resources to achieve justice. It is also suggestive of equal distribution of opportunities, which can be a part of resource distribution, but also encompasses the non-material—access to high quality education, political participation, etc. Bromberg et al. (2007) note that Keynesian economic policies "operated within in these principles" (p. 1), with policies that shifted resources to those most in need. This extended to transit planning, where for example city planners in the 1970s actively advocated for transit resources to benefit the most transit-dependent of the population (Garrett & Taylor, 1999).

Fraser (1995) also approached justice as distribution, both of material and non-material resources, but in her description, distribution is tied to social relations and group identity, such as race, class, or gender. She saw social justice movements centered around more distributive demands and those centered around demands for recognition not as being in opposition to one another, but rather social justice demands dealing with both issues. Unequal (or unjust) distribution is a result of power. Gough (2010) argued that "the radical conception of justice points to collective struggles against power" as opposed to individualistic conceptions, which envisions an "enlightened state" equitably redistributing resources (Gough, 2010, p. 132). Additionally, Bromberg et al. (2007) criticized the Rawlsian conception of justice for failure to establish "where notions of justice would be established and activated" (p. 1). In fact, spatial difference is left largely unaddressed by Rawls.

Another point of criticism regarding Rawls comes from Marxist geographers, such as Harvey (1973), because Rawls did not consider the causes, nor the structural processes causing social differences, thus undermining questions about the role that production—capitalism and private property—play in creating injustice. Soja (2010), however, states that geographically uneven development (as discussed by Smith, 2008) will always play a role in the creation and maintenance of inequalities—advantages and disadvantages—and is a framework for understanding the processes that produce unjust spaces. For example, spatial aspects of injustice arising from social injustices (Marcuse 2008). These spatial aspects of social injustices can spring from differentiations in power relationships *and* structural processes. In this way, Rawls's conception of justice is not a completely contradictory discourse to Marxist geography in regards to how justice or injustice is produced.

Drozdz (2014), a contemporary imperial social geographer whose work centers around urban regeneration policies and their impacts on local communities, did not consider Rawls's conception of justice as incompatible as Harvey interpreted it, but stated that Rawls argued strongly against "high concentrations of wealth, which he deems as incompatible with political equality" (p. 8). Also, not discounting the role of structural processes, Soja (2010) noted that anything we do will rarely be distributed evenly across space, or for that matter, randomly distributed. Human activities and "all of the metrics of quality of life (Bromberg et al., 2007, p. 2) are distributed unevenly, and tend to be nodal or clustered, which produces both advantages and disadvantages. Therefore, the spaces we create will always have some injustices embedded within them. These ideas have prompted a more spatial analysis of justice, one that seeks to understand the geography of difference, the social production of space, and the effects on social groups (Bromberg et al., 2007).

These different conceptions of justice are not exclusive, and researchers have used both distributive and structural approaches to understanding spatial justice. Recoquillon (2014) adopted an approach that considered both the Rawlsian conception and an approach defined by Iris Young (1990). In her approach, oppression and domination among groups creates a process by which the city is negotiated and produced.

The ways in which (in)justices are produced though space, in other words, the way that space is both reflected and used to perpetuate (in)justice are an important component of understanding spatial justice. Lefebvre (1974) discussed the social reproduction of space, and Bromberg et al. (2007) stated that "space—like justice—is not just handed out or given, that both are socially produced, experienced, and contested" (p. 2). Young (1990) argues there is no universality of justice. Rather, justice is negotiated by different social groups, and particularly those that suffer from one or more forms of oppression, through social and spatial place-making. Soja (2010) also encouraged struggles against inequality based on common spaces.

The importance of Rawls's conception of justice for the purposes of this research lies in the distribution of opportunities (to individuals) across space and their access to those opportunities. When President Obama stated that "(justice is) the presence of opportunity," he may not have been directly speaking about place or space; yet, opportunity cannot be removed from space. Opportunities need to exist within spaces. The location of those opportunities and who has access to them have a profound impact on the outcomes of residents. How people come together in order to shape the spaces in which they live and alter the processes that affect them is central to the concept of spatial justice. Spatial justice has the capacity to expand the inclusion of various social movements by focusing on the spaces where injustices take place. This can lead to more solidarity among diverse groups and move those movements by focusing on the spaces where injustice take place. This can lead to more solidarity among diverse social groups and help to push those movements forward.

1.5.1 Spatial Justice and Transportation

Bromberg et al. (2007) stated that connecting issues based on social movements across multiple geographic scales has not yet been fully recognized, but movements such as the right to the city provide an example of diverse groups coming together to address issues facing a cohesive spatial group. There are also examples of justice movement centered around issues of transit planning.

Grengs (2005) stated,

> Hidden behind the surge of headlines about sprawl, smart growth, and maddening freeway congestion lies a series of conflicts emerging in cities

> across the USA. These conflicts pit poor people of color in inner cities against mostly white commuters in the suburbs over scarce public transit funds, with questions of civil rights and social equity playing central roles. (p. 52)

Disadvantaged groups of color and social classes are more vulnerable to mechanisms that may impede access to employment, whether in the central city or the suburbs.

Transit planners are torn between providing alternative transit options to those who drive cars or focusing on those who have few transit options (traditionally residing in the central city). This issue was most notably brought to light by the formation of the Los Angeles Bus Riders Union (BRU), who mobilized to fight for better bus services. In 1980, Los Angeles County voted to support a sales increase to fund the construction of new subway and rail lines that would connect the city with the suburbs in a hub and spoke pattern. The first lines of this project opened in 1990, 1993, and 1995. The project eventually ran into financial trouble, and the Los Angeles Metropolitan Transit Authority (MTA) proposed raising bus fares and cut back on bus services. This put an undue burden on bus riders who were predominantly minority people of color (80%), and who would not benefit from the rail project that was serving the predominantly white suburban communities (only 28% of whom were minorities). Additionally, 94% of the MTAs riders were bus customers.

In 1994, the BRU sued the MTA, claiming discrimination under Title VI of the Civil Rights Act of 1964, which prohibits discrimination in any federally funded projects. They claimed that the MTA was discriminating against racial minorities by constructing a suburban commuter rail line while at the same time increasing costs for bus riders, and that the MTA was discriminating against the bus riders in violation of the 14th Amendment, Title VI (Grengs, 2005; Soja, 2010). The judge hearing the case ruled in favor of the BRU.

Today, there is a similar struggle ongoing in metropolitan Baltimore over the Red Line light-rail project that would have served much of West Baltimore, a predominantly low-income, African-American community, with additional transit options, including links to local and national rail lines and access to job centers in Baltimore County. The project, which had 10 years of planning behind it, was canceled soon after the election of the state's Republican governor Larry Hogan in 2015. The $900 million in federal funds promised to the project were forfeited and nearly $300 million had already been spent. The same day the Red Line project was cancelled, the Transit Administration announced its plan to shift the State's funding to a new Highways, Bridges, and Roadways initiative, along with $1.35 billion in new spending (Citizens Planning and Housing Association [CPHA], 2015; Shen, 2015). The road improvement projects identified by the Transit Administration were outside of Baltimore City, several in heavily agricultural and forested areas (CPHA, 2015). The governor later announces a $135 million plan to improve the bus system in Baltimore. However, it is unclear if the improvements in the bus system can match those that would have occurred had the Red Line been built. It also left communities along the line without a voice for improving their neighborhoods, which had been tied to the Red Line's development. A coalition of civil rights groups and city residents, including the NAACP, the Civil Rights Education and Enforcement Center, and others, filed a complaint in December 2015, asking the U.S. Department of

Transportation to investigate whether the cancellation of the project violated federal law, specifically Title VI of the Civil Rights Act of 1964, similar to the BRU lawsuit.

The Red Line project was tied to regional economic development and would have played an important role in getting more people to work and increasing job access. For example, it would have provided access to the former Bethlehem Steel plant at Sparrows Point (there are plans to develop this area), the newly created Amazon warehouse, Horseshoe Casino, Woodlawn (the headquarters of the Social Security Administration) and even the BWI area, which is an employment center in the region.

Grengs (2005) stated that within neoliberal urbanization, transportation planning—once was intertwined with larger social goals—is now being shifted towards a narrower goal of simply increasing efficiency and reducing congestion. Federal transportation policy, he claims, is very imbalanced in favor of car drivers, leaving transit riders at a great disadvantage. But even in transit planning, resources are shifted to attracting car riders to bus and rail lines. The dissolution of the Red Line plan was quickly replaced with discussions about the Maglev train project, a high-speed rail line linking Baltimore and Washington, DC. (Fritze, 2016). In addition, funding for the Purple Line project, which is part of the Washington metropolitan area, was also approved, although at a lower amount than promised under the former political leadership. Funding of these projects were not related to each other: each one could have happened independently, as the political discourse, and the funding has shifted to car riders, of whom a majority are more affluent, from suburban areas (Baltimore Regional Initiative for Developing Genuine Equality, Inc. and Earl Andrews vs. State of Maryland, 2016).

The decrease in support and revenue for transit projects such as the light rail in Baltimore and increased bus service in other metropolitan regions are decisions that do not take place in isolation, and there are many reasons behind them. For example, budget, political pressure, resources. In addition to increased focus on sustainability and the environmental impacts of automobile travel are public concerns over congestion on major roadways. These concerns create public pressure on local and state government planning offices to solve those problems, and to do so in ways that are "attractive to automobile users, especially single-occupant automobile commuters who tend to have higher incomes and far more travel options than transit dependents" (Garret & Taylor, 1999, p. 7). Voters who support higher transit spending are typically residents of suburban areas and heavy automobile users, making projects such as high-speed rail to Washington, DC, for example, more popular among them, and by extension, public officials.

As noted by Garret and Taylor (1999), poor transit service in areas with high proportions of transit-dependent people exacerbates social isolation and reduces the choices for those who already have limited ones. For example, the cancellation of the Red Line has taken away the possibility that residents served by the line could more easily access additional areas surrounding the city, increasing their exposure to employment opportunities. There is also a component of the transit-dependent not often discussed in the literature. These are the transit-dependent residents in suburban and rural areas. These residents do not always require transit access to the central city.

Despite an increase in suburban employment centers, suburban-to-suburban (or rural) transit links are uncommon and not often studied. One reason for this, as found in this study, is that these areas lack transit infrastructure except in very limited ranges.

With cities taking on new spatial configurations and changing forms of economic production have come new forms of social division that "intensify the scale and effect of the seriation of peoples and places" (Grengs, 2005, p. 59). These divisions are not always recognized in relation to transit planning based on environmental concerns or smart growth planning around suburban employment centers, which is also a response to sprawl and the negative externalities associated with increased time and distance of commuting. These areas are important initiatives, and they are responses to environmental concerns, yet the impact of different social groups and different spatial groups is not always recognized.[2]

This dissertation seeks to find a better understanding of how new spatial configurations along with changing forms of economic production have impacted employment access for various spatial groups and where those impacts have occurred.

[2] This is not to say that it is never recognized. There are many examples from the environmental justice literature where multiple social actors have worked together to seek justice about environmental concerns impacting spatial groups.

Chapter 2: Typologies of Residential Change, 1970 - 2000

2.1 Introduction

In this chapter, I analyze the transformation of neighborhoods within the Baltimore metropolitan region, and identify neighborhood typologies for the years 1970, 1980, 1990, and 2000, based on socio-demographic data from the decennial census. This research builds on previous studies recognizing the diversity and changing nature of residential neighborhoods in metropolitan Baltimore specifically, and urban areas more generally. The purpose of this chapter is to create a residential typology that can be used in determining how employment access has varied over time for different socio-spatial demographic groups in the metropolitan area.

Restructuring of the postindustrial urban environment has been described as “radical” (Knox, 1991), “splintered” (Graham & Marvin, 2001), “fractal” (Soja, 2000), and “restless” (Wyly, 1999). Sampson (2012) used the phrase “the highly variegated mosaic of twenty-first-century” to describe contemporary American cities in the wake of deindustrialization (p. 12). The central premise of these descriptions and others like them is to highlight the changes to the social, economic, and urban landscape that began around the 1970s, and the resulting neighborhood disparities across dimensions including economics, education, and social outcomes.

Postindustrial reconstruction of the urban environment was not the only cause of disparities between neighborhoods. As Wyly (1999) noted, spatial forms have persisted as well. Spatial segregation of African-American communities and neighborhood separation by income are two examples of persistent spatial patterns of residential development that have continued since well before the 1970s. Despite the end of lawful discrimination practices, local government policies and extralegal mechanisms have led to many African-Americans residing in impoverished and segregated areas of Baltimore City.

Metropolitan Baltimore includes neighborhoods defined largely by their racial and economic characteristics. Economic characteristics include median income as well as industry and occupational categories—for example, neighborhoods with much of the working-class residents occupied in manufacturing, or a majority of residents in administrative and clerical positions. In some cases, the economic characteristics that defined a particular neighborhood changed over time. My research found that racial and economic segregation was not limited to a central city/suburban divide, but rather, the patterns seen in the suburbs suggest a separation between racial, ethnic, and socio-economic groups similar to the separation that has often described the city and suburbs. Although race and class were strongly related to residential neighborhood patterns, my research shows other patterns of change those two demographics.

2.2 Overview of the Chapter and Contributions to the Literature

With the creation of new kinds of spaces comes the need to find new ways to measure and understand the contemporary urban processes that created them. The urban theories developed in the midcentury, based on simple patterns of urban development, are not viewed as useful for analyses of contemporary metropolitan areas in the context of increasingly complex postindustrial structure of metropolitan regions (Wyly, 1999). In the next section of this chapter, I discuss how the current literature has examined the changing socio-spatial structure of metropolitan areas over time and describe the use of residential typologies in studies of suburban and central city spaces.

In sections 2.2, I present a brief review of the literature specific to typology studies, including social ecology, social area analysis, factorial ecology and principal components analysis as they relate to the present study. In section 2.3, I describe the research methods used in this chapter. My use of multivariate principal components analysis is based on similar approaches to the creation of neighborhood typologies applied by Goodman and Taylor (1983), Hanlon et al. (2006), Orfield (2002), Vicino (2008), and Wyly (1999). Although I employ similar methods, to my knowledge, there are no parallel studies analyzing longitudinal data within a single metropolitan area. Many typology analyses have focused on the central city or the suburbs only, or compared multiple metropolitan areas for one or two time periods. In addition, the goal of the present research is not to create a completely unique neighborhood typology, but to use the typologies developed in this chapter in analyzing employment access.

The results of the factor analysis are presented in section 2.4.1, and the neighborhood typologies for each decennial census year are presented in section 2.4.2. In section 2.5, I summarize the findings of this analysis.

2.3 Typology Studies: A Brief Overview of Their History and Present Usage

2.3.1 Social Ecology

The history of typology studies begins with the founding of the Chicago School and the development of urban ecological research (also called social ecology) within urban sociology, an area of research concerned primarily with geographical and social space. The following paragraphs are meant as a brief overview to orient the reader with the development of typology studies and to bring forward the ideas that came from the Chicago School that have shaped research related to neighborhoods, and where the research has gone since that time.

The social ecology perspective, introduced by Park and Burgess in the early 1900s, emphasized free-market competition for land between businesses and population groups in different areas of the city as the driving force shaping land use patterns and the movement of population groups through the city. Borrowing concepts from the ecological sciences, chemistry, and physics, the Chicago school and other social scientists sought to establish 'social laws' that operated similarly to 'natural laws'. They described the process of urban development as occurring by "natural forces." The now well-known concentric zone map, with the central business district at the core and radial zones around it, illustrated urban development and "neighborhood succession" in predictable patterns for all cities.

One critique of the social ecological perspective is that the literature viewed residential variation as a result of competition and natural (market) forces, leaning towards determinism, in which social patterns followed natural laws or were the result of impersonal forces rather than human action or decision-making processes

(Kleniewski & Thomas, 2011). The ecological perspective alluded to segregation resulting from a natural process and did not consider the role of human action, individual choice, organizational decision making, overarching social structures, and/or power relations in segregation nor in neighborhood variation. The concentric zone model itself was critiqued as inaccurate and outdated in regards to the ways in which cities grow (predictable patterns) and the patterns that cities exhibit (concentric rings) (Sampson & Morenoff, 1997). Urban growth has changed dramatically over time, and the patterns that cities exhibit are not uniform across all cities.

2.3.2 Social Area Analysis

Social area analysis was a development within the Chicago School pioneered by Shevky and Bell (1955) in response to a perceived emphasis on spatial differentiation in early research, including that by Park and Burgess. The focus of social area analysis was social differentiation, and unlike earlier studies, they connected their analyses of the internal structure of cities with broader structural changes (Sampson & Morenoff, 1997).

The social area analysis Shevky and Bell (1955) developed measured social differentiation and stratification along three main categories: social rank, urbanization and family status, and segregation. Within each category were a number of variables. Social rank was constructed by grouping together occupation, education, and rent. Urbanization included women in the labor force and changing family structures. Lastly, the segregation dimension included ethnicity, foreign-born status, and race (Shevky & Bell, 1955). All of these variables were measured at the census tract level. Census tracts were then assigned scores for each of the three main categories, and categories with the same scores were clustered together to form typologies of social structure. This seminal study paved the way for numerous other typology studies, but was not without criticism.

Whereas social area analysis was developed as a response to a perceived lack of focus on social differentiation, a criticism of social area analysis is that it went too far in the other direction and focused on social space to the exclusion of how social space relates to physical space. Shevky and Bell (1955) were also criticized for various aspects of their theories and methodology. Despite these criticisms, social area analysis shifted the focus of research to the broader social-structural composition of urban spaces and the ways that social indicators are related in space (Sampson & Morenoff, 1997).

2.3.3 Factorial Ecology and Principal Components Analysis

Factorial ecology offers yet another approach to social differentiation, attempting to link the ecological and the social area analysis approaches (Sampson & Morenoff, 1997). This method uses factor analytic techniques such as Principal Components Analysis (PCA) to empirically determine the different dimensions of social differentiation across space. This differs from social area analysis, which determines those dimensions a priori.

Critiques of studies using PCA have noted that these methods "obscur[e] the underlying societal dynamics responsible for observed urban geographies" (Wyly, 1999, p. 311) in favor of research about spatial patterns. This criticism stems from a belief that such research focuses excessively on descriptions of *where* activities took place and the patterns that exist, and not enough on *why* these patterns exist or change through time (Wyly, 1999). Yet, Mikelbank (2004) noted that "typologies serve as a springboard from which the behavior of complex and diverse phenomena can be more clearly understood" (p. 936). Typologies help to clarify the phenomena. I believe this critique is unfounded in regards to current PCA studies. More recent analyses of residential spaces have included details regarding the historical processes that contributed to neighborhood differentiation, such as white flight, fiscal inequality, and sprawl to name just a few (Orfield, 2002; Vicino, 2008a, b).

PCA (and cluster analyses) methods are useful in identifying major characteristics of urban spaces, and for understanding the outcome of broader social, economic, demographic, or urban processes (Baum, 2004). They help in painting a picture of change which has some value in its visual and analytical outcomes. Recent studies, some of which I will discuss in the following paragraphs, have used this technique to classify or examine the variation within and between urban and suburban neighborhoods (Goodman & Taylor, 1983; Hanlon, 2009; Hanlon et al., 2006; Orfield, 2002; Vicino, 2008a, b).

Mikelbank (2004) noted that classification research studies using a multivariate approach to classify and group locations based on data began as a tool to better understand the nature and function of the central city, but the same work was lacking for suburban areas for many years. More recently, this research has shifted focus to suburban areas and the neighborhood typologies constructed by Orfield (2002), Mikelbank (2004), Hanlon (2009), Hanlon et al. (2006), and Vicino (2008b). These studies all reiterate the heterogeneity of suburban neighborhoods in U.S. cities and the ways in which suburban places have outgrown the stereotypical view of what the suburbs look like and who lives within them.

2.3.4 The City and the Suburbs: What PCA has Revealed About Neighborhood Differentiation

Suburban typologies have identified distinct characteristics differentiating suburban neighborhoods, including (1) socioeconomic status, (2) racial and ethnic variation, and (3) the occupation and industry of residents living within the neighborhood, from Lang and LeFurgy's (2007) description of 'boomburgs'[3] to Hanlon's (2010) depiction of 'suburbs in crisis'.[4] Many neighborhoods were distinguished by these three main categories of characteristics. Despite these findings, the dichotomous model of an urban core and homogenous suburbs still exists in the popular imagination.

The traditional model of central cities surrounded by homogenous suburbs arose during the post WWII period, a time in which large suburban community developments were being constructed. Many of these early suburbs were primarily inhabited by white, middle-class families. This picture of the American suburb has often been contrasted with the central city as place of "danger and decay" (Hanlon et al., 2006, p. 2130). Other dualisms include the white suburbs and the black city, or the rich suburbs and the low-income city. However, the last 40 years of economic and social change have made this traditional model incomplete. Vicino (2008b) suggested that the suburbs surrounding central cities were never "a monolithic unit" but instead

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[3] Suburban locations of rapid growth.
[4] Areas of population loss and declining economic indicators.

were always a diverse mixture of spaces (p. 108), and Anas et al. (1998) noted that "even sprawl is far from homogenous" (p. 1427).

Despite current research emphasizing this increased heterogeneity of the suburbs, Mikelbank (2004) argued that the variety only extends to approximately half of them. The other half, Mikelbank (2004) claims, conforms to the more traditional notion of suburban America. It is possible then that both descriptions of suburban areas as homogenous and heterogeneous are correct. The traditional model works to describe the duality of the suburban and urban divide for some neighborhoods, but that description does not extend to all of them.

My research reveals that this traditional model still exists to some extent within metropolitan Baltimore, but is too simple a classification to describe the economic, social, and demographic difference of these spatial locations. Consistent with Hanlon (2009), Hanlon et al. (2006), Mikelbank (2004), Orfield (2002), and Vicino (2008a, b), I find that neighborhoods in the suburbs and the central city of metropolitan Baltimore all exhibit socio-demographic and economic diversity.

2.3.5 Summary of Typology Studies Literature Review

Despite past criticism of PCA and cluster analyses, I elected to use these methods and build upon the research described in the preceding paragraphs because the clusters created by the analysis will help paint a picture of sociodemographic change that took place over time in the metropolitan area. My goal in using these methods is to classify residential neighborhoods across the metro area through time, from 1970 to 2000. With this information, I will be able to illustrate the defining characteristics of neighborhoods in the metro area, and how those characteristics may have changed or stayed the same in particular neighborhoods. Although it is possible that this chapter suffers from too much focus on descriptions of the patterns that exist and not enough on *why* these patterns exist or change through time, I will address the role that structural factors played in shaping residential spaces in the discussion. Geography is not one's destiny, but it can impact residents' ability to access employment.

My aim is not to reinvent similar studies already conducted but rather to use the typologies created in understanding how access to employment opportunities changed over time for various socio-demographic groups living within different areas in metropolitan Baltimore. If the traditional model of the city-suburban divide is no longer useful as some studies suggest, then it is also possible that studies concerning issues of employment access, such as the spatial mismatch hypothesis, may be more complicated than a simple city/suburban problem of employment distribution. Additionally, if the socio-demographic makeup of suburban and urban neighborhoods is diverse, access to employment opportunities may vary more greatly by spatial location than by demographics, meaning that the neighborhood that a resident lives within may play a significant role in access to employment, and may add to difficulty in accessing employment opportunities that already exists in discriminatory hiring practices based on race and social class.

In the next section, I will present the methods I used to conduct the PCA and cluster analysis for this study, and which my work builds upon. The neighborhood typologies I have created depict the variation of socioeconomic characteristics in metropolitan Baltimore as well as how the characteristics of these spaces have changed through time

2.4 Methods

2.4.1 Data and Variables

The variables I chose for this analysis are based on established dimensions of urban differentiation. While the variables selected by Shevky and Bell (1955)—occupation, education, housing tenure, family structure, female labor participation, ethnicity, foreign-born status, and race—are still viewed by urban scholars as important (Vicino, 2008a,b; Wyly 1999), with the availability of census data and statistical software, the number of variables used in similar research today has expanded. Given the descriptive nature of this research, I chose the widest selection of variables available for each census year, encompassing five major categories related to population characteristics, education, workforce characteristics, income, and housing. Appendix A1.1 lists the specific variables used in the analysis.

For the primary source of data to create this residential typology, I used the Geolytics' (2003) *Census CD Neighborhood Change Database*. This database provides long form U.S. Census data at the census tract level from 1970, 1980, 1990, and 2000, normalized to 2000 tract boundaries. Because census tract boundaries often change over time, being split, combined, or changed in other ways, normalized data makes it easier for users to perform a time series analysis. It should be noted here that although the use of census tracts is common in studies of neighborhoods because of the readily available data at that spatial scale, census tracts (and census blocks) are imperfect in terms of defining the operational boundaries of a neighborhood.

Although researchers have begun to develop strategies to define neighborhoods, I have chosen to use the census tract boundaries in this study because of the availability of the normalized data. One area for future research is to use neighborhood boundaries that are more aligned with residents' understanding or interpretations of those boundaries.

A detailed description of the methods used to normalize the 1990, 1980, and 1970 data to 2000 tract boundaries is available on the Geolytics' website in Appendix J of the *Census CD Neighborhood Change Database.* An outline of their approach follows. Geolytics started with remapping the 1990 tract data to 2000 tracts using census block-level data, the smallest geographical unit for which the U.S. Census Bureau publishes census data. Block level data is available for both 1990 and 2000. Because of the availability of this smaller geographical unit, Geolytics' documentation states that it was able to use block level data to "determine the population-weighted proportion of a 1990 tract that was later redefined as part of a 2000 tract" (Geolytics, 2003, p. J-3). Those weights were then applied to the 1990 tract level data to remap and relate it when they were split apart into the 2000 tract level boundaries using the 2000 Census TIGER/Line shape files.

Block level data was unavailable for 1980 and 1970, which complicated the remapping process. Geolytic's documentation stated that the "1980 tracts were related to 1990 tracts using the correspondence between the two tracts found in the 1992 release of the TIGER/Line files," and the "1970 tracts were bridged to 1990 blocks using a tract 1970 to 1980 correspondence file produced by the US Census Bureau" (Geolytics, 2003, p. J-4).

I compiled data on 40 variables for 609 census tracts in the Baltimore metropolitan area. I normalized the data by transforming it into percentages so that it could be compared with other data. Census tracts with no population data and/or no housing data were removed from the analysis, as were as three additional census tracts. These three census tracts were residential and mixed use in 1970 but by 1990, contained only industrial sites. The tracts were in Southeastern Baltimore County and contain the areas known as Hawkins Point, Sparrows Point, and Wagners Point.

The population variables I selected for this analysis were related to racial and ethnic composition, foreign born status, age, and the family structure of the population. Racial and ethnic composition included the percentage of non-Hispanic white, non-Hispanic black, Hispanic, and Asian populations (1990 and 2000 only) within each census tract. Other categories were ignored due to lack of available data dating back to 1970. Age variables were divided into two groups: the percentage of those under 18 and those over 65. The primary purpose of using these two age groups was to capture the population of children (under 18), individuals in their retirement years (over 65), and the working age population (19-64). Family structure variables included female-headed households with and without children under 18, married couples with and without children under 18, and nonfamily households.

Although a category called “male-headed households” exists within the data, I did not include it within this analysis because the U.S. Census defined husband and wife families as “male-headed,” a category that leads to difficulty in determining the composition of family households that fall into it. Female-headed households are designated as such when women are divorced or separated, widowed, or the head of family (husband) was absent during the time of the census count (Ross & Sawhill, 1975). More detailed categories of family and nonfamily households were excluded. Each variable was calculated as a percentage of total households.

The education variables included four categories for individuals aged 25 years and older: no high school diploma (0-12 years of school); completed high school but no college; completed some college but did not earn a degree; and earned a college degree (including bachelor's, graduate, or professional degree). Each category was calculated as a percentage of total persons 25 years and older.

Workforce variables included employment status of residents and the occupation of employed residents aged 16 years and older. Nine standard occupational categories were comparable for the entire study period. These workforce variables provided information about the labor force participation of residents as well as the types of work that they did. Each occupational category, as well as unemployment, was calculated as a percentage of all persons aged 16 years and older in the civilian labor force. Unemployment is defined as the percentage of people in the labor force actively searching for work. There are some analytical problems with this definition; specifically, that it may leave out workers who, after long periods of unemployment, have stopped actively looking for work, known as the "discouraged worker" phenomenon (Goodman & Taylor, 1983). However, no other measure is widely available.

To capture different kinds of neighborhood change, I included three measures of economic status in this study: average household income, average family income, and the percentage of the population below the poverty line. For example, Lucy and

Phillips (2000) found that suburban neighborhoods that experienced a loss of family income also experienced a general socioeconomic decline. The economic decline of residents can be captured in the central city or suburban neighborhoods by analyzing these three variables. Processes of gentrification can also be shown in the data in areas where housing passes from lower income residents to higher income residents.

I selected a range of variables related to housing. These included age of the housing stock, size of the housing stock, home value, and tenure status. To determine the age of the housing stock, I collected data on the number of homes within each census tract built during a specific decade—including homes built 1939 and earlier, and houses built in the 1940s, 1950s, 1960s, 1970s, 1980s, and the 1990s—and calculated the percentage of homes built during each time period. To determine the average size of homes within each census tract, I used the number of bedrooms as a proxy for housing size. I divided the number of rooms into three categories: homes with 0-1 bedrooms, homes with 2-3 bedrooms, and homes with 4-5 bedrooms. I then calculated the percentage of homes with each bedroom number category for the census tracts. For housing tenure, I collected data on homes that were vacant and renter-occupied. Appendix A1.2 and A1.3 includes a table of the total numbers for all the variable data from 1970 to 2000 and the change in total numbers between each decade.

2.4.2 Principal Components Analysis

To develop a residential typology for the Baltimore metropolitan area, I first conducted a principal components analysis (PCA) of the metropolitan area's census tracts. Principal components analysis (PCA) is "a way of identifying patterns in data and expressing the data in such a way as to highlight their similarities and differences" (Smith, 2002, p. 12). It is a systematic way of examining correlations among many variables with an aim at identifying underlying principal components, or latent variables that cannot be measured directly (Burstyn, 2004). PCA is both a variable reduction technique and a data preprocessing method, often used to reduce the number of variables in a data set to a smaller number of principal components when the data is highly correlated. We know that variables such as race, class, and education are inter-related and can influence one another. A principal components analysis differs from other statistical methods in that the PCA is used to reduce the entire set of these inter-related variables into a smaller set of independent variables. It reduces the total number of variables in order to detect the structure of the relationships between those variables. This reduction is often done before employing additional statistical methods such as a cluster analysis (Demšar et al., 2012).

In this study, I use PCA as both a dimension reduction/pre-processing technique, and as a means for gaining a better understanding of the relationship between the socioeconomic residential variables. The PCA reduces the entire set of variables that I selected to a smaller set of variables called components. These components are groups of variables that are interrelated. PCA also identifies the relationship between the resulting components and their spatial location within the Baltimore metropolitan area, and allows me to identify patterns in the socio-spatial structure of these components.

For each data set―1970, 1980, 1990, and 2000―I used the selected variables in a PCA with a varimax rotation method. After a PCA has been computed, the factors need to be rotated before they can be interpreted. Rotation of the factor axes is used to obtain simple and interpretable factors, and the rotation serves to make the loading pattern of the PCA clearer. I chose a varimax rotation because it is one of the most commonly used rotations in PCA; it makes the large loadings larger and the small loadings smaller within each component (Abdi, 2003). My next step in the PCA was to evaluate the component loadings to determine the number of components to retain. One of the most important decisions that individual researchers need to make in a PCA is how many components to retain; this decision can be very subjective (Ledesma & Valero-Mora, 2007). A balance must be found between reducing the number of components and representing the correlations among the data. Extracting too many components may lead to a loss of relevant information; however, extracting not enough may lead to confusion in interpretation (Ledesma & Valero-Mora, 2007).

I used two methods to limit subjectivity in the decision about how many total components to retain for each analysis. First, I limited the output of the components loadings to only those with an eigenvalue above one. Eigenvalues are the weights that are used to calculate the component scores. Eigenvalues less than one have less explanatory power than the original variables (Kline, 1994). Therefore, in this initial step, I retained only variables with eigenvalues equal to or greater than one. Next, I evaluated the scree plot on the data output. Cattell's scree test (Cattell, 1966) suggests that the number of factors to retain should be determined by the point on the graph where the last significant drop occurs or where it levels off. The following two figures are examples of scree plots created from the 1990 and 2000 data sets. My analysis showed a slight drop between components 1 and 2, and again between components 5 and 6, and 6 and 7 on the scree plot.

Because one component would not be useful in explaining the variation in all the data, I chose to select seven components, seven being the point in which there is a leveling off in the graph. The graph in Figure 1 shows a more distinct leveling off after the fourth component. Therefore, five components were selected for the year 2000. The PCA produced component-loading scores for each of the variables. The scores are measures of how significant each variable is to the new components created by the analysis (Vicino, 2008b). I used these loading scores to interpret the characteristics of each component, limiting the scores to only those greater than 0.30 and less than -0.30. According to Kline (1994), loading scores closer to zero do not contribute significantly to the meaning of the components.

2.4.3 Cluster Analysis

The second step in the residential data analysis was a cluster analysis, which is useful for identifying relatively homogeneous groups of components. In this step, the PCA scores for each census tract were clustered using a k-means clustering procedure. This procedure was chosen because it allowed me to select the number of clusters that I wanted. I ran three, four, five, and six-cluster solutions for each of the year's data sets. In selecting the best cluster solution for each year, I first mapped the results of each possible cluster solution using a Geographic Information System (GIS). I recognized that the three-cluster solution would not provide enough detail about the diversity of spaces present in metropolitan Baltimore, and I discarded that as a possible solution for any of the study years. Next, I identified the primary characteristics of the cluster formations for the four-, five-, and six-cluster solutions and selected the cluster solution that best explained the data.

Choosing the number of clusters to retain is more of an art than a science, and like choosing the number of components to retain in a PCA, very subjective. I followed the methods used by Hanlon (2009) and Vicino (2008a, b) who performed both a PCA and cluster analysis to investigate neighborhood differentiation in inner-ring and suburban neighborhoods. Similar to those methods I observed the primary characteristics of each cluster to determine the number of clusters to retain and for greater ease of interpretation. In the end, I chose a five-cluster solution for 1970, 1990, and 2000, and a six-cluster solution for 1980. This solution seemed to retain the greatest diversity of variables in each cluster, while at the same time maintaining representative variables within each cluster that would help to interpret the characteristics of each individual cluster.

2.5 Results

2.5.1 PCA Results

Six components were selected from the PCA of the 1970 variables. These six components explain over 75% of the total variance in the original 1970 data set. As Table 1 illustrates, component 1 explains 38% of the total variance; component 2 explains 14% of the total variance; and the rest of the components explain the remaining variance in the data set. The 1980, 1990, and 2000 data sets indicate a very similar pattern; the first component in each data set explains approximately a quarter of the variance within each data set, and the second component explains approximately 10-15% of the variance. In each data set, the number of variables was significantly reduced through the PCA. I use the PCA scores resulting from the analysis to measure the relationship between the census tracts and the components generated by the PCA. The higher the PCA score, the more strongly a component's characteristics (the variables in each component) are represented in a particular census tract.

The PCA analysis showed that there was great diversity in metropolitan Baltimore's neighborhoods between 1970 and 2000. In this section, I describe four distinctive features of the residential neighborhoods' socio-spatial structure: class, race, ethnicity, and family structure. Each study years' components and related variables are listed in Appendix A1.4.

Table 1
Total Variance Explained for PCA, 1970

Component	***Eigenvalue***	***% of Variance***	***Cumulative %***
1	14.18	38%	38%
2	5.14	14%	52%
3	4.09	11%	63%
4	2.05	6%	69%
5	1.71	5%	73%
6	1.10	3%	76%

Class. Class was a distinctive feature of the metropolitan socio-spatial structure. The 1970 and 1980 PCA feature what I am calling "professional class households," a term used by Vicino (2008b) to describe the inner-ring suburban neighborhoods surrounding Baltimore City. Here, I am using this term in the same way that Vicino (2008b) did in his analysis. This component explained the largest proportion of the original dataset in both study years, accounting for 38% of the variance in the data in 1970 and 36% in 1980. Professional class households were characterized by high socioeconomic status, including the following features: higher than average family and household incomes; high home values; professional occupations; and high levels of achievement in education.

In contrast to professional class households, the 1990 and 2000 PCA showed that low-income, African-American households had emerged as the component explaining the second largest proportion of the original dataset, with professional class households falling second for both years. These households were characterized by race (non-Hispanic black), and socioeconomic status (population living under the poverty line and housing values). Other variables that had high loadings in this category included female-headed households, children under the age of 18, vacant properties, and blue collar or manual labor occupations. Many of these variables match the characteristics of the underclass living in high-poverty neighborhoods as described by Jargowsky (1997).

Figures 1 and 2 illustrate the locations of the professional class and low-income, African-American households within metropolitan Baltimore in 1970, 1980, 1990, and 2000, per the results of the PCA analysis. Appendix A1.6 contains reference maps for neighborhoods in Baltimore City and areas of the metropolitan region that will be discussed in this, and subsequent chapters of this dissertation. In Figure 1, the darker shaded areas represent higher PCA scores for that component, which means that these census tracts are more strongly associated with it. In 1970, professional class households were located mostly in the north of Baltimore City and extended north of the city into Baltimore County. There are also some census tracts to the south of the metropolitan area, in Anne Arundel County, located close to the capitol, Annapolis. The spatial distribution of the census tracts including professional class households expanded between 1970 and 2000 in the suburban regions of the metropolitan area. The expansion occurred around Howard County near Columbia, and westward towards Washington, D.C. Some expansion also occurred to the north into Cockeysville. By the year 1990, professional class households encompassed a large portion of Howard County, but by the year 2000, some areas that once had the highest PCA scores for this component now had lower scores. This means that some neighborhoods, once very strongly characterized as professional class, became less strongly associated with this component. Neighborhoods with high component scores include the northern areas of metropolitan Baltimore, around Glen Arm, and in some sections of Howard County.

Vicino's (2008a, b) analyses revealed a strong presence of professional class households in Baltimore's inner-ring suburbs in 1970, particularly in neighborhoods located to the north and west of Baltimore City. He also found significant suburban spatial restructuring between 1970 and 2000, noting that by the year 2000, those professional class neighborhoods to the west of the city were characterized as low-income. I found similar results in my PCA analysis. Overall, however, my analysis showed metropolitan-wide a great deal of overall continuity to the residential neighborhood socio-spatial structure between 1970 and 2000. This change described by Vicino is most visible in my analysis around the Lochearn and Woodlawn areas.

The spatial distribution of professional class households also suggest that with the suburbanization of employment, these households would be located more proximate to employment opportunities. In the next chapter I will discuss how some centers of employment in areas such as Columbia, in Howard County, and Owings Mills, Reisterstown, in Baltimore County were characterized by employment in FIRE and professional services. However, if for professional jobs that remained more concentrated in the central city, suburbanization of these households would suggest their commute times increased over time.

The low-income, African-American households were strongly concentrated with Baltimore City and also in the Dundalk area, just southeast. Between 1970 and 1990, this component showed some expansion out of Baltimore City. The highest loading census tracts remained primarily within the eastern and western neighborhoods of the central city, but some positive loadings for census tracts began to appear in inner-ring suburban areas such as Carney, Essex, Lochearn, Milford Mill, Randallstown, and Woodlawn.

The spatial distribution of these households remained very static over time which suggest that the suburbanization of employment could have a negative impact on residents living in these communities, forcing longer commutes to reach employment opportunities.

Professional class and low-income, African-American households have spatially distinct locations within metropolitan Baltimore. Both components exist within the central city and the suburbs, but the majority of professional class households are located in suburban neighborhoods, whereas the low-income, African-American neighborhoods are primarily located in the central city.

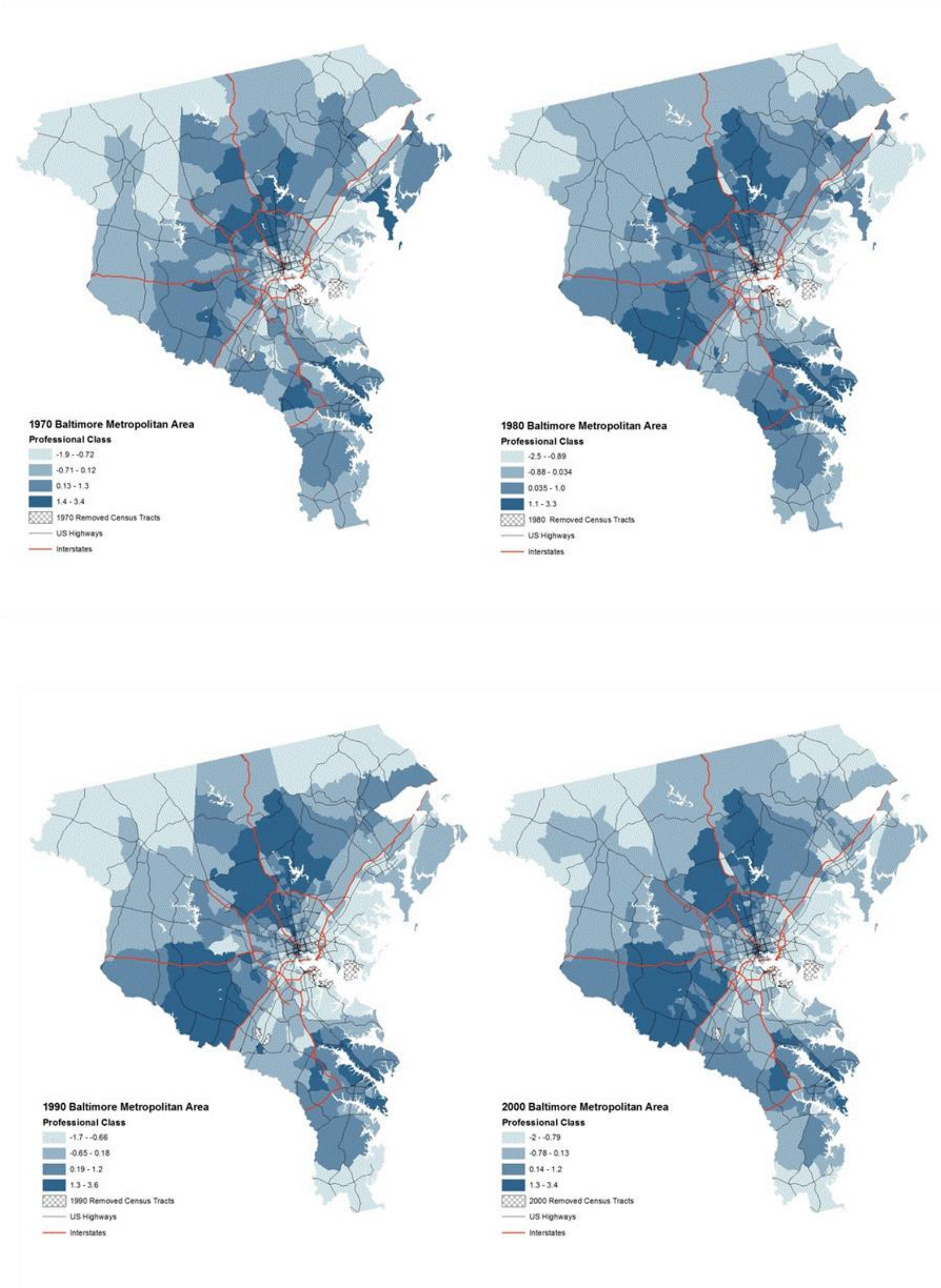

Figure 2. Professional class households in metropolitan Baltimore, 1970-2000, based on PCA. This figure illustrates the spatial distribution of the census tracts including professional class households from 1970 to 2000.

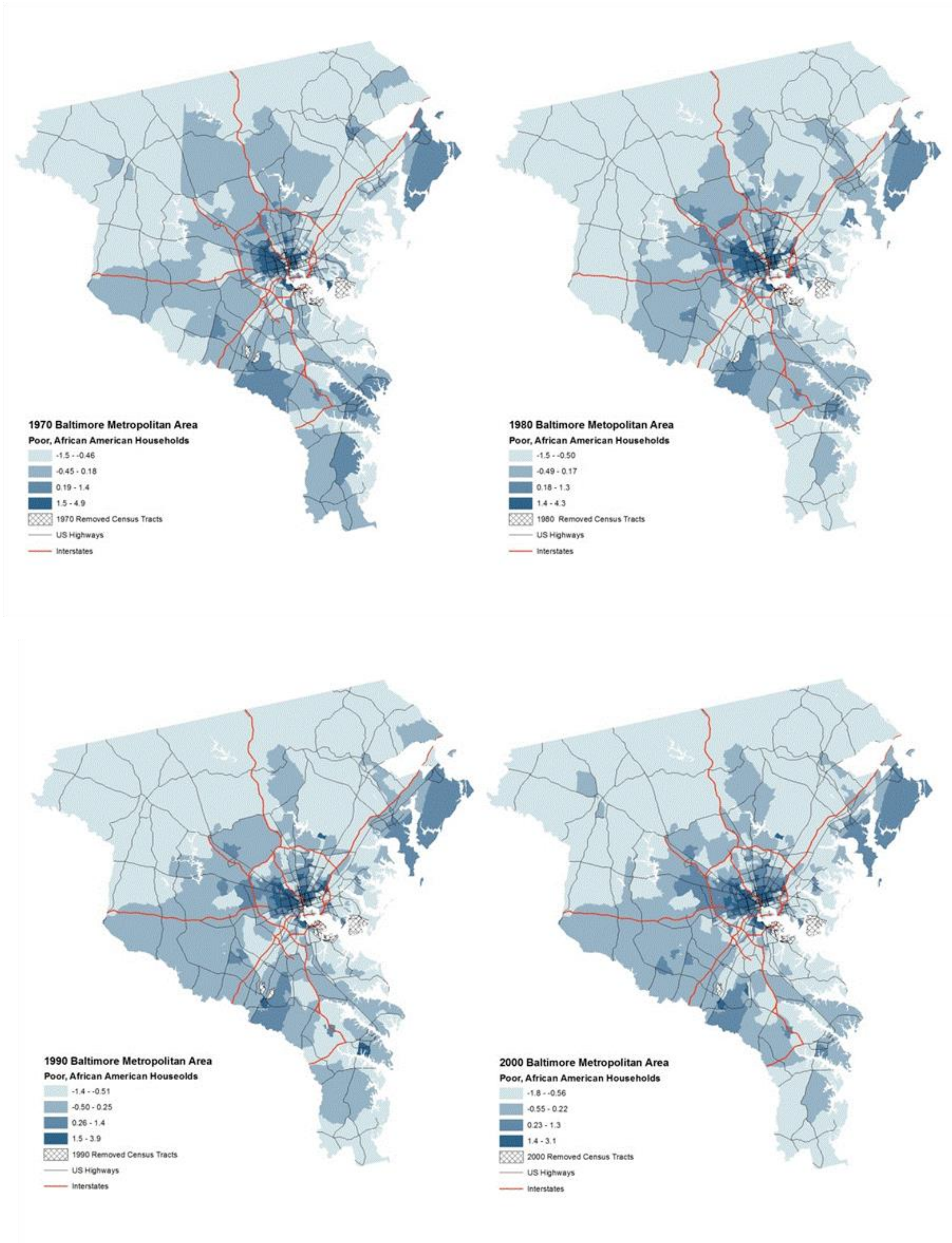

Figure 3. Low-income, African-American households in metropolitan Baltimore, 1970-2000, based on PCA. This figure illustrates the spatial distribution of the census tracts including low-income, African-American households from 1970 to 2000.

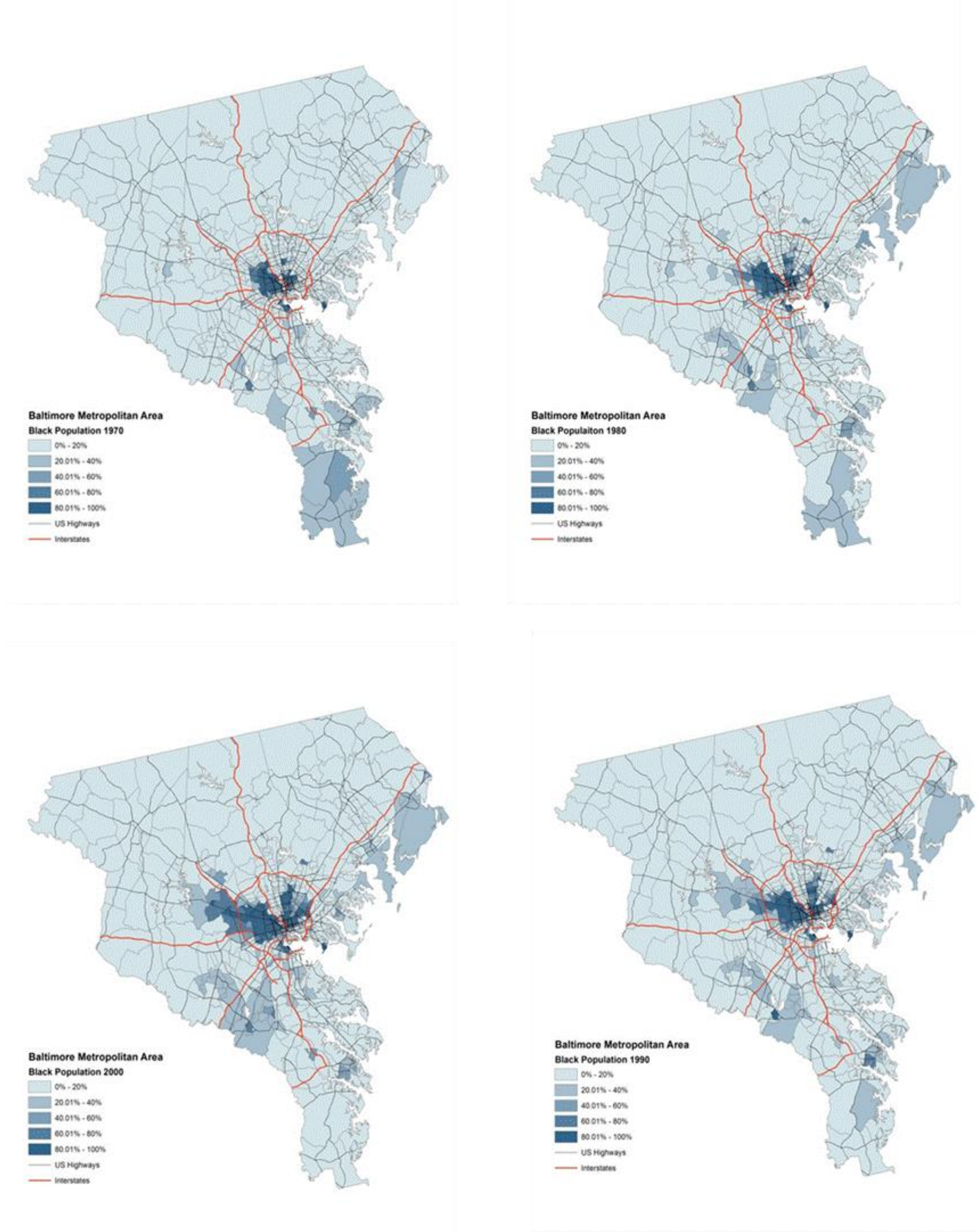

Figure 4. African-American population distribution, metropolitan Baltimore, 1970-2000. This figure shows the percentage of African-American residents across the metropolitan area by census tract.

Race. Race was another distinctive feature of the metropolitan socio-spatial structure between 1970 and 2000, appearing as a significant variable in the professional class and low-income, African-American households. The African-American variable had a positive loading in the low-income, African-American households' component for each study year. As discussed in the previous paragraph, the majority of these households were located within Baltimore City. Figure 3 illustrates the African-American population in metropolitan Baltimore from 1970 to 2000. These maps show that the highest concentrations of African-Americans were predominantly in Baltimore throughout the study period but that higher concentrations expanded into the suburbs over four decades. Between 1970 and 1990, the percentage of middle-class[5] African-American families living in the city dropped from 85% to 56% (Levine, 2000). As noted by Levine, "Lochearn, Woodmoor, Milford Mill, and Randallstown . . . saw their black communities grow from 6 percent of the population in 1970 to 65 percent in 1990, a huge exodus of income and social capital from city neighborhoods" (2000, p. 140).

Ethnicity. By 1980, ethnicity—a fourth distinguishing feature—appeared within metropolitan Baltimore, representing Hispanic, Asian, and foreign born populations. Figure 4 illustrates its location within metropolitan Baltimore. Because this component did not show spatial patterns as neatly clustered together as the features already mentioned, I will describe the neighborhoods with high positive PCA scores for it.

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[5] Earning more than $35,000/year in 1990 dollars.

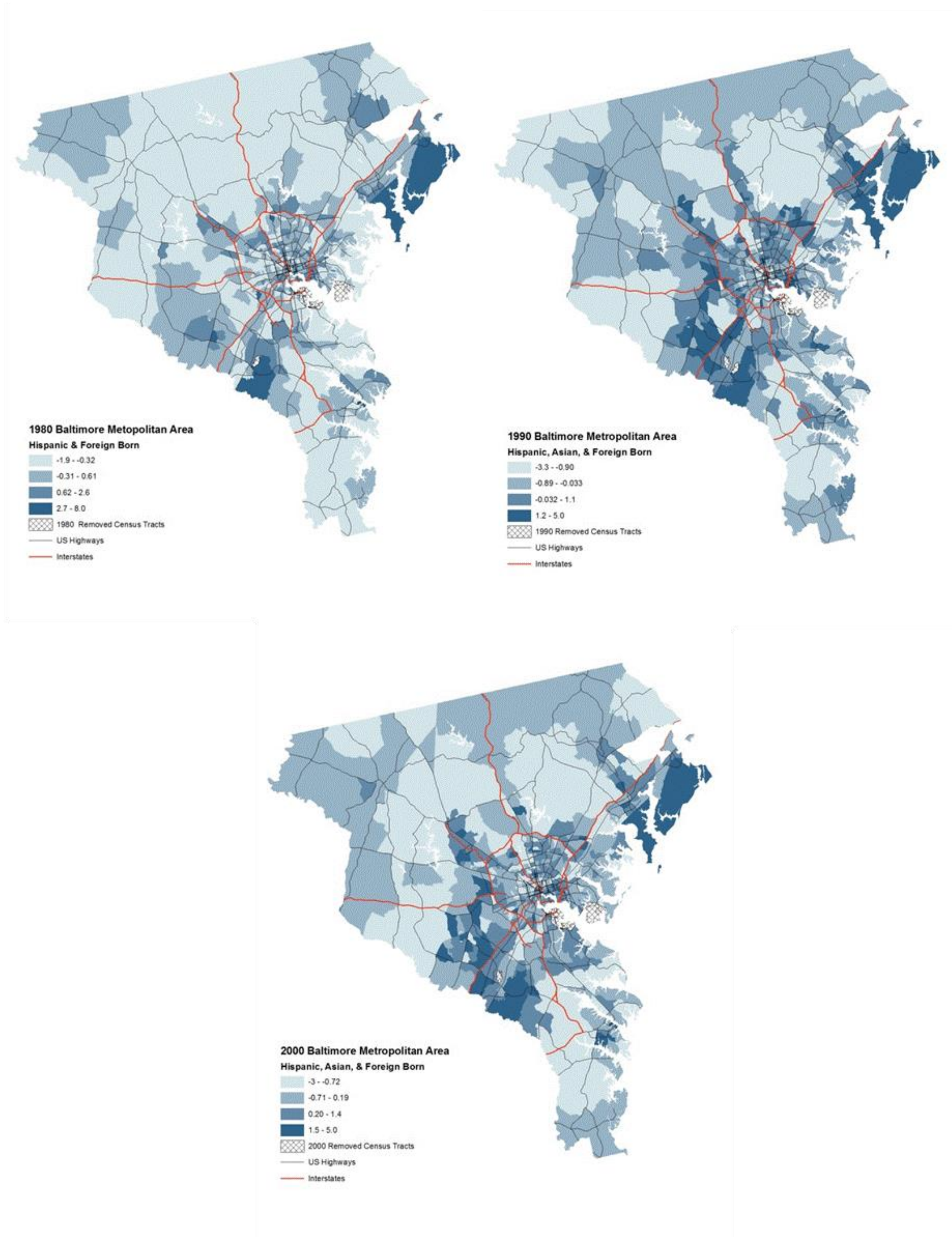

Figure 5. Hispanic, Asian, and foreign-born population distribution, metropolitan Baltimore, 1970-2000. This figure shows the percentage of Hispanic, Asian, and Foreign-born residents across the metropolitan area by census tract.

In 1980, the census tracts that showed the strongest PCA scores for this component were located near two military facilities, Ft. Meade and Aberdeen proving ground, and also in Halethorpe/Arbutus. Some census tracts within Baltimore also belonged to this category, including Fells Point and Washington Hill. In 1990, the census tracts having positive scores for this component expanded. They were largely located in the southwestern sections of the metropolitan area, in Woodlawn, Ellicott City, and Laurel, and around Aberdeen Proving Ground. Lastly, within Baltimore City, this component had the highest scores in the Canton and Canton industrial areas, and east of the city where I-95 and I-895 intersect. In 2000, it showed a similar pattern to the 1990 data, with a slight overall shift towards the western part of the metropolitan area.

Family structure. The last distinctive feature of metropolitan socio-spatial structure was family structure, most notably in the years 1980 and 1990. This component accounted for approximately eight percent of the variation in the original dataset in 1980 and five percent in 1990, and married couples with children under the age of 18 comprised its main characteristic. Larger homes and higher average home values represented other important characteristics. Figure 5 shows that the spatial distribution of this component was primarily in the suburbs, but some census tracts had high positive loadings for it within Baltimore City neighborhoods. Between 1980 and 1990, a change occurred in the spatial location of this feature within metropolitan Baltimore counties, and it appears to become more prevalent in outer suburban neighborhoods and less prevalent within inner suburban neighborhoods.

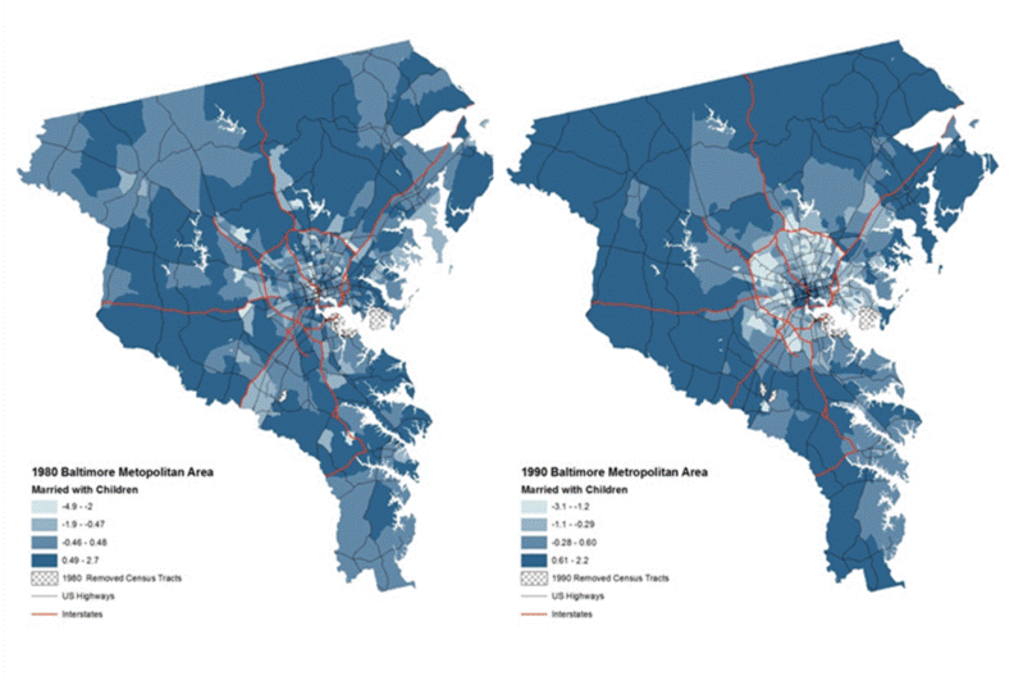

Figure 6. Married families with children component in Metropolitan Baltimore, 1980 and 1990. This figure illustrates the spatial distribution of the census tracts including the married families with children component from 1970 to 2000.

This finding is consistent with Vicino's (2008b) for metropolitan Baltimore's inner suburbs in 2000. He discovered that in 1970, the inner suburbs were home to neighborhoods with many young families raising children, but by 2000, this area had transformed into older, white households. Vicino (2008b) did not look at data from 1990, but this may account for why this component has lower PCA scores in the inner neighborhoods in 2000. It is possible that families with children began to move out of inner suburban neighborhoods as early as the 1990s.

In summary, the PCA revealed that metropolitan Baltimore was comprised of diverse types of neighborhoods throughout the study period, yet at the same time, the socio-spatial structure of the metropolitan area did exhibit some distinctive characteristics that persisted over time, including class, race, ethnicity, and family structures. The socio-spatial features of class and race appeared to remain somewhat static in terms of their physical location over the four-decade study period, but changes indicate some transformation of the socio-spatial structure. These changes include an increase in Hispanic, Asian, and foreign-born residents, and a higher number of families with children living in the suburbs. This PCA provided a baseline of information about the metropolitan area, including patterns of metropolitan socio-spatial structure and the characteristics that define and differentiate the neighborhoods within the metropolitan area. In the next section, I will discuss the results of the cluster analysis and present the neighborhood typology I developed for each study year. The cluster analysis provides the means to further reduce and classify the varying census tracts into groups based on common characteristics.

2.5.2 Residential Typologies: 1970 – 2000

Based on an examination of the cluster centers, an examination of the means of the different variables, and maps of the various cluster solutions, I selected the number of clusters to be chosen for each census year. For all years except 1980, I found that a five-cluster solution was the most useful in describing the various neighborhood types. In this section, I will review the results of each cluster analysis and describe the characteristics that typify each cluster. I will also describe the spatial distribution of each cluster across metropolitan Baltimore.[6]

1970: The cluster analysis for the year 1970 resulted in a five-cluster solution. The key characteristics for the 1970 residential typologies are displayed in Table 2 along with the percentages of each variable within each cluster.

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[6] The total population for each cluster can be found in Appendix A1.5.

Table 2

1970, Five-Cluster Solution

	Cluster 1	***Cluster 2***	***Cluster 3***	***Cluster 4***	***Cluster 5***
POPULATION CHARACTERISTICS					
Percentage of population non-Hispanic White, 1970	94.43%	93.49%	10.20%	90.37%	73.41%
Percentage of population non-Hispanic Black, 1970	4.99%	6.13%	89.46%	9.18%	24.93%
Percentage of population Hispanic, 1970	1.00%	1.02%	0.82%	0.60%	1.31%
Percentage of population under 18, 1970	28.99%	37.89%	40.35%	31.96%	20.32%
Percentage of population over 65, 1970	12.34%	5.51%	7.35%	8.30%	17.97%
Percentage of population foreign born, 1970	5.20%	1.98%	1.08%	2.49%	5.17%
Percentage of family households, married couple with own children under 18 years old, 1970	34.80%	50.80%	28.07%	39.51%	13.00%
Percentage of family households, married couple without children, 1970	35.09%	29.06%	21.09%	32.87%	22.16%
Percentage of family households, female-headed household with own children under 18 years old, 1970	3.53%	3.86%	15.55%	4.36%	4.37%
Percentage of family households, female-headed household without children, 1970	5.86%	2.75%	8.45%	3.91%	5.37%
Percentage of nonfamily households, 1970	18.28%	11.32%	23.24%	16.74%	53.61%
EDUCATION ***Percentage of persons 25+ years old who have:***					
Less than a high school diploma, 1970	51.26%	47.70%	72.31%	58.83%	53.88%
Completed high school but no college, 1970	25.83%	30.20%	18.91%	28.51%	19.95%
Completed some college but no degree, 1970	9.40%	9.62%	4.57%	6.45%	9.24%
Bachelor's or graduate/professional degree, 1970	13.50%	12.49%	4.21%	6.21%	16.93%
EMPLOYMENT ***Percentage of persons 16+ years old who are in the civilian labor force and employed as:***					
Professional and technical occupations, 1970	18.62%	18.18%	8.94%	12.83%	24.69%
Executives, managers, and administrators (excl. farms), 1970	10.38%	8.98%	2.56%	6.18%	7.57%
Sales workers, 1970	10.57%	6.80%	3.07%	6.69%	5.44%
Administrative support and clerical workers, 1970	23.45%	19.77%	15.93%	23.87%	19.45%
Precision production, craft, and repair workers, 1970	12.58%	16.84%	9.85%	18.21%	10.27%
Operators, assemblers, transportation, and material moving workers, 1970	12.31%	14.20%	23.40%	17.85%	13.16%
Nonfarm laborers, 1970	2.78%	3.65%	9.39%	3.77%	4.27%
Service workers, 1970	9.09%	9.77%	26.44%	10.36%	15.07%
Unemployed, 1970	2.74%	2.70%	6.08%	3.27%	4.31%

Table 2 continued

INCOME & POVERTY					
Average income per family ($), 1970	$14,684	$13,098	$7,925	$11,770	$10,888
Average income per household ($), 1970	$13,870	$12,649	$7,409	$11,412	$8,788
Percentage of total persons below the poverty level in the last year (1969)	6.72%	6.78%	26.19%	6.01%	21.61%
HOUSING					
Percentage of renter-occupied housing units, 1970	31.94%	28.70%	62.55%	34.87%	66.77%
Percentage of vacant housing units, 1970	3.02%	4.65%	6.07%	2.47%	10.91%
Percentage of housing built before 1939 (over 31 years old)	43.28%	22.87%	67.67%	24.38%	72.58%
Percentage of housing built between 1940 and 1949 (21-30 years old)	11.71%	8.60%	15.45%	32.08%	4.97%
Percentage of housing built between 1950 and 1959 (11- 20 years old)	26.28%	25.99%	10.29%	32.35%	5.55%
Percentage of housing built between 1960 and 1969 (0-10 years old)	18.72%	42.54%	6.59%	45.91%	16.91%
Percentage of homes with 0-1 bedrooms, 1970	15.28%	10.17%	22.24%	19.30%	56.90%
Percentage of homes with 2-3 bedrooms, 1970	73.04%	72.49%	64.95%	71.08%	33.64%
Percentage of homes with 4-5 bedrooms, 1970	12.06%	17.39%	12.82%	8.95%	9.55%
Average home value ($), 1970	$17,633	$20,019	$6,951	$13,114	$8,356

Figure 6 displays the neighborhood typology of metropolitan Baltimore for 1970; this map exhibits the spatial distribution of each cluster within the metro area. Cluster One is similar to the primary principal component from the 1970 PCA analysis: professional neighborhoods. However, the highest percentage of residents in this cluster worked as administrative or clerical workers. Therefore, I have defined this cluster as “service class” It is not repeated in the following years’ analyses and is unique to 1970. This could be related to changes in the labor market, changes in wages due to union contracts and or the relative higher wages afforded to all-white occupations based on Jim Crow policies that were established.

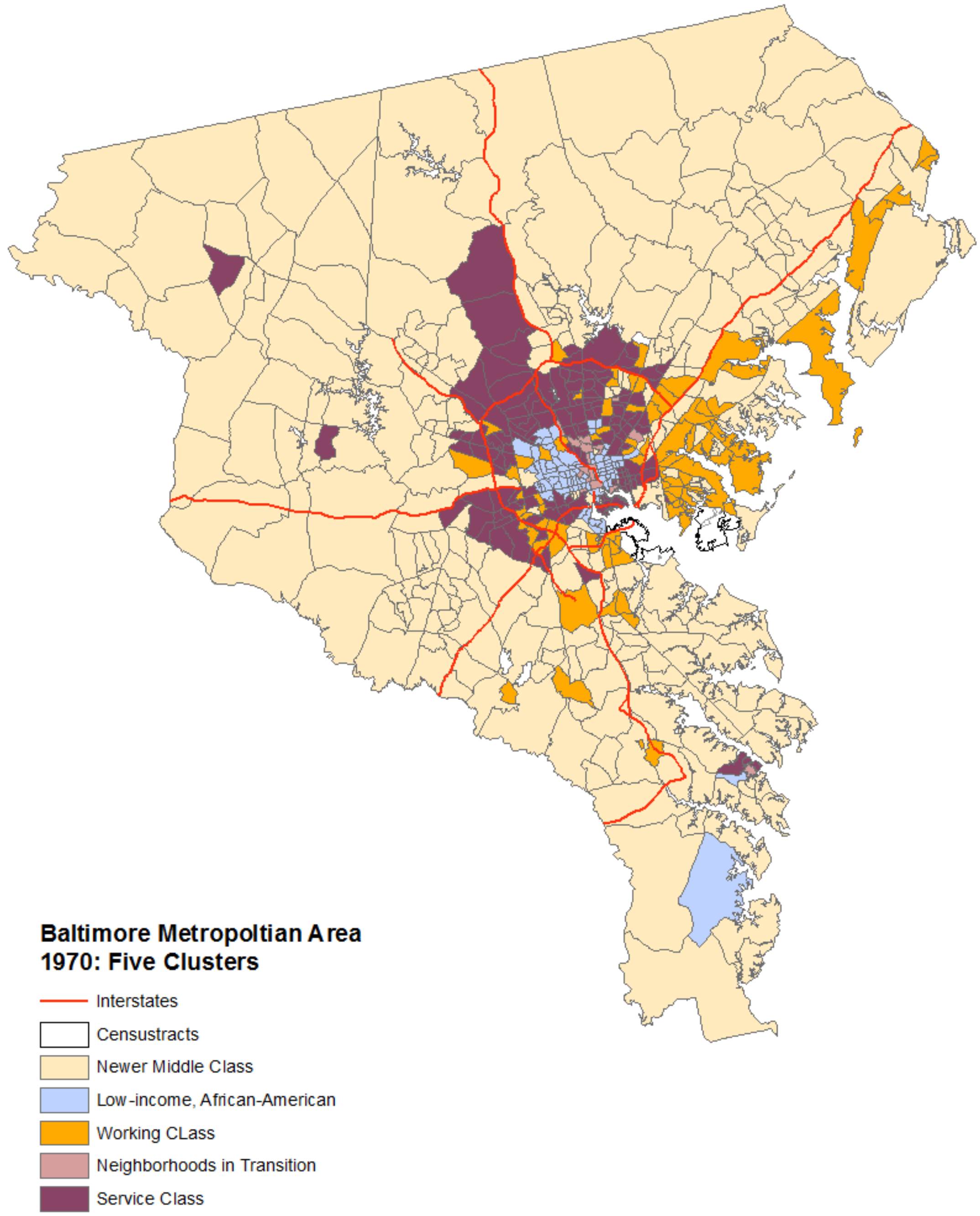

Figure 7. 1970 cluster map. This maps shows the distribution of the residential clusters identified in the five-cluster solution for the year 1970.

The service-class cluster accounted for 23% of all neighborhoods in metropolitan Baltimore in 1970. The distinctive characteristics of this cluster were related to race, foreign born status, employment, and income. It had the highest age of white residents and the highest percentage of foreign-born residents. In addition, approximately 63% of the population worked in white-collar professional positions or administrative positions. More than half the residents had less than a high school education. The average family income in this cluster was the highest of all the clusters, but not significantly. These service-class neighborhoods were primarily located in the inner-ring suburbs surrounding Baltimore City and the outer suburbs north of the city, including Cockeysville, Lutherville/Timonium, and Hampton. This cluster also appeared in parts of Annapolis, and in portions of Carroll County, including Eldersburg/Sykesville and Westminster.

Cluster Two identifies what I call the "newer, middle-class families." This cluster, like the professional neighborhood cluster, had a high percentage of white residents and was also defined by a higher percentage of families with children under 18, newly constructed homes, and higher home values. This cluster was spread throughout the metropolitan area, most notably in the exurban areas, and was spatially the largest cluster of the five typologies with 36% of the total population in the metropolitan area living within it.

Cluster Three classifies the "low-income and African-American neighborhoods." These areas were defined by race, family status, income, and occupation. Almost 90% of those living in this cluster were African-American. This cluster had the highest percentage of female-headed households and also the highest percentage of children under 18 of all five clusters. Of the residents within these neighborhoods, 26% lived below the poverty line, and the cluster had the lowest average household and family incomes. Of the residents living in these neighborhoods, most were employed as a service worker, laborer, operator, assembler, and material moving worker, or were unemployed. The census tracts of this cluster were spatially located in east and west Baltimore City, southern Annapolis, and a small, sparely populated census tract in southern Ann Arundel County.

Cluster Four, “working-class neighborhoods,” is primarily characterized by occupation, i.e., blue-collar residents. Approximately 59% of the residents in these areas lacked a high school diploma, and 23% completed high school with no college experience. Although in terms of education, this cluster was similar to the service-class cluster, occupation loaded very differently between these two. The working-class neighborhoods were, for the most part, distributed in the eastern inner-ring suburbs and along the I-95 corridor, including places like the Aberdeen Proving Ground/Edgewood area, Bel Air, Essex, Middle River, and White Marsh. There were also census tracts within Baltimore City, and to the west and south west of the city, including Arbutus, Glenburnie, Linthicum Heights, Milford Mill, and Severn.

The last cluster identified in 1970 I have defined as “neighborhoods in transition.” I chose this purposefully broad term to emphasize the cluster’s changing residential makeup. The residents within these neighborhoods were diverse in terms of age, race, and family status. This cluster had a higher percentage of residents over 65 than the other four clusters, but over-65 residents do not represent a majority. A higher percentage of older residents may indicate that these neighborhoods were in a state of transition from older, white to younger, white or African-American residents. However, the data from 1980 to 2000 show variable rates of older residents within the neighborhoods in transition, with no identifiable trend. A quarter of the population in this cluster were non-Hispanic black, the second highest percentage of all the clusters in 1970, making these neighborhoods some of the most racially diverse in metropolitan Baltimore. In 1990 and 2000, the percentage of African-American residents increased in these neighborhoods relative to the white population. These neighborhoods also had a higher percentage of nonfamily households (53%). Aside from one area near Annapolis, the census tracts associated with this cluster were all located within Baltimore City, with the majority clustered around Interstate 83 in the central part of the city, including the neighborhoods included Bolton Hill, Charles Village, Downtown, Mount Vernon, and Waverly.

1980: The cluster analysis for 1980 produced six clusters. The key characteristics for the 1980 residential typologies are displayed in Table 3. Figure 7 displays the neighborhood typology of metropolitan Baltimore for 1980. Cluster One in 1980 I define as the "newer, upper middle-class family neighborhoods." This cluster was similar to the newer middle-class family neighborhood identified in 1970. Its distinguishing characteristics were based on race, income, occupation, and the housing stock.

Table 3

1980, Six-Cluster Solution

	Cluster 1	***Cluster 2***	***Cluster 3***	***Cluster 4***	***Cluster 5***	***Cluster 6***
POPULATION CHARACTERISTICS						
Percentage of population non-Hispanic White, 1980	90.13%	5.51%	73.08%	73.75%	90.51%	85.98%
Percentage of population non-Hispanic Black, 1980	7.79%	93.77%	20.81%	24.14%	8.10%	12.91%
Percentage of population Hispanic, 1980	1.08%	0.84%	5.54%	0.98%	0.86%	0.69%
Percentage of population under 18, 1980	29.97%	32.18%	25.38%	20.99%	29.11%	22.61%
Percentage of population over 65, 1980	7.29%	9.13%	2.13%	12.70%	8.63%	13.57%
Percentage of population foreign born, 1980	4.53%	1.20%	6.16%	4.80%	2.63%	4.12%
Percentage of family households, married couple with own children under 18 years old, 1980	41.50%	16.17%	64.02%	17.29%	34.58%	26.98%
Percentage of family households, married couple without children, 1980	32.91%	18.73%	17.50%	23.54%	30.07%	36.73%
Percentage of family households, female-headed household with own children under 18 years old, 1980	4.34%	22.44%	5.61%	7.31%	6.60%	4.58%
Percentage of family households, female-headed household without children, 1980	2.86%	12.15%	1.39%	4.29%	4.72%	5.63%
Percentage of nonfamily households, 1980	16.34%	25.29%	10.39%	44.93%	20.98%	23.42%
EDUCATION ***Percentage of persons 25+ years old who have:***						
Less than a high school diploma, 1980	15.92%	58.71%	12.63%	30.46%	44.45%	37.95%
Completed high school but no college, 1980	27.91%	25.36%	38.36%	31.19%	34.56%	35.52%
Completed some college but no degree, 1980	18.62%	9.68%	24.86%	16.06%	10.78%	12.86%
Bachelor's or graduate/professional degree, 1980	37.56%	6.24%	24.15%	22.29%	10.21%	13.67%
EMPLOYMENT ***Percentage of persons 16+ years old who are in the civilian labor force and employed as:***						
Professional and technical occupations, 1980	27.14%	10.62%	21.84%	22.22%	12.64%	15.39%
Executives, managers, and administrators (excl. farms), 1980	18.65%	5.05%	8.73%	12.31%	8.77%	10.70%
Sales workers, 1980	12.12%	4.68%	9.12%	10.12%	8.48%	9.97%
Administrative support and clerical workers, 1980	17.14%	18.99%	22.90%	21.01%	18.69%	23.17%
Precision production, craft, and repair workers, 1980	8.23%	7.85%	3.70%	9.30%	16.19%	12.82%

Table 3 continued.

Operators, assemblers, transportation, and material moving workers, 1980	4.42%	16.32%	7.62%	8.61%	15.36%	11.39%
Nonfarm laborers, 1980	2.43%	8.63%	6.21%	3.63%	5.75%	4.42%
Service workers, 1980	8.67%	27.20%	19.54%	12.26%	12.67%	11.70%
Unemployed, 1980	3.62%	15.35%	11.03%	5.59%	6.18%	5.30%
INCOME & POVERTY						
Average income per family ($), 1980	$36,736	$14,771	$17,985	$23,008	$22,754	$25,212
Average income per household ($), 1980	$34,034	$14,030	$17,229	$18,972	$20,887	$22,733
Percentage of total persons below the poverty level in the last year (1979)	3.43%	32.65%	11.36%	12.33%	9.80%	5.38%
HOUSING						
Percentage of renter-occupied housing units, 1980	19.15%	56.32%	88.70%	64.39%	64.39%	24.85%
Percentage of vacant housing units, 1980	4.19%	9.31%	4.60%	5.67%	5.01%	1.90%
Percentage of housing built before 1939 (over 41 years old)	12.32%	53.89%	11.86%	21.18%	31.60%	21.25%
Percentage of housing built between 1940 and 1949 (31-40 years old)	4.77%	21.54%	21.94%	7.74%	9.30%	21.95%
Percentage of housing built between 1950 and 1959 (21-30 years old)	13.47%	12.60%	33.30%	12.84%	14.69%	36.03%
Percentage of housing built between 1960 and 1969 (11-20 years old)	27.33%	6.49%	24.90%	27.96%	17.54%	15.58%
Percentage of housing built between 1970 and 1979 (0-10 years old)	42.10%	5.49%	7.84%	30.27%	26.86%	5.19%
Percentage of homes with 0-1 bedrooms, 1980	7.07%	17.96%	13.44%	35.84%	10.97%	12.32%
Percentage of homes with 2-3 bedrooms, 1980	58.43%	66.98%	73.61%	56.82%	76.12%	77.31%
Percentage of homes with 4-5 bedrooms, 1980	34.50%	15.06%	12.79%	7.33%	12.90%	10.37%
Average home value ($), 1980	$81,947	$17,963	$13,576	$43,489	$40,443	$43,981

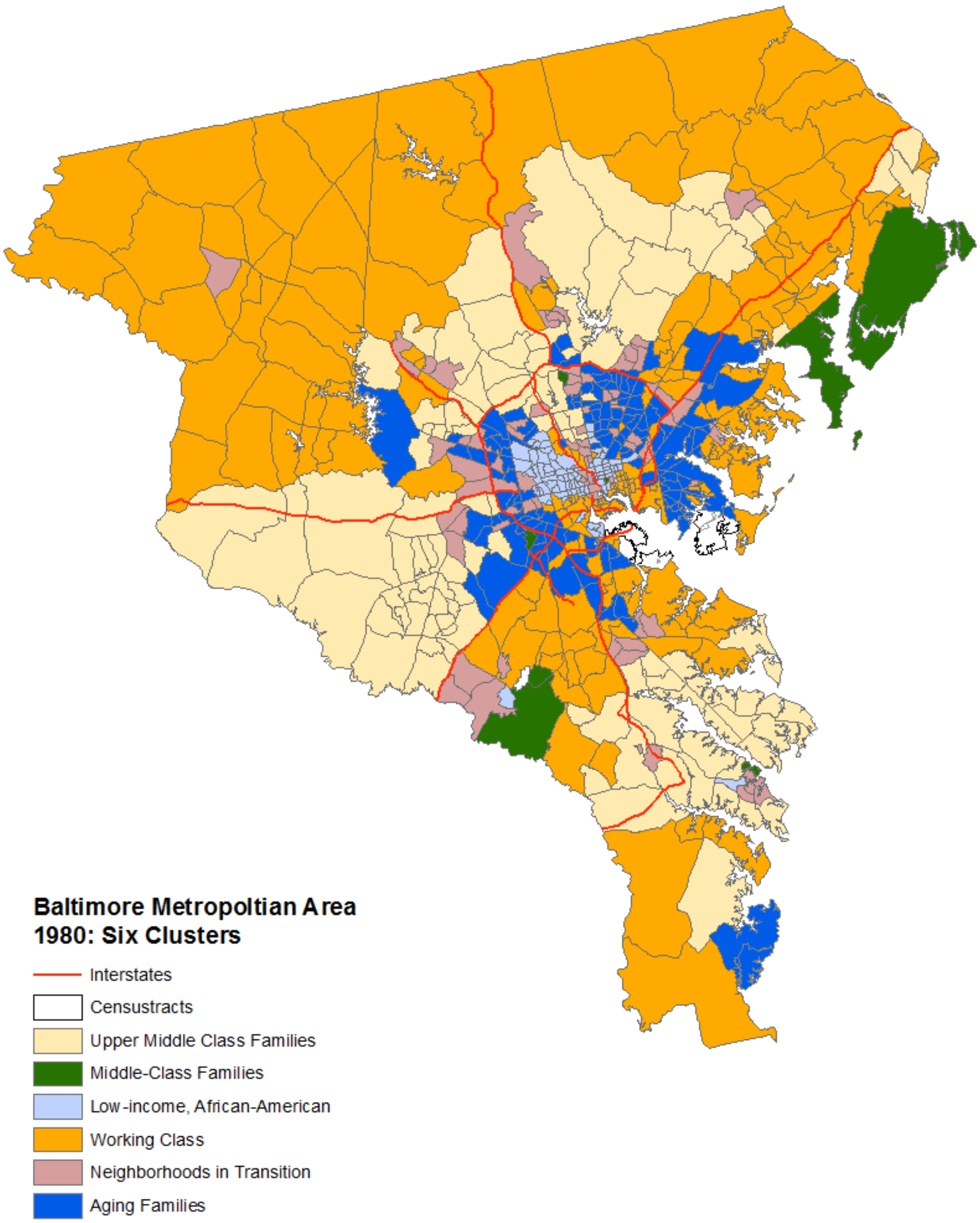

Figure 8. 1980 cluster map. This maps shows the distribution of the residential clusters identified in the six-cluster solution for the year 1980.

Just over 90% of residents within these neighborhoods were white. Families with children under 18 years old made up 33% of the total households. Residents within this cluster primarily worked in professional, white-collar jobs, such as professional and technical occupations, executive, managerial, or administration occupations; 17% of occupied workers were employed in administrative or clerical occupations. It should also be noted that over half of the residents in this area had some college education, including a bachelor's degree or higher. This cluster had the highest household and family incomes out of all six neighborhood clusters. The houses within these neighborhoods were valued well about the metropolitan average and were typically large, four to five bedroom homes built between 1960 and 1980. The majority neighborhoods in this cluster were in Baltimore County, Howard County, and Anne Arundel County.

Cluster Two in 1980 identifies the "low-income and African-American neighborhoods." Similar to the same cluster in 1970, this cluster was characterized by a higher percentage of African-Americans and female-headed households. 33% of the residents within these neighborhoods were under the poverty line**.** Residents of this cluster primarily worked in service occupations; almost 18% worked in administrative or clerical occupations; and another 16% worked as operators, assemblers, transportation, and material movers. In addition, 15% of the residents in this cluster were unemployed. The census tracts associated with this cluster were located within Baltimore City, specifically east and west Baltimore. A census tract in western Annapolis and one in a small section of the Ft. Meade area were also associated with the low-income and African-American neighborhoods.

Neighborhoods part of Cluster Three, “middle-class families with children,” are characterized by a very ethnically and racially diverse population working in professional and technical occupations, in administrative and clerical occupations, or as service workers. A high percentage of residents in these areas were married couples with children and who rented their homes. This cluster was also spatially located near military facilities such as the Ft. Meade area, Aberdeen Proving Ground, and north of Annapolis. These facilities were large employers in the area, and may have attracted particular kinds of residents.

Cluster Four is defined as “neighborhoods in transition.” In this cluster, 73% of the residents were white, 24% were African-American, and almost 13% were foreign-born, making this one of the most racially and ethnically diverse clusters of neighborhoods in 1980. Almost half of the households were nonfamily households, and over 12% of the population were over 65. These clusters were spread around the metropolitan area, with the majority close enough to the beltway to be considered inner suburbs.

Other neighborhoods classified within this typology were located near Annapolis and Glen Burnie in Anne Arundel County, Westminster in Carroll County, Ellicott City in Howard County, and three main areas of Baltimore County. These included Cockeysville, Towson, and Perry Hall; Randallstown and Woodlawn; and the Golden Ring.

Cluster Five is characterized as "working-class neighborhoods." These neighborhoods had the highest percentage of residents working in blue-collar professions, including precision production craft and repair occupations, as operators, assemblers, transportation, and material moving occupations, as in administrative and clerical positions. Over 90% of residents in these neighborhoods were white, and the majority in married family households. These neighborhoods had many newer homes, built within the last 0-10 years, but the majority were rental properties, which means that there were low levels of home ownership in these areas. A large portion of Carroll and Harford counties contained these blue-collar neighborhoods. Other census tracts identified as part of this cluster were in the exurban areas of Baltimore County, Ann Arundel County, including Davidsonville, Pasadena, and Severn.

The last cluster identified in 1980 was associated with a higher percentage of retired residents but also a high percentage of family households with families; thus, I have defined this cluster as "aging with families." Homes in these areas tended to be older, built before 1939 and 1959, although there were some newer homes present in these neighborhoods as well. 85% of the residents within these neighborhoods were white and just over four percent were foreign born. These neighborhood clusters were located within and just outside of the inner-ring suburbs and include places like Brooklyn Park, Catonsville, Eldersburg, Lochearn, and White Marsh.

1990: The cluster analysis for 1990 yielded a five-cluster solution. The key characteristics for the 1990 residential typologies are displayed on Table 4.

Table 4
1990, Five-Cluster Solution

	Cluster 1	***Cluster 2***	***Cluster 3***	***Cluster 4***	***Cluster 5***
POPULATION CHARACTERISTICS					
Percentage of population non-Hispanic White, 1990	90.37%	9.49%	65.50%	77.47%	89.79%
Percentage of population non-Hispanic Black, 1990	7.94%	89.63%	31.31%	17.43%	7.34%
Percentage of population Asian, 1990	1.09%	0.44%	2.51%	3.92%	2.53%
Percentage of population Hispanic, 1990	1.03%	0.57%	1.29%	2.60%	1.06%
Percentage of population under 18, 1990	23.48%	28.31%	16.81%	26.57%	24.05%
Percentage of population over 65, 1990	12.76%	10.75%	18.40%	5.13%	11.91%
Percentage of population foreign born, 1990	2.66%	1.75%	6.58%	5.92%	4.75%
Percentage of family households, married couple with own children under 18 years old, 1990	25.99%	12.23%	10.73%	32.17%	31.89%
Percentage of family households, married couple without children, 1990	33.14%	19.55%	19.64%	25.06%	37.94%
Percentage of family households, female-headed household with own children under 18 years old, 1990	5.42%	19.56%	6.63%	7.15%	2.86%
Percentage of family households, female-headed household without children, 1990	5.96%	15.68%	5.83%	4.45%	4.19%
Percentage of nonfamily households, 1990	26.05%	27.36%	54.24%	27.89%	21.00%
EDUCATION ***Percentage of persons 25+ years old who have:***					
Less than a high school diploma, 1990	29.03%	42.06%	26.09%	12.72%	10.91%
Completed high school but no college, 1990	34.30%	29.05%	23.41%	24.31%	20.93%
Completed some college but no degree, 1990	17.70%	15.16%	16.15%	22.64%	19.23%
Bachelor's or graduate/professional degree, 1990	14.23%	10.15%	30.01%	33.58%	43.00%
EMPLOYMENT ***Percentage of persons 16+ years old who are in the civilian labor force and employed as:***					
Professional and technical occupations, 1990	15.50%	13.85%	25.70%	24.88%	28.71%
Executives, managers, and administrators (excl. farms), 1990	12.61%	7.83%	15.75%	17.99%	21.55%
Sales workers, 1990	10.98%	7.54%	11.96%	12.36%	14.47%
Administrative support and clerical workers, 1990	19.16%	20.84%	17.25%	16.99%	14.18%
Precision production, craft, and repair workers, 1990	14.88%	8.03%	7.07%	8.50%	7.00%
Operators, assemblers, transportation, and material moving workers, 1990	10.17%	12.79%	6.21%	5.81%	3.51%
Nonfarm laborers, 1990	3.91%	5.31%	2.68%	2.36%	1.48%
Service workers, 1990	11.58%	23.09%	12.75%	10.46%	7.97%
Unemployed, 1990	3.98%	12.09%	5.26%	3.12%	2.37%

Table 4 continued.

INCOME & POVERTY					
Average income per family ($), 1990	$44,502	$30,796	$44,155	$49,578	$79,587
Average income per household ($), 1990	$40,355	$28,693	$34,803	$46,178	$72,238
Percentage of total persons below the poverty level in the last year (1989)	6.51%	25.78%	17.05%	5.18%	3.11%
HOUSING					
Percentage of renter-occupied housing units, 1990	25.95%	49.07%	61.20%	39.30%	16.19%
Percentage of vacant housing units, 1990	4.75%	8.87%	10.30%	5.98%	4.10%
Percentage of housing built before 1939 (over 61 years old)	20.44%	33.95%	28.17%	5.35%	10.65%
Percentage of housing built between 1940 and 1949 (51-60 years old)	13.15%	22.72%	8.63%	3.54%	5.32%
Percentage of housing built between 1950 and 1959 (41- 50 years old)	21.26%	19.67%	12.15%	8.89%	14.19%
Percentage of housing built between 1960 and1969 (31-40 years old)	15.79%	9.66%	18.18%	11.09%	20.64%
Percentage of housing built between 1970 and1979 (21-30 years old)	15.33%	7.71%	21.00%	30.87%	22.54%
Percentage of housing built between 1980 and 1989 (11-20 years old)	14.03%	6.29%	11.88%	40.26%	26.65%
Percentage of homes with 0-1 bedrooms, 1990	9.14%	15.25%	37.45%	10.82%	5.28%
Percentage of homes with 2-3 bedrooms, 1990	75.57%	71.36%	53.57%	72.33%	55.54%
Percentage of homes with 4-5 bedrooms, 1990	15.29%	13.39%	8.98%	16.84%	39.18%
Average home value ($), 1990	$87,192	$44,251	$79,184	$106,114	$174,302

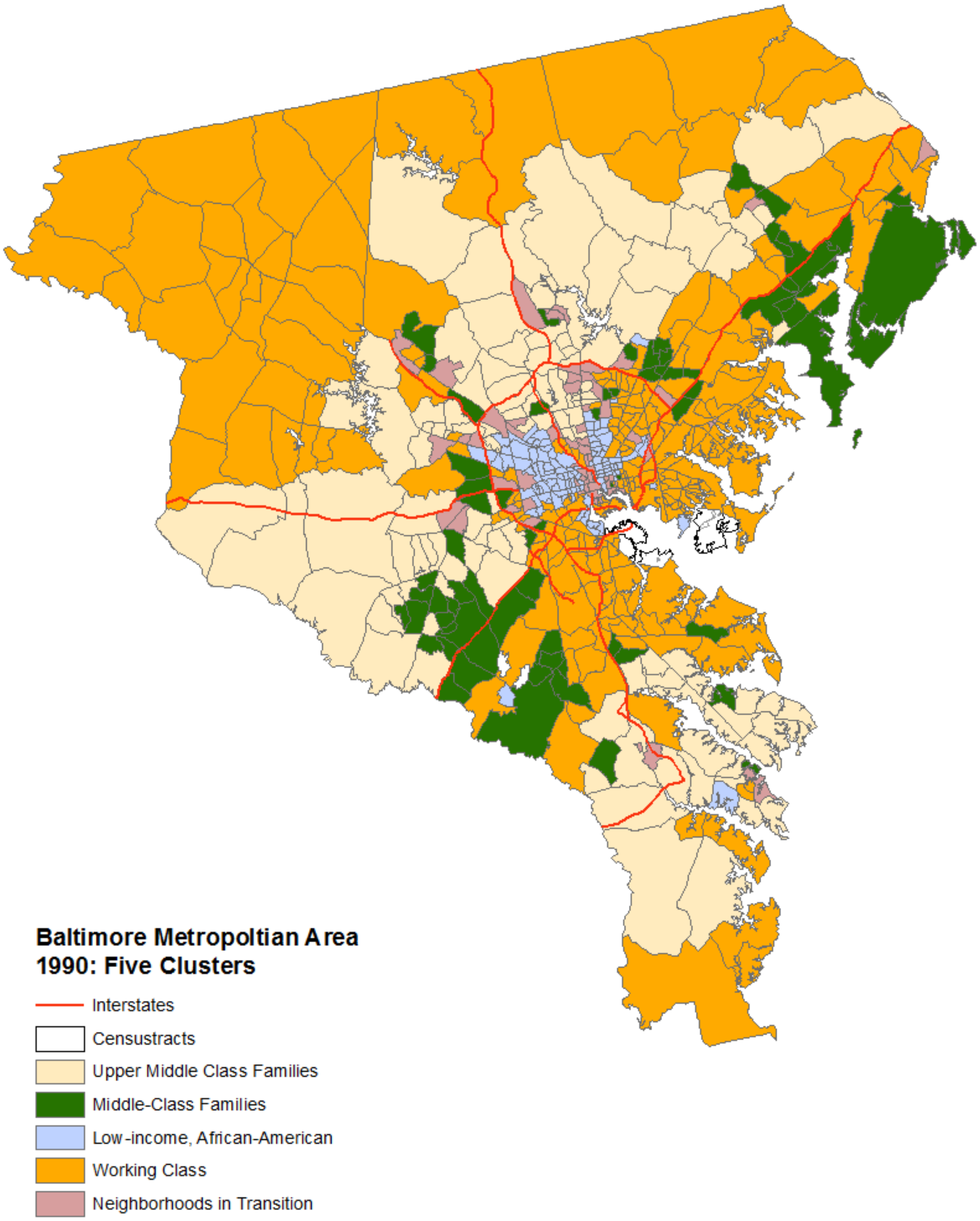

Figure 9. 1990 cluster map. This maps shows the distribution of the residential clusters identified in the five-cluster solution for the year 1990.

Figure 8 displays the neighborhood typology of metropolitan Baltimore for 1990. The cluster centers for Cluster One showed that none of the components were significantly represented. However, this cluster did have high negative loadings for low-income, African-Americans and the foreign-born professional class. This indicates that neither of these two components was well represented in Cluster One.

I have designated Cluster One as the "working-class neighborhoods." A review of the means of the socioeconomic variables showed that the majority of residents within this cluster were white, and over 33% were married households with children. Most residents in this cluster had completed high school and just over 14% had a bachelor's degree or higher. I defined this cluster as working-class neighborhoods because the majority of residents worked in blue-collar occupations, including precision production craft and repair occupations, operations, assembly, transportation, material moving, and pink-collar occupations such as administration or clerical work. The neighborhoods associated with this cluster were located in northern Carroll County in areas such as Taneytown, Union Bridge and Westminster. This cluster was also located in northern Baltimore and Harford counties. Harford County had a large proportion of neighborhoods identified as blue-collar. These neighborhoods included areas south of Baltimore City, and in Anne Arundel County, Glen Burnie, Lansdowne, Lake Shore, and Severn.

Cluster Two is identified as the "low-income and African-American neighborhoods." This cluster once again had the highest percentage of African-Americans living within it, almost 90%. It also had a higher percentage of female-headed households and households with children under 18. Residents of these neighborhoods typically lacked a high school diploma and were employed in service occupations or unemployed. This cluster was located primarily within the eastern and western neighborhoods of Baltimore City. There appears to have been some expansion of these neighborhoods to the northwest into the Woodlawn and Windsor Mill areas from 1970 to 1980. Smaller census tracts also belonged to this cluster in Carney, a small section of Ft. Meade, and just south of Annapolis.

I define Cluster Three as “neighborhoods in transition.” The distinguishing characteristics of this cluster were related to the age of residents, family status, and housing tenure. Within these neighborhoods, 66% of the population were white, and 31% were African-American, making this the most racially diverse neighborhood cluster in 1990. There were more residents over 65 within this cluster than any of the four other neighborhood clusters. Over half of the homes in these neighborhoods were rental properties with zero to one bedrooms. Cluster Three was located in parts of Annapolis, Bel Air, Carney, a small section of Catonsville, Cockeysville, Havre de Grace, a section of Randallstown, Rossville, and neighborhoods in central Baltimore City. The neighborhoods in Baltimore City included Charles Village, Downtown, Mt. Vernon, and Roland Park.

Cluster Four is defined as “middle-class married with children.” This cluster was located in some of the same areas as Cluster Three in 1980—locations that contain military facilities. These neighborhoods were racially and ethnically diverse and had a high percentage of married couples with children under 18. Residents in this cluster typically had some college education or a bachelor’s degree or beyond. They worked in many different occupations; the highest percentages worked in professional and technical occupations, as executives, managers and administrators, or in administrative and clerical support positions. As noted earlier, this cluster tended to be spatially located in the same areas as military facilities, and in 2009, this cluster expanded to the census tracts surrounding the military facilities and into other sections of metropolitan Baltimore. These areas included sections of Bel Air North and Carney, Crofton, Edgewood, Laurel, Millford Mill, and Severna Park.

I define Cluster Five as “newer, upper-middle-class neighborhoods.” Similar in its characteristics to 2008, this cluster was characterized by a high percentage of white residents, married couples both with and without children, high household and family incomes, and larger, newer homes with a high average home value. Residents in this cluster tended to be well-educated and had a college degree or higher. They also worked in professional, white-collar positions. Most of the neighborhoods in Howard County were classified as newer, upper-middle-class neighborhoods, as were large sections of Baltimore and Ann Arundel counties. In Ann Arundel County, this cluster was located primarily by the western metropolitan border and the Chesapeake Bay waterfront.

2000: The clusters identified from the cluster analysis of the 2000 data were very similar to those identified in 1990. The cluster analysis for 2000 yielded a five-cluster solution. The key characteristics for the 2000 residential typologies are displayed in Table 5.

Table 5
2000, Five-Cluster Solution

	Cluster 1	***Cluster 2***	***Cluster 3***	***Cluster 4***	***Cluster 5***
POPULATION CHARACTERISTICS					
Percentage of population non-Hispanic White, 2000	81.23%	17.23%	53.75%	72.01%	87.54%
Percentage of population non-Hispanic Black, 2000	16.21%	80.83%	40.35%	20.39%	8.22%
Percentage of population Asian, 2000	1.70%	0.98%	4.76%	5.74%	3.67%
Percentage of population Hispanic, 2000	1.49%	1.29%	2.48%	3.75%	1.43%
Percentage of population under 18, 2000	24.85%	28.48%	19.78%	27.88%	25.45%
Percentage of population over 65, 2000	13.65%	12.80%	14.45%	6.23%	12.78%
Percentage of population foreign born, 2000	3.47%	2.67%	9.89%	8.94%	6.49%
Percentage of family households, married couple with own children under 18 years old, 1990	24.36%	8.71%	12.28%	30.91%	30.53%
Percentage of family households, married couple without children, 2000	30.92%	15.83%	17.91%	24.39%	35.91%
Percentage of family households, female-headed household with own children under 18 years old, 2000	6.43%	17.80%	9.20%	7.56%	3.36%
Percentage of family households, female-headed household without children, 2000	5.93%	15.45%	5.45%	4.08%	3.42%
Percentage of nonfamily households, 2000	28.03%	35.87%	51.56%	29.35%	24.26%
EDUCATION ***Percentage of persons 25+ years old who have:***					
Less than a high school diploma, 2000	20.02%	38.73%	17.49%	9.56%	7.11%
Completed high school but no college, 2000	34.09%	31.01%	24.26%	21.06%	16.88%
Completed some college but no degree, 2000	21.17%	16.35%	21.03%	22.66%	17.17%
Bachelor's or graduate/professional degree, 2000	19.03%	10.91%	32.25%	39.92%	53.50%
EMPLOYMENT ***Percentage of persons 16+ years old who are in the civilian labor force and employed as:***					
Professional and technical occupations, 2000	18.84%	16.43%	27.50%	29.14%	33.92%
Executives, managers, and administrators (excl. farms), 2000	12.70%	7.48%	13.24%	18.25%	23.49%
Sales workers, 2000	10.33%	8.71%	10.75%	11.15%	12.57%
Administrative support and clerical workers, 2000	18.47%	18.14%	18.51%	15.38%	11.78%
Precision production, craft, and repair workers, 2000	18.44%	15.40%	9.88%	10.23%	7.16%
Operators, assemblers, transportation, and material moving workers, 2000	4.00%	4.42%	2.78%	2.47%	1.52%
Nonfarm laborers, 2000	2.42%	4.60%	1.67%	1.29%	0.73%
Service workers, 2000	14.36%	24.68%	15.56%	11.96%	8.52%
Unemployed, 2000	3.87%	14.74%	6.04%	3.13%	2.76%

Table 5 continued.

INCOME & POVERTY					
Average income per family ($), 2000	$57,430	$34,555	$46,734	$69,369	$107,577
Average income per household ($), 2000	$63,564	$37,586	$59,081	$74,837	$120,985
Percentage of total persons below the poverty level in the last year (1999)	6.31%	28.41%	14.71%	5.02%	3.34%
HOUSING					
Percentage of renter-occupied housing units, 2000	21.05%	40.75%	58.53%	30.18%	15.11%
Percentage of vacant housing units, 2000	4.86%	18.27%	7.51%	4.26%	3.37%
Percentage of housing built before 1939 (over 61 years old)	12.95%	42.82%	14.02%	4.79%	11.68%
Percentage of housing built between 1940 and 1949 (51-60 years old)	12.54%	20.85%	7.11%	2.64%	4.63%
Percentage of housing built between 1950 and 1959 (41- 50 years old)	22.23%	15.75%	12.84%	6.35%	10.98%
Percentage of housing built between 1960 and 1969 (31-40 years old)	14.49%	8.52%	20.44%	8.12%	14.82%
Percentage of housing built between 1970 and 1979 (21-30 years old)	13.66%	5.76%	23.35%	18.17%	18.63%
Percentage of housing built between 1980 and 1989 (11-20 years old)	11.98%	3.67%	13.75%	26.05%	20.24%
Percentage of housing built between 1990 and 1999 (0-10 years old)	12.15%	2.62%	8.49%	33.89%	19.03%
Percentage of homes with 0-1 bedrooms, 2000	8.18%	16.88%	35.12%	9.94%	6.46%
Percentage of homes with 2-3 bedrooms, 2000	71.92%	70.14%	55.77%	66.04%	49.19%
Percentage of homes with 4-5 bedrooms, 2000	19.90%	12.99%	9.10%	24.02%	44.35%
Average home value ($), 2000	$120,119	$52,626	$100,401	$142,270	$245,434

Figure 9 displays the neighborhood typology of metropolitan Baltimore for 1990. The first cluster I identified in 2000 was the “working-class neighborhoods.” These neighborhoods were similar to working-class neighborhoods in 1980 and 2000 with two exceptions. In the year 2000, the number of residents employed as operators, assemblers, and material movers decreased, while the number of residents employed in service occupation increased. A high number of residents were still employed in precision production, craft, and repair occupations, and in administrative and clerical roles. The location of the neighborhoods associated with this cluster was similar to the year 1990. This included northern Carroll County in areas such as Taneytown,

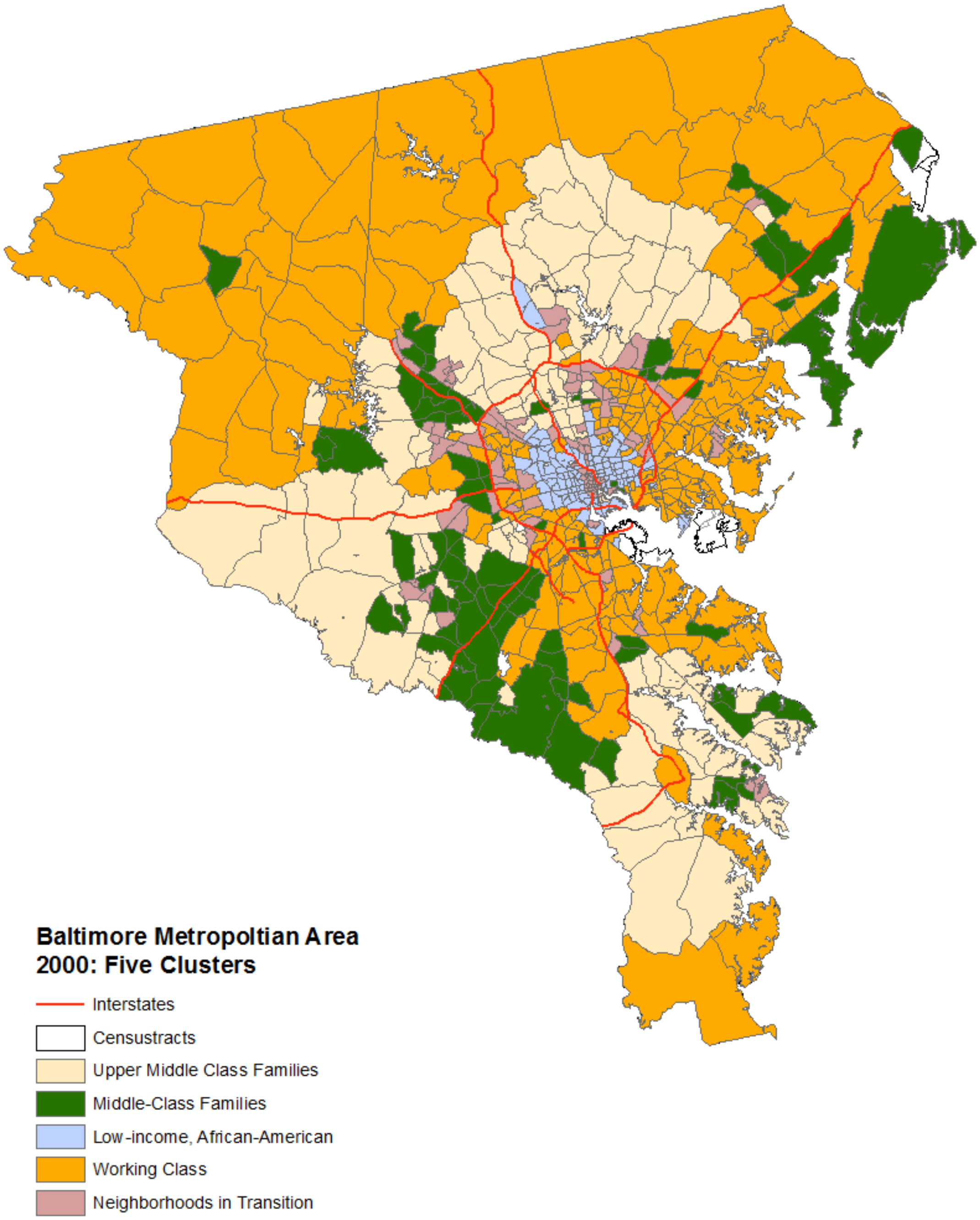

Figure 10. 2000 cluster map. This maps shows the distribution of the residential clusters identified in the five-cluster solution for the year 2000.

Union Bridge and Westminster; in northern Baltimore and Harford counties; and south of Baltimore City in Anne Arundel County, in areas such as Glen Burnie, Lansdowne, Lake Shore, and Severn.

Cluster Two in 2000 comprised the “low-income and African-American neighborhoods.” These neighborhoods shared similar characteristics and spatial locations as the low-income, African-American neighborhoods identified in the previous year. Although much of the population in these neighborhoods were African-American, the percentage of white residents increased to 17% from 9% in the previous census year. Also, rather than expanding, the census tracts associated with this cluster contracted between 1990 and 2000. The only exception was a census tract in Cockeysville that belonged to the aging and integrated neighborhoods in 1990, and in 2000, belonged to the low-income and African-American neighborhood cluster.

Cluster Three identifies the “neighborhoods in transition.” This cluster was characterized by an almost equal number of African-American and white residents, as well as a high number of foreign-born residents. More than 50% of households in this cluster were nonfamily households. Although this cluster had the highest percentage of residents over 65 years of age, just over 14% of residents fell into this age range, whereas almost 20% were under the age of 18.

Residents of these neighborhoods had varied education attainment at the high school level and beyond. They worked in a wide range of occupations, the highest percentages of which were in professional and technical occupations, followed by administrative support and clerical occupations, and service occupations. Most homes were rental properties built in the 1950s and 1960s. This cluster was located mainly in the inner-ring suburbs in areas such as Carney, Catonsville (inside the beltway), Lochearn, Parkville (closest to Baltimore City), Randallstown, Rossville, Milford Mill, and Woodlawn. Small areas of this cluster were also in Annapolis, Dundalk, Ellicott City, Essex, and Ferndale.

Cluster Four is defined as “middle-class married with children.” This cluster was located in similar locations and had the same characteristics as the middle-class married with children cluster in 2009. This cluster had a high number of married couples with children, and the majority of residents had a high school diploma or higher. 70% of the population was white, 20% African-American, and nine percent foreign born. This cluster also had a high number of homes built in the 1980s and 1990s. It was located in and around Aberdeen Proving Ground, Edgewood, Eldersburg, Ft. Meade, Jessup, North Laurel, Owings Mills, Savage, and Westminster, some areas of which were formally part of the military cluster.

The final cluster, Cluster Five, is identified as “upper-middle-class neighborhoods.” Similar to 1980 and 1990, this cluster was characterized by a high percentage of white residents, married couples both with and without children, high household and family incomes, and larger homes with a high average home value. The residents in these neighborhoods typically held a college degree or higher and worked in professional, white-collar positions. Most of Howard County was comprised of this cluster in 2000. The cluster was also located in parts of Baltimore County, including Lutherville-Timonium, Towson, and Mt. Washington. In Harford County, this cluster was found around the Bel Air area, and in Ann Arundel County, around the Annapolis area, including Crofton and Edgewater. Two important neighborhoods were worth noting: the Federal Hill and Riverside neighborhoods in Baltimore City. In 2000, these neighborhoods joined the upper-middle-class neighborhood type, whereas in 1990, they were classified as blue-collar. This does not mean that middle- and upper-class whites replaced working-class white residents outright, but that the increase in the number of more affluent white residents coming into the neighborhoods changed the averages of key variables like income, education, and occupation.

2.6 Discussion

2.6.1 Continuity and Change in Metropolitan Baltimore

As Wyly (1999) noted, although recent urban studies have highlighted the "dynamic restructuring" of urban areas "with new elements of the landscape taken as reflections of sweeping economic and sociocultural change . . . the persistence of residential segregation and suburban development processes provide reminders of the historical continuity of American urban form" (p. 309). Wyly's (1999) statement echoes what occurred in metropolitan Baltimore between 1970-2000, as it experienced both 'continuity and change'. The PCA and cluster analysis uncovered some patterns within metropolitan Baltimore's landscape that changed over time, while others remained relatively unchanged. This finding is also consistent with those by Hanlon (2009), Hanlon et al. (2006), Mikelbank (2004), Orfield (2002), and Vicino (2008a), in regards to the suburbs becoming more diverse places.

The overall picture of residential change in metropolitan Baltimore shows a few features significant to the question of access to employment, which will be discussed in greater detail in the next chapters. First, the majority of white upper-middle-class neighborhoods remained out in the suburbs, while the majority of low-income African-American communities remained in the inner city and parts of the inner suburbs. Second, there are a higher proportion of diverse and aging family and nonfamily neighborhoods in the inner-ring suburbs as well as census tracts just outside of the inner-ring suburbs. Third, by the year 2000, there is some evidence of gentrification happening just south of the inner harbor in Baltimore City. These last two changes may or may not have any impact on employment access, but it does suggest a separation between different communities in the central city and suburbs. The following paragraphs will discuss three of the clusters uncovered in the analysis in greater detail: low-income, African-American neighborhoods, newer middle-class neighborhoods, and working-class neighborhoods.

2.6.2 Low Income, African-American Neighborhoods

The analysis revealed that the location of the low-income, African-American households cluster generally remained in the same census tracts between 1970 and 2000. The majority of these census tracts were located in Baltimore City's eastern and western neighborhoods throughout the study period (Figure 10).

These neighborhoods consistently had the lowest household and family incomes, the highest rates of poverty, and the lowest home values. They also had the highest percentage of African-Americans living within them. Vacant housing was another defining characteristic of this cluster. The percentage of vacant housing in 1970 represented just six percent of the housing stock—just a bit higher than the percent of vacant housing for the entire metropolitan area. In these clusters, vacant housing grew to nine percent in 1980 and 1990, and by the year 2000, doubled to

18% of the housing stock. This represents an increase of over 21,000 housing units. This increase can possibly be attributed to the decline in total population from these neighborhoods, because the total population in this cluster declined by just over 63,000 people over that period.

Census data provides some detail regarding overall population patterns in Baltimore during this time period. Baltimore City's population steadily decreased between 1970 and 2000. The decennial census data for the year 2000 showed that the rate of population loss between 1990 and 2000 had accelerated to almost double its rate between 1980 and 1990 (Johns Hopkins University, 2001). While some of the change was related to the overall loss of population and households, some stemmed from major, U.S.-wide demographic shifts during this time period, including decreasing household sizes and increasing numbers of single households (Johns Hopkins University, 2001). In 1990, for example, over half (55%) of the households in the Baltimore region were only made up of one or two people. The percentage was higher for Baltimore City and Baltimore County (58%). By the year 2000, the rates were 63% and 61% for Baltimore City and county respectively. This data is for all households in the United States not broken down by ethnic or racial group.

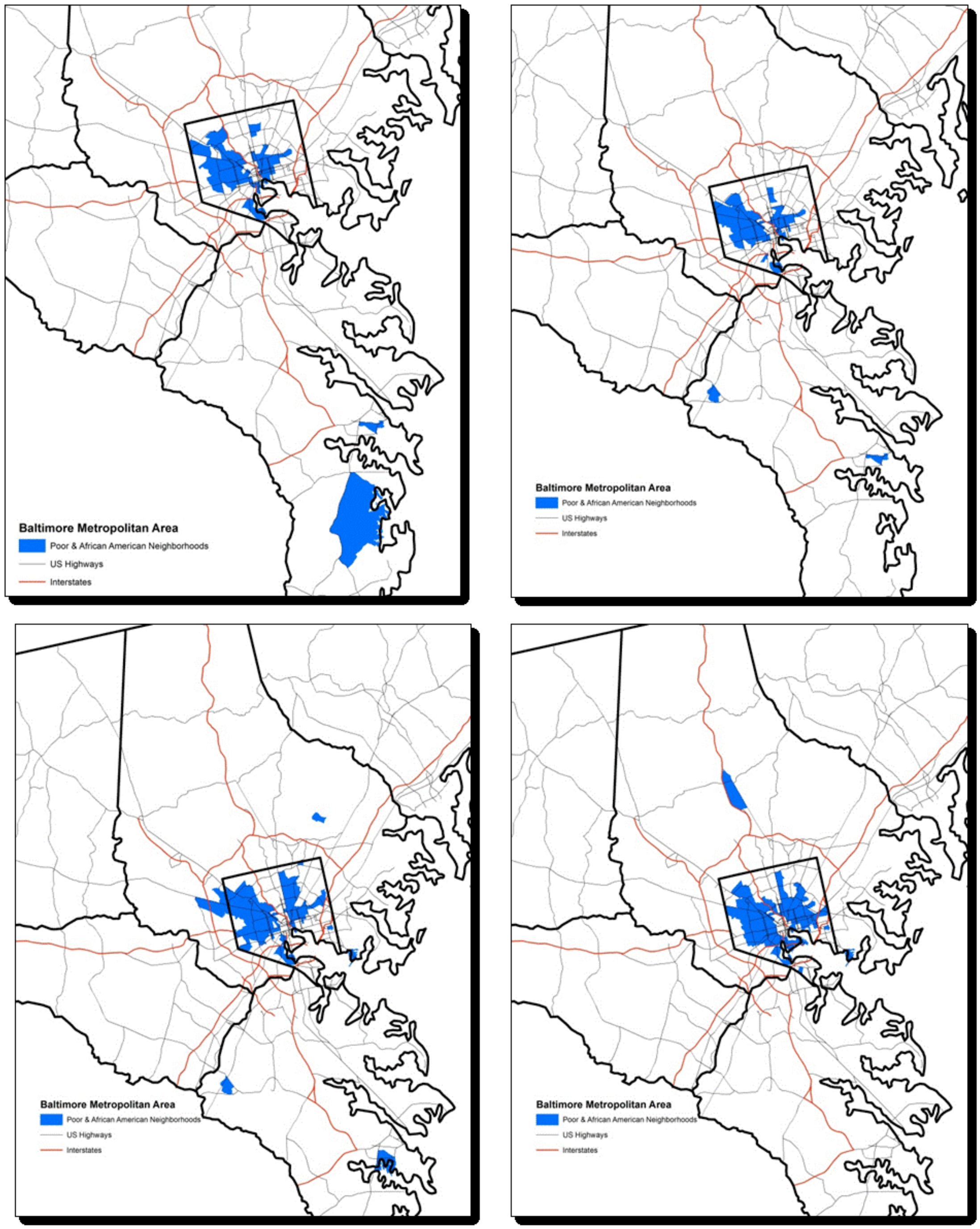

Figure 11. Low Income, African-American Cluster 1970-2000. These maps highlight the spatial locations of the Low Income, African-American Cluster across the study years, 1970 to 2000.

Within the low-income, African-American clusters, total population decreased by 61,000 residents. Residents who identified as non-Hispanic black decreased by close to 85,000. Between 1970 and 2000, the number of residents identifying as non-Hispanic white increased by a little over 18,000 people. There are some limitations to this analysis, particularly in that the census tracts making up each cluster change every decade. For example, the increase in white residents in 2000 may in part be due to the inclusion of a census tract in the Lutherville/Timonium area, north of the city. Another limitation of the data is that it is not possible to track where residents moved to or from before residing within the census tracts included in this cluster.

Other characteristics of the neighborhoods in this cluster—poverty, low-income households, and low housing values—suggest that a persistence of economic disadvantage and poverty is linked to these neighborhoods. They also suggest that discrimination remains prevalent in urban housing markets and/or that the housing discrimination practices of the past, such as block busting and redlining, have continued during this post WWII period. After rapid disinvestment hollowed out these neighborhoods, little capital has been reinvested into these areas.

Both the legal and extra-legal means by which racial segregation has been maintained is well documented. The racial and class divisions along neighborhood lines in the Baltimore region have been maintained through a combination of banking, real estate, and government policies. One of the earliest segregation ordinances passed by the city of Baltimore City occurred in 1910. This ordinance excluded black residents from moving into neighborhoods in which more than half the residents were white and white residents from moving into neighborhoods in which more than half the residents were of color (Power, 1983). Although the law was nullified by a Supreme Court decision on *Buchanan v Warley* in 1917, which provided an avenue to end residential segregations laws (Power, 1983), the practice of excluding certain groups of people from neighborhoods continued through up until the 1970s (Kast, 2012). The residential segregation laws created a hardship for black residents, which Power (1983) aptly points out, "the effects of which are apparent even today" (p. 306).

These ordinances limited an already limited housing supply for a growing population of black residents of the city, in effect both increasing prices and lowering the quality of housing (Power, 1983). Few opportunities existed for black residents to secure new housing, even if they had the capital. Finding housing outside of the city met with its own challenges, including hostile reception from white neighbors (Power 1983).

When black residents were free to move into white residential neighborhoods after the residential segregation laws were repealed, they faced new means of opposition, as slum clearance, containment through restrictive covenants, intimidation, and discouraging the sale or rental of housing to blacks "replace[ed] de jure segregation with de facto segregation" (Power, 1983, p. 315). Redlining was a practice instrumental in segregation, preventing people from obtaining home loans in certain parts of the city that were deemed unstable to areas of risky investment. The government prepared real estate maps that outlined which neighborhoods were places of good real estate risk or bad real estate risk. Neighborhoods ranked as good real estate were typically areas with white, non-Jewish homeowners. The government went as far as to require that these neighborhoods have restrictive covenants barring African-Americans and Jews. This practice set up two very separate markets for real estate: one market for credit worthy, usually white residents and another more speculative market operated by blockbusters, and in later years by subprime market lenders (Power, 1983; Pietila, 2010). Redlining also made it difficult for residents to secure loans for home improvements in those neighborhoods defined as a bad real estate risk. This lead to declining property values that perpetuated the decline of neighborhoods and increased the likelihood that residents would abandon their property.

By as early as the 1930s, many white residents of Baltimore moved to newly annexed areas of the city surrounding the central, older part of Baltimore, and thus the African-American population of the older part of the city increased while the white population decreased (Power, 1983). These containment practices reduced the overall housing availability for African-Americans, a problem that encouraged the practice of blockbusting (Power, 1983). Real estate agents could sell homes to African-American residents at a premium, and they could sell at even higher prices if they capitalized on white homeowners' fears that their neighborhood's racial make-up was changing. Agents bought entire blocks at low prices from white homeowners and sold them at a premium to African-Americans. Although the era of redlining and blockbusting in Baltimore officially came to an end prior to 1970, the resulting patterns of neighborhood segregation have clearly remained to this day (Kast, 2012), as it has been difficult to draw capital into areas hollowed-out by disinvestment and abandonment.

White flight has been a prominent theme in Baltimore's history. Today, however, the flight ensuing now is not white flight, but African-American flight. This movement has been captured to some extent in the current analysis. The "Liberty Road Corridor" (Levine, 2000, p. 141), including Lochearn, Woodmoor, Milford Mill, and Randallstown, saw a large increase in middle-class African-American households between 1970 and 2000. For example, the percentage of African-Americans living in "neighborhoods in transition"—included in some of the aforementioned areas—increased from 1970 to 2000. This suburbanization of middle-class African-Americans left a large concentration of low-income African-American households in the city, in neighborhoods such as Sandtown-Winchester, Upton and Greenmount West (Levine, 2000). This poses an interesting question about what the socio-economic composition of some of Baltimore City's neighborhoods will look like in 10-20 years.

2.6.3 Newer, Middle-class Neighborhoods

Neighborhoods within the newer, middle-class cluster were characterized by high percentages of white residents and families with children under 18. Residents in these neighborhoods were college-educated, with bachelor degrees or higher and typically worked in professional, white-collar careers. The houses in these neighborhoods were characterized by newer and larger four to five bedroom homes. The value of the housing stock was also higher relative to houses in other clusters. Figure 11 shows that the neighborhoods defined by this cluster remained relatively consistent in their location over time. One of the biggest changes occurred between 1970 and 1980.

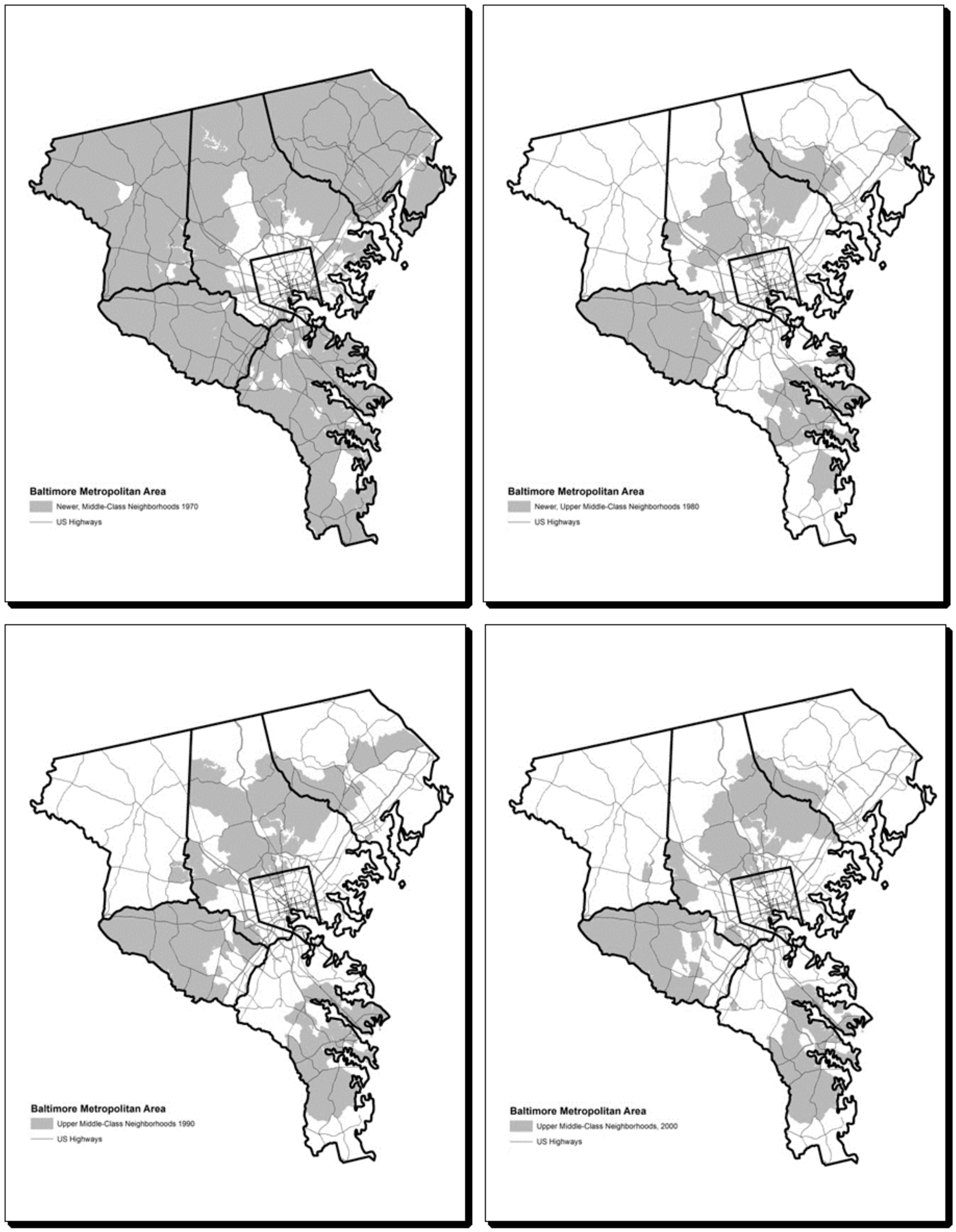

Figure 12. Newer, middle-class cluster, 1970-2000. These maps highlight the spatial distribution of the newer, middle-class clusters across the study years. This includes the newer, middle-class cluster (1970), new, upper middle class cluster (1980), and the upper middle class clusters (1990 and 2000).

In 1970, the newer, middle-class cluster was the largest cluster in each of the counties surrounding Baltimore City. However, by 1980, far fewer census tracts held this classification. One reason for the predominance of this cluster in 1970 could be the large number of homes built in the suburbs in the 1960s and 1970s. Another possibility is that there was much less racial and ethnic integration in the suburbs in 1970 as compared to 1980-2000. Baltimore County's exclusive zoning practices and development control activities, such as restricting low income housing, reinforced discriminatory practices and prevented many African-Americans from moving into the county in the 1970s (Pietila, 2010). Although today, many African-Americans of different economic classes live within the counties in metropolitan Baltimore, the PCA and cluster analysis revealed that many neighborhoods within the counties are still occupied by a majority of white residents.

From 1980 to 2000, the spatial location of the newer, middle-class cluster in the metropolitan area became more consistent, covering large portions of Howard County, north and east in Baltimore County, western Harford County, and southern Anne Arundel County. The population of Howard County grew from approximately 118,500 to almost 250,000 people during this time, and the populations of Anne Arundel and Harford counties also grew by just over 100,000 people in this 20-year span. The changing demographics may reflect changes in total population numbers, as the clusters may have appeared to be more varied because fewer people lived within those areas, and less varied as the population increased.

Between 1980 and 2000, some of the neighborhoods along Liberty Road, North Laurel, and Columbia transitioned to blue-collar neighborhoods, middle-class married with children neighborhoods, and aging, integrated neighborhoods. Some of this transition may be due to the aging of the housing stock, particularly those neighborhoods that transitioned from newer, middle-class neighborhoods to middle-class, married families with children neighborhoods. The aging of the population and the increase in African-American, Asian, and foreign-born populations into the suburbs during this time also explains some of this change.

Carroll, Harford, and Howard counties growth rates exceeded statewide averages between 1970 and 2000. In terms of domestic migration, out-migration from Baltimore City "fueled growth in Baltimore County and, to a lesser extent, Anne Arundel and Howard counties" (Baltimore Metropolitan Council, n.d., p. 2). Movement out of Baltimore County contributed to much of the growth in Carroll and Harford counties. In general, the population has been moving further and further out from the central core towards the edges of the metropolitan region. Migration from Baltimore, Carroll, and Harford counties has even moved into Pennsylvania. The Baltimore Metropolitan Council (n.d.) attributes this to rising house prices. Some of this movement might also be attributed to vacancy chains, households moving into new housing stock, and households moving out of the metropolitan area.

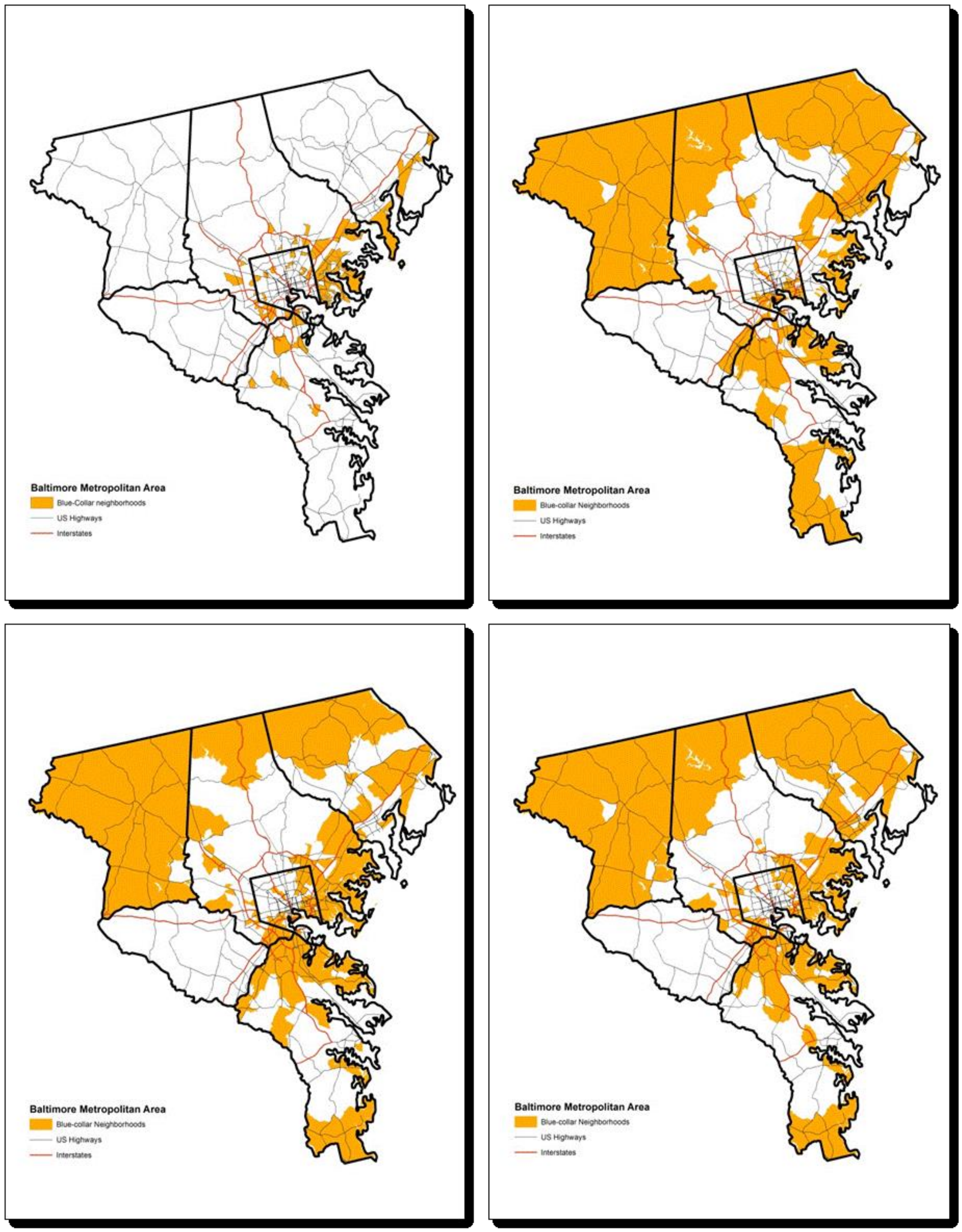

Figure 13. Working-class neighborhoods. These maps show the distribution of the blue-collar, or working-class cluster neighborhoods across the study years, 1970 to 2000.

2.6.4 Working-class Neighborhoods

Working-class neighborhoods were primarily characterized by occupation. Residents living within these neighborhoods worked in manufacturing, administrative, and clerical occupations. The number of census tracts classified as working-class neighborhoods grew between 1970 and 1990. In 1970, there were very few census tracts classified as blue-collar in metropolitan Baltimore (see Figure 14). The majority of these census tracts were located to the south and east of Baltimore, including Aberdeen, Dundalk, Essex, Rosedale, Middle River to the northeast, and Glenburnie and Odenton to the South. It is important to note that these clusters are almost a mirror image of the newer, middle-class clusters.

Between 1980 and 2000, the number of census tracts classified as working-class grew significantly, incorporating much of Carroll County, the northernmost portion of Baltimore and Harford Counties, and the areas just south of Baltimore City and the southern tip of Anne Arundel County. This increase in working-class neighborhoods is particularly interesting because it occurred at a time when manufacturing jobs in the region decreased.

2.6.5 Newer, Middle-class Neighborhoods

Goodman and Taylor (1983) and Taylor and Covington (1988) found that in Baltimore City, the gap between the most and least well-off neighborhoods widened in the 1970s, as measured by increased poverty and unemployment levels. The PCA and cluster analysis revealed that low-income, African-American neighborhoods sat adjacent to, and sometimes surrounded by, professional class neighborhoods. Yet, by 1980, those adjacent and surrounding neighborhoods were more diverse, and included aging family neighborhoods, working-class neighborhoods, and diverse, nonfamily neighborhoods.

This finding is consistent with the findings of other researchers, such as Dreier et al. (2004), who noted that the consequences of rising economic segregation include a reinforced disadvantage between the central city and the suburbs, an increase in the concentration of the poor, as well as increased deterioration of central city and inner-ring suburbs. Despite changes outside of central city neighborhoods, these patterns of economic and racial segregation within the city remained durable and entrenched throughout time.

Taylor and Covington (1988) also found that neighborhoods in Baltimore City were experiencing gentrification in the 1970s, but that this gentrification was different from the popular view of the phenomena. Gentrifying neighborhoods in Baltimore were made not "made over into middle-income, stable areas; rather they evidenced continuing diversity of both housing stock and in-migrants" (p. 560). This trend is more difficult to identify from the PCA and cluster analysis. The only evidence of gentrification of any kind appears in the 2000 map around Federal Hill, near Baltimore City's inner harbor. This is not to say that some form of gentrification was not happening in other areas prior or within the year 2000, but that such gentrification is difficult to identify from this analysis.

The reasons for many of these changes are complex and are likely driven by a combination of many factors. Some of these residential patterns are closely linked to the governmental, banking, and real estate policies of the past; some are closely linked to a long history of racism in Baltimore. Other patterns may be associated with the economic restructuring. Every neighborhood likely has its own story to tell, and these stories will be explored in more detail in Chapter 6.

Differences in opportunity, in housing, education, employment, and other facets of life exist in metropolitan Baltimore. Factors such as race and class have played into those differences, as have the neighborhoods in which people live. The importance of creating these neighborhood typologies is not to create one grand explanation for the residential changes that have occurred within metropolitan Baltimore, but to evaluate the changes that have occurred with respect to spatial distribution of socio-demographic groups. When analyzing changing access to employment from different spaces in the metro region, this analysis provides the details about who lives in the spaces and who is being affected, and how that has changed through time.

This analysis extends analyses by Vicino (2008ab) and Hanlon (2009), it covers the entire metropolitan area and results in the creation of regional neighborhood typologies. It also shows how those neighborhoods changed through time and highlights the idea that neighborhood types can cross spatial ‘boundaries’ such as the city, inner suburbs, or exurbs. The PCA/cluster analysis allows for aggregating a range of variables over a large spatial area and identification of where there ware socio-demographic and economic differences in the households in those spaces. These methods are common to studies of urban growth and aid in understanding how broader economic and political trends impact spatial dimensions of change. For example, employment suburbanization taking place over the course of the study period was related to the continued suburbanization of middle class families with the means to leave the city.

Chapter 3: Sectoral and Spatial Shifts in Employment

3.1 Introduction

In this chapter I present an analysis of the change in the employment levels for workers in every industrial category in the Baltimore metropolitan area between 1970 and 2000, and the impact of those changes on the region's spatial patterns of employment. The analysis begins with a description of industrial employment data from the US Bureau of Economic Analysis (for 1970 to 2000) and Census Transportation Planning Package (for 1990 and 2000) by county, and follows with a closer look at employment at the sub-county level. Along with this data, I present maps that assist in describing the intra-metropolitan, industrial location shifts that occurred between 1990 and 2000. Lastly, I present an analysis of employment centers in region in 1990 and 2000, examining the industrial makeup of these centers to describe their roles in the changing economic activity of the region, and how it affects employment accessibility.

In the United States, the decentralization of people and jobs in aging, industrial, metropolitan areas coincided with the decline of the manufacturing economy (Glaeser & Kahn, 2001; Doussard et al., 2009). These combined factors had a profound impact on communities located near centers of manufacturing employment. An example of this comes from Sparrows Point, an important space in the historical landscape of Baltimore's manufacturing industry. At its height of operation, Bethlehem Steel employed 30,000 workers in Sparrows Point. In addition to steel, the area was home to a cable and telecommunications plant, a Lever Bros.

factory, General Motors, and a shipyard. Deindustrialization in general, and the decline of Bethlehem Steel specifically, significantly affected the working class of Dundalk and Edgemere, two residential neighborhoods situated next to Sparrow's Point.

Because of the sectoral shifts in the labor market away from manufacturing over the 30 years studied, easily accessible employment opportunities for the working class living in these two communities were greatly reduced. Although some manufacturing remained in the area, other opportunities were moved to the suburbs. In Dundalk, the percentage of residents employed in manufacturing industries declined from 48% in 1970 to 16% in 2000 and, in Edgemere they declined from 56% to 20%. To reach more suburban employment opportunities, including manufacturing sector jobs, community residents were forced to incur higher commuting costs; in some cases, potential opportunities were too distant. In other cases, education and skill barriers limited alternative employment opportunities in their home communities.

3.1.1 Overview of the Chapter and Contributions to the literature.

The focus of this chapter is on two variables affecting employment access in the metropolitan Baltimore, (1) the demand for workers in different industrial categories, and (2) the spatial patterning of employment by industry. Both of these variables have the capacity to limit or expand workers' access to employment opportunities. As in the above example, shifts in the labor market away from manufacturing to a more service-based economy may limit the access of workers whose experience, skills and/or training do not allow for employment in higher demand service sectors. Manufacturing workers faced with declining manufacturing positions available in the region have more restricted access to employment opportunities because fewer of those opportunities exist. In addition, the suburbanization of employment suggests that there are more employment opportunities in the suburbs, and fewer in the central city (or in some cases, the inner-ring suburbs). A central city resident may therefore have more restricted access to employment opportunities due to the spatial divide between residence and workplace. This can be exacerbated by reliance on public transit or skills mismatch, in which the skills, education, and/or training of workers in a particular spatial location do not match the those required of the employment opportunities in that same location.

In the next section of this chapter, I discuss the sectoral and spatial shifts within the national labor market that have thus far been documented in academic research. In sections 3.4.1 and 3.4.2, I present data related to a changing labor market from the US Bureau of Economic Analysis and Census Transportation Planning Package and describe the spatial pattern of employment in metropolitan Baltimore from 1970 to 2000. Although the data I describe are not novel, it is necessary to introduce this information in order to outline the labor market changes that took place in the metro area from 1970 to 2000. It is also helpful to display these changes at the TAZ level to better understand the spatial distribution of industrial employment and various sectors may have shifted over time.

In section 3.4.3, I present the results of my employment center analysis. This analysis follows the methods of similar research (See Giluiano, 1991, Gardner and Marlay, 2013, and Knapp & Ding, 2014). Previous research identified over 20 regional activity or employment centers in the Baltimore-Washington and Baltimore metropolitan areas (The Baltimore Metropolitan Council, 2004; Knapp & Ding, 2014. In this study, I use historic data to identify employment centers that existed in 1990 and 2000. This allows for an analysis of changes to the spatial locations and sectoral employment within centers over time. Both a historical analysis and an investigation of change in employment centers in the region are missing from the current literature but are needed to situate current employment trends within a historic context, and to understand how employment has remained the same or changed over time, specifically in regards to where workers are working throughout the region. At the conclusion of this chapter I discuss how this topic can be framed within the spatial justice literature through its connection to the spatial mismatch hypothesis.

3.2 Background

3.2.1 Sectoral Shifts in Employment

In this section I will discuss some of the shifts that have taken place in the labor market since 1970, with regard for the geography of employment, nationally and locally. Since the end of World War II, the number of people employed in the agricultural and goods/manufacturing industrial sectors has notably decreased while the number employed in the services sectors has increased. Though the composition of each of these sectors has not remained static over time, the overall trend of rises and falls in employment has remained consistent over time in these and other major industrial categories.

In his study relating to sectoral change, Urquhart (1984) divided the shift to the services sector into two main time periods: pre- and post-1967. The time period prior to 1967 is characterized by a decline in agricultural employment as people were replaced with machines. After 1967, agricultural employment remained relatively stable, and the continued shift in employment to the services sector is characterized as being due to the relative decline in the goods-producing industries, which Urquhart defined as including mining, construction, and manufacturing. He included all other non-agricultural, forestry, or fishing employment in the services sector.

By using only three industry or sector categories as Urquhart (1984) did, the differences in the employment trends within these categories are over-simplified and left undetermined. Urquhart acknowledged that because of the heterogeneity of each sector, there is a problem in "determining the composition of the major sectors" (16), especially the services sector, which has become more heterogeneous over time due to advances in technology.

Another study, conducted by Noyelle and Stanback (1984), also analyzed economic changes over the same time period, and summarized these changes as including: (1) a period of stabilization followed by a decline in manufacturing employment; (2) a growth of employment in certain service sectors; and (3) a shift in the occupational structure of employment to white collar jobs, thereby increasing the demand for different kinds of labor and different groups of workers with more education or specialized training.

From the late 1960s to the late 1970s, Urquhart (1984) found that retail, food, health, and education services increased dramatically; Noyelle and Stanback (1984) also noted an increase in education and healthcare related services in the 1970s. However, they placed healthcare and education in the category of public sector and non-profit services, which was problematic in that for-profit health care and education were becoming a growing part of the economy. In fact, Urquhart found that private employment in education and health care were growing at a much faster rate than the public employment component of both industries.

Both studies (Noyelle & Stanback, 1984; Urquhart, 1984) found that not all service sector employment rose evenly. In fact, between 1967 and 1979, the US lost 2 million jobs in personal/consumer services; this post-war period decline resulted in consumer services being one of the smallest of six service categories by 1977. There were also smaller employment declines in public utilities, postal employment, and federal public administration (Urquhart, 1984).

Urquhart's (1984) study lacked substantial detail on the rise of the corporate complex during the time period studied, including industries such as banking, advertising, and the FIRE (Finance, Insurance, and Real Estate) industries. This could be in part because the increased employment in these industries was not as significant as healthcare and educational services within the time period of his analysis. The FIRE industries experienced a larger growth in employment after Urquhart completed his analysis during the 1980s, when the economy continued to experience shifts from manufacturing to services.

Despite experiencing two recessions during the 1980s, the US economy continued to add large numbers of jobs in the services sectors. Overall, more than 6% of employment shifted from the goods-producing sector to the services sector during that decade (Plunket, 1990). Non-service sector jobs, such as manufacturing and mining, decreased, while the construction sector added jobs. As was the case in the 1970s, job growth was unequal across the different types of service sector jobs.

Throughout the 1980s, employment in some service sectors—including communications, transportation, and government—declined during recessions and experienced slower growth during times of economic recovery, whereas post-recession employment flourished in the nonprofit, public, and producer services. According to Plunket (1990), one out of four new jobs added during the 1980s occurred in both non- and for-profit business or health related services. He also noted that the fastest growing industries in total jobs added between 1979 and 1989 were eating and drinking establishments, business services, grocery stores, hospitals, and personal supply services. Contrary to Plunket (1990), Noyelle and Stanback's (1984) data from the late 1970s suggested that customer service jobs—jobs that are the focus of much of the discussion in popular media regarding the rise of the service sector—had declined in terms of total employment due to increases in productivity (Noyelle & Stanback, 1984). This difference in findings may be because increases in those types of customer service jobs did not happen until the latter part of the 1970s and throughout the 1980s, which Noyelle and Stanback's (1984) data did not capture.

In 1970, Baltimore metro area had a very large manufacturing base, but like many "rust belt" cities, those employment opportunities significantly declined by 2000 (Faberman, 2001). From 1992 to 1999, total private and public-sector employment grew in Baltimore's suburbs, while the city experienced a decrease, mostly in private-sector employment (Faberman, 2001). Faberman attributed the loss in city employment to both job destruction (firm closures and layoffs) and low rates of job creation (new business or new hires). By 1997, health services, business services, and eating and drinking establishments employed the highest numbers of workers.

Because of the heterogeneity inherent within each employment industry category, it is difficult to draw sweeping conclusions regarding the reasons for employment expansion, particularly in regards to the services sector (Urquhart, 1984). For example, government expansion can explain some of the growth in certain service sector employment while changing demographics or public policy may explain increases in public and social services. Changes in finance regulation potentially caused some of the increases in FIRE industry employment, particularly at the beginning of the 1980s. Public and non-profit sector services, such as health and education services, demonstrated increases that occurred in part because of a need to support "an increasingly complex and human capital intensive modern society" (Noyelle & Stanback, 1984). The decline of employment in manufacturing also forced many workers to change to service industry jobs, which illustrates the dramatic shift of total employment numbers from manufacturing to services. Additional local and regional causes for these shifts demonstrate that any employment shift from manufacturing and goods producing employment to service-based employment was multifaceted.

Urquhart (1984) discovered that employment gains in the services sector in the late 1970s were in large part due to the expansion of service industries employing those previously unemployed rather than shifting those already employed to another industry. Additionally, women and the baby boomer generation entered the job market during this time, and in the 1980s and 1990s, smaller cohorts of workers were entering the workforce, which continued to grow, but at a slower pace (Lee & Mather, 2008). However, these causes combined still may not explain overall trends from 1970 to 2000 as the increase in service occupations in the latter decades was more tied to workers from other industries moving into service sector jobs.

3.2.2 Sectoral Shifts in Employment and its Impact on Earnings Distribution]

One of the greatest concerns regarding the shifting labor market is the impact it has on worker earnings, particularly the impact on those positions requiring less education and training, and the distribution of wages across the spectrum of all workers. Sassen (1990) sought to understand what impact economic restructuring had on earnings and employment distribution, especially in relationship to the decline of the manufacturing sector and the rise of the service sector. Her specific concern was the unequal distribution of income and earnings in the United States, and the rise of the number of workers employed in low-paying service sector jobs. Indeed, income inequality has grown in most parts of the US since the 1970s. Incomes of the highest earning households climbed whereas middle- and lower-income earning households experienced low to modest growth or decline (Bernstein et. al., 2002).

In 1996, a report by the U.S. Council of Economic Advisors that investigated job growth between 1993 and 1996 showed that approximately 70% of job growth took place in occupations above the median income while low-wage service jobs—“hamburger-flipping” jobs—actually fell. This suggests that though job growth was not polarized in the sense that it was split between the highest lowest wage groups only, it was one-sided, with more growth occurring towards the upper half of the wage distribution (U.S. Council of Economic Advisors, 1996). However, there is alternative evidence that suggests job growth was, in fact, uneven during the 1990s, spilt between high and low wages (Farber, 1997; Ilg & Haugen, 2000; Milkman & Dwyer, 2002; Wright & Dwyer, 2003; Doussard et. al., 2009).

Studies by Milkman and Dwyer (2002), Wright and Dwyer (2003), and Doussard, Peck and Theodore (2009), expanded on the U.S. Council of Economic Advisors (1996) initial research. Wright and Dwyer were interested in determining if job growth in the 1960s was similar to that of the 1990s, and found that national job growth in the 1960s differed in terms of the kinds of jobs created and the quality of those jobs. In the 1960s, they found that employment expansion was even across low-, middle-, and high-quality job categories. In contrast, their findings supported the argument that employment expansion throughout the 1990s was characterized by growth in the top and bottom categories of job quality, but low growth in the middle, solidifying the idea of polarization. They referred to this new distribution of employment as "geographies of inequality." The result of these polarizing trends was a loss of middle-class jobs, the "disappearing middle phenomenon," and an increased intensification of wage inequality. Research by Doussard, Peck, and Theodore and Milkman and Dwyer drew similar findings. Doussard, Peck, and Theodore (2009) also found that the anatomy of job growth was spatially distinctive with a degree of local variation across different metropolitan areas; some metropolitan areas had more polarized job growth than others. Milkman and Dwyer (2002) found that intragroup polarization was being observed along with older forms of job polarization, for example polarization between genders, and also among women.

These studies are important in that they provide a picture of the differentiating effects this kind of job growth has on employment incomes and the economy, including the reduction of middle class employment opportunities and increased unemployment, underemployment, and poverty. Doussard, Peck, and Theodore (2009) observed that these geographies of inequality “have yet to be adequately mapped, let alone understood” (203), referring to the processing of mapping the socio-spatial consequences of this uneven growth. In this chapter, mapping changes in industrial employment across the Baltimore metropolitan region provides more detail about the changing spatial patterns of employment. However, this research contributes to this body of literature by analyzing and mapping a consequence of economic restructuring, access to employment.

The economic transformation described above raises questions about how workers in particular communities have had their access to employment opportunities change as the spatial and sectoral distribution of employment has shifted over time. Access plays a role in limiting (or encouraging) a worker’s ability to both find and hold employment in high paying jobs. If those high paying jobs do not exist within a metropolitan area due to changes in the economy, the structure of employment, and physical location, access is limited.

3.2.3 Spatial Shifts in Employment

The shift in the labor market from manufacturing to a services economy transformed not only the labor market, but also the population and landscape of metropolitan Baltimore (Hanlon & Vicino, 2007; Noyelle & Stanback, 1984; Sassen, 1990). Noyelle and Stanback (1984) claimed that the economic and labor market shift to a services economy gave "rise to a system of cities, fundamentally different from that which structured the economic geography of the United States during the previous manufacturing era" (*xix*). Kneebone and Holmes (2015) stated that "demographic and economic changes have redrawn the map of economic opportunity in metropolitan America" (2).

At the scale of the United States, there has been a dramatic change in the economic landscape. Manufacturing has become more prominent in the sunbelt cities, some older manufacturing cities have strengthened their position as regional economic centers (Boston, Philadelphia), and others have fallen upon economic stress (Flint, Yongstown) (Noyelle & Stanback, 1984). In addition, changes have occurred at the metropolitan-scale and sub-metropolitan scale.

The most common descriptions of changing spatial employment patterns describe overall decentralization and suburbanization. Berry and Cohen (1973) established that employment decentralization was first led by retail. Today, generally, all sectors of the economy are suburbanized to some extent. According to Glaeser and Khan (2001), residential location decisions were important in determining industry location; in essence, they argued that jobs follow people and drive current spatial patterns of employment. In White's (1999) description of the causes for decentralized employment, she noted that in addition to the multitude of causes for increased suburbanization, the research on whether people follow jobs or jobs follow people is inconclusive. Regardless of the lack of conclusive research, a degree of socio-spatial privilege is evident. When researchers hypothesize that jobs are following people, the reality is that they are referring to "some people" (white, middle class residents).

Evidence of employment suburbanization described by Mills (1972) and Macauley (1985) showed that residential populations and employment levels were converging, which is precisely what has been occurring in the Baltimore metropolitan region with the decline of residents and jobs in the city. Lower wage, entry-level jobs, and those having low educational requirements such as in retail and personal services, became more dispersed as these industries followed middle-class residents to the suburbs (The Job Opportunities Task Force, 2003). In 1970, fifty-five percent of all jobs in the metropolitan area were located in Baltimore City, but by the 1990s, the city accounted for only 33% of total regional employment (Abell Foundation, 1996). Glaeser et al. (2001) found metropolitan Baltimore's employment to be decentralized, with 56% of the share of employment located between 3 and 10 miles from the central business district (CBD), and 44% greater than 10 miles away. Only 18% of employment was located within 3 miles of the CBD.

Glaeser and Khan (2001) found that despite overall suburbanization across industries, some industries are more frequently located in the cities. For example, industries requiring workers with technological skills and high levels of education, which they identified as a measure of the "intellectual intensity" of an industry, and computer-driven industries—the information industry, professional, scientific, management, and administrative industries, FIRE industries, and public administration. Conversely, they found that firms with higher electricity or land demands, such as manufacturing industries, tended to decentralize.

Hanlon & Vicino (2007) found that within metropolitan Baltimore, the labor market shift from manufacturing to services shifted the concentration of economic activity from the city and inner suburbs (e.g., Arbutus, Brooklyn Park, Dundalk, Edgemere, Essex, Lansdowne, and Middle River) to other locations throughout the outer suburbs. They attributed this to the fact that the highest concentrations of industrial land use within metropolitan Baltimore were located in the city and inner suburbs, including Dundalk, Edgemere, Essex, Middle River, and Rosedale. As manufacturing declined, so did the importance of those areas in terms of economic activity. Although Hanlon and Vicino (2007) stated that jobs shifted to locations in the outer suburbs, they provided no specific details regarding where in the outer suburbs the jobs and people move to. This was in part due to their focus on inner-ring suburbs, but is a piece missing from much of the research in general and is important for understanding how the economic transformation of the labor market impacted the landscape of metropolitan region.

The emergence of suburban employment centers has made these locations important for both jobs and revenue in regional and metropolitan economies. It has also led to the creation of a more of a polycentric landscape, with employment concentrated in multiple employment centers. The Baltimore Metropolitan Council (1999) identified 10 employment centers in the Baltimore region, and Knapp and Ding (2014) identified 23 employment centers in the Baltimore-Washington metropolitan area. Knapp and Ding (2014) noted that industries have tended to co-locate in specific geographic areas, and therefore employment centers typically have some degree of industry specialization.

Polycentric urban development in the Baltimore metropolitan area was not solely an organic process that arose out of shifts in the labor market and the result of jobs and people moving to the suburbs. It has been promoted by the department of planning as a way to achieve sustainable development and limit sprawl, particularly in cases where development is tied to transit hubs (Knapp & Ding, 2014).

Although there is a degree of spatial clustering of employment in metropolitan areas, Lang (2003) detailed the rise of more regional large-scale retail centers and office buildings along suburban highways and commercial corridors, indicating further decentralization of retail establishments that are not necessarily attached to suburban employment centers. In addition, Shin (2002) noted that 'scatteration' has occurred as another form of decentralizing employment. In this example, firms are scattered across the metropolitan area in low-density employment locations and unattached to centers. This is similar to the concept of edgeless cities (Lang, 2003), and the results from this analysis suggest that patterns of workers fit all of these descriptions of firm location. There is a degree of clustering in employment centers, but also workers are scattered across the metropolitan landscape and spread along highway and urban corridors in nearly every industrial category. These development patterns present challenges to commuting access, particularly if employment locations are not accessible to transit routes.

3.2.4 Spatial Shifts in Employment and the Relation to Spatial Justice

The concept of spatial mismatch is strongly related spatial justice in that space is "connected to and embedded in social structures and labor market processes" (Preston & McLafferty, 1999: 388). Socio-spatial privilege is attached to the location of jobs and employment opportunities. Employment decentralization shifts that privilege from city to suburban residents, and to more white communities if the demographic distribution of the metropolitan area is such that more African-Americans are concentrated in the city and more whites are in the suburbs. The effect of employment decentralization on African-American communities further exacerbates the already present issues of racial segregation in the housing and job markets. The spatial mismatch theory does not directly address spatial justice, but the distribution of residential population and employment are important factors in both theories. As Preston & McLafferty (1999) noted, spatial mismatch is related to how space both affects and is affected by labor market processes.

Although Kain (1968) did not use the term spatial mismatch in his original work, his ideas laid the groundwork for the spatial mismatch theory. In his research, he investigated the relationship between housing market segregation and the distribution and level of employment for non-white residents in Detroit and Chicago. His three main hypotheses were that residential segregation in the housing market "(1) affects the geographical distribution of Negro employment and (2) reduces Negro job opportunities, and that (3) postwar suburbanization of employment has seriously aggravated the problem" (1968: 176).

The idea of residential segregation is central to all three of Kain's hypotheses, and he operated from the recognition that there was a disproportionate concentration of poor, black residents located in cities due racial discrimination in the housing market. He based this theory on residential segregation indexes from 1940, 1950, and 1960, which recorded high levels of segregation in cities and metropolitan areas. He also noted that over time, segregation of African-Americans increased whereas the segregation of other racial and ethnic groups decreased.

In his hypothesis “residential segregation affects the geographical distribution of Negro employment,” Kain (1968) called out the “obvious reasons” for such effects on employment opportunities (Kain, 1968:179). Firstly, commuting costs were higher for African-Americans living in segregated, central-city neighborhoods because public transportation systems were absent or too far away. African-Americans also had less information and opportunity to learn about jobs distant from their place of residence. Lastly, employers located outside of African-American residential neighborhoods may have discriminated against non-white applicants and employers. Kain saw each of these items, separately and together, as mechanisms that restricted access to “certain jobs”[7] and resulted in more black workers working in, or close to, their own residential neighborhoods.

Kain’s (1968) second hypothesis narrows in on his first hypothesis, stating that because of racial discrimination in the housing market, there is a smaller set of job opportunities available to black residents, thereby resulting in residential segregation. Restricting African-Americans to fewer areas limited housing choice, and, thus, the number of employment opportunities that African-Americans would have been exposed to. Ultimately, this led to higher black unemployment.

His second hypothesis is predicated on the fact that between 1950 and 1960, jobs—those held by black workers, in particular—were suburbanizing at a much higher rate than African-Americans. Therefore, according to Kain (1968), African-

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[7] Kain did not say specifically what or where these “certain jobs” are, but based on further reading of his article, he was most likely referring to suburban jobs.

American workers would have fewer employment opportunities near their residential locations. However, despite employment suburbanization, he found that a disproportionate number of jobs remained in the central city of Chicago. He also found that the white population decreased within 15 miles of the city center while the black population increased. One would expect that employment opportunities would improve for African-American workers; instead, by studying a measure of manufacturing jobs only, Kain (1968) found that employment rates declined.

Kain's (1968) third hypothesis is most often associated with the spatial mismatch theory, and presumes that a surplus of *labor* in the city and a surplus of *jobs* in the suburbs negatively affects blacks as those jobs move further away. This theory makes several assumptions, most notably the assumption that the majority of African-Americans are located in the city and whites in the suburbs. Traditionally, the population with the suburban advantage has consisted of a whiter and/or more affluent population, but this does not match the actual, more complex distribution of races. For example, in his analysis of Chicago, Kain found large middle-class, black suburban communities. The same holds true for modern Baltimore. Traditional assumptions of suburban population are likely inaccurate representations of suburban Baltimore.

The spatial mismatch hypothesis is also based on assumptions about the distribution of employment. First, employment, like race, is often segmented into just two locations—the city and the suburb—and employment in these two locations is tied to skill-level. Greater skills are required for employment opportunities closer to the city while low-skilled[8] jobs are located in the suburbs; therefore, an unequal spatial distribution of skill requirements impacts black employment if the majority of black residents are located in the city. Within this statement assumption, black, city residents largely work in low-wage jobs with lower educational requirements. Kain (1968) stated that black workers "typically have less skill and less education than whites" (183). Therefore, researchers, including Kain, who apply the spatial mismatch hypothesis claim that the decentralization of low-skill jobs traditionally held by a larger segment of poor, black populations in cities has led residents constrained to the city to become economically disadvantaged.

Lastly, Kain (1968) advanced the notion that residential segregation and the relatively low numbers of African-Americans moving to the suburbs to follow jobs is primarily due to housing discrimination. The result of this is continued concentration of African-Americans in particular neighborhoods within the metropolitan region. Massey and Denton (1993) discussed the reinforcing effect of increased social differentiation and the spatial concentration of minority groups, noting that "segregation concentrates poverty to build a set of mutually reinforcing and self-feeding spirals of decline into black neighborhoods" (2). Further, any economic shock that increases unemployment and poverty of an already segregated group will also increase the socioeconomic deprivation and geographical concentration of that group. Cortright (2014) discovered that three-quarters of the urban neighborhoods exhibiting high levels of poverty in 1970 were still poor in 2000. Although Kain did not directly

[8] The definition of low-skilled jobs includes those that require no more than a high school education and no more than one year of work. Unskilled or low-skilled workers are those without a college education or other formal skilled training (e.g., auto-repair and medical assistance). The term low-skilled is problematic in that denigrates people in occupations requiring a high level of skill, even if those occupations require low levels of formal education or training.

address this, the reinforcing effects of spatially concentrated segregation and poverty certainly played a part in the increased segregation of the inner-city, African-American neighborhoods he described. The rapid and continued disinvestment in some of these neighborhoods also played a role in concentrating poor and minority residents into certain sections of the city.

More than four decades of empirical research on the spatial mismatch theory since Kain's (1968) first publication on the topic has yielded mixed results regarding the effect of employment suburbanization on job outcomes. Research done after the 1990s offered some support for the theory (Preston & McLafferty, 1999) as methods of investigation improved. As Mouw (2002) points out, residential location is not truly exogenous; "living in a good neighborhood may help you get a good job, but having a good job will also help you live in a good neighborhood" (731). Also, some studies, such as Ihlanfeldt's (1994) analysis of Atlanta, showed that access actually improved for some black workers over time because the suburbanization of employment was not evenly distributed across the suburban metropolitan area. Therefore, in some instances suburban black communities benefited (at least spatially) from employment decentralization.

Ihlanfeldt's (1994) study of job access in Atlanta between 1980 and 1990 demonstrated that residential disadvantage intensified for those black residents that were already at a locational disadvantage in 1980, particularly those in the city. Employment opportunities for low-skilled workers continued to decentralize while the workers themselves remained concentrated with the inner city. This geographical disadvantage was found to particularly affect less-educated, inner-city, minority workers. Ihlanfeldt and Sjoquist (1990) found that blacks living in Philadelphia lived further away from low-wage jobs than whites.[9]

He also found that despite the negative effect the decentralization of jobs had on minority residents, some inner-ring suburban areas heavily populated by minority residents gained an advantage. For example, in Atlanta, the suburbanization of jobs took place to a greater extent north of the city while African-Americans migrated out of the central city to the north and south, equally. In this case, even though minority residents in the southern suburbs were negatively impacted, those who had migrated north were positively affected.

Most importantly, Ihlanfeldt's (1994) study demonstrated that spatial mismatch played a role in explaining the growth of inner-city poverty in Atlanta during the 1980s. This study brings up relatable questions about Baltimore's metropolitan area, such as: are residents in the inner city at a greater disadvantage when attempting to access specific kinds of employment opportunities? Would the findings for the suburban metropolitan Baltimore area be similar to Ihlanfeldt's findings? Are the residents of some suburban locations at a greater disadvantage than others?

Galster (1991) reviewed both black and white decentralization patterns in 40 Metropolitan Statistical Areas (MSAs), and concluded that "job growth…and informal social networks promoting upward mobility tend to follow higher-socioeconomic-status households to the ever-more distant exurbs" and "blacks will benefit little if they remain spatially centralized, albeit outside the central city."

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[9] This study was based on 16-19-year-old workers.

Meaning, even in cases where African-American communities have suburbanized and consolidated, job growth and mobility were still higher for white, exurban communities. This could mean that despite the suburbanization of middle-class African-Americans in the metropolitan Baltimore region, residents of these communities may still face challenges accessing employment opportunities.

Spatial mismatch is one impact of the spatial and sectoral economic changes on workers, but it fails to explain how workers outside of the inner city might be impacted by changes in the labor market. In addition, the spatial mismatch hypothesis focuses solely on the employment outcomes of African-American workers. Houston (2005: 407)) argued, “race does not lie at the heart of the spatial mismatch problem,” “[spatial mismatch] in the context of residential and commuting immobility” is the core of the issue, which happens to affect low-skilled workers irrespective of their race. His emphasis was on the role of space and the spatial inequalities that result from decentralization of employment opportunities.

Despite these criticisms of the spatial mismatch hypothesis, I think it is still of relevance to research on employment access because it provides a framework to measure the impact of employment suburbanization, and beyond that spatial shifts in employment in general. Additionally, the specific critique that spatial mismatch limits its focus to the central city and African-Americans is somewhat misplaced. As Houston (2005) notes, spatial mismatch and discrimination can simultaneously impact minority groups and the spatial mismatch hypothesis is one that emphasizes discrimination. Kain’s (1968) research on the effect of housing discrimination on

African-American employment arose because of the suburban (and even central city) housing discrimination affecting African-Americans.

The goals of his research were to investigate the impact of that racialized housing discrimination. Houston's (2005) conception of the spatial mismatch is an extension of Kain's, and should not negate the role that race and discrimination have played in employment access, nor should Houston's revaluation of Kain's work replace the spatial mismatch hypothesis. A broader conceptualization of spatial mismatch would include questions about how both spatial relations and social relations affect employment outcomes for multiple groups of people (Preston & McLafferty, 1999). For example, Preston & McLafferty (1999: 388) defined spatial mismatch as "the geographical barriers to employment for inner city residents that arise from changing social and economic relations and the impacts of those barriers on labor market achievement". In a similar manner, I interpret spatial mismatch very broadly as the geographical barriers to employment for all workers that arise from changes in the labor market-specifically spatial and sectoral shifts, and the impact of those barriers on employment access. In terms of the spatial focus on the city, this is particular to spatial mismatch studies in the U.S. Similar studies on the topic in other counties such as France, do not have the clear differences between cities and suburbs. There is a much more complex geography of poverty (Lehman-Frisch, 2011). To this point, my research focuses on employment access from different spaces within the metropolitan area rather than employment access by a particular race or social class.

3.3 Methods, Data, and Variables

3.3.1 Data Sources and Their Limitations

The two data sources used for this analysis are from the U.S. Bureau of Economic Analysis (BEA) and the U.S. Census Bureau. Both data sets reported employment data by *place of work*. BEA data contained information about the number of jobs by county between 1970 and 2000. Census Transportation Planning Package (CTPP) data contained data about the number of workers at multiple spatial scales in 1990 and 2000.

Table 6
Data sources for employment data. Spatial resolution available, and years available

Name of Data Set	**Spatial Resolution**	**Years**
Bureau of Economic Analysis (BEA), Regional Economy Accounts[10]	County	1970, 1980, 1990, 2000
Census Transportation Planning Package (CTPP)	TAZ	1990, 2000

Census Transportation Planning Package (CTPP) is a special tabulation of the Long Form Decennial Census data and American Community Survey. The CTPP tabulations include data from three geographies: a residence-based geography that summarizes worker and household characteristics at their place of residence, a workplace-based geography that summarizes worker characteristics at their place of work, and worker flows between home and work, which includes the mode of transportation and transportation times. The CTPP presents data at different spatial units, including census tracts, census blocks, and Transpiration Analysis Zones (TAZ). TAZ are spatial delineations created by state departments of transportation or

[10] BEA data comes from the Regional Economic Accounts, Table CA25: Total Full-Time and Part-Time Employment by SIC Industry (www.bea.gov).

local planning offices. TAZ may be made up of one or more census tract or block, or block groups. TAZ boundaries often coincide with road and natural boundaries, such as rivers. These zones can be very large in rural areas and quite small in more urban areas.

One disadvantage of the BEA data is that data before the year 2001 uses the Standard Industrial Classification (SIC) system. In 2001, the BEA switched to the North American Industrial Classification System (NAICS), which has more categories than the SIC coding system, particularly in terms of the services related industries. Because of this, I have included 1990 and 2000 data from the CTPP to provide more detailed information on employment change in industrial categories from the NAICS.

There are some drawbacks with using CTPP data as well. One limitation is that it did not exist in its current form in 1970 or 1980. There is no one publicly available data set for workplace location on a small spatial scale, such as TAZ, census tract, or census block from 1970 through 2000, which limits the TAZ-level analysis to just 1990 and 2000. The second limitation is a result of changes to the industry and occupational classification systems used by the Census Bureau between 1990 and 2000. The comparison of occupational and industrial classifications across different censuses is important for analyzing long-term trends in employment. However, the result of these changes meant that major industrial categories in 1990 were not comparable to similar categories in 2000, even in cases where the wording was the same. To conduct a comparative analysis across census years, I used a crosswalk table provided by the U.S. Census Bureau. The crosswalk table allows analysts to convert the 1990 industry data into the newer 2000 classifications.[11]

Another issue that arose using these two data sets was that the BEA and CTPP data for place-of-work worker counts differ. Typically, total job counts were higher in BEA data than they were in CTPP data. Reasons for this are: (1) the differing industry codes that the BEA and CTPP data use result in statistical differences, (2) the U.S. Census Bureau counts *employed* persons, not *jobs*, and therefore persons with more than one job were only counted once—for their principal job, (3) only workers that were at work the week of the reference week were counted—any workers out of work for any reason were not counted, and (4) workers who work for a business with multiple locations sometimes report only the headquarters as their place of work. Consequently, some worker counts may be artificially low, particularly those where many workers have more than one job such as retail establishments, colleges, and universities (U.S. Census Bureau). In the remainder of this chapter, the term "workers" will be used as a way of referring to the primary job of workers who worked in the reference week of data collection for the CTPP data, and the term "jobs" will refer to all jobs reported by workers who worked during the reference week of data collection for the BEA data.

3.3.2 Variables Used in the Analysis

Industries using both the SIC between 1970 and 2000 and the CTPP industry categories for 1990 and 2000 are listed in Table 7.

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[11] The methods for constructing this crosswalk were described by the U.S. Census Bureau (2003).

Table 7
Industrial employment categories, changes between 1970 and 2000.

1970, 1980, 1990		1990, 2000
Construction		Construction
Manufacturing		Manufacturing
Transportation & Public Utilities		Transportation & Warehousing, & Utilities
Wholesale Trade		Wholesale Trade
Retail Trade		Retail Trade
Finance, Banking, Real Estate, Insurance		Finance, Insurance, Real Estate, & Rental & Leasing
Services		Information
Government		Professional, Scientific, Management, Administrative, & Waste Management
		Educational, Health, & Social Services
		Arts, Entertainment, Recreation, Accommodation, & Food Services
		Other Services except Public Administration
		Public Administration

Agricultural and mining industries were not included in this study as they were not a major source of employment in the metropolitan area. With 8% of the total employment, Carroll County had the largest number of workers employed in farming industries. Other counties had between zero to 3% of total workers employed in farming or nonfarm agricultural services, or mining employment (U.S. Bureau of Economic Analysis). The BEA includes a category for government employment that consists of employment not only in federal, military, state, and local government, but also government enterprises. The CTPP data do not have an equivalent category.

3.3.3 Methods

My analysis proceeds with an assessment of the overall trends in employment opportunities by examining the total number of jobs in each industry from 1970 to 2000 (BEA data) at the county level, and the number of workers employed in each industrial category in 1990 and 2000 at the TAZ level (CTPP data). In this analysis, I assume that an increase in the number of workers or jobs within a specific industry between a given time period indicates that there are more employment opportunities available in that industry and vice versa. For example, the decline in the number of workers and jobs in the manufacturing sector in metropolitan Baltimore between 1970 and 2000 was related to a decrease in certain types of manufacturing taking place in the area. Therefore, there were fewer opportunities to work in that industry over time. The same can be said of the increase in jobs within the service industries; more people employed means more opportunities.

Korsu and Wenglenski (2010) argued that job growth was not a reliable proxy for job vacancies, because the net between jobs created and jobs eliminated doesn't reveal how many jobs were created and eliminated in each job category or each spatial location. Although this is true, the data presented in this chapter do provide insight into the overall trends in employment in each industry, and within specific spatial locations. Also, because I am looking at historical data, it is not as important to know to the number of jobs created or eliminated for each year, the important element is how many workers in that year were employed in each industry.

Because of the differences in the spatial resolutions available and the time periods for which data are available, I have divided this analysis into two sections. In section 3.4.1, I present the BEA data from 1970 to 2000, and describe total employment and employment change by industry within each county and Baltimore City. I also compare the 1990 and 2000 BEA data with the CTPP data for those same years. In section 3.4.2, I present TAZ-level data from the CTPP for 1990 and 2000

(CTPP data are not available for 1970 or 1980), mapping the data to aid in understanding the spatial patterns of employment in those two years, and any changes that occurred between those years.

To be able to compare the data across time periods, I used a crosswalk table to transform the 1990 industrial categories into 2000 industrial categories. The resulting worker totals from this crosswalk were not round numbers, and some of the 1990 values were close to zero, subsequently causing an extreme percentage change in employment and skewing the results. Because of this, I rounded the values to whole numbers to calculate the percentage change from 1990 to 2000, and then calculated the percentage change of employment in each industrial category from 1990 to 2000 for every TAZ. Any change from zero employees in 1990 to a positive number in a TAZ was assigned a null value, and any change from a positive number in 1990 to a zero value was assigned a -100% change. In cases where there were no employees in 1990 and a positive value in 2000, I evaluated the GIS attribute table to note the change in the number of workers; when there was a significant change, I included those results in this discussion.

I mapped worker density in every industry by hectare, and mapped the percentage change of employment in every industrial category. I then used these maps, along with the attribute table information, to analyze the data and specify TAZ with a highest number of jobs in each industry (1990 and 2000), and the TAZ that had the most substantial job increases and/or decreases in each industry. The discussion of my results are presented for each industry.

In section 3.4.4, I identified regional employment centers[12] in metropolitan Baltimore in 1990 and 2000 following a similar methodology to Giliuano (1991), Gardner and Marlay (2013), and Knapp & Ding (2014). Based on the definition put forth by McDonald (1987), I define employment centers as areas or zones where employment density exceeds those of the surrounding areas or zones, I define that as one or more (adjacent) TAZ with a higher worker to resident ratio, and any surrounding TAZ with a worker density of 2,000 workers per square mile or greater. Furthermore, to be considered an employment center there must be at least 10,000 total workers.

Cervero (1989) reviewed different methods for identifying ‘suburban employment centers’ or ‘activity centers’. Some of these previous analyses relied heavily on local area knowledge and the study of area maps to identify specific industrial employment zones that either were important or experienced significant change between time periods being studied. Other studies relied on locations meeting certain threshold criteria such as floor space or number of offices (Garreau, 1991).

To identify these areas, I first calculated the employment ratio and job density (number of jobs per square mile) of each TAZ using residential and workplace data from the CTPP. I used square miles instead of hectares to conform to the U.S. Census Bureau’s standard unit of measure in defining aspects of urban form, including urban areas. Next, I selected TAZ that had a higher ratio of jobs to residents (jobs/residents > 1.0) and classified these areas ‘high employment TAZ’. These eliminated areas that

[12] Knapp and Ding (2014) classify industrial clusters and employment centers as two separate entities, but for the purpose of my analysis I defined clusters as the “high employment TAZ” and any touching high density TAZ, before determining if these clusters met the definition of an employment center, having 10,000 workers or more.

were more residential in nature, and selected those that were "commercial and economic in makeup" (Gardner & Marlay, 2013: 799). In many cases, there were multiple high employment TAZ adjoined to one another. In those cases, all those TAZ were included as a singular 'cluster.' I then examined the TAZ with a density of 2,000 jobs per square mile or higher.[13] Any of these higher density TAZ touching a 'high employment TAZ' were included in the cluster. In cases where a high density TAZ touched more than one cluster, I assigned it to the cluster with a higher number of workers. Last, I counted the number of workers in each cluster. Those with 10,000 or more workers were considered an employment center.[14] Anas et al. (1998) noted that these defined cluster patterns can be sensitive to the choices of those cutoff values, therefore I completed the analysis a few different times with different cut off values, and found the values I describe above to be the most useful in describing employment centers in metropolitan Baltimore.

Although the employment centers have boundaries, they do not necessarily coincide with census designated places or neighborhood boundaries. The identification of the TAZ that make up an employment center do not necessarily indicate additional surrounding TAZ are also not important areas for workers, it simply means that they did not meet the threshold for inclusion as outline by the selection process. This cluster analysis is geared towards identifying areas of

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[13] This job density threshold departs from the methods described in Gardner and Marlay (2013), who selected cutoff points of 1,000 and 500 workers because of comparability with census requirements for population densities in urbanized areas. I found that thresholds set that low resulted in the selection of a very high number of TAZ, making it difficult to discern separate employment clusters.

[14] Gardner and Marley (2013) specified that a cluster must have a minimum of 50,000 total number of workers to be considered an employment cluster based on the U.S. Census Bureau's definition of an urban area. However, because selecting only those clusters with 50,000 workers or more would exclude many of the potential clusters in this analysis and because my analysis is of employment centers within metropolitan Baltimore rather than a multi-city or regional area, I specified that clusters must have at least 10,000 workers. This number aligns with Guiliano (1991)

economic significance that attract workers in metropolitan Baltimore, and is used to guide that discussion.

This analysis allows for the identification and comparison of employment centers in 1990 and 2000, but it does not fully encompass an explanation of all the types of spatial shifts that occurred with respect to employment. As Lang (2003) noted, edgeless cities, which he specified accounted for "two-thirds of the office space found downtowns" (1), are not easy to locate because of their scattered pattern.

3.3.5 The Modifiable Area Unit Problem (MAUP)

In measuring employment change, the way that TAZ or census tracts are drawn can influence the results of an analysis, and measurement errors can occur when artificial boundaries, such as TAZ or census tracts, are imposed on continuous geographical surfaces, in addition to the aggregation of geographical data (Openshaw, 1984). Even when the underlying data are the same, redefining boundaries used as the geographical unit of analysis will produce different results. For example, boundaries drawn along roads may obscure high density areas of employment that cluster around major intersections. An area of high employment may be divided into smaller TAZ, which would then show fewer jobs than if those boundaries were drawn differently and included the high employment area in just one TAZ.

Additionally, the count of workers employed within each industry is tabulated over areas of unequal size TAZ, and those with more workers will likely have more workers within each industry in proportion to the total number of workers. To overcome these issues, I analyzed the data in two ways. I mapped the percentage change in the number of workers within each TAZ from 1990 to 2000 rather than the total change in the number of workers within each TAZ, and normalized the data by calculating the number of workers per hectare in 1990 and 2000. Although neither solution was necessary for overcoming the MAUP, I found it useful to have maps of worker density for analyzing some of the changes in industrial employment between 1990 and 2000.

3.4 Results and Discussion

Section 3.4.1 presents the population and employment trends for each county and Baltimore City, including overall population growth/decline and increases/decreases in the number of jobs in each industrial category. Section 3.4.2 presents an analysis of changing industrial employment throughout metropolitan Baltimore using TAZ as the unit of analysis.

3.4.1 Employment Data by County, 1970 to 2000

Anne Arundel

Between 1970 and 2000, the population and the number of people working within the county of Anne Arundel County grew. Although journey to work data are not available for 1970 and 1980, data from 1990 and 2000 show that overall, the county drew in many commuters from the surrounding metropolitan area. The exception to this was the county's negative net number of commuters to Baltimore City, Washington, D.C., and Howard County (year 2000 only).

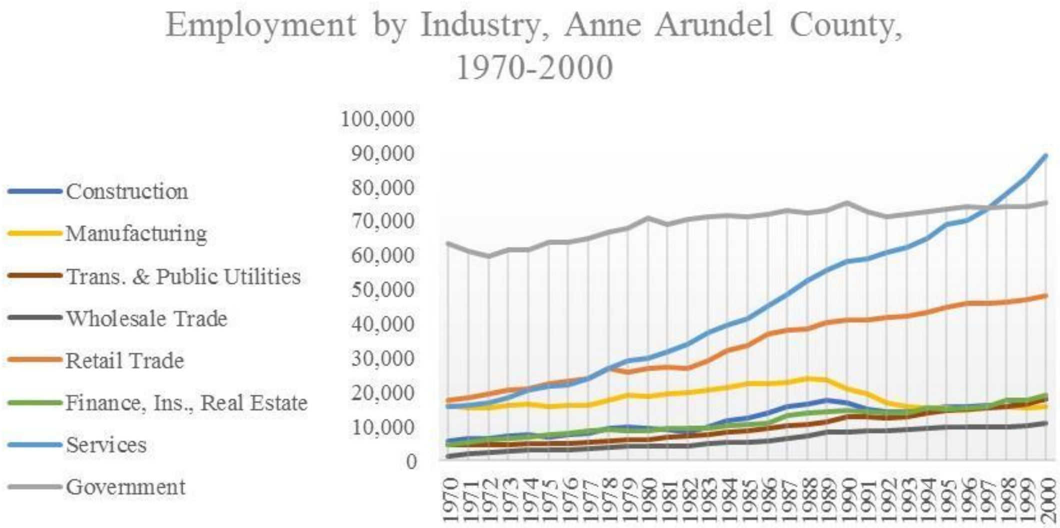

Figure 14. Employment by Industry, Anne Arundel County 1970-2000. *Note:* Adapted from the Bureau of Economic Analysis Regional Economic Accounts, http://www.bea.gov/regional/.

The Bureau of Economic Analysis (BEA) data show the number of jobs in Anne Arundel County increased in every industry except manufacturing, which declined by a net of 206 jobs from 1970 to 2000. However, year-to-year trends were not accounted for in the overall decline. The number of manufacturing jobs increased by almost 5,000 jobs from 1970 to 1990, peaking at just over 24,000 jobs in 1998; then, between 1990 and 2000, manufacturing jobs declined steeply (see Figure 13) as did the percentage of the total workforce employed within manufacturing, from over 12% of the total jobs in the county to just 5.4%. The CTPP data showed a small increase in manufacturing between 1990 and 2000, but the total number of manufacturing jobs reported were much lower overall than the BEA county data.

The government sector had the largest number of workers in 2000, ranking the county as the second highest in total government employment— local, state government, and federal—in the metropolitan area. The presence of the state capitol and associated offices in Anne Arundel has played a role in the continuing importance of this sector in the county's job market. Although CTPP data did not include a government jobs category, the data showed an increase of over 23,000 workers in public administration employment, which included national, state, and local government employment, government contractors, and public services jobs. The sectors with the largest growth in new workers were services (71,955), retail trade (30,334), and FIRE (13,981) (BEA). By 2000, the services sector surpassed government in total number of workers.

The CTPP data showed that between 1990 and 2000, the highest worker increases were in public administration, retail trade, and professional services (professional, scientific, management, administrative, and waste management). It also indicated that the largest decreases in the total number of workers were in the education, health, and social services category. In 1990, education, health, and social services employed 31% (38,400 workers) of the total workers in the county, but in 2000, employment dropped to just 15% (39,710)—an overall increase in total number of workers, but a lower percentage of the entire workforce in the county.

Attributed to some of the growth in the county, Anne Arundel Mills Mall opened in 2000, which may account for some of the growth in retail if workers were hired prior to its opening. Another large employer to emerge at the end of the 1990s was Ciena Corp, a fiber-optics technology company, which accounts for some of the growth in the transportation and public utilities sector and professional services (Patalon, 2001).

Baltimore County

Between 1970 and 1990, the population of Baltimore County grew by 133,000 people, and the number of jobs in the county increased by 225,000 (BEA). From 1970 to 2000 manufacturing jobs shrank from 62,000 to 35,000, a loss of 27,000 jobs. The percentage of the total workforce employed in manufacturing industries in the county dropped from being the largest sector, at over 27% in 1970, to just 6 % in 2000. At the same time, service related industries grew by over 220,000 jobs, a 218% increase; the percentage of the county workforce employed in services increased from 15% in 1970 to 36% in 2000. The three industries that added the most new jobs were services (127,609), retail (44,132), and FIRE (32,405) (see Figure 14). Lastly, although the total number of government jobs increased from 45,700 to 57,700, the percentage of the workforce employed in government jobs decreased from 20% to 13% between 1970 and 2000 (BEA).

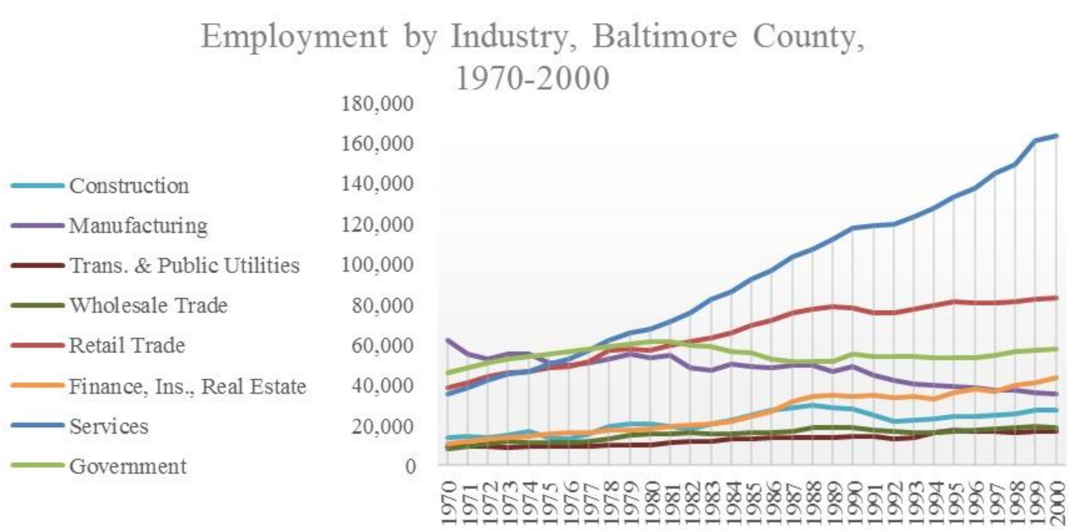

Figure 15. Employment by Industry, Baltimore County 1970-2000. ***Note:*** Adapted from the Bureau of Economic Analysis Regional Economic Accounts, http://www.bea.gov/regional/.

The CTPP data showed that the number of workers in Baltimore County declined between 1990 and 2000 (see Appendix A2.1), and that this included a loss in almost every industrial sector, with the greatest losses in public administration and manufacturing. The only industry that added workers between 1990 and 2000 was retail trade. The percentage of total workers employed within manufacturing, wholesale trade and transportation (transportation, utilities, and warehousing) decreased during this decade. Despite total worker reductions in the remaining industries, the percentage of workers employed within those industries rose (CTPP, 1990 & 2000). The difference in what these two data sets reported may be because BEA data counted jobs, whereas CTPP data counted workers, some of whom potentially held more than one job. In addition, they used different industry classification schemes, which would result in some differences in the data. Lastly, the time at which information is collected can have an impact on the number of workers, as employment rises and falls over the course of a year.

Data from the BEA suggest that the decline of employment opportunities that occurred in Baltimore City between 1970 and 2000 did not spread to the Baltimore County suburbs, but, the CTPP data does show an overall decrease in employment. Recent literature has depicted the county's inner-ring suburbs as "in decline" (Hanlon, 2010; Hanlon & Vicino, 2005 and 2007). Hanlon and Vicino (2005, 2007) found that inner-ring suburbs experienced increasing rates of poverty, relatively fixed population growth, and decreased economic activity. The decline was, in part, attributed to labor market restructuring and the shift from manufacturing to services. For example, they noted that "suburbs located on Baltimore County's southeastern industrial belt witnessed a significant decline in the manufacturing base, and subsequent declines in household income of residents" (Hanlon & Vicino, 2007, 265). However, within the inner-ring suburbs, the neighborhoods with the highest rates of service employment had the highest median household incomes and the lowest poverty rates (e.g., Hamden and Catonsville). This indicates that labor market restructuring benefitted some of the residents living in inner-ring neighborhoods in Baltimore County. From this data, it is not possible to know who benefited from this change in the economy—those who lost employment in manufacturing industries, new residents of the county, or some other perhaps this is entirely the result of other factors. Mapping this data at the TAZ level provides more detail as to where these changes in employment are occurring within the county, though not necessarily to who the changes impact.

Carroll County

Carroll County is a predominantly rural county, with its highest population density located in and around the city of Westminster. The population of the county grew by approximately 80,000 people (119%) between 1970 and 2000, while the population of Westminster grew by a little over 9,500 people (132%). During this same 30-year period, the number of jobs in the county increased by 42,000 (153%).

Service related jobs experienced the largest increase between 1970 and 2000—services (16,441), transportation (9,837), and retail trade (9,433) being the highest. In 2000, retail trade and service industries had the largest number of jobs. Non-service related jobs also increased, mainly due to the increase in the number of construction jobs (1,730), but farming, agricultural services, and mining jobs increased as well. In 1970, the county had the third smallest number of manufacturing jobs, but this accounted for 28.6% of the workforce at the time. By 2000, the industry lost just over 1,500 of those jobs and represented just 8.9% of the total jobs in the county (Figure 15).

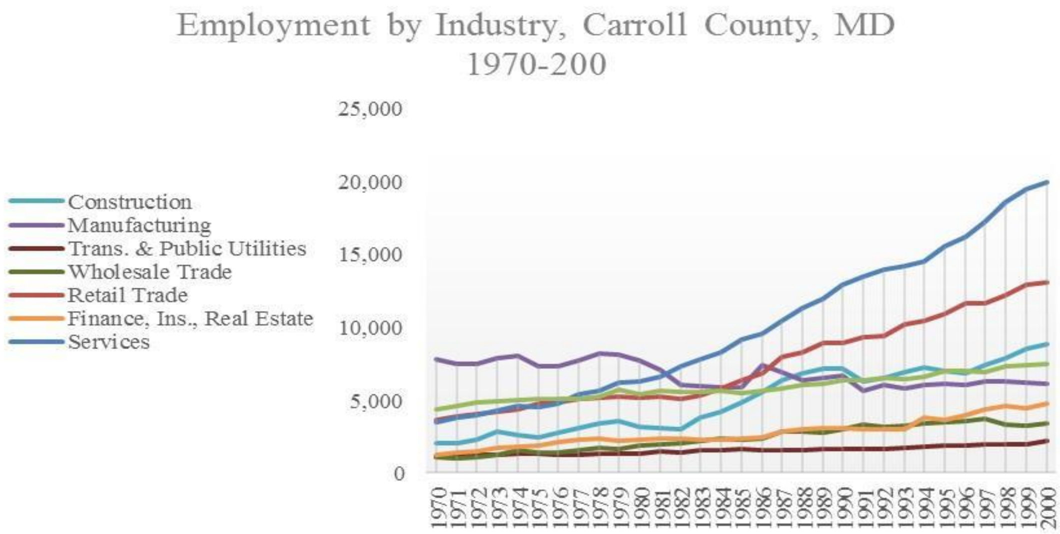

Figure 16. Employment by Industry, Baltimore County 1970-2000. *Note:* Adapted from the Bureau of Economic Analysis Regional Economic Accounts, http://www.bea.gov/regional/.

Between 1990 and 2000, according to the CTPP data, Carroll County experienced small employment gains in construction and manufacturing. However, both data sets show that the overall trend was growth in non-service related industries. The highest growing sector, per the CTPP data, was education, health, and social services (3,351 workers).

In the late 1990s, the 3M company closed its plant east of Westminster, laying off 95 workers (Burns, 1998), and the Black & Decker Corporation cut back its workforce to 250 workers (from 3,000 at its height) at its Eldersburg location ("Cup deal overflows," 1999). However, in 1992, Jos A. Bank Clothiers moved its headquarters and distribution center to the county, adding a small number of jobs

("National names, local impact," 1999) and the largest ceramic tile manufacturer, Dal-Tile International, moved its distribution center to Eldersburg (Hare, 1997). Marada Industries, an auto-parts manufacturing plant, also opened a third factory in 1998 (Shelsby, 1998). Public schools and hospitals were also large employers in Carroll County.

Harford County

Between 1970 and 2000, Harford County increased by 30,000 residents, and every industry added jobs, with a total of 25,000 new jobs. The top employer in the county was Aberdeen Proving Ground, the army's oldest, active proving ground. Therefore, a large number of people who were working in the county held jobs classified in the government sector. From 1970 to 1990, data from the BEA (see Figure 16) showed the government sector had the highest number of jobs.

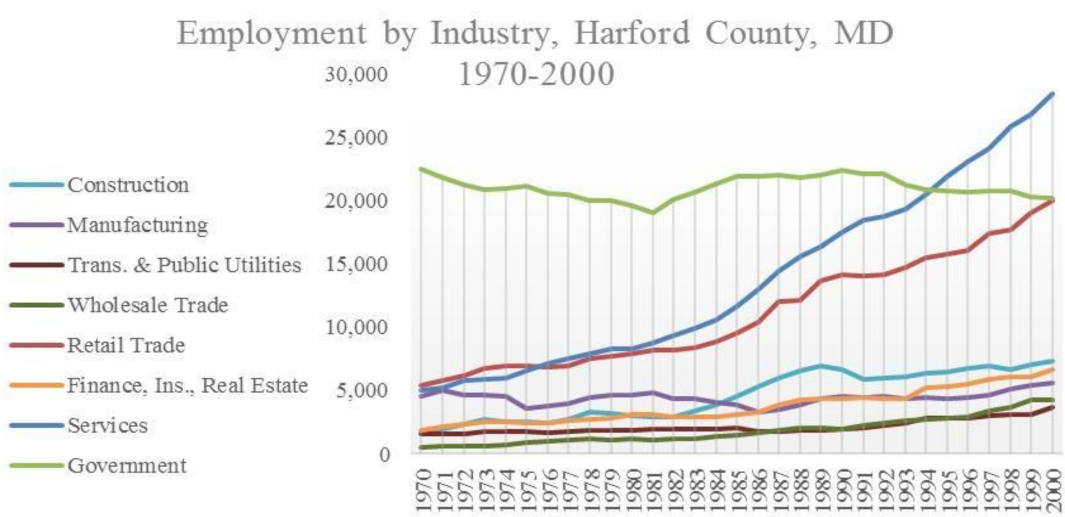

Figure 17. Employment by Industry, Harford County 1970-2000. *Note:* Adapted from the Bureau of Economic Analysis Regional Economic Accounts, http://www.bea.gov/regional/.

In 2000, jobs in Harford County's government sector shrank by just over 2,000 jobs while, between 1970 and 2000, jobs in the services grew the most (10,931), overtaking the government sector in 2000 as the industry with the largest number of jobs. However, government remained the second highest employment sector in total number of jobs. Within the county during this same time period, retail trade (5,869) and FIRE (2,234) added the second and third most new jobs. Although the total number of jobs in manufacturing increased by 1,127 jobs between 1970 and 2000, the percentage of the total workforce employed in manufacturing declined from 10% to 5.7%.

From 1990 to 2000, the CTPP data showed a decrease in the number of workers in manufacturing, wholesale trade, information, and FIRE. Accordingly, the industries with the largest numbers of jobs were retail trade, professional services, and educational, health, and social services, and public administration.

Howard County

Howard County experienced the largest growth of population and jobs in the metropolitan area. Its population in 1970 was slightly less than that of rural Carroll County, but it had the third largest population of the suburban counties by 2000. Similar to its population growth, no other county in the metropolitan area experienced a similarly rapid growth of jobs. From 1970 to 2000, the total number jobs in Howard County grew from 22,397 to 160,189 (615%).

Howard County is home to the planned community of Columbia. Beginning in the late 1960s, Columbia's development had a significant impact on the population and employment within Howard County because it included residential, office, retail, and community-related plans. Some of the most rapid population increase in the county (10% per year from 1970-1974) occurred right around the time Columbia was being developed.

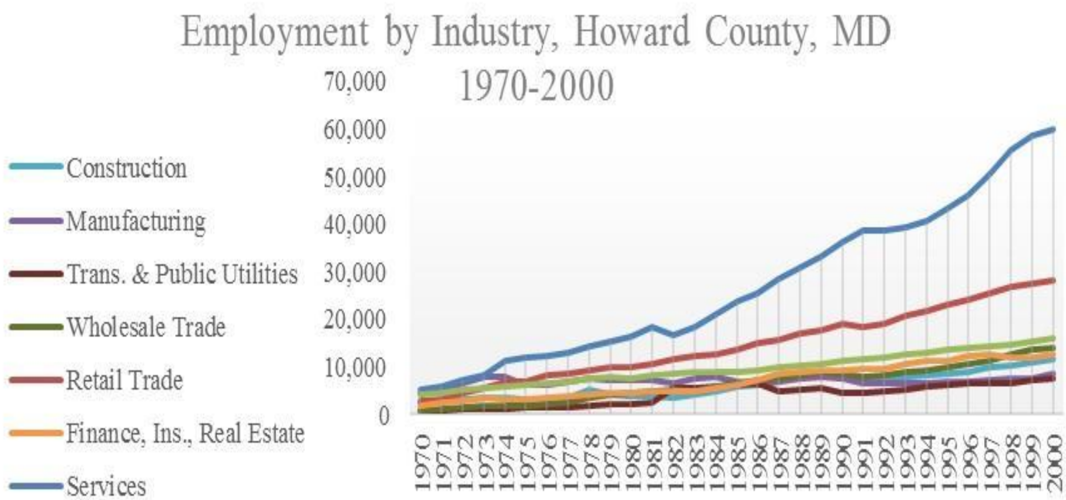

Figure 18. Employment by Industry, Howard County 1970-2000. ***Note:*** Adapted from the Bureau of Economic Analysis Regional Economic Accounts, http://www.bea.gov/regional/.

Part of Howard County's appeal is its location between Baltimore and Washington, D.C., giving residents a desirable commuting distance to both cities. It is an attractive location for businesses as well since it attracts workers from both metropolitan areas. Commuting data from 1990 and 2000 showed that Howard County had the fourth largest number of in-commuters, drawing in a net of 3,225 workers from the metropolitan Baltimore area in 1990 and 8,982 workers in 2000. However, overall more workers commuted out of the county for work than into it. Howard County was one of only three counties in Maryland that had a growth in the number of people who worked in their county of residence (Maryland Department of

Planning, 2003). Howard County offered lower cost of living where people could still find jobs with high paying salaries.

The number of jobs increased in every industry (see Figure 17). Manufacturing industries in Howard County had an overall increase in the number of jobs (4,162), but the percentage of the workforce employed in that industry declined from 19% to 5% of total employment in the county (BEA). Services (54,917) and retail trade (25,329) added the highest number of jobs between 1970 and 2000, and had the highest amount of jobs in 2000. Although retail trade added more than 25,000 new jobs, it only increased from 11% to 17% of total jobs in the county (BEA).

The CTPP data showed similar trends with regards to the growth and decline of workers in Howard County, including an increase in manufacturing workers, and large gains in retail and professional services. The CTPP data also indicate that education, health and social services declined slightly between 1990 and 2000, as did public administration.

Baltimore City

The Abell Foundation (1996) stated that one of the biggest problems facing Baltimore City is its widespread joblessness and poverty. Although the city has the highest total number of workers in the metropolitan area, the statistics for Baltimore City between 1970 and 2000 vary greatly from the rest of the metropolitan area. Both the residential population and the number of jobs declined over the 30-year period, by 255,000 and 105,000 respectively (BEA). Figure 20 shows the decline in the city's jobs in contrast with the job growth occurring in surrounding counties.

According to the BEA data, Baltimore City had declining levels of employment in almost all industrial categories between 1970 and 1990 except for services and government (see Figure 18). The largest declines were seen in retail trade (18,023), FIRE (16,334), and manufacturing (15,242), with services being the only industry to increase (9,328) by the year 2000. CTPP data showed a small net increase in total number of workers between 1990 and 2000 (22,114), the highest being in education, health, and social services. This data set also showed that gains occurred in transportation, information, FIRE, professional services, other services, and public administration. The difference between the 60,000 job loss between 1990 and 2000 reported by the BEA and the 20,000 worker gain is somewhat surprising. It is possible that these difference can be attributed to differences in counting jobs vs workers, differences in industrial classifications schemes used, or time of year the data was gathered.

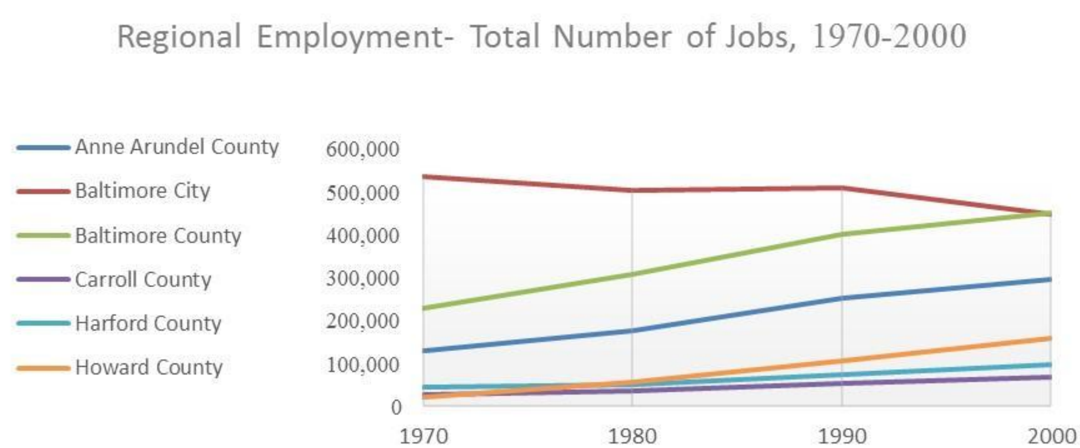

Figure 19. Regional Employment by County, 1970 to 2000. ***Note:*** Adapted from the Bureau of Economic Analysis Regional Economic Accounts, http://www.bea.gov/regional/.

Figure 20. Employment by Industry, Baltimore City 1970-2000. *Note:* Adapted from the Bureau of Economic Analysis Regional Economic Accounts, http://www.bea.gov/regional/.

Maryland Department of transportation data shows that in 1990 and 2000, over 60% of the workers residing in Baltimore City also worked in the city. That is a higher percentage of workers whose jobs are within their jurisdiction of residence than any of other counties in the metropolitan area. However, the also show that the percentage of the city's jobs held by its own residents was only 51% is 1990 and 45% in 2000. According to Goldstein (2000), this is a result of the large in-commuting by suburban residents into the city to work. The journey to work data for 1990 and 2000 showed a small decrease in the number of in-commuters into Baltimore City, although for both years it had the highest positive net commutation, meaning more commuters coming into the city than residents of the city commuting out to work in another jurisdiction. It also showed that there were a larger number of commuters into Baltimore City from areas outside of the city's metro area. This included Washington D.C., Frederick, Montgomery, and Prince Georges counties in Maryland, southern

Maryland, western Maryland, the Eastern Shore, and Maryland's surrounding states in 2000 (Maryland Department of Planning, 2003). Between 1990 and 2000, the number of Baltimore City residents working in the city decreased from also 51% to 45%, indicating more city residents were commuting to suburban or out of the state employment locations. Goldstein (2000) indicated that these data emphasize the importance of the city as to the region and the state's economy, but these data may have a very different meaning to those who reside in the city.

According to Short (2011), the loss of employment "caused by the long slow decline of manufacturing" in cities such as Baltimore "is yet to be replaced completely by new forms of economic growth" (1). Employment growth in the services, in particular education, health, and social services, offset some of the job losses from manufacturing, but it was not enough to replace the total amount of jobs lost since 1970. Furthermore, jobs in these industries may not have been employing the same people, or people of a similar socio-economic status, that were once employed in manufacturing. The declining number of jobs in Baltimore City held by city residents is one indication that changes within the labor market may be having a negative effect of employment status of city residents.

In 2000, six of the top eight employers in Baltimore City included industries that would be categorized in the education, health, and social services category—Johns Hopkins Medical Institutions, University of Maryland Medical System, GMC Assembly Division for Trucks and Busses, Bayview Medical Center/Johns Hopkins Geriatrics Center, Abacus Security Service, Mass Transit Administration, Sinai

Hospital, and St. Agnes Healthcare/St. Agnes Hospital (Baltimore Metropolitan Council, 2000).

Summary of BEA Data and CTPP data 1970 to 2000

In summary, though manufacturing did not decrease in every county in the metropolitan area, the percentage of the total workforce employed within that industry decreased across the region, indicating that manufacturing's role as a top employer was in decline by 2000. Manufacturing jobs increased in Harford and Howard counties, Carroll County experienced only a small decrease, and both Baltimore City and Baltimore County experienced larger losses of manufacturing jobs and workers. These last two areas were once the manufacturing hubs of the metropolitan region.

The various types of manufacturing subsumed under the manufacturing category is exhaustive. Even though industry data do not provide details as to what kinds of manufacturing workers were doing, heavy industries, such as steel and other heavy metals fabrication, dominated the manufacturing industries in and around Baltimore prior to 1970. Over time, employment in these types of manufacturing industries decreased as other types of manufacturing took over, including "printing and publishing, biosciences, defense electronics, and light tools" (DiLisio, 2014: 179). The fastest growing manufacturing industries in the area have been in the high-tech and knowledge-based categories, such as manufacturing that requires advanced degrees and/or specific jobs-skills training. Overall, the manufacturing sector has become smaller and more specialized (DiLisio, 2014). Such changes within manufacturing may result in spatial shifts where manufacturing is physically taking place (Galster & Kahn, 2001; Levine, 2000; Giuliano & Small, 1999; Massey, 1973). For example, manufacturing companies may not need to be located close to shipping, and find it more affordable to locate in suburban areas. As previously discussed, county-level data did not provide detail about where manufacturing takes place within each county or whether there was any spatial shift over time within each county. The data presented in this section demonstrate that the outer suburban areas were places of growth, albeit limited, for manufacturing. In addition, more recently the growth of high-tech manufacturing industries has created demand for service sector workers in positions related to manufacturing (DiLisio, 2014; Lawrence, 1984), thus increasing jobs in this and other industrial categories.

The number of jobs in the services and retail sectors increased in every county, as did the percentage of total workers employed in services and retail jobs. Baltimore City also had an increase in the number of services jobs, but retail declined as the city became less of a destination for suburban shoppers (Levine, 2000). The services category used by the SIC system is diverse, containing both high- and low-wage data; for this reason, only a general trend in employment and changes in the local economy can been determined from this data. However, the CTPP used more detailed data, and showed a decrease in workers employed within manufacturing, along with an increase in workers employed within industries in the top (information, FIRE, and professional services) and bottom (retail trade and arts and recreation) of the employment structure, which is consistent with the findings of Wright and Dwyer (2003) and Doussard, Peck, and Theodore (2009). The BEA also provided data with regards to earnings both per job and per capita income in each county. According to the BEA, Baltimore City, followed by Howard County, had higher average earnings than other counties in the region in 2000. This could indicate the presence of more high-wage occupations in these counties, but per capita income was much lower in the city than other counties, which suggests that city residents were not generally the recipients of the city's higher-wage jobs.

3.4.2 Mapping Employment Change with CTPP data, 1990 to 2000

In this section, I analyze the 1990 and 2000 CTPP data at the TAZ level, which is a much smaller unit of analysis than the County. This data provided the number of workers, counted at their workplace, in each industry. The maps that follow display the percentage change and the change in density of workers in many industrial categories between 1990 and 2000. Not all industrial categories are included in this discussion; change maps that did not show any discernable spatial patterns were left out of this discussion, but a brief overview of those industries can be found in Appendix A2.2.

Figure 20 compares 1990 and 2000 total worker densities. Both maps show higher densities of workers along beltways and radial highway corridors, including the I-695 Baltimore Beltway, I-70 extending north and west from the beltway, and I-83 extending north from the city. This illustrates what Lang (2003) described as "edgeless cities," where new offices are spread out along highways and commercial corridors rather than being concentrated in employment centers or edge cities. This type of development can raise commuting times and congestion (Kneebone, 2009) and often necessitates car ownership. But these are not the only areas where workers are clustered. Higher worker densities are also located in areas of the city and inner suburbs, as well as a few locations in in the outer suburbs.

Between 1990 and 2000, worker density increased around Annapolis, Columbia, and Woodlawn, and along I-70 through Reisterstown. Worker density decreased in some areas of Baltimore City, particularly east and west Baltimore. Worker density also decreased Northern Laurel and Jessup. Overall these patterns suggest a contraction of the employment opportunities available in the city and an expansion of the opportunities in some of the outer suburbs, and as will be discussed in the following paragraphs, areas where opportunities increased where in large part located in specific suburban neighborhoods.

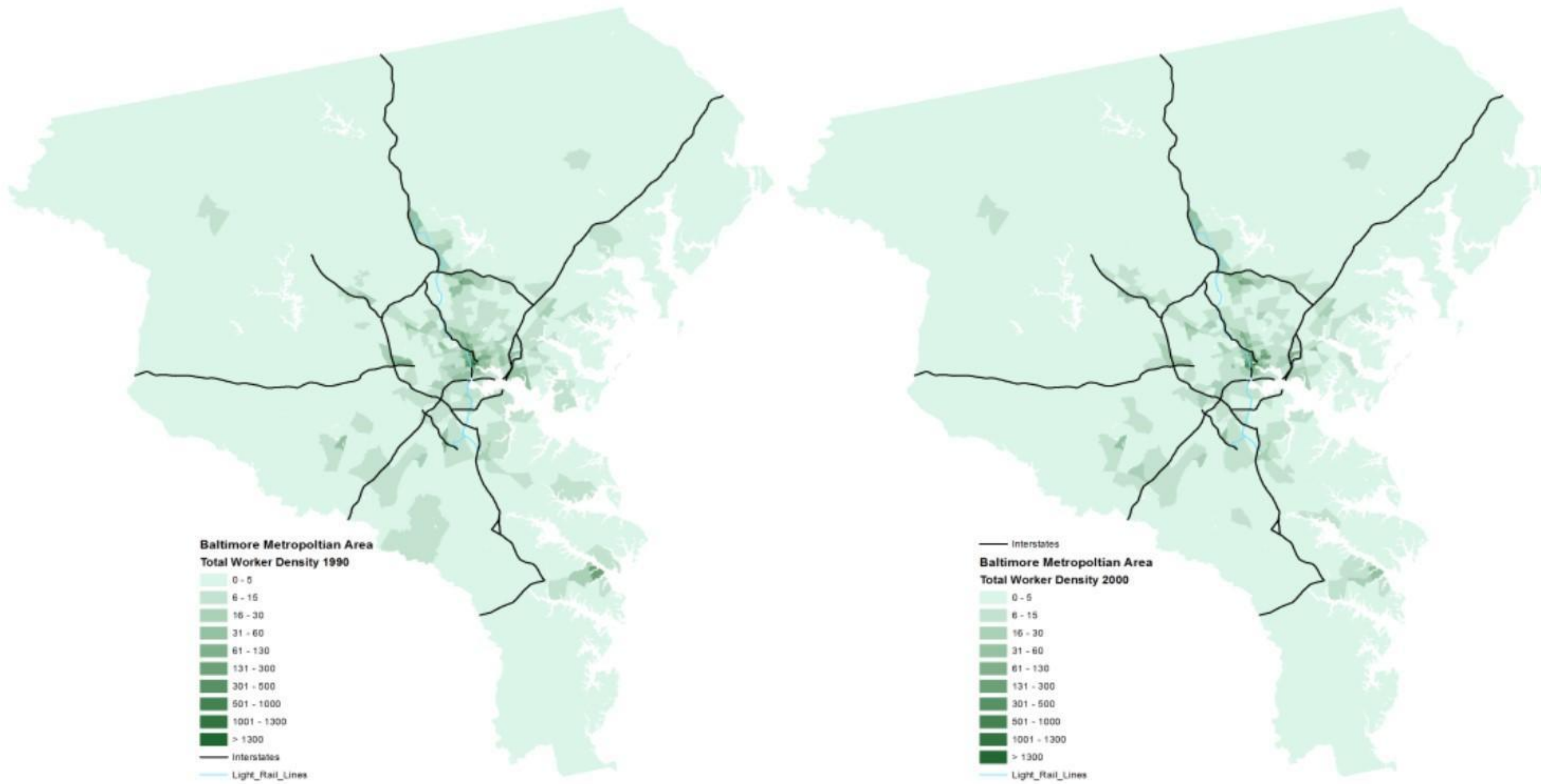

Figure 21. Worker Densities, 1990 and 2000.

Manufacturing

Figure 21 maps the percent change in the number of workers employed within the manufacturing industry between 1990 and 2000 for each TAZ. Increases and decreases in manufacturing workers are listed in Table 3. Because Baltimore is a post-industrial city, reductions in manufacturing jobs are widely discussed. Thousands of workers were laid off between 1970 and 2000. However, the decline in workers between 1990 and 2000 was much smaller than before 1990. Therefore, the CTPP data and the maps do not show as a dramatic change as they may have if TAZ level data was available dating back to 1970.

One of the disadvantages of this map is that it does not show distinctions between areas where the manufacturing positions increased, for example, from 1 to 81 workers versus 25 to 2,000, both of which resulted in more than 100% change in manufacturing workers. The result of this is that some of the areas with ostensibly large increases in workers were areas with low densities of workers that added few workers. To overcome this and to aid in my analysis, I mapped the change in the density of workers within each industry (see Figure 22).

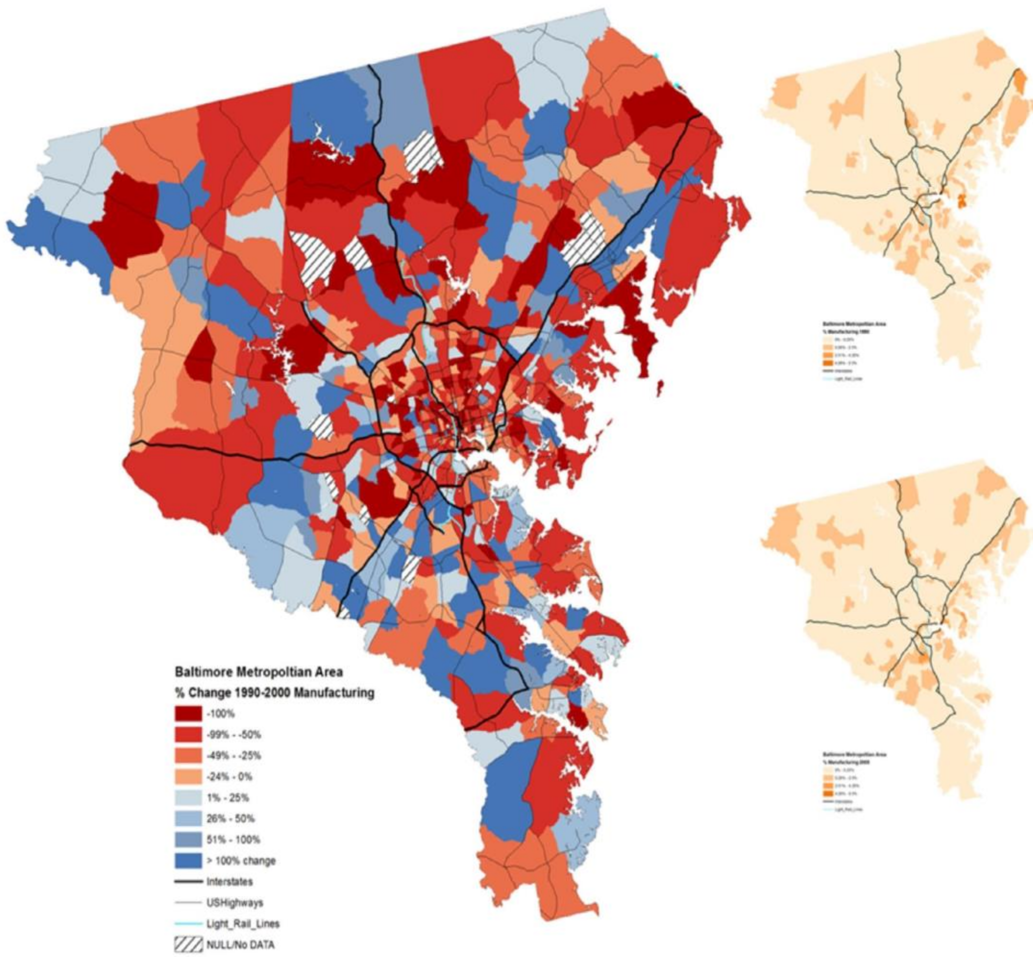

Figure 22. Percent Change, Manufacturing Workers 1990 to 2000. This map shows the change in the percentage of workers employed in a manufacturing industry at their place of work between 1990 and 2000. The smaller maps on the right show the percentage of workers in manufacturing at their place of work in 1990 (top) and 2000 (bottom).

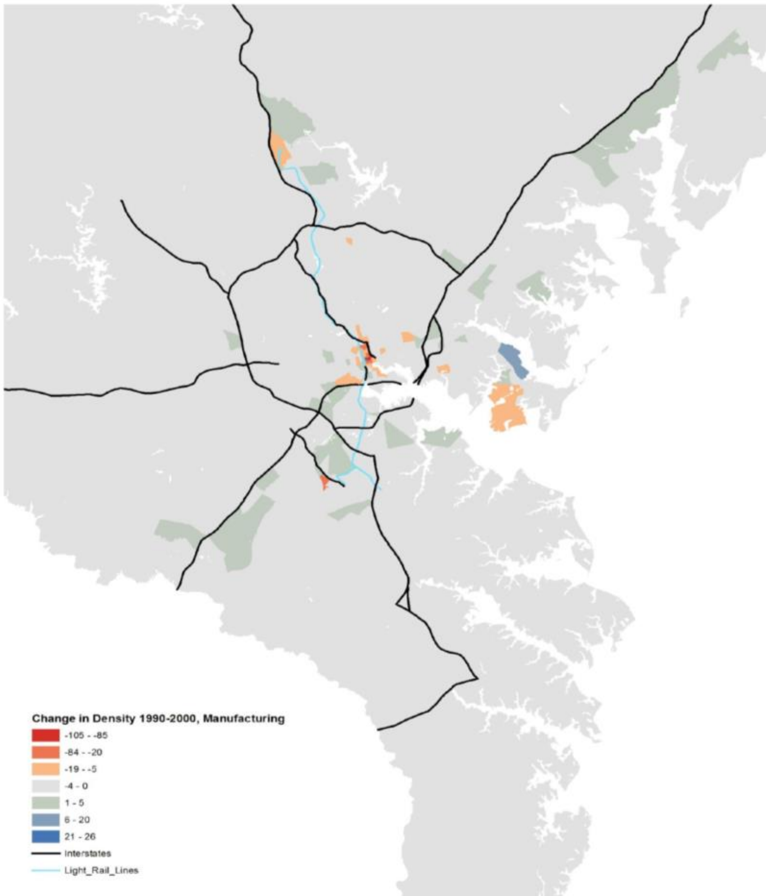

Figure 23. Change in Density of Manufacturing Workers, 1990 to 2000.

Table 8

Locations of greatest increase and decrease in percentage of manufacturing workers.

Increase	Decrease
Abington/Belcamp	Maritime Industrial areas: Canton Industrial area, Curtis Bay, Essex, Locust Point, Sparrows Point, Wagners Point
Columbia	
Crofton	
Glen Burnie/Linthicum Heights/BWI	Cockeysville
Hawkins Point, Baltimore City	Downtown Baltimore City
Lutherville-Timonium/Hunt Valley/Monkton	Shipley Hill/Mill Hill, Baltimore City
Middle River	
Savage, Jessup/N. Laurel	
Westminster	

Figure 24 highlights areas of growth along north and south I-95, and I-83, and helps to further identify the areas listed in Table 8. With the exception of a small area of Dundalk, the increase in manufacturing worker density was rather small in terms of the number of workers per hectares, only a few TAZ experienced a growth of 500 or more manufacturing workers. Those areas included Abington/Belcamp/Edgewood, Middle River, a small section of Dundalk, Monkton, Linthicum Heights/BWI, and in the Savage/Jessup area. Many more areas lost 500 or more manufacturing workers, the majority within city limits, but also in Annapolis, Eldersburg, Havre de Grace, some sections of the Lutherville-Timonium area, and Westminster. The analysis of change in other industries reveals that the areas of the largest gains and losses were similar across many industries.

Retail Trade

Retail trade was one of the largest sectors of employment growth between 1990 and 2000. Retail was scattered throughout the metropolitan area, but Figures 23 and 24 show that overall there was a decrease in retail workers in Baltimore City between 1990 and 2000, and in increase in suburban locations. In some instances, particular sections of an area experienced a decrease in retail workers and others an increase. This occurred in Columbia, around the BWI and Arundel Mills areas, and White Marsh. This may be attributed to newer developments and renovations occurring in an area, replacing older shopping and retail centers.

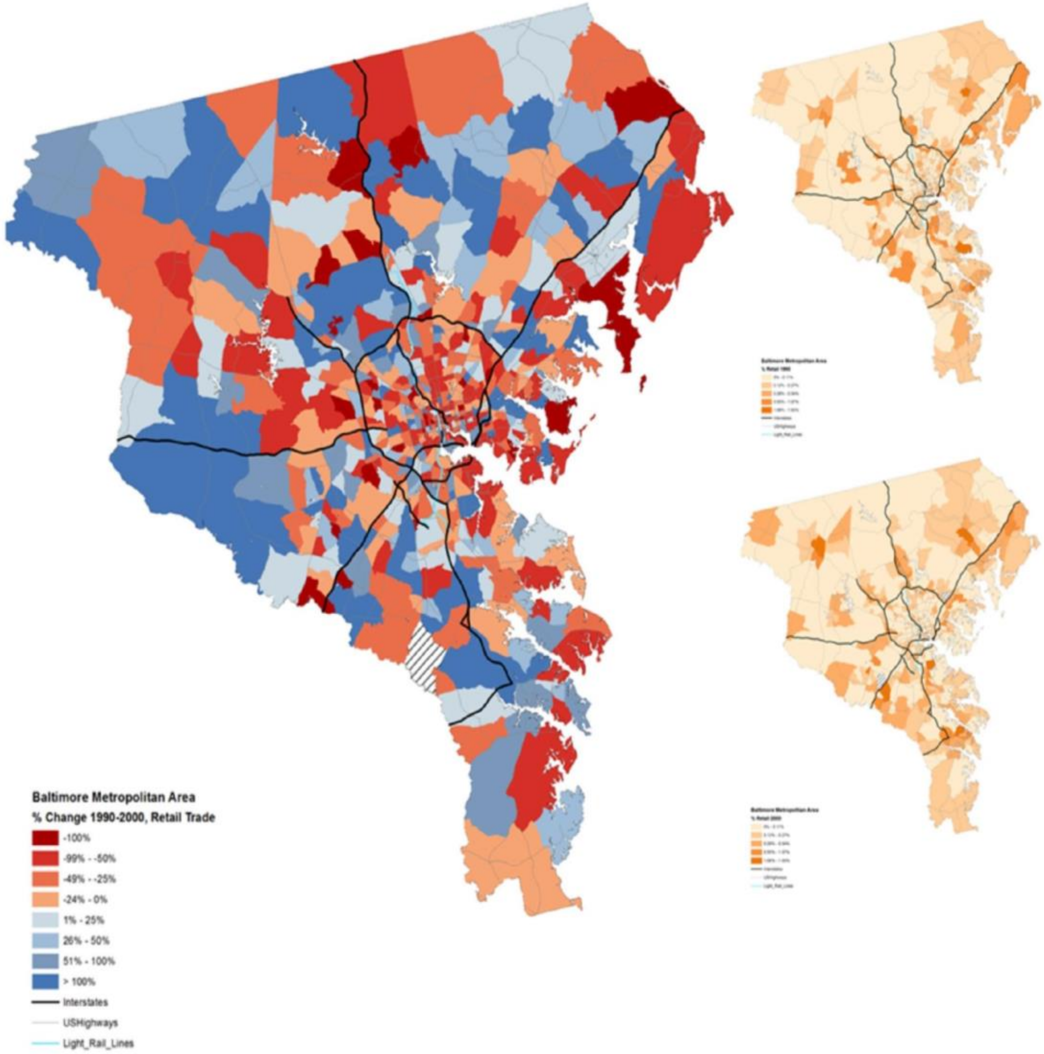

Figure 24. Percent Change in Retail Workers, 1990 to 2000. This map shows the change in the percentage of workers employed in a retail industry at their place of work between 1990 and 2000. The smaller maps on the right show the percentage of workers in retail at their place of work in 1990 (top) and 2000 (bottom).

Many of the large percentage increases in retail are result of increased development in those areas, more houses, big box stores and shopping centers. For example, one TAZ in Glen Burnie increased in retail workers by almost 200%. That TAZ is home to Marley Station Mall, which was expanded in 1993 and 1997 (Blumberg, 2013). Another TAZ in Howard Park, Baltimore City increased by 150%. Both Northwest Plaza Shopping Center and Reisterstown Road Plaza are located in that TAZ. Reisterstown Road Plaza underwent a renovation in 1991, adding shops and updating existing ones (Gunts, 1991). These are just two examples, of where the percentage of retail workers increases, but they describe the reason for increases across the metropolitan area; the renovation and development of new shopping centers.

The areas that had the highest absolute increase in the number of workers were Aberdeen/Belcamp, Annapolis Junction/Ft. Meade/Laurel, Bel Air/Bel Air South, Towson, White Marsh, and Westminster. The areas with the highest absolute decline in retail workers were Annapolis, Eldersburg, Havre de Grace, Hunt Valley, Inner Harbor/Federal Hill neighborhoods in Baltimore City, Linthicum Heights, Mt. Vernon neighborhoods in Baltimore City, Security Square, and White Marsh/Kingsville.

Table 9
Locations of greatest increase and decrease in percentage of retail workers.

Increase	**Decrease**
North and Eastern Annapolis (Parole, Millersville)	Arnold
Bel Air	Carroll Park Neighborhood, Baltimore City
Columbia	Charles Village and Greenmount neighborhoods, Baltimore City
East Baltimore/Midway neighborhoods, Baltimore City	Columbia
Edgemere	BWI area (some TAZ experienced a decrease, others an increase)
Ft. Meade	Downtown and Midtown neighborhoods, Baltimore City
Glen Burnie	Dundalk
Halethorpe/Arbutus	Halls Crossroads
Howard Park, Baltimore City	Hawkins Point, Rivera Beach
Lutherville-Timonium and Towson	Inner Harbor and Harbor East neighborhoods, Baltimore City
North Laurel/Savage	Lutherville
Mt. Airy and Sykesville	Old Town and East End neighborhoods, Baltimore City
Mt. Washington, Baltimore City	Owings Mills
Owings Mills and Reisterstown	Pasadena
White Marsh	Southeastern/St. Helena neighborhoods/Segrit Marine Terminal, Baltimore City
Westminster	White Marsh/Perry Hall

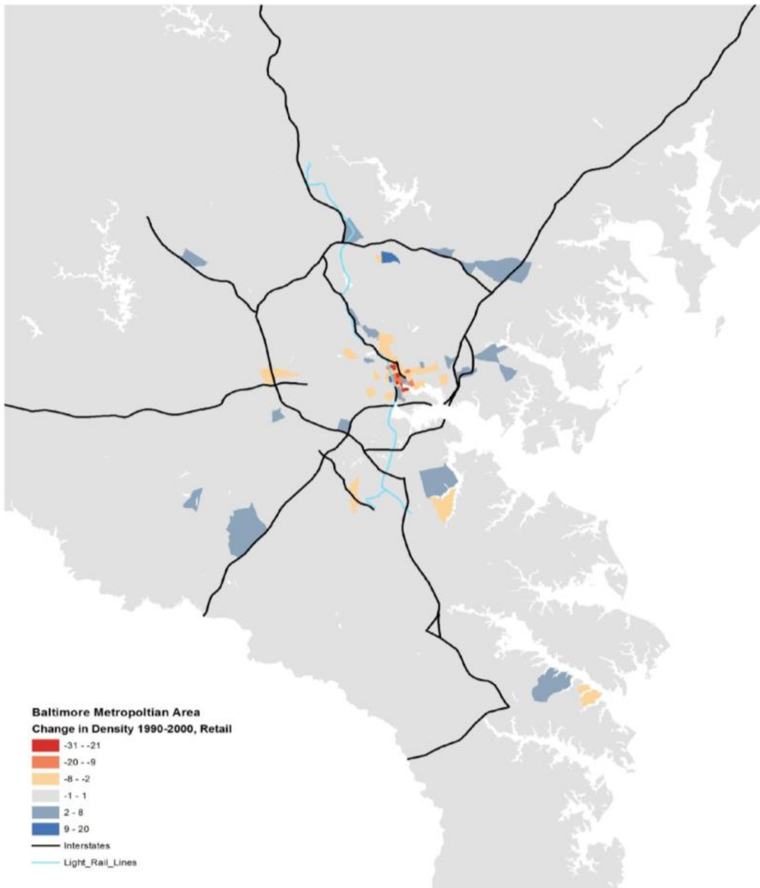

Figure 25. Change in Density of Retail Workers, 1990 to 2000.

Information

The percentage change in the number of information industry workers is displayed in Figure 25. Areas that experienced an increase in the percentage of workers employed in the information sector were spread across the metropolitan region, in both the city and the suburbs. These areas are listed in Table 10. In some instances, these increases are associated with the locations of Universities, such as Towson University, and in other examples, they are associated with the location of business parks, such as Seton Business Park on the west side of Baltimore City.

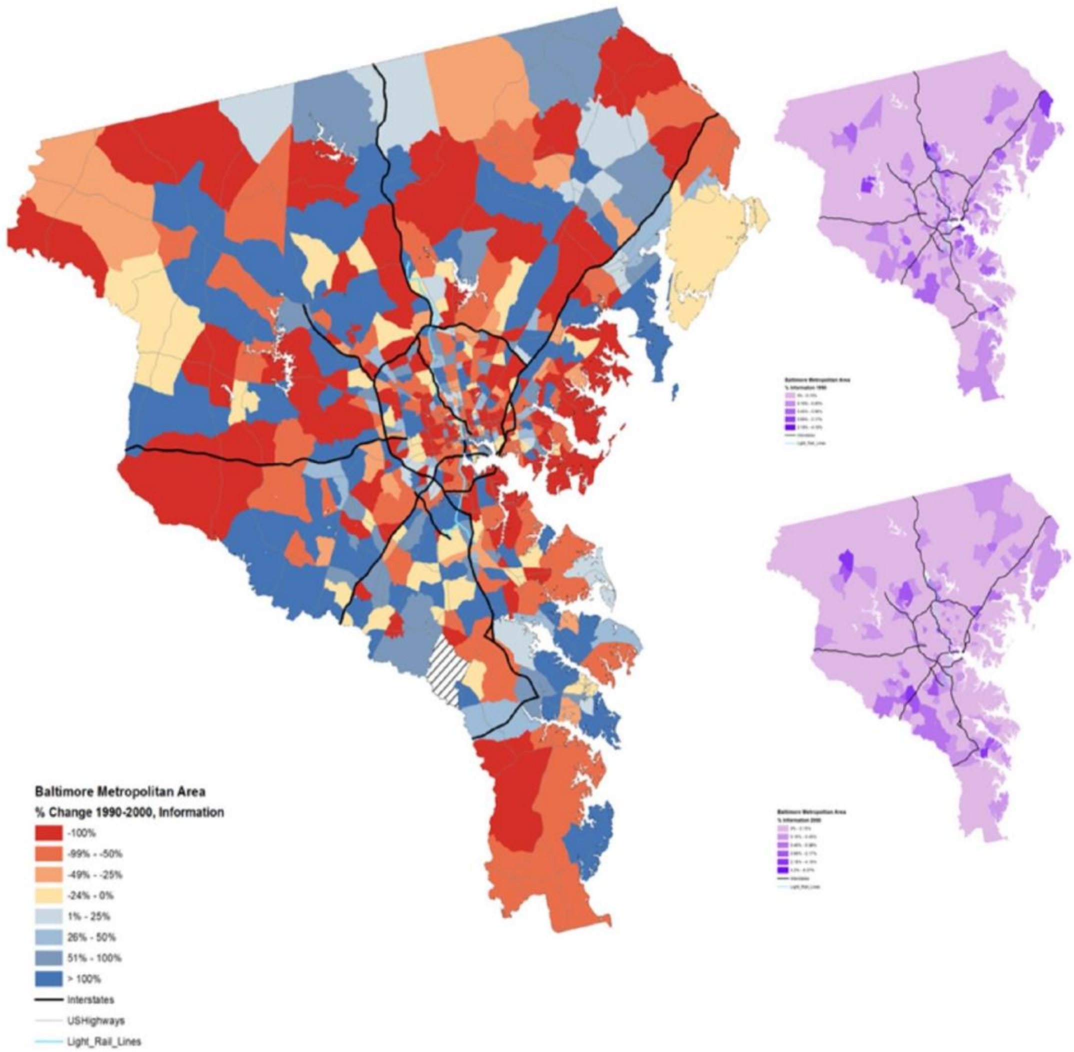

Figure 26. Percent Change in Information Workers, 1990 to 2000. This map shows the change in the percentage of workers employed in an information industry at their place of work between 1990 and 2000. The smaller maps on the right show the percentage of workers in information at their place of work in 1990 (top) and 2000 (bottom).

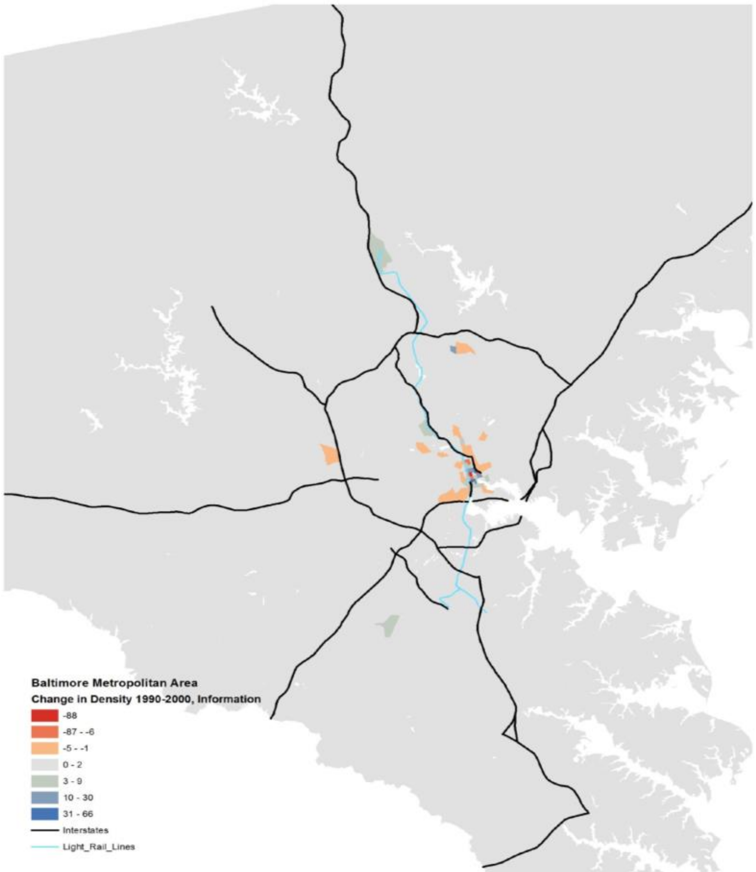

Figure 27. Change in Density of Information Workers, 1990 to 2000.

Table 10

Locations of greatest increase and decrease in percentage of information workers.

Increase	**Decrease**
Annapolis and Arnold	Carroll Park and Carroll South neighborhoods, Baltimore City
Bel Air South	Downtown and Midtown neighborhoods, Baltimore City
BWI area including Linthicum Heights	Dundalk
Columbia	Eldersburg
Downtown Baltimore City	Glen Burnie
Ellicott City	Hawkins Point
Federal Hill and Washington Village neighborhoods, Baltimore City	Inner Harbor, Baltimore City (one section of this neighborhood)
Harbor East and Little Italy neighborhoods, Baltimore City	Pasadena
Glen Burnie	Southeastern Baltimore City (Holabird Industrial Park, Segrit Marine Terminal)
Golden Ring	Sparrows Point
Howard Park/West Arlington neighborhoods, Baltimore City	
Hereford/Monkton	
Jessup	

Table 10 Continued

Owings Mills	
Perry Hall	
Towson	
Westminster	

The list of areas where the percentage of information workers decreased in Table 10 is not an exhaustive list. Many areas that experienced a 100% decrease in information workers were areas that decreased by 20 or less workers. I chose to limit the list to areas with a 50+ worker decrease.

Absolute change in the number of workers showed that Annapolis; Columbia; the Downtown, Inner Harbor, and Woodberry neighborhoods in Baltimore City; Hunt Valley; White Marsh; and Westminster had the highest total increase in workers between 1990 and 2000. Downtwon also had the largest total decrease in information workers, as did Windsor Mill. Overall, the losses and gains in the downtown area balanced each other, and resulted in a small net increase in information workers between 1990 and 2000.

FIRE Industries

Figure 27 shows that FIRE workers were spread out across the metropolitan area. The largest percentage increase in FIRE workers were in areas inside of the city, but also in exurban areas. Table 6 lists the areas with the highest percentage increases and decreases in FIRE workers. Areas at the outer edges of metropolitan Baltimore appear to have some of the highest percentage increases of workers in this industry, but looking closer at the numbers reveals that the large percentage increases area small total increases, from one or two workers to 30 workers. The areas with the highest percentage increase (over 100%), that were also areas that had a total increase

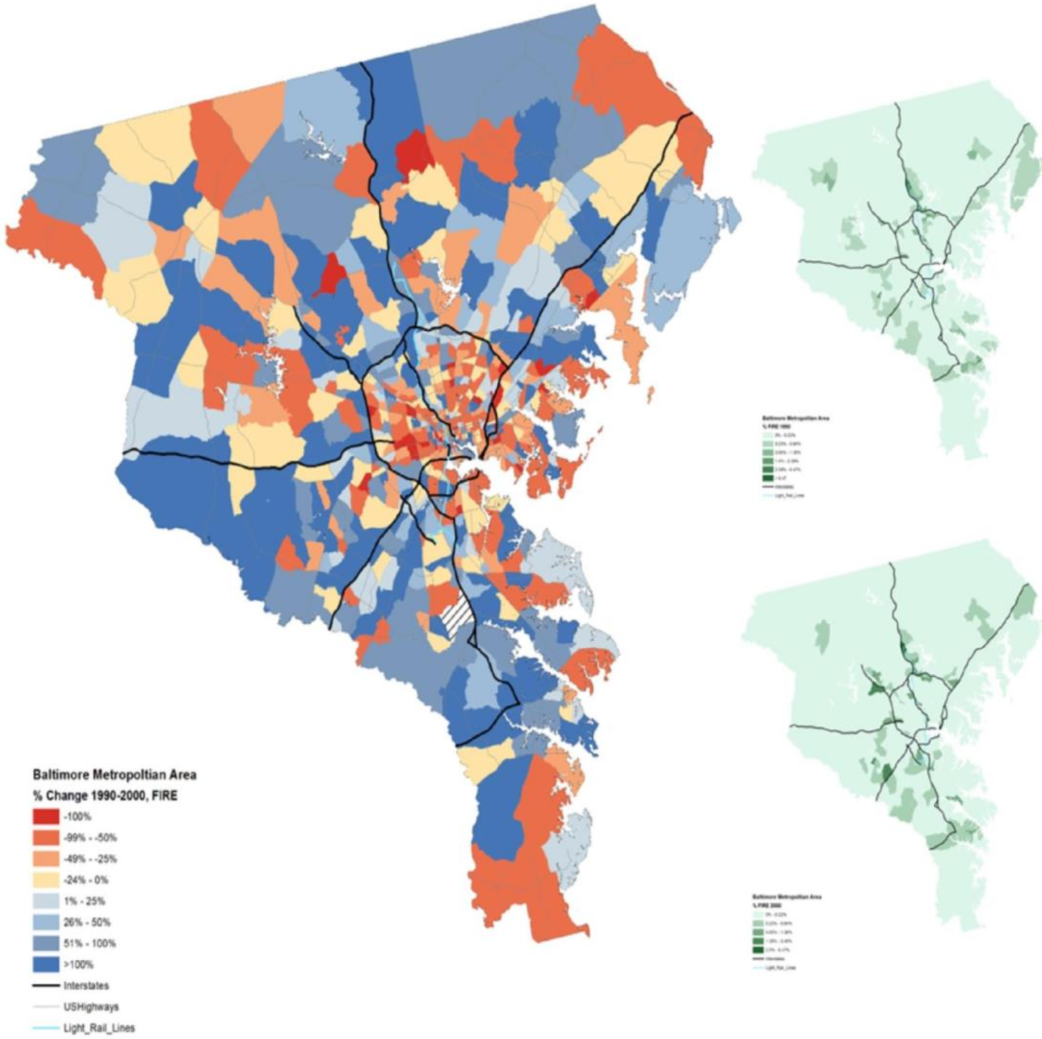

Figure 28. Percent Change in FIRE Workers, 1990 to 2000. This map shows the change in the percentage of workers employed in a FIRE industry at their place of work between 1990 and 2000. The smaller maps on the right show the percentage of workers in FIRE at their place of work in 1990 (top) and 2000 (bottom).

in 100 workers were the areas selected for inclusion in Table 6. The same methods were used to determine which locations to include in the table for the areas of greatest percentage decrease.

The percentage change map (Figure 28) shows the greatest change in worker densities, with decreases in some of the TAZ in the central part of the city, but there were also increases in TAZ spatially located very neat by. This may be attributed to business openings and closures, slightly shifting the location of where FIRE workers are employed, but overall the access to those areas is not greatly changed. The largest percentage increase in FIRE works in Figure 15 appears in the Downtown and Midtown sections of the city, and in Hunt Valley.

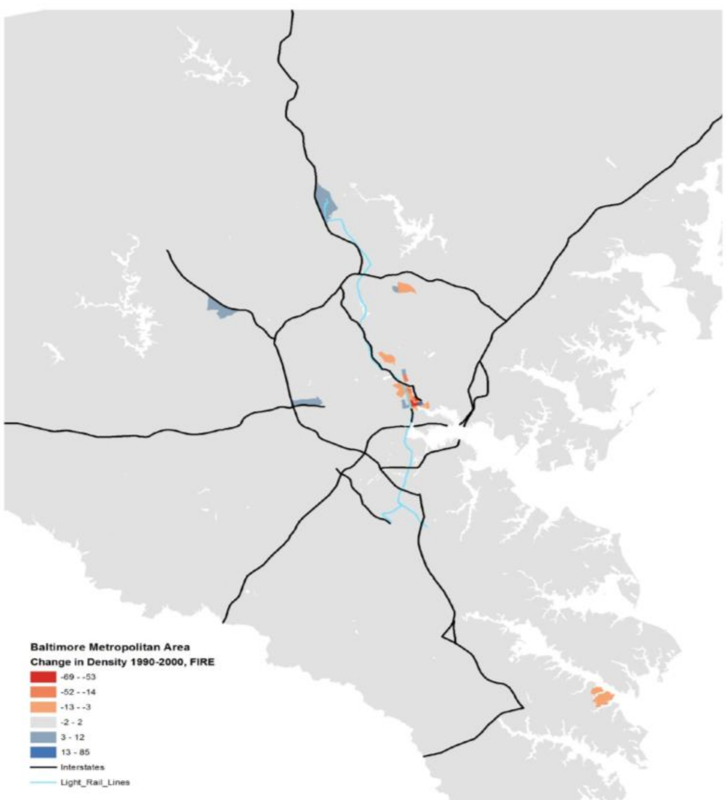

Figure 29. Change in Density of FIRE Workers, 1990 to 2000.

Table 11

Locations of greatest increase and decrease in percentage of FIRE workers.

Increase	Decrease
Bel Air South	Annapolis (small section of this area)
Catonsville/Lansdowne	Brooklyn, Fairfield, Wagners Point neighborhoods, Baltimore City
Cockeysville/Hunt Valley	Central Park Heights neighborhood, Baltimore City
Columbia	Charles Village neighborhood, Baltimore City
Downtown and Midtown neighborhoods, Baltimore City	Curtis Bay area, Baltimore City
Glen Burnie	Gunpowder (near Edgewood)
Haover	Orangeville/East Highland neighborhoods, Baltimore City
Linthicum Heights	Pasadena
North Laurel	Perry Hall
Nottingham/White Marsh	
Owings Mills/Reisterstown	
Severn/Hanover	
Towson	
Woodlawn/Milford Mill	
Westminster	

The data also show that overall total numbers of workers increased the most (500 workers or more) in Columbia, Downtown, Hunt Valley, Reisterstown, White Marsh, and Woodlawn. The areas that lost the highest total workers were also in the downtown area, also Midtown, and Homewood neighborhoods in the city. Outside of the city limits, Annapolis and Ruxton (near Lutherville-Timonium) had the greatest total losses.

Professional, Scientific, Management, Administrative and Waste Management

Growth in the percentage of workers in professional services was spread across metropolitan Baltimore, but the city did not experience growth to the extent that the rest of the region did. The areas with the largest percentages of increase and decrease are listed in table 12. Some of these areas correspond to the locations of Colleges and Universities, for example, the area associated with an increase in the percentage of professional services workers in Catonsville.

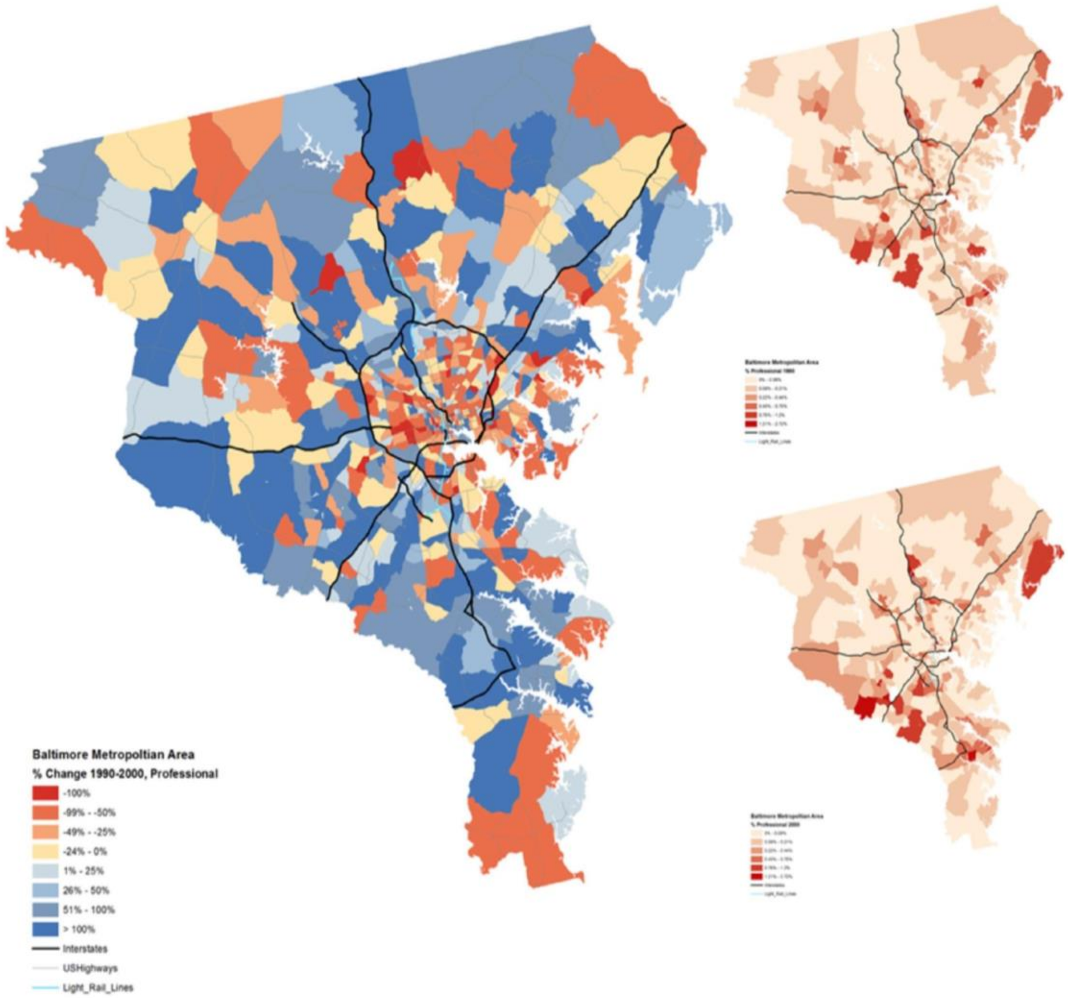

Figure 30. Percent Change in Professional Industries Workers, 1990 to 2000. This map shows the change in the percentage of workers employed in a professional services industry at their place of work between 1990 and 2000. The smaller maps on the right show the percentage of workers in professional services at their place of work in 1990 (top) and 2000 (bottom).

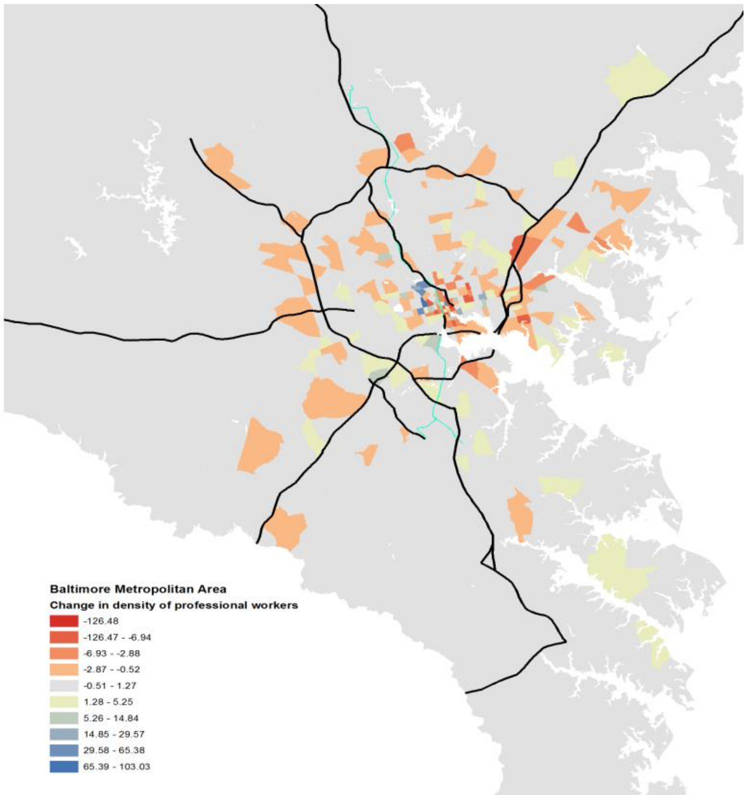

Figure 31. Change in Density of Professional Industries Workers, 1990 to 2000.

Table 12

Locations of greatest increase and decrease in percentage of professional industries workers.

Increase	Decrease
Aberdeen	Clifton-Berea neighborhoods, Baltimore City
Annapolis	Eldersburg
Annapolis Junction	Federal Hill neighborhood, Baltimore City
Bel Air/Bel Air South and Edgewood	Glen Burnie
Brooklandville	Hanover
BWI area	Hunt Valley
Catonsville (CCBC and UMBC)	Oldtown/Middle East section of Baltimore City
Columbia (and surrounding area)	Pasadena
Downtown and Harbor East neighborhoods, Baltimore City	Southwest Baltimore City
Lutherville	Sparrows Point
Middle River	
Odenton	
Owings Mills/Reisterstown	
Sparks/Glenco (Loveton center)	
White Marsh	
Woodlawn/Windsor Mill	

They also correspond to business parks. The Sparks/Glenco area is somewhat rural, but is also where Loveton Center and Highlands Center business parks are located, as well as the headquarters for McCormick.

There were fewer areas that experienced dramatic losses in the percentage of workers employed within professional services, and all were less than 500 total workers. Examining just total workers reveals that only two areas in metropolitan Baltimore experienced a decrease greater than 500 professional services workers: Annapolis and Pasadena. This is in part because this industrial category grew from 92,955 workers in 1990 to 123,063 workers in 2000.

Figure 29 shows that the density of workers in professional services decreased around the beltway and in the downtown area of Baltimore City. This maps also indicates a growth in the density of workers around Baltimore's Penn Station, Reservoir Hill and in portions of west Baltimore. Despite some changes in worker densities in these areas between 1990 and 2000, the area from Downtown, and north along I-83 and North Charles Street remained one of the areas with the highest densities of professional workers in the entire metropolitan area, along with Columbia and Towson. Table 12 describes the areas with the greatest change in workers in more detail.

3.4.3 Employment Centers: Identifying Concentrations of Employment

In Section 3.4.2, I discussed areas within metropolitan Baltimore that had the highest percentage of workers within each industry in 1990 and 2000, and areas that experienced the largest increases and decreases in workers. In this section, I present the results of an employment cluster analysis that helps to identify the location of employment centers in the region, based on worker density in high employment TAZ. I also describe employment trends within some of these clusters.

Table 13 depicts the structure of each county's economies based on CTPP data at the county level. This is a summary of the findings presented in the previous section. A cursory analysis of this data shows that there were some concentrations of employment localized within particular counties. Baltimore City and Baltimore County together accounted for the highest employment in the region in all sectors, but Anne Arundel County also had high employment in retail trade and education, health and social services.

The 2000 data show a shift from the highest employment just with Baltimore City and County to other areas of the region. For example, in 2000, Baltimore and Howard Counties had the highest employment in wholesale trade, followed by Baltimore City and Anne Arundel. Baltimore City and Anne Arundel County had the highest employment in public administration, and transportation and warehousing. And although Baltimore City and Baltimore County had the highest employment in professional services, Ann Arundel and Howard counties also had a high number of workers in these industries.

Table 13

Employment by Place of Work in Metropolitan Baltimore, 1990

Year 1990						
Total Employment	**Anne Arundel**	**Baltimore City**	**Baltimore County**	**Carroll County**	**Harford County**	**Howard County**
Construction	123,072	319,871	496,610	30,309	72,897	82,441
Manufacturing	8,249	23,732	27,303	1,508	1,949	3,366
Wholesale Trade	11,406	42,898	54,987	1,341	1,804	3,288
Retail Trade	4,187	15,035	19,133	433	576	1,197
Transportation and Warehousing	11,754	13,392	35,558	2,716	3,378	5,248
Information	5,798	25,829	31,460	1,098	1,408	2,499
FIRE	3,318	11,066	11,955	594	762	1,213
Professional and Scientific	8,557	64,489	36,561	2,750	3,178	4,069
Education, Heath, and Social Services	9,790	31,755	35,134	2,490	3,108	4,591
Arts, Ent., Recreation, and Food Services	38,400	98,110	101,933	11,599	13,135	19,418
Other Services	8,130	21,919	24,490	2,052	2,524	4,073
Public Administration	5,544	17,337	19,021	1,526	1,899	2,814

Table 14

Employment by Place of Work in Metropolitan Baltimore, 1990

Year 2000						
Total Employment	**Anne Arundel**	**Baltimore City**	**Baltimore County**	**Carroll County**	**Harford County**	**Howard County**
Construction	225,094	341,985	341,660	48,650	75,785	119,968
Manufacturing	16,971	19,311	21,503	5,493	5,897	8,393
Wholesale Trade	17,317	26,507	33,500	5,119	6,487	10,454
Retail Trade	7,696	8,890	10,439	1,482	2,628	9,156
Transportation and Warehousing	25,479	21,326	44,765	6,668	11,415	14,924
Information	14,894	21,414	11,139	1,617	3,105	4,670
FIRE	6,931	11,042	10,659	1,771	1,365	4,286
Professional and Scientific	12,365	26,186	34,864	2,249	3,789	9,626
Education, Heath, and Social Services	23,442	34,898	35,023	3,514	6,672	19,535
Arts, Ent., Recreation, and Food Services	33,558	99,822	75,219	10,663	13,899	20,591
Other Services	15,592	22,173	22,960	3,724	6,180	7,798
Public Administration	10,642	17,080	16,744	3,069	3,830	5,811

Although this data can provide some information in regards to the clustering of employment, the high total number of workers in the most populated counties does not provide much information beyond the information that the higher populated counties also have high employment.

3.4.4 Employment Center Characteristics

The analysis of employment centers provided much more detailed data about the specific locations within counties that attracted the most workers, and the industrial mix of those areas. The location of the employment centers identified for 1990 and 2000 are presented in Figure 31. The analysis resulted in 14 clusters being identified in 1990 and 16 centers in 2000. Employment centers were located in relatively similar areas of metropolitan Baltimore both years, although many of the centers grew to surrounding TAZ over the course of the decade. There were also three centers located in suburban areas in 2000: Bel Air, Columbia, and Westminster, and one center lost between 1990 and 2000: Dundalk. This center was subsumed into another one by the year 2000. These patterns were expected based on the overall trends towards employment suburbanization.

My findings indicate that these employment centers differed in several characteristics including number or workers and industrial makeup; while the largest industrial employment categories remained the same over time in some centers, they shifted in other. The next few paragraphs will describe employment in each of the areas. Calculating the Herfindahl-Hirschman Index (HHI) for each employment center revealed that most centers had a moderate concentration of industries, with most scores between 1,000 and 1,800. The centers that were highly concentrated included Aberdeen, Bel Air (2000 only), Dundalk (1990 only), East Baltimore/Golden Ring (2000 only), and Security Square/Woodlawn, Owings Mills (2000 only). These results will be elaborated in the following paragraphs. I present the centers here in alphabetical order.

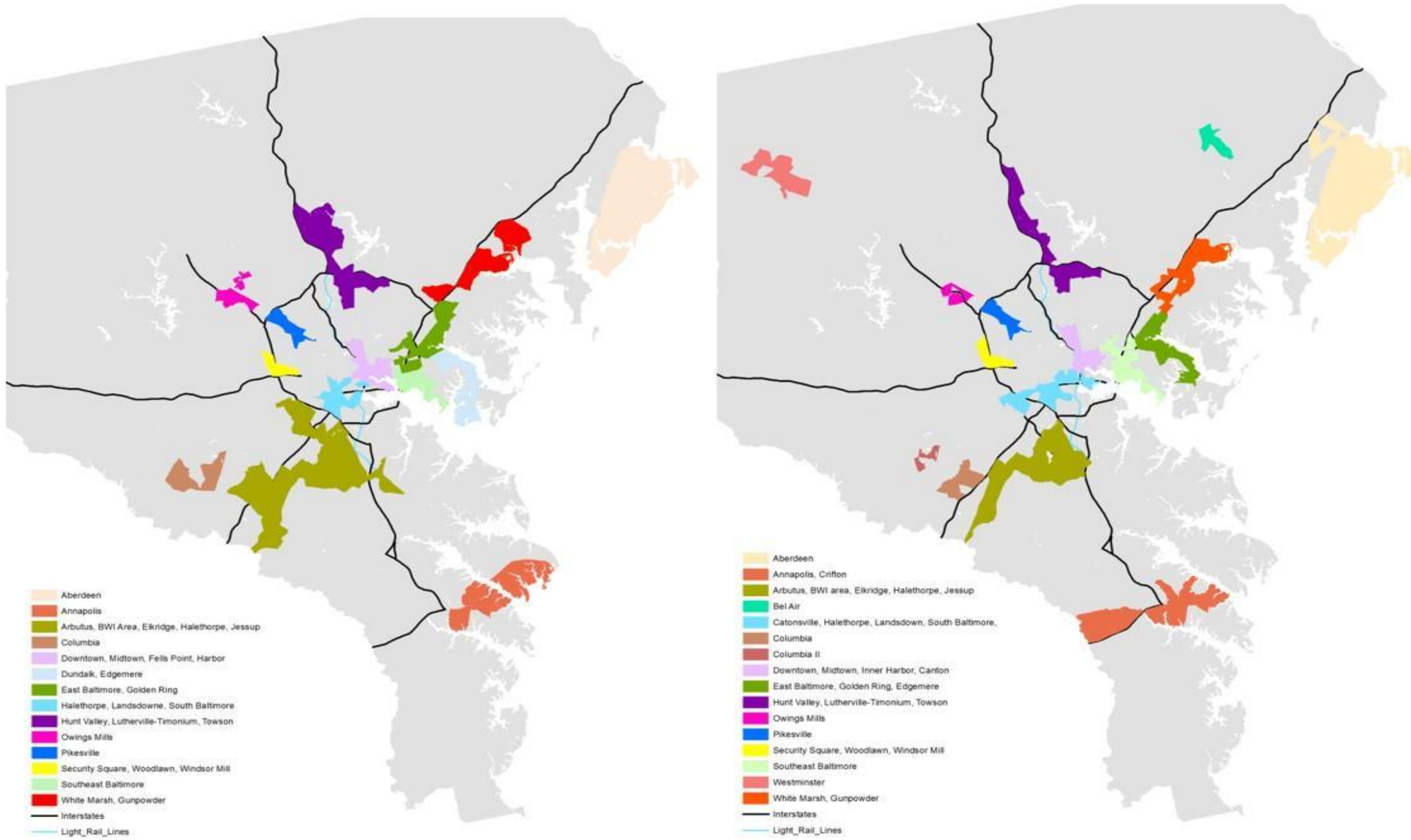

Figure 32. Employment Centers in Metropolitan Baltimore, 1990 and 2000.

Tables 15 and 16 provide summary statistics for the 1990 and 2000 employment centers. The tables rank employment centers from highest to lowest total number of workers. These ranks, along with the maps, show that the region's employment in 1990 and 2000 and still conformed to a metropolitan pattern with a dense center and surrounded by decreasing worker density. This is true overall, although some employment centers do not fit with this pattern (Aberdeen). In 2000, some of the suburban centers shifted higher up in the ranks, as more central centers moved downwards. That, as well as the rise of new employment centers in the suburbs (Westminster, Bel Air), suggests a trend towards decentralization, although the Downtown/Midtown area of Baltimore City continued to employ the highest number of workers. The Downtown/Midtown section of the city, at just 0.29% of the land area, contained 17% of the workers in 1990 and 15% in 2000 in the metro area, and 28% of all workers in the employment centers.

Employment centers and the clustering of workers into these centers are significant to the employment patters of the metro area. These centers represent between 8 and 9 percent of the total land area of the region, but they employed 54% and 61% of the workers in the region in 1990 and 2000, respectively. These findings are very similar to the findings of Giuliano and Small (1991) in Los Angeles in the late 1980s. Centers in that metro region, although important to the economic landscape of the region, did not employ the majority of workers. The Los Angeles region was much more dispersed than that of Baltimore, where over half of all workers worked in a center.

Table 15
Employment centers by rank order, 1990

Rank	Location	Employment	Residents	Employment Density (No./Acres)	Area (ac)
1	Downtown, Midtown	204,888	115,813	42	4,850
2	Hunt Valley	113,190	60,953	9	12,474
3	Annapolis	111,844	38,242	10	11,646
4	Arbutus, BWI	86,028	40,814	3	30,604
5	Southeast Baltimore	41,560	20,698	12	3,561
6	East Baltimore	35,803	29,998	5	7,215
7	Security Square	26,899	2,474	15	1,774
8	Halethorpe*	26,089	35,377	6	4,053
9	Aberdeen	18,888	6,807	1	28,151
10	White Marsh	17,747	11,443	2	9,607
11	Dundalk	17,027	10,710	3	6,225
12	Pikesville*	16,163	17,568	6	2,497
13	Columbia	14,985	7,861	30	501
14	Owings Mills	12,570	4,939	5	2,635

* denotes residential population > workers

Table 16
Employment centers by rank order, 2000

Rank	Location	Employment	Residents	Employment Density (No./Acres)	Area (ac)
1	Downtown, Midtown	174,655	95,245	42	4,201
2	Hunt Valley	94,010	35,254	10	9,116
3	Arbutus, BWI	60,815	11,849	4	16,871
4	Annapolis	47,720	29,145	3	13,817
5	Catonsville*	35,885	44,570	6	6,403
6	Southeast Baltimore	34,015	23,365	6	5,448
7	Columbia I	25,905	8,345	8	3,407
8	White Marsh	24,125	7,825	3	7,829
9	Security Square	22,985	4,560	11	2,015
10	East Baltimore	19,840	13,490	3	6,417
11	Westminster	16,125	5,644	3	6,011
12	Aberdeen	15,265	9,455	0	31,137
13	Pikesville*	14,890	19,615	6	2,497
14	Columbia II	13,715	5,020	13	1,028
15	Owings Mills	13,495	2,455	9	1,551
16	Bel Air	12,620	6,965	6	2,278

Aberdeen

The public administration industry was the top employer in both 1990 and 2000 in this employment center, employing 68% of all workers in 1990, and 37% in 2000. As the percentage of workers in that industry decreased (~3,000 workers), retail and professional services grew (by ~1,100 and 1,200 workers, respectively). The concentration of industries calculated by the HHI revealed that there was a much lower concentration of industries in 2000 as compared to 1990. This is directly related to the decrease in public administration workers and the increase in the percentage of workers working in other industries. This change could be related to an increase in defense contractors and other professional, scientific, management, and administrative workers supporting the work of the base, which would increase the number of professional workers. The increase in retail occurred all across metropolitan Baltimore, and was not unique to this area.

Annapolis

Annapolis was another employment center that had a high percentage of its workers employed in public administration, 21% in 1990 and 16% in 2000. However, a high percentage of workers were also employed in education, health, and social services, 25% in 1990 and 23% in 2000. Therefore, there was less of concentration of public administration workers in this employment center. Professional and retail industries both employed over 10% of the workers both years; and the information, FIRE, and entertainment industries grew a few percentage points over the decade. Between 1990 and 2000, this employment center grew from just those TAZ in and around Annapolis, to encompassing areas west of I-97, including Crofton. This has some impact on the makeup of the workforce, it also indicated a growing importance of the area in the state's economy. Despite encompassing more physical space, the total number of workers in this employment center declined between 1990 and 2000, but the number of residents increased.

Arbutus, BWI area, Elkridge. Halethorpe, Jessup

The character of this employment center was much more industrial than some of the other centers in the region. This center had a high percentage of workers in manufacturing, wholesale trade, and transportation. Over 21% of all of the workers in this employment center in were employed in the manufacturing industry, in both 1990 and 2000. A hot spot analysis of manufacturing workers in the metropolitan region confirmed with over 90% confidence that that this area was a hot spot for manufacturing.

In 1990 the other industrial categories employing a high number of workers included wholesale trade, retail trade, and education, health, and social services. In 2000, the wholesale trade remained a top employer, but the percentage of workers in transportation and professional services became the third and fourth top employers. Transportation had the highest gain in total number of workers, and education, health, and social services had the highest loss. One of the reasons for this was that by 2000, employment shifted such that Catonsville became part of the Halethorpe employment center, this removed many education workers from the cluster when the Community College of Baltimore County (CCBC) and the University of Maryland Baltimore County (UMBC) joined the Halethorpe center.

Bel Air

Bel Air arose as an employment enter in 2000. Public administration accounted for over 50% of all workers, followed by retail at just over 13%. The high percentage of workers in this one industry resulted in a score over 1,800 on the HHI, which indicated a high market concertation. Many of Harford County’s local government offices are located in Bel Air, which would account for the higher percentage of workers in that center working in public administration.

Columbia

My analysis resulted in one employment cluster within Columbia in 1900 and two centers in 2000. The industries employing the highest percentage of workers in the first center were education, health, and social services, FIRE, and retail in 1990. In 2000 professional services overtook FIRE as a top employer. In 2000, the second cluster in Columbia had a high percentage of workers employed in education, health, and social services, professional services, FIRE and retail, similar to the other cluster. One of the reasons for the change in employment percentages is related to how the clusters were formed in the analysis. In 1990, the *Arbutus, BWI area, Elkridge. Halethorpe, Jessup* employment center was very large and incorporated many areas along I-95, including parts of Columbia. By 2000, workers in these areas of Columbia became more concentrated and a new cluster emerged, becoming a new employment center in Columbia.

A hot spot analysis of information, FIRE, and professional workers revealed that parts of Columbia were hot spots for information in 1990, and in both 1990 and 2000, areas of this employment center were hot spots for FIRE and professional workers.

Downtown, Midtown, Fells Point, Inner Harbor

Education, health, and social services employed the highest percentage of workers in this center in both 1990 and 2000. The was an expected finding as medical and educational institutions are the top employers in the city. In 1990, both FIRE and public administration employed approximately 12 percent of the workers in this center. In 2000, professional services grew by over 5,000 employees, and employed just over 13% of the workers in this center. These figures show that education and heath were not solely the most important industries in the city, but that the city is still important as a financial and business center in the region. The hot spot analysis showed that Baltimore City was a hot spot for information, FIRE, and professional services, but the confidence level of hot spot declined between 1990 and 2000. This suggests the importance of the center in terms of these industries though still high, may be declining somewhat.

Dundalk, Edgemere & East Baltimore, Golden Ring, Edgemere

The employment cluster located in *Dundalk and Edgemere* in 1990 was subsumed by the *East Baltimore, Golden Ring* employment center in 2000. In 2000, the latter employment cluster included Edgemere, but Dundalk dropped off. Manufacturing employed the highest percentage of workers in the Dundalk and Edgemere center in 1990, over 56% of all workers. A hot spot analysis confirmed these areas were hot spots for manufacturing in the metro area. The second highest percentage of workers was in retail, at 11%, with the rest of the workers divided among the remaining categories at much lower percentages. Because of its inclusion of Edgemere in the 2000 cluster, the *East Baltimore, Golden Ring, and Edgemere* employment center also employed a high percentage of manufacturing workers, 36%. This was again followed by retail. In 2000, this employment center had a high score on the HHI, indicating that this center came to be characterized as primarily a manufacturing center. This was a bit different from the employment center in 1990, which had the largest percentage of workers employed in public administration, education, health and social services, and then manufacturing.

In addition to adding Edgemere, another reason for this change is because in 1990, this employment center included the area where Johns Hopkins Bayview is located, but in 2000, that became part of the *Southeast Baltimore* employment center, taking the education, health, and social services workers out of this cluster. Although this explains the decrease in education, health, and social services, it doesn't fully explain the decrease in public administration.

Halethorpe, Lansdowne, South Baltimore (and Catonsville in 2000)

In 1990, the percentage of workers employed in the education, health and social service industry and manufacturing were close to equal, with both industries employing just over 5,000 workers, or 21% of the total workers in this employment center. In 2000, the number of workers employed in manufacturing decreased by over 1,000 total workers, and the percentage of those employed in the industry dropped to just over 14%. At the same time employment in education, health, and social services grew to employing over 30% of the total workers. This is attributed to the addition of Catonsville within the cluster, including workers employed at CCBC and UMBC. Employment in the transportation and warehousing sector also grew by 2000, making it the third largest employer (by percentage).

Hunt Valley, Lutherville-Timonium, Towson

Between 1990 and 2000, the spatial area represented by this cluster became more concentrated along interstate 83 and moved further north toward Hunt Valley and Cockeysville. Education, health, and social services employed the highest percentage of workers in 1990 and 2000. In 1990, the other industries that were large employers included manufacturing, FIRE, and retail, in that order. In 2000, manufacturing declined and was no longer one of the top three largest industries in terms of the percentage of workers employed. Also by 2000, professional services employed the second largest percentage of workers, growing from just 9% of all workers to 15%.

Towson and Hunt Valley/Cockeysville were hot spots for retail and information industries in 1990, but the Towson area was not part of either hot spot in 2000. Towson, Lutherville-Timonium, and Hunt Valley/Cockeysville were also hot spots for the FIRE and professional industries in 1990 and 2000.

Owings Mills

In 1990, nearly 28% of the workers in this center were employed in manufacturing, but by 2000, that dropped to just 19%, while FIRE became the top employment sector, employing 35% of the workforce. The HHI score for this employment center in 2000 indicated it had a high market concentration of FIRE workers. The 2000 hot spot analysis revealed this area to be a hot spot for FIRE employment in 2000. Retail and education, health and social services employed a moderate number of workers, around 12-13% each year. Professional services rose to become the industry with the third highest percentage of workers by 2000, employing 14% of all workers.

Pikesville

In 1990, the industries with the highest percentages of workers in this employment center included education, health, and social services, retail, and public administration. In 2000, education, health, and social services remained the top employers, but retail tied with professional services as the second largest sectors, and other services tied with public administration as the third largest sectors. This indicates an increased diversity in the industries that were located in the area.

Security Square, Woodlawn, Windsor Mill

The HHI results specify that this area had a high market concentration, higher in 1990 than 2000. The data reveal that the industry with the highest percentage of workers in 1990 and 2000 was public administration. This was related to the Social Security Administration, which is located in Woodlawn. In 2000, employment in the area became a more diversified with retail moving to the position of employing the second highest percentage of workers. This area was also a hot spot for retail in 2000. Contributing the rise in retail employment was the revitalization of Security Square Mall which added retailers to the area ("Security Square mall may change," 1997) and the development of strip malls and big box stores along Security Boulevard.

Southeast Baltimore

Public administration employed the highest percentage of workers in this employment center in 1990, but in 2000, manufacturing was the top employer. The data indicate a very high loss of public administration workers during this decade. The percentage of workers employed in education, health, and social services increased between 1990 and 2000, but this was most attributed to the center adding Johns Hopkins Bayview in 2000. That TAZ was previously associated with the *East Baltimore, Golden Ring* employment center.

Westminster

Part of Westminster became an employment center in 2000. Education, health, and social services employed the highest percentage of workers, followed by retail. This area become much more populated between 1990 and 2000, which accounts for higher employment in these sectors. This area was a hot spot for information in 1990 and 2000, and retail in 2000.

White Marsh, Gunpowder

Between 1990 and 2000, the TAZ included in this employment center decreased slightly, and those that were once part of Edgewood were not part of the 2000 cluster. In 1990, the industries with the highest percentage of workers were manufacturing and retail. This shifted to education, health, and social services, along with retail in 2000. The loss of manufacturing was partially to the loss of those TAZ that were originally included in 1990. However, manufacturing declined in all of the TAZ between 1990 and 2000, so even if they had been included, manufacturing still would not have been a top employer in this center in 2000.

The employment centers identified in this chapter are similar to the findings by Knapp & Ding's (2014) for the region in 2007. This confirms the findings in this chapter and also suggests that there was little change in the location of employment centers since the year 1990. Because of the limitations of their data, they were not able to do a time series analysis to describe changes within each center over time. For future research, I suggest carrying through the analysis with 2010 CTPP data to assess how these centers have changed since 2000 in regards to both spatial location and employment structure.

3.5 Conclusions

Data from the Bureau of Economic Analysis (BEA) provided county-level data about changes in the local economy, whether employment increased or decreased over time, and the number of jobs or workers employed within each sector. However, the data did not provide any information regarding jobs or employment at a sub-county level, information that is critical for understanding how the shifting labor market can impact workers' ability to access employment opportunities.

Using data from the CTPP to map workers at their place of work made it possible to explore employment trends at a sub-county level. The CTPP data provided information about places within the metropolitan region where employment (as measured by the number and percentage of workers) increased or decreased over time. Analyzing changes at the sub-county level removes the assumption that an increase or decrease in opportunities within a county will result in uniform access to those opportunities. Though beneficial to a county's economy, a growth in jobs does not benefit every resident equally.

Data at level of the metropolitan region, county, or city-suburbs can provide information about overall trends in employment at that level of analysis. For example, Wright and Dwyer (2003) noted an increase in retail and personal services on the bottom quintile of the employment structure and business services and high-tech jobs at the top quintiles for the entire United States, and Doussard et al. (2009), note similar changes for the Chicago metropolitan area. The BEA data for metropolitan Baltimore show an increase in retail employment and services within metropolitan Baltimore between 1970 and 2000, but the limitations of the data are such that no further conclusions can be drawn in regards to job polarization. The CTPP data provided more information in these regards.

The CTPP data presented an overall increase in industries that would be included in those higher-quantile jobs within the metropolitan area; professional services, which includes such activities as legal services, accounting, scientific research, administrative support, and management (42% growth), and the information industry which, includes higher technology industries such as internet publishing, telecommunications, and data processing and hosting (31% growth). Lower growth was revealed in retail (6%) and entertainment (7%). The CTPP data help to specify the ways in which these patterns within not uniform across the region.

Between 1990 and 2000, the largest percentage gains in the outer suburbs were in information (52%) and professional services (53%). The inner ring suburbs and the city also saw a growth in professional services, 19% and 7%, respectively; but they lost workers in the information sector over the course of the decade. Retail increased in the outer suburbs (7%) and the inner-ring suburbs (2%), but declined in the city (-33%). And, entertainment workers grew only a small amount in the outer suburbs (2%), and declined in the inner-ring suburbs (-18%) and city (-1%).

The data also revealed a widespread reduction in manufacturing employment. Between 1990 and 2000, much of that reduction was focused in and around Baltimore City. If viewed in terms on the city, inner ring, and outer suburbs only, the city lost as many manufacturing workers as all of the areas outside of the inner ring suburbs between 1990 and 2000, just over 21,000 workers. This represented a 47% loss in manufacturing workers in the city, a 36% loss of manufacturing workers from the inner ring suburbs, and a 27% loss of manufacturing workers from the outer suburbs. The city and inner ring suburbs also lost very high percentages of wholesale trade workers, 46% and 35%, respectively; and transportation, utilities, and warehousing, 25% and 24% respectively.

It is difficult to definitively conclude from this data whether the results of this analysis support the findings that employment gains in services sectors occurred in those categories described as belonging to the top and bottom quintiles (Wright & Dwyer, 2003; Doussard, et al., 2009). It does appear that professional services workers increased across the metropolitan area, but retail and entertainment were varied. The smaller the until of analysis, the more varied the results. This is one reason that analyzing the change in employment at the TAZ level is so important if the goal is understanding intra-metropolitan change. For example, although not as a dramatic a loss as inside the city, areas in inner-ring and outer suburbs lost manufacturing workers, including Annapolis, Aberdeen, and the White Marsh & Gunpowder areas. At the same time, the BWI area, the southern I-95 corridor (Columbia and Savage), Owing Mills, Hunt Valley and Lutherville-Timonium retained manufacturing workers between 1990 and 2000, despite the fact that these areas would not typically be portrayed as “industrial.” These findings have implications for job accessibility, which will be measured in the next chapter. They also have implications related to spatial justice within metropolitan Baltimore.

This chapter has shown the impact of changes in the labor market on the number of workers employed in each industrial category, and the locations where employment rose and fell in each category. Because the changes are quite vast, I defined employment centers within the metropolitan area and described the changes within those spaces between 1990 and 2000. This analysis revealed that suburbanization of employment is occurring in the metropolitan region. That trend can be seen in the creation of new employment centers in Bel Air and Westminster, and in some of the expansion of employment centers closer to the central city. For example, Halethorpe, Lansdowne, South Baltimore, and Catonsville begin to form one large employment center, and those areas are still expanding to include the BWI employment center, emphasizing the importance of suburban employment centers in the regional economy.

The spatial mismatch literature identified that employment suburbanization had the potential to impact workers; central city, African-American workers specifically. This analysis revealed that suburbanization has been taking place in metropolitan Baltimore, but also that employment measured as the total number of jobs is highest in the central city. In metropolitan Baltimore, the highest percentage or African-American's live where the highest number of jobs are located. This could signal to some that spatial mismatch is not an issue in the region, despite the increasing suburbanization of jobs. However, more investigation of this is needed, because as this chapter showed, manufacturing jobs decreased in the central city and surrounding area since 1970, while public administration, professional, information, and education, health and social services jobs grew.

The next step in the analysis will be taking a closer look at how those changed impacted access. In the next chapter, I address these questions by looking at changes in commuting costs from particular neighborhoods and unemployment rates within those neighborhoods.

Chapter 4: Measuring Employment Access

4.1 Introduction

In Chapter 2, I explored the spatial distribution of socio-demographic groups across the Baltimore metropolitan area, identifying neighborhood clusters for the years 1970, 1980, 1990, and 2000. In Chapter 3, I presented an analysis of the changes in the employment levels of workers in every industrial category in the Baltimore metropolitan area between 1970 and 2000, and examined how those employment levels impacted the spatial distribution of jobs and workers, with particular attention paid to the years 1990 and 2000. I identified 14 employment centers in 1990 and 16 centers in 2000, within the city and suburbs of the region. In this chapter, I draw upon commonly used measures of accessibility and spatial proximity between housing and jobs to identify the commuting sheds of workers in each residential cluster and employment centers via car and bus in 1990 and 2000. I highlight the changes in commuting patterns between the two decades, and discuss those changes in relation to employment accessibility. Along with this analysis, I present and test a novel approach to calculating time and distance measures between travel nodes.

4.1 Background

According to Helling, (1998), new spatial patterns of opportunity, including access to employment, have resulted from the growth of residential and commercial activities in suburban areas. These can result in an urban landscape in which "individuals or groups may be disproportionally disadvantaged in terms of their proximity or access to those opportunities" (Scott & Horner, 2008, p. 92). Residential and workplace decentralization have the potential to reduce commute times and distances by locating firms closer to workers in the suburbs. Alternatively, it has the potential to make commute times and distances longer for workers residing in the central city. Because public transit has not kept pace with new patterns of development in terms of connecting workers to jobs (Tomer et al., 2011), the most profound impact of employment suburbanization is on workers who rely on public transportation. And this is not limited to just city residents, it impacts transit-dependent suburban residents as well. Harlan (2015) suggests that transit-dependent suburban residents face greater access challenges than those in the city, due to the radial patterns of public transportation.

Because profit-maximization drives businesses location decisions, not social welfare or equity concerns (Scott & Horner, 2008), worker accessibility is not necessarily a primary factor in firms making those locational decisions. That leaves matching workers to jobs in the hands of state, city, and local government planning offices. What seems like a straightforward task is made complex by the different needs, concerns, and priorities of the residents living within the metropolitan area.

The primary concerns driving planning offices typically revolve around issues of sustainability and mitigating commuting externalities such as congestion and pollution. The solution then is either to encourage auto commuters to use alternative means of transportation, or roadway improvements that reduce travel time. Planners have also suggested alternative land use patterns to reduce the environmental effects of long commutes and congested roadways, such as increased development around employment centers and transit hubs, and creating more mixed-use development (Knap & Ding, 2014).[15]

In Maryland, the Department of Planning has encouraged polycentric development—the development of areas within and around employment centers—to meet sustainability goals, including controlling sprawl and reducing vehicle miles traveled (Knapp & Ding, 2014). However, the impact that this polycentric development has had on employment access for various socio-spatial demographic groups is unclear, or whether encouraging this type of growth results in benefits for workers in addition to the environment.

Although employment center development may have beneficial environmental impacts, other studies suggest that commutes to employment centers are on average longer in terms of distance and time, and that the larger the center, the longer the commute (Guiliano & Small, 1991). Therefore, sprawl may be contained by development of jobs and residences in and around employment centers, but if the result is longer commutes to those centers, other environmental impacts, such as increased greenhouse gas emissions and runoff issues will become more problematic.

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[15] Knapp and Ding (2014) explored the commuting shed of 23 employment centers in the Baltimore-Washington metropolitan region, based on data from 2007. In their article, the authors analyzed the role of economic centers in developing employment in the Baltimore-Washington region and promoted continued development of these centers as a means to achieve sustainable development. Their findings showed that two out of the three centers attracting the highest share of public transit trips were centers in the DC metro area: Rockville and Bethesda. Cockeysville was the center with the highest share of public transit trips in the Baltimore metro area. This result is expected due to the nature of the DC area's transit system, which is much larger in scope than Baltimore, particularly with regards to its metro system. Although many residents in metropolitan Baltimore travel to the DC region for work, the majority of worker-residents in metropolitan Baltimore remain in the metro area for work.

Sustainable development and mitigating the impacts of automobile travel on the environment are important goals, but often this body of research does not focus on commuting behaviors of different socio-spatial groups, specifically, the transit dependent. Nor does this research regularly question the possible impacts that suggested planning changes may have on various spatial and socio-demographic groups. The emphasis on environmental issues plays a role in concentrating transit spending dollars on projects that benefit those who already have transit flexibility, not on projects that would benefit the most transit-dependent groups of people (Garrett & Taylor, 1999).

4.1.2 Overview of the Chapter and Contribution to the Literature

Accessibility measures are a first exploratory step in understanding people's needs (Reggiani, Bucci, & Russo, 2011) and evaluating social inequalities. Studies measuring the job accessibility and employment outcomes of various individuals or groups have often concentrated on the accessibility of 'low-skilled'[16] workers and/or African-American workers, particularly since Kain's (1968) publication on spatial mismatch. Some of these studies set out to empirically test the spatial mismatch hypothesis (Houston, 2005; Inlanfeldt & Sjoquist, 1991; Taylor & Ong, 1995). Accessibility studies related to social justice typically control for race and/or ethnicity, and they identify the commuting patterns and options among those various worker groups. Other studies (Tomer et al., 2011) have focused on just the transit-dependent population of a metropolitan area in measuring job accessibility.

[16] As discussed in Chapter 3, the term "low-skill" is problematic, because many occupations and industries given this label are in fact jobs that demand a great deal of skill. However, the term is often applied in the literature.

The present analysis differs from those that test the spatial mismatch hypothesis and those that focus on just one population group, whether it be minority workers, workers of a particular age, gender, or education/skill level group, or workers using just one primary mode of transit. The focus of the present study is on multiple spatial groups. This chapter investigates whether the neighborhood that a person lives in can result in different access. This research draws from the concepts of neighborhood effects and spatial justice, wherein space is the factor that impacts access to employment.

In this chapter, I am not suggesting that space plays a more important role than the effects of race, class, or ethnicity on employment accessibility. In many instances, Baltimore included, factors including residential neighborhood, race, and economic status are closely connected, and in addition, residential spaces can be the product of racialized processes. It is not possible to completely separate space, race, ethnicity, education, and other socio-demographic attributes, nor always desired to discuss these factors separately.[17] One benefit of the neighborhood typology analysis performed in Chapter 2 is that it accounted for the high correlation among socioeconomic and demographic variables and allowed for identifying the relationship among those variables, and which variables had a strong influence on the differentiation manifest between neighborhoods in the metropolitan area. The PCA analysis allowed me to determine the primary characteristics of the neighborhood types. Therefore, in this analysis, when I discuss worker access from the various

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[17] As discussed in Chapter 2, some neighborhood types are dominated by a particular racial or ethnic group, but this chapter does not carry out a separate analysis for each racial or ethnic group. Analysis of subgroups within those neighborhood types is possible with the data presented in this chapter and suggested as future research.

neighborhood types, the socioeconomic and demographic variables are part of those neighborhoods and those spaces. It is important to identify the differences though an accessibility analysis to better understand people's needs in various communities.

In section 4.2 of this chapter, I will draw examples from the literature to discuss some of the different methods employed in measuring accessibility and how I define accessibility for the purposes of this research. This literature review does not cover all aspects of the vast literature related to accessibility and transportation analyses.[18] There are many reviews of the varying methods for analyzing accessibility (see Bhat et al., 2000; Guers & Wee, 2004, Handy & Niemeier, 1997), as well as the benefits and drawbacks of different measures. The discussion in this chapter is meant to introduce basic concepts and allow the reader to understand the methods that informed my research.

In section 4.3, I present the methods I used to calculate access from each of the residential clusters identified in chapter 2 and to each of the employment centers identified in Chapter 3. In addition, I describe a novel methodology for calculating travel distance and time between transportation nodes. The results of the analyses are presented in section 4.4.

[18] Black (2003, p. 3) noted, "it would be easy to fill volumes with various travel and flow models found in the literature."

4.2 Investigations of Accessibility

4.2.1 Employment Access for Specific Spatial Groups: Inner-city residents, Minorities, and 'Low-Skilled' workers.

Urban and rural areas have different histories and different characteristics. Access to employment poses different kinds of problems in the two areas. Jargowsky (1997) stated that "many issues, such as the suburbanization of jobs or the fiscal strains between city and suburbs, are of concern only in urban areas" (p. 19). According to Sassen (1990), a major focus of the sociological literature on the study of economic restructuring has been on the urban manifestations of these processes, in particular, the acceleration of racial and ethnic segregation in large cities, and the rapid decline and the suburbanization of low-skilled jobs.

Research indicates that job accessibility is more difficult for workers with less training and education, or those that are often referred to as "low-skilled" workers. Korsu and Wenglenski (2010) attribute this to two phenomena: workers living in neighborhoods with poor job accessibility, and neighborhood effects. Poor accessibility, they state, is due to the spatial separation of low-skilled workers' residences and low-skilled job opportunities—often referred to as skill mismatch—and the necessity of automobiles to reach workplace locations because of the poor development of U.S. transit options.

Kasadra (1993) and Hess (2005) found that low-skilled workers typically have lower numbers of car ownership. This makes workers more dependent on public transportation and therefore may limit the job opportunities available to them, more so if they are making trips from suburban origins to suburban destinations. Kasadra

(1993) also suggested that the skill and education demands for jobs in the city were higher than those in the suburbs; therefore, low-skilled workers are generally required to travel further to reach jobs that match their skill level.

Racial segregation can also play a role in access to employment. Spatial mismatch literature has questioned whether residents in segregated neighborhoods were “at a disadvantage in terms of equal opportunity and access to employment” (Lehman-Frisch, 2011, p. 77), and many studies have found that African Americans have longer commute times than comparable white workers (Gabriel & Rosenthal, 1996; Preston & McLafferty, 1999). Mouw (2002) noted that the racial segregation of workers has remained consistent over the time, but the spatial distribution of employment has not. However, debate continues as to the causes of this lack of employment opportunity. Researchers have hypothesized that employment prospects for inner-city, minority residents have become more limited as jobs are increasingly located outside of cities (Kain 1968, 1992; Ihlanfeldt, 1992, 1994; Mouw, 2002; Wang, 2003). In addition, individual socioeconomic factors, such as car ownership, limit opportunities (Taylor & Ong, 1995), particularly for low-income and minority residents (Wang, 2006), and can impact access for inner-city workers.

Neighborhood socioeconomic status plays a role in the employment rates of residents (Wilson, 1987, 1996), and racism in the job market limits black employment in suburbs (Kain, 1968). Wilson (1996) documented the role of high rates of joblessness in inner-city ghetto neighborhoods, which have resulted in a cycle of joblessness, as well as increased and concentrated levels of poverty. In sum, limited employment access for minority workers have been related to both spatial and non-spatial issues. Wang (2006) notes that this makes access a social justice issue. Access to employment centers and transportation is a social and spatial justice issue.

The hypothesis that spatial distance is a limiting factor in employment outcomes for minority residents in inner cities has generally been supported by research examining labor market outcomes of black and white city vs suburban residents, and research investigating differences in transportation access by race, residential mobility, and unemployment levels (Gabriel & Rosenthal, 1996; Stoll 1999; Immergluck, 1998; Mouw 2002). Commute times and unemployment for black workers living in the central city have been found to be higher in studies by Holzer, (1991), Ihlanfeldt (1992), and Kain (1992). Immergluck (1998) found that African-American neighborhoods in Chicago had a lower number of workers who worked close to home.

However, other research (Ihlanfeldt, 1994; Ihlanfeldt & Sjoquist, 1991; Wang 2003) has shown that minority city residents can be located closer to a higher number of jobs than suburban residents.[19] As will be described in the results section, this research also found that central city residents had access to a higher number of employment opportunities as defined by proximity to jobs. In such instances, these poorer employment outcomes can be attributed to other types of access restrictions, but those factors are more likely to be non-spatial attributes. For example, because many inner-city residents rely on public transportation, their commute times may be longer, even though they are spatially closer to the employment opportunities;[20] thus

[19] Wang (2007) found that neighborhoods with greater socioeconomic disadvantage were closer in proximity to jobs in 1980, but by 2000 lost that advantage.
[20] This phenomenon is referred to as automobile mismatch.

the number of employment opportunities available to them within a reasonable commute time is limited.

Handy and Niemeier (1997) suggested accessibility is more accurately measured if the measures included some differentiation in the characteristics of the individuals or households, for example, measuring accessibility for different income/wage groups or occupation groups. Horner and Mefford (2007) proposed exploring how the ‘jobs-housing’ balance impacted the commuting experience of minorities. The authors claim that the spatial mismatch literature has not focused on “the underlying structure of jobs and housing that shapes commutes” (p. 1422), meaning that they do not focus enough on changing urban form. They argue, for example, that past studies have ignored the broader spatial distribution of workplaces and the subsequent effects on commuting patterns by focusing too narrowly on one firm, ignoring workplace altogether, or not analyzing data at a detailed enough spatial scale. They claim that at a metropolitan scale, jobs and housing are relatively balanced, but at a smaller scale, some parts of a metropolitan area will have many more jobs than houses and vice versa because of the suburbanization of jobs and development of employment centers.

To overcome these issues, Horner and Mefford (2007) assessed the relationship between residences and workplaces for an entire metropolitan area using TAZ level data. Rather than determining job accessibility by neighborhood, they created an index of worker-job separation to apply to various minority groups. They found larger commute ranges for non-Hispanic whites who drove alone as compared to other non-Hispanics who drove alone. This also revealed that non-Hispanic black commuters who drove alone have more spatially clustered home and work areas. Additionally, although non-Hispanic blacks were the largest public transit users, the same findings were true for non-Hispanic black commuters. This finding came despite fixed bus routes, which suggests something is limiting employment access other than just the spatial configuration of jobs and housing.

Other non-spatial factors limiting employment access include the education and skill level of those employment opportunities in close proximity to city residents. For example, the employment opportunities physically located the closest may not fit the education or training level of the job seeker. Employment opportunity barriers may also be related to housing discrimination in suburban areas, limiting the ability of minority residents to move closer to suburban employment opportunities, or discrimination in the job market (Ihlanfeldt, 1994; Kain 1992).

The policy solutions related to solving proximity issues include moving low-income and minority inner-city residents into the suburbs, where more low-skill jobs are presumed to be located, targeting job creation within specific neighborhoods, or improving public transit mobility. Metropolitan areas that undertook programs to move city residents to suburban locations relocated residents who were highly transit-dependent. This resulted in residents having continued trouble accessing employment opportunities due of the inadequacy of the suburban public transportation systems (Ihlanfeldt, 1994; Wang, 2006).

Targeted development with the goal of job creation has largely consisted of creating enterprise zones in which tax breaks and other types of assistance and incentives are given to developers in economically depressed areas. This can result in job expansion within the zone, but often at the expense of jobs elsewhere. In addition, the residents of those special economic zones are typically not the beneficiaries of the newly created jobs or the tax breaks (Ihlanfeldt, 1994). Critics of redevelopment projects in Baltimore argue that taxpayer money was used to develop businesses, but that they came with little to no gain for the residents of the neighborhoods in terms of increased employment or job training. This includes the development of M & T Stadium, Harbor Point, and University of Maryland BioPark (Berkowitz, 1987; Shen, 2016).

An alternative to large development projects is investment in transit. Public transportation improvements can help move people to employment opportunities more quickly and efficiently, but long commute times still plague many city residents despite these improvements. This is particularly an issue in the Baltimore metropolitan area, where bus transportation is slow and inconsistent, and few other public transportation options exist. It is unclear whether improved public transit mobility can positively affect the employment status or overcome the spatial disadvantages that some low-income workers face.

Although there has long been a focus on accessibility for residents in central cities, with particular attention paid to low-income groups, ‘low-skilled’ workers, and/or minority workers, job access is also an issue in suburban and exurban areas, where public transit does not extend and reliance on a car is paramount to reaching work.

4.2.2 Definitions of Accessibility

Geographical research related to commuting and land-use generally fall into one of three categories: the jobs-housing balance, excess commuting, and accessibility. The jobs-housing balance analyzes the relative locations of jobs with respect to housing (Giuliano & Small, 1993; Horner, 2004a, 2007). The study of excess commuting compares observed commuting patterns, including times and distances, with theoretical minimums derived from a scenario in which all workers chose work locations that minimized their commutes (Horner, 2004a).

Accessibility studies, and accessibility itself, have numerous descriptions in the literature. Guers and Wee (2004) stated that accessibility is often poorly defined and poorly measured and that "finding an operational and theoretically sound concept of accessibility is quite difficult" (p. 21). Handy and Niemeier (1997) similarly stated that over four decades of research had yet to conclusively determine the best method of measuring accessibility (or even determining what was a good measure). Additionally, the metrics used to measure accessibility can highly depend on the chosen definition within the research. Definitions and measures range from very simple to very complex. In the next few paragraphs, I will provide a very brief overview of some definitions of accessibility and common measures used to operationalize those definitions.[21]

Accessibility studies typically involve measuring the potential for interaction between different places, but they can also include measures of actual interaction (Horner 2004a). Hansen (1959) defined accessibility as "the potential of opportunities

[21] For a thorough review of accessibility measures see Jones (1981), Bhat et al. (2000), Guers and Wee (2004), and Handy and Niemeir (1997).

for interaction" (p. 4) and stated that accessibility is the "measurement of the spatial distribution of an activity (opportunities for interaction) adjusted for the ability and desire of people or firms to overcome spatial separation" (p.5). Activities include those that meet people's needs (Krizek & Levinson, 2012), or pursue desired activities (Bhat et al., 2000). Wang (2006) specified that accessibility was "dependent on distributions of supply and demand and how they are connected in space" (77). Bhat et al. (2000) combined many different elements in their definition, where accessibility is "a measure of the ease of an individual to pursue an activity of a desired type, at a desired location, by a desired mode, and at a desired time" (p.1). Krizek and Levinson (2012) noted that accessibility has two sides to it: land-use and transportation, and Handy and Niemeier (1997) specified that that travel cost, destination choice, and travel mode were critical components to accessibility.

Common to these definitions is an opportunity or activity component, which is a measure of the number and location of activities, and a transportation component that uses measures of time and/or distance to assess the ease of travel between two points (Handy & Niemeier, 1997). Accessibility is often measured to or from a specific place. It can be subdivided into relative accessibility, a measure between two points on the same surface, and integral accessibility, the degree of connection between all points on a surface (Bhat et al., 2000). In the present study, locations are the residential Transportation Analysis Zones (TAZ) where workers live and the TAZ where they work. The transport component is time, which is derived from the physical separation of locations.

In order to calculate time or distance, one must have the means of moving between two places through the transportation system via automobile, public transit, or via other methods. In some instances, there may be no way of moving between two locations via public transit options. The means by which individuals move through the transit system or the distance that they must travel can increase the difficulty in reaching desired locations. This can be accounted for in accessibility studies by the friction of distance, an expression of a distance measure in which the location with the least friction is the most accessible (Rodrigue, 2016). This will be discussed in further detail in section 4.2.7.

Examples of accessibility studies include the spatial mismatch hypothesis (Kain, 1968; Mouw, 2002; Wang, 2007; Ihlanfeldt, 1994; Ihlanfeldt & Sjoquist, 1991), or the relationship between spatial form and an individuals' or groups' accessibility to (or exclusion from) activities (Hess, 2005; Scott & Horner, 2008). Accessibility can also focus specifically on job access, which is the study of understanding "which populations are more likely to experience reduced employment access, which residential areas of a city are less accessible to job opportunities, and the underlying causes" (Boschmann, 2011, p. 671). These various avenues of research overlap in many ways.

Horner (2004b) described two different "perspectives" on accessibility, an individual perspective and a location perspective. The individual perspective focuses on the activities accessible to a given person, whereas the focus of the locational perspective is on the "attractiveness of places within the urban system relative to one another" (p. 266). Accessibility can be defined spatially, but it can also be aspatial (Wang, 2006).

Spatial access emphasizes spatial separation as a barrier to access, e.g., the physical proximity of residence to job locations, sometimes referred to as proximity or proximity measures. The focus of aspatial access is on the non-spatial, social, and demographic barriers. These may include transportation-related barriers such as congestion, or the means of transportation residents use that may shorten or extend commuting and hinder reaching employment opportunities (i.e., buses vs cars). These types of factors operate regardless of distance between residential and job locations. Non-spatial factors may also include phenomena not related to transportation, such as competition for employment opportunities among residential workers, barriers to employment based on levels of education or training, or issues of housing discrimination. Spatial and non-spatial factors can both impact a worker's ability to access employment opportunities (Wang, 2006). In sum, there are numerous ways to frame accessibility, and in terms of employment accessibility, any number of constraints may play a role in limiting access to particular workplace locations or non-specific locations.

This chapter focuses on employment accessibility. To frame my definition of accessibility I borrow from Boschmann's (2011) description of research specific to the investigation of employment access where he states that job access research "seeks to understand which populations are more likely to experience reduced employment access, which residential areas of a city are less accessible to job opportunities, and the underlying causes" (p. 671). In this chapter, accessibility is the quantitative measure of workers' commuting costs in reaching employment opportunities as measured by time, by varying modes of transportation, including car and bus. Accessibility is also defined by the ease of moving through the transportation systems via these modes of transit to reach employment locations. In practical terms, this means that areas with shorter commuting times have more accessibility to employment locations. It also means that areas with access to a higher number of jobs have greater accessibility to employment.

As Pirie (1979) noted, accessibility is more than just "a property of the built environment" (299). Challenges to employment access can be more complex than the time and distance between residential and work locations. However, aspatial measures are more complicated to assess, because non-spatial barriers to employment can be observed (level of education, race, gender) or unobserved (motivation, ability) (Mouw, 2002). Although these non-spatial barriers that impact a worker's potential access to those opportunities are significant, I have decided to limit this study to spatial analysis only, with plans to address aspatial barriers to employment in future research. Spatial measures are relatively straightforward; they examine the spatial distribution of employment opportunities in relation to residential spaces, allowing for the identification of areas with higher and lower commuting costs. In this study, I calculate those commuting costs by car and bus transit.

4.2.3 Measuring Accessibility

In addition to the many definitions of accessibility, numerous methods exist for calculating it. Handy and Niemeier (1997) list seven different accessibility measures, while Geurs and Ritsema van Eck (2001) list 23. Geurs and Wee (2004) claimed that the different components that make up accessibility include (1) land-use component—distribution of opportunities, demand (at origin), and supply of opportunities (at destination); (2) transportation component—time, distance, and other costs of travel through the transportation system from origin to destination; (3) time constraints (time of day affecting level of congestion); and (4) individual component—the needs, abilities, and opportunities available to individuals based on age, income, education, and other characteristics. According to the authors, accessibility measures should consider all of these components, and the elements within them should be easy to operationalize. The results should also be simple to interpret. But, as the authors note, in practice, most accessibility studies typically focus on just one or two of these measures.

Both distance and time are can be calculated as the commuting costs in accessibility measures. The choice of which to use is dependent on both data availability and the research question. Shin (2002) asked, “how do we assess job decentralization if it is related to shorter travel times but longer trip distances with greater automobile dependence?” (p. 36). He noted that “shorter travel times do not necessarily reflect the social costs of urban infrastructure, air pollution, and public safety” (p. 36). However, as he also explained, travel distance does not reflect individual mobility (such as automobile availability) and transportation services. Although the goal of transportation planners may be to reduce travel time, such may come at a cost when solutions are automobile-centered. Both methods have their drawbacks, and the choice between them should be driven by the goals of the research.

Commonly used distance measures are Cartesian distances (Euclidian or Manhattan), shortest network distance, or shortest network time, the last two generated through a network analyses using GIS or transportation planning software (Apparicio, Shearmur, Brochu, and Dussault, 2008). In terms of their use in potential accessibility measures, Houston's (1998) opinion was that using Cartesian distances as a measure of spatial barriers to labor markets was problematic because space is not correlated with time, it doesn't include a financial cost of travel, and it introduces bias by overstating the job availability to high unemployment neighborhoods and thus "weakening the relationship between job proximity and employment rates" (p. 2535). Straight-line distance measures tend to underestimate travel distance more for shorter trips and become more accurate as distances increase. This, in effect, gives more weight to inner-city residents' job accessibility. In addition, most public transit (metro, subway, light rail) is radial, meaning that commuters have to travel into the central part of the city and then travel out to their destination, while a straight line measure of the distance between residential location and workplace would not take into account the added travel distance into and out of the central city. Houston (1998) suggested the use of total generalized travel costs, where the monetary and non-monetary costs are each weighted differently and taken into account in forecasting travel costs. But as Immergluck (1998) points out, replacing distance with monetized travel costs oversimplifies the spatial component, particularly when access to employment is dependent on more than just travel cost, e.g., knowledge about job openings, which has a spatial component to it.

In general, shortest distance measures the distance of a path if taken by foot, whereas shortest time evaluates access via automobile or public transportation. However, shortest driving distance can also be calculated for origins and destinations within a road network. Apparicio, Shearmur, Brochu, and Dussault (2008) compared the accuracy of different distance measures—Cartesian (Euclidian and Manhattan distance) and network distance use—to find the shortest path. They found that at a sub-metropolitan level or in places away from the business district, network-based distance and time measures are more accurate, supporting Houston's (1998) opinion. These findings make it clear that the use of a traffic assignment model or transit simulation software that can take into account travel speed, traffic volume, and route alternatives to calculate the most accurate measures of transportation costs possible is necessary for a more robust analysis.

I developed an innovative method for calculating commuting travel time and distance that will be discussed in further detail in section 4.3 of this chapter. I have elected to base accessibility measures on calculated time because commuting time has the greatest impact on workers. To most commuters, an hour commuting is an hour commuting; it does not matter as much if the distance is 10 miles or 25. I verified though a regression analysis that these two measures were correlated and confirmed that as distance increased, so did time.

Horner (2007) used calculated distance to compare accessibility between 1990 and 2000. He noted that a distance measure removed any variability in the data that may have resulted from improvements in the road network, as he was primarily concerned with changes in urban structure. I generated time and distance measures for 1990 and 2000, both of which are in the past. Therefore, the differences in the results are not be based on road network improvements; instead, comparability between the two years is based almost exclusively on the commuting patterns of residents in those two years, specifically, the number of trips taken between origins and destinations via different modes of travel and the time travel between residential and workplace locations.

Critics have noted that many accessibility studies suffer from methodological weaknesses (Korsu & Wenglesnki, 2010). There is much disagreement as to which measures are most effective, and few ways to analyze the effectiveness of each (Guers & Wee, 2004; Handy & Niemeier, 1997). Bach (1981) stated that the mathematical formulas and operational definitions of accessibility "do no more than hide basic issues of spatial politics" (p. 957). Methods range from very simple to very complex, and some disagreement exists as to whether more complex measures are more useful for analysis. The following measures described in this chapter are the most common measures of accessibility. These measures focus on the physical construct of the metropolitan area and the travel costs of traveling between residential origins and workplace destinations. All measures will be discussed in terms of residential TAZ for origins and workplace TAZ as the destinations, although these calculations can be used for different types of zones.

4.2.4 Measures of Average Commuting Time

A simple approach to calculating accessibility is to calculate the average commutes for all workers in particular residential areas, or for all areas of the metropolitan region. Wang (2003) suggested calculating the average commuting range in a residential TAZ *i* (A_i) as:

$$A_i = \sum_{j=1}^{n} \frac{T_{ij}}{W_i} d_{ij} \tag{1}$$

In this equation, T_{ij} is the actual number of commuters from TAZ *i* to TAZ *j*, d_{ij} is the distance between them (Wang used aerial distance), and W_i is the total number of residents at *i*. The result of this measure shows what the average commute radius is for each residential TAZ.

It is also possible to calculate in- and out-commutes separately for each residential and workplace TAZ. This relies on using revealed travel behavior, i.e., the number of commutes from each origin to each destination as reported by a dataset, such as the Census Transportation Planning Package (CTPP). Figure 32 illustrates this concept. The figure shows the out-commute, or commute by residence, which measures the average time or distance that residents of one TAZ take to reach all the workplace TAZ. This is most similar to Wang's (2003) average commuting range calculation. Alternatively, the in-commute, or commute by workplace, measures the average time or distance that it takes all residents in every TAZ combined to reach a particular workplace TAZ. This effectively measures the attractiveness of the employment within a given spatial unit (i.e., an employment center).

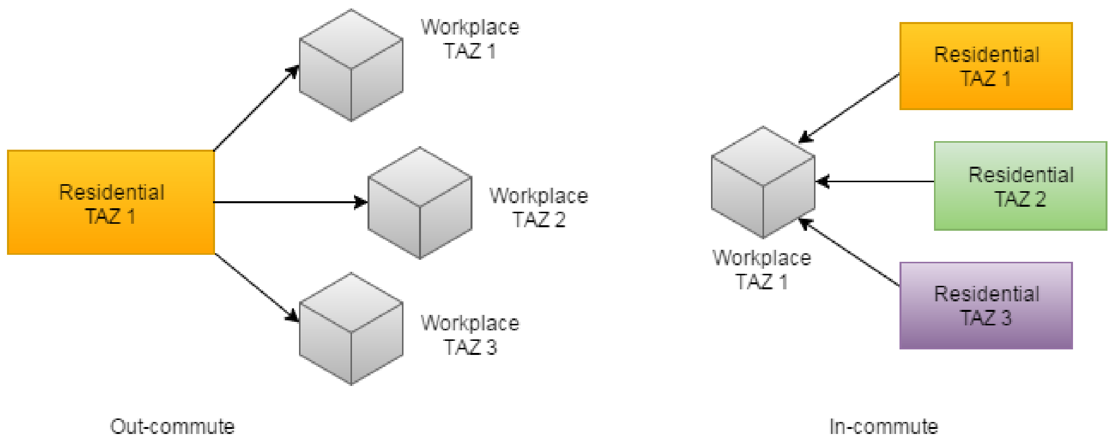


Figure 33. Illustration of the (out-commute) by residence and the (in-commute) by workplace concepts.

Horner (2007) demonstrated this "unit-by-unit" calculation of average commuting concept in the following equations:

$$\omega_i = \frac{\sum_j C_{ij} X_{ij}}{\sum_j X_{ij}}$$ and

$$\mu_j = \frac{\sum_i C_{ij} X_{ij}}{\sum_i X_{ij}} \qquad (2)$$

Where ω_i = the workers leaving TAZ i, C_{ij}= travel costs (time or distance) between TAZ i and TAZ j, X_{ij}= journey to work trips from TAZ i to TAZ j, μ_j= workers inbound to TAZ j. In these equations, X_{ij} can be different kinds of commute matrices: actual observed commutes, minimum average, or maximum average. Plugging in observed commutes gave the actual average commute for each TAZ in the study area.

Horner's (2007) research investigated how the structure of jobs and housing impacted commuting between 1990 and 2000. Using the same calculations with my dataset, I could analyze the change in average time it took to reach workplace TAZ and the change in commuting time from each residential TAZ and neighborhood cluster between 1990 and 2000. Bhat et al. (2000) noted that some researchers question the appropriateness of using revealed data, such as the number of commutes, because those data are based on constraints for workers. This data may not reflect "preferences or desires" (p. 48). However, my interest is in assessing changes in travel behavior between 1990 and 2000, considering those constraints that residents have on their commuting, specifically, where the jobs were located and how long it took to reach them.

4.2.5 Cumulative Opportunities Measure

To assess whether the number of jobs accessible residents in various neighborhoods had changed between 1990 and 2000, I calculated a cumulative opportunities measure. This is a commonly used measure of accessibility used by transportation planners. It calculates the total number of job opportunities that can be reached in a given time or distance from residential locations. For example, it shows how many jobs a person living in each neighborhood in the study area could reach within 10 minutes, 20 minutes, or more. The result for TAZ A will be different for TAZ B, and so forth. This accessibility measure provides basic data about the "range of choice available to residents" (Handy & Niemeier, 1997: 1117) within given time constraints, with all other things being equal. The measure doesn't account for differences in jobs that a resident may or may not be qualified for.

The cumulative opportunities measure is calculated as follows:

$$A_{i,co} = \sum_{j=1}^{n} O_j \, f(C_{ij}) \tag{3}$$

where O_j is the number of opportunities, in this case jobs in TAZ (j), C_{ij} is the generalized travel cost (time or distance) from TAZ (i) to TAZ (j), and $f(C_{ij})$is an impedance function. In this equation, the impedance function is defined as 1 if $C_{ij} < T$, and otherwise it is 0. T is the travel time threshold computed, i.e., 5 minutes, 10 minutes, etc.

One of the drawbacks of this measure is that the cut-offs of commuting time can make distinctions between areas that may have similar costs. Owen and Levinson (2012) give an example where a destination 29 minutes away would be counted in a 30-minuite accessibility measure, but a destination 31 minutes away would not be counted. That one-minute difference is not very significant in terms of total commuting costs. Houston (2005) and Shen (1998) also criticized this type of measure because it does not account for competition around the number of jobs. Higher density areas will have more competition, so the number of accessible jobs may be high, but competition for those jobs is also high, thus overstating the number of jobs accessible in these areas. However, accurate information about unemployed workers and job seekers is extremely difficult to obtain, particularly within smaller spatial areas such as a neighborhood or TAZ. Despite potential drawbacks of the cumulative opportunities measure, the results of this calculation are easily interpreted, and provide reliable data about facilities within typical commute times. At the neighborhood scale, the measure can provide a general picture of accessibility over time, based on the changing number of jobs accessible from that neighborhood. This relates directly to labor market shifts in total employment and the location of workplaces.

Handy and Niemeier (1997) stated that simple accessibility measures can be just as useful as those that are more complex, particularly in presenting data in order to inform policy decisions, because simple measures are more easily understood. If measuring accessibility between multiple places, then possible ways to interpret those results are to compare relative levels of accessibility across places, across two time periods, or both (Handy & Niemeier, 1997). The accessibility of a neighborhood can be compared against a total average, or the change in a neighborhoods position on a scale of accessibility relative to all other neighborhoods can be interpreted. These are relatively simple measures, yet they give an idea as to accessibility to and from areas, and changes in access over time.

4.3 Methods

4.3.1 Data

The primary source of data used for the analysis was the Census Transportation Planning Package (CTPP) from the U.S. Census Bureau. The CTPP provided the land-use component of this analysis, where residents and workers are located. The distribution, or the supply, of jobs across metropolitan Baltimore in 1990 and 2000 is the number of workers in each TAZ from Part 2 of the data package. Using workers or jobs as a proxy for job vacancies can be problematic because workers apply for vacancies, not for jobs (Houston, 2005; Ihlanfeldt & Sjoquist, 1998; Immergluck, 1998). Houston (2005) describes the issues related to this in detail. Despite these objections, information on job vacancies can be very difficult to obtain, particularly across an entire metropolitan area, for different time periods, and at the same spatial resolution as other data on the labor force and residents. These data on jobs are frequently used as a proxy for worker data and I followed those examples as a best approximation available for the study. The demand side data—the number of workers at their place of residence—is provided in Part 1 of the data package. Part 3 provides detailed information about the journey to work, including the number of commuters between the origin and destination, and the mode of transportation.

The 2000 CTPP data Journey to Work, "flow" data was subjected to limitations imposed by the Census Bureau. This suppression includes rounding numbers and implementing thresholds for worker flow tables. The rounding and suppression of the number of commutes reported in 2000 contributed greatly different results for the 1990 and 2000 data on the flow of commutes and lead to significant undercounts of commuters (Christoper & Srinvasan, 2005). The undercounting is more extreme with the data separated by type of commute, for example drove alone or rode the bus vs all commute types. Because of these issues, my analysis focuses on all commute types rather than by mode of travel. The redaction of the data is too great for bus travel to draw conclusions from, and it also impacts the results of the travel by all modes, but to a lesser extent.

In addition to flow data of the number of workers traveling between origins and destinations, the CTPP data calculates median and mean travel times for workers from their place of residence to their workplace, estimated by survey recipients.[22] It does not account of the travel costs between all origins and destinations in the metro area. Therefore, I used an innovative method to calculate the commuting time and

[22] These data are not available for 1970 or 1980 data; therefore, this analysis is limited to 1990 and 2000. Although not optimal for describing changes since 1970, it is a good starting point for future research.

distances with various modes of travel between the centroids of the origins and the destinations. I limited the analysis to only those TAZ where trips originated and terminated within the bounds of metropolitan Baltimore. Therefore, the analysis does not capture all commuting associated with the region. In 1990, 44.8% of workers in the region commuted to jobs outside of the metropolitan area, and in 2000 that percentage dropped slightly to 46.8%. Because the number of origin and destination pairs was so large, I narrowed-in and performed detailed analyses based on the residential neighborhoods clusters identified in Chapter 2 and the employment centers in Chapter 3.

4.3.2 Methods for Calculating Time Travel Costs

I used ArcGIS to calculate the centroids of each TAZ to serve as the origin and destination points for all the journey to work data. A Google Maps Direction Application Programming Interface (API) was then used to calculate the commute distances and times between all origins and destinations (TAZ centroids) with Google Maps. The API is a service that calculates directions between locations using an HTTP request or with script written in Java or Python. This method overcomes some of the shortcomings in other ways of calculating travel time and travel distance, and it is more accurate than calculating Euclidian or Manhattan distance, or using the intra-zonal commute data provided from the CTPP data (Wang, 2003).

Mathematically modeling a traffic network requires a large amount of data, including but not limited to data about road speeds, on and off ramp speeds, and congestion. The API considers all data without requiring the user to obtain it. It is not based on the shortest path of a theoretical commute developed in a simulation model, which need additional calculations to account for rush-hour congestion or different modes of travel. Instead, Google calculates the shortest path for a given travel time (determined by the user) and bases the results on actual recorded commuting distances and times.

I chose to calculate all traveling time and distances based on a theoretical time and date. A date was selected two weeks into the future, and the time was set at 5:30 p.m. on Monday-Thursday, a peak evening commute time. Because I was limited to selecting just one time, and because I am measuring workplace accessibility, I wanted to calculate the typical travel time that workers face during the busiest travel time of the day. When route information is calculated for a future time, Google Maps uses speed limit data, real time speed travel, average speed data gathered from historic travel speeds, the current traffic, and recommended speeds derived from road types to predict travel times and select driving paths. Google relied more heavily on historic data the further in the future the query is made[23]. The usage of historical data overcomes some issues. For example, a major accident or road construction on the day that the query is made will not throw off the data. However, it does not completely capture the improvements in the road or transit network between the two study periods.

This method required less training than transportation planning software, and it was less time-intensive then setting up a network in ArcGIS. Therefore, the method is much more user-friendly than building a network. It also does not require purchasing and learning a software program that may calculate these variables, either

[23] Google allows you to select a best guess, pessimistic guess, or optimistic guess for predicating travel times. Each will return a slightly different result. Best guess was used in this analysis.

with one's own input or like a black box where the estimation process is unknown. Lastly, this method has an advantage in that Google maps is commonly used by commuters daily to find their best route to and from work; therefore, the paths that Google calculates are likely very close to those driven by actual commuters (more so if calculating recent commuting than calculating past travel).

The biggest drawback of the method is that it can be very expensive to run queries using the Google API if running over 25,000 queries a day. One run can cost $600. For this study, I was required to run 398,161 queries for each method of transportation for the 1990 data, and 1,324,801 queries for each method of transit for the 2000 data. Non-profits may qualify for a discount, but individual researchers may need to compromise by either running queries over a longer period, or incur higher costs of running queries.

This method can also be used to determine travel costs in the public transportation system by changing travel mode. I chose to calculate travel costs using various modes of travel to assess the differences between car owners and those reliant on public transportation. Using Google maps to calculate public transportation is useful in that it considers the time that passengers must wait at terminal stops. These costs should be estimated in transportation models, or bus route information must be manually added to the system. For the 1990 data, I ran the API with bus-only travel and on-the-fly public transportation, where Google chooses the best methods of traveling between the two points given all the public transportation options available. Because of the similarity of the results between bus-only travel and on-the-fly transportation, and because of monetary constraints, I chose to run bus-only travel as the public transportation option for 2000, and use only car and bus for the analyses within this chapter. The results showed that the retraction of the data in the 2000 dataset was too great to draw meaningful conclusions, therefore despite running the data for bus travel with the Google API, I chose to limit my final analysis to the all modes of travel calculated with car times and distances.

Determining travel distance and time from TAZ centroid origins and destinations posed no issues for automobile travel when using the Goggle API. However, an error arose when attempting to calculate transit commuting costs. Google was unable to find bus or mixed transit options for all the TAZ centroids, even in cases where TAZs did contain at least one bus stop. No preference to select less walking was made in the code. Accessibility analyses such as Wang (2007) use a general road network and regression analysis to calculate public transit commuting costs rather than bus stops or bus routes. In this study, actual bus routes are used to determine commuting times and distances. When Google cannot find a bus or other transit stop near the TAZ centroid, it cannot calculate the route.[24] In some of the more rural areas of metropolitan Baltimore, there is no bus service; therefore, the return of a null value is an accurate result for those travel costs (one cannot travel from there from here). However, in other instances, bus stops exist within the TAZ—just not within a reasonable walking distance of the TAZ centroid. In most cases, where no route was found those area were largely inaccessible by busses anyway. After much searching, it was not possible to determine the distance walking cut-off used by the system when it delivers a result of no route found.

[24] Google does not publish data about the maximum distance that a bus stop can be from a coordinate for it to be included in a travel calculation.

4.3.3 Potential Issues

Accessibility is typically measured from one zone of activity (i.e., a residential zone), to another zone of activity (i.e., an employment zone), and calculating measures based on zones is inherently problematic. Aggregation errors can arise from the distribution of the population around the centroid of the spatial unit. The larger the spatial unit, the more subject it is to aggregation errors. Using this method suggests an even distribution of activity sites within the zone and equal access to transport modes and nodes, and suggests equal opportunities among all of the individuals in those zones, neglecting the actual distribution of all of these factors (Apparicio, Shearmur, Brochu, and Dussault, 2008; Pirie, 1979; Hanson & Schwab, 1987).

To overcome these issues, some researchers have elected to use individual trip diaries and point locations. This data is difficult to obtain and cannot cover an entire metropolitan area. Other researchers also likely face this issue in the methods used to map distances and times with CTPP data, but there was surprisingly little discussion of such in the literature. The centroid of a census tract, census block group, or TAZ are commonly used as the basis for calculating travel distances. Because of the data limitations and the scale at which transportation data is available, the use of TAZ centroid for origins and destinations is commonplace, and as Apparicio, Abdelmajid, Riva, and Shearmur (2008) noted, many studies do not employ methods to minimize these errors.

One way to deal with this issue of bus and transit travel would be to find the nearest bus stop to every TAZ centroid and calculate travel costs from those locations. However, mapping from those bus stops means calculating travel costs for those who live near the bus stop, not the residents in the TAZ who live further away from it. The issue of mapping from the centroid or mapping from the nearest bus stop are the same; in either scenario, the access for residents is different, even within the same TAZ area, and it is not possible to calculate access for each individual. Therefore, I chose to leave the TAZ centroids as the origins and destinations for both automobile and bus transit with the understanding of the problems inherent in selecting this method of calculation. An alternative approach for future research is to divide the spatial area into smaller sections, such a grid, or to go through each TAZ that returns a null value and determine walking distances to the bus stop from various buffer distances within the that TAZ. Smaller zones are preferable, as they will result in less error (Handy & Niemeier, 1997).

Another drawback exists with calculating travel times and distance in past years. Theoretically, travel costs should be measured for the time that commuting took place, when the data for CTPP were collected in 1990 and 2000. This is because travel systems are continuity changing and improving. New roads and interchanges have been added, and bus routes have been added, subtracted, or modified since 1990. However, it is not possible to measure those commuting times and distances in the past. CTPP data does have commute times in the journey-to-work data, but it does not have very high accuracy.

In this study, the calculations of travel costs in 1990 and 2000 are based on time between TAZ centroids. For results based on revealed commuting data, the differences in the results calculated are due to changes in commuting behavior, in other words, changes in the number of commuters traveling between each TAZ. If residents of a particular residential cluster are traveling further to reach their workplaces, this would suggest additional commuting burdens. My analysis investigates how commuting patterns from neighborhoods are the same or different over time, whether residents in those neighborhoods consistently have high commuting times, or if changes to employment location somehow altered their accessibility.

This chapter presented additional challenges because travel costs are not a measure made at a singular point. Instead, all of the travel cost data is related to two points, an origin and a destination. To be able to compare average travel times between origins in 1990 and 2000 (or to destinations), I used ArcGIS Geostatistical Analysis areal interpolation to create a prediction surface and then re-aggregate the prediction of the 2000 data back to 1990 polygons. "The method takes data collected at one set of polygons and predicts the data values for a new set of polygons" (ESRI, n.d.). I compared the results of the interpolation with maps of the 2000 data using 2000 TAZ to verify the accuracy of the results and determined the results would be useful for this analysis.

4.4 Results

4.4.1 Regional Average Commuting Times in Metropolitan Baltimore and the Impact of Data Modifications

The regional average commute time for all workers via all modes of transportation are presented in Figure 33. Median travel time in 1990 was 25.67 minutes, and 20.15 minutes in 2000. This represents a decrease of just under six minutes. Although not a large decrease, the results contradict median travel times reported by survey recipients from the 1990 and 2000 Census data. Those data show that commuting time to work increased by 15% between 1990 and 2000. The differences between these findings may be based on time of day travel was calculated, differences in historic travel times vs the times recorded by the Google API, or due to the redaction of the Census data in 2000.

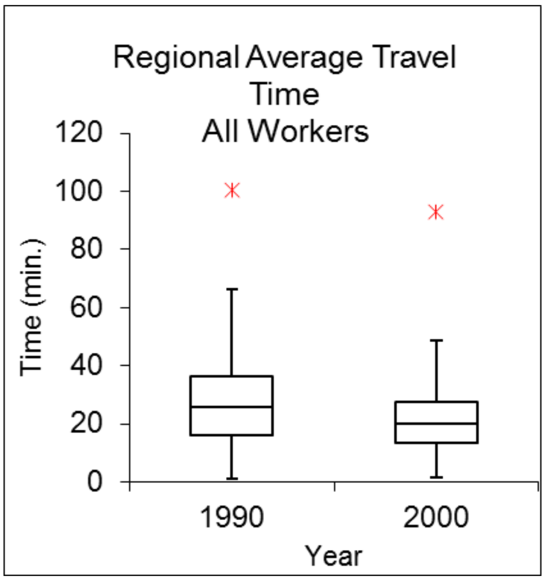


Figure 34. Regional Average Travel Time for All Workers, All Modes of Transportation 1990 and 2000.

The distribution of the regional average travel times for workers who dove alone and workers who rode the bus showed a greater decrease in travel time between 1990 and 2000 than the comparison of all workers. This confirms that the restrictions and modifications done to the 2000 CTPP data can have a significant impact on results using these data. Rounding did affect the data for all workers by all modes of travel, but because there were less modifications on that dataset, those results are more accurate than drove alone or by bus, and are the focus of this analysis.

4.4.2 Cumulative Opportunities

The results of the cumulative opportunities measure revealed a pattern in which the highest number of jobs were accessible in the center of the city at various commute time intervals. The results for 1990 and 2000 revealed a similar pattern, as did calculations of the cumulative opportunities for various industrial categories. These results are since the cumulative opportunities measure is an actual count of reachable destinations (jobs) within various commuting times, therefore the area with the highest number of jobs, in the case of metropolitan Baltimore it is the central city, will be the areas with the highest cumulative opportunities. An example of these findings is shown in Figure 34.

The results generated from the cumulative opportunities measure are similar to those found in similar studies using this same measure (see Owen & Levinson, 2012), namely, that accessibility is highest in the central city. Houston (2005) said that greater number of destinations that can be reached, the greater the level of accessibility. If this is the case, then the results clearly indicate Baltimore City has some of the highest levels of accessibility. However, this outcome doesn’t reflect findings in the literature. Research has found that in some cases residents of the central city, specifically lower income residents and/or and African-Americans’ residents, have lower access to employment opportunities. The cumulative opportunities measure may not reflect that same finding, because it does not account for differences in the skills or education levels workers in residential neighborhoods, or those required by jobs available. The measure did not prove useful for furthering an understanding of accessibility as it is related to spatial justice, but does provide a picture of the change in the number of jobs accessible from each neighborhood in the region. As displayed in Figure 35, the number of jobs available to residents in many central city neighborhoods declined between 1990 and 2000. This decrease has the potential to affect job seekers over time who are stuck in place and unable to move to an area not impacted by job loss.

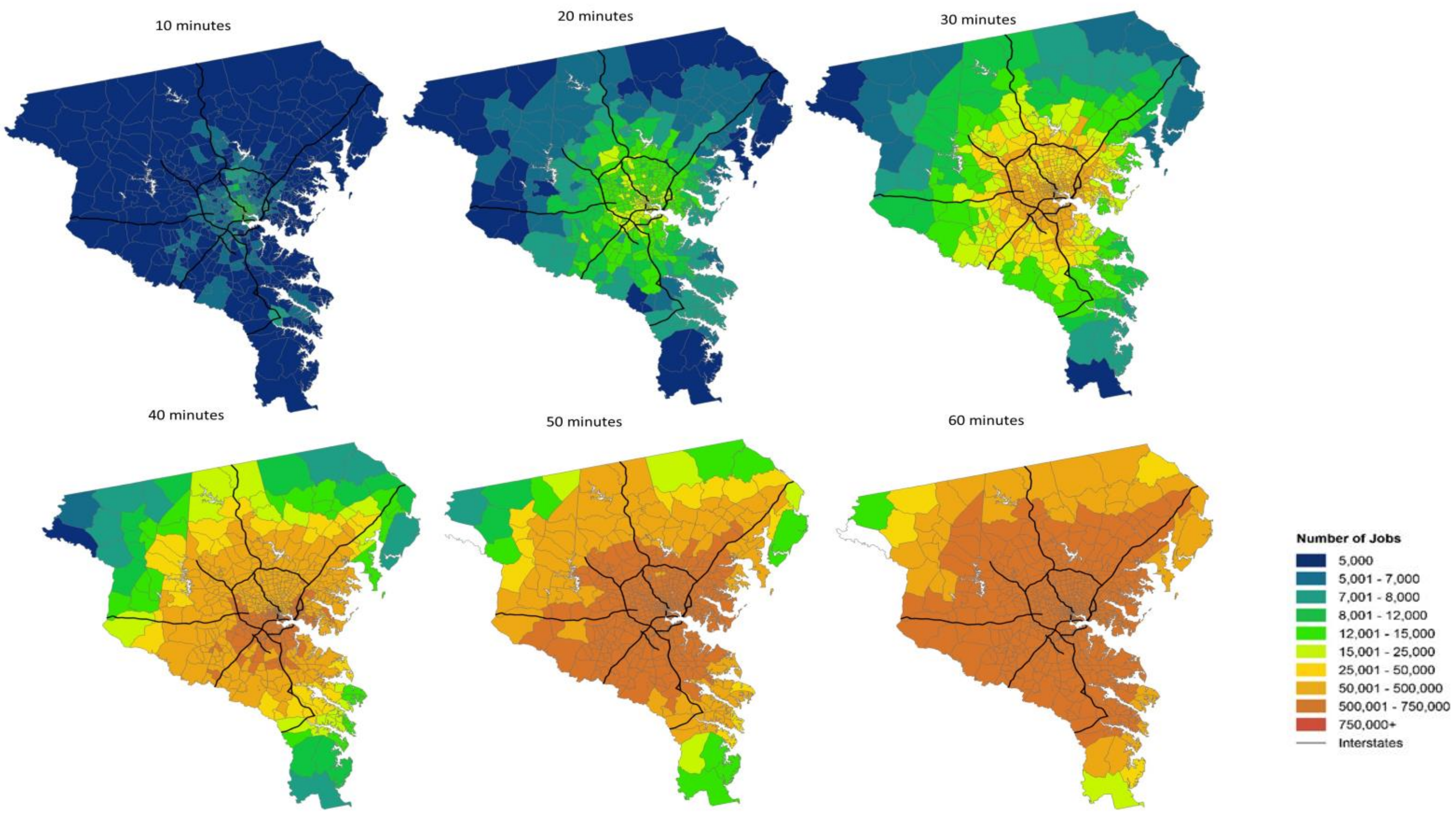


Figure 34. number of jobs accessible from every *residential* TAZ (origin) to every *workplace* TAZ (destination), within a 10- minute, 20-minute, 30-minute, 40-minute, 50-minute, and 60-minute commute by car, 1990.

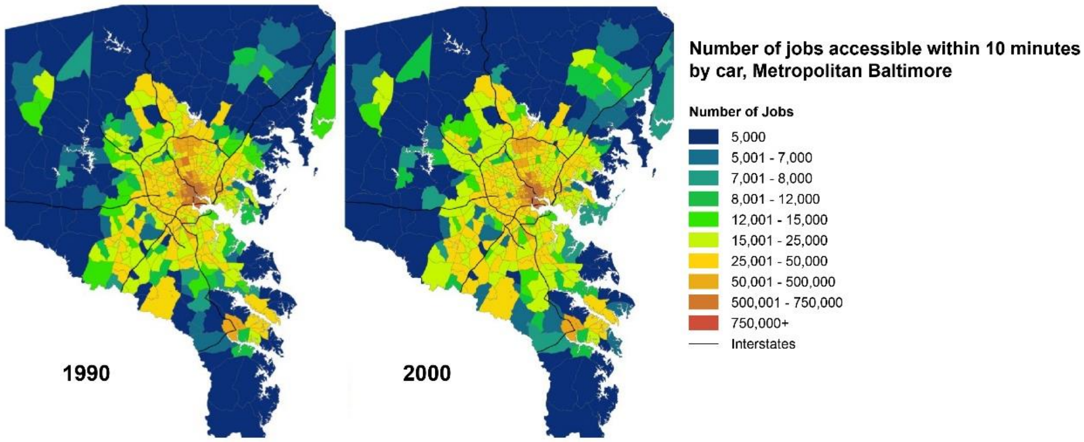


Figure 35. Cumulative accessibility to jobs in metropolitan Baltimore within 10 minutes by car, 1990 (left) and 2000 (right).

4.4.3 An Analysis of the 1990 and 2000 Commuting Data from Residence to Workplaces

Mean travel time for each TAZ as reported in the journey-to-work data from the CTPP indicate that residents in some of Baltimore City's neighborhood have much longer commutes as compared to residents in other parts of the region. The median reported times differ from those calculated by the Google API. Although the Google API does use historic data to calculate travel time and distance, a few things could result in differences between reported data from commuters and calculated Google API data. The historic data is from Google only; no other sources of data on travel time are included. The Google API calculates travel at just one time; when reporting travel time, commuters may be thinking about the time it takes them on average to reach their place of work rather than one driving experience. The API calculates travel time to and from TAZ centroids and not addresses, this can result in increased or decreased actual travel times compared to travel times between residential locations and work places specifically.

In 1990, more than half of all resident workers living the five neighborhood clusters commuted to an employment center and by 2000 that number had grown to 78% of all workers. Between 1990 and 2000, Downtown and Hunt Valley were consistently the areas with the largest number of workers and the most prominent destinations for commuters traveling to employment centers.

The results for average commute times from residential neighborhood clusters to all workplace TAZ are present in Table 17. These results show little change in overall travel time by neighborhood clusters between 1990 and 2000. There was a small decrease in the travel time from upper, middle class neighborhood but less than a minute change in all other categories.

Table 17
Average commute times from residential neighborhood clusters to all workplace TAZ

Neighborhood Cluster	1990 Average Travel Time (minutes)	2000 Average Travel Time (minutes)
Working Class	21	21
Low-income, African American	18	18
Neighborhoods in Transition	17	17
Middle-class, Married with Children	20	20
New, Upper Middle Class	21	20

Tables 18 and 19 show the average travel time from each residential neighborhood cluster to each employment center. In the next few paragraphs I will discuss the results on this analysis in terms of commuting from neighborhoods cluster groups to employment centers, as well as areas not part of employment centers, which are visible in the maps presented below.

Table 18
Average travel time from neighborhood cluster types to employment centers, 1990

Employment Center	Working Class	Low-income, African American	Neighborhoods in Transition	Married with Children	Upper Middle Class
Aberdeen	31	52	35	19	37
Annapolis	24	26	9	11	16
Arbutus, BWI area, Elkridge, Halethorpe, Jessup	22	24	24	20	24
Columbia	27	25	21	13	16
Downtown, Midtown, Fells Point, Inner Harbor	23	15	15	26	26
Dundalk, Edgemere	18	29	28	29	35
East Baltimore, Golden Ring	16	18	20	22	29
Halethorpe, Lansdowne, South Baltimore	19	15	20	22	28
Hunt Valley, Lutherville-Timonium, Townson	26	23	16	22	19
Owings Mills	24	21	17	19	18
Pikesville	28	27	14	23	18
Security Sq., Woodlawn, Windsor Mill	24	16	17	18	22
S.E. Baltimore	18	21	23	26	32
White Marsh, Gunpowder	19	27	26	15	27

Table 19
Average travel time from neighborhood cluster types to employment centers, 2000

Employment Center	Working Class	Low-income, African American	Neighborhoods in Transition	Married with Children	Upper Middle Class
Aberdeen	24	50	35	19	35
Annapolis, Crofton	23	25	30	8	15
Arbutus, BWI area, Elkridge, Halethorpe, Jessup	23	26	27	21	26
Bel Air	19	50	17	15	13
Catonsville, Halethrope, Lansdowne, South Baltimore	18	16	19	20	25
Columbia	30	26	24	17	21
Columbia II	27	24	19	12	15
Downtown, Midtown, Inner Harbor, Canton	23	15	15	26	26
East Baltimore, Golden Ring, Edgemere	15	22	22	24	31
Hunt Valley, Lutherville-Timonium, Townson	26	23	16	22	19
Owings Mills	24	20	17	19	18
Pikesville	27	17	14	23	17
Security Sq., Woodlawn, Windsor Mill	24	16	17	18	22
Southeast Baltimore	18	20	22	26	31
Westminster	15	44	35	37	33
White Marsh, Gunpowder	17	25	22	18	29

Working Class Neighborhoods:

In 1990, workers from the working-class neighborhood cluster had the longest average commutes to the Pikesville, Aberdeen, Columbia, and Hunt Valley employment centers. However, the percentage of workers traveling to Pikesville, Aberdeen, and Columbia were very small, representing just 2%[25] of workers from the working-class cluster in 1990.[26] The highest percentages of workers from the working-class neighborhoods cluster traveled to the employment centers Downtown/Midtown/Fells Point/Inner Harbor (Downtown), Hunt Valley/Lutherville-Timonium/Townson (Hunt Valley), and Arbutus/BWI/Elkridge/Halethorpe/Jessup (BWI area). In addition, East Baltimore, Annapolis, Halethorpe/Lansdowne/South Baltimore (Halethorpe), and Dundalk/Edgemere (Dundalk), had higher percentages of workers from the working-class neighborhood cluster. Table 20 summarizes the commute data for workers in the working-class neighborhood cluster traveling to these employment centers.

Table 20
Commuting data for working-class cluster resident workers traveling to employment centers, 1990.

Employment Center	**Average Travel Time from Neighborhood Cluster, 1990 (minutes)**	**Workers Traveling to an Employment Center, 1990 (%)**
Downtown	23	29%
Hunt Valley	26	17%
BWI	22	14%
East Baltimore	16	8%
Annapolis	24	5%
Halethorpe	19	5%
Dundalk	18	4%

In 2000, the Downtown and Hunt Valley employment centers continued to be some of the top destinations for working-class neighborhood residents traveling to an employment center, and average commute time for those workers remained the same

[25] Data on the number of workers from each residential neighborhood type to each employment center is presented in Appendix 3.
[26] This was calculated from all workers traveling to an employment center, the percentage of total workers traveling to those areas were 1% or less.

as in 1990. A higher percentage of workers from this cluster traveled to Southeast Baltimore, BWI, Catonsville, Annapolis, and Westminster. Table 21 summarizes the commute data.

Table 21
Commuting data for working-class cluster resident workers traveling to employment centers, 2000.

Employment Center	**Average Travel Time from Neighborhood Cluster, 2000 (minutes)**	**Workers Traveling to an Employment Center, 2000 (%)**
Downtown	23	27%
Hunt Valley	26	16%
Southeast Baltimore	18	10%
BWI	23	8%
Catonsville	18	6%
Annapolis	23	6%
Westminster	15	5%
Aberdeen	24	4%

In Chapter Two it was noted that working class neighborhoods were characterized by education at the high school level, and just over 14% had a bachelor's degree or higher (1990 data). In 1990, most workers in that cluster were employed in blue collar occupations including precision production craft and repair occupations, operations, assembly, transportation, material moving, as well as occupations such as administration or clerical work. In 2000, more workers were in administrative and clerical roles and employment for operators, assemblers, and material mover occupations decreased.

In 1990, manufacturing industries were present in Hunt Valley, BWI area, East Baltimore, Halethorpe, and Dundalk. Annapolis was characterized by public administration and education, health and social services industries. By 2000, manufacturing workers decreased in Hunt Valley, and the employment center in 2000 was characterized by workers in professional services, FIRE, and retail. There was not a significant change in either the average commute time to this area or the percentage of workers traveling there between 1990 and 2000. Downtown and Annapolis remained relatively unchanged in their industrial makeup; Annapolis had a higher percentage of workers in retail and downtown added more professional workers. Commuting to those destinations also remained similar in 1990 and 2000.

The data suggest that workers may have been traveling a slightly longer distance to reach employment in the BWI employment center and had fewer options for employment in those blue-collar occupations. This is seen in the shift to new locations in 2000 becoming more prominent and the reduction in number of centers with blue-collar and manufacturing jobs. Although reduced from 1990 levels, the BWI area, Southeast Baltimore, and Catonsville centers retained some manufacturing blue-collar occupation employment. The data show that those areas became more prominent locations as the commute destinations of workers residing in this residential cluster. However, overall commute times did not change that dramatically for workers, the remained between 18-23 minutes for workers commuting to those employment centers.

Figure 36 shows the average commute time from the working-class neighborhoods to all workplace locations and Figure 37, below illustrates the change in travel time from that neighborhood cluster to all workplace TAZ. The change map highlights some of those workplace destinations that lie outside of the employment centers where average commute times for working-class neighborhood residents changed. For example, workers experienced longer commutes to areas just outside of Reisterstown, as well as some areas along Rt. 29, in sections of Ellicott City and

Columbia that are not part of one of the Columbia employment centers identified in Chapter 3. Workers also had longer commutes to Bel Air, which was not an employment center in 1990, but in 2000 accounted for 2% of the commutes to an employment center. Commute times to Westminster also increased, and in 2000 accounted for 5% of the total commutes to a center. These results indicate that workers were traveling longer distances to reach these locations in 2000.

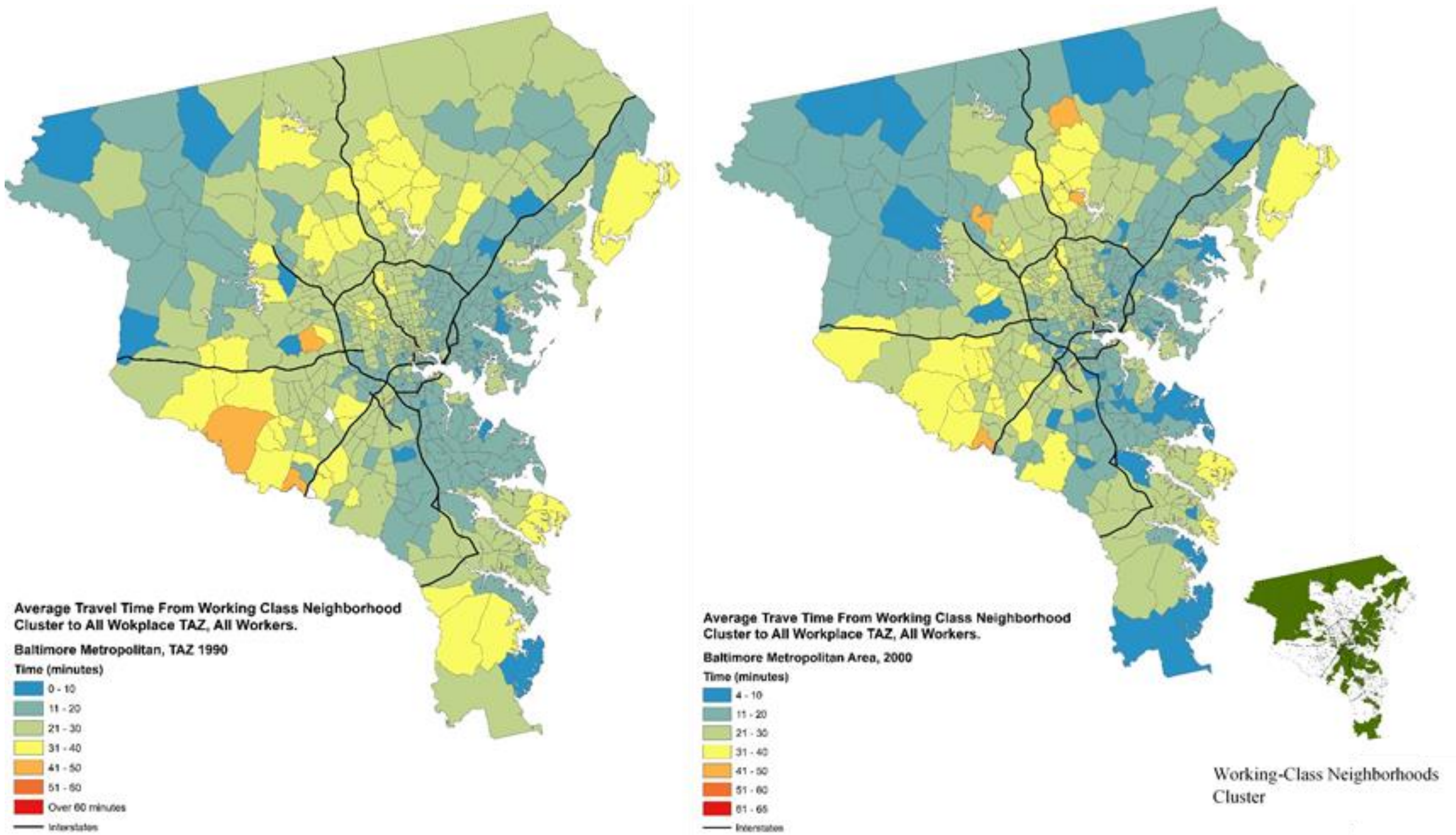


Figure 36. Average commute time from working-class neighborhood cluster to all workplace TAZ.

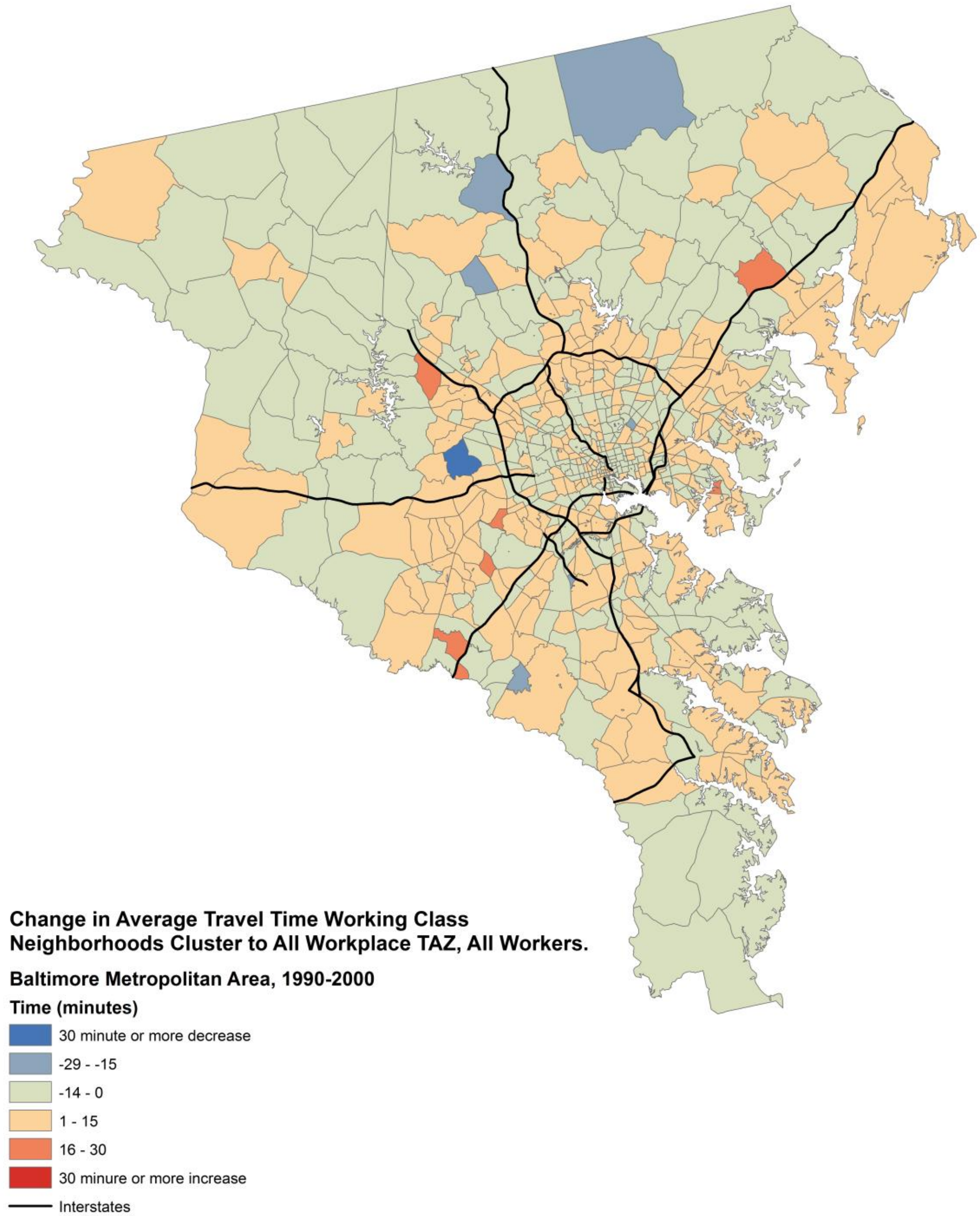


Figure 37. Change in average travel time from the working-class neighborhood cluster to all workplace TAZ.

Low-income, African-American Neighborhoods

In 1990, the Downtown employment center was the destination of travel for more than half of the residents living in the low-income, African-American neighborhood cluster. Most neighborhoods making up this cluster were in East and West Baltimore City, therefore, the travel time to the Downtown center was relatively short, 15 minutes' average travel time. In 2000 the percentage of workers commuting to employment in that center decreased slightly, and the average commute time remained the same. It is important to note that residential population in this cluster also decreased during this time.

In 1990 and 2000, the areas with the highest commute times, over 25 minutes were all employment centers where less than 2% of the resident-workers from that neighborhood group were traveling to. The high commute times likely play a role in few workers commuting to those locations. The exceptions to this were the BWI and Security Square employment centers. In 1990 these areas had a 24 and 23-minute average commute time, respectively, with 6% of workers commuting to that center (out of all workers commuting to an employment center). In 1990, the most workers from the low-income, African American neighborhood cluster commuted to this center, behind Downtown and Hunt Valley. Employment to the BWI center declined in 2000, and travel time increased, while travel time to Social Security remained the same. Tables 22 and 23 summarize the commuting data for this residential cluster.

Table 22
Commuting data for low-income, African-American cluster workers traveling to employment centers, 1990.

Employment Center	**Average Travel Time from Neighborhood Cluster, 1990 (minutes)**	**Workers Traveling to an Employment Center, 1990 (%)**
Downtown	15	55%
Hunt Valley	26	12%
BWI	23	6%
Security Square	24	6%
East Baltimore	16	5%
Pikesville	27	4%

Table 23
Commuting data for low-income, African-American cluster workers traveling to employment centers, 2000.

Employment Center	**Average Travel Time from Neighborhood Cluster, 2000 (minutes)**	**Workers Traveling to an Employment Center, 2000 (%)**
Downtown	15	51%
Hunt Valley	23	11%
Southeast Baltimore	20	9%
Catonsville	16	8%
Security Square	16	6%
BWI	26	3%

Higher percentages of workers in this neighborhood cluster also commuted in higher percentages to employment centers in East Baltimore in 1990, and Southeast Baltimore, Catonsville in 2000. As previously noted, these employment centers were characterized by a greater number of workers in manufacturing, transportation, and warehousing industries, but also in retail and public administration. Demographic characteristics observed in Chapter 2 showed that many residents in this cluster had a below high school education and worked in service industries.

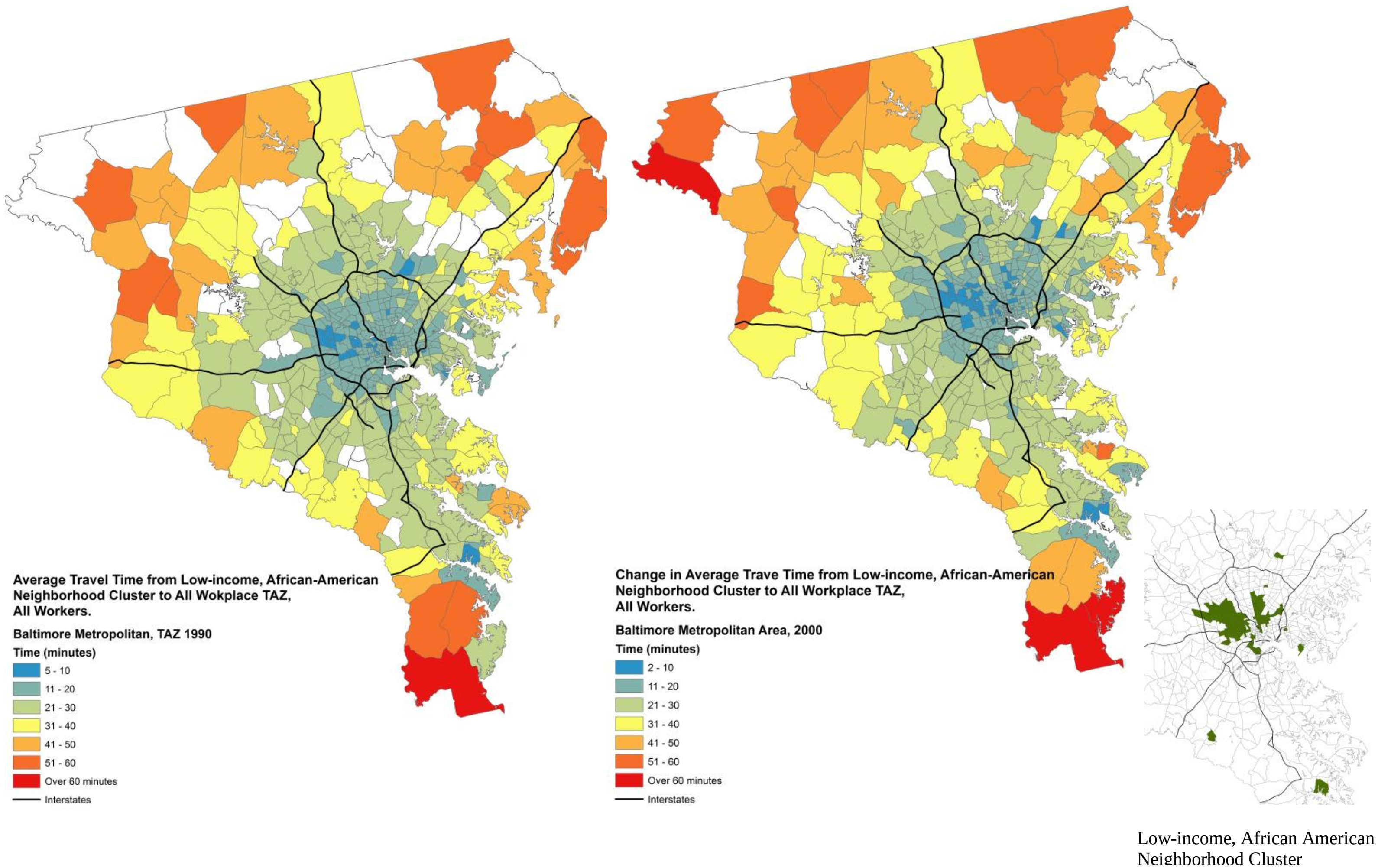
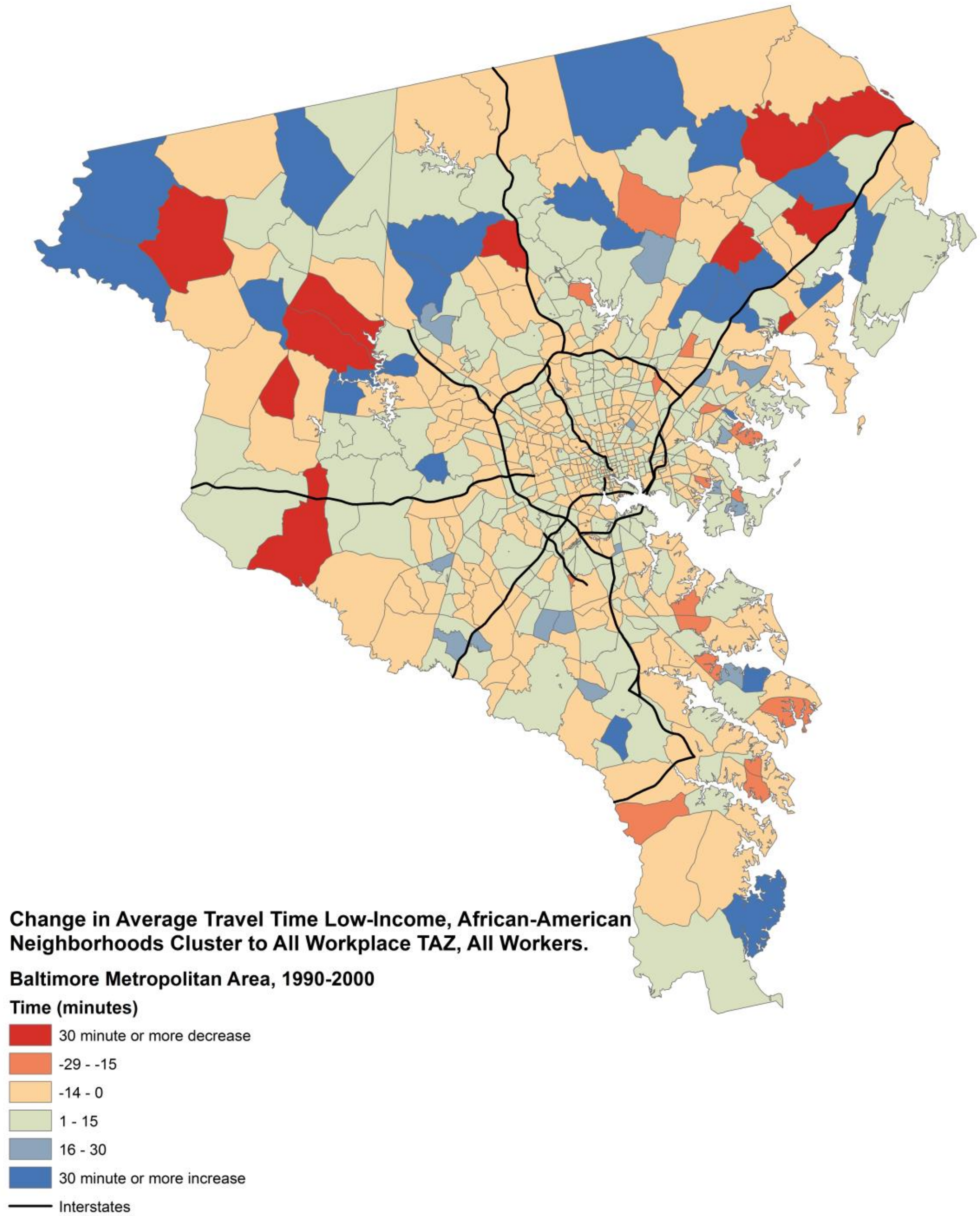


Figure 38. Average commute time from low-income, African-American neighborhood cluster to all workplace TAZ.


Change in Average Travel Time Low-Income, African-American
Neighborhoods Cluster to All Workplace TAZ, All Workers.
Baltimore Metropolitan Area, 1990-2000
Time (minutes)
30 minute or more decrease
-29 - -15
-14 - 0
1 - 15
16 - 30
30 minute or more increase
Interstates

Figures 38 and 39 show little change between 1990 and 2000 for workers commuting from the low-income, African-American neighborhoods cluster to workplace TAZ throughout the metropolitan area. Although the map in Figure 39 does show some areas of change, further investigation of those areas found that the areas with the greatest change were areas that had no workers commuting to them in 1990 and 2000, and the change in number of workers between those two time periods were very small, not representing any large-scale change. The data and the maps suggest that workers in these neighborhoods have shorter ranges in their commute activities and that those commute patterns did not change much over the decade.

Neighborhoods in Transition

Similar to the working-class and low-income, African-American neighborhood clusters, workers residing in the neighborhoods in transition made a higher percentage of commuting to work trips to Downtown, Hunt Valley, Annapolis, BWI area, and Security Square. The average travel times to these areas ranged from 9 minutes (Annapolis) to 24 minutes (BWI area). In 2000, higher percentages of residents were commuting to Southeast Baltimore and Catonsville. Southeast Baltimore had a longer average commute time, 26 minutes.

Table 24
Commuting data for neighborhoods in transition cluster resident workers traveling to employment centers, 1990.

Employment Center	Average Travel Time from Neighborhood Cluster, 1990 (minutes)	Workers Traveling to an Employment Center, 1990 (%)
Downtown	15	42%
Hunt Valley	16	19%
Annapolis	9	9%
BWI	24	7%
Security Square	17	4%

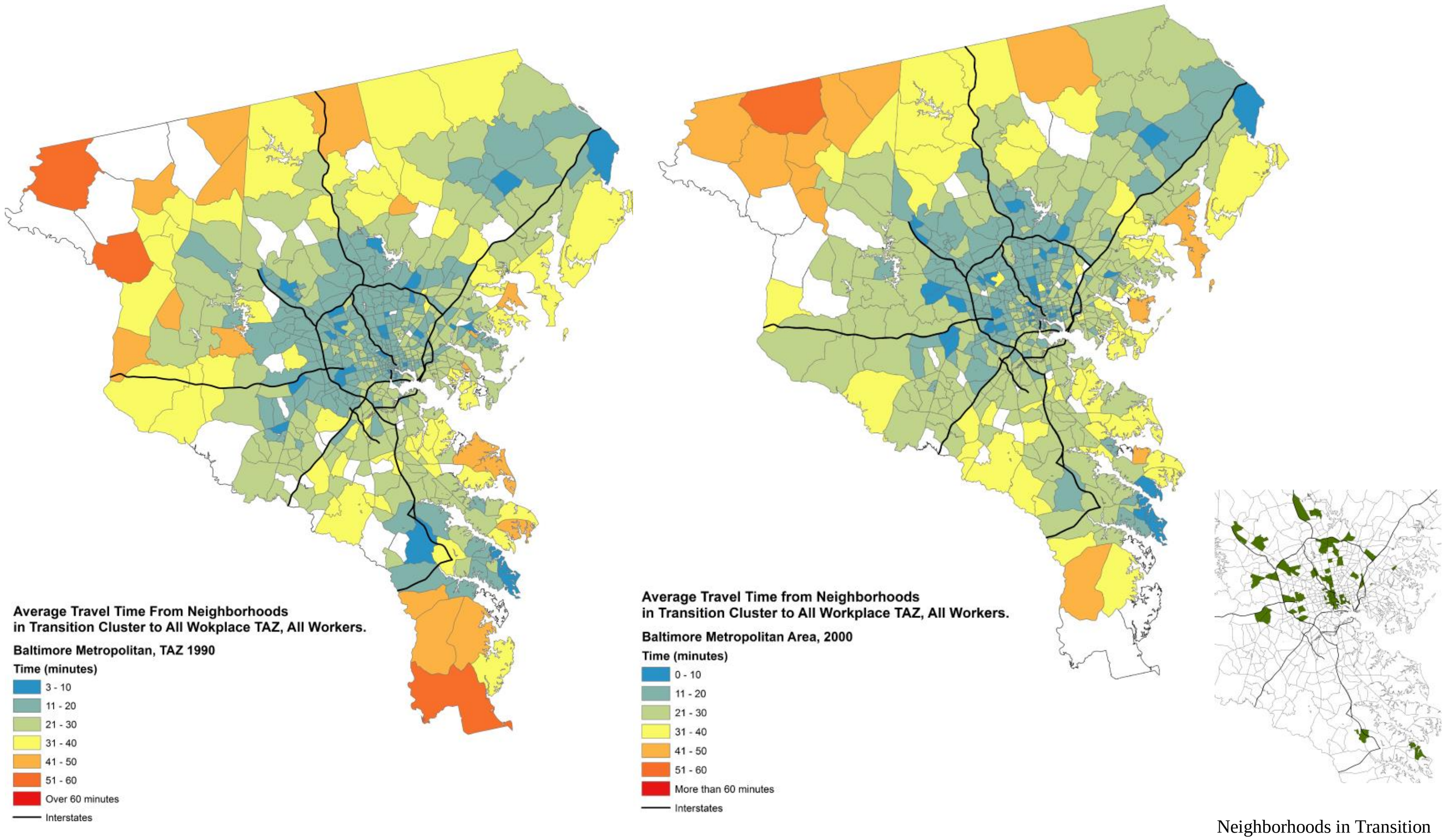


Figure 350. Average commute time from neighborhoods in transition cluster to all workplace TAZ.

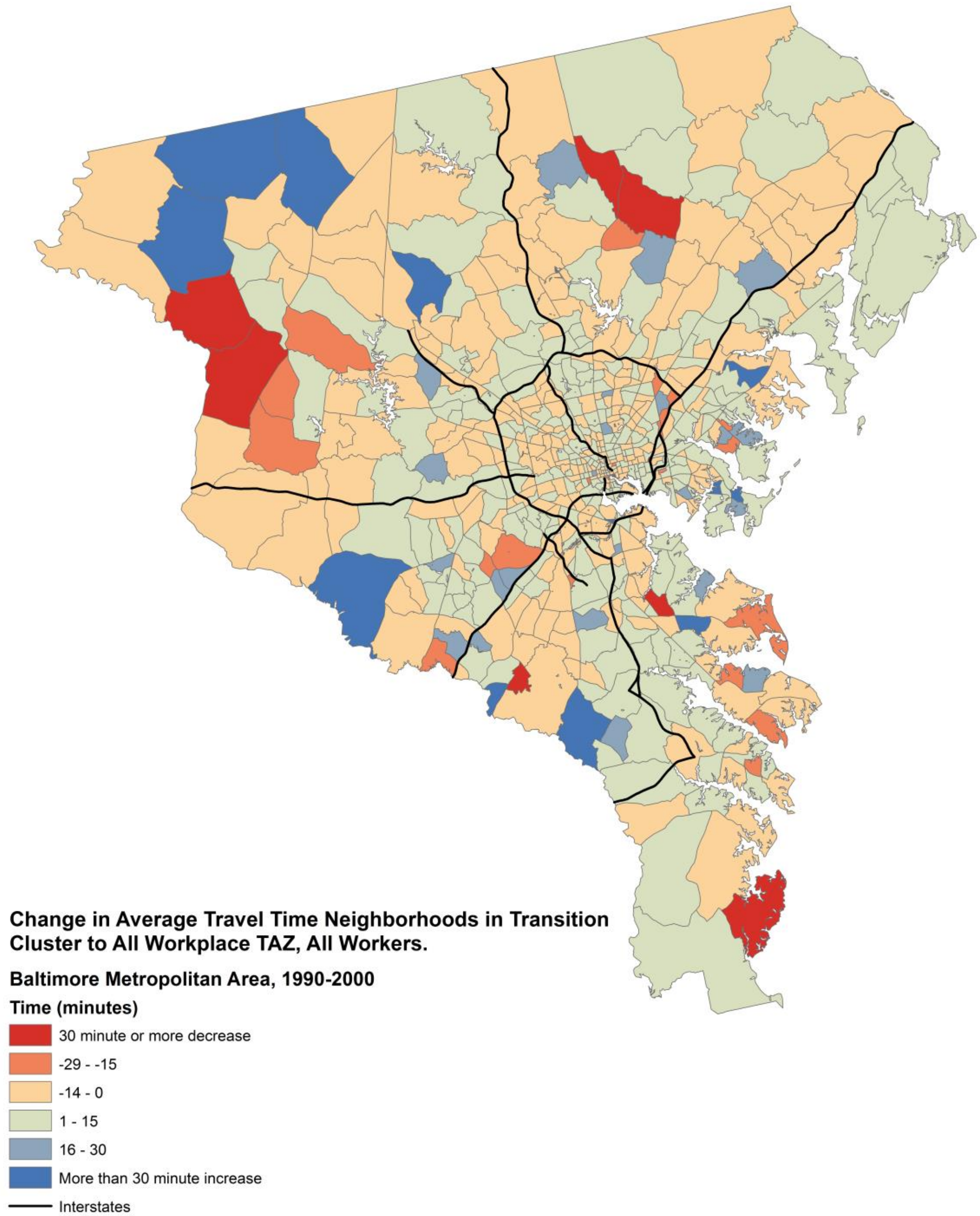


Figure 41. Change in average travel time from the neighborhoods in transition cluster to all workplace TAZ.

Table 25
Commuting data for neighborhoods in transition cluster resident workers traveling to employment centers, 2000.

Employment Center	**Average Travel Time from Neighborhood Cluster (minutes)**	**Workers Traveling to an Employment Center (%)**
Downtown	15	44%
Hunt Valley	16	20%
Catonsville	19	6%
Southeast Baltimore	22	5%
Security Square	17	5%
BWI	27	4%

Commuting data presented in tables 24 and 25 summarize the employment center locations and the average commute times for where the main destination of workers residing in the neighborhoods in transition cluster. Overall, the data suggest workers in this cluster had lower average commute times but that in 2000 commute times and the areas they were commuting to both increased.

Figures 40 and 41 show that the average commute to some areas of West Baltimore decreased. This can be attributed to less workers commuting to that area. There is also an increase seen in the average time to Pikesville, which corresponds to the data showing a higher percentage of workers commuting to that area. The change map shows an increase in average travel time to Bel Air South, and Ft. Meade, suggesting that workers were traveling further in 2000 to reach those destinations. Ft. Meade was a large employer in 1990 and 2000, and continues to be today.

The diverse nature of residents in this community, with workers in professional and technical occupations, administrative support and clerical occupations, and service occupations means that there was unlikely to be an association of workers commuting to one type of industrial employment center. The results do indicate that workers from these neighborhoods were traveling a little further to reach employment, as new opportunities opened in the suburbs.

Middle-class, Married with Children

In 1990 the largest percentage of workers from this neighborhood cluster were traveling to Downtown, Hunt Valley, the BWI area, Annapolis, and Aberdeen. By 2000, the percentage of workers to Downtown decreased slightly, but was still the top employment center destination. Hunt Valley, the BWI area, and Annapolis also remained top destinations, and Columbia II was added in 2000. Tables 26 and 27 summarize commuting trends from this neighborhood cluster.

Table 26
Commuting data for middle-class, married with children cluster resident workers traveling to employment centers, 1990.

Employment Center	**Average Travel Time from Neighborhood Cluster, 1990 (minutes)**	**Workers Traveling to an Employment Center, 1990 (%)**
Downtown	26	23%
Hunt Valley	22	17%
BWI	20	17%
Annapolis	11	8%
Aberdeen	19	7%

Table 27
Commuting data for middle-class, married with children cluster resident workers traveling to employment centers, 2000.

Employment Center	**Average Travel Time from Neighborhood Cluster, 2000 (minutes)**	**Workers Traveling to an Employment Center, 2000 (%)**
Downtown	26	21%
Hunt Valley	22	16%
Annapolis	8	13%
BWI	21	9%
Columbia II	12	6%

Resident workers from the middle-class, married with children cluster had some of the longest commutes to the Downtown employment center. They also had somewhat different commute patterns than workers in the neighborhood clusters previously described. In particular, they had a longer average commute to the BWI employment center and a higher percentage of workers commuting to that location in 1990 and 2000. In 2000, Columbia emerged as a center where workers were traveling to from this cluster, but average travel time to this center was low, based on the location of where these neighborhoods are located within the metro area (see Figures 9 and 42).

The average travel times to these employment centers remained relatively unchanged between 1990 and 2000. The resident-workers of this cluster had the shortest commute Aberdeen, and approximately 7% of the residents commuted to that location in 1990, dropping to 4% in 2000. The neighborhoods in this cluster were also located in Aberdeen and surrounding vicinity.

The change map in Figure 43 shows an increase in the average commute time to northern Baltimore County, around White Hall and Jarrettsville, and around Manchester and Westminster. The residential areas of this cluster were not located in those are so that suggest workers traveling to opportunities in the exurbs.

The longest commute times in 2000 to the BWI area and Pikesville suggest that some workers from this neighborhood cluster are traveling to further to opportunities in those employment centers, which could be professional occupations, education, health and social services, and public administration jobs. These were the industries that would match the education and occupational status of the majority of residents in those neighborhoods. The decrease in workers traveling Downtown is not likely to be a reflection of declining jobs in the city, because in Chapter 4 the data showed that professional and administrative jobs remained in the city in 2000. This shift may be more to do with choice for these commuters.

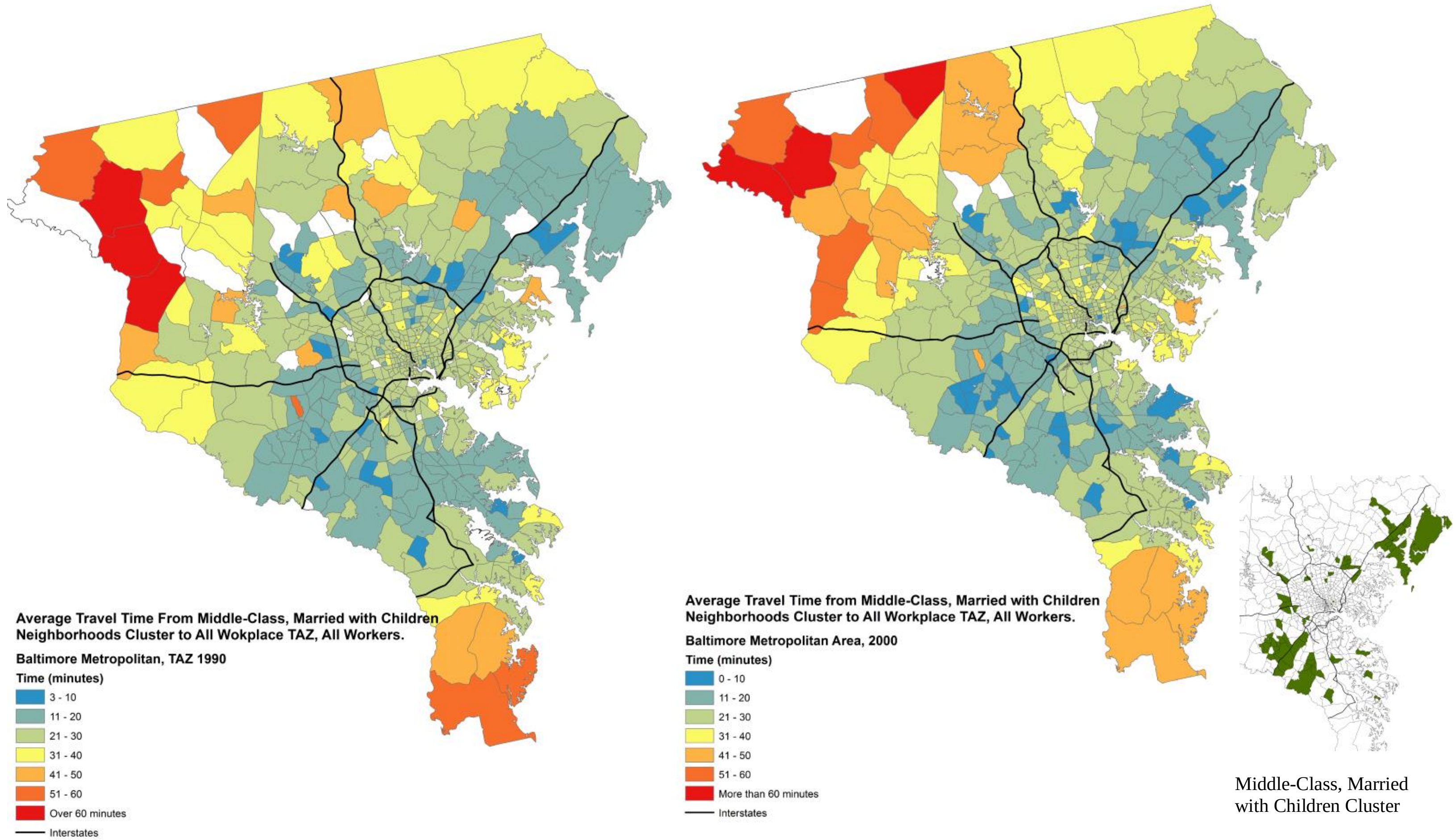


*Figure 42***.** Average commute time from middle-class, married with children cluster to all workplace TAZ.

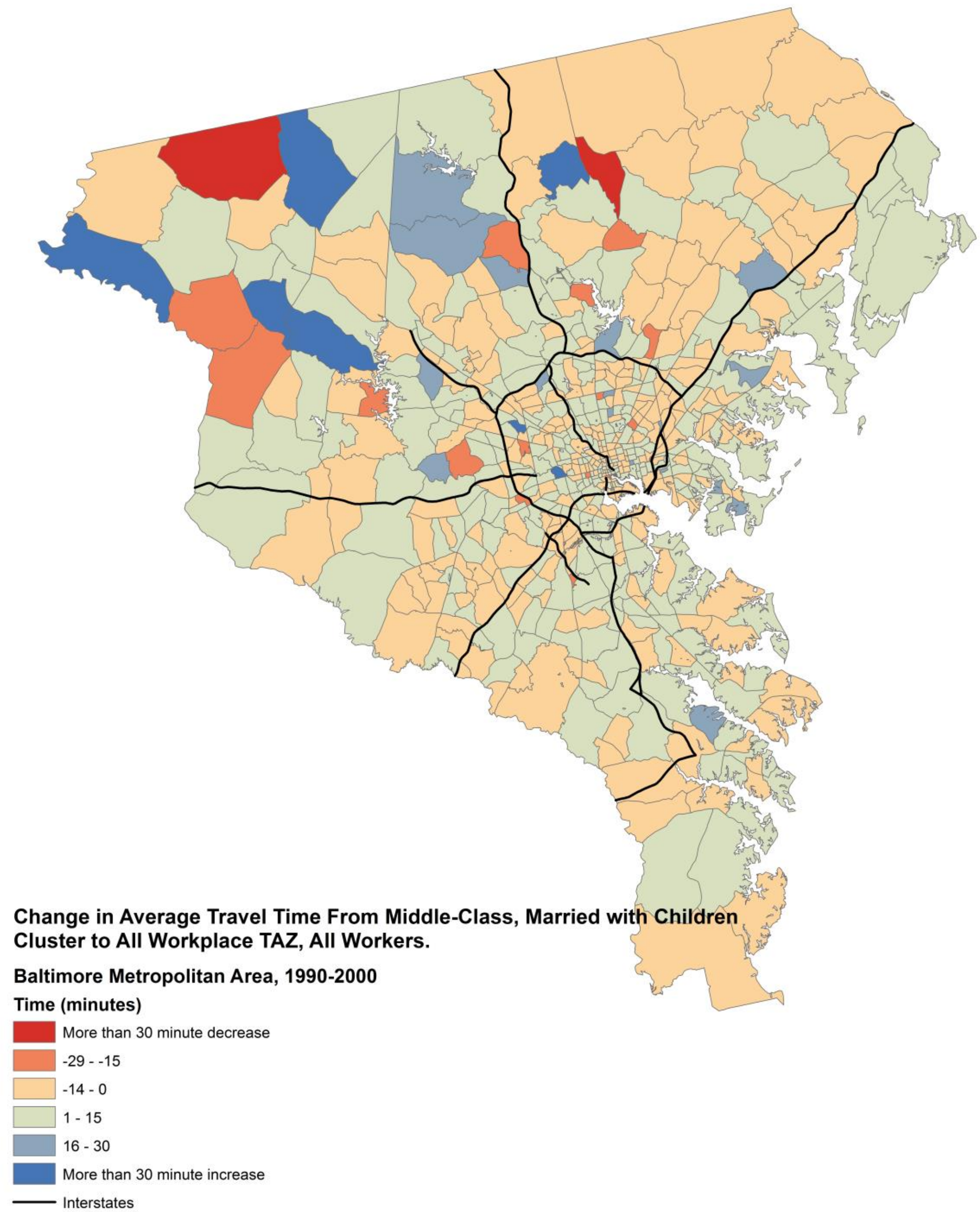


Figure 43. Change in average travel time from the middle-class, married with children neighborhood cluster to all workplace TAZ.

Newer, Upper Middle Class

In 1990 and 2000, the highest percentage of working residents from the newer, upper middle class neighborhoods cluster commuted to the BWI area, Downtown, Hunt Valley, Annapolis, Security Square, and Columbia. The percentage of workers commuting to each of these areas remained relatively unchanged, except for a decrease traveling to the Downtown employment center and an increase traveling to Annapolis.

Average commute times to the Downtown and BWI employment centers where on the higher end of average commute times for this residential cluster. This could suggest that workers must travel further to reach employment opportunities.

Table 28
Commuting data for new, upper middle class cluster resident workers traveling to employment centers, 1990.

Employment Center	Average Travel Time from Neighborhood Cluster, 1990 (minutes)	Workers Traveling to an Employment Center, 2000 (%)
Downtown	26	27%
BWI	19	23%
Hunt Valley	24	16%
Annapolis	16	8%
Security Square	22	5%
Columbia	16	4%

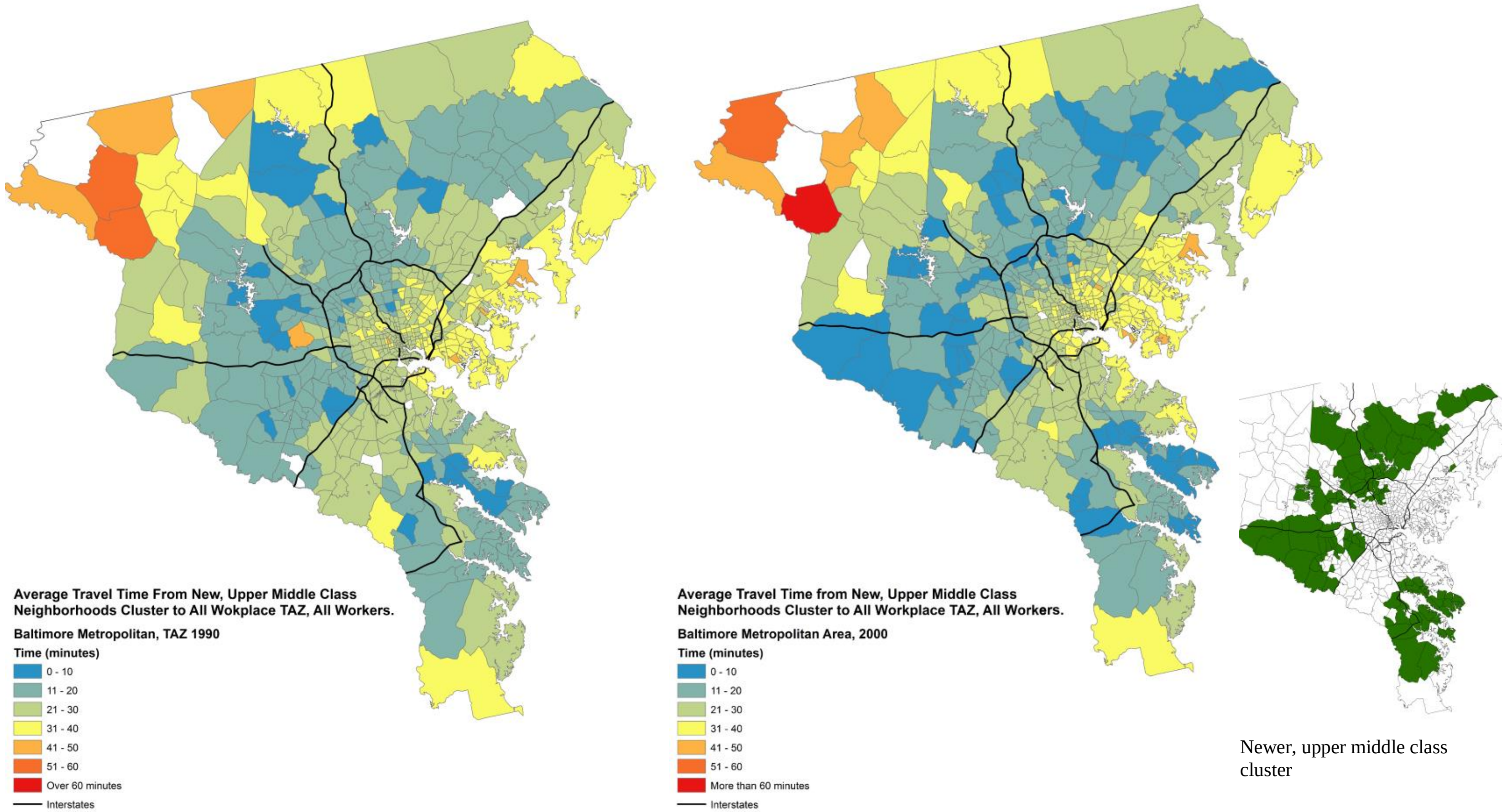


Figure 44. Average commute time from middle-class, married with children cluster to all workplace TAZ.

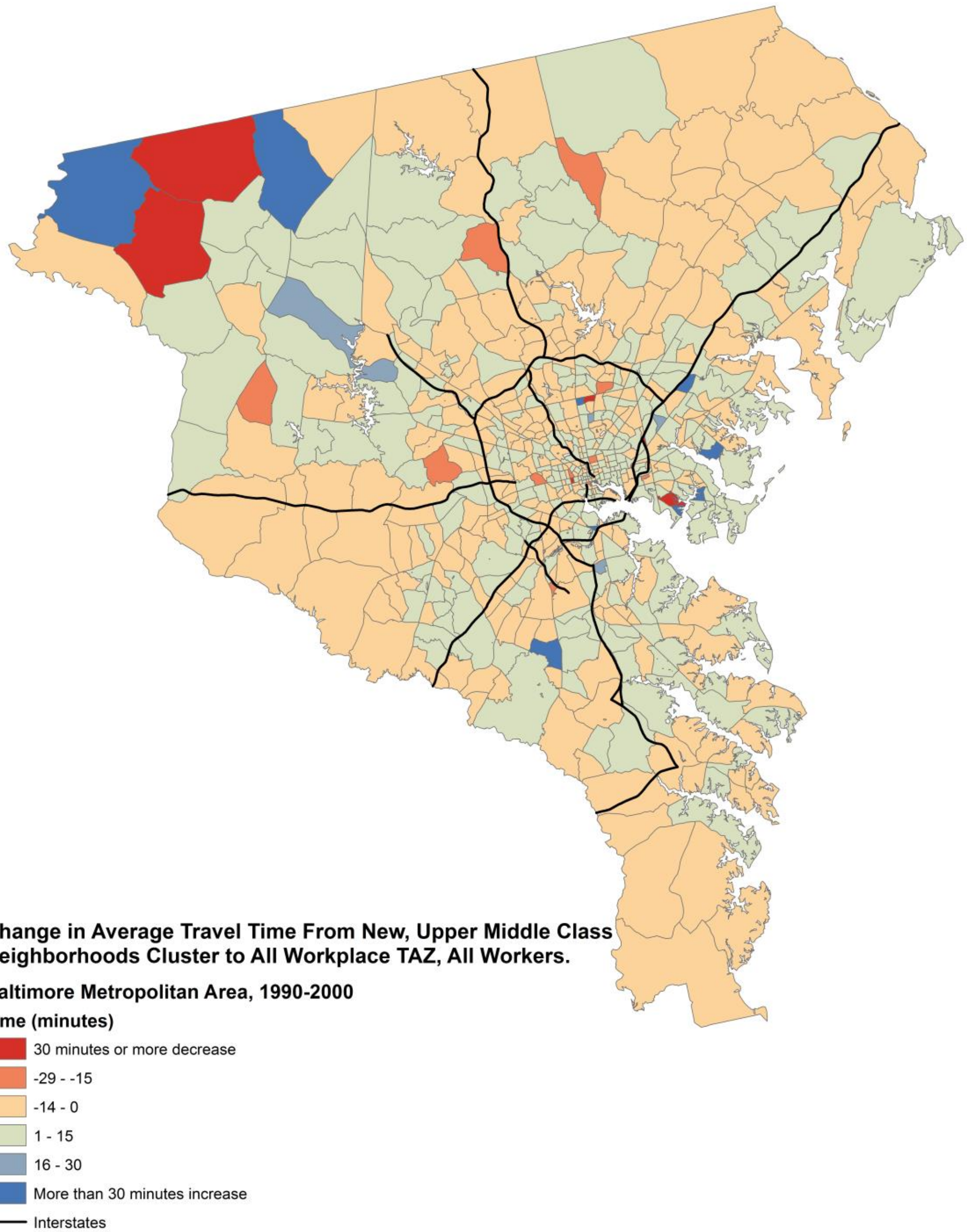


Figure 45. Change in average travel time from the new, upper middle class neighborhood cluster to all workplace TAZ.

Table 29
Commuting data for new, upper middle class cluster resident workers traveling to employment centers, 2000.

Employment Center	**Average Travel Time from Neighborhood Cluster, 1990 (minutes)**	**Workers Traveling to an Employment Center, 2000 (%)**
Annapolis	15	68%
Downtown	26	9%
Hunt Valley	19	7%

Tables 28 and 29 indicate higher average travel times to Downtown, Hunt Valley and the BWI employment center, but lower times to Annapolis and Columbia. The average travel time to Hunt Valley decreased between 1990 and 2000, a reflection of the decrease in workers traveling there. The greatest commuting change that occurred for workers from this neighborhood cluster is the increase in the number of workers commuting to Annapolis, and the decrease to other locations. Only three main employment centers could be identified for 2000, with lower percentages of workers traveling to the other centers.

The change map in figure 45 shows increased average commute times to the Crofton area and well as White Marsh, and the area near Westminster. Jobs in those areas were typically in industries such as professional services, retail, education, health, and social services. The majority of workers living in the new, upper middle class neighborhoods were employed in professional, white collar occupations.

Although not visible in the change map, the data and the map in Figure 44 indicate longer average commute times to some areas Downtown such as the east side of Baltimore, the area around Johns Hopkins University and Johns Hopkins Hospital.

4.5 Conclusions

Analyzing the average commuting time and change in average commuting time between 1990 and 2000 for the different residential cluster types showed a few broad trends, such as greater average commute times to some suburban employment centers and some exurban TAZ. However, these changes were not seen in all residential groups. Downtown, Hunt Valley, Annapolis, and the BWI employment centers were consistently the centers with the highest percentages of workers traveling to them. However, this was not the case of the African American cluster which had higher percentages of workers traveling to Security Square in 1990 and 2000.

There was an increase in travel time for workers from the working-class neighborhood cluster. The maps and the data suggest that workers were traveling further to work, away from their residential locations. The change map indicated that those areas they were commuting further to included, Bel Air, Owings Mills, and areas along Rt. 29 towards Washington, DC. Some of these areas were locations of manufacturing and blue-collar jobs were in 2000, other areas were more characterized by retail and public administration. A continuing shift away from manufacturing between 1990 and 2000 would result in these workers needing to either find alternative types of employment or traveling to where those jobs were located, and the data supports this.

Workers from the low-income, African-American neighborhood cluster had a low commute time to workplace TAZ in the Downtown employment center. The reason for this low commute time is related to the location of the neighborhoods in this cluster, with most of those neighborhoods located in close proximity to Downtown. The data for 1990 also show that there were 60,000 workers commuting between those locations in 1990 and 2000.

The average commute times to other locations and the destinations to where most workers from this cluster traveled in 1990 and 2000. This suggest that options for workers in this cluster were constrained, either by restrictions related to movement (car ownership, bus routes, travel time to other workplace locations) or job skills.

Workers from the neighborhoods in transition cluster had some of the lower commute times to employment centers compared to other residential clusters. The longest commute times were to BWI and Southeast Baltimore. Many of the neighborhoods that made up this cluster were in or adjacent to employment centers, such as Owings Mills/Reisterstown, Ellicott City/Columbia, Hunt Valley, and Downtown/Midtown. This influences travel time from those areas. The diverse nature of this cluster makes it difficult to interpret the results, but suggest that residents in this cluster had sufficient access to workplaces in 1990 and that remained the same in 2000.

Average travel times to employment centers for workers in the middle-class married with children and the new, upper middle class cluster were longer for many more workers than for workers in other neighborhood clusters. The physical location of new, upper middle class neighborhood in Howard County, northern Baltimore County, Harford County and Ann Arundel, resulted in longer average travel times to Baltimore City, where most of these workers were employed. Workers in this cluster also had a long commute to Hunt Valley, the second largest place of employment, employing 17 and 16 percent of the workers in the residential group in 1990 and 2000, respectively. Travel time to BWI was also over 20 minutes. Similar trends were found for residents of the middle-class, married with children residents.

In general, there appeared to be some level of continuity to the commuting patterns of workers in these residential groups. This continuity may be related to the fact that a ten-year period is a short amount of time in which to see big changes in commuting behavior. It could also be due to factors related to the immobility of some workers. Immobility may be related to low-wage labor, the housing market, or living arrangements (i.e., living closer to a spouse's place of work). For example, workers may voluntarily choose to live in a residential area with low employment accessibility for reasons unrelated to employment; they may be selecting that location for its amenities (Giuliano, 1995), or they may have a partner who has a shorter commute time. It is possible that workers in the middle-class, married with children and upper middle class neighborhood clusters longer commutes are more related to choice than the other possibility presented here. In that case, long commute times may actually be a reflection of high mobility (associated with highly paid workers) (Simpson, 1992). But another possibility is a spatial mismatch between job location and residence, requiring residents to drive into the city, BWI, or Annapolis for the types of employment they are seeking.

Short commutes can result from workers being constrained in the distances or times that they can travel to work, as appears to be the case of the workers in the low-income, African American cluster. This would result in lower average commutes for a residential neighborhood but not be the result of higher accessibility (Houston, 2005). It is difficult to separate out the reasons behind shorter and longer commute times for these more personal reasons, and accessibility measures don't adequately capture these factors. Research suggests that particular sociodemographic groups commute less than others, for example low-income workers (Ihlanfeldt, 1993) or women (Madden, 1981). This could result in shorter commute distances and times from particular neighborhoods, like those in the low-income, African-American cluster.

Some studies have examined the commute experiences of the transit-dependent population and found that they experience lower levels of employment access (Grengs, 2010; Horner & Mefford, 2007; Taylor and Ong, 1995). As discussed in the introduction chapter of this dissertation, the number of public transit riders has declined over the last century, and now the largest share of riders are those traveling to central city locations (typically on commuter rail, light rail, or metro/subway systems) and the transit-dependent. Despite the high ridership of the transit-dependent, fewer resources have gone to improving transit services in low-income, central city areas, which tend to serve the majority of transit-dependent riders. Instead, resources are poured into attracting car drivers to rail and bus services (Garrett & Taylor, 1999). Garrett & Taylor (1999) concluded that this uneven distribution of resources is "economically inefficient and socially inequitable" (p. 6). Despite attempts at improving bus routes, transit-dependent riders remain limited in their workplace options.

Chapter 5: Conclusions

In Chapter 1, I discussed the idea that economic restructuring, coupled with urban expansion created new patterns of opportunity within metropolitan Baltimore, and that neighborhoods across the area experienced those transformations in different ways, particularly with regards to their access to economic opportunity. I argued that these transformations can be viewed through the lends of spatial justice, because the shifting landscape of jobs and residences take place in space. Although it is not necessary to use this type of a framework to study commuting patterns, it provides a different way of understanding the implications of these changes on the residents living within different communities. Rather than focusing on the impacts of these changes on a particular racial, class, ethnic, or gender group, for example, the focus is on areas of the region, which may include a diverse sociodemographic group of people living within it.

Residential and employment suburbanization have the potential to create areas where residents can experience less access to employment opportunity over time, greater access, or maintain the status quo. The goal of this research was to investigate these changes in more detail, and analyze the impact of these trends on employment access in metropolitan Baltimore. In Chapter 1, I presented brief accounts of the Bus Riders Union in Los Angeles and the Red Line project in Baltimore as two examples where transit planning decisions compounded issues of employment access, and where residents organized around the impacts of these decisions on racial, class, and spatial groups.

5.1 Continuity and Change in Metropolitan Baltimore

5.1.1 Residential Analysis

There are numerous ways in which access as a spatial justice issue can be evaluated, and I have presented one approach within these chapters. My approach explored residential and workplace change, as well as commuting patterns. In Chapter 2, I presented an analysis of residential change in metropolitan Baltimore from 1970 to 2000. This analysis built upon previous PCA and cluster analysis of metropolitan Baltimore (Hanlon 2006, 2009; Vicino,2008a, b), by expanding the scope of the study area to the entire metropolitan region and expanding the study period over a long time, 1970 and 2000.

The results presented in Chapter 2 illustrate Wyly's (1999) concept, that the socio-spatial landscape of urban areas can exhibit both continuity and change over time. For example, the metropolitan area exhibited patterns of residential segregation that persisted over the 40-year study period. The residential clusters identified as 'newer middle-class,' 'upper middle class,' 'middle class families with children,' 'upper middle class families,' and 'working class' from 1970 to 2000, were strongly characterized by a high percentage of white residents (70% or more). Moreover, these neighborhood clusters were predominately located in the suburbs—although there were some of these neighborhood types downtown, suggesting gentrification in neighborhoods of the central corridor, Canton, and the inner harbor in 2000. The low-income, African-American neighborhoods located in the east and western sections of Baltimore City where characterized by a high percentage of African-American residents (89% or more). This continued separation of these socio-spatial demographic groups is an example of the continuity of racial segregation in metropolitan Baltimore over this 40-year period.

The results also identified examples of change occurring within neighborhoods, and in the distribution of neighborhood types. For example, the characteristics of households changed through time, which resulted in new types of neighborhood types forming. This was due in part to nationwide demographic changes, such as the growth of single-family and non-family households, the aging of the population, and the increase of immigrants and foreign-born residents. The characteristics making-up each cluster group were slightly different each decade, which is a primary reason why many the clusters have different names over the course of the study period. The PCA and cluster analysis captured these changes in socio-demographics as well as spatial location.

The results in Chapter 2 also revealed the presence of neighborhood types that consisted of a more diverse makeup of householders' race, class, ethnicity, and occupation. These neighborhood types included, 'middle class married with children,' 'service class,' and 'neighborhoods in transition' These residential clusters were typically located in areas that are referred to as inner-ring suburbs; areas that are somewhat urban, but located outside of the city. These neighborhoods represent areas of change in metropolitan Baltimore.

As was discussed in Chapter 1 and 2, the residential analysis and the creation of neighborhood typologies served to paint a picture of the spatial distribution of various socio-demographic groups across metropolitan Baltimore. In addition, the analysis served to further refine the study of employment accessibility in Chapter 4, by locating different groups in space.

5.1.2 Employment Analysis

In Chapter 3, I described shifting employment patterns, including the change in demands for workers in different industrial categories and the spatial distribution of employment locations. The results revealed changing patterns of employment across metropolitan Baltimore, specifically, a trend towards greater employment suburbanization. Employment suburbanization was evident from the analysis of employment by industry in each county, where the data showed jobs growing in the suburban counties and declining in Baltimore city. This trend was also seen in the analysis of employment at the TAZ-level, in 1990 and 2000; particularly with regards to employment centers. The emergence of two exurban employment centers, and the agglomeration of other suburban employment centers also supported this finding.

Shifts in the labor market occurred simultaneously with the suburbanization of employment. In Chapter 3, I presented a detailed analysis of changes in employment by industry at the neighborhood level. Overall, there was reduction in manufacturing workers in the region and an increase in workers employed in the services. The data also suggest some polarization of employment in the upper and lower earnings sectors of the services.

The transformation of the labor market and the spatial shifts in employment demand exhibited change in the metropolitan area, but there were aspects of employment and the labor market in metropolitan Baltimore that remained consistent over time. Despite a decline in total jobs, the city remained the center of economic activity for the region. This is confirmed by the number of jobs and workers located in the city, and the number of commuters to city-based employment centers. Between 1990 and 2000, the largest employment centers outside of the city, BWI, Hunt Valley, and Annapolis remined the largest suburban employment centers, drawing workers from all over the region, not just their local areas. Overall, these trends seen in Chapter 3 exemplify the idea of continuity and change taking place simultaneously.

5.1.3 Access Analysis

In Chapter 4, I presented an analysis of access to employment by exploring commuting patterns and travel time for residential neighborhood cluster types identified in Chapter 2, to employment centers identified in Chapter 3. The results of this analysis indicate that residents of some neighborhood types have had little change in their employment access between 1990 and 2000, while others have experienced some degree of change.

In 1990 and 2000, workers residing in the low-income, African-American neighborhood cluster saw little to no change in their average commute times to workplaces in employment centers. The data indicated that over half of all workers commuted to the downtown employment center, a higher percentage of workers commuting to a single location than all the other residential neighborhood groups. The low average commute time to that employment center might suggest that residents in these neighborhoods have very good access to employment opportunities; over half of all workers have short commute times and workers have a high number of jobs in close proximity. However, that interpretation of the data doesn't consider the high levels of unemployment in in the low-income, Africa-American neighborhood type, nor the decline in the number of workers commuting to downtown between 1990 and 2000, or the number of commuters who take public transportation. It also doesn't consider the context of these findings.

In 1990, average commute times to almost all other employment centers traveled to by residents of the low-income, African-American cluster, had higher commute times, over 23 minutes. As noted in Chapter 4, this suggests workers from those neighborhoods were constrained in their access to employment opportunities. This can be due in part to the difficulty in accessing employment in other locations, based on the higher travel times revealed in the analysis. This is an example of a spatial justice issue, but rather than seeing access change over time, justice conditions remained the same for residents of this neighborhood group. They had poor access to jobs in 1990 and 2000.

Residents of the middle-class, married with children neighborhood cluster and the new, upper middle class neighborhood cluster had higher average commute times to the employment centers where most workers traveled to. It would follow that a longer commute time to workplace and lower number of jobs in close proximity suggests poorer job access. However, I believe that would be the wrong interpretation of that data. Rather, I believe that the distribution of commute destinations shown in the data for these two groups suggest that they have greater spatial choice, and experience less constraint in the commuting destinations. This indicates that there was more choice for these residents in where to live and to work in 1990 and 2000. As discussed in Chapter 4, workers make choices to live further from work for a variety of reason. This does not discount the fact that for some, these longer commute distances may not be by choice, but there is not enough data in this analysis to analyze subsets of the households.

Workers from the neighborhoods in transition cluster generally had lower commute times to employment centers compared to other residential clusters. There were a high proportion of workers traveling to two employment centers, downtown and Hunt Valley. They also had lower commute times to other suburban employment centers. The data suggest that very little change occurred for workers of this neighborhood group, but the there is a level of uncertainty due to the diverse nature of this the residents in this cluster. What stood out from the data is that commute times were low to places that were proximal to these residential neighborhoods. It follows that residents living in these neighborhoods area commuting to employment centers close to them. However, there was not enough data to draw more conclusions for this neighborhood group.

As discussed in Chapter 4, residents of the working-class neighborhood cluster were shown to be traveling slightly longer distance to reach employment opportunities. The shift in the distribution of manufacturing jobs and other blue-collar jobs, as well as the decline of these types of opportunities between 1990 and 2000 likely played a role in the changing commuting patterns and increased travel time for workers in this neighborhood group. This is the only neighborhood group that the data show a clear change.

These findings suggest that there were few large-scale changes in access between 1990 and 2000, employment access for most of these neighborhood groups remained the same over the study period. There were neighborhood groups experiencing injustice in terms of access to employment, workers in the low-income, African-American neighborhood cluster for example, experienced a level of spatial injustice in their access to employment. But this did not change over time, they continued to experience the same constraints in 1990 and 2000 and their justice conditions remained the same. Workers residing the working-class cluster saw some decrease in the access, and thus experienced a greater spatial injustice over time. Lastly, workers in the middle-class, married with children neighborhood cluster and the new, upper middle class neighborhoods had little change in their access over time, suggesting their justice conditions also remained the same over time.

5.2 Final Conclusions and Suggested Future Research

This dissertation is a starting point, upon which future research can be based. It is my hope that this research provides an example of how to more quantitatively evaluate issues of spatial justice. In addition, as the Baltimore metropolitan region makes decisions in regards to the future of transit planning, It is my belief that research like this can help to inform planners on how these decisions impact workers in different areas.

I suggest future research investigate the 2010 CTPP data. The redactions of this data are similar to those in 2000, which may make for better comparability between different types of commuters possible. I also suggest considering the commute differences between various sociodemographic groups, in addition to the neighborhood types. This would incorporate more data into the analysis of commute distances and times. In addition, I suggest investigating aspatial barriers to employment along with the spatial barriers. I do not believe that accessibility measures are enough to describe the challenges inherent in employment access. These types of future research would allow for a comparison between the impact of space, job education and training, and belonging to a particular socio-demographic group on employment accessibility.

Appendices

Appendix 1: Supplemental material for Chapter 2

A1.1: Residential Typology Variables

Variable Name	***Description***
Population	
SHRWHT*y*N	Percentage of population that is White
SHRBLK*y*N	Percentage of population that is Black
SHRHSP*y*N	Percentage of population that is Hispanic/Latino
FORBORN*y*	Percentage of population foreign born
NONFAM*y*	Percentage of nonfamily households
MCWKID*y*	Percentage of family households, married couple with own children under 18 years old
MCNKID*y*	Percentage of family households, married couple without children
FHWKID*y*	Percentage of family households, female-headed household with own children under 18 years old
FHNKID*y*	Percentage of family households, female-headed household without children
Education	
EDUC811*y*	Percentage of persons 25+ years old who have competed 0-8 years of school and 9-12 years of school but no diploma
EDUC12*y*	Percentage of persons 25+ years old who have completed high school but no college
EDUC15*y*	Percentage of persons 25+ years old who have completed some college but no degree
EDUC16*y*	Percentage of persons 25+ years old who have a bachelor's or graduate/professional degree
Employment	
OCC1*y*	Percentage of persons 16+ years old who are in the civilian labor force and employed in professional and technical occupations
OCC2*y*	Percentage of persons 16+ years old who are in the civilian labor force and employed as executives, managers, and administrators (excl. farms)
OCC3*y*	Percentage of persons 16+ years old who are in the civilian labor force and employed as sales workers

OCC4*y*	Percentage of persons 16+ years old who are in the civilian labor force and employed as administrative support and clerical workers
OCC5*y*	Percentage of persons 16+ years old who are in the civilian labor force and employed as precision production, craft, and repair workers
OCC6*y*	Percentage of persons 16+ years old who are in the civilian labor force and employed as operators, assemblers, transportation, and material moving workers
OCC7*y*	Percentage of persons 16+ years old who are in the civilian labor force and employed as nonfarm laborers
OCC8*y*	Percentage of persons 16+ years old who are in the civilian labor force and employed as service workers
UNEMPTyP	Percentage of persons 16+ years old who are in the civilian labor force and unemployed
Income	
FAVINC*y*	Average income per family ($)
POVRAT*y*N	Percentage of total persons below the poverty level in the last year (before census year)
Housing	
VACHU*y*	Percentage of vacant housing units
RNTOCC*y*	Percentage of renter-occupied housing units

A1.2: Sociodemographic Variables by Census Year

VARIABLE	*1970*	*1980*	*1990*	*2000*
Total population	2,051,501	2,159,530	2,329,240	2,493,615
White	1,557,034	1,575,042	1,670,266	1,686,834
Black	484,730	552,029	603,148	702,145
Hispanic	18,842	20,280	27,969	50,787
Asian	No data	No data	41,552	78,129
Under 18	710,741	584,861	564,578	632,008
Over 65	172,835	217,763	272,725	300,302
Foreign born	57,059	73,504	86,924	144,830
Households	618,850	752,972	863,913	955,442
Married with children	238,949	213,622	206,228	214,781
Married without children	182,335	219,781	251,459	251,370
Female-headed Household with children	37,403	61,453	65,665	77,882
Nonfamily	113,763	193,141	250,471	311,205
Education				
Education, 0-8 years	364,340	254,176	140,878	88,984
Education, 9-12 years	247,443	233,740	243,585	208,122
Education, h.s. diploma	291,541	411,571	433,599	445,462
Education, some college	89,889	172,464	276,037	332,130
Education, bachelor's or higher	115,289	219,612	356,685	485,893
Employed persons 16+	804,511	967,746	1,170,655	1,208,072
Professional, technical	128,169	166,963	238,388	297,329
Executives, managers, administrators	61,487	107,694	174,135	184,746
Sales	56,626	89,907	134,752	130,336
Administrative support, clerical	166,776	192,671	209,154	201,013
Precision production, craft, repair	116,262	113,742	123,894	159,935
Operators, assemblers, transportation, material moving	128,489	110,605	95,315	37,683
Nonfarm labor	36,276	46,918	38,139	24,124
Service	103,937	130,371	145,305	169,601
Forestry, fishing, farming	6,478	8,878	11,582	3,305
Unemployed	29,190	69,499	60,290	64,020
Below poverty line	225,991	249,996	229,855	239,263
Housing Units	647,821	792,104	921,023	1,027,400

Occupied housing	618,850	752,984	864,084	955,223
Vacant housing	28,977	39,125	56,938	72,177
Renter-occupied	252,409	300,867	315,916	318,370
Owner-occupied	366,441	453,425	548,168	636,853
0-1 bedrooms	115,225	128,472	122,121	143,604
2 bedrooms	178,829	219,506	230,643	240,877
3 bedrooms	267,439	325,600	396,525	422,672
4+ bedrooms	86,410	118,488	171,740	220,247
Built 1939 or earlier	255,617	218,725	182,855	164,662
Built 1940-1949	93,244	103,799	105,593	102,201
Built 1950-1959	149,470	149,036	155,727	155,459
Built 1960-1969	149,480	149,541	140,885	137,911
Built 1970-1979	No data	170,980	167,440	160,137
Built 1980-1990	No data	No data	168,528	151,960
Built 1990-1999	No data	No data	No data	155,070
Average home value (in 2000 dollars)	$65,300.00	$93,400.00	$101,100.00	$119,600.00

A1.3: Total change by sociodemographic variable

VARIABLE	*Change 1970 to 1980*	*Change 1980 to 1990*	*Change 1990 to 2000*
Total population	108,029	169,710	164,375
White	18,008	95,224	16,568
Black	67,299	51,119	98,997
Hispanic	1,438	7,689	22,818
Asian	No data		36,577
Under 18	-125,880	-20,283	67,430
Over 65	44,928	54,962	27,577
Foreign Born	16,445	13,420	57,906
Households	134,122	110,941	91,529
Married with children	-25,327	-7,394	8,553
Married no children	37,446	31,678	-89
Female-headed Household with children	24,050	4,212	12,217
Nonfamily	79,378	57,330	60,734
Education			
Education, 0-8 years	-110,164	-113,298	-51,894
Education, 9-12 years	-13,703	9,845	-35,463
Education, h.s. diploma	120,030	22,028	11,863
Education, some college	82,575	103,573	56,093
Education, bachelor's or higher	104,323	137,073	129,208
Employed persons 16+	163,235	202,909	37,417
Professional, technical	38,794	71,425	58,941
Executives, managers, administrators	46,207	66,441	10,611
Sales	33,281	44,845	-4,416
Administrative support, clerical	25,895	16,483	-8,141
Precision production, craft, repair	-2,520	10,152	36,041
Operators, assemblers, transportation, material moving	-17,884	-15,290	-57,632
Nonfarm labor	10,642	-8,779	-14,015
Service	26,434	14,934	24,296
Forestry, fishing, farming	2,400	2,704	-8,277
Unemployed	40,309	-9,209	3,730
Below poverty line	24,005	-20,141	9,408
Housing Units	144,283	128,919	106,377
Occupied housing	134,134	111,100	91,139

Vacant housing	10,148	17,813	15,239
Renter-occupied	48,458	15,049	2,454
Owner-occupied	86,984	94,743	88,685

A1.4: Total component loadings for PCA Analyses

1970

Component		
1 **Professional class households**	***Population Characteristics***	**Negative loadings**: Female-headed households without children.
	Education	**Positive loadings**: Completed h.s. but no college; completed some college but no degree; have bachelor's or graduate/professional degree. **Negative loadings**: No h.s. diploma.
	Employment	**Positive loadings**: Professional and technical occupations; executives, managers, and administrators; sales. **Negative loadings**: Precision production, craft, and repair workers; operators, assemblers, transportation, and material moving workers; service workers; nonfarm laborers; unemployed.
	Income	**Positive loadings**: Average family and household incomes. **Negative loadings**: Poverty.
	Housing	**Positive loadings**: Home value; 4-5 bedroom homes; homes 0-10 years old. **Negative loadings**: 2-3 bedroom homes; homes 31 + years old.
2 **Low-income, African-American households**	***Population Characteristics***	**Positive loadings**: Black; female-headed household with and without children; children under 18. **Negative loadings**: White; married couples with and without children.
	Education	**Negative loadings**: Completed h.s. but no college.
	Employment	**Positive loadings**: Nonfarm laborers; service workers; unemployed. **Negative loadings**: Administrative support and clerical workers; precision production, craft, and repair workers.
	Income	**Positive loadings**: Poverty. **Negative loadings**: Average family income.
	Housing	**Positive loadings**: Rent occupied housing, homes 31+ years old. **Negative loadings**: Home value; homes 0-10 years old.
3 **Female-headed & nonfamily aging population & foreign born**	***Population Characteristics***	**Positive loadings:** Foreign born; married couples without children; female-headed households without children; nonfamily households; over 65. **Negative loadings**: Married couples with children; children under 18.
	Education	**Negative loadings**: Completed h.s. but no college.
	Employment	--
	Income	--
	Housing	**Positive loadings**: 0-1 bedrooms; homes 31+ years old. **Negative loadings**: Homes 0-10 years old.
4 **Vulnerable nonfamily**	***Population Characteristics***	**Positive loadings**: Nonfamily households. **Negative loadings**: Married couples with and without children; children under 18.
	Education	--

households	*Employment*	--
	Income	**Positive loadings**: Poverty. **Negative loadings**: Average household income.
	Housing	**Positive loadings**: Vacant properties; rent occupied housing; 0-1 bedrooms. **Negative loadings**: 2-3 bedrooms; homes 11-20 years old.
5 **Foreign born; sales and admin.**	***Population Characteristics***	**Positive loadings**: Foreign born.
	Education	**Positive loadings**: Completed h.s. but no college.
	Employment	**Positive loadings**: Sales workers; administrative assistant and clerical workers.
	Income	--
	Housing	**Positive loadings**: 2-3 bedroom homes; homes 11-20 years old. **Negative loadings**: 4-5 bedroom homes; homes 31+ years old.
6 **Newer properties**	***Population Characteristics***	--
	Education	--
	Employment	--
	Income	--
	Housing	**Positive loadings**: 0-10 year old homes. **Negative loadings**: 11-30 year old homes.

1980

Component		
1 **Professional class households & foreign born**	***Population Characteristics***	**Positive loadings**: Foreign born. **Negative loadings**: Female-headed household without children.
	Education	**Positive loadings**: Completed some college but no degree; have bachelor's or graduate/professional degree. **Negative loadings**: No h.s. diploma.
	Employment	**Positive loadings**: Professional and technical occupations; executives, managers, and administrators; sales. **Negative loadings**: Precision production, craft, and repair workers; operators, assemblers, transportation, and material moving workers; nonfarm laborers; service workers, unemployed.
	Income	**Positive loadings**: Average family and household incomes. **Negative loadings**: Poverty.
	Housing	**Positive loadings**: Home value; 4-5 bedroom homes; homes 0-20 years old. **Negative loadings**: 2-3 bedroom homes; homes 41+ years old.
2 **Low-income, African-American households**	***Population Characteristics***	**Positive loadings**: Black; female-headed households with and without children; children under 18. **Negative loadings**: White; married couples with and without children.
	Education	**Positive loadings**: No h.s. diploma. **Negative loadings**: Completed h.s. but no college.
	Employment	**Positive loadings**: Nonfarm laborers; service workers; unemployed. **Negative loadings**: Executives, managers, and administrators; sales; precision production, craft, and repair workers.
	Income	**Positive loadings**: Poverty. **Negative loadings**: Average family and household incomes.
	Housing	**Positive loadings**: Rent occupied housing; vacant properties. **Negative loadings**: Home value.
3 **Families with and without children, higher income**	***Population Characteristics***	**Positive loadings**: Married couples with and without children; children under 18. **Negative loadings**: Nonfamily households; over 65.
	Education	--
	Employment	--
	Income	**Positive loadings**: Average household and family income.
	Housing	**Positive loadings**: 2-3 bedroom homes; 4-5 bedroom homes. **Negative loadings**: Rent occupied housing; 0-1 bedroom homes.
4 **Larger older homes,**	***Population Characteristics***	--
	Education	**Negative loadings**: Completed h.s. but no college.

poverty	*Employment*	**Negative loadings**: Administrative support and clerical workers.
	Income	**Positive loadings**: Poverty
	Housing	**Positive loadings**: Vacant housing; 4-5 bedroom homes; homes 40+ years old. **Negative loadings**: 2-3 bedroom homes; homes 11- 20 years old and 21-30 years old.
5 **Married couples with children**	***Population Characteristics***	**Positive loadings**: Married couples with children; children under 18. **Negative loadings**: Married couples without children; female-headed households without children; over 65.
	Education	--
	Employment	--
	Income	--
	Housing	**Positive loadings**: Homes 0-20 years old. **Negative loadings**: Homes 21years and older.
6 **Hispanic and foreign born**	***Population Characteristics***	**Positive loadings**: Hispanic; foreign born.
	Education	--
	Employment	**Negative loadings**: Farm workers or in forestry and fishing.
	Income	--
	Housing	--

1990

Component		
1 **Low-income, African-American households**	***Population Characteristics***	**Positive loadings**: Black; female-headed households with and without children; children under 18. **Negative loadings**: White; married couples with and without children.
	Education	**Positive loadings**: No h.s. diploma.
	Employment	**Positive loadings**: Operators, assemblers, transportation, and material moving workers; service workers; nonfarm laborers; unemployed. **Negative loadings**: Executives, managers, and administrators; sales; precision production, craft, and repair workers.
	Income	**Positive loadings**: Poverty. **Negative loadings**: Average household and family incomes.
	Housing	**Positive loadings**: Vacant properties; rent occupied housing. **Negative loadings**: Home value.
2 **Foreign born professionals**	***Population Characteristics***	**Positive loadings**: Asian; foreign born.
	Education	**Positive loadings**: Have a bachelor's, graduate or professional degree. **Negative loadings**: No h.s diploma; completed h.s. but no college.
	Employment	**Positive loadings**: Professional and technical occupations; executives, managers, and administrators; sales. **Negative loadings**: Administrative support and clerical workers; precision production, craft, and repair workers; operators, assemblers, transportation, and material moving workers; nonfarm laborers; service workers.
	Income	**Positive loadings**: Average family and household incomes.
	Housing	**Positive loadings**: Home value; 4-5 bedrooms; homes 0-10 years old. **Negative loadings**: 2-3 bedrooms
3 **Vulnerable population**	***Population Characteristics***	**Positive loadings**: Nonfamily households; over 65. **Negative loadings**: Married couples with and without children; children under 18.
	Education	--
	Employment	--
	Income	**Positive loadings**: Poverty **Negative loadings**: Average household income.
	Housing	**Positive loadings**: Vacant properties; rent occupied housing; 0-1 bedrooms. **Negative loadings**: Average home value; 4-5 bedrooms
4 **Married with children**	***Population Characteristics***	**Positive loadings**: Married couples with children; children under 18. **Negative loadings**: Over 65.
	Education	**Positive loadings**: Completed some college but no degree. **Negative loadings**: No h.s. diploma.

	Employment	--
	Income	--
	Housing	**Positive loadings**: Homes 0-30 years old. **Negative loadings**: Homes 31-50 years old.
5 **Newer homes, some college education**	***Population Characteristics***	--
	Education	**Positive loadings**: Completed some college but no degree. **Negative loadings**: No h.s. diploma.
	Employment	--
	Income	--
	Housing	**Positive loadings**: Homes 11-30 years old. **Negative loadings**: Vacant properties; homes over 51 years old.
6 **Hispanic, Asian and foreign born**	***Population Characteristics***	**Positive loadings**: Hispanic; Asian; foreign born.
	Education	--
	Employment	--
	Income	--
	Housing	--
7 **Agricultural and larger homes**	***Population Characteristics***	--
	Education	
	Employment	**Positive loadings**: Farm workers or in forestry and fishing. **Negative loadings**: Administrative support and clerical workers.
	Income	--
	Housing	**Positive loadings**: 4-5 bedroom homes. **Negative loadings**: 2-3 bedroom homes; homes 31-40 years old.

2000

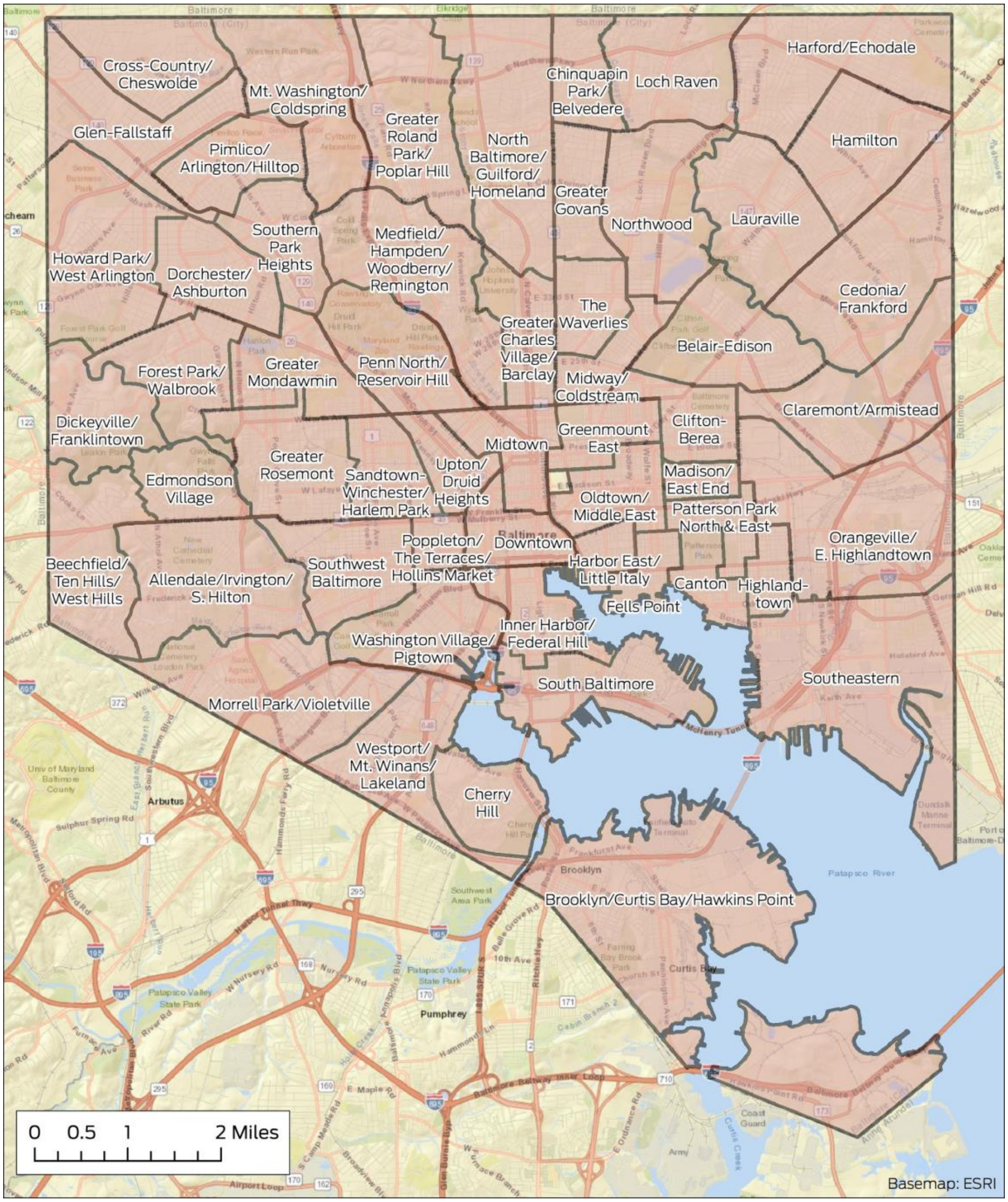
Component		
1 **Low-income, African-American households**	***Population Characteristics***	**Positive loadings**: Black; female-headed households with and without children; children under 18. **Negative loadings**: White; married couples with and without children, over 65.
	Education	**Positive loadings**: No h.s. diploma. **Negative loadings**: Has bachelor's or graduate/professional degree.
	Employment	**Positive loadings**: Nonfarm laborers; service workers; unemployed. **Negative loadings**: Executives, managers, and administrators; sales.
	Income	**Positive loadings**: Poverty **Negative loadings**: Average household and family incomes.
	Housing	**Positive loadings**: Vacant properties, rent occupied housing, 0-1 bedroom homes. **Negative loadings**: Average home value.
2 **Foreign born professionals**	***Population Characteristics***	**Positive loadings**: Foreign born; Asian.
	Education	**Positive loadings**: Has bachelor's or graduate/professional degree. **Negative loadings**: No h.s. diploma; completed h.s. but no college.
	Employment	**Positive loadings**: Professional and technical occupations; executives, managers, and administrators. **Negative loadings**: Administrative support and clerical workers; precision production, craft, and repair workers; operators, assemblers, transportation, and material moving workers; nonfarm laborers; service workers.
	Income	**Positive loadings**: Average household and family incomes.
	Housing	**Positive loadings**: Average home value; 4-5 bedroom homes.
3 **Married with children**	***Population Characteristics***	**Positive loadings**: Married couples with and without children; children under 18. **Negative loadings**: Nonfamily households; over 65.
	Education	--
	Employment	--
	Income	**Positive loadings**: Average household and family income. **Negative loadings**:
	Housing	**Positive loadings**: Average home value; 4-5 bedrooms. **Negative loadings**: Rent occupied properties; 0-1 bedrooms.
4 **Newer homes**	***Population Characteristics***	**Negative loadings**: Over 65.
	Education	--
	Employment	--
	Income	--
	Housing	**Positive loadings**: Homes 0-30 years old. **Negative loadings**: Homes 31- 50 years old.
5	***Population***	--

At risk	***Characteristics***	
	Education	**Positive loadings**: No h.s. diploma. **Negative loadings**: Complete some college but no college.
	Employment	**Positive loadings**: Unemployed **Negative loadings**: Administrative support and clerical workers.
	Income	**Positive loadings**: Poverty **Negative loadings**:
	Housing	**Positive loadings**: Vacant properties; homes over 51 years old.
6 **Foreign born, Hispanic, Asian**	***Population Characteristics***	**Positive loadings**: Foreign born; Hispanic; Asian. **Negative loadings**: Over 65.
	Education	--
	Employment	--
	Income	--
	Housing	--
7	***Population Characteristics***	--
	Education	--
	Employment	--
	Income	--
	Housing	**Positive loadings**: Homes 21-40 years old. **Negative loadings**: Homes over 51 years old.

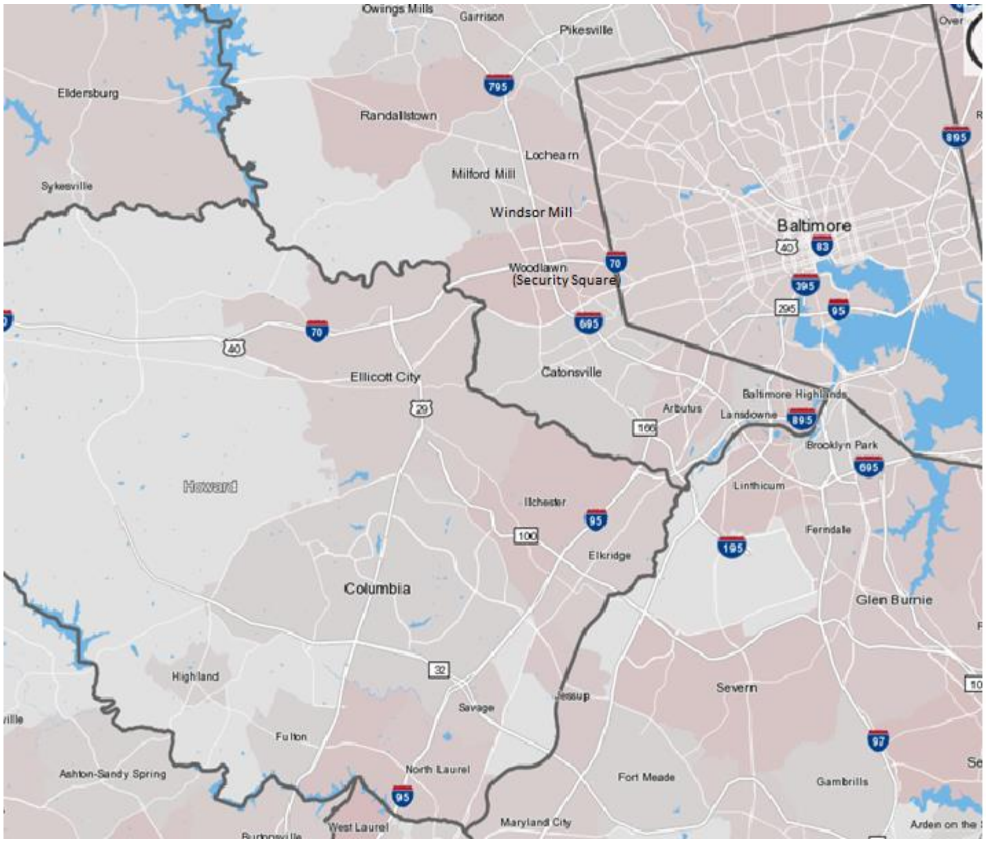
A1.5: Total population by cluster, 1970, 1980, 1990. 2000

	1970	*1980*	*1990*	*2000*
Cluster 1	502,913	357,264	922,370	910,381
Cluster 2	736,808	351,826	412,918	348,785
Cluster 3	409,902	30,536	224,240	346,662
Cluster 4	332,876	310,298	328,217	491,237
Cluster 5	69,002	628,237	441,495	296,550
Cluster 6	n/a	481,369	n/a	n/a

A1.6: Reference maps for neighborhood of Baltimore City and locations throughout metropolitan Baltimore.

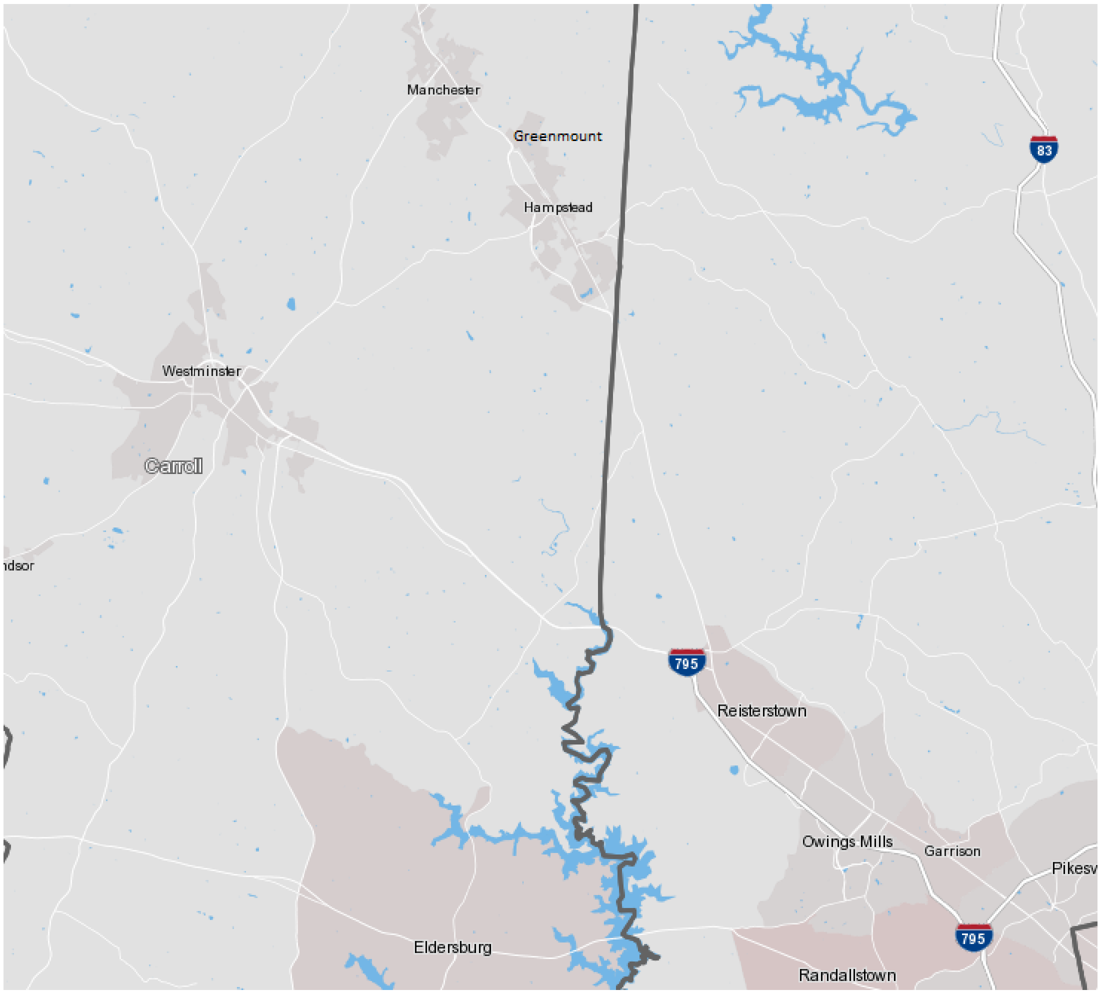


Baltimore City neighborhoods

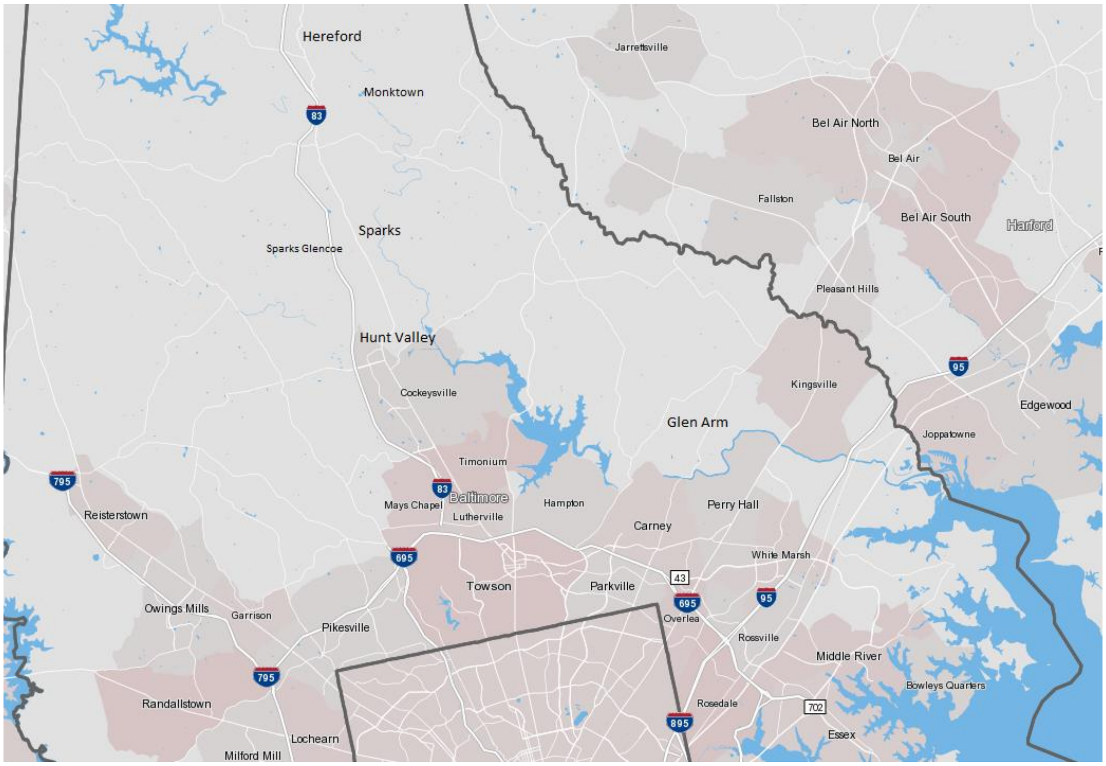


Metropo

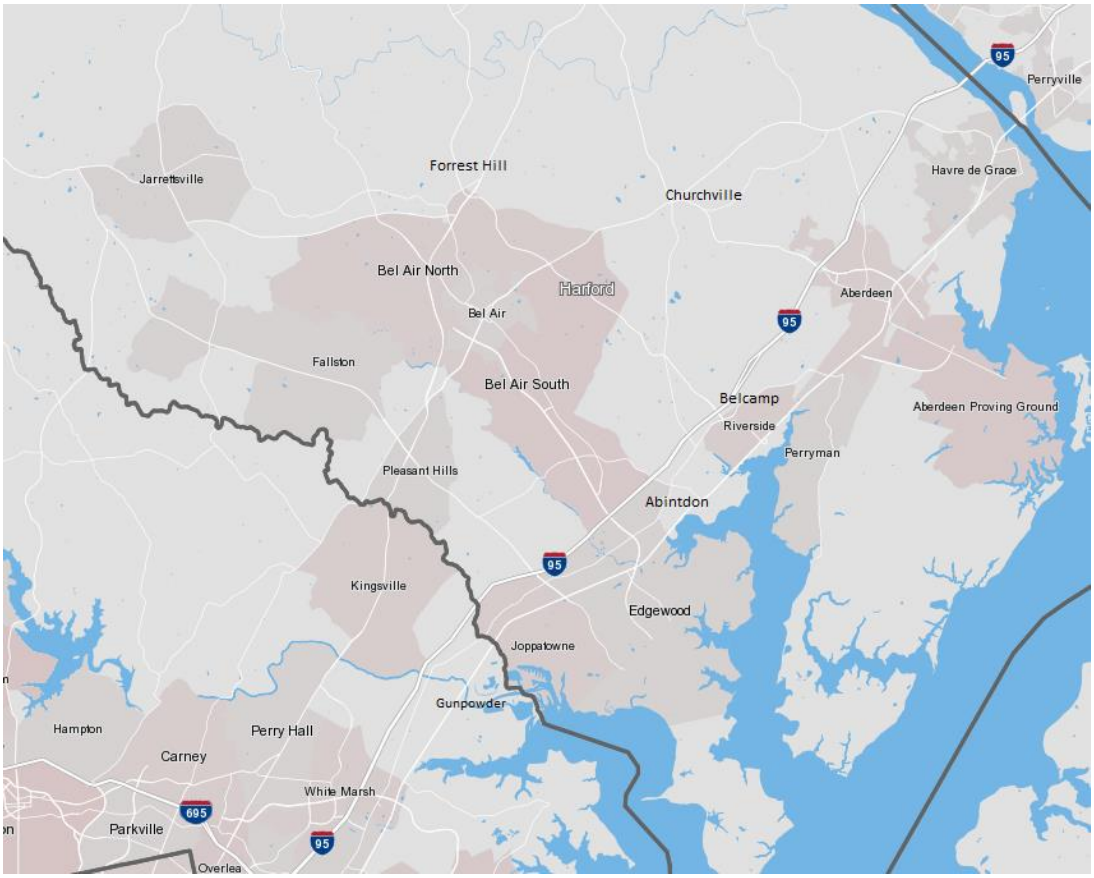
Metropolitan Baltimore West 1: Arbutus, Brooklyn Park, Catonsville, Columbia, Ellicott City, Elkridge, Eldersburg/Sykesville, Ft. Meade, Fulton, Gambrills, Glen Burnie, Jessup, Laurel, Linthicum, Lochearn, Milford Mill, Owings Mills, Randallstown, Savage, Windsor Mill, and Woodlawn/Security Square.



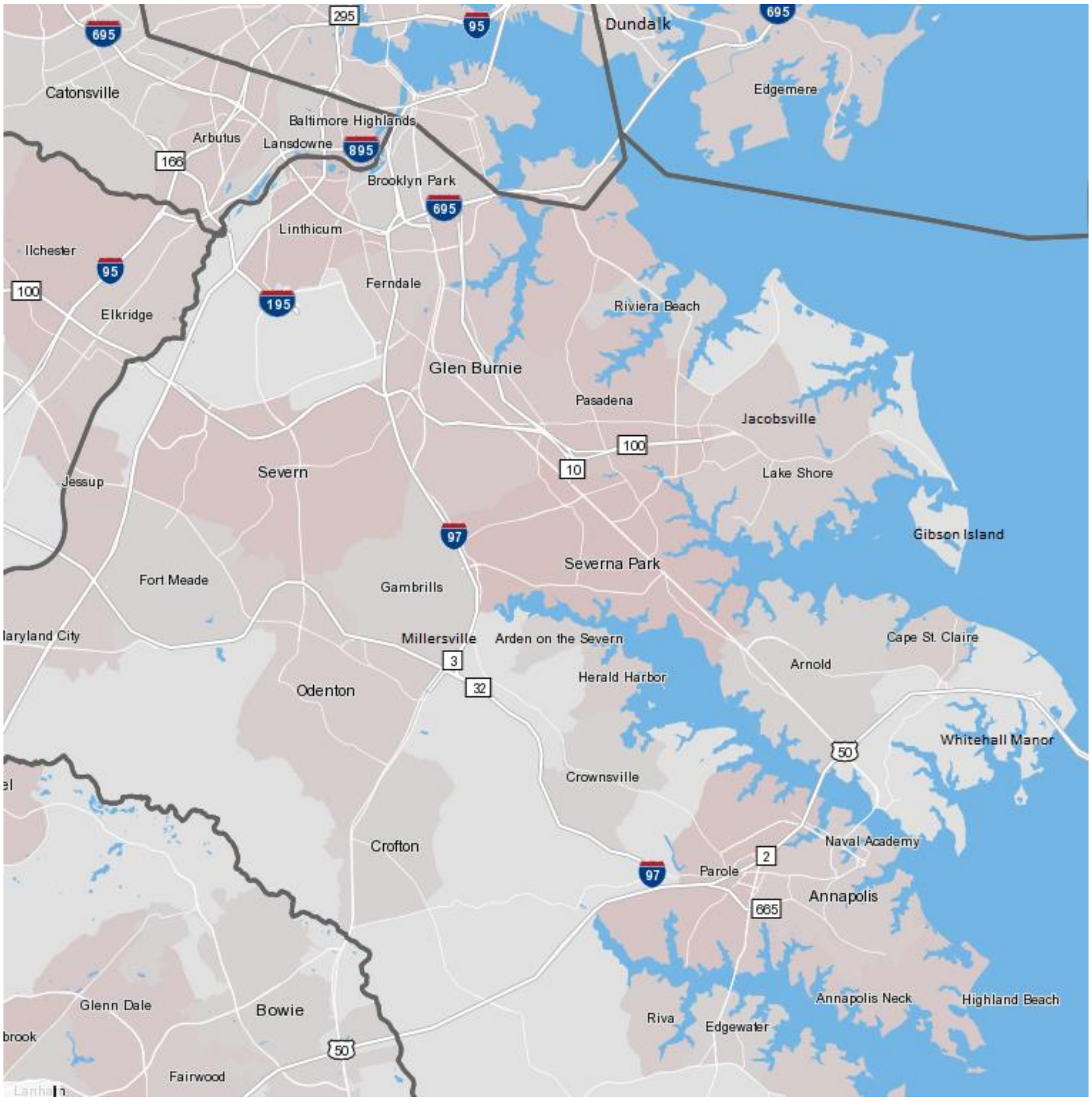
Metropolitan Baltimore West 2: Eldersburg, Garrison, Greenmount, Hampstead, Manchester, Owings Mills, Randallstown, Reisterstown, and Westminster.



Metropolitan Baltimore East 1: Bel Air, Bel Air North, Bel Air South, Bowleys Quarters, Carney, Cockeysville, Edgewoood, Essex, Fallston, Garrison, Hampton, Hunt Valley, Joppatowne, Kingsville, Mays Chapel, Monktown, Overlea, Owings Mills, Parkview, Perry Hall, Pleasant Hills, Randallstown, Reisterstown, Rosedale, Rossville (Rosedale and Rossville are part of the Greater Golden Ring area), Sparks, Sparks Glencoe, Towson, and White Marsh.



Metropolitan Baltimore East 2: Aberdeen, Aberdeen Proving Ground, Abington, Bel Air, Bel Air North, Bel Air South, Bel Camp, Carney, Churchville, Edgewood, Fallston, Forrest Hill, Gunpowder, Hampton, Jarrettsville, Joppatown, Kingsville, Perry Hall, Parkville, Pleasant Hills, Riverside, and White Marsh.



Metropolitan Baltimore South: Annapolis, Arbutus, Brooklyn Park, Baltimore Heights, Cape St. Claire, Catonsville, Crofton, Crownsville Dundalk, Edgemere, Edgewater, Elkridge, Ft. Meade, Ferndale, Gibson Island, Highland Beach, Ilchester, Jacobsville, Jessup, Lake Shore, Landsdowne, Linthicum, Odenton, Pasadena, Rivera Beach, Severn, and Whitehall Manor.

Appendix 2: Supplemental material for Chapter 3

A2.1: Total numbers and percentages of workers in each industry, by county 1970-2000.

Anne Arundel County BEA data

Employment by Industry 1970 to 2000	1970	1980	1990	2000	Change 1970 -2000
Total Employment (number of jobs)[27]	***130,013***	***175,706***	***250,070***	***297,465***	***167,452***
Non-Services Related	**23,380**	**29,795**	**40,328**	**37,853**	**14,473**
Construction	5,720	9,389	16,932	18,152	12,432
Manufacturing	16,128	18,528	20,810	15,922	-206
Services Related	**43,514**	**75,213**	**134,802**	**184,612**	**141,098**
Transportation & Public Utilities	4,449	5,998	12,946	17,881	13,432
Wholesale trade	1,376	4,087	8,269	10,889	9,513
Retail trade	17,497	26,691	40,931	48,105	30,608
Finance, Insurance & Real Estate (FIRE)	4,463	8,627	14,484	18,993	14,530
Services	15,729	29,810	58,172	88,744	73,015
Government	**63,119**	**70,698**	**74,940**	**75,000**	**11,881**
Percent of Total					**Percentage change 1970-2000**
Non-Services Related	**18.0%**	**17%**	**16.1%**	**12.7%**	**61.9%**
Construction	4.4%	5.3%	6.8%	6.1%	217.3%
Manufacturing	12.4%	10.5%	8.3%	5.4%	-1.3%
Services-Related	**33.5%**	**42.85**	**53.9%**	**62.1%**	**324.3%**
Transportation & Public Utilities	3.4%	3.4%	5.2%	6.0%	301.9%
Wholesale trade	1.1%	2.3%	3.3%	3.7%	691.4%
Retail trade	13.5%	15.2%	16.4%	16.2%	174.9%
Finance, Insurance & Real Estate (FIRE)	3.4%	4.9%	5.8%	6.4%	325.6%
Services	12.1%	17.0%	23.3%	29.8%	464.2%
Government	**48.5%**	**40.2%**	**30.0%**	**25.2%**	**18.8%**

[27] Total number of jobs includes jobs in the agricultural and mining industries, not otherwise listed in this table.

Anne Arundel County CTPP data

Employment by Industry 1990 to 2000	**1990**	**2000**	**Change 1990 - 2000**
Total Employment (number of workers)	***123,072***	***225,094***	***102,022***
Non-Services Related	**19,655**	**34,288**	**14,633**
Construction	8,249	16,971	8,722
Manufacturing	11,406	17,317	5,911
Services Related	**102,523**	**181,064**	**78,541**
Wholesale trade	4,187	7,696	3,509
Retail trade	11,754	25,479	13,725
Transportation & Warehousing & Utilities	5,798	14,894	9,096
Information	3,318	6,931	3,613
Finance, Insurance, Real Estate, & Rental & Leasing	8,557	12,365	3,808
Professional, Scientific, Management, Administrative, & Waste Management	9,790	23,442	13,652
Education, Health, & Social Services	38,400	33,558	-4,842
Arts, Entertainment, Recreation, Accommodation, & Food Services	8,130	15,592	7,462
Other Services except Public Administration	5,544	10,642	5,098
Public Administration	7,045	30,465	23,420
Percent of Total			**Percentage change 1990-2000**
Non-Services Related	**16.0%**	**15.2%**	**74.4%**
Construction	6.7%	7.5%	105.7%
Manufacturing	9.3%	7.7%	51.8%
Services-Related	**83.3%**	**80.4%**	**76.6%**
Wholesale trade	3.4%	3.4%	83.8%
Retail trade	9.6%	11.3%	116.8%
Transportation & Warehousing & Utilities	4.7%	6.6%	156.9%
Information	2.7%	3.1%	108.9%
Finance, Insurance, Real Estate, & Rental & Leasing	7.0%	5.5%	44.5%
Professional, Scientific, Management, Administrative, & Waste Management	8.0%	10.4%	139.4%
Education, Health, & Social Services	31.2%	14.9%	-12.6%
Arts, Entertainment, Recreation, Accommodation, & Food Services	6.6%	6.9%	91.8%
Other Services except Public Administration	4.5%	4.7%	92.0%
Public Administration	5.7%	13.5%	332.4%

Baltimore County BEA data

Employment by Industry 1970 to 2000	1970	1980	1990	2000	Change 1970 -2000
Total Employment (number of jobs)	*227,055*	*308,319*	*399,498*	*451,618*	*224,563*
Non-Services Related	**79,051**	**77,562**	**82,158**	**68,551**	**-10,500**
Construction	14,020	20,380	27,946	27,324	13,304
Manufacturing	62,238	53,470	49,034	35,186	-27,052
Services Related	**102,290**	**169,583**	**262,180**	**325,272**	**222,982**
Transportation & Public Utilities	9,325	10,348	14,240	17,191	7,866
Wholesale trade	7,984	15,970	18,490	18,954	10,970
Retail trade	38,637	57,242	78,058	82,769	44,132
Finance, Insurance & Real Estate (FIRE)	10,940	18,413	34,097	43,345	32,405
Services	35,404	67,610	117,295	163,013	127,609
Government	**45,714**	**61,174**	**55,160**	**57,795**	**12,081**
Percent of Total					**Percentage change 1970-2000**
Non-Services Related	**34.8%**	**25.2%**	**20.6%**	**15.2%**	**-13.3%**
Construction	6.2%	6.6%	7.0%	6.1%	94.9%
Manufacturing	27.4%	17.3%	12.3%	7.8%	-43.5%
Services-Related	**45.1%**	**55.0%**	**65.6%**	**72.0%**	**218.0%**
Transportation & Public Utilities	4.1%	3.4%	3.6%	3.8%	84.4%
Wholesale trade	3.5%	5.2%	4.6%	4.2%	137.4%
Retail trade	17.0%	18.6%	19.5%	18.3%	114.2%
Finance, Insurance & Real Estate (FIRE)	4.8%	6.0%	8.5%	9.6%	296.2%
Services	15.6%	21.9%	29.4%	36.1%	360.4%
Government	**20.1%**	**19.8%**	**13.8%**	**12.8%**	**26.4%**

Baltimore County CTPP data

Employment by Industry 1990 to 2000	**1990**	**2000**	**Change 1990 - 2000**
Total Employment (number of workers)	***496,610***	***341,660***	***-154,950***
Non-Services Related	**88,796**	**55,003**	**-33,793**
Construction	32,435	21,503	-10,932
Manufacturing	56,361	33,500	-22,861
Services Related	**388,910**	**284,889**	**-104,021**
Wholesale trade	20,522	10,439	-10,083
Retail trade	43,456	44,765	1,309
Transportation & Warehousing & Utilities	32,243	11,139	-21,104
Information	11,885	10,659	-1,226
Finance, Insurance, Real Estate, & Rental & Leasing	3,8175	34,864	-3,311
Professional, Scientific, Management, Administrative, & Waste Management	37,681	35,023	-2,658
Education, Health, & Social Services	87,914	75,219	-12,695
Arts, Entertainment, Recreation, Accommodation, & Food Services	28,085	22,960	-5,125
Other Services except Public Administration	20,094	16,744	-3,350
Public Administration	68,855	23,077	-45,778
Percent of Total			**Percentage Change 1990 - 2000**
Non-Services Related	**17.9%**	**16.1%**	**-38.1%**
Construction	6.5%	6.3%	-33.7%
Manufacturing	11.3%	9.8%	-40.6%
Services-Related	**78.3%**	**83.4%**	**-26.7%**
Wholesale trade	4.1%	3.1%	-49.1%
Retail trade	8.8%	13.1%	3.0%
Transportation & Warehousing & Utilities	6.5%	3.3%	-65.5%
Information	2.4%	3.1%	-10.3%
Finance, Insurance, Real Estate, & Rental & Leasing	7.7%	10.2%	-8.7%
Professional, Scientific, Management, Administrative, & Waste Management	7.6%	10.3%	-7.1%
Education, Health, & Social Services	17.7%	22.0%	-14.4%
Arts, Entertainment, Recreation, Accommodation, & Food Services	5.7%	6.7%	-18.2%
Other Services except Public Administration	4.0%	4.9%	-16.7%
Public Administration	13.9%	6.8%	-66.5%

Carroll County BEA

Employment by Industry 1970 to 2000	1970	1980	1990	2000	Change 1970 -2000
Total Employment (number of jobs	***27,223***	***36,133***	***52,388***	***68,896***	***41,673***
Non-Services Related	**12,351**	**13,898**	**16,559**	**17,851**	**5,500**
Construction	2,013	3,162	7,108	8,838	6,825
Manufacturing	7,784	7,672	6,623	6,106	-1,678
Services Related	**10,490**	**16,845**	**29,523**	**43,330**	**32,840**
Transportation & Public Utilities	1,063	1,343	1,622	2,226	9,837
Wholesale trade	1,047	1,871	3,006	3,347	2,300
Retail trade	3,628	5,129	8,894	13,061	9,433
Finance, Insurance & Real Estate (FIRE)	1,259	2,279	3,102	4,762	3,503
Services	3,493	6,223	12,899	19,934	16,441
Government	**4,382**	**5,390**	**6,306**	**7,469**	**3,087**
Percent of Total					**Percentage change 1970-2000**
Non-Services Related	**45.4%**	**38.5%**	**31.6%**	**25.9%**	**44.5%**
Construction	7.4%	8.8%	13.6%	12.8%	339.0%
Manufacturing	28.6%	21.2%	12.6%	8.9%	-21.6%
Services-Related	**38.5%**	**46.6%**	**56.4%**	**62.9%**	**313.1%**
Transportation & Public Utilities	3.9%	3.7%	3.1%	3.2%	109.4%
Wholesale trade	3.8%	5.2%	5.7%	4.9%	219.7%
Retail trade	13.3%	14.2%	17.0%	19.0%	260.0%
Finance, Insurance & Real Estate (FIRE)	4.6%	6.3%	5.9%	6.9%	278.2%
Services	12.8%	17.2%	24.6%	28.9%	470.7%
Government	**16.1%**	**14.9%**	**12.0%**	**10.8%**	**70.4%**

Carroll County CTPP Data

Employment by Industry 1990 to 2000	1990	2000	Change 1990 - 2000
Total Employment (number of workers)	***30,309***	***48,650***	***18,341***
Non-Services Related	**5,756**	10,612	4,856
Construction	2,842	5,493	2,651
Manufacturing	2,914	5,119	2,205
Services Related	**24,224**	**36,845**	**12,621**
Wholesale trade	1,236	1,482	246
Retail trade	4,594	6,668	2,074
Transportation & Warehousing & Utilities	1,121	1,617	496
Information	875	1,771	896
Finance, Insurance, Real Estate, & Rental & Leasing	4,718	2249	-2,469
Professional, Scientific, Management, Administrative, & Waste Management	2,290	3,514	1,224
Education, Health, & Social Services	4,786	10,663	5,877
Arts, Entertainment, Recreation, Accommodation, & Food Services	2,751	3,724	973
Other Services except Public Administration	1,220	3,069	1,849
Public Administration	633	2,088	1,455
Percent of Total			**Percentage change 1990-2000**
Non-Services Related	**19.0%**	**21.8%**	**84.4%**
Construction	9.4%	11.3%	93.3%
Manufacturing	9.6%	10.5%	75.7%
Services-Related	**79.9%**	**75.7%**	**52.1%**
Wholesale trade	4.1%	3.0%	19.9%
Retail trade	15.2%	13.7%	45.1%
Transportation & Warehousing & Utilities	3.7%	3.3%	44.2%
Information	2.9%	3.6%	102.4%
Finance, Insurance, Real Estate, & Rental & Leasing	15.6%	4.6%	-52.3%
Professional, Scientific, Management, Administrative, & Waste Management	7.6%	7.2%	53.4%
Education, Health, & Social Services	15.8%	21.9%	122.8%
Arts, Entertainment, Recreation, Accommodation, & Food Services	9.1%	7.7%	35.4%
Other Services except Public Administration	4.0%	6.3%	151.6%
Public Administration	2.1%	4.3%	229.9%

Harford County BEA data

Employment by Industry 1970 to 2000	1970	1980	1990	2000	Change 1970 -2000
Total Employment (number of jobs)	***44,726***	***50,932***	***75,058***	***97,931***	***53,205***
Non-Services Related	**8,288**	**9,409**	**13,130**	**15,219**	**6,931**
Construction	1,753	2,940	6,563	7,243	5,490
Manufacturing	4,451	4,614	4,445	5,572	1,121
Services Related	**14,037**	**21,992**	**39,613**	**62,596**	**48,559**
Transportation & Public Utilities	1,479	1,838	1,913	3,585	2,106
Wholesale trade	425	1,093	1,930	4,164	3,739
Retail trade	5,361	7,797	14,070	19,939	14,578
Finance, Insurance & Real Estate (FIRE)	1,786	3,025	4,275	6,552	4,766
Services	4,986	8,239	17,425	28,356	23,370
Government	**22,401**	**19,531**	**22,315**	**20,134**	**-2,267**
Percent of Total					**Percentage change 1970-2000**
Non-Services Related	**18.5%**	**18.5%**	**17.5%**	**15.5%**	**83.6%**
Construction	3.9%	5.8%	8.7%	7.4%	313.2%
Manufacturing	10.0%	9.1%	5.9%	5.7%	25.2%
Services-Related	**31.4%**	**43.2%**	**52.8%**	**63.9%**	**345.9%**
Transportation & Public Utilities	3.3%	3.6%	2.5%	3.7%	142.4%
Wholesale trade	1.0%	2.1%	2.6%	4.3%	879.8%
Retail trade	12.0%	15.3%	18.7%	20.4%	271.9%
Finance, Insurance & Real Estate (FIRE)	4.0%	5.9%	5.7%	6.7%	266.9%
Services	11.1%	16.2%	23.2%	29.0%	468.7%
Government	**50.1%**	**38.3%**	**29.7%**	**20.6%**	**-10.1%**

Harford County CTPP data

Employment by Industry 1990 to 2000	1990	2000	Change 1990 - 2000
Total Employment (number of workers)	*72,897*	*75,785*	*2,888*
Non-Services Related	**21,800**	**12,384**	**-9,416**
Construction	5,464	5,897	433
Manufacturing	16,336	6,487	-9,849
Services Related	**49,915**	**49,915**	**0**
Wholesale trade	3,292	2,628	-664
Retail trade	8,308	11,415	3,107
Transportation & Warehousing & Utilities	3,098	3,105	7
Information	2,574	1,365	-1,209
Finance, Insurance, Real Estate, & Rental & Leasing	6,989	3,789	-3,200
Professional, Scientific, Management, Administrative, & Waste Management	5,574	6,672	1,098
Education, Health, & Social Services	9,085	13,899	4,814
Arts, Entertainment, Recreation, Accommodation, & Food Services	5,164	6,180	1,016
Other Services except Public Administration	3,235	3,830	595
Public Administration	2,596	8,154	5,558
Percent of Total			**Percentage change 1990-2000**
Non-Services Related	**29.9%**	**16.3%**	**-43.2%**
Construction	7.5%	7.8%	7.9%
Manufacturing	22.4%	8.6%	-60.3%
Services-Related	**68.5%**	**65.9%**	**0.0%**
Wholesale trade	4.5%	3.5%	-20.2%
Retail trade	11.4%	15.1%	37.4%
Transportation & Warehousing & Utilities	4.2%	4.1%	0.2%
Information	3.5%	1.8%	-47.0%
Finance, Insurance, Real Estate, & Rental & Leasing	9.6%	5.0%	-45.8%
Professional, Scientific, Management, Administrative, & Waste Management	7.6%	8.8%	19.7%
Education, Health, & Social Services	12.5%	18.3%	53.0%
Arts, Entertainment, Recreation, Accommodation, & Food Services	7.1%	8.2%	19.7%
Other Services except Public Administration	4.4%	5.1%	18.4%
Public Administration	3.6%	10.8%	214.1%

Howard County BEA data

Employment by Industry 1970 to 2000	1970	1980	1990	2000	Change 1970 -2000
Total Employment (number of jobs)	***22,397***	***56,654***	***105,751***	***160,189***	***137,792***
Non-Services Related	**7,634**	**12,505**	**17,500**	**22,716**	**15,082**
Construction	2,285	3,770	7,959	11,532	9,247
Manufacturing	4,291	7,114	7,330	8,453	4,162
Services Related	**10,834**	**36,650**	**76,969**	**121,643**	**110,809**
Transportation & Public Utilities	693	1,957	4,531	7,495	6,802
Wholesale trade	786	4,373	8,271	13,856	13,070
Retail trade	2,603	9,789	18,776	27,932	25,329
Finance, Insurance & Real Estate (FIRE)	1,818	4,284	9,242	12,509	10,691
Services	4,934	16,247	36,149	59,851	54,917
Government	**3,928**	**7,499**	**11,282**	**15,917**	11,989
Percent of Total					**Percentage change 1970-2000**
Non-Services Related	**34.1%**	**22.1%**	**16.5%**	**14.2%**	**197.6%**
Construction	10.2%	6.7%	7.5%	7.2%	404.7%
Manufacturing	19.2%	12.6%	6.9%	5.3%	97.0%
Services-Related	**48.4%**	**64.7%**	**72.8%**	**75.9%**	**1022.8%**
Transportation & Public Utilities	3.1%	3.5%	4.3%	4.7%	981.5%
Wholesale trade	3.5%	7.7%	7.8%	8.6%	1662.8%
Retail trade	11.6%	17.3%	17.8%	17.4%	973.1%
Finance, Insurance & Real Estate (FIRE)	8.1%	7.6%	8.7%	7.8%	588.1%
Services	22.0%	28.7%	34.2%	37.4%	1113.0%
Government	**17.5%**	**13.2%**	**10.7%**	**9.9%**	**305.2%**

Howard County CTPP data

Employment by Industry 1990 to 2000	**1990**	**2000**	**Change 1990 - 2000**
Total Employment (number of workers)	***82,441***	***119,968***	***37,527***
Non-Services Related	**11,110**	**18,847**	**7,737**
Construction	5,433	8,393	2,960
Manufacturing	5,677	10,454	4,777
Services Related	**70,534**	**100,507**	**29,973**
Wholesale trade	2,014	9,156	7,142
Retail trade	9,699	14,924	5,225
Transportation & Warehousing & Utilities	2,339	4,670	2,331
Information	1,913	4,286	2,373
Finance, Insurance, Real Estate, & Rental & Leasing	8,958	9,626	668
Professional, Scientific, Management, Administrative, & Waste Management	7,478	19,535	12,057
Education, Health, & Social Services	21,970	20,591	-1,379
Arts, Entertainment, Recreation, Accommodation, & Food Services	6,267	7,798	1,531
Other Services except Public Administration	4,072	5,811	1,739
Public Administration	5,824	4,110	-1,714
Percent of Total			**Percentage change 1990-2000**
Non-Services Related	**13.5%**	**15.7%**	**69.6%**
Construction	6.6%	7.0%	54.5%
Manufacturing	6.9%	8.7%	84.1%
Services-Related	**85.6%**	**83.8%**	**42.5%**
Wholesale trade	2.4%	7.6%	354.6%
Retail trade	11.8%	12.4%	53.9%
Transportation & Warehousing & Utilities	2.8%	3.9%	99.7%
Information	2.3%	3.6%	124.0%
Finance, Insurance, Real Estate, & Rental & Leasing	10.9%	8.0%	7.5%
Professional, Scientific, Management, Administrative, & Waste Management	9.1%	16.3%	161.2%
Education, Health, & Social Services	26.6%	17.2%	-6.3%
Arts, Entertainment, Recreation, Accommodation, & Food Services	7.6%	6.5%	24.4%
Other Services except Public Administration	4.9%	4.8%	42.7%
Public Administration	7.1%	3.4%	-29.4%

Baltimore City BEA data

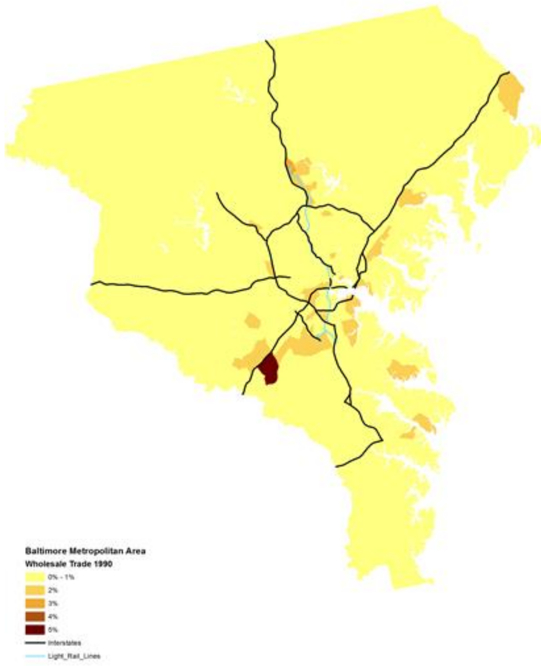
Employment by Industry 1970 to 2000	1970	1980	1990	2000	Change 1970 -2000
Total Employment (number of jobs)	***533,697***	***503,343***	***508,534***	***448,239***	***-60,295***
Non-Services Related	**129,091**	**92,007**	**66,469**	**46,412**	**-20,057**
Construction	26,068	20,117	21,027	16,158	-4,869
Manufacturing	102,172	70,673	43,688	28,446	-15,242
Services Related	**323,929**	**325,787**	**356,088**	**318,474**	**-37,614**
Transportation & Public Utilities	44,898	41,363	26,619	22,422	-4,197
Wholesale trade	33,473	29,162	27,700	19,312	-8,388
Retail trade	83,829	75,771	64,517	46,494	-18,023
Finance, Insurance & Real Estate (FIRE)	43,388	48,720	57,600	41,266	-16,334
Services	118,341	130,771	179,652	188,980	9,328
Government	**80,677**	**85,549**	**85,977**	**83,338**	**-2,639**
Percent of Total					**Percentage change 1970-2000**
Non-Services Related	**24.2%**	**18.3%**	**13.1%**	**10.4%**	**-64.0%**
Construction	4.9%	4.0%	4.1%	3.6%	-38.0%
Manufacturing	19.1%	14.0%	8.6%	6.3%	-72.2%
Services-Related	**60.7%**	**64.7%**	**70.0%**	**71.1%**	**-1.7%**
Transportation & Public Utilities	8.4%	8.2%	5.2%	5.0%	-50.1%
Wholesale trade	6.3%	5.8%	5.4%	4.3%	-42.3%
Retail trade	15.7%	15.1%	12.7%	10.4%	-44.5%
Finance, Insurance & Real Estate (FIRE)	8.1%	9.7%	11.3%	9.2%	-4.9%
Services	22.2%	26.0%	35.3%	42.2%	59.7%
Government	**15.1%**	**17.0%**	**16.9%**	**18.6%**	**3.3%**

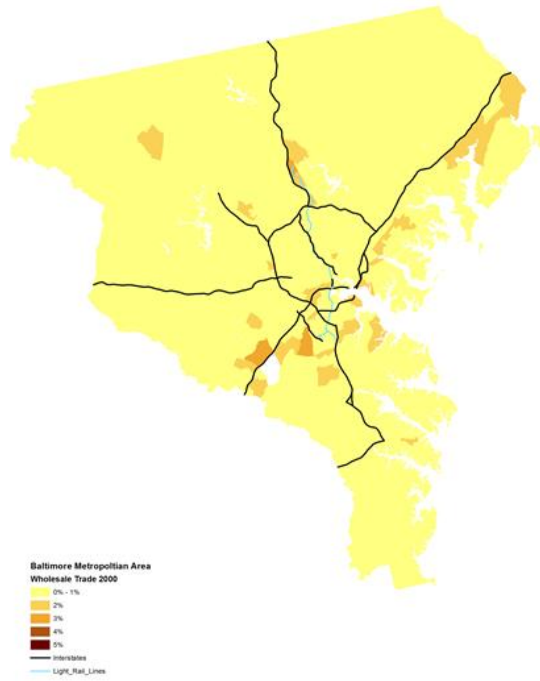
Baltimore City CTPP data

Employment by Industry 1990 to 2000	1990	2000	Change 1990 - 2000
Total Employment (number of workers)	*319,871*	*341,985*	*22,114*
Non-Services Related	**73,121**	**45,818**	**-27,303**
Construction	28,427	19,311	-9,116
Manufacturing	44,694	26,507	-18,187
Services Related	**236,475**	**294,806**	**58,331**
Wholesale trade	17,328	8,890	-8,438
Retail trade	40,863	21,326	-19,537
Transportation & Warehousing & Utilities	13,861	21,414	7,553
Information	7,017	11,042	4,025
Finance, Insurance, Real Estate, & Rental & Leasing	18,938	26,186	7,248
Professional, Scientific, Management, Administrative, & Waste Management	23,885	34,898	11,013
Education, Health, & Social Services	52,324	99,822	47,498
Arts, Entertainment, Recreation, Accommodation, & Food Services	23,199	22,173	-1,026
Other Services except Public Administration	12,050	17,080	5,030
Public Administration	27,010	31,975	4,965
Percent of Total			**Percentage change 1990-2000**
Non-Services Related	**22.9%**	**13.4%**	**-37.3%**
Construction	8.9%	5.6%	-32.1%
Manufacturing	14.0%	7.8%	-40.7%
Services-Related	**73.9%**	**86.2%**	**24.7%**
Wholesale trade	5.4%	2.6%	-48.7%
Retail trade	12.8%	6.2%	-47.8%
Transportation & Warehousing & Utilities	4.3%	6.3%	54.5%
Information	2.2%	3.2%	57.4%
Finance, Insurance, Real Estate, & Rental & Leasing	5.9%	7.7%	38.3%
Professional, Scientific, Management, Administrative, & Waste Management	7.5%	10.2%	46.1%
Education, Health, & Social Services	16.4%	29.2%	90.8%
Arts, Entertainment, Recreation, Accommodation, & Food Services	7.3%	6.5%	-4.4%
Other Services except Public Administration	3.8%	5.0%	41.7%
Public Administration	8.4%	9.3%	18.4%

A2.2: Industries excluded from results and discussion sections of chapter.

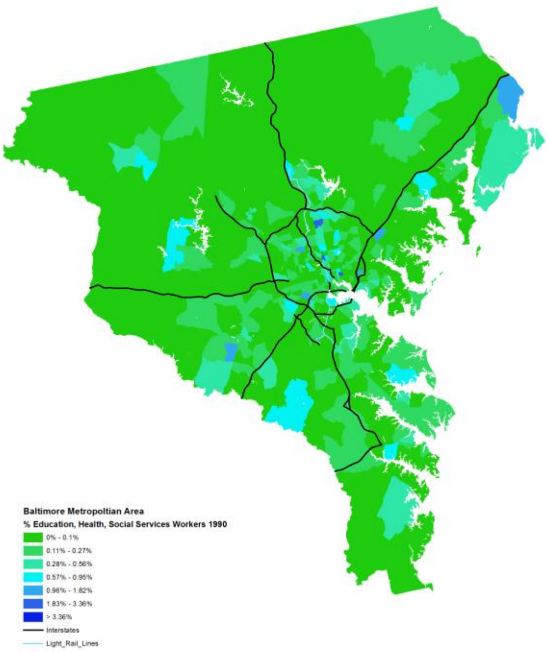
Wholesale Trade

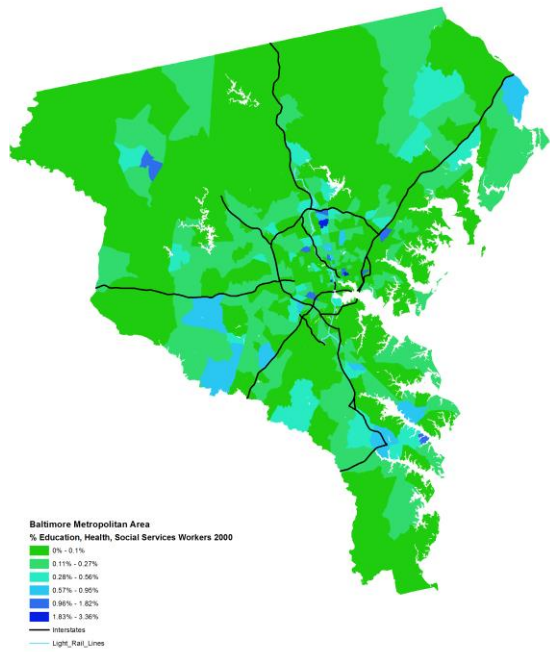




In 1990 and 2000, the highest percentage of wholesale trade workers were located along I-95. There was overall a loss of wholesale trade workers between 19990 and 2000, but the spaces where the majority of wholesale trade workers were employed did not change over time. These areas included Aberdeen, the BWI area, Hunt Valley, The Greater Golden Ring area, Severn, Jessup, and Laurel.

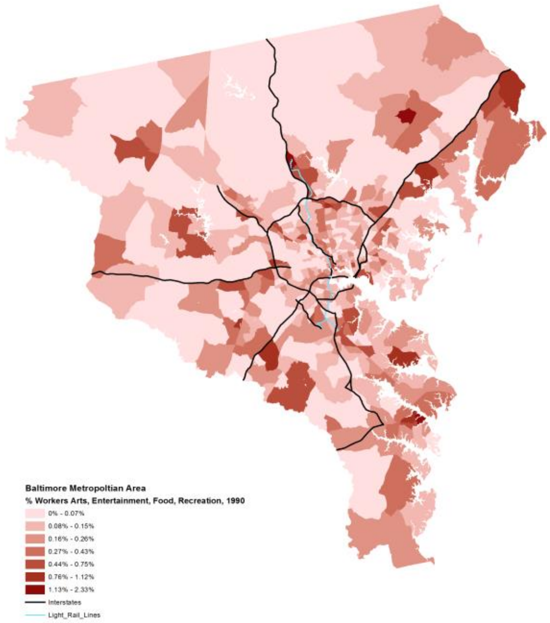
Education, Health, and Social Services

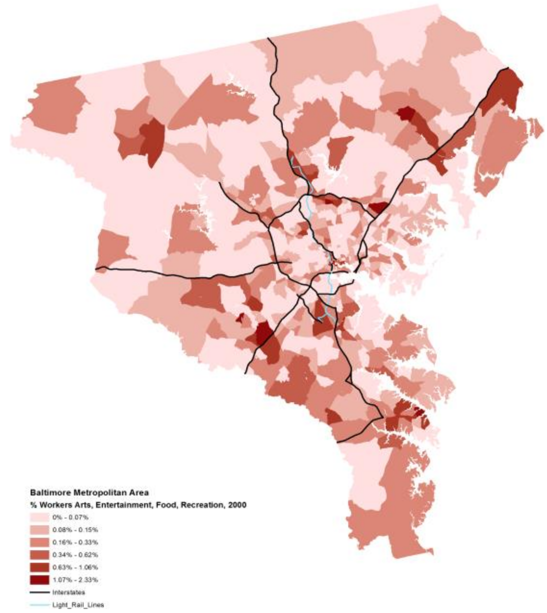




The education, health, and social services industry was one of the largest employers in the region in 1990 and 2000, and there was little change in the location of workers in that industry between the two decades. There are some areas where the number of employees increased, including the areas where these institutions are located: Johns Hopkins Bay View Medical Center, Johns Hopkins Community Physician in Westminster and Carroll College (located in close proximity), Towson University, Community College of Baltimore County Essex, Sinai Hospital, and St. Agnes Hospital. This suggests that these particular educational and health facilities grew in their numbers of employees between 1990 and 2000. There was also an overall increase in workers in areas including Annapolis, Ellicott City and Laurel.

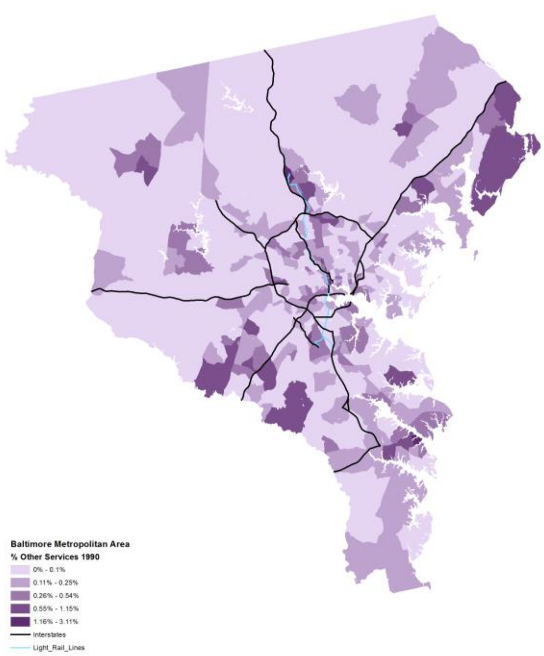
Arts, Entertainment, Recreations, Food Services, and Accommodations

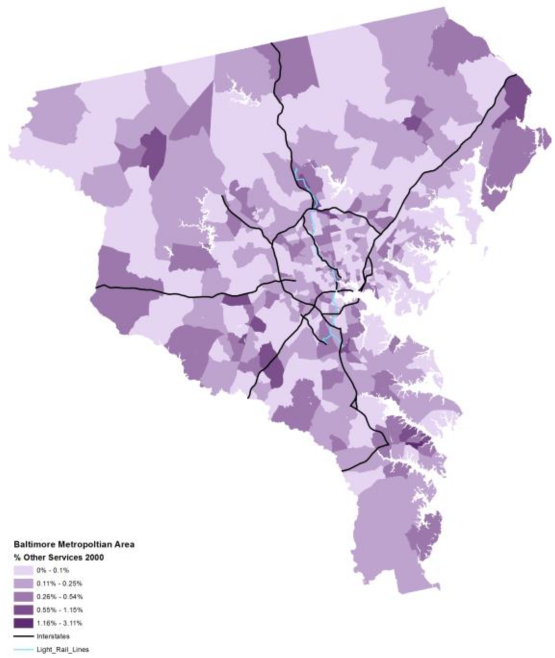




Workers in the arts and entertainment industries were spread across the metropolitan area in 1990 and 2000. This can be attributed to the nature of these types of businesses, which can be found in many types of development, including strip malls, edge cities, and downtown. The percentage of workers in many TAZ employed in these industries grew between 1990 and 2000, as can be viewed in the above maps. However, the maps also show that workers employed in these industries decreased in the eastern part of Baltimore City.

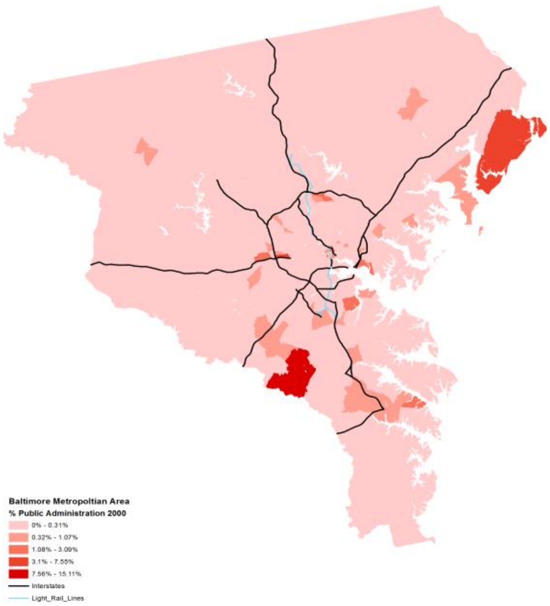
Other Services

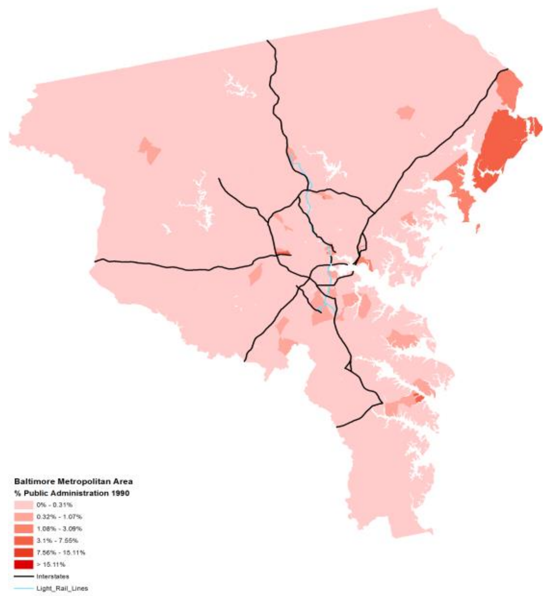




Workers employed in industries classified as other services were spread across the metropolitan area. Overall, the maps show that many TAZ had an increase in the percentage of workers employed in these industries, particularly in the suburbs.

Public Administration





In 1990 and 200, the TAZ with the highest percentage of workers employed in public administration were located in Aberdeen, Annapolis, Bel Air, Dundalk, Towson, Woodlawn, and Westminster. There was decrease in the percentage of workers employed in this industry in the Ft. Meade area, the areas surrounding Annapolis, and Woodlawn by 2000

Appendix 3: Supplemental material for Chapter 4

A4.1:

Number of commuters from residential neighborhood types to each employment center, 1990.

	Working Class	Low-Income, African-American	Neighborhoods in Transition	Middle-Class, married with Children	New, Upper Middle Class
Aberdeen	5,989	104	1307	7,660	1,901
Annapolis	12,836	1,670	8220	9,128	8,671
Arbutus, BWI	34,161	6,673	6,425	18,599	18,378
Columbia	2,179	829	932	6,663	4,984
Downtown, Midtown	70,298	58,717	38,736	25,514	3,0864
Dundalk	10,628	2,969	1,144	1,691	1,302
East Baltimore	18,974	5,602	3,124	4,694	3,680
Halethorpe	11,456	3,987	3,006	3,215	3,460
Hunt Valley	40,227	13,091	17,851	18,647	26,157
Owings Mills	4,538	2,635	2,024	1,841	2,617
Pikesville	4,543	3,960	3,076	2,097	3,976
Security Square	9,724	6,199	3,879	4,990	5,838
Southeast Baltimore	11,339	4,043	2,040	2,314	1,955
White Marsh	4,170	322	424	2,424	1,006

Number of commuters from residential neighborhood types to each employment center, 2000.

	Working Class	**Low-Income, African-American**	**Neighborhoods in Transition**	**Middle-Class, married with Children**	**New, Upper Middle Class**
Aberdeen	9,029	143	1,307	7,641	2,594
Annapolis	15,257	2,397	1,928	15,092	229,980
Arbutus, BWI	19,490	3,207	3,067	10,520	10,325
Bel Air	4,451	45	1,202	3,314	3,700
Columbia	16,302	8,746	4,939	5,572	5,464
Columbia II	3,656	1,092	1,219	5,033	3,525
Downtown, Midtown	2,242	856	959	7,662	5,592
Dundalk	67,826	57,637	37,909	25,100	30,280
East Baltimore	9,093	1,477	859	1,620	1,068
Hunt Valley	39,975	12,950	17,440	18,420	25,352
Owings Mills	4,358	2,237	1,816	1,721	2,567
Pikesville	4,711	4,121	3,236	2,234	4,159
Security Square	9,955	6,448	3,995	5,089	5,989
Southeast Baltimore	24,466	10,278	4,701	5,266	4,539
Westminster	13,834	200	388	387	678
White Marsh	9,661	972	1,133	3,557	2,148

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