GENTRIFICATION IN CHARLOTTE: A COMPLEX TALE OF URBAN REDEVELOPMENT ACROSS GEOGRAPHIC SCALES

by

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ABSTRACT

DANIEL ANTHONY YONTO. Gentrification in Charlotte: A Complex Tale of Urban Redevelopment Across Geographic Scales.
(Under the direction of DR. JEAN-CLAUDE THILL)

Gentrification research almost exclusively focuses on traditional postindustrial cities. Despite a growing number of scholars emphasizing the importance of understanding gentrification outside of traditional urban areas, its presence and modalities in mid-sized cities remains underexplored. This holds particularly true in the U.S. South where unique historical processes of industrialization, segregation, and immigration form low-density spatial patterns of urbanization that set Southern cities apart from other U.S. regions. A group of rapidly emerging mid-size U.S. Sunbelt cities – known as the New South – share concerns over a number of converging and interrelated trends: urban core revitalization, rising housing costs, lagging economic mobility, investing in public infrastructure, and shifting demographics. In this context, the New South is an ideal region for investigating longitudinal neighborhood development trends within a gentrification framework. Using a case study approach in Charlotte, my dissertation explores the spatial, temporal, and spatial-temporal aspects of contemporary gentrification. A survival analysis also tests the relationships between gentrification and changes in housing renovation, urban amenities, proximity to light rail development, and other factors. Results reveal that administrative data at the parcel level is more precise at pinpointing where gentrification occurs and how it diffuses overtime. Findings also identify

substantial differences between area estimates of gentrification hot spots calculated from parcel data, demonstrating that spatial aggregation error may lead to significant errors in measuring gentrification. Findings suggest that aggregating data to census blocks or tax parcel spatial unit provide more precise measurements of gentrification. Key findings from the survival analysis identify a strong spatial effect with dependence that neighborhood parks and greenways increase the likelihood of gentrification. Results also highlight a strong spatial effect, demonstrating that neighborhood effects do influence spatial patterns of gentrification. Findings also suggest that light rail variables do not increase the likelihood of gentrification. Additional variables correlated with the increase of gentrification include parcels with older homes, parcels in and around historical areas, lower home values per square foot, proximity to quality education, proximity to highways, and proximity to commercial areas increase the likelihood of gentrification. Thus, at a time when urban areas are rapidly changing and considering how to accommodate future growth, a local level understanding of gentrification aids policy makers and community organizers to tailor more effective public policy.

DEDICATION

To my parents, Tony Yonto and Kathleen McAllister, who provided the foundation for me to be the independent and curious person I am today. To my siblings: Carey, Allison, Kevin, Catie, Anthony, and Michaela. Although we are spread out across the U.S., we always find a way to laugh and smile together. To my friend, Patric, for traveling to three continents with me. Let’s make it four someday soon.

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LIST OF ABBREVIATIONS

ACS	American community survey
API	Application programming interface
CAMA	Computer assisted mass appraisal
CBD	Central business district
CCCHNDC	Charlotte city council housing and neighborhood development committee
CLR	capitalized land rent
CSV	Comma separated value
EC	Extended cox
GI	Gentrification index
GIS	Geographic information system
GSV	Google street view
HTTP	Hypertext Transfer Protocol
HNDC	Housing and neighborhood development committee
IDS	Integrated data store
LISA	Local Indicators of Spatial Association
NCSHPO	North Carolina state historic preservation office
NODA	North Davidson
SSI	Social status index
URL	Uniform Resource Locator

CHAPTER I: INTRODUCTION

The neighborhood I moved away from in 2019 was called Villa Heights, a diverse community located about 1-mile northeast of Charlotte, North Carolina. Cheap rent, access to a light rail station, access to restaurants/bars, and friendly neighbors drew me to the area. However, a trend started around 2014 in the neighborhood and continued until I left. Older homes that were once rented to lower-income residents were gutted, torn down, and replaced with new craftsman-style homes, Figure 1. One home being refurbished in this way did not appear to change the complexion of the neighborhood. Yet, when multiple homes within the same timeframe underwent a similar process across the street, Figure 2, it became clear that my neighborhood was changing. Despite local media arguing that gentrification has swept through Villa Heights (Frear, 2016; Logan, 2018), no maps or analytics could be found that increased residents' awareness of gentrification's impact in the area.

Figure 1. Villa Heights neighborhood home transforms physical appearance. Images obtained from Google Street View for 2014 and 2016.

Figure 2. Villa Heights neighborhood housing boom raises fears of gentrification. Images obtained from Google Street View for 2014 and 2016.

In the U.S., gentrification analysis almost exclusively focuses on older and larger postindustrial cities. Despite a growing number of scholars emphasizing the importance of understanding gentrification outside of these traditional urban areas (Ocejo, 2019, Billinghan, 2015, Tierney & Petty, 2015), its presence and modalities in mid-sized cities remains underexplored (Mathews, 2018, Ocejo, 2018, Prouse et al., 2015). This holds particularly true in the Southern U.S. where unique historical processes of industrialization, segregation, and immigration form low-density spatial patterns of urbanization that set Southern cities apart from other U.S. regions (Yonto & Thill, 2020). The timing of urbanization in Southern cities (de Oliver, 2016) adds to the region's dynamic population growth that has occurred at the expense of Northeast and Midwest cities over the past half century (Garner, 2017).

As the fastest growing U.S. cities continue to be in Southern and Western states, a group of rapidly emerging mid-size U.S. Sunbelt cities known as the New South– including Charlotte, Nashville, Orlando, Tampa, and Jacksonville–share concerns over a number of converging and interrelated trends, including urban core revitalization, rising housing costs, lagging social and economic mobility, investing in public infrastructure, and growing populations and shifting demographics coming out of the latest recession. In

this context, the New South is an ideal region for investigating the longitudinal neighborhood development trends analyzed within a gentrification analytical framework.

Yet, an underexplored feature of gentrification research is the different outcomes that arise based on the scale at which the process of gentrification unfolds in Southern cities. On the one hand, gentrification can be analyzed as a process of class turnover at the neighborhood level. Understanding gentrification in this way focuses on class formation and the process of class succession through socio-economic and demographic change. Operationalizing gentrification with this assumption leads to identifying an increase in professionalization of the city as a proxy for gentrification. On the other hand, gentrification can be analyzed as a housing process. While built structures can be modified to facilitate change in the spatial economy, more radical transformations demand that existing building are demolished and replaced. Operationalizing gentrification with this assumption leads to identifying gentrification as reinvestments in residential properties. Despite having the ability to quantify gentrification multiple ways, no academic study exists to guide research as to which method best captures the process of gentrification unfolding in growing Southern cities.

Another underexplored area of gentrification research is that there have been few academic studies addressing the different outcomes that arise based on the spatial unit being used to measure gentrification. Historically, the most popular quantitative method to measure gentrified areas was through socio-demographic data aggregated to the census tract level. Although data limitations prevented researchers from drilling down further into neighborhoods undergoing socio-demographic change, the increasing availability of socio-economic data are more readily available at finer spatial resolutions to test which

spatial scale is more precise at identifying gentrified areas in Southern cities. With the low-density nature of Southern cities, the importance of understanding these distinctions ensures policy makers enact appropriate strategies to halt the spread or dampen the effect of gentrification.

While specific definitions vary in their detail, gentrification is often understood as "the process by which higher-income households displace lower income [households] of a neighborhood, changing the essential character and flavor of that neighborhood" (Kennedy & Leonard 2001, p. 5). Using this definition, researchers have repeatedly measured gentrification using U.S. Census and American Community Survey (ACS) data at the census tract level to detect physical, economic and cultural aspects of neighborhood change (Chapple, 2017; Bosic & Martin, 2003; Atkinson, 2000). Academic researchers have also defined gentrification as a housing process by "which low-income central-city neighborhoods experience investment and renewal accompanied by an in-migration of middle- and upper-middle class residents" (Smith, 1998, p. 198) and measured it through tracking physical forms of real estate reinvestment and renovations (Hwang & Sampson, 2014; Hammel & Wyly, 1996).

In contemporary geographic research on gentrification, standard quantitative analysis of gentrification is often applied to socio-demographic census data aggregated to the neighborhood level to identify class turnover (Ellen & O'Regan, 2011). While gentrification research has started to quantify displacement by studying individual movements in and out of neighborhoods (Dawkins & Moeckel, 2016; Martin & Beck, 2016; Lopez & Greenlee, 2016), explicit attention to scale seldom takes into consideration the spatially heterogeneous dynamics of gentrification when context and

scale are taken into consideration (Smith & Graves, 2006; Beauregard, 1990; Lees, 2000). Moreover, researchers tend to make the assumption that gentrification's actors, mechanisms, and motivation in larger traditional cities will be the same in smaller urban areas (Slater, 2002).

As alternative data sources become increasingly available, such as street-level imagery, researchers can offer deeper insights that can help advance this effort. Moreover, combining these sources with administrative data for research, evaluation, and policy innovation presents a new frontier for neighborhood change researchers (Actionable Intelligence for Social Policy, 2016). The use of administrative records can be useful for community indicators since most of these records are timelier and can be applied to smaller geographic areas than U.S. Census or ACS data (Coulton, 2008). Applying a geographic information system (GIS) with administrative records makes the calculation of indicators for smaller areas more feasible and aids in displaying them in helpful ways. An advantage administrative data offer over other data sources is the ability to overcome data limitations of spatial and temporal scale, as alternate data tend to be released at inconvenient time intervals or aggregated to administrative geographies like census tracts instead of how neighborhood change actually unfolds at the street level (Zuk et al., 2017). The challenge moving forward lies in combining these new data sources and implementing computational methods with established theoretical approaches applied to longstanding questions such as neighborhood change (Shelton et al., 2015).

Despite the importance of scale and context in gentrification research (Lees, 2000) and a call for gentrification to be analyzed in cities further down the urban

hierarchy (Dutton, 2003), there have been relatively few fine-scale empirical studies on growing cities in the New South to test whether gentrification exists, to what extent, and under what forms (Tierney & Petty, 2015). Analyses like these are critically needed because a large share of neighborhoods are transitioning from single-family homes towards multi-family ones in many New South cities, with a number of local governments using smart growth strategies (Chappel & Zuk, 2017). Concerns about gentrification have been triggered by a growing body of literature that points to several key challenges that can arise in this context (Zuk et al., 2015) with researchers arguing that it is time scholarship moves beyond socio-demographic census measures for understanding current gentrification trends (Hwang, 2016).

To better address the needs of policymakers, community activists, and researchers, it is urgent to enhance the body of research related to neighborhood change in emerging New South cities. With little research being conducted on gentrification in the New South, and no formal way to classify contemporary gentrification trends, even the most basic questions about gentrification in New South cities seem to be unanswerable, except anecdotally. For instance, how do we know what the current distribution of gentrification is in a city like Charlotte, NC? What has happened to this distribution of gentrified properties and its spill over into other areas over time, and what drives these shifts? Once these basic questions are addressed, a more in-depth analysis can then help explain and predict future gentrification trends.

The present study will contribute to the empirical urban geography literature by providing a nuanced use of data analytics to increase the awareness of gentrification's impact in a Southern city. In this way, researchers can leverage fine-scale administrative

data to examine contemporary gentrification trends using a case study approach in the rapidly growing New South city of Charlotte, NC. In doing so, a process can be put into place to replicate this analysis and compare other New South cities undergoing similar trends.

1.1 Statement of Research

The purpose of this research is to investigate the underlying conditions associated with gentrification in growing cities of the New South. Using Charlotte as a case study, the analysis constructs a data warehouse that leverages multiple real estate administrative datasets over the course of 2002-2017 from the city of Charlotte's open data portal. Utilizing a complex dataset that combines multiple data types (text, numeric, and pictures), this research will formalize a gentrification database for quantitative analysis to examine whether neighborhood change patterns in Charlotte can be classified as gentrified at an intra-urban scale.

First, the location and magnitude of gentrified neighborhoods are identified in Charlotte using socio-demographic census data aggregated to the census tract. I then compare this approach with a nuanced method of identifying gentrified properties through tracking real estate investments at the parcel level. Second, an examination of whether gentrified properties are spatially clustered – whether a gentrified property influences the chance of additional gentrification taking place. Additionally, the trajectory in which spatial clusters of gentrified properties occur will be identified by revealing how the location and extent of gentrified clusters change from 2002 to 2017. Furthermore, I address how identifying gentrified areas at different spatial scales impacts

results of identifying gentrified areas. Finally, I address what factors drive the spatial distribution of gentrified properties in Charlotte.

Despite the data collection process being very labor intensive, the vast majority of cities will have access to these types of data. Thus, one of the goals of this dissertation is to provide a roadmap for future researchers to implement in different urban areas. To frame these tasks, the first three questions explore the spatial, temporal, and spatial-temporal aspects of contemporary gentrification. The fourth research question acts as a confirmatory analysis to determine what factors drive the spatial distribution of gentrified properties across Charlotte.

1.1.1 What is the current spatial distribution of gentrification in Charlotte?

The first phase of my dissertation compares two approaches that address how gentrification patterns may vary based on the different outcomes that arise based on the scale at which the process of gentrification unfolds in Southern cities. Ley (1986) provides a theoretical framework that outlines two broad methods for identifying gentrified areas. First, I measure changes in household status derived from census data. The second indicator used is taken from housing market activity indicators (renovations, turnover rates, or building permits). Ley (1986, 1988, 1992) uses changes in household status to measure gentrified neighborhoods in his seminal works. Although Ley does not provide a method to identify gentrified areas through housing market activity, this dissertation develops an index that captures real estate reinvestment to identify micro gentrified neighborhood trends using Ley's (1986) framework as a guide.

Prior studies on gentrification's uneven development tend to analyze the processes' features in broad terms (Smith, 1984). While the socio-demographic

approaches are valid measures of finding gentrified neighborhoods for early waves of gentrification in traditional dense U.S. cities (New York, Chicago or Philadelphia), it fails to identify the many complexions of contemporary gentrification impacting cities across the New South (Charlotte, Jacksonville, or Nashville). Thus, analyzing contemporary gentrification at a finer temporal and spatial scale allows a baseline to be mapped to see if any spatial patterns exist in New South neighborhoods and what outcomes exist based on the scale where gentrification unfolds.

1.1.2 How has the spatial distribution of gentrification spread in Charlotte?

Generating a baseline that examines the overall changes in Charlotte neighborhoods provides a snapshot of where gentrification has landed today. Yet, the second research objective allows for a deeper analysis by seeing how the process of gentrification diffuses over time. Hence, the second phase of my dissertation compares how the two methods generated in the first research question can trace the spread of gentrification across Charlotte.

Tracking the diffusion process is important because it enables us to correlate with socio-spatial conditions that may trigger, fuel, or dampen the gentrification process. For instance, instead of staying closer to the inner city, where traditional gentrification has focused, fast development in New South cities has the potential to stretch the spread of gentrification into neighborhoods that may not be expecting rapid neighborhood change. In this way, this dissertation examines if the process of gentrification is spreading through alternative spatial pathways due to the low-density nature of Southern cities.

1.1.3 How does spatial scale impact results of gentrification analysis?

With the third research question, I aim to identify what outcomes arise based on the granularity at which gentrification is measured. Despite most studies using census tracts for their spatial unit of analysis, there is a call to use finer geographic scales, such as census blocks or tax parcels, to discover micro gentrification patterns (Rigolon & Nemeth, 2019; Delmelle & Nilsson, 2020; Mathews, 2018; Ocejo, 2018). With investment and reinvestment data more readily available at finer spatial resolutions, researchers now have the tools to move the frontier of gentrification scholarship beyond census tract analysis to analyze neighborhood change trends at a finer spatial resolution. With relatively little scholarship available to understand which spatial scale is more appropriate when identifying gentrification trends, I anticipate a parcel level analysis should be able to pick up micro gentrification patterns that provide more useful insights into how the process diffuses over space and time. The lack of objective gentrification research on which scale is best to measure gentrification is a significant barrier in advocating interventions that arrive at site specific strategies for growing New South cities.

1.1.4 What factors drive the spatial distribution of gentrification in Charlotte?

While the first three questions examine the spatial, temporal, and spatial-temporal aspects of contemporary gentrification, the next research question acts as a confirmatory analysis to determine what factors drive the spatial distribution of gentrification across Charlotte. This dissertation argues that, given the common methods that define gentrification in academic studies, the presence of gentrification should be considered an event or the moment when the value of the real property on the tax parcel (land plus the

built structures) increases faster in that place than the surrounding areas. To this end, I use a statistical technique (survival analysis) to analyze data where the dependent variable is time until an event occurs to test the relationship between gentrification and changes in housing renovation, on the one hand, access to employment, urban amenities, proximity to light rail development, and other factors, on the other hand.

Together these four research questions offer insights into the spatial and temporal dimensions of contemporary gentrification in Charlotte. The overarching question that guides my research is whether more advanced modeling, complex indices, or finer geographic scales lead to more useful measures to identify gentrification in New South cities. Given the lack of research on medium-size U.S. cities and growing urban areas in the New South, there exists a need to fill this void with studies on gentrification in this context.

1.2 Structure of the Dissertation

The dissertation will consist of six chapters. Chapter I contains the research purpose and the structure of the work. Chapter II deals with concepts and background of gentrification. Chapter III covers the conceptual framework of this research and further elaboration on the research questions. Chapter IV outlines the study area and establishes the research design that describes the data and their manipulation, and introduces the methodologies adopted for each research question. Chapter V will present the result and discussion of the analysis in relation to the stated research questions. Chapter VI concludes the dissertation.

CHAPTER II: LITERATURE REVIEW

This chapter consists of several subsections that provide a foundation for research in gentrification. The first and second sections provide the necessary background on the definition and measurement of gentrification. Sections three and four describe the major theories of neighborhood change and how gentrification fits into this scholarship. The fifth section reviews the drivers of gentrification that helps formulate the research design. The final two sections identify gentrification in the New South and explain Charlotte's emerging gentrification concerns. Overall, this chapter synthesizes a rich academic history of gentrification research in order to demonstrate a gap in our understanding of the current processes.

2.1 Defining Gentrification

Geography and urban studies scholars have produced one of the largest bodies of literature over the past 50 years that tries to understand the causes, modalities, and consequences of gentrification (Annunziata & Rivas-Alonso, 2018). While specific definitions vary, two definitions form the foundation for this dissertation research. First, gentrification is "the process by which higher-income households displace lower income [households] of a neighborhood, changing the essential character and flavor of that neighborhood" (Kennedy & Leonard, 2001, p. 5). With this definition, researchers have repeatedly measured gentrification using the U.S. Census and ACS data at the census tract level to detect physical, economic and cultural aspects of neighborhood changes (Chapple, 2017; Bosic & Martin, 2003, Atkinson, 2000). The second definition that drives this research views gentrification as a housing process by "which low-income

central-city neighborhoods experience investment and renewal accompanied by an in-migration of middle- and upper-middle class residents" (Smith, 1998, p. 198); accordingly, this strand of the literature measures gentrification through tracking physical forms of real estate reinvestment (Hwang & Sampson, 2014; Hammel & Wyly, 1996).

Both definitions capture the process of gentrification where disinvested communities often undergo an increase in residents from either the middle or upper class in a concentrated area (Rigolon & Nemeth, 2019). In this way, the impact of gentrification tends to displace residents originally from that neighborhood. These residents tend to have lower incomes, poorer education, older ages, and minority status (Marcuse, 1985). The process tends to be driven by younger residents with a higher education from the upper or middle class. The facilitators also tend to be white (Marcuse, 1985). The impact of gentrifying neighborhoods is that on residents is that real estate speculation increases rapidly, which also corresponds to increases in home values and rents. Rezoning and land use changes are also typically found transforming an area from industrial areas to residential ones, or single-family homes transforming to higher density mixed-use developments (Zuk & Chapple, 2017; Hammel & Wyly, 1996).

While there certainly are negative outcomes that come along with gentrification (displacement, exclusion, social isolation), gentrification also has a number of positive changes. Many neighborhoods that experience gentrification report reductions in crime, improvements in amenities, and increases in property values (Mullenbach & Baker, 2018). The key to gentrification analysis is keeping in mind that these benefits are not evenly distributed. Residents that are financially better off are able to stay inside a neighborhood with increasing housing prices or match the demographics of the incoming

residents. While gentrification's positive impacts on neighborhood change should not be overlooked, it should be one of the many options that are addressed in the context of other experiences – possibly negative- that impact residents in a changing community.

Recent contributions of urban geographers to the study of gentrification focus on pushing the definition to become more holistic in nature (Hamnett, 1991). For instance, after the 1990 recessions, many cities tried to incorporate new developments to spur economic development such as hotels, urban water fronts or convention centers (Lees, Slater, & Wyly, 2010). City planners and public officials also constructed places aimed at bringing in the middle-class to change the urban landscape. Recognizing these changes, Lees (2000) reenergized the gentrification research by suggesting researchers use gentrification as a means to study how cities reconstruct. During this time, research acknowledged the role that government had in the process of gentrification (Hackworth & Smith, 2001).

As gentrification research continues to capture various spatial and temporal aspects of neighborhood change, current gentrification definitions have scholars questioning whether the term is being stretched too far. A recent challenge to gentrification research is whether new-build development on reclaimed land or residual green sites amount to gentrification. Historically, newly built developments aimed residential areas are in contrast to traditional views of aging homes going through a filtering or succession process in residential neighborhoods. As such, researchers have questioned the validity of labeling these types of changes gentrification (Lambert & Boddy, 2002).

Table 1 identifies the case for and against new-build gentrification. It can be broken into the following:

Table 1. Pros and Cons of New-Built Gentrification

Pro	Con
• Cause indirect or direct displacement • Draw a new urban middle class • Produce a gentrified landscape • See a large reinvestment of capital	• Populations are not displaced • Does not restore old housing • Different version of urban living

Investigating brownfield development along the River Thames in London, Davidson and Lees (2005) argue that the development promoted segregation and social exclusion. Additionally, Davidson & Lees (2006) argue that new-built developments can act as a form of gentrification by being a seed from which future paths of investment/ reinvestment can grow.

Another expansion to the gentrification definition comes as urban areas look to redevelop their economy and images through sustainability initiatives (Anguelovski, 2016; Checker, 2011; McKendry, 2018; Quastel, 2009). The challenge is that when these initiatives are invested in areas that have low-income neighborhoods, new infrastructure has the potential to increase property values high enough to displace low-income residents. (Anguelovski, 2016; Lubitow et al., 2016). While a demand across socio-economic status argues for more livable urban communities, balancing investments with the potential negative implications of environmental gentrification constitutes a major challenge for local governments (Anguelovski, 2016; Hyra, 2015). According to the literature, urban amenities that align with the sustainability framework that foster gentrification include major greenways, urban green spaces, and large parks (Anguelovski et al., 2018b; Gould & Lewis, 2017).

As the call for a more complete analysis of environmental gentrification increases, most research is being done on the impact of single greenway investments across cities: New York City's High Line and Atlanta's BeltLine (Immergluck, 2009; Immergluck & Balan, 2018; Loughran, 2014). Many scholars have tried to incorporate a strategy known as "just green enough" to find strategies that look at creating small parks to cater to long-term term residents (Curran & Hamilton, 2012, 2018; Wolch et al., 2014). However, this has recently been challenged by environmental gentrification advocates who argue that even smaller parks can trigger gentrification if the neighborhood has the right combination of amenities and housing (Anguelovski et al., 2018b). Despite calls for cities to head the warnings of urban sustainability initiatives, many cities are moving ahead with the intent to make sustainable investments under the vision of heling all residents. By not prioritizing the implications of green gentrification complexities, urban areas may create spaces that are eventually going to be only for those who can afford it (Checker, 2011; Lubitow et al., 2016; Pearsall & Anguelovski, 2016).

While some researchers hesitate to consider the new-built or environmental gentrification movements true processes of gentrification, sticking to traditional definitions can hinder identifying trends that lead to new discoveries in the gentrification literature. For instance, Smith and Graves (2005) call Charlotte, NC a strange case because of its strong corporate presence in the gentrification process. Diverging from traditional studies of gentrification, Charlotte had a corporate gentrifier that motivated city officials to help improve a disinvested neighborhood. Furthermore, the historical process through which Charlotte gentrified emphasized that gentrification differs across

space and must be studied temporally and contextually to truly understand the underlying process.

As U.S. New South cities continue to redevelop, the low-density nature of these cities supports the new-built gentrification definition because recent housing booms spurred redeveloped found in suburbs close to the center city that did not rely on capital disinvestment. Instead, it follows Hackworth's (2002) rational that recent changes in these neighborhoods where all property values are rising. In this way, the redevelopment and reinvestment process of inner suburbs in U.S. New South neighborhoods appear fundamentally different than from the traditional central city found in northern cities. Moreover, as environmental amenities are found to foster gentrification, it is important to understand this type of relationship in New South cities to protect negative impacts from impacting marginalized communities.

Despite the definition of gentrification morphing into a more holistic term, the foundation of gentrification research continues to be a "process that is fundamentally rooted in class and inherently geographic in its manifestations" (Wyly & Hammel, 1999, p. 716). Hence, in order to scrutinize "the effects of gentrification rather than its causes" (Weesep, 1994, p. 74), there is a need to investigate how the expression of uneven capital reinvestment can be measured from place to place (Harvey, 1978; Ley, 1986; Smith, 1982). Although researchers continue to define gentrification as "the process by which higher-income households displace lower income [households] of a neighborhood, changing the essential character and flavor of that neighborhood" (Kennedy & Leonard 2001, p. 5), my research takes the perspective that there is a development/redevelopment decision within the context of gentrification. As such, the definition conceptualized by

Smith (1998) that highlights continual investment or reinvestment in neighborhoods also drives this dissertation. This type of definition allows researchers to measure reinvestment through physical forms of upgrading that capture the neighborhood change process (Hwang & Sampson, 2014). However, as will be shown in the next section, this type of analysis is not straightforward.

2.2 Measuring Gentrification

In early gentrification analysis, gentrification identification was left to local expert's perceptions of neighborhoods. One of the earliest examples of trying to measure gentrification comes from Black (1975) who survey 143 cities across the U.S. Black's (1975) survey asked real estate officials or public officials to what extent they saw changes consistent with gentrification. The results revealed that 48% of urban areas that have a population more than 50,000 had neighborhood change in deteriorating neighborhoods. While Black's (1975) survey represents one of the earliest ways to measure gentrification, later studies incorporated more advance statistical analysis.

In a seminal work in gentrification analysis, Ley (1986) argues different possibilities to identify gentrified neighborhoods. First, gentrification can be identified by looking at how household status changes through the decennial census. Second, gentrification can be identified though the changes in housing market activity. Ley (1986, 1988, 1992) used the first method in his later works to generate what is now known as the social status index (SSI). The application of his work has captured important class turnover in multiple Canadian cities.

More importantly, Ley's work helps establish gentrification as a process of class formation and class succession through demographic change (Atkinson, 2000).

Operationalizing gentrification with this assumption leads to identifying an increase in professionalization of the city as a proxy for gentrification. In this way, Ley's (1986) SSI provides researchers a guide to identify this sociodemographic class change. Despite Ley's SSI reflecting a degree of social upgrading occurring, the SSI has been scrutinized because, as Schaffer and Smith (1986) point out, identifying gentrification needs to incorporate shifts in the housing market. DeGiovanni (1983) furthers this idea by identifying the major parts of gentrification, which include changes in homes inside a neighborhood. These changes can vary but tend to include home sales or increased in reinvestment. Smith (1979, 1982) adds to this argument by stating what needs to occur for a neighborhood to gentrify is a disinvestment in certain areas so capital can move into the neighborhood to instigate reinvestment.

In contrast to Ley's theory on demographic change, Harvey (1982) advocates that land is in a constant state of change. Harvey (1982) continues that as reinvestments are made in the built environment, these become locked in a particular place. As the building ages in that space, the value of the structure starts to decline. While the structure can be modified overtime, more radical changes are needed to transform the landscape into something new. In the seminal rent gap theory stipulated by Neil Smith (1996), he argued that capital that flowed into these areas formed certain "valleys". In this way, Smith (1996) describes the uneven spatial development of how capital investment moves from one place to the other:

> The logic of uneven development is that the development of one area creates barriers to further development, thus leading to an underdevelopment that in turn creates opportunities for new phases of development. Geographically this leads to the possibility of what we might call a "locational seesaw": the successive, development, underdevelopment and redevelopment of a given area as capital jumps from one place to another, then back again, both creating and destroying its

own opportunities for development (Smith, 1996, p. 88).

While the rent gap theory became a prominent way to understand the uneven spatial distribution of development (Clark, 1988; Kary, 1988; Badcock, 1989; Yung and King, 1998), measuring gentrification in this way has proven to be a difficult undertaking (Bourassa, 1993).

One of the most laudable studies on measuring the rent gap came from Malmö, Sweden. In order to measure the rent gap, Clark (1988) identified three steps. The first step collected tax assessment data. Next, he normalized the data across time. Finally, he incorporated sales data to address the magnitude of the rent gap. Building on this method, Hammel (1999a) used a similar technique to estimate the rent gap in Minneapolis. Despite Clark (1988) and Hammel (1999a) using finding the rent gap to capture gentrification, their work has been criticized for being time- and labor-intensive (Lees et al., 2006). Additionally, both Clark (1988) and Hammel (1999a) focus their research on extremely localized areas in their analysis. For instance, Clark (1988) only sampled four blocks in Malmö, whereas Hammel's (1999a) only included nine properties in Minneapolis. Although the author's intent was to test if they could identify the rent gap, overtime, their methods have become less practical when looking at entire cities.

The most influential data and method for measuring gentrification to date is the research done by Wyly (1996) and Wyly & Hammel (1998, 1999, 2004). The authors initially created a database that incorporated 23 U.S. cities where gentrification was occurring. Next, the authors provided a systematic approach to "ground truth" census reports. The three-step process included a discourse analysis to identify gentrifying areas in the city, a discriminant analysis to distinguish gentrified and non-gentrified areas, and

a socio-economic benchmark of characteristics that had a baseline in either 1960 or 1970 to determine the complexion of gentrification in 1990 cities. According to Wyly & Hammel (1998), a census tract was considered gentrifiable if the medium household income was below citywide medium during the baseline year. Hwang and Sampson (2014) used Wyly's (1996) data and analyzed the pace of gentrification in Chicago from 2007 to 2009. Instead of ground truthing the results in the field, the authors used Google Street maps to verify their findings. Heidkamp and Lucas (2006) also used Wyly's indicator to look at the gentrification frontier linked with census data in Portland, Maine, arguing that this method is more useful than Smith's rent gap analysis due to the CLR being too labor intensive to make the indicator a meaningful approach to identify gentrification.

Researchers who take a more purely economic approach to identifying gentrified areas look at the change in average income of census tracts of the inner city (Kolko, 2007). For instance, Bostic and Martin (2003) compare median income change of a geographic area (census tract) to the median income of the MSA. Landis (2016) also used the idea of an area being gentrified if it experienced a substantial socio-economic upgrading that puts them within the first four income deciles of their metro areas. An upward change of two or more-deciles of a census tract's median household income over two time periods is how the authors measured gentrified areas (Landis, 2016).

With many ways to operationalize gentrification, most quantitative gentrification research typically use a strategy to identify neighborhoods that are gentrifiable when they have certain features at the beginning of a time period, and are considered gentrified when they demonstrate change in those characteristics at the end of the time period

(Barton, 2016). Quantitative studies also tend to rely on census data and define gentrification through socio-economic, demographic, and housing changes (Barton, 2016). Yet, as more and more researchers have access to different data types, researchers have tried to measure gentrification in different ways. Indicators for gentrification have ranged from coffee shops (Papachristos et al., 2011), mortgage lending (Kreager et al., 2011), and restaurants (Tierney and Petty, 2015).

Alternatively, studies in urban economics use building permits as a proxy for residential redevelopment (Munneke & Womak, 2013). Although redevelopment is a necessary condition for gentrification, redevelopment is such a broad term because it can mean a small structure that is already in existence, or an entirely new structure that is built. A specific type of residential reinvestment occurs when a demolition, or teardown, replaces single-family housing. The teardown process typically includes an older single-family house that is demolished in favors of a larger home to be built in its places (Pinnegar et al., 2010; Randolph and Freestone, 2012; Wiesel et al., 2013). Alternatively, a property developer may decide to purchase a property with the idea of tearing down the existing house so a new larger home can be constructed. The end result in this process is that the developer than sells the property for a profit (Charles (2013). on a speculative basis or for a particular client.

However, demolitions are not torn down in a random process. Developers are constantly searching for homes that fit certain criteria: small houses on large lots that tend to be older (Dye & McMillen, 2007). The goal for the developer is to make the most profit based on the potential rising land values. In this way, demolitions are a precursor for the rapid redevelopment of a site, but have not been widely used by gentrification

scholars to identify the neighborhood change process. Instead, attention has been focused on reinvestment reflected in the housing market. Several authors (DeGiovanni, 1983; Schaffer and Smith, 1986; Kary, 1988) have shown that housing sales experience a significant increase in gentrifying neighborhoods. In this way, home sales show a reinterest and act as good indicator of neighborhood reinvestment, acting as a proxy for gentrification.

Scholars have been interested in the outcome of redevelopment and gentrification through a process called mansionization (Nasar et al., 2007; Szold, 2005). The analysis focuses on mostly newly built homes single family homes that are labeled McMansions and are built after the demolition of a house or on a vacant greenfield site. To identify the impact of mansionization, Nasar et al. (2007) surveyed 103 cities across the US to find that the phenomenon has permeated most urban areas. The key finding to these studies is that is that we can identify these mansions through focusing on the change in square footage (Kendig, 2004; Szold, 2005).

As gentrification's definition has mutated, so too has the call for capturing a broader range of government indicators of gentrification at the local level that trigger gentrification (Ringolon & Nemeth, 2019, Logan & Molotch, 1987). Despite the creative ways aimed at measuring gentrification, the use of differing methods often means that different outcomes arise. The reasoning is that gentrification's scope and scale are presented differently. Geographers or urban scholars interested in the human and cultural side of gentrification tend to present the process at the scale of the individual (Butler, 1997). Working at this scale, the researchers tend to rely on survey and in-depth interviews to identify the reason a decision maker moves into a residence (Butler &

Robson, 2001). Approaching gentrification in this way makes the neighborhood change process seem more complex by focusing on different reasons why individuals move into certain areas (Ley, 1996).

Alternatively, researchers interested in the political or economic implications of gentrification conceptualize the process on a much larger scale. Moreover, instead of identifying individual in-movers to survey, the conceptualization of gentrification is at the neighborhood scale (Hackworth, 2002). Thus, these researchers focused more on capturing the changes in class turnover or capital reinvestment (Smith, 1996). Urban planners, however, explore factors that hope to create early warning tool kits and focuses on preparing communities for changes in the future (Chapple, 2009). For planners, the focus is on the physical reinvestment that accompanies demographic changes (Kennedy & Leonard, 2001).

There is no consensus in the gentrification community regarding the measurement of the phenomenon due to differences in how the process has been conceptualized and operationalized over the past 50 years. Differences in conceptualization and operationalization were in part due to differences in standpoint as gentrification has been studied by researchers from a wide array of disciplines, but mostly due to methodological reasons. Given their focus on a single or small group of neighborhoods, qualitative studies of gentrification have been able to identify the full extent of changes that gentrification produces in a neighborhood and therefore are better able to draw upon richer conceptualizations of gentrification. In contrast, quantitative studies have compared gentrification in a large number of neighborhoods, but often relied on official socio-demographic data sources such as census data. Although useful in identifying

gentrified neighborhoods, the latter are limited in how gentrification can be conceptualized and in turn operationalized.

Additional gentrification measurement differences can be summarized as followed. To start, the idea of what should be an indicator of gentrification is far from settled. On the one hand, empirical scholars argue that gentrification should have some sort of racial turnover incorporated into their indicator, whereas others do not. Freeman and Braconi (2004), state that the focus of gentrification should be on educational attainment variables, whereas many other scholars suggest the focus should be on the change in median household income (Hwang, 2016). There is a push for gentrification to focus on the changes in the value of the home (Immergluck, 2009) or lending patterns (Kreager et al., 2011). Finally, there is also a push to include commercial and nonresidential changes in the analysis (Hwang & Sampson, 2014, Papachristos et al., 2011; Hosman, 2016).

Furthermore, there are many differences between the spatial unit of analysis that qualitative and qualitative researchers employ. For example, many scholars that use quantitative analyses use census tracts as a proxy for neighborhoods (Hwang, 2016). Yet, these areas tend to be either too broad, narrow (Barton, 2016; Landis, 2015, Owens, 2012) or take attention away from small pockets of gentrification that gets overlooked from using a spatial unit of analysis that is too large.

In terms of the spatial unit of analysis, gentrification research in geography is commonly analyzed by aggregating census data to the tract level (Bereitschaft, 2020; Yonto & Thill, 2020; Delmelle & Nilsson, 2020; Preis, Janakiraman, Bob, & Steil, 2020; Rigolon & Nemeth, 2019; Baker & Lee, 2019; Gibbons, Barton, & Brault, 2018). One

criticism of the use of tract-level data is that census tracts are too large to allow the accurate identification of gentrification processes which frequently occur on a block by-block basis (Spain, 1981). Since tract populations average nearly 4,000 households, much of the local detail of gentrification may be obscured working at this scale. This is particularly true in southern cities where census tracts can vary in size to capture the tract population. Following Clark's (1988) use of the parcel as a unit of analysis, Hammel (1999) was one of the first researchers to examine specific locations, whereas most studies examined large districts within cities. Hammel (1999) regarded the latter as inappropriate area for an analysis of gentrification.

Despite most research using the census tract as the spatial unit of analysis, researchers have started to use smaller areal units. For instance, Hess (2020) examined gentrification in Seattle at the census block level to understand the relationship between transportation investment and gentrification dynamics. The results demonstrated the role public transportation plays in changing demographic trends along light rail corridors. The objective was to identify whether racial or ethnic changes are homogenous across neighborhoods investing in infrastructure projects, or if certain areas of a neighborhood are at higher risk of neighborhood change. However, ACS data at time granularity come with a cost. The finer the spatial resolution, the high the sampling errors (Jung, Thill, & Issel, 2019). This is especially true in populations with low socio-economic status, which typically include those impacted by gentrification.

Gibbons and colleagues (2018) also used census block groups to capture how local gentrification dynamics and social media impact neighborhoods in Washington, DC. Despite data used in the analysis not having census block groups available from the

Neighborhood Change Database, the authors developed a tool to interpolate Census and ACS data to the block group level that captured local gentrification effects (Gibbons et al., 2018). Moreover, Kramer (2018) published an expanded census block analysis of eighteen North American cities by looking at how the spatial distribution of poverty and access to transit impact gentrification. The author notes that using a smaller spatial resolution is imperative to "offset the limitations of using aggregated data" that may impact variable measurement (Kramer, 2018, p. 4). This type of analysis is in line with researchers arguing that it is time scholarship moves beyond census-based measures for understanding current gentrification trends (Hwang, 2016).

Operationalizing gentrification at different scales allows for a richer measurement of gentrification than has been used previously. In doing so, gentrification research can create a more precise approach that analyzes the identification and spread of gentrification (Yoon & Lubiensku, 2018). However, until such datasets at finer spatial resolutions are collected or made available, the extent of gentrification will remain largely unrecorded and invisible, especially in understudied urban areas that have experienced rapid growth.

Building on the previous gentrification research, I will use the case of Charlotte to bridge two important gaps in the measurement of gentrification. First, I will identify different outcomes based on the scale where gentrification unfolds, and I will examine the outcomes based on the granularity of where gentrification is measured. In doing so, a process can be put into place to determine an appropriate spatial scale to observe the neighborhood change process for emerging U.S. New South cities.

2.3 Theories of Neighborhood Change

Gentrification is nested within broader theories of neighborhood change that have developed since the early 1900s. Leading studies used the neighborhood as the primary unit of analysis to look at how changes fit under an invasion/succession, filtering, life-cycle, and transportation-housing cost trade-off framework (Liu & O'Sullivan, 2016). Gentrification, however, emerged as a unique phenomenon that saw reinvestment of capital back into disinvested city centers. As such, gentrification countered traditional theories of neighborhood change, which are being challenged again as gentrification continues to unfold in U.S. New South cities.

2.3.1 Invasion/Succession. Much of the work of the School of Chicago sociologists sought to understand the causes and cures of the social problems that arose as American cities developed during the first half of the twentieth century. For the current study, the work on spatial ordering of urban populations conducted by Park et al. (1967) was the most important as it laid the foundation for much of the research on neighborhood change. In developing the Concentric Zone theory, Park et al. (1967) argued that the spatial patterning of cities could be understood as a series of ever-widening circles. The center circle, the central businesses district (CBD), was the most desirable for businesses because of its location near major waterways or other forms of transportation hubs. The CBD was surrounded by an area of low-income housing, referred to as the Zone of Transition and featured high proportions of immigrants and poverty-stricken residents. The Zone of Transition was surrounded by the Zone of Workingmen's Homes, which was populated by working class residents. The Workingmen's Homes were surrounded by the Residential Zone, which was

characterized by middle-class residents. The final zone, the Commuter Zone, was a suburban area characterized primarily by middle to upper-income households. Park et al. (1967) found that as individuals were able to accumulate resources and improve their socioeconomic status, they tended to move away from the CBD and into housing in more affluent areas that matched their improved socioeconomic standing. Drawing upon the natural sciences, this process was explained through a series of invasions and successions. Areas started off being inhabited by a group of residents who typically shared a common ethnic heritage. Over time, members of this group accumulated enough resources to be able to move to areas with lower density housing that were considered to be more affluent, creating vacancies in the areas left behind. These vacancies allowed for members of different and often poorer residents to invade the area. As a greater proportion of the original residents accumulated enough resources to migrate to more affluent areas, greater numbers of minorities would move in until the original residents had succeeded the area entirely to the new group.

Gentrification scholars have discussed a similar series of invasions and successions, but the pattern of invasion and succession identified by gentrification scholars contradicts the patterns identified by Park et al. (1967). Whereas the "invaders" identified in the traditional concentric zone theory were of a different racial/ethnic minority group and of even lower socioeconomic status, the invaders in gentrifying neighborhoods were typically white and came from higher socioeconomic backgrounds than incumbent residents. Additionally, the pattern identified by Park and colleagues showed that individuals typically moved from areas with poorer housing stock to areas with better quality housing stock. In contrast, gentrification scholars have often pointed to

the poorer quality (and therefore inexpensive) housing stock in disadvantaged neighborhoods as being a draw for gentrifiers.

Darwinian in nature, neighborhoods would go through a process where one group invades and supplants the previous occupiers of that space. Offered as a view of competition and conflict among neighborhoods, this model became a foundation for understanding racial and socioeconomic changes inside industrial cities (Schwirian, 1982). Critics of the invasion and succession model argued that the framework lacked real-world practicality and wanted to understand how cities change using a more economic approach (Saunders, 1986).

2.3.2 Filtering. With little housing specifically built to serve low-income populations, new housing traditionally is built from the demand of higher income groups (Rosenthal, 2014). As demand for the new housing changes, older homes are passed on to lower income groups (Ohls, 1975). This progression demonstrates a filtering process where the spatial pattern differs from the traditional concentric ring approach by having wedges or sectors of new growth bisecting the urban area (Hoyt, 1939). With this model, newer houses tend to be built on the urban fringe and would attract wealthier residents. The abandonment of the older homes would be left to filter down to lower-income residents (Sweeney, 1974).

The key idea behind the traditional filtering model is an emphasis on the aging housing stock (Roberts, 1991). As homes age, the cost to maintain the quality of the housing stock becomes more expensive which, in turn, creates an incentive reduce the investment and upkeep of the properties (Grigsby et al., 1987). Due to physical and capital deterioration, individuals may relocate to better housing that suits their income.

An implication for filtering theory, therefore, is that the distribution of household characteristics plays a determining role in explaining neighborhood change dynamics (Liu & O'Sullivan, 2016). The interest in the neighborhood drops when the demand for the site location, housing, or location decreases (Grigsby, 1963).

With the idea that most cities consist of housing markets shaped by demand and supply forces, Grigsby et al., (1987) identifies that the filtering process as changing due to urban areas having unique, yet interrelated submarkets dedicated to housing that form supply and demand. The authors argue that neighborhoods go into decline when the filtering process is linked to both micro and macro forces. The result is that instead of viewing the filtering model as just a housing condition, the changes are now due to the neighborhood conditions (Megbolugbe et al., 1996). Grigsby et al, also note how some of these changes can seem quite stable over time, but others may change quickly and have an impact of the value of the investment. Galster (2001) examines this claim and states that neighborhood change comes down to risky decisions made by the residents, businesses, local governments of a neighborhood.

The previous models of neighborhood change base their ideas on the idea that the housing submarkets create an interconnectedness to the larger urban area (Galster, 2001; Grisby et al.,1987). Their research implies that a main neighborhood change component exists that is exogenous to the neighborhood itself. The argument is that the change going on in the neighborhood is, in fact, due to a non-linear change in other parts of the city (Delmelle & Thill, 2014). In this way, homes that are older and are becoming ready to revitalize, while other homes are left to decline (Brueckner & Rosenthal, 2009).

In one of the most comprehensive explanations of this view in the gentrification literature, Berry (1985) explains a rise of "islands of renewal" for the end result of city housing reconstruction and filtering that creates "seas of decay" inside the urban core. In order to create the conditions needed for "islands of renewal" older housing near the center city is removed at a rate that is faster than new housing so "the markets are tightened and older central-city housing becomes an attractive option" (Berry, 1985). This condition also needs certain factors to change along with it, namely center city office buildings and an increase in professional employment. Each of these signals the growth and concentration of more advanced services in the city. As cities continue to expand these "islands of renewal", it depends on a convergence of urbanization trends that reflect "apparent contradictions but logical links between suburban overbuilding, contagious inner-city abandonment, decreasing vacancies and tightening markets, and gentrification" (Berry 1985, p. 96).

2.3.3. Neighborhoods as a Life-Cycle. Related to the invasion/succession and filtering ideas of neighborhood change is the economic-driven life-cycle model. Hoover and Vernon (1959) envisioned a more step-by-step approach to neighborhood change by proposing a five-stage process that neighborhoods would go through a development, a transition, a down-grading, a thinning out, and a renewal. As neighborhoods change, so do certain characteristics including age, race, land use intensity, population and housing conditions (Schwirian, 1982). Thus, a theme of this model is that social mobility and spatial mobility are inherently intertwined.

The early neighborhood change stage models predict that there will be a decline and abandonment in neighborhoods over a certain period of time (Hackworth & Smith,

2001). Using these theories as a framework for understanding neighborhood change can lead to a negative deterministic view of how neighborhoods evolve, often with intervention necessary by governments to help revitalize run-down areas (Metzger, 2000). Consequences of this view can be seen during the 1970s with the U.S. Department of Housing and Urban Development promoting inner-city revitalization programs through slum clearance with an assumption that once neighborhoods reach a certain point, there was no way for a neighborhood to recover without large-scale capital reinvestment (Metzger, 2000).

2.3.4. Transportation and Housing Cost Trade-off. Urban economics and regional scientists tend to rely on a separate set of assumptions when identifying neighborhood change processes. The starting point for these researchers is the standard urban model developed by Alonso (1964), Mills (1967), and Muth (1969). The location of high-income housing in the standard model reflects a tension between two competing forces. On the one hand, high income households are drawn to the suburbs where a large supply of housing can be reached at a low price while, on the other hand, a time-cost pull to the center of the city exists where shorter commutes allow high-income household the ability to save time (Brueckner & Rosenthal, 2009). As evidence traditionally demonstrated the draw to suburbs dominated location patterns in the U.S. due to cheap urban lands, Wheaton (1977) presented evidence that competing forces are approximately equal in size, meaning that location patterns are not as determined as researchers once thought. In a seminal piece by Glaeser, Kahn, and Rappaport (2008), the authors argue that the housing force is much weaker than the time-cost pull. The consequence is that high-income households would prefer a central location instead of the general U.S.

pattern of suburban living. The literature points to two explanations: the effect of amenities and access to public transit.

Amenities take on multiple forms, such as parks, rivers, beachfronts, or monuments, and attract higher-income households more than poor ones to that area (Brueckner, Thisse, and Zenou, 1999). In addition to natural amenities, some argue that areas with similar income households form communities that attract residents wanting to improve the quality of their public schools (Nechyba & Walsh, 2004). Alternatively, LeRoy and Sonstelie (1983) reason that transportation choice provides the main factor in location patterns. For instance, when a new faster transportation mode is available and adopted by upper-income households, the time to commute to locations may cause them to abandon their initial inner-city location for the suburbs. With central cities having higher densities, Glaeser et al. (2008) point out that public transit service offers more reliable and frequent service. Without access to a car, poorer households will naturally be attracted to this service and concentrate in the center city (Glaeser et al., 2008).

With a focus on amenities and access to public transit explains general location patterns of higher- and lower-income families. However, Brueckner & Rosenthal (2009) argue that these results are based on static models and do not allow for neighborhood evolution over time. Linking the urban economic models with the filtering models, Brueckner & Rosenthal (2009) demonstrate that local amenities, access to public transit, and dwelling ages all contribute to the general location patterns of households.

In the seminal work by Tiebout (1956), location decisions by household are made by the combination of available public goods. The residential sorting occurs due to the ability and willingness that households have to pay for them, along with the demand for

the amenities. In this way, as long as transit access (or any other kind of public investment) is conceived as residential, capitalization should be an expected outcome in neighborhoods that have properties surrounding certain station which, in turn, impacts the sorting of residents along income lines (Delmelle & Nilsson, 2020).

Along with economic sorting, a neighborhood's socioeconomic makeup also contributes to the shaping of local migration patterns (Delmelle & Thill, 2014). For instance, residents tend to desire neighborhoods that have higher levels of quality of life indicators (Rosenthal, 2008). In this way, resident mobility decisions are based on features offered by a neighborhood and are decided only after there is a comparison with other places inside the city (Galster, 2001). Due to the self-sorting, local externalities are created by wealthier inhabitants that live within close proximity of each other. However, when concentrations of poverty occur in old neighborhoods that are not as desired, the result is a host of negative externalities that can create a downward neighborhood trajectory (Delmelle & Thill, 2014). This process, also known as a tipping point, involves certain levels of residents based on income, racial, or other socio-economic compositions that they are willing to tolerate and live with inside the neighborhood (Quercia & Galster, 2000). Yet, when that level inside the neighborhood is exceeded, that resident will relocate to a place that better fits their preferences. The movement begins with the person who has the lowest level of tolerance (Galster et al., 2007). In addition to tipping points, there are cases when certain social can apply pressure to influence residents to conform to certain norms, customs or behaviors (Dietz, 2002).

2.3.5. Neighborhood change and social outcomes. The previous theories illustrated factors that influence a neighborhood's economic or racial complexion, the

next section focuses on how the changes impact social outcomes. For instance, poverty being concentrated and the outcome of social problems was first articulated by Wilson (1987) and Massey and Denton (1993). The authors argued that the concentration of poverty intensifies social problems in neighborhoods, especially in youths. A number of theories exist on how social outcomes are influenced by neighborhoods and are briefly reviewed here to help contextualize gentrification in the neighborhood change process.

These broad types of impacts on neighborhoods can be classified as neighborhood effects, defined as a community influence on individual, social, or economic outcomes (Dietz, 2002). Three different types of neighborhood effects are explained in the literature: endogenous, correlated, and exogenous (Manski, 1993). With endogenous effects, the behavior of an individual directly influences the behavior of every other individual in the neighborhood. This kind of effect is also known as a peer effect or bandwagon effect because it has a direct chain of causality associated with it (Dietz, 2002). For instance, if a teenager in one neighborhood starts to use drugs, this may lead to an increase in drug use by other teens in the area. In this example, the action of one individual has a direct effect on others and causes a multiplier effect. Relating this to housing behavior, individuals who view a neighbor's decision to maintain or repair their house may decide to keep up by making similar decisions, thereby increasing their own housing consumption (Ioannides & Zabel, 2001). This type of process is consistent with the process of gentrification that researchers try to capture.

The second type of neighborhood effect cited by Manski (1993) is correlated effect. Correlated effects are the result of the residential sorting process; individuals residing in the same neighborhood tend to have similar characteristics or opportunities.

The distinction between endogenous effects and correlated effects is the determination of causality. Correlated effects have a more difficult time to demonstrate direct causality. For instance, “If the process of population sorting results in a sorting of behaviors, a correlated effect is present but no neighborhood causality is implied. However, if the correlated effect arises due to sorting and common exposure to institutional or other within neighborhood influences, causality is generated by the effect” (Dietz, 2002, p. 542).

The final neighborhood effect identified by Manski (1993) is exogenous effects or contextual effect. In this situation, the effect is place-based and arises when an individual’s action depends on the characteristics of the individual’s neighborhood, such as religion or racial neighborhood makeup (Dietz, 2002). The contextual effect occurs when household owners see their neighbors’ characteristics, such as income, signal a new future housing consumption pattern. This signal alters their own patterns of consumption (Ioannides & Zabel, 2003).

An important note is a difference from non-causal and causal neighborhood effects between each. When policy creation and modeling are taking into consideration, endogenous and correlated effects have two different implications. In endogenous processes, a multiplier effect is generated because of the direct effect. However, since there is no causal impact of correlated effects, no multiplier effect is generated. These different interventions need to be taken into consideration based on the different types of neighborhood effect.

Endogenous neighborhood change processes may play out due to a variety of starting conditions that include stability or threshold instability. There is evidence that

suggests different neighborhoods may exhibit conflicting temporal trajectories (Galster et al., 2007). For instance, crime rates take longer to return to a stable state after an exogenous shock. Galster et al. (2007) identify this process occurring much slower in neighborhoods where poverty rates are high.

Several theories on the interrelationship of spatial processes exist in the geography literature to identify how an outcome, in this location, is affected by events in another. The first includes the processes of spatial diffusion, where the gradual adoption of an attribute is greatest to those in close proximity to previous adopters (Paez & Scott, 2004). The second is spatial spillovers, which identifies locations as interconnected, so ideas and information may freely be exchanged across borders (Paez & Scott, 2004). Finally, spatial interaction is based on the changing spatial locations of people, goods, or ideas (Paez & Scott, 2004). Results of the movement include geographic patterns with similar geographic patters in close proximity.

Applying these phenomena to neighborhoods, spatial spillovers have been identified to extend over short distances (Jun, 2016). For example, Galster et al. (1999) found that investments in Section 8 housing sites in certain neighborhoods had a positive impact on housing prices due to the physical upgrading required by the investment. Thus, the local improvements contributed to the overall quality of the area. Spillover effects in property values are also observed in close proximity to public housing development (Santiago et al., 2003), supportive housing developments (Galster et al., 2004), and revitalization investments in distressed neighborhoods (Galster, 2006). The findings from these studies demonstrate that local investments can create a process that

has impacts on the surrounding neighborhoods that, in turn, creates spatial dependence in neighborhood change (Jun, 2016).

The role of spatial dependence in neighborhood change continues to present researchers with challenges (Ellen and O'Regan, 2011). First, the boundaries utilized to delimitate neighborhoods and aggregate their characteristics may not coincide perfectly with the actual boundaries in which the social, physical, and economic processes are taking place, thus creating a different type of spatial dependency. Second, the processes leading to neighborhood effects and spatial spillovers create a spatial spread of social outcomes. These spatial processes may lead to clustering or dispersion that violates assumptions of independence for conventional statistical analysis. These violations led to information loss and flawed conclusions when crafting public policy (Griffith & Layne, 1999).

Keeping these challenges in mind, the invasion/secession, filtering and urban economic models each describe a process of urban decline in older neighborhoods towards the center of the city. A consistent theme in these processes is the movement away by the wealthiest urban residents to the suburbs. Beginning in the 1960s, urban scholars were introduced to a different phenomenon that saw a reinvestment of capital back into the center cities. The process was introduced by Ruth Glass (1964), and from this moment, urban scholars have been trying to understand the underlying causal factors that drive gentrification ever since.

2.4 Theories of Gentrification

Gentrification is often thought of as set of stages that revitalized a neighborhood (Kerstein, 1990; Lees, 2000; Ley, 2003; Smith, 2012). While there have been multiple

attempts to identify the precise states, the general idea focuses on a set of in-movers that are considerable different from those who are already living in the neighborhood. The earlier the in-movers are in the process, the more risk oblivious they tend to be as they are attracted to more obsolete parts of neighborhoods to transform a home into a place for them to live. The later arrivers, or more risk averse, tend to be those who move into the neighborhood when it has improved substantially (Gale, 1979; Kerstein, 1990). Researchers have also found that the more later arrivals tend to be a different socio-economic class, one that is more middle-class with jobs in managerial sectors. Alternatively, earlier arrivers tend to be more modest in their jobs and income backets and tend to hold more diverse employment (Kerstein, 1990; Smith, 2002; Van Criekingen and Decroly, 2003).

As gentrification research progressed, Rose (1996, 1984) and Bondi (1999) identified those who arrive early as marginal professionals who decided where to live based on their lifestyle. Investment in neighborhoods is critical at the beginning of the gentrification process, however, the duration is often challenged (Watt, 2005; Zukin, 1989). Smith (2012), Smith and DeFelippis (1999) and Cameron and Coaffee (2005) point out that instead of in-movers coming in to create a home, later arrivers try to 'aestheticize' the neighborhood (Ley, 2003), which transforms it into a more affluent place.

Although stage models are useful to help explain the dynamics of gentrification, the first articulation of gentrification as a distinct theory came from the geographer Neil Smith in 1979. Smith (1979) argued that gentrification can be explained by addressing the production or supply-side arguments based in classical economics which categorizes

gentrification as a natural market adjustment process. Critical to Smith's argument was ground rent, or the money demanded by landlords for the right for someone to use lands and whatever building located on it (Slater, 2017). It was the landlords in poorer central cities that Smith (1979) argued used the concept of highest and best use principle. The idea is to invest the landlord's capital to maintain the building and land as low-cost rental units in order to get the most return on the investment. With each passing year, the investments became difficult to recover from low-income tenants (Slater, 2017). Even though it makes economic sense to keep those properties as low-income units, over time the low maintenance will eventually drive tenants out to find better places to live. From the rent gap perspective, the primary causal mechanism of gentrification is the perception that neighborhoods are currently undervalued and that restoration or development efforts will increase property values to their maximum potential. Drawing upon Logan and Molotch (1987), the perceived value of a neighborhood is a consequence of factors related to use value such as the prevalence of amenities and factors related to exchange value such as the age of buildings in the neighborhood and policies implemented by local governments that influence the availability and affordability of housing. Further, exchange values are at least in part determined by use values as properties with greater use values are more attractive to potential buyers and therefore will sell for higher prices.

Along with the landlords using the idea of highest and best use, financial institutions would redline low-income neighborhoods to make loans (Lees et al. 2010). The combination of these two processes helped drive the physical decline with middle and higher income-residents and businesses moving away while poorer individuals were pushed into these areas due to not being able to afford anywhere else to live.

Referring back to the rent gap, the process of gentrification takes place when there is a gap between the potential returns on a building and the actual gains from the use that it is currently providing. Therefore, reinvestment only takes place when the time is right to make the most profit for its future use. Closing the rent gap requires separating people from the land so that the land can be transformed into its highest and best use. In this way, gentrification only happens to areas that have a rent gap wide enough so developers can purchase buildings at the lowest possible cost and then sell for profit. In this way, neighborhoods are in a cycle that sees capital flowing in and out. However, research into the rent gap after the 2000 recession finds the rent gap's mechanics may be changing in certain cities (Hackworth, 2002). According to Hackworth (2002), many areas within inner cities are, "sufficient enough to stave off earlier waves of gentrification. Thus, even public housing and rent-controlled apartments, both of which bring in some revenue, are now being gentrified more frequently" (p. 828). In this sense, the 2000 recession has primed certain location to be more susceptible to gentrification practices that ever before.

The perceived value of a neighborhood is also impacted by the age of the housing stock. Research on the importance of the age of housing stock has been largely guided by the filtering model, which argues that housing becomes increasingly devalued as it ages (Brueckner & Rosenthal, 2009; Clark, 1992). According to the filtering model, housing stock that was once occupied by higher-income households becomes occupied by increasingly poorer households while newer housing stock, which is typically constructed on the periphery of cities, is inhabited by higher-income individuals. This is best exemplified by the suburbanization of the mid-twentieth century where many middle and

upper-class residents moved away from inner-city neighborhoods and into newly constructed suburban neighborhoods.

Gentrification poses a problem to the filtering model in that it typically involves higher-status households moving into disadvantaged neighborhoods with older and poorer housing stock. Research by Rosenthal (2008) sheds light on this issue in that the author found a U-shaped relationship between the status of a neighborhood and the age of the housing stock. These findings partially support the traditional filtering model in that they show that higher-income households were attracted to newer housing stock, but also partially contradict the filtering model in that they show that older housing stock was also attractive to higher-status households. The bottom of the U-shape contains middle-aged homes, which Rosenthal (2008) identified as falling in the range between 10 and 39 years old. Rosenthal's (2008) findings were important for the gentrification literature, as scholars have long argued that gentrifiers are attracted to neighborhoods with older housing stock without specifying the age of such housing.

The perceived value of a neighborhood is also impacted by policies that influence the availability of housing. Applying basic supply and demand logic to housing markets, housing in tight markets, that is markets where a limited number of desirable housing units are available, is inherently more expensive because the greater demand for housing than the supply allows for results in increased competition for space. While the availability of housing in a neighborhood is mostly market controlled, it can be greatly impacted by government policies both at the federal and local levels. An example of the impact of federal policy on housing demand is seen in the suburbanization movement, which resulted from the implementation of federal programs that encouraged the

construction of a greater number of housing units in suburban areas and ensuring that such housing was more affordable than similar housing in inner-city areas, thereby decreasing the competition for housing (Jackson, 1985; Rusk, 1999).

Moreover, the broader trends in urbanization help to explain why the overarching process of gentrification began and continues to occur. To explain why specific neighborhoods or areas of cities gentrify, scholars typically draw upon some combination of the production and consumption explanations. Proponents of the production explanation argue that neighborhoods gentrify because property owners, developers, or city governments believe that development or redevelopment will result in financial gain or what Logan and Molotch (1987) referred to as an increase in exchange value. In contrast to the production explanation, proponents of the consumption explanation are more interested in the characteristics of gentrifiers as a group and their attraction to what Logan and Molotch (1987) identified as the use values, which refers to idiosyncratic reasons for living in a particular neighborhood such as personal tastes, of neighborhoods being gentrified. Drawing upon the consumption explanation, neighborhoods are more likely to gentrify if they feature access to amenities such as bars, restaurants, shops, and employment in high skill service-oriented occupations through either proximity to such amenities in the neighborhood or to transportation that can be used to access such amenities. Each of these arguments is discussed in more detail below.

Proponents of the consumption explanation have argued that gentrification was the result of an influx of younger individuals into cities. Scholars have varied in the specific age range argued to be most important. For example, Robson, Bradford, and Deas (1994) argued that an increased proportion of the population aged 25 to 34 was the

most important. In contrast, Hammel and Wyly (1996; Wyly & Hammel, 1999) and Bostic and Martin (2003) focused on changes in the proportion of residents between the ages of 30 and 44, while Rosenthal (2008) expanded this range to 55. Differences in the specific age range aside, the increased proportion of individuals in the overarching age range of 25 to 55 was important for gentrification because members of this group typically had access to greater financial resources than the young or elderly, which makes them better able to maintain their homes and support local community development projects (Rosenthal, 2008).

An alternative explanation for the increase in median age was provided by Zukin (1982), who argued that the increased popularity of loft-living among the middle-class during the 1980s increased property values to a point where fewer young artists could afford to live in these areas. Essentially, the greater representation of middle-class residents, who were older than the young artists, helped to increase the average age of the population. This transition from young artists to middle-class residents helps to explain the gentle increase in the median age between 1980 and 2000 as similar waves of gentrification and increases in middle-class residents continued to occur in places of New York such as the Lower East Side (Smith, 1996; Zukin & Kosta, 2004), Clinton (Hackworth & Smith, 2001), and Harlem (Freeman, 2006; Hackworth, 2002; Taylor, 2002).

The increased proportion of middle-class residents in cities was also associated with increased homeownership. While the majority of occupied housing in cities continued to be renter-occupied during the second half of the twentieth century, analysis by Birch (2005) showed that that homeownership rates in downtown areas of 44 cities

increased by 141 percent between 1970 and 2000. Many cities also experienced substantial changes to their racial composition during the second half of the twentieth century. The suburbanization movement was often discussed in reference to white flight from central cities to suburban areas, resulting in a substantially increased proportion of racial and ethnic minorities in cities. According to Beauregard (2003), the white population in all of the central cities in the U.S decreased dramatically between 1960 and 1968 while minority populations swelled. Beginning in the early 1970s, however, the racial and ethnic composition of cities began to change as many cities experienced gains in the proportion of white, Hispanic, and Asian residents. The increased representation of each of these groups was important for gentrification, but in slightly different ways.

The connection between the increased representation of white residents and gentrification has been well established in the research with most treatments of gentrification discussing the process as one that results in an increased proportion of white residents in non-white, particularly black, neighborhoods (Atkinson, 2003; Lee et al., 1985; Lees, 2003; Wyly & Hammel, 1999). The increased representation of whites was important in and of itself, but also important because of the potential conflicts it created, an important theme in the gentrification literature over the past 50 years.

Interviews of Harlem residents conducted by Maurrasse (2006) and Freeman (2006) reported that incumbent black residents reported fears that the neighborhood was being whitened, which generally referred to changes in the local culture from traditional black culture to more mainstream, middle-class culture. In essence, the interviewees were not opposed to the greater representation of whites in their neighborhoods so much as they were opposed to changes to the character of the neighborhood. Research by

Anderson (1990) in the Germantown neighborhood in Philadelphia and by Boyd (2005; 2008) in the Douglas/ Grand Boulevard area on Chicago's South Side discussed similar tensions between white and black residents due to fear of changes to the traditional character of neighborhoods.

While the majority of gentrification research has focused on the impact of changes in the proportion of white residents as an indicator of gentrification, the increased proportions of non-white groups such as Hispanic and Asian residents in many cities also had important implications for gentrification as these groups tend to be highly correlated with immigration. Census statistics reported by Been et al. (2012) showed that the percent of Hispanics and Asians increased during the 1990s and 2000s in Chicago, New York City, and Philadelphia. Gentrification was also being documented in all three cities during this time, begging the question of whether gentrification in these cities was being driven by members of these groups. Due to limited research on the association of immigration and gentrification, this question cannot be definitively answered. According to Ley and Dobson (2008), however, gentrification initially affected areas of cities populated by native-born residents rather than immigrants. Therefore, it is likely that the spread of gentrification and increased presence of immigrants in these cities were likely occurring in different parts of the respective cities.

In contrast to the production explanation, which emphasizes factors related to the production of housing that affect where gentrification occurs, proponents of the consumption explanation are more interested in the characteristics of gentrifiers as a group and their attraction to the use values of housing being gentrified. The basic argument of the consumption explanation is that gentrification was a consequence of the

shift in urban economies from manufacturing-based to service-based during the 1960's and 1970s, which resulted in the replacement of low-skill manufacturing jobs with high skill service-oriented jobs (Hamnett, 1991; Ley, 1996). This increased availability of service-oriented jobs discouraged lower-class and working-class residents from living in cities, but encouraged population growth among middle class individuals due to the perception of increased use value of city living as city living allowed these individuals to live closer to their jobs. Gentrification scholars have noted that the increased proportion of middle-class residents in cities was also associated with factors associated with decreased concentrated disadvantage in cities such as the increased representation of nonfamily households, college-educated residents, individuals in the age range of 25 to 50, homeowners, and white residents. The importance of the greater proportion of individuals with these characteristics in cities in encouraging gentrification and associated reductions in neighborhood disadvantage is discussed below.

Much of the increase in non-family households in cities has been the result of a greater proportion of young people delaying marriage and instead choosing to live alone or with unrelated individuals (Cherlin, 2010; Teachman, Tedrow, & Crowder, 2000). While this trend has been important for Americans in general, this trend has been especially important for cities. Boustan and Shertzer (2013) analyzed trends in population for cities and suburbs between 1950 and 2000 and found that married individuals were 11.4 percent more likely to live in suburban areas. Analyzing census data for 45 downtown areas located within 44 large U.S. cities, two of which were situated in New York City, Birch (2005) found that the percent of non-family households increased from 62 percent in 1970 to 71 percent in 2000. Drawing upon data from the 1990 and 2000

Censuses for New York City, Bahchieva et al. (2008) reported that the percent of non-family households increased by 10.2 percent and that the percent of non-family households increased in all five boroughs during this period. The increase in non-family households was an important predictor of gentrification research and has consistently shown that gentrifiers tend to be single or married couples without children (Carpenter and Lees, 1995; Laska et al., 1982; Lee, Spain & Umberson, 1985). Individuals in these types of living situations have more time and money to invest in home renovations.

In addition to an increase in the proportion of non-family households, the greater availability of service-oriented jobs attracted a greater proportion of college-educated individuals, which was frequently associated with gentrification, as many of the new jobs located in cities required a college degree (Freeman, 2005; Ley, 1996; Zukin, 2010). Research has shown that educational attainment was a predictor of gentrification for two reasons. One reason was that educational attainment is positively associated with income, which means that the greater educational attainment of gentrifiers should provide them with great amounts of disposable income to spend on home improvement. Another reason was that educated, specifically college-educated, people tend to be attracted to central city neighborhoods because they are located near cultural amenities, which they valued (Kennedy & Leonard, 2001; Laska et al., 1982).

Drawing upon a combination of the production and consumption explanations, gentrification scholars also recognize spillover effects of gentrification. In other words, neighborhoods may gentrify because they are located near neighborhoods that previously gentrified or are simultaneously experiencing gentrification. Further, the investments made in gentrifying neighborhoods make the surrounding neighborhoods more attractive

to gentrification as neighborhood investments often result in spillover investments in neighboring areas (Bailey, 1997; Ellen et al., 2001; Wyly & Hammel, 1999). Neighborhoods located near gentrified or gentrifying neighborhoods tend to be attractive to people who cannot afford to live in a gentrified or gentrifying neighborhood, but who want to have access to the amenities that such a neighborhood provides (Bridge, 2006; Ley & Dobson, 2008). While gentrification scholars often discussed the impact of changes in neighboring areas, no study could be located that explicitly tested this assertion. Given the findings of research on other urban phenomenon, this dissertation will incorporate a spatial spillover variable in order to account for the influence of changes in neighboring areas on whether a neighborhood experienced gentrification.

2.5 Covariates of Gentrification

During the late 1970s-1990s, the seminal debate between Ley and Smith helped revolutionize the determinants of gentrification. The application of decennial census data with empirical studies have allowed a deeper understanding of the magnitude of gentrification's impact in certain cities (DeFillips, 1999). Due to the research focusing on Canadian cities, Ley (1993) identifies certain gentrification predictors include: dwelling value, mean monthly rent, size of household, median household income, distance to city center, while collar jobs, parks, and waterfronts. To identify neighborhoods that have gentrified, scholars point to a changing population that consists of residents employed in professional, technical, and managerial occupations (Lipton, 1977; Maher, 1978; Clay, 1979; Fale, 1979; Hamnett & Williams, 1980; Ley, 1986).

On the one hand, research argues that the process of gentrification unfolds in localized areas and is not a widespread process that affects the entire city (Bourne, 1993).

To advance this point, Schuler et al. (1992) argue that only a compact neighborhood in Cleveland, consisting of 7 blocks, has been impacted by gentrification. On the other hand, research suggests that the opposite is also true (Meligrana & Skabuskis, 2005). In fact, research has demonstrated that gentrification afflicts widespread areas of cities and can reshape the inner cities so that only "islands of decay in seas of renewal" (Wyly & Hammel, 1999, p. 718) remain.

Recent indicators of gentrification appear to be substantially different from a changing middle class. Couture and Handbury (2015) argue that "downtown areas experiencing urban revival are small in size, but the aggregate effects are large" (p. 1). Additionally, the authors identified that neighborhoods closest to the city center were the ones that felt the most impact from gentrification from 2000-2010. Jackelyn Hwang and Jeffrey Lin draw similar conclusions: "[D]uring recent decades, an increase in SES near city centers has occurred along with an expansion of this pattern to more neighborhoods and more cities than before" (Hwang & Lin, 2016, p. 14). In this way, the current waves of gentrification are impacting an increasing number of cities and more neighborhoods withing those cities (Freeman, 2016). What is surprising is that research suggests the newest gentrification waves has less impact on renovating older homes (Taylor, 2016). While more research is needed, the argument is that many older homes in urban areas have already been transformed. Therefore, there is no real ability to get a good return on one's investment.

Helms (2003, 2012), Weber et al, (2006), Dye and McMillen (2007), and Charles (2013) all use regression analysis to identify characteristics associated with why certain homes in neighborhoods redevelop while others do not. In Helms' (2003) research, the

houses that are most likely to redevelop tend to be older, next to the central business district, near transit stations, and are low-density. Specifically looking at teardown redevelopment, Dye and McMillen (2007) and Weber et al. (2006) found that the housing structures are the most important characteristics. The authors do not place specific emphasis on the socio-economic and demographic characteristics of the neighborhoods in which teardown redevelopment occurs.

A reduction of property has also played a more important role in recent gentrification waves. As Ellen, Horn, and Reed (2016) point out, criminal activity inside neighborhoods is an indicator that deters reinvestment. Yet, for those urban areas that are focusing on declining crime rate, there is an increased chance that "high-income, college-educated, and white households choosing to move into both central city low-income and central city high-income neighborhoods" and, in select cities, "households are especially likely to move into the central city neighborhoods where crime is lowest" (Ellen, Horn, & Reed, 2016). Thus, the relationship between increasing crime and gentrification has been linked to many urban areas growing since 2010.

In their description of neighborhood change warning signs, Zuk et al. (2015) mention proximity to high quality schools, highways, as well as access to public transportation as an amenity that increases home values. The authors state that these investments are vital to many neighborhoods, however, if left unchecked, they can trigger a change that pushes out long-term residents and changes the essential character of the neighborhood (Anguelovski, 2016; Fullilove, 2004).

Recent environmental gentrification studies have identified that the proximity to parks is critical in determining whether size of location impact gentrification. In a recent

study of Barcelona (Anguelovski et al., 2018b), the authors identify that new green space only fostered gentrification if it was close to the downtown area or near historic housing stock. Additionally, Gould and Lewis (2017) researched parks in New York City and found that the largest parts (80 acres) and parks located next to commercial areas with desirable housing trigger gentrification in this place. Interestingly, the smallest part in the dataset did not increase the chance of gentrification. However, this part was located furthest from the city and was surrounded by an industrial center. While the evidence is still mixed, Rigolon and Nemeth (2019b) point out that not all parks stimulate gentrification in the surrounding neighborhoods. Additionally, previous greenway research also suggests that property owners should experience a small increase in wealth effect as a result of proximity to greenways, however, these effects would be too small to adversely affect vulnerable household (Campbell & Munroe, 2007). Thus, based on the literature, Table 2 displays gentrification indicators that researchers have identified before and after 2000. The more recent scope of gentrification indicators stresses the evolution of the term and ways that the process has been attempted to be measured.

Table 2. Gentrification indicators

Pre 2000 Gentrification Indicators	Post 2000 Gentrification Indicators
• Older housing stock • Mean monthly rent • Dwelling value • Median household income • Size of households • Distance to central business district • College education • Professional, technical, & managerial occupations • Spatial spillover	• Bike paths • Greenways • Proximity to quality schools • Proximity to highways • Proximity to transit • Decrease in crime • Parks size • Access to parks and waterfronts

2.6 Southern U.S. Cities and Gentrification

As gentrification continues to sweep across America (Hyra et al., 2018), part of this scholarship indicates that the gentrification we associate with New York, San Francisco, and increasingly cities like Boston, Seattle, and Washington, D.C., requires additional research to advance our understanding of the concept (Ellen & Ding, 2016). As the pace, scale, and intensity of gentrification vary by region (Maciag, 2015; Lichter et al., 2012; Solari, 2012; Dwyer, 2010), an investigation into Southern cities is needed to push our understanding of societal change in this part of the U.S. (Nagel, 2018).

Southern cities, in particular, "take shape in ways not well captured by the standard models of urban culture and morphology generated on the Northern prototype" (Lloyd, 2012, p. 484). For instance, traditional neighborhood change describes historically dense cities like Chicago and New York, which does not capture the low-density nature Southern cities such as Atlanta or Charlotte demonstrate (McDonald, 2013). Compared to their Northern counterparts, Southern cities blur rural – urban boundaries (Garner, 2017) and have seen an influx of immigrants settling in mixed-income suburbs (Weeks, Weeks, & Weeks, 2007). To that end, urban ethnographers have formed different conceptual and methodological approaches when studying neighborhoods in Atlanta as compared to Chicago (Oakley, 2015). As Atlanta redevelops, gentrification concerns continue to identify how suburban neighborhoods (Markley & Sharma, 2016) and large-scale public investments, such as the Atlanta Beltline, impact residential landscapes of African American and Latino populations (Immergluck & Balan, 2017).

One of the few Southern gentrification studies undertaken outside of Atlanta is

Smith and Graves' (2005) review of how one neighborhood in Charlotte, NC underwent a strange case of gentrification during the 1970s. The research emphasized the importance of temporal and spatial context to understand the complexity and geographical specificity of gentrification at all levels of the urban hierarchy, especially when large corporate actors are involved in the development process. Smith and Graves' (2005) provided an in-depth study of the gentrification process in Charlotte, yet the analysis was limited to one neighborhood when Charlotte was still a relatively small city. Lloyd (2011) also contributes to the Southern gentrification literature by critically examining key themes in contemporary neighborhood restructuring in Nashville, TN. As Southern metropolitan areas continue to grow, a concern is that investments in urban cores may be used to reinforce policies that drive social exclusion through New Urbanist principles (Markley, 2018, Lloyd, 2011). However, many cities in the U.S. New South have yet to be investigated through the lens of gentrification.

2.7 Charlotte's Gentrification Concern

Within the New South, Charlotte has emerged as one of the fastest growing cities with a population between 500,000-1 million residents (Cohen et al., 2015). Concerns about gentrification in Charlotte are triggered by a number of converging and interrelated trends: population growth and demographic shifts coming out of the recession, urban revitalization, and rising housing costs. As Charlotte grows, the population continues to become more global and more diverse. In recent years, however, another shift has begun to occur as the city increasingly attracts a younger, more highly educated population. In 2016, 51% of Charlotte's in-movers were ages 18-34, compared to just 26% of incumbent residents, and 50% of in-movers had a bachelor's degree or higher, compared

to just 40% of incumbent residents (U.S. Census, 2016). Attending Charlotte's growth and economic recovery since the Great Recession, investment and development have increased significantly. From 2010 to January 2015, building permits were issued for over 16,000 new multi-family units and over 12,000 new single-family units. Over 1,600 demolition permits and more than 20,000 residential renovation permits were also issued during this time (Mecklenburg County, 2010-2015). This construction activity is increasingly concentrated in the city's urban core and inner-ring neighborhoods as opposed to the suburbs in the previous decades.

While housing costs in Charlotte have been regarded as affordable compared to national averages for urban areas (Payscale, 2020; Urban Institute, 2012), the recent growth and development have been accompanied by overall increases in rents and housing prices. Median gross rent, which remained relatively constant coming out of the 2007 recession, spiked in 2016 to $943, a 6% increase in real dollars since 2010 (U.S. Census, 2016) and is currently on par with U.S. median rent for a one-bedroom apartment at $969 (Josephson, 2019). Home sales prices are also on the rise. From 2010 to 2014, average home sales price per square foot increased approximately 5% annually (Mecklenburg County, 2015). The median home price for 2019 in Charlotte was around $226, 000, which is a 9.5% increase since 2018 (ACS, 2019). Recent forecasts for the Charlotte housing market suggest that home prices in the area will continue rising steadily. Over this same time period, median household income has remained stagnant, posting a real decline of about 1% between 2010-2016 (U.S. Census, 2016). However, at $66,399, the median household income for Charlotte was at a new high in 2019 (ACS, 2019).

Despite a national health emergency and economic downturn, the home values in Charlotte continue to rise. Although counterintuitive at first, many of the jobs associated with Charlotte's financial industry allow home buyers to work remotely. These workers are not as vulnerable to job losses compared to those in the hospitality or restaurant industry. Moreover, lower mortgage rates have motivated home buyers who were previously unsure of making a purchase to act. Finally, there is an imbalance between supply and demand with the Charlotte housing market. Currently, there are plenty of buyers but not enough homes to go around (Cornett, 2019).

Not all residents have benefited equally from this economic boom. The city is also marked by urban inequalities and segregation by race and income. An influential 2014 study ranked Charlotte 50th out of 50th US metropolitan areas in terms of upward mobility (Chetty, et al., 2014). Significant increases in rents and property values in many areas, coupled with stagnant wages for many workers, have driven the affordable housing unit shortage up to around 30,000. This cost-burden is disproportionately felt by the city's African American and Latino residents (UNC Charlotte Urban Institute, 2019). This has led to extensive discussions, policy initiatives and research in the past five years by local government, philanthropic agencies, and nonprofits to create greater opportunities and housing options for lower-income residents. Most notably, Charlotte-Mecklenburg's Opportunity Task Force explored the structural challenges facing the Charlotte community (Charlotte-Mecklenburg Opportunity Task Force, 2017), Charlotte's recently passed housing bond provided $50 million to the Charlotte Housing Trust Fund to improve affordable housing (Gillis, 2020), and Bank of America made a $1 billion

commitment to advance racial equity and invest in economic opportunities in its local communities (Girimonte, 2021).

As Charlotte continues to grow, the region has tried to maintain a balance between investing in the urban core and the rapidly suburbanizing landscape (Walters, 2010). According to Charlotte's Transit Vision (Charlotte Area Transit System, 2019), investing in light rail marks a juncture in the city's history that provides a sustainable alternative to the automobile. The plan aligns with several other initiatives by Charlotte that highlight the need for alternative transit growth strategies through bike lanes (Charlotte Department of Transportation, 2017) and greenways (Mecklenburg County Parks and Recreation, 2018). The opportunity comes to enhance the existing pattern of growth by promoting a higher density development where transportation infrastructure capacity is greatest, especially around rapid transit as seen in Figure 3. In addition to the transit plan, the Charlotte Regional Transportation Planning Organization (2012) provides supplemental goals for the light rail system. The regional plan supports the idea of creating a globally competitive environment to support the economic vitality of the area through promoting equitable options for low income and minority neighborhoods, as well as aging populations. With the light rail line consisting of 19.3 miles and 26 stations complete, planning for additional segments of the light rail is currently underway with a comprehensive system plan to grow along five transportation corridors (Charlotte Area Transit System, 2019). The justification is that light rail has helped invigorate businesses and residential areas. The city of Charlotte documents an increase of property values in the initial South End corridor from $233 million to 1.4 billion from 2001-2012. That

resulted in $16 million in annual new property tax revenue that increased investments for the community (Charlotte Area Transit System, 2020).

Figure 3. Optimist Park neighborhood with high density apartment complexes being built near light rail station. Images obtained from Google Street View from 2019.

Behind the infrastructure investments, Charlotte also has a history of racial segregation. A relatively small city in the early 1970s, Charlotte had a vibrant African American population distributed across its four central wards. However, with the city's business and political leadership fearing the flight of the city's white population and businesses, several waves of urban renewal strategies systematically pushed the African American population to the fringes of the urban core (Ingalls & Heard, 2010). The impact on the population living in the central region was a 75 percent decrease in the African American population from the 1960s-2000s (Ingalls & Heard, 2010).

With concerns over growing populations and shifting demographics coming out of the great recession of 2007-2009 recession, Charlotte City Council referred the issue of gentrification to the Housing & Neighborhood Development Committee (HNDC) for additional study in April 2014. During a June 2014 HNDC meeting, a presentation was given providing national best practices for further study and local application and provided information on existing local tools that can be used to address the issue. The discussion on gentrification started with a decision to use the following definition,

"…gentrification is a process by which higher income households displace lower income households of a neighborhood changing the essential character and flavor of that neighborhood" (Charlotte City Council Housing and Neighborhood Development Committee [CCCHNDC], 2014, June).

The city council also recognized that gentrification is not an easy concept to define and has changed over time. For instance, Council Member Austin stated that: "In our definition of gentrification, in the 1970's gentrification was more of one race taking over another race in that community. What I begin to see around Charlotte, is more income oriented. Even in Cherry you see more wealthy African Americans and Hispanics moving in. It is our evolution; more a division of the haves and have not" (CCCHNDC, 2014, June).

Aligning with historical research, the presence of gentrification in Charlotte is not new. In the 1970s, Charlotte's urban renewal plans targeted neighborhoods such as Elizabeth, Dilworth, Third, and Fourth Wards and pushed out residents in these neighborhoods as they changed (CCCHNDC, 2014, September 10). Development then started to shift in the 1980s to areas such as Plaza Midwood and Chantilly. However, in 2014, the Charlotte Council Members believe areas ripe for gentrification are located in Cherry, Belmont, McCrorey Heights, Washington Heights, and Wilmore (CCCHNDC, 2014). The reason these neighborhoods are prime for gentrification, as seen in Figure 4, is because these areas have:

- A high proportion of renters near the central city
- Transportation with easy access to jobs
- Increasing growth in the metropolitan area
- Low housing value, particularly houses with architectural merit

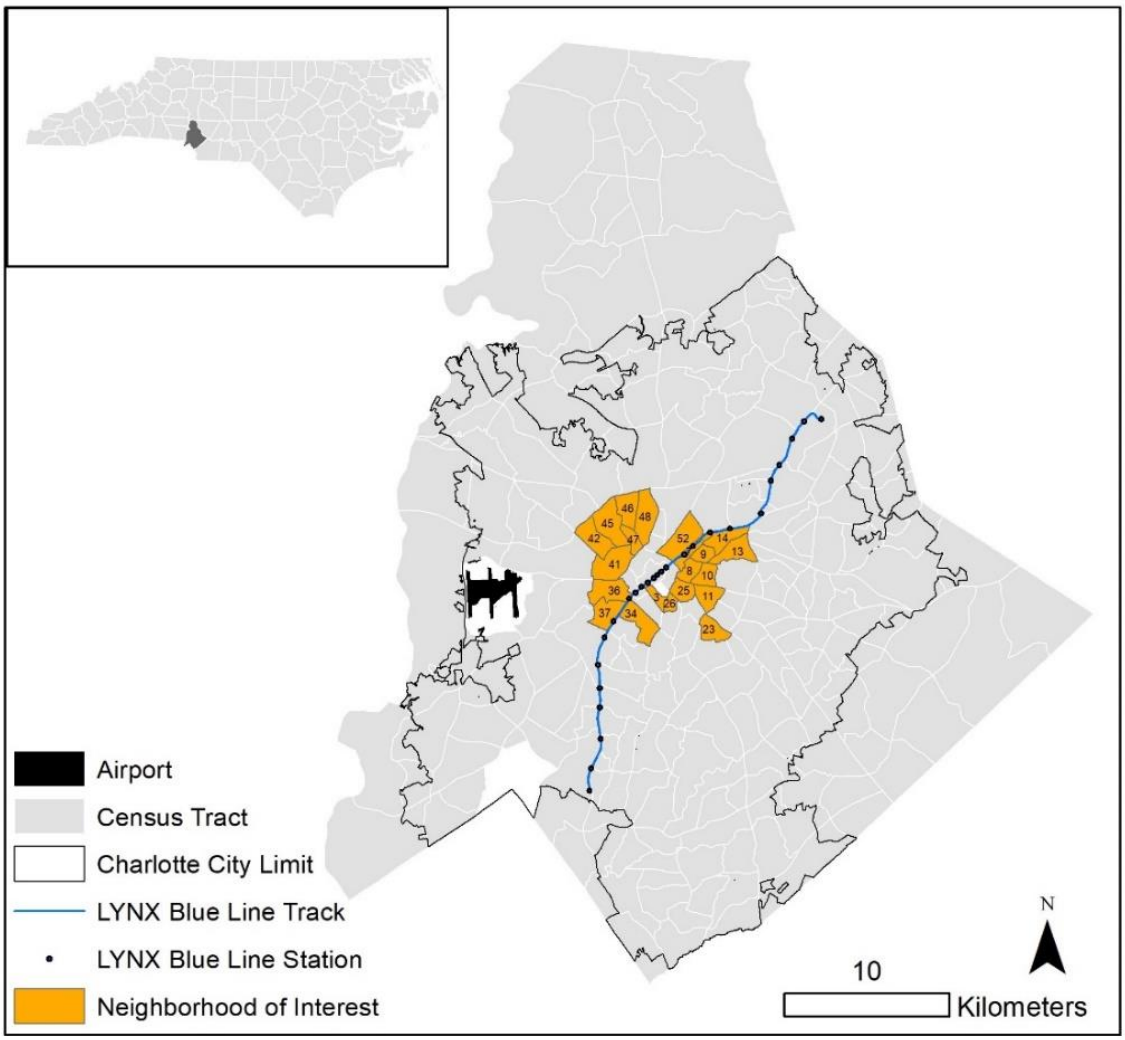


Figure 4. Charlotte neighborhoods of specific interest for gentrification (Census tract IDs provided in Table 3)

Table 3. Charlotte neighborhoods of interest

Neighborhood	Census Tract ID	Neighborhood	Census Tract ID
Midtown	3	Sedgefield	33
Optimist Park	7	Dilworth	34
Belmont	8	Wilmore	36
Villa Heights	9	Brookhill	37
Plaza Midwood	10	Wesley Heights	41
Chantilly	11	Enderly Park	42
Shamrock	13	Lakewood/Smallwood	45
NoDa	14	Washington Heights	46
Grier Heights	23	Biddleville	47
Elizabeth	25	McCrorey Heights	48
Cherry	26	Lockwood	52

While Charlotte Council Members recognize that gentrification is not all good or all bad, the main concern for the council is when residents are displaced without having an opportunity to stay. Council Member Mayfield provided the following account as a constant problem in the Charlotte area:

> The reality is that homes in a number of minority communities are overvalued by Mecklenburg County. I have a homeowner who according to tax records has a home valued at $60,000. They are trying to refinance to get work done and make an investment in their home. The appraisal comes back at $30,000. The home is over appraised, but our county tax process says you have 30 days to address your tax bill and not everyone has the $300 to have an independent appraisal. A good part of my community does not have the ability to spend money for an appraisal every year to make sure the County is doing their job. When we are looking at gentrification and looking at the value of the homes, we need to see what has happened to the value of homes in the last few years (CCCHNDC, 2014).

To address these concerns, Charlotte City Council has attempted two efforts to research gentrification.

In 2005, the City Council asked staff to monitor neighborhoods for a 30-month period that might be classified as gentrifiable. The research study ended in December 2007 with no report made available to the public (CCCHNDC, 2014, September 10). More recently, in April 2014, Charlotte City Council referred the issue of gentrification to the HNDC requesting that staff consider strategies and actions to mitigate the negative impacts of gentrification. For this referral, gentrification was defined as a type of neighborhood change where higher-income households invest in a neighborhood,

potentially displacing lower-income households and changing the composition and character of the neighborhood. The HNDC engaged in Committee discussions about gentrification on June 11th, September 10th, September 24th, October 29th and November 12th of 2014 (CCCHNDC, 2014, June 11; CCCHNDC, 2014, September 10; CCCHNDC, 2014, September 24; CCCHNDC, 2014, October 29; CCCHNDC, 2014, November 12). Staff presented information on the following proposed practices to mitigate potential negative impacts of gentrification:

- Build more affordable housing
- Link development to affordability commitments
- Stabilize housing for existing renters
- Utilize city-owned land for infill development and incentivize affordable housing development with land contributions
- Develop tax abatement measures to assist homeowners
- Create community land trusts
- Enact below market rate ordinances
- Create limited equity housing cooperatives.

Tyler Mulligan from the School of Government at the University of North Carolina at Chapel Hill also presented to the HNDC about legal authority and policy options for local governments to address gentrification-related concerns in North Carolina. The Committee determined that the City is already engaged in the first four practices listed above, and asked Neighborhood & Business Services staff to explore the potential for two additional practices in Charlotte: tax abatement programs and community land trusts. One current example is the West Side Community Land Trust (2020) that aims to develop the neighborhood to benefit low-income residents during rapid reinvestment. Under its business model, the trust would buy land and build homes deemed affordable for families making less than 60% of area median income. As of 2019, the land trust has acquired 3 land parcels and successfully sold the first home to a family in need (Burkins, 2019).

In addition to the HNDC debating gentrification concerns, in 2012, the City of Charlotte was awarded a federal grant from the North Carolina State Historic Preservation Office (NCSHPO) to conduct an architectural survey of Charlotte. The findings of the report state that:

- Many of the center city's major buildings, among them Bank of American Stadium, Bank of America Corporate Center, and the Duke Energy Center, have arisen in the last twenty years.
- The light rail line that runs from downtown to the city's southern subdivisions opened in 2007 and has spurred adjacent, high-density, residential and commercial investment through the historic Dilworth neighborhood and other blocks farther south of downtown.
- Modern sprawling suburban-style growth and large retail malls at certain highway exits have replaced former farmland on all sides of the center city.

The NCSHPO documented that the center city and surrounding neighborhoods are experiencing both development pressure and historic preservation efforts. According to the NCSHPO report, all the existing National Register and local historic districts are facing the challenges of gentrification. Also, historically important neighborhoods without historic designations, such as Lockwood along North Graham Street, and the Black communities of Cherry, Washington Heights, and Biddleville, are threatened by demolitions and new construction (Charlotte Historic District Commission, 2014).

2.8 From Literature to Dissertation Research Innovation

As Charlotte continues to experience gentrification, my dissertation research seizes this as an opportunity to provide local governments with an approach to understand how different administrative data types can be used to address the process of identifying gentrified areas. The goals of my dissertation align with those of many other empirical case studies of gentrification that are evidence-based and data intensive. This study seeks to: (1) identify those variables most useful in identifying a gentrified area, (2)

document varying levels or degrees of gentrification within a study area, and (3) pinpoint the key co-variate differences between gentrified and non-gentrified areas. At the same time, my dissertation attempts to meet these goals diverging in two important ways. On the one hand, my dissertation compares two approaches that address how gentrification patterns may vary based on the different outcomes that arise based on the scale at which the process of gentrification unfolds in Southern cities. On the other, it addresses the different outcomes that arise based on the spatial granularity being used to measure gentrification.

Although simply identifying a transition in the housing stock or class composition of a neighborhood is no longer novel, linking that change to the wider economic restructuring that is fueling such processes in U.S. New South cities is. As U.S. New South cities continue to redevelop, the low-density nature of these cities supports the new-built gentrification definition due to redevelopment in inner-ring suburbs not being solely dependent on capital disinvestment in the suburban areas. It also follows Hackworth's (2002) line of thought that redevelopment is occurring within a climate of rising property values. Thus, the process of reinvestment and redevelopment in inner-ring suburban neighborhoods in the U.S. New South appears to be fundamentally different from that occurring in more traditional central city neighborhoods found in northern cities.

In order to captures these changes, a new methodological framework is needed to capture gentrified areas annually based on data-driven analytics. Hence, an essential component of this research creates a process that allows a nuanced detection of gentrified areas. Although researchers have used building permits to identify the likelihood of

renovations within gentrification research (Helms 2003, 2012), no previous study identifies what type of residential building permit reinvestments are consistent with identifying gentrified areas. To that end, this research is aimed at filling this gap in the literature.

CHAPTER III: THEORETICAL FRAMEWORK

This chapter consists of two sections that connect the theoretical framework driving the research questions discussed in the dissertation. First, I provide an analysis of the relevant theoretical framework, whereas the second section revisits how the framework motivates the questions driving my research. Overall, the chapter's goal examines what aspects of the neighborhood change and gentrification literature are applicable to this research.

3.1 Theoretical Overview

In the U.S., major socio-economic forces created cities where the urban poor tend to live near the center of the city in older small homes. On the other hand, wealthier residents tend to occupy newer structures outside of the city. When these patterns are analyzed, two variables are identified as major contributors. First is the distance to the center city. The second is the age of the housing. However, the overall changes of neighborhoods are connected to larger housing markets that create a complex environment.

Gentrification is a function of both supply side and demand side factors that shape urban landscapes. The supply side argument states that preference for consumers has changed from wanting larger, homes in the suburbs to more historic structures found near urban amenities. Yet, the demand side argument states that it is the chance in a structures value on highly sought-after land that drives producers to seek a profit through reinvestment or renewal. Spatial proximity is important in the gentrification process as the spatial spillover effect impacts areas adjacent to higher income neighborhoods.

Although the concept of gentrification has evolved over the years, stressing the diverse actors involved in the neighborhood change process, researchers have not been provided appropriate tools to formalize the impacts these actors have on the urban environment. Concerns over gentrification have also triggered a growing body of literature that points to several key challenges that can arise with the urban sustainability movements that create amenities in a neighborhood that may inadvertently cause gentrification. As Figure 5 shows, a convergence around concept, scale, and location forms a gap in the gentrification literature, which makes this research both relevant and timely.

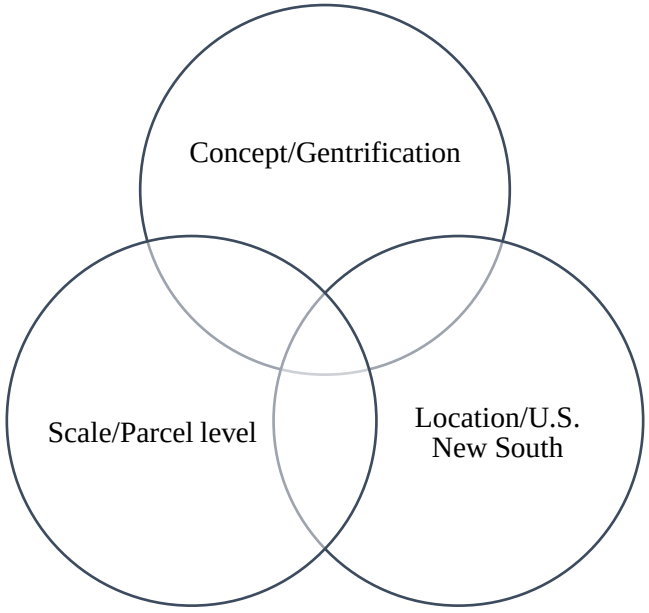


Figure 5. Dissertation's theoretical argument

In today's gentrification literature, there exists a distinct bias towards researching major urban areas. Gentrification has also analyzed the neighborhood change process at a geographic unit that is a very coarse representation of a neighborhood, which may wash away important details of how contemporary gentrification spreads with and between neighborhoods. Moreover, if we are to see the impact of urban amenities on

neighborhoods, combining administrative data at the parcel level provides a much more detailed approach to identifying urban characteristics that might be used as factors highlighting contemporary gentrification. On a more refined scale, urban analysts will be able to identify the spatial-temporal patterns of gentrification spreading in a particular neighborhood. Analyses such as these are needed for gentrification's heterogeneous nature can be recognized, especially in the U.S. New South where there have been relatively few fine-scale empirical studies examining gentrification and neighborhood change.

3.2 Research Questions

1. What is the current spatial distribution of gentrification in Charlotte?
   - This question is in line with current studies of gentrification that takes two time periods and identifies socio-demographic changes and housing redevelopment changes between 2010 to 2017. In this context, the research will identify where gentrification is located currently and examine the outcomes based on the scale where gentrification unfolds.
2. What has happened to the spatial distribution of gentrification over time in Charlotte?
   - This question advances our ability to identify and track gentrification annually from 2002-2017. In this context, the research will identify where and how gentrification has spread and examine the outcome based on the scale where gentrification unfolds overtime.
3. How does spatial scale impact results of gentrification analysis?
   - This question involves examining different outcomes that arise based on the

granularity at which gentrification is measured. By doing so, this research will identify what spatial scale provides a more meaningful indicator of gentrification in growing Southern cities.

4. What factors drive the spatial distribution of gentrification in Charlotte?
   - The focus of this research question addresses changes in housing tenure, access to employment, urban amenities, and proximity to light rail development using a survival model to identify the time a property is gentrified.

I hypothesize that identifying gentrified areas through a process that includes real estate reinvestment at the parcel level allows researchers the ability to (1) detect a more precise measurement of gentrified areas across Charlotte at an intra-urban scale, (2) confirm housing characteristics and urban amenities that are associated with the spread of gentrification, (3) explore how the low-density nature of southern cities allows gentrification spread in different manners instead of following the traditional gentrification spatial diffusion processes.

Together these four research questions offer insights into the spatial and temporal dimensions of contemporary gentrification in Charlotte. Given the lack of research on medium-size U.S. cities and growing urban areas in the New South, there is a need to fill this void with studies on gentrification in this context. The four research questions increase our awareness of the spatial/temporal changes of gentrification at smaller spatial resolutions. These empirical analyses will collectively depict a relatively complete picture of the contemporary gentrification process occurring in Charlotte.

CHAPTER IV: RESEARCH DESIGN

This chapter serves as the foundation for the relationship between research objectives and the methods proposed to answer the research questions. The chapter consists of four sections: study area, data types, constructing the residential building permit dataset, and methods.

4.1 Study Area

The Sun Belt is a region that stretches across the Southeast and Southwest portion of the U.S. Aside from the warm climate, this region has seen a surge in population growth since the 1960s, attributed to both international and internal migration patterns (Glaser & Tobio, 2008). Instead of following the traditional dense U.S. city development such as New York, Pittsburgh, or Boston, cities in the U.S. Sun Belt follow a more auto-centric pattern that enabled the current suburban spatial pattern. Even though internal migration patterns to the Sun Belt region slowed during the 2007-2009 recession, a recent Brookings report documents that the migration pattern has resumed (Frey, 2016).

A group of Sunbelt cities known as “New South”, depicted in Figure 6, are characterized by rapid demographic and economic changes that have unfolded over the past 20-25 years. Cities such as Charlotte, Nashville, Orlando, Tampa, and Jacksonville feature a relatively large share of neighborhoods that have transitioned from single family towards multifamily, highly educated group, which reflects the changing trend in residential construction and national demographic shifts (Delmelle, 2017). Within the New South, Charlotte has emerged as one of the fastest growing cities with a population between 500,000-1 million residents (Cohen et al., 2015). Without growth management

strategies or natural barriers to halt the spatial expansion of development, Charlotte's development patterns are often linked with those of other geographically similar metropolitan areas such as Atlanta or Orlando. Charlotte is also supported by one of the largest banking concentrations in the country (Smith & Graves, 2005).

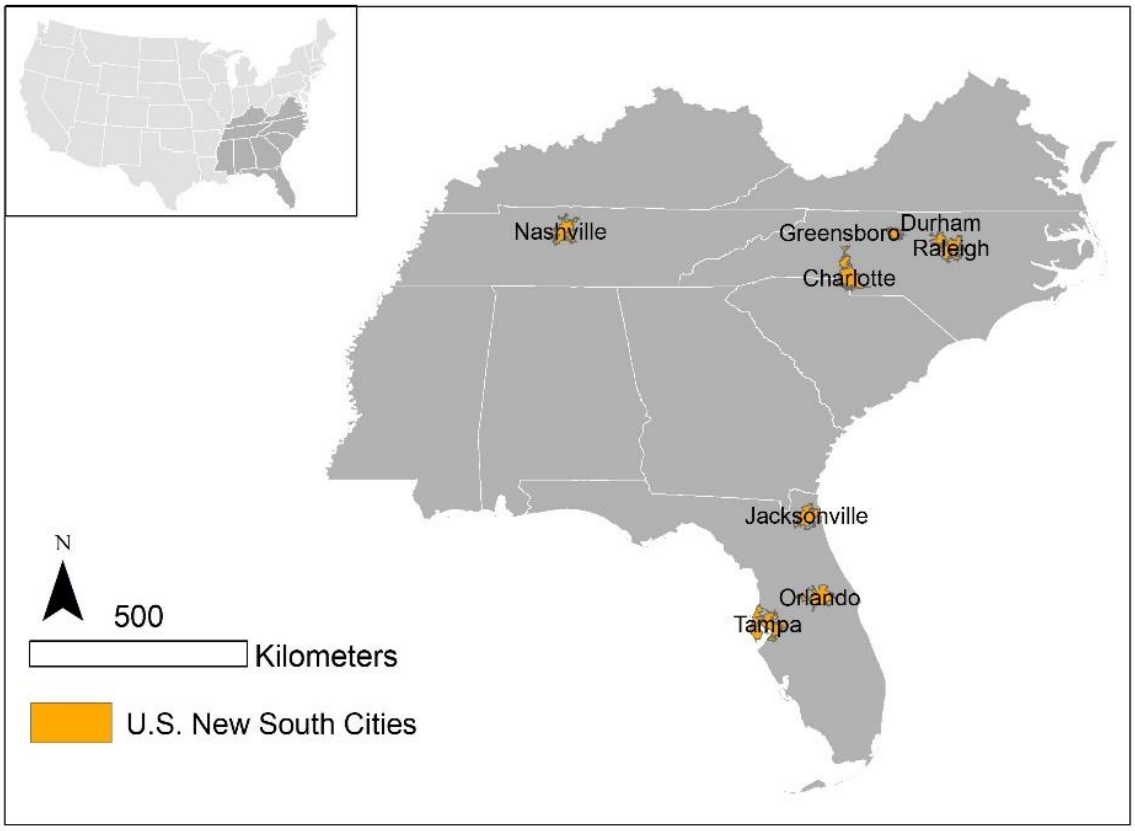


Figure 6. Spatial Distribution of U.S. New South Cities

However, the changes occurring in New South cities are not new. With Bank of America and other financial institutions, Charlotte has been groomed to attract skilled workers to transform the city into one of the most influential financial centers on the east coast since the 1980s (Graves & Kozar, 2010). With a drive to promote growth, the Charlotte Chamber of Commerce has consistently focused on Charlotte being a center for businesses and families choosing to move into the Sunbelt. The Chamber also boasts that "this vibrant Sunbelt city" had a new identity as a banking capital of national influence

and international reach (Lassiter, 2006). Investing in the economic growth in the financial sector, Charlotte has seen a dramatic increase in its population according to the US Census estimates. Between 2000 and 2016, the city increased by 56 percent from 540,828 to 842,051 (Census, 2016).

Charlotte's rapid population growth during the past two decades and the heightened dynamism of real estate activities were the main reasons it was chosen for the analysis. The time period of the study, 2002-2017, was selected due to the surge in class turnover and reinvestment activity. Thus, results from the analysis have the potential to be generalized to reinvestments and neighborhood change processes common to other Southern cities.

Although the spatial unit being analyzed is the parcel, the unit of analysis is the property record in Charlotte. The property records sampled in the research will be limited to parcels within Charlotte's city limits since gentrification is currently a process that occurs in areas closer to the center of urban areas. With gentrification primarily being an urban phenomenon, this excludes parcels residing outside the city limit.

To this end, I compare two methods for identifying gentrified neighborhoods to determine which provides a more precise measure of gentrified areas in New South cities. The first measure captures gentrified neighborhoods through class turnover and employs U.S. decennial censuses and ACS data. The second measure identifies gentrified properties through housing stock reinvestment and uses residential tax assessment and building permit data within three miles of the geographic center of Charlotte. I use the land parcel ID as the key to join the administrative datasets. The goal is to understand

which indicator provides a more meaningful and discriminating way to identify gentrified areas for growing New South cities.

4.2 Data types

The first dataset used in the analysis consists of residential building permits retrieved from the Charlotte-Mecklenburg Integrated Data Store (IDS). The IDS is a local public entity that encompasses databases from various administrative systems across Mecklenburg County, which are stored and accessed from one location. Currently, the IDS stores data from the Mecklenburg County Register of Deeds and Property Assessment and Land Records Management of the Land Use and Environmental Services Agency (CharMeck Integrated Data Store, 2017). I downloaded all residential building permits from 2002 to 2017 inside the study area. The variables obtained in this dataset include project descriptions, estimated value of the work, name and address of the petitioner, housing characteristics, demolition activity, and land use types. The residential building permit data from 2002 to 2017 were downloaded as comma-separated values (CSV), cleaned using Microsoft Excel, geocoded in a GIS, and joined with the tax parcel dataset using the parcel ID as the join key.

The first step in generating the residential building permit dataset is to parse out which building permits are candidates for gentrification. As a general rule, building permits for residences are necessary for anything constructed, installed, repaired, replaced or altered with a cost greater than $15,000 (Code Enforcement, 2020). To ensure only residential building permits are included in the dataset, the initial coding scheme utilized the USDCcodeNU attribute found in each building permit. USDCcodeNU refers to the U.S. Department of Commerce (USDC) code that creates broad classifications for

building permits. Table 4 lists all potential USDC codes that can be used to classify any building permit issued during a calendar year in the study area. To be considered in the final dataset, a residential building permit must have one of the following USDC codes: 101 - 105, 114, 115, 434, 645, 647, or 648. These codes represent reinvestments or demolitions in residential properties. Alternatively, USDC codes classified as 112, 213, 214, 318 – 329, 437, 438, 540, and 649 were removed from the dataset since they do not represent reinvestment or demolitions in residential properties consistent with gentrification.

Classification	Code	Explanation-Example
New Residential	101	Single-family houses, detached
	102	Single-family houses, attached
	103	Two-family buildings
	104	Three-and four-family buildings
	105	Five-or-more family buildings
	112	Mobile Home
	114	Three-and-four family condos (no land for sale with unit)
	115	Five-or-more family condos (No land for sale with unit)
New Residential	213	Hotels, motels, and tourist cabins
	214	Rooming, Boarding, Fraternity, Sorority
New Nonresidential Buildings	318	Amusement, Social, Recreational
	319	Churches and other religious buildings
	320	Industrial, Factories, Manufacturing, and Printing Plants
	321	Parking Garages
	322	Services Stations and Repair Garages
	323	Hospitals, Clinics, Rest and Convalescent Homes, Clinics
	324	Offices, Banks, Medical Offices
	325	Public Works, Utilities, Sewage Disposal, Water Supply
	326	Schools, Libraries, Universities, Museums
	327	Stores, Restaurants Malls, Markets, Beauty Shops
	328	Other Nonresidential - Sheds, Barns, Post Offices,

		Jails
	329	Parks, Outdoor Stadiums, Marinas
Additions, Alterations, and Conversions	434	Residential
	437	Nonresidential
	438	Additions of residential garages and carports
	540	non-residential/Non-housekeeping to housekeeping
Demolitions of Buildings	645	Residential demolition
	647	Residential demolition
	648	Residential demolition
	649	All other buildings and structures demolition

Table 4. Building permit classification codes based on U.S. Department of Commerce

While cleaning the data, residential building permits for the study area were discarded if they were issued for repairs that could not be identified or in the record of the renovation cost was not listed. For any instance where multiple permits had been allotted for a parcel during the same calendar year, the estimated construction costs were summed. However, if multiple residential building permits were allocated to a parcel with condominiums, I summed the construction costs and divided by total number of condominium units to return an average construction cost for that parcel. Finally, if a residential building permit was issued for a parcel listed as mixed-use – derived by a Python script to generate information for determining land-use codes for parcels with buildings of multiple types – the land-use type was defined for each parcel based on the building type and heated area. If it could be determined that the permit was allocated for a residential portion through manual inspection, it was included in the dataset. Otherwise it was discarded. With the initial coding scheme established, 208,416 residential building permits were issued for the study area between January 1, 2002 and December 31, 2017.

The second dataset used in this study comes from Mecklenburg County's GIS Data Portal. The county's data center combines databases from various administrative

systems that are stored and accessing from one single URL. Known as Open Mapping, the purpose of the open source public data portal is to enhance government transparency and encourage public participation and collaboration (Geospatial Information Services, 2017). From the data repository, I downloaded official tax assessment shapefiles from 2002 to 2017. The shapefiles are created using a computer assisted mass appraisal (CAMA) system. For the purpose of this research, only records listed as residential will be used. The data retrieved from the files consist of home sales, assessed home value, house ownership, housing square footage, and year built for each parcel in Charlotte.

One of the challenges of working with the CAMA file is the merging and dividing of parcels. Figure 7 illustrates this process by identifying two large parcels located in the Cherry Hill neighborhood. It shows that the two large parcels in 2014, the image on the left, were divided into 23 smaller parcels in 2015, the image on the right. In situations like this, the residential building permit issued in 2015 would be assigned to the newly subdivided parcel. Any information needed from the previous year would be gathered from the original parent parcel. The opposite would occur if the parcels were merged instead of divided. These issues were addressed and dealt with manually on a 1 by 1 basis as they occurred in each neighborhood. This laborious process minimized the risk of errors.

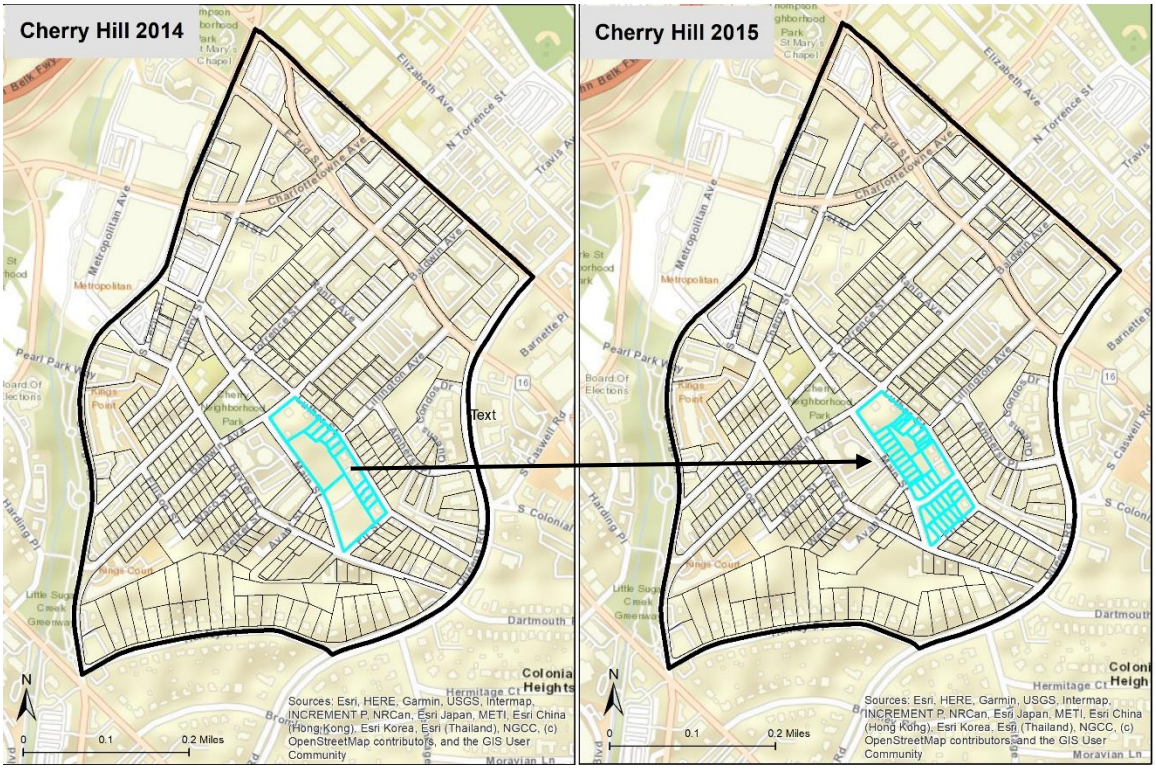


Figure 7. Splitting of parcels in the Cherry Hill neighborhood from 2014 to 2015

The third dataset in the analysis consists of census and ACS data. I obtained census tracts from the SimplyAnalytics data platform, which normalizes census tract variables though time to the 2010 boundary files. I also downloaded decennial U.S census data for the year 2000, ACS data for the year 2010 (5-year version), and ACS for the year 2016 (5-year version) from SimplyAnalytics. Variables included in these datasets are average rents, household income, occupational status, and educational attainment. Although there is concern that ACS data have high margin of error rates, the goal of the census tract level data is to identify broad neighborhood change trends from 2000-2016. In this regard, the data from the ACS provide acceptable margin of error rates to conduct analysis for these trends.

The fourth dataset consists of Google Street View (GSV) images that identify the temporal change of built structures. GSV images were used as a validation process to test

whether the gentrification index (GI) being created identifies properties being gentrified. To obtain the data, a GSV application programming interface (API) provides the ability to download individual street view images. The process to obtain the GSV image involves defining a set of Uniform Resource Locator parameters sent through a standard Hypertext Transfer Protocol request. The standard API usage allows the user to obtain 25,000 images every 24 hours. However, this API only allows the most updated house image to be gathered. Therefore, I manually gathered a set of longitudinal images from 2006 to 2017 for a random sample of 600 residential building permits (roughly 10 percent of the final dataset). The GSV images were downloaded and stored with the parcel ID used as a key to match the image to the parcel.

An essential component of this research is the construction of the final dataset used in the analysis. The dataset consists of residential building permits from the Charlotte-Mecklenburg IDS from 2002-2017. Appendix A explains the steps taken to (a) identify the keywords in residential building permits that identify gentrification (b) indicate a threshold where a physical transformation in a dwelling-unit would signal reinvestment high enough to trigger gentrification and (c) validate the dataset to ensure the residential building permits were acted upon. The goal of the residential building permit dataset is to identify which permits increase the footprint of the physical structure of a dwelling unit or signals reinvestment in a neighborhood consistent with gentrification.

To briefly summarize the process for identifying keywords from residential building permits (Appendix A), I used the *Project Description* attribute found on each building permit to understand what type of renovation occurred. Moreover, instead of

analyzing all building permits across the study area at one time, one neighborhood (Cherry Hill) was used to identify what types of residential building permits best highlighted the process of gentrification in 2016. In this way, residential building permits would be eliminated if the reinvestment was not consistent with gentrification.

While creating the dataset, many challenges arose when deciding whether a reinvestment subtly improved on the existing dwelling unit or drastically repaired an old house into a new one. To understand the difference, I reached out to multiple residential general contractors and the City of Charlotte's Land Development Office to decipher what the project descriptions meant. Although the total number of residential building permits were successfully reduced through this process, the keyword "renovation" continued to highlight homes that did not show any visible sign of reinvestment when searched using GSV. The problem was that for many residential building permits, the amount reinvested was not enough to indicate a residence would undergo a physical transformation or signal a new class of people moving into the area. Out of this observation, I created a rule. A residential building permit would be eliminated if the total reinvestment was not at least 20% of the current year's assessed home value. This rule only applies to reinvestments if it is not a new built.

The goal of the threshold rule is to eliminate properties that do not have enough reinvestment to signal gentrification. For instance, if the assessed value of a dwelling unit on a parcel was $100,000, then the residential building permit issued for that dwelling unit must be at least $20,000 to remain in the dataset. Although thresholds of 5% and 15% were experimented with, these lower thresholds allowed for too many residential building permits that had a value of $5,000 - $15,000 to remain in the dataset. Moreover,

leaving the threshold at these levels increased the chance of false positives because the likelihood of reinvestments at that amount triggering gentrification is very low. Conversely, when a threshold of 25% and 35% of the assessed home value was used, it eliminated residential building permits that were likely to signal reinvestment consistent with gentrification. In other words, the chance of false negatives increased the higher I set the threshold. Therefore, I settled on 20% as a discriminating characteristic of gentrification.

After successfully reducing residential building permits for Cherry Hill in 2016, the next step expanded my keyword elimination and threshold process to include all years in Cherry Hill for the study year's timeframe – 2002-2017. Although I made attempts to automate the process of sifting through the residential building permits, constant misspellings, abbreviations, and combinations of keywords made it difficult to create an algorithm to assist in the process. This left me with a choice of searching for an automation process to help with the data reduction or manually reviewing each permit. Weighing the costs and benefits of spending more time coming up with an automated process, I decided that since this was the first attempt at creating a residential building permit dataset identifying gentrification, manually reviewing each residential building permit would be the appropriate step to ensure future researchers can build off of this process.

To that end, from 2002-2017, a total of 208,416 residential building permits were issued for Charlotte within the 3-mile study area of the city. From that initial dataset, I manually inspected each residential building permit to identify if:

1. Permits contained keywords found in Table 5

2. Permits met a threshold where physical transformation in a dwelling unit would signal reinvestment high enough to trigger gentrification - this rule only applies to reinvestments if it is not a new built

As to not be overwhelmed by the amount of information at one time, I chose to review building permits based on 2010 census tracts. I also chose this approach so I could easily validate any questionable residential building permit descriptions using GSV.

Table 5. Residential building permit keywords associated with gentrification

New Modular Home	Residential Renovation	Demo
New Residential	Interior Renovation	Demolition
New Bedroom	Residential addition	Total Demolition
	Addition	

Following the steps laid out in Appendix A, I manually reduced the residential building permits from 208,416 to 7,161. To ground truth the validity of the residential building permit dataset, a random sample of 10% of residential building permits issued during the time frame revealed that 83% of the residential building permits were listed as complete during the study timeframe. The validation confirmed that residential building permits issued were acted upon. The importance of these results is that the keyword and threshold filtering process identified verifiable reinvestment activity. Although the process was labor intensive, the result constructed a dataset that acts as the foundation for identifying gentrified areas in growing New South cities consistent with the definition and processes of gentrification.

4.3 Methods

The following section describes the methods used in the analysis after the data were downloaded, processed, and verified. The first two questions elaborate on the steps taken to identify the spatial and temporal aspects of contemporary gentrification. The

third research question addresses which spatial scale provides a more useful method to analyze gentrification for public policy purposes. Finally, the fourth research question acts as a confirmatory analysis for the study area.

4.3.1. Methods for research question 1. To identify the current distribution of gentrification in Charlotte, I construct two indices that capture gentrification in different ways. The first uses an SSI to measure class turnover through socio-demographic data using census tracts from the years 2010-2016. The second uses a nuanced GI to capture reinvestment in residential properties using real estate administrative data at the tax parcel level in 2010-2017. The goal is to compare which indicator provides a more precise measure at identifying gentrified neighborhoods in growing New South cities.

4.3.1.1. Ley's SSI for 2010-2016. The first part of the analysis identifies the spatial distribution of gentrification in Charlotte from 2010-2016. Census tracts are used as proxies for neighborhoods and were obtained from Simply Analytics, which interpolated census tract variables through time to the 2010 boundary files. The corresponding dataset uses decennial census data for 2010 and ACS data for 2016. There are 233 census tracts in Mecklenburg County, where Charlotte resides. Since gentrification was traditionally restricted around the city center with older housing, a 3-mile radius, where over 30% of the housing stock dates back to 1970 or older, was applied to focus the research area. Datasets were combined in a spreadsheet and uploaded into a GIS for processing.

To operationalize gentrification, Ley (1986) proposed measuring household status change with a linear combination of occupation and education variables to create an SSI. The SSI continues to be in line with extensive studies that used the SSI as a reliable

gentrification indicator in North American inner-city neighborhoods (Moos, 2016; Sequin, Apparicio, & Riva, 2012; Skaburskis, 2012). However, due to Charlotte's large financial industry, incomes tend to be skewed, which suggests that an income variable be added to enhance the breadth of the index. Specifically, the SSI in this research is the average of (1) percentage of work force employed in professional, managerial, and administrative jobs, (2) percentage of the population with a university-level education, (3) log of median household income[1].

An SSI is generated for each census tract[2] inside the study area in 2010 and 2016. Each input variable is first standardized by subtracting the mean and dividing by the standard deviation before combining to form the SSI. Next, I calculate the SSI difference for each census tract between 2010 and 2016. SSI differences are rescaled using the min-max standardization so that the minimum is 0 and the maximum is 1. To validate the SSI, correlations at the census tract level were calculated with average rents. The correlation is statistically significant and highly correlated for 2010, $r = 0.569$, $p < 0.01$ and 2016, $r = 0.654$, $p < 0.01$.

Figure 8 illustrates how the SSI in 2010 and 2016 is spatially distributed across the study area. In these maps, light green colors indicate a low SSI value and dark green indicates a high value. A census tract with the highest percentage of work force employed in professional, managerial, and administrative jobs, highest percentage of the population with a university-level education, and highest median household income, would receive a 1. In general, census tracts with high SSI scores form a wedge to the south of the city

[1] The log of income is used because of skewness in this variable, where individuals who make large incomes shift to a level that is generally higher than the median.
[2] The SSI analysis was also conducted at the census block group and census blocks levels. However, only census tracts provided meaningful results, possibly due to the high margin of error rates of the ACS.

center. Census tracts with low SSI scores tend to be geographically distributed in a crescent shape on the north side of the city center. According to Ley (1986), census tracts with high SSI differences, above the mean, experience gentrification.

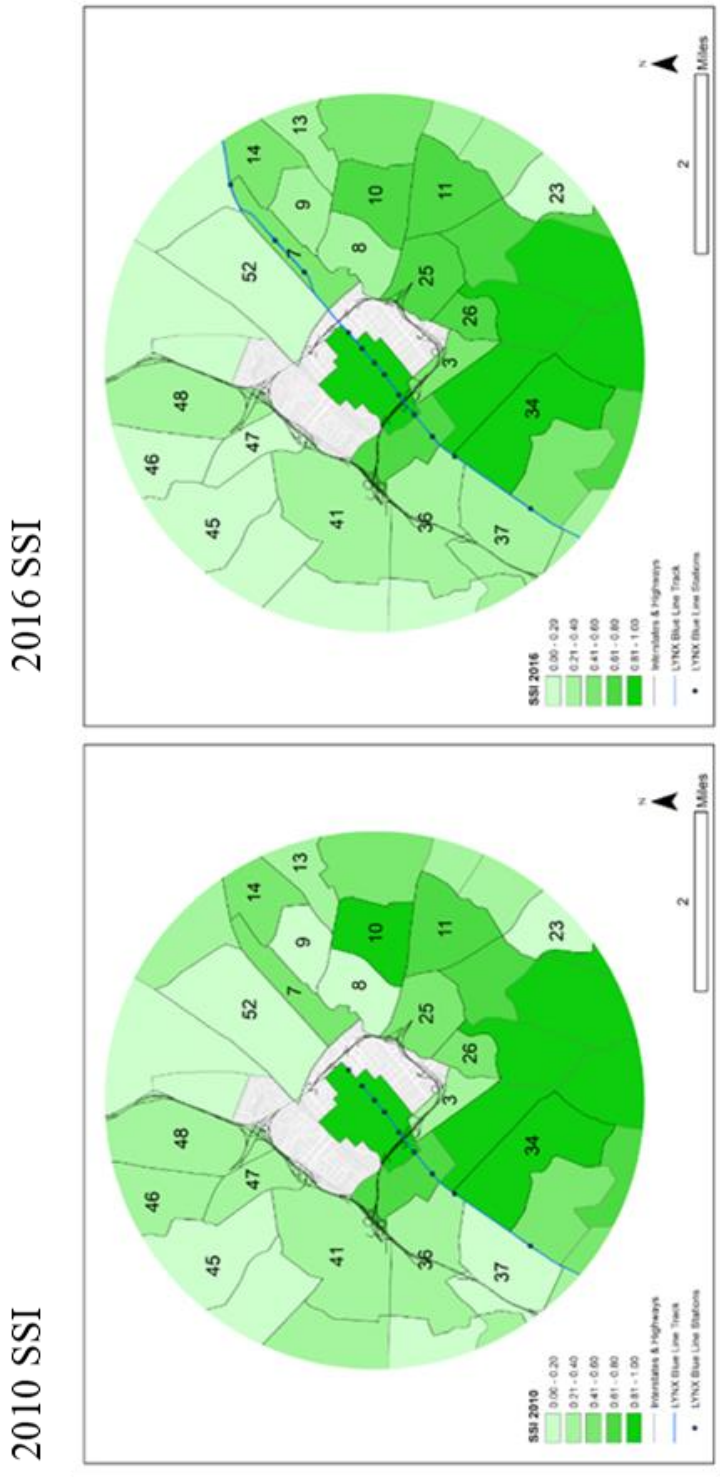


Figure 8. Distribution of SSI for 2010 and 2016 in study area. *Numbers refer to census tract IDs that can be found in Table 3

4.3.1.2. Yonto's GI for 2010-2017. The second part of research question one identifies the spatial distribution of gentrification in Charlotte from 2010-2017 using a nuanced GI technique. Ley (1986) suggests class turnover can be operationalized through real estate reinvestment. Despite Helms (2003, 2012) using building permits to identify the likelihood of renovations within gentrification research, no previous study identifies what type of residential building permit reinvestments are consistent with identifying gentrified areas. Here I outline steps taken to generate the GI, validate the GI, and analyze the extend and location of gentrification.

GI variables. To explore the current spatial distribution of gentrification, a GI is constructed using the residential building permit and tax assessment data with the spatial unit being tax parcels from 2010-2017. The two administrative datasets are merged by a spatial join using the Parcel ID as the key. Here again, to focus the research area, a 3-mile radius from the center of Charlotte is used along with using parcels with homes that have a year built for the dwelling unit that predates 1970. Table 6 identifies the variables taken from the residential building permit and tax assessment dataset to construct the GI – residential building permit, residential demolition, sale of home, change in square footage, land use change and value of improvement.

Table 6. Gentrification Index (GI) descriptions and coding schemes

GI Variable	Description	Data Source	Code Scheme
Residential building permit	Residential building permit issued for a parcel during calendar year. Captures reinvestment activity.	Mecklenburg County Daily Building Permits	1 = Building Permit issued 0 = No building permit issued
Residential demolition permit	Residential demolition permit issued for a parcel during calendar year. Captures reinvestment activity.	Mecklenburg County Daily Building Permits	1 = Demolition permit issued 0 = No demolition permit issued
Sale of home	Sale on parcel during calendar year. Captures home ownership change	Mecklenburg County tax assessments	1 = Sale occurred 0 = No sale occurred
Change in square footage	Indicates a change of square footage on parcel occurred. Captures renovations in residential properties and new residential construction.	Mecklenburg County tax assessments	1 = Increase in square footage 0 = No square footage increase
Land-use change	Identifies intensity of land-use change consistent with gentrification	Mecklenburg County tax assessments	1 = Commercial parcel to Single Family Residential 2 = Any type other than commercial to Mixed Use 2 = Any type to Transit-oriented development 4 = Single Family Residential parcel to Multi-Family 4 = Commercial parcel to Multi-Family 4 = Commercial parcel to Mixed Use 0 = No land use change
Value of improvement	Construction cost over assessed home value. Expenditure per parcel in dollars. Differentiates between renovating small homes versus building mansions	Mecklenburg County Daily Building Permits and Mecklenburg County tax assessments	Scale variable capped at 10 as to not overpower the other variables in GI

A stipulation in this research is that continual neighborhood reinvestment creates conditions necessary for gentrification. Following urban economics studies, residential building permits are used as a proxy for redevelopment. In this way, the variable *residential building permit* is a dummy variable created to capture whether a residential unit had a building permit issued for that calendar year. The calendar year refers to any building permit issued between January 1 and December 31. This is found under the *Issue Date* attribute in the building permit dataset. To code the variable, residential building permits with a USDC code of 101, 102, 103, 104, 105, 114, 115, or 434 and issued in the appropriate calendar year would be coded 1 (see Table 4 and Appendix A for a review of USDC code descriptions). If there was no residential building permit issued with the specified USDC code for the parcel, it would be given a 0.

A specific type of residential building permit issued is a demolition, which signals a teardown that replaces single-family housing. When a teardown occurs, we tend to see single-family homes that are older being demolished and replaced with single-family homes that are larger. Alternatively, developers can acquire a property with the intent of demolishing current structure, rebuild it with a bigger home, and then sell it for a profit. If this type of residential building permit is associated with a parcel, it would add to the intensity of reinvestment consistent with gentrification. Thus, residential demolitions act as a separate indicator of gentrification activity. A dummy variable is created to identify *residential demolition building permits* identified by the USDC codes in Table 4. If a residential demolition building permit has a USDC code labeled 645, 647, or 648 and issued in the appropriate calendar year, it would be given a code of 1. If there was no demolition permit, it would be given a 0.

Typically, gentrified neighborhoods receive reinvestment in older housing stock, which is then reflected in the housing market. Capturing that activity, previous research identifies gentrifying neighborhoods having housing sales increase. In this way, home sales act as a good indicator of neighborhood reinvestment. To code when a property had a sale, the tax assessment data's *dateofsale* variable will be used. A dummy variable is created called *sale of home* to identify any residence that had a home sale during the appropriate calendar year. If a sale was recorded and issued in the appropriate calendar year, it would be given a code of 1. If there was no sale, it would be given a 0.

Gentrification research on McMansions focuses on large homes that are built after the demolition of a smaller older home or a new build on a greenfield site. These studies highlight the importance of identifying an increasing square footage during reinvestments or renovations in homes. To capture this process, a dummy variable called *square footage increase* is created to compare whether a parcel had an increase in square footage from the previous calendar year. The increase would be identified by taking the difference between the heated square area attribute in the tax assessment data. If an increase of square footage was recorded, it would be given a 1. If there was no increase, it would be coded as 0.

Not only can reinvestment consistent with gentrification stimulate real estate speculation and rising home values or rents, it can also foster land use change. The type of land use change tends to be industrial to residential or single family to higher density. If this type of change is associated with a parcel, it would add to the intensity of reinvestment on a parcel consistent with gentrification. To capture this process, a new variable called *land use change* is created to identify whether a parcel experienced a land-

use change from the previous calendar year. The change would be identified by comparing the *landusecode* attribute in the tax assessment data from the current calendar year to the previous calendar year. However, different land-use changes have the potential to reshape the complexion of a neighborhood. To capture the difference in intensities, the following coding scheme is created to give more weight to land-use changes associated with higher density development. If land-use change is detected on a parcel, it is coded as follows:

- 1 = Commercial parcel to single-family residential
- 2 = Any residential parcel to mixed use
- 2 = Any type to transit-oriented development
- 4 = Single-family residential parcel to multi-family
- 4 = Commercial use to multi-Family
- 4 = Commercial use to mixed use
- 0 = No land-use change

To evaluate the magnitude of gentrification, an indicator needs to be created that captures the difference between costs of constructing small homes and mansions. In order to capture what Smith (1998) deems the continual investment or reinvestment in neighborhoods, the annual *Construction Costs* attribute listed on the residential building permit and the annual assessed value from the tax assessment data is used. To define the *value of improvement* (VOI) variable, I use the estimated work cost divided by the assessed value of the home. The construction cost (numerator) comes from the building permit's *Construction Cost* attribute and the assessed value of the home (denominator) is taken from the tax assessment data's *TotalValue* attribute. Although the VOI can have an unlimited maximum score, the VOI is capped at 10 as to not overpower the other components of the GI. This attribute captures the difference between construction of a

small home versus a McMansion in the study area. Examples of how the VOI is constructed are:

- If the building permit has a construction cost of $100,000 and the total value of the home is $100,000 when the building permit is pulled, the resulting VOI would be 1. Despite the large amount of reinvestment, because the home has a high value, this would provide a check at highlighting a false positive - a property where gentrification is not likely to occur, but the coding model picks up as such.
- If the building permit has a construction cost of $200,000 and the total value of the home is $50,000, the resulting VOI would be 4. This higher score indicates a home that has undergone significant redevelopment with a low original home value. This kind of reinvestment is consistent with gentrification.
- If the building permit has a construction cost of $10,000 and a total value of the home is $50,000, the resulting VOI would be 0.2. Although it is important to capture this reinvestment, the intensity invested on this parcel would not signal gentrification.

Although the VOI was a straightforward variable to construct for most parcels in the dataset, a note needs to be added about vacant lands. An unimproved parcel in the tax assessment database has a listed value of improvement of zero. If the total construction is divided by 0, the VOI would be undefined. However, redevelopment on vacant land does add to the new-built gentrification process. Therefore, if a building permit was issued for a vacant land, then the resulting VOI would be given a 5 to illustrate that redevelopment activity was conducted on that parcel.

With the variables in place, the GI is constructed by computing z-score of each

parcel score listed in Table 6. The values associated with each z-score are then summed and a min-max standardization is applied to create a 0-1 GI scale. Results provide an annual GI value to each parcel inside the study area. The annual GI of a parcel *i* is calculated as:

Equation 1

$$GI_{i,t} = \sum_{k=1}^{6} \frac{x_{ik,t} - \bar{x}_{k,t}}{\sigma_{k,t}}$$

and

$$\text{Normalized } \mathrm{GI}_{\mathrm{i,t}} = \frac{\mathrm{GI}_{\mathrm{i,t}} - \mathrm{GI}_{\mathrm{min,t}}}{\mathrm{GI}_{\mathrm{max,t}} - \mathrm{GI}_{\mathrm{min,t}}}$$

Where:

- $GI_{i,t}$ is the index for each parcel in a specific year
- GI_{max} is the maximum score of all study area parcels during a year
- GI_{min} is the minimum score of all study area parcels during a year
- i indicates each study area parcel
- t indicates data collected during a particular year
- x indicates the variable that we are studying
- $\bar{x}$ represents the mean of a variable over all parcels in the study area during a particular year
- σ is standard deviation over all parcels in the Charlotte study area during a particular year
- $\sum_{k=1}^{6}$ represents a summation of 6 variables being used in the index

A parcel with a building permit issued, demolition permit issued, sale, change in square footage, change in land use, and high value over input would receive the highest GI score. Higher GI values represent parcels that are more likely to experienced the process of gentrification. Figure 9 illustrates the spatial distribution of property records receiving a GI score between 2010-2017. Each point represents the centroid of a parcel. Out of the 7,161 residential parcels that have a GI score between 2002-2017, 4,950 are found between the time period 2010-2017.

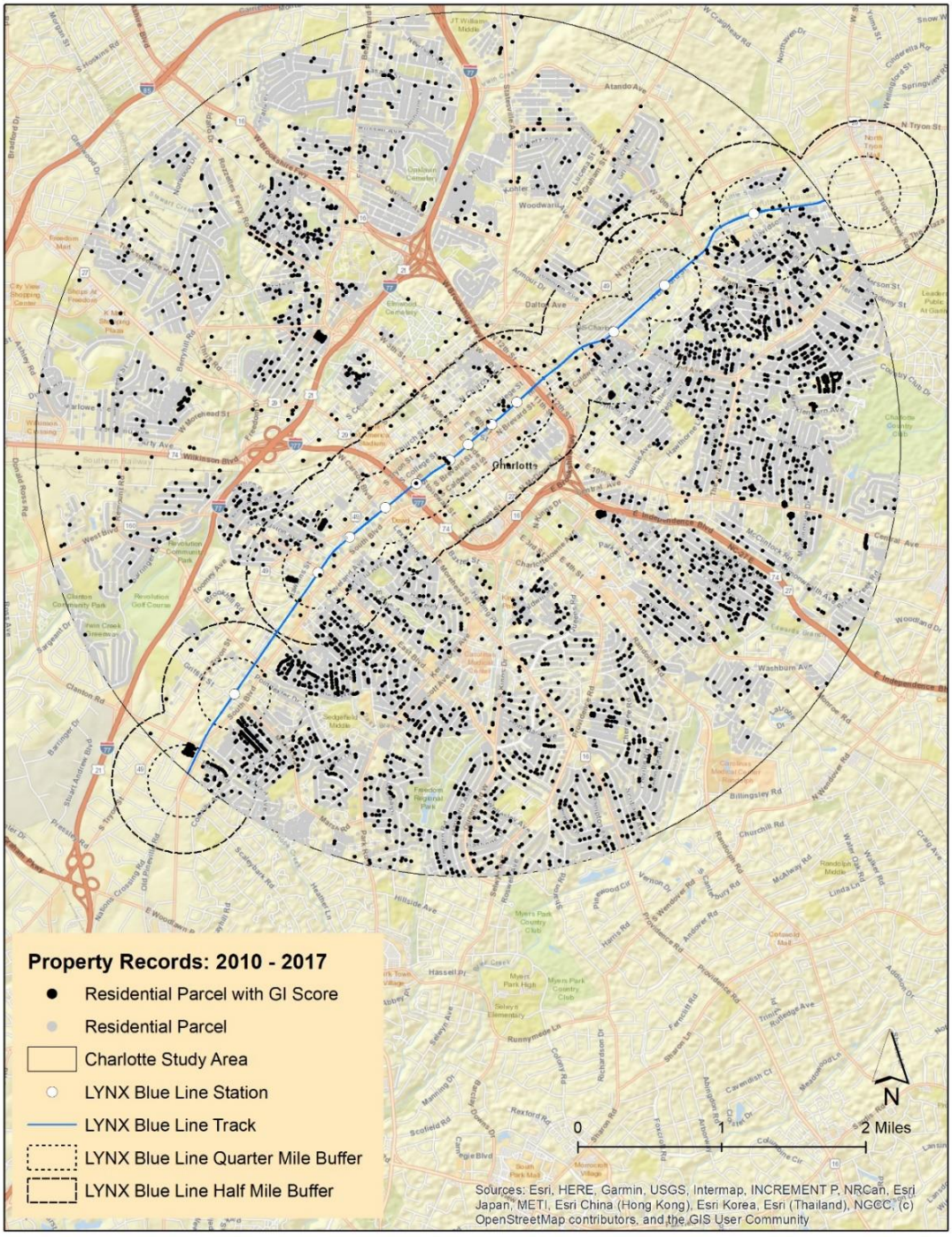


Figure 9. Parcels with a GI score between 2010-2017

To verify the GI, GSV is determined how parcels have changed and whether these changes are consistent with assigned GI scores. The approach codes neighborhood characteristics from GSV images that correspond to gentrification. To guide this process, I implemented a survey used by Hwang and Sampson (2014) who manually analyzed GSV images to identify neighborhood and housing characteristics consistent with gentrification. Table 7 outlines the validation process that I employed with the dataset, whereas Figure 10 provides a sample of how a response would be coded.

The GI validation process randomly sampled 662 parcels, approximately 10% of final dataset, to identify whether parcel characteristics demonstrate changes consistent with gentrification. The identification was conducted manually, not through an automated data processing, which is why only a sample is validated. Moreover, the GI validation process examined what years GSV data are available and what structural changes are detectable in each image. Cross-referencing the data in this way ensures that high GI scores correspond to parcels experiencing gentrification and are not false positives.

After completing the validation survey, 66% of the parcels demonstrated visual structural changes consistent with the process of gentrification and had an average GI score of 6.37. Results also revealed that 27% of the properties that did not demonstrate visual structural changes consistent with gentrification had an average GI score of 2.12, with another 7% of the survey results listed as undetermined because no GSV pictures were available for the parcel. The validation process helped illustrate that higher GI scores are consistent with properties that undergo transformations consistent with gentrification.

Table 7. GSV Validation Process

Indicator	Code
a. Parcel ID	ID#_____
b. Year of GSV available	2005 2006 2007 2017 2008 2009 2010 2012 2012 2013 2014 2015 2016
c. GSV Change Detected	1 No change detected in-house structure 2 Structural decline of house 3 Structural improvement of house 4 House structure decline and improvement 5 House structure improvement and decline
d. GSV Year Change Detected	Year(s)_____
e. If Change detected, what type?	1 New condominium development 2 Major house renovation 3 Minor house renovation 4 Street renovation
f. Consistent with gentrification?	1 Yes 2 No 3 Undetermined

Result: (a) 08315803 (b) 2008, 2011, 2014, 2016 (c) 3 (d) 2016 (e) 2 (f) 1

Figure 10. Sample GSV validation survey result

4.3.1.3 E*xploratory spatial data analysis*. The final part of research question 1 implements global and local measure of spatial autocorrelation to analyze the spatial extent and location of gentrified properties.

When using global spatial autocorrelation techniques, results return one measure to identify whether mapped pattern is random, clustered, or dispersed overall. A time-tested technique that will be used in this analysis is global Moran's I (Getis, 2010, Anselin,1988; Moran, 1950). In ArcGIS 10.6, the spatial autocorrelation tool returns five values: the Moran's I Index for the observed variable, Variance, z-score, p-value and Expected Index. The ArcGIS function generates z-scores and p-values test whether the null hypothesis of complete spatial randomness can be rejected. The objective of a global Moran's statistic is to determine if a spatial pattern is random, or if the spatial pattern is clustered or dispersed. The statistics is generated using the following:

Equation 2

$$I = \frac{n\sum_{i=1}^{n}\sum_{j=1}^{n} wij\,(x_i - \bar{X})(x_j - \overline{X})}{\sum_{i=1}^{n}\sum_{j=1}^{n} wij \sum_{i=1}^{n}(x - X)^2}$$

In the formula, x_i and x_j represent tax parcel GI values *i* and *j*. In addition, w_{ij} should be identified as the weight between parcels *i* and *j* that has been defined from a spatial weight matrix. Finally, n represents the study area tax parcels. The process taken in this research is that if the global Moran's *I* returns a result that indicates spatial autocorrelation in the study area is present, the next step is to incorporate the extend and location of the gentrification clusters using local spatial autocorrelation measures.

To identify local spatial autocorrelation, researchers have used the powerful set of geospatial tools known as local indicators of spatial association (LISA) (Anselin, 1995).

Through the incorporation of LISA statistics, researchers now have a powerful tool that returns a measure that tests whether the that score is correlated with scores of areas that are nearby. When running a LISA analysis, the results highlight patterns around spatial observations at the individual level. To calculate Local Moran's *I*, the following formula can be used:

Equation 3

$$I_i = \frac{x_i - \bar{X}}{S_i^2} \sum_{j=1, j \neq i}^{n} w_{ij}\left(x_j - \bar{X}\right)$$

with

$$S_i^2 = \sum_i (x_, - \overline{X}\ )^2 / n - 1$$

In the formula, x_i represents the spatial unit of i, whereas, $\bar{X}$ indicates the grand mean of an attribute. The w_{ij} corresponds to the spatial weight given to features *i* and *j*, while n is the total number of features used in the analysis. The final values produced is a value that has a range of -1 to +1. Any value *I* that returns a positive value demonstrates a neighborhood that has high or low values similar to it. This feature is then said to represent the cluster's core. Any value *I* that returns a more negative value demonstrates neighborhoods that have values that are dissimilar. The result is a spatial outlier with negative spatial autocorrelation. When the p-values returned indicate values that are small enough, they highlight a set of touching spatial units that are considered statistically significant.

Fundamental to the global and local Moran's *I* is the creation of what is called a spatial weight matrix – W. Typical W matrixes included using boundaries of adjoining polygons distances to see what the neighbor is based on all attributes within a certain

distance threshold.

In this study, multiple spatial weight matrices were created to examine the impact of the results. These W-matrices included both contiguity-based and distance-based. The result was that a fixed distance W-matrix was used to identify any neighborhood that was within a ¼ mile for the parcel-based analysis and a ½ mile for the census tract analysis. Although the weight matrix could be set at an eighth-, quarter-, third -, or half-mile, the purpose of the distance acts to determine how much impact a reinvestment decision or class turnover would have on the surrounding area.

Setting the weight matrix for the parcel-based analysis required careful consideration. As shown in Figure 11, creating an eighth-mile buffer limits the impact of the reinvestment activity to the houses in the surrounding streets. This type of buffer may underestimate the spatial spillover extent of gentrification's impact on the neighborhood. Conversely, incorporating a third- or half-mile buffer extends the parcel's reinvestment impact to adjacent neighborhoods. Although larger buffers may be more consistent with the gentrification literature on spatial spillover qualities, the low-density nature of Charlotte means that homes in neighborhood a half-mile away may be qualitatively different than the surrounding area. Thus, a quarter-mile buffer acts as a compromise that allows for the spatial spillover quality of gentrification to be incorporated without overestimating results. This type of spatial weight matrix is used throughout the dissertation for the parcel-based analysis when examining spatial effects.

Overall, research question one addresses the current spatial distribution of gentrification in Charlotte. The analysis constructs two indexes that capture gentrification in different ways. The first uses an SSI to capture class turnover through socio-

demographic data, whereas the second uses a nuanced GI to capture reinvestment in residential properties using real estate administrative data.

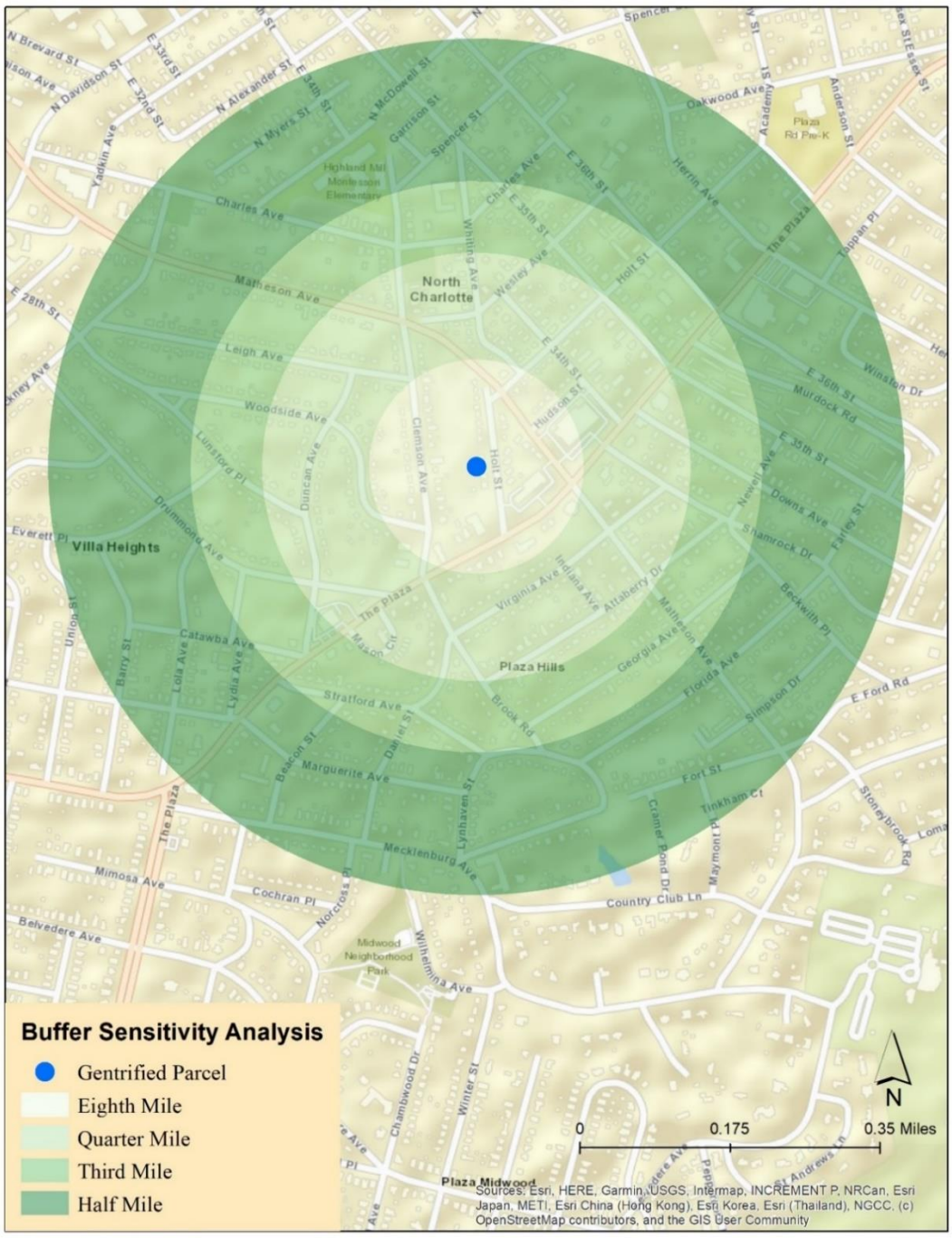


Figure 11. Buffer sensitivity analysis for the spatial weight matrix

4.3.2. Methods for research question 2. Generating a baseline that examines the overall changes in Charlotte neighborhoods provides a snapshot of where gentrification has landed. Yet, the second research objective allows for a deeper analysis by seeing how the process of gentrification has unfolded overtime. Hence, the second phase of my dissertation compares how the two methods generated in the first research question can trace the spread of gentrification across Charlotte. Consistent with the first research objective, the goal is to compare which indicator provides a more precise measure at identifying gentrified neighborhoods in growing New South cities.

4.3.2.1. Ley's SSI for 2000-2010 & 2010-2016. The first part of research question two identified what was the spatial extent of gentrification in Charlotte in 2000-2010 and in 2010-2016. Census tracts are used as proxies for neighborhoods and are obtained from Simply Analytics which interpolates census tract variables through time to the 2010 boundary files. The corresponding dataset uses decennial census data for 2000 and 2010, in addition to the ACS data for 2016. The same 3-mile buffer where over 30% of the housing stock was built before 1970 is applied to focus the research area. Datasets are combined in a spreadsheet and uploaded into a GIS for processing.

To measure changes in household status drawn from census information, Ley's SSI is generated for each census tract inside the study area in 2000, 2010 and 2016. Each input variable is first standardized by subtracting the mean and dividing by the standard deviation before combining to form the SSI. Next, the SSI difference is calculated for each census tract between 2000 and 2010, as well as between 2010 and 2016. SSI differences are again rescaled using the min-max method. To validate the SSI, correlations at the census tract level were done with average rents. The correlation is

statistically significant and highly correlated for 2000, $r = 0.579$, $p < 0.01$; 2010, $r = 0.569$, $p < 0.01$ and 2016, $r = 0.654$, $p < 0.01$.

Figure 12 illustrates the spatial distribution of SSI for 2000, 2010, and 2016. As with the previous research question, a census tract with the highest percentage of work force employed in professional, managerial, and administrative jobs, highest percentage of the population with a university-level education, and highest median household income, would receive a 1. Light green indicates a low SSI value and dark green indicates a high SSI value. Census tracts with low SSI scores tend to be geographically distributed in a crescent shape on the north side of the city center. Low SSI scores also tend to be pushed away from the city center as time progresses. According to Ley (1986), census tracts with high SSI differences, above the mean, experience gentrification.

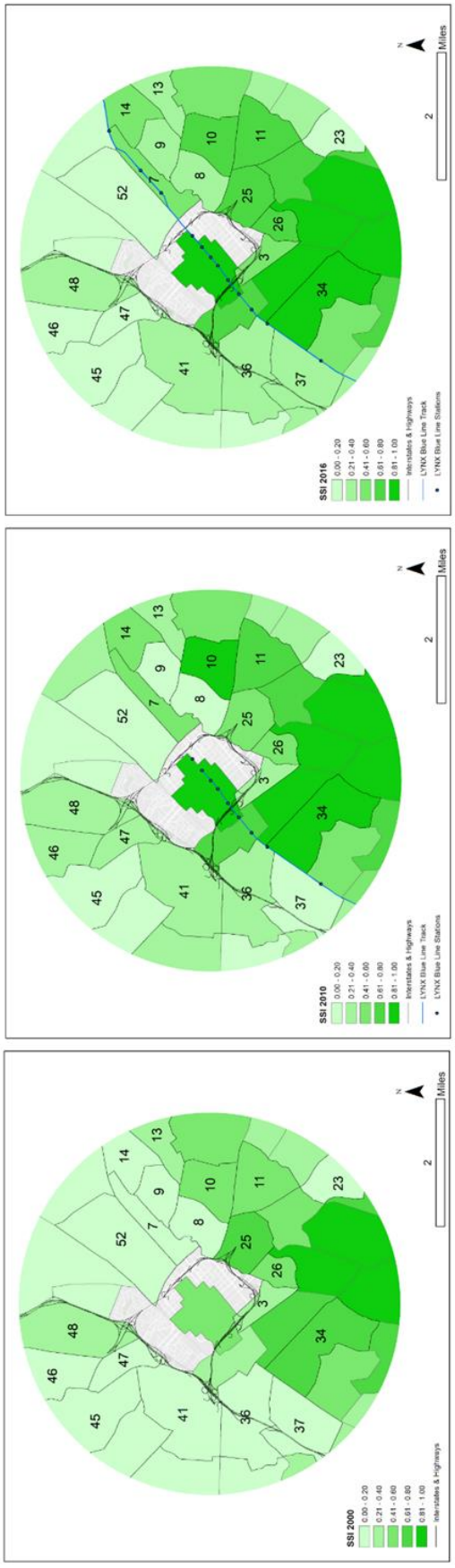


Figure 12. Distribution of SSI for 2000, 2010 and 2016 in study area. Numbers refer to census tract IDs that can be found in Table 4

4.3.2.2. Yonto's GI for 2002-2017. The second part of research question two identifies the spatial distribution of gentrification in Charlotte from 2002-2017. To explore the spatial distribution of gentrification over time, the GI uses the new residential building permit and tax assessment data with the spatial unit being tax parcels from 2002-2017 is used. To map the process, Figure 13 illustrates the spatial distribution of property records receiving a GI score between 2002-2009 and 2010-2017. Each point represents the centroid of a parcel. In total, 2,211 residential parcels are displayed in 2002-2009 and 4,950 residential parcels are displayed in 2010-2017. Research question 2 uses the same spatial data analysis techniques to examine the extent and location of gentrification annually. The goal is to use the annual LISA cluster maps to pinpoint the diffusion of gentrification hot spots across the study area from 2002-2017.

Overall, tracking the diffusion of gentrification in Charlotte is important because it enables us to correlate with socio-spatial conditions that may trigger, fuel, or dampen the gentrification process. Utilizing both the SSI and the GI, a comparison can be done to evaluate which indicator provides a more precise measure at identifying gentrified neighborhoods in growing New South cities.

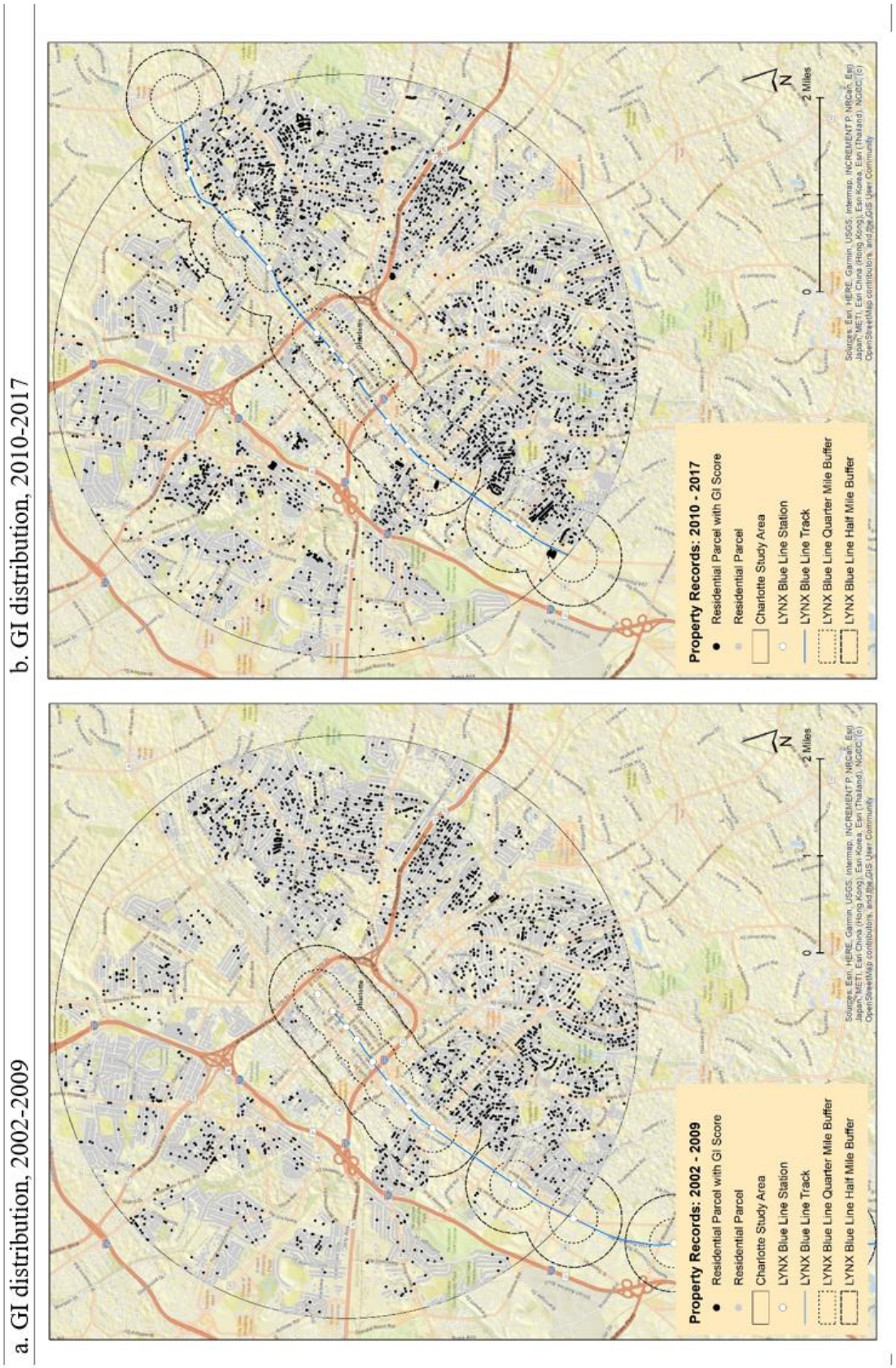


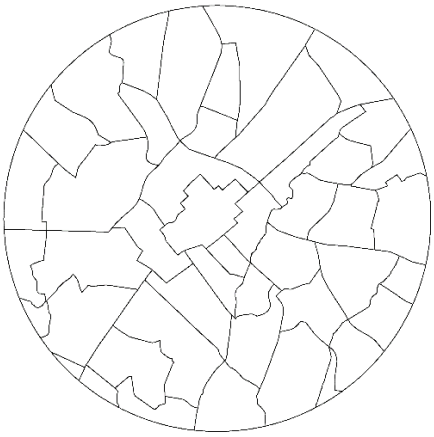
Figure 13 Distribution of GI for 2002 -2009 and 2010-2017 in study area.

4.3.3. Methods for research question 3. The third research question identifies what outcomes arise based on the granularity at which gentrification is measured. Despite most gentrification studies using census tracts for their spatial unit of analysis, there is a call to use finer geographic scales, such as census blocks or tax parcels, to discover micro gentrification patterns. To identify how spatial scale impacts gentrification results, 2002-2009 and 2010-2017 parcel level GI scores will be compared to scores aggregated to census tracts, census block groups, and census blocks, Figure 14. The results will be an annual average GI score per spatial scale. The goal is to compare which spatial scale is more precise at identifying the gentrification process in growing New South cities to advocate interventions that arrive at site specific solutions.

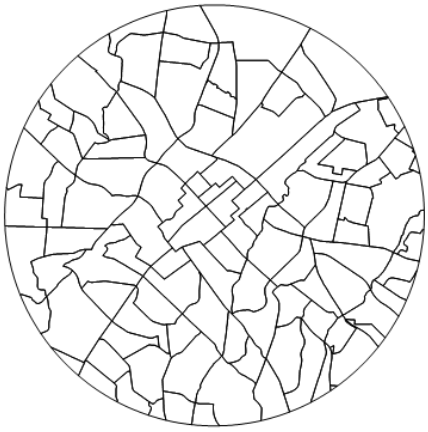
To aggregate the GI, the join function in ArcGIS will be used to append data from two different shapefiles. Therefore, each census block will be assigned the average of the GIs of all the entities within the block's perimeter in the parcel layer being joined. For each year, the result of the join is a new census block attribute, the annual average GI. To map the process, research question 3 uses similar techniques to the previous research questions. This includes the use of local measures of spatial autocorrelation. The goal is to use the annual LISA cluster maps to pinpoint the diffusion of gentrification hot spots across different granularities at which gentrification is measured.

Figure 14. Geographic scales used in study area

a. Census tract



b. Block group



c. Census block

d. Tax parcel

With relatively little scholarship available to understand which spatial scale is more appropriate at identifying gentrification trends, this analysis will pick up micro gentrification patterns that provide more useful insights into how the process diffuses over space and time. The lack of objective gentrification research on which scale is best suited to detect the gentrification process is a significant barrier in advocating interventions that arrive at site specific strategies for growing New South cities.

4.3.4. Methods for research question 4. The objective of the fourth research question acts as a confirmatory analysis to test the effect of factors advanced by the literature and theories that drive the spatial distribution of gentrification across Charlotte.

Per the literature review, gentrification tends to be identified through several variables that need to increase at a rate faster than the souring region. When a certain census tract or tax parcel experiences a relative increase of any of the relevant variables, it is considered to have undergone gentrification. As the analysis in this research is trying to identify when a tax parcel experiences gentrification, the use of a dependent variable that is conceptualized as a time-to-event analysis is more appropriate. While not common in geography, the must utilized statistical technique for time-to-event studies is called survival analysis. The "event" in this dissertation is gentrification. The population in question encompasses all residential tax parcels in a 3-mile radius of the geographic center of Charlotte from 2002 to 2017.

Primarily used in the health and medical fields, the use of survival analysis is geography is very limited. According to Gruber, Craver and Patterson (2015), survival analysis offers the important contribution that not all of the population will experience the "event" in question or, in this case, will be gentrified. This phenomenon, known as censoring, is crucial for survival analysis to have valid interpretations of the results. Another reason why a survival analysis is preferred over traditional regression analysis is the skewed nature of the dataset. If the survival times are generally skewed, this would violate the assumptions of normality. As such, ordinary least squares regression and generalized linear models, including logistical regression may be inappropriate for gentrification analysis due to the assumptions not being met. To this end, survival analysis appears to be the more appropriate method to model the relationships between predictors and time to gentrification.

The model that would be best suited to this analysis would be a spatial survival model because it would incorporate spatially dependent processes. While there has been attempts to create spatial survival models that incorporate random effects, there are many challenges when spatial survival models encounter large datasets. The challenges in spatial survival analysis are handling large datasets or when the researcher wishes to combine information from multiple spatial scales. As a result, the code necessary to run a spatial survival model for the data in the research is not developed at this time. Therefore, this research incorporates a survival analysis that gives the survival time of residential tax parcels with the use of independent and control variables, which include an exogenously determined spatial spillover variable. While this is a limitation of the present analysis, our main goal is finding the appropriate model to test time-to-event data. Hence, a survival model with an exogenous spatial spillover variable is preferred over a spatial autoregressive model.

Two functions are fundamental to understating a survival model: survival function and the hazard function. First, the survival function is used to describe the chance an event lasts beyond a specific point a time. In other words, the chance that the event being studies did not occur. A hazard function is the rate that an event occurs during a time period. This function identifies the rapid rate the event occurs over time. If the hazard rate has a high number, then the survival of the event declines faster. If the hazard rate has a low number, then survival of the event declines slower. These results can be understood as a hazard ratio to better interpret the results. With the hazard ratio, ant value that is higher than 1 indicates an increase in the likelihood of the event occurring. Any

number lower than 1 indicates a decrease in the likelihood of the event occurring. If the number is 1, then the chance is random.

A Cox proportional hazards model is used for the study. This type of model is one of the most widely used survival techniques that can analyze the impact of various covariates without restrictions. The aim of using a Cox proportional hazards model helps us understand the impact of a variable while controlling all other variables in the model. The equation for the Cox proportional hazards model is:

Equation 4

$$h(t) = h_0(\mathrm{t})\exp(b_1X_1 + b_2X_2 + \cdots b_nX_n)$$

In the equation, h(t) represents an expected hazard at the time t. Additionally, $h_0(t)$ indicates the hazard when all of the predictors X_1, X_2, …, X_n equal zero. Moreover, h(t) represents the predicted hazard and is the produced by $h_0(t)$ as an exponential function.

The coefficients produced in the model, b_1, identify the change in the hazard ration in relation to a one unit change in X_1. The results, while holding constant the other predictors, gives a ratio that describes the survivability. For instance, if the variable is close to 1, then there is no effect of survival. However, if the predictor is less than 1, then the results is consistent with improving the survivability. Finally, if the results are greater than 1, that is consistent with a decrease in survivability. That is what this analysis is interested in capturing.

To this end, the dependent variable in the survival analysis is made up of two parts. First is the spell, which represents the number of periods a parcel is in the analysis. For instance, in Table 8, the first parcel has been in the analysis for 5 years, the second parcel for 12 years, and the third parcel for 16 years. The second part of the dependent

variable is the event, which is when a parcel experienced gentrification. For instance, in Table 8, the first parcel is gentrified after 5 periods, whereas the second tax parcel is gentrified after 12 periods. The zero, Parcel ID 3 in Table 8, represents a parcel that after 16 periods has not gone through gentrification. The term for this is that this parcel is censored. For each year a parcel is in the dataset, the dependent variable will be an ordinal variable coded 1-16 for the spell and a dummy variable coded 1 or 0 for the event. Several predictor variables are considered in the survival analysis. Table 9 lists all variables and descriptions for each. Further justification for each variable is also given below.

Parcel ID	Spell	Event
1	5	1
2	12	1
3	16	0

Table 8. Description of dependent variable creation

Variable	Description
Spell	Dependent variable Number of years a parcel is in a dataset
Event	Dependent variable Parcel that experienced gentrification
Distance to center city	Independent Variable Sites closer to downtown workplaces increase desirability for residents than neighborhoods further away
Age of structure	Independent Variable Buildings that are older tend to have more renovations needed, which have positive impact on gentrification
Proximity to nearest Light Rail stop	Independent Variable Light rail transit stations have the potential to impact property values in surrounding neighborhoods consistent with gentrification
Floor-area ratio	Control Variable Parcels with a low FAR are houses located on relatively larger lots. These types of homes are expected to increase likelihood of gentrification
Proximity to Parks	Control Variable Certain parks act as an amenity that can increase the surrounding home values consistent with gentrification
Proximity to greenway	Control Variable Greenways act as an amenity that can increase the surrounding home values consistent with gentrification
Historic areas	Control Variable Historic areas tend to have housing stock that are attractive to gentrifiers
Proximity to schools	Control Variable Proximity to public schools is an amenity that may encourage renovation consistent with gentrification
Quality of education	Control Variable Quality of public schools is an amenity that may encourage renovation consistent with gentrification
Proximity to highway	Control Variable Identified as a disamenities that prevents reinvestment consistent with gentrification
Value of home	Control Variable Parcels with a low value of home have qualities that are attractive to gentrifiers.

Crime rates	Control Variable Households where property crime is low is expected to increase likelihood of gentrification
Proximity to commercial centers	Commercial centers act as an amenity that can increase the surrounding home values consistent with gentrification
University	Control Variable Johnson C. Smith is an important part of the Black community in Charlotte. Although not a historic area, the university may act as an amenity that can increase the surrounding home values consistent with gentrification
Spatial spillover	Control Variable Gentrification often results in spillover investments in surrounding areas
Fixed effects	Control Variable Reduce the risk of omitted variable

Table 9. Description of variables in survival model of variables in survival model

- **Distance to center city**. One of the traditional variables in gentrification research is the distance to the center city. This is primarily used to identify access to urban amenities. The variable is calculated annually in ArcGIS with the near tool. This tool captures a straight-line distance between the geographic center of Charlotte – where Trade Street and Tryon Street intersect – and the centroid of a parcel located within the study area measured in meters.
- **Age of structure**. Older homes tend to deteriorate over time. According to the gentrification literature, the age of a home increases the change of it being gentrified. To calculate this variable, the current year is subtracted from when the parcel's structure was built. Data is found in the tax assessment files.
- **Proximity to light rail.** Proximity to light rail transit has the potential to increase desirability in the surrounding neighborhoods consistent with gentrification. To calculate the variable, the network analysis tool in ArcGIS us used to create

buffers around each light rail transit station in the study area. The result is a walk time service area covering the roads that can be reached within a 5-, 10-, and 15-walk. Light rail station shapefiles were obtained from the Charlotte Open Data Portal.

- **Floor-area ratio.** According to the rent gap literature, smaller homes that have a large lot tend to signal a large rent gap. The ration of floor area to the lot (FAR) has been used as a factor that drives residential demolition in previous studies. In this way, parcels with a low FAR are expected to be more likely to go through the gentrification process. The variable is calculated by dividing the square footage of the building divided by the square footage of the lot. Data is found in the tax assessment files.
- **Parks**. The gentrification literature identifies parks as an amenity that can increase the surrounding home values. However, the size of parks must be taken into consideration as not all parks have the same impact on homes in the surrounding area. Charlotte classifies parks based on size: neighborhood, community, and regional parks (Mecklenburg County Park and Recreation Master Plan, 2015). Regional parks have a size greater than 100 acres. Freedom Park is the only regional park located inside the study area. Community parks have a size greater than 20 acres and less than 100. Nine community parks are located inside the study area: Clanton Park, Camp Greene Park, Cordelia Park, Derita Park, Martin Luther Ling Park, Latta Park, Randolph Road Park, Revolution Park, and Southside Park. Neighborhood parks have a size of 2-20 acres. Across the study area there are 48. As gentrification is generally limited to the areas directly

surrounding a park, dummy variables are created for any parcel located with a quarter-, half-, or one-mile buffers for each type of park. Park shapefiles were downloaded from the Charlotte Open Data Portal with dummy variables calculated in a GIS.

- **Proximity to greenway**. Recent gentrification analysis highlights the importance of greenways in increasing the likelihood of gentrification. According to the Greenway Master Plan (2020), Mecklenburg County had 52 miles of greenways developed. A dummy variable was constructed to capture any parcel within a half mile of a greenway in the study area. Greenway shapefiles were downloaded from the Charlotte Open Data Portal with dummy variables calculated in a GIS.
- **Historic areas**. Localized impacts of gentrification tend to impact historic areas and the housing stock associated with these places. At the time of this study, Charlotte has given historic district designations to six older neighborhoods. These include Wesley Heights, Hermitage Court, Dilworth, Plaza-Midwood, Fourth Ward, and Wilmore. A dummy variable was constructed to capture any parcel within a half mile of the historic districts. Historic area shapefiles were downloaded from the Charlotte Open Data Portal with dummy variables calculated in a GIS.
- **Proximity to schools**. Proximity to public schools is an amenity that will likely encourage renovation. The variable proximity to schools acts as an indicator that increases the likelihood of gentrification in an area. The variable is calculated annually in ArcGIS with the near tool. The goal was to capture the straight-line distance from the geographic center of a high school, middle school, or

elementary school to the centroid of a parcel located within the study area. The school shapefile was obtained from the Charlotte Open Data Portal. The variable is measured in meters.

- **Quality of education**. High quality education acts as an amenity to a neighborhood that has been found to increase the likelihood of gentrification. To identify high achieving schools, the percentage of Charlotte-Mecklenburg test used at the end of each grade to identify student proficiency was calculated for neighborhood profile area. To calculate the variable, I took the students in elementary through high school that achieved a score of Level III, IV or V on the end of grade reading and math end tests, then I divided this by the total number of students in elementary, middle, and high school that took the tests in 2014-2017. The variable is calculated in ArcGIS to determine what school district the parcel falls within and the score associated with that score. I downloaded test proficiency scores shapefiles from Charlotte/Mecklenburg's Quality of Life Explorer.
- **Proximity to highway**. Reinvestment near a highway tends to be a disamenity for reinvestment. The variable is calculated annually in ArcGIS with the near tool. The goal is to capture the shortest travel distance from parcel to limited access highway entrance. Included in the analysis are developed NC and US highways within the study area that have an average speed of 45 miles per hour. Highway shapefiles were obtained from the Charlotte Open Data Portal. The variable is measured in meters.
- **Value of home.** Parcels with a low house value are ripe for gentrification redevelopment. The variable is calculated by taking the value of the home

(exclusive of the land value) divided by the square footage. The variable is broken up into quartiles with the reference group being the highest quartile. Data is obtained from the tax assessment files.

- **Crime rates.** I expect household to move into areas where property crime low. To identify where low property crime areas are located, I use crime rate per 1,000 residents. The variable is constructed by taking the number of property offences in the year, divided by the population, multiplied by 1,000. I downloaded property crime rates shapefiles from Charlotte/Mecklenburg's Quality of Life Explorer
- **Proximity to commercial centers.** The variable is calculated annually in ArcGIS with the near tool. The goal is to capture the straight-line distance between the centroid of each residential parcel within the study area and the closest commercial parcel. Commercial parcels are obtained from the tax assessment files. The variable is measured in meters.
- **University**. Johnson C. Smith University is treated as a localized amenity as it is in one of the oldest Black communities in Charlotte. Although not a historic area, the place holds historic importance in the region. The university shapefile was obtained from the Charlotte Open Data Portal. Dummy variables were calculated in a GIS for any parcel located with a quarter-, half-, or one-mile buffer of Johnson C. Smith University.
- **Spatial spillover.** Gentrification often results in spillover investments in surrounding areas. To calculate the spatial spillover variable in the analysis, a dummy variable is created for any parcel within $1/8^{th}$ of a mile of a gentrified property over the past 3 years. Data are obtained from the tax assessment files.

- **Fixed effects.** To reduce the risk of omitted variable bias in the survival analysis, neighborhood profile areas will be used to incorporate geographic fixed effects for the study area. It is appropriate to use spatial fixed effects when there are characteristics in a group that is not able to be observed. Dummy variable is created for any parcel within a neighborhood profile area to incorporate geographic fixed effects for the study area. Neighborhood profile areas were obtained from the Charlotte Open Data Portal to be used.

Together these four research questions offer insights into the spatial and temporal dimensions of contemporary gentrification in Charlotte. Given the lack of research on medium-size U.S. cities and growing urban areas in the New South, there exists a need to fill this void with studies on gentrification in this context. In doing so, a process can be put into place to replicate this analysis and compare other New South cities undergoing similar trends.

CHAPTER V: RESULTS & DISCUSSION

The following chapter presents results aimed at answering the questions identified in chapter three by using the data and methods presented in chapter 4. The following sub-sections reveal how a more complex index at a finer spatial scale is deemed more reflective of communities impacted by gentrification in Charlotte. Findings also demonstrate that mapping gentrification at a finer spatial resolution removes the arbitrary nature of boundaries imposed by census tracts. Results contribute to discussions on whether more advanced modeling, complex indices, or finer geographic scales lead to more precise measures identifying gentrification and its covariates in New South cities.

5.1 Research Question 1: Location and extent of gentrification

Table 10 summarizes class turnover through socio-demographic data at the census tract level. A total of 41 census tracts are compared between 2000-2010 and 2010-2016. Out of the 41 census tracts for 2000-2010, 39% experienced class turnover consistent with gentrification (M = 0.40, SD = 0.24). Table 10 also shows results based on 2010-2016 SSI difference. During this timeframe, 37% of census tracts experienced class turnover consistent with gentrification (M = 0.33, SD = 0.22). While both time periods demonstrate gentrification occurring in the study area, Figure 15 illustrates that class turnover between 2000-2010 is more dispersed over the study area with a wider range of scores. From 2010-2016, the range of the data is narrowed and Midtown (Census tract 3) and Brookhill (Census tract 37) appear as outliers in the data. The inference from the data in Charlotte is that the process of class turnover consistent with gentrification produces an uneven distribution that, over time, has become more concentrated.

Table 10. Descriptive statistics comparing SSI differences across two time periods

SSI difference (n = 41)	2000-2010	2010-2016
Min	0	0
Max	1	1
1st Quartile	0.24	0.18
Median	0.34	0.27
3rd Quartile	0.56	0.47
Inter quartile range	0.32	0.29
Mean	0. 40	0.33
SD	0.25	0.23
Tracts above Mean	39%	37%

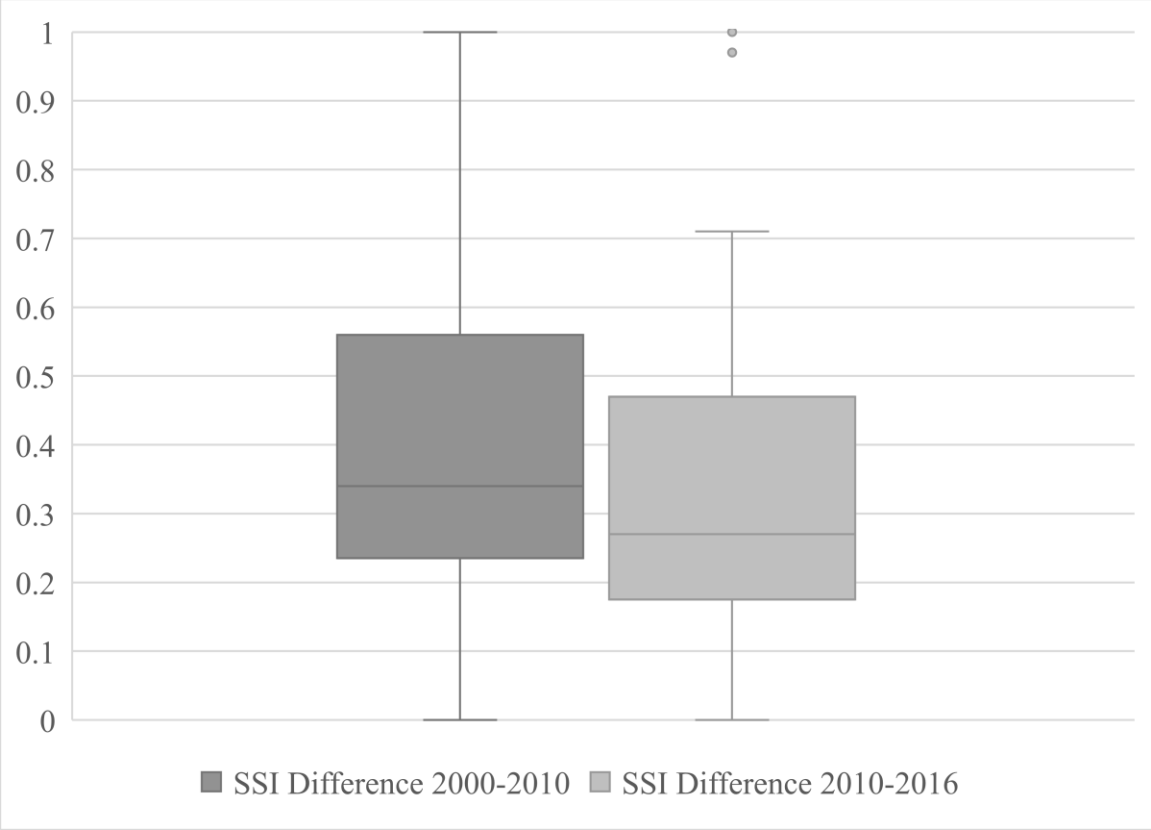


Figure 15. Box plot comparing SSI differences across two time periods

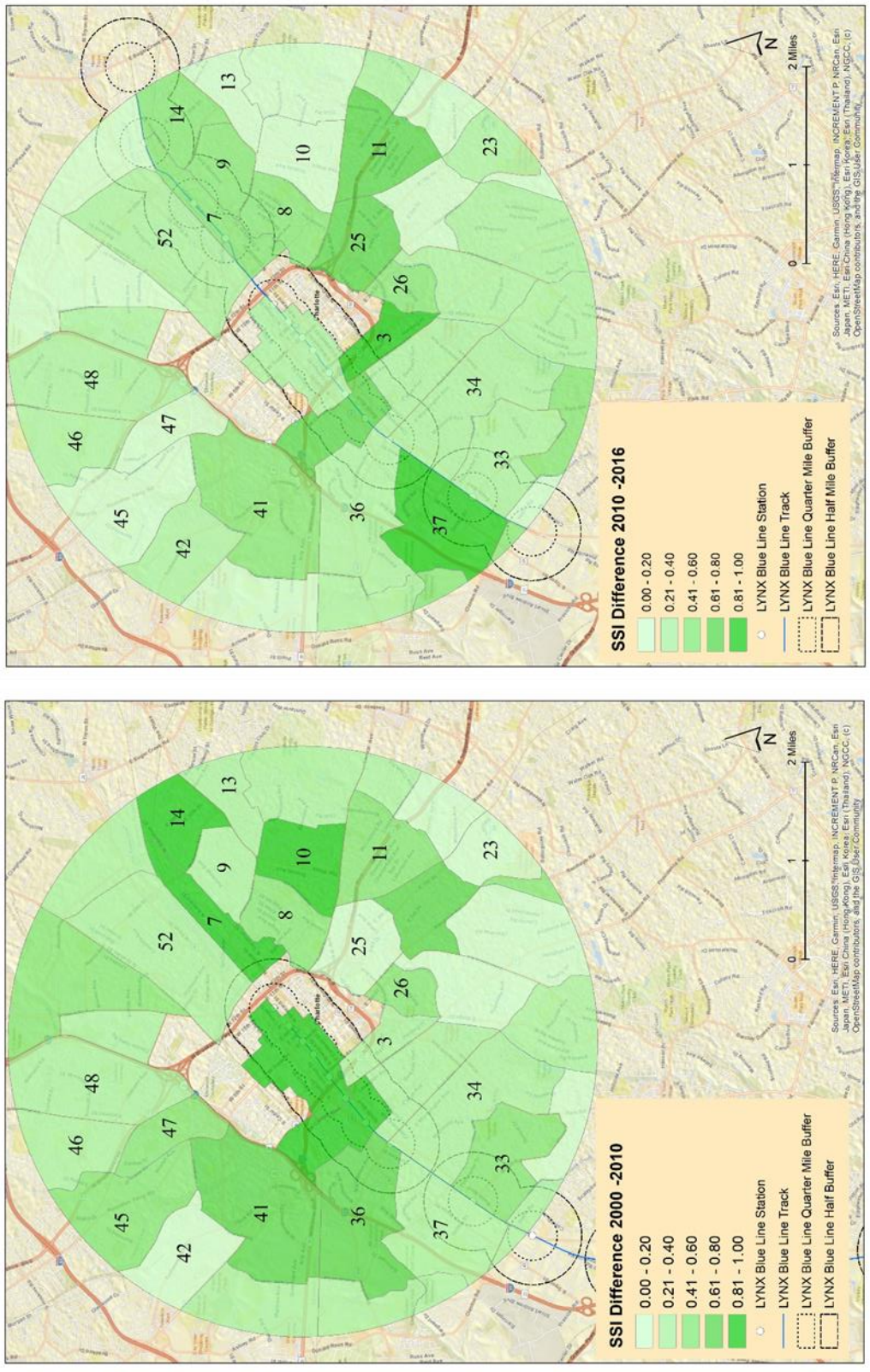


Figure 16. SSI differences for study area. Numbers refer to census tracts (see table 4).

To map the process, Figure 16 illustrates class turnover at the census tract level during 2000-2010 and 2010-2016. In this figure, dark green colors indicate census tracts with a high SSI difference value, whereas light green indicates a low SSI difference. The mapped data indicate that class turnover concentrated primarily on the east and west of Charlotte during 2000-2010, and the southeast and southwest of Charlotte during 2010-2016. The five census tracts with the highest intensity of class turnover between 2000-2010 include three neighborhoods of interest: NoDa (census tract 14), Plaza Midwood (census tract 10), and Optimist Park (census tract 7). Two census tracts with the highest intensity of class turnover between 2010-2016 are Midtown (census tract 3) and Brookhill (census tract 37), both neighborhoods of interest. Findings reveal that class turnover has been a substantial aspect of the change experienced by many Charlotte neighborhoods.

In line with the notion that gentrification is not a static condition but a process that evolves over time, census tracts found to have the largest class turnover in 2000-2010 are no longer neighborhoods undergoing the largest SSI change in 2010-2016. Instead, the process drifts south and southeast, while remaining in close proximity to the city center. Other observations can be made on the basis of the SSI analysis. Whereas no traditional Black suburb is highlighted as undergoing class turnover during 2000-2010, one is shown to be gentrifying in 2010-2016, the neighborhood of Cherry (census tract 26). Additionally, the neighborhood of Plaza Midwood (census tract 10) is high on the SSI in 2000-2010 but falls off the index in 2010-2016. Alternatively, NoDa (census tract 14) had the highest SSI difference during 2000-2010 and remained above the mean in 2010-2016, which provides evidence of continued strength in gentrification in this

neighborhood. Moreover, in 2000-2010, Charlotte' city center (census tract 1) and the census tract adjacent to the southwest (census tract 4) of it appear to have undergone gentrification. An unexpected result is how these two census tracts dropped down the SSI scale in 2010-2016. Although high on the SSI index, the center city census tract may in fact be a false positive as few residents lived downtown in 2000. While a low likelihood exists that the rapid population growth displaced residents from 2000-2010, this part of the city saw surge of higher socio-economic status individuals moving into the area.

In 2007, Charlotte also opened the LYNX Blue Line rail service to passengers that spurred considerable condo and apartment investments along the light rail corridor. The corridor aligned with an existing rail right-of-way. Along with the two center-city census tracts in Figure 16, the neighborhood of Wilmore (census tract 36) undergoes class turnover in 2000-2010. However, Wilmore also drops off the SSI scale in 2010-2016. In contrast, Brookhill (census tract 37) is a fast-growing apartment community near the light-rail line that experienced very high SSI change in 2010-2016. This would suggest that population turnover and growth related to the LYNX Blue Line may play a role in the new population moving into the area.

Despite results illustrating where gentrification is occurring with the SSI change, it should be noted that over 60% of the census tracts during each time period did not experience elevated class turnover consistent with gentrification. Charlotte's affluent wedge in the south that comprises of Eastover and Myers Park stand out as neighborhoods that have historically retained affluent and highly educated residents. Other areas that have not been highlighted as undergoing gentrification include tracts on the edges of the study area, particularly for 2010-2016. Many of these neighborhoods

such as Washington Heights (census tract 46), McCrorey Heights (census tract 48), and Lockwood (census tract 52), are not near the urban amenities that have pulled new residents into the Charlotte metro area. In the case of Lockwood (census tract 52), although being close to the LYNX Blue Line extension, a major throughway of North Tryon Street effectively blocks off easy access to the light rail station.

To test for the existence of clustering of gentrification, the Moran's *I* statistic was calculated on the longitudinal changes in the SSI. The Moran's statistic ($I = 0.083$, $p = 0.05$) for 2000-2010 is statistically significant and positive, whereas the Moran's statistic ($I = 0.1588$, $p = 0.260$) for 2010-2016 is positive but not significant statistically. Findings reveal that spatial clusters of gentrification is significantly clustered for 2000-2010. However, empirical evidence does not support that the change in SSI departs from a spatially random distribution across the study area for 2010-2016. This finding is not surprising for 2000-2010 as it confirms the anecdotal evidence and city council minutes that gentrification in Charlotte impacts specific neighborhoods. What is surprising is that in 2010-2016, a non-statistically significant result is returned from the Moran's *I*. Therefore, complete spatial randomness – the null hypothesis – cannot be rejected. Despite the 2010-2016 Moran's *I* result appearing to be random, it may be that multiple factors help explain gentrification in 2010-2016, which may muddle the spatial pattern results.

To identify where statistically significant clusters of gentrification are located, the LISA statistic is utilized. Overall, the process of class turnover does not happen randomly in Charlotte. The analysis identifies one High-High cluster to the east in the Belmont neighborhood (census tract 8) for 2000-2010 (Figure 17a). Over time, the gentrification

hot spot shifts to the southwest in 2010-2016 (Figure 17b) to the neighborhood of Cherry (census tract 26). Strictly speaking, these locations are the core of a clusters of higher-class turnover. Actual clusters include neighbors a well as the core. In this way, the High-High clusters on Figure 17a/b map known gentrification patterns across the city.

The High-High cluster in 2000 – 2010 (Figure 17a) also near to three spatial outliers that are categorized as Low-High. Two of these clusters are neighborhoods of interest: Villa Heights (census tract 9) and Shamrock (census tract 13). What makes these neighborhoods interesting is that the surroundings tracts have gone through substantial change during this time periods. For instance, Plaza Midwood (census tract 10) saw a rise in the number of bachelors' degrees held by adults from 3.1% in 2000 to 72% in 2017. Moreover, the median household income rose from $39,000 in 2000 to $109,897 in 2017. In the same vein, the neighborhood of NoDa (census tract 14) saw a similar demographic change with from 2000 to 2017, 6.8% to 47.8% of adults holding a bachelor's degree respectively. The median household income of NoDa also jumped from $25,000 in 2000 to $74,000 in 2017. While the neighborhoods of Optimist Park (census tract 7), Belmont (census tract 8), and Chantilly (census tract 11) do not have the same magnitude of change, each document rises in education and household income along the same lines. What makes Villa Heights (census tract 9) and Shamrock (census tract 13) interesting is that these areas have not seen the same turnover in residents moving into the area during 2000-2010. Moreover, Figure 17b, these neighborhoods transition from spatial outliers to locations with no significant local spatial autocorrelation. Instead, spatial outliers in 2010-2016 listed as Low-High clusters are found to the southwest near Wilmore (census

tract 36), center city, and the census tract sandwiched between Midtown (census tract 3) and Dilworth (census tract 34).

Cold spots, Low-Low clusters, are found in the south of the study area in Figure 17a and fan out to the southwest in 2010-2016 (Figure 17b). Cold spots are found in neighborhoods that are further away from the central city where, traditionally, gentrification is less prominent. Moreover, cold spots appear in Charlotte's traditional southern wealth wedge where neighborhoods have a higher rate of populations that are more Caucasian, higher educated, and wealthier (Charlotte-Mecklenburg Quality of Life Explorer, 2021). While the Lynx Blue Line Extension extends into the region containing the hot spot in 2000-2010, this area is no longer a hot spot in 2010-2016. In fact, the hot spot core in Charlotte during 2010-2016 is Cherry (census tract 26) (Figure 17b). Socio-economic data indicate a rise in Cherry along the same lines as the neighborhoods in the previous years with the number of bachelors' degrees held by adults increasing from 40% in 2000 to 54% n 2017. Median household income also increased in Cherry from $33,000 to $55,000 between 2000 and 2017.

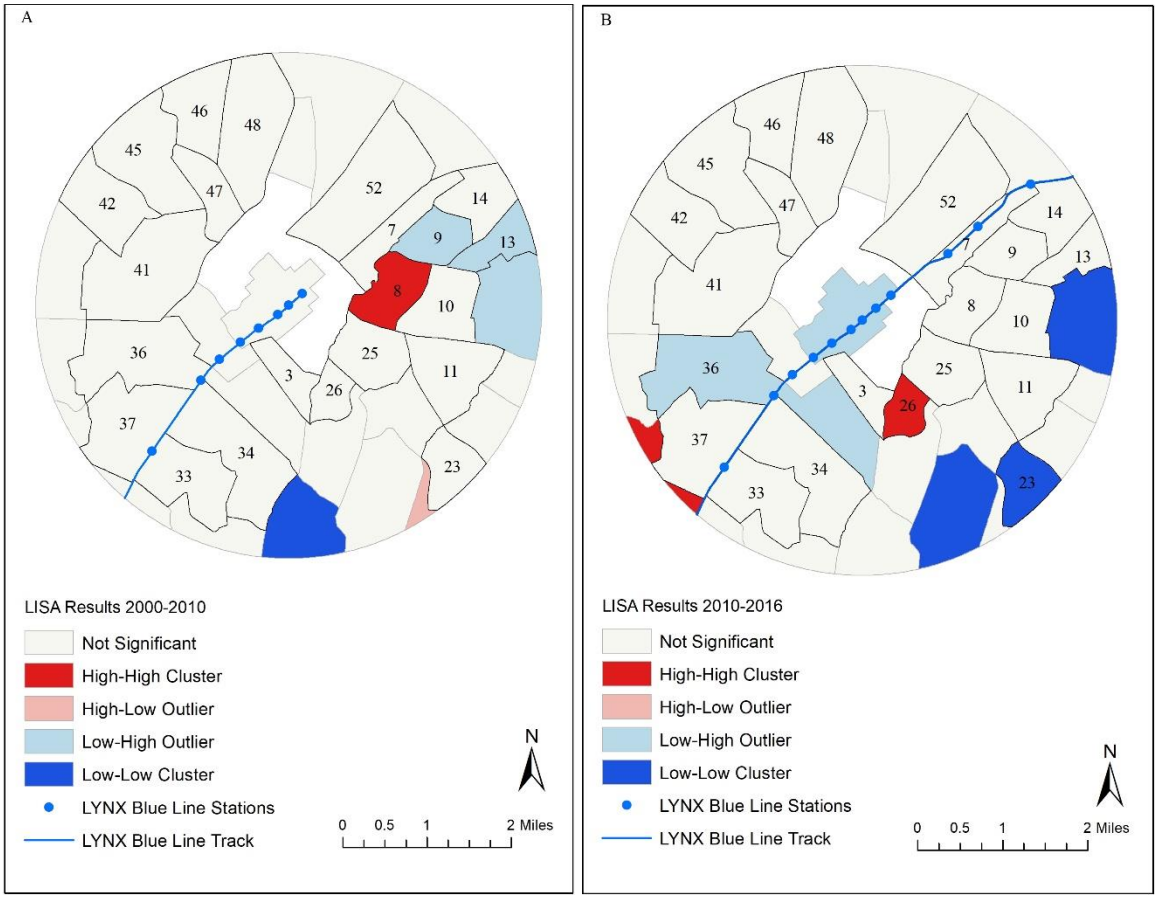


Figure 17. SSI difference LISA results for study area (Numbers refer to census tracts from Table 4)

Overall, Ley's method that uses class turnover through socio-demographic data at the census tract level illustrates two areas of Charlotte that are known to have gone through gentrification. An alternative method to identify gentrification is by using the GI that captures reinvestment in residential properties using real estate administrative data. Table 11 summarizes reinvestment in 7,161 residential properties at the land parcel level over two time periods, 2002-2009 and 2010-2017. A total of 2,211 parcels (M = 2.67, SD = 1.41) had a non-zero GI score between 2002-2009 and a total of 4,950 parcels had a non-zero GI score between 2010-2017 (M = 2.26, SD = 1.18). Table 11 shows that the minimum value of the GI is 1 for both periods with the maximum GI value being 14 and

13 for 2002-2009 and 2010-2017, respectively. Figure 18 illustrates that both time periods include outliers. However, the time period of 2010-2017 records a much higher concentration of outliers.

Table 11. Descriptive statistics comparing GI scores across two time periods

GI (n = 7,161)	2002-2009	2010-2017
Count	n =2211	n =4950
Min	1	1
Max	14	13
Quartile1	2	1.79
Median	2	2
Quartile 3	3	2.76
Inter quartile range	1	0.97
Mean	2.68	2.27
SD	1.42	1.18

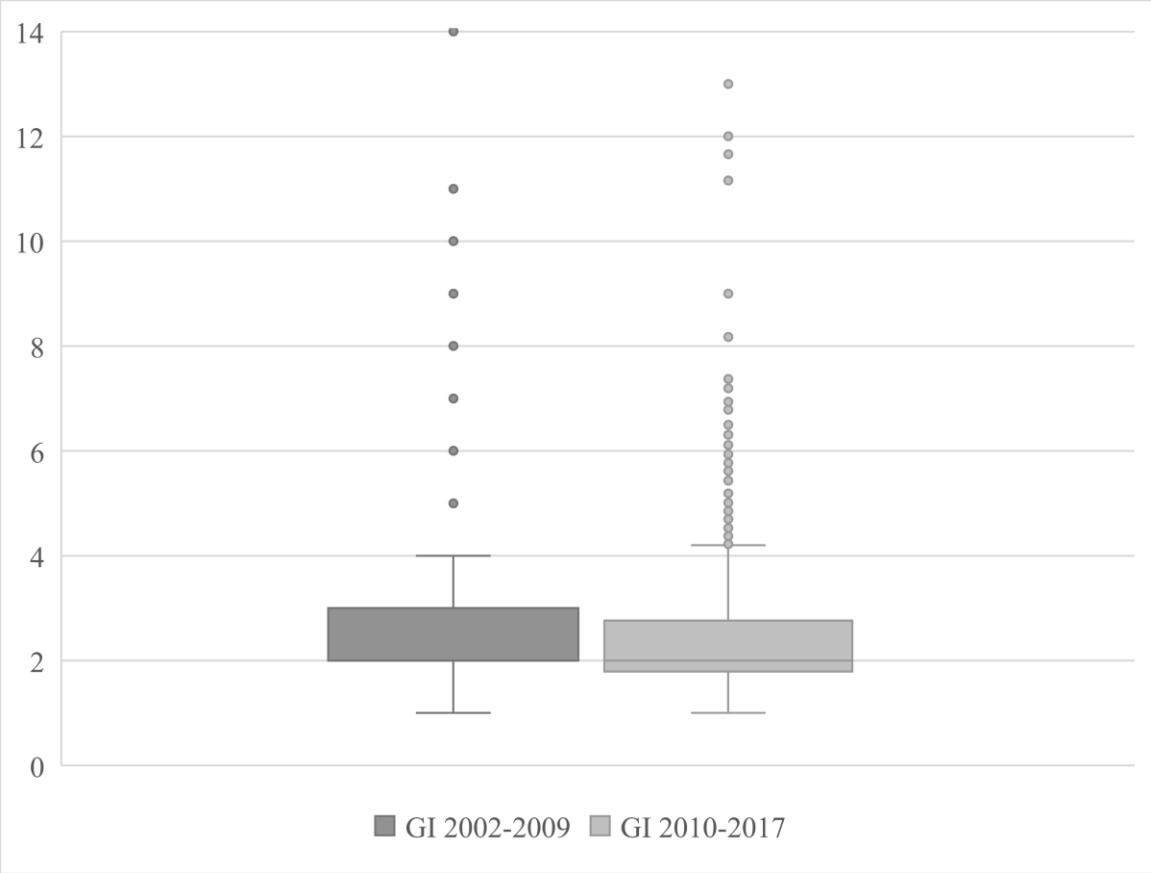


Figure 18. Box plot comparing GI scores across two time periods

The Moran's I statistic is calculated to test for spatial clustering of GI scores. The Moran's statistic (I = 0.19, p = 0.001) for 2002-2009 and the Moran's statistic (I = 0.34, p = 0.001) for 2010-2017 are highly statistically significant and positive. This finding aligns with anecdotal evidence, personal experiences, and city council minutes that residential reinvestment in Charlotte has impacted and continues to impact specific regions more than others. Therefore, the null hypothesis of complete spatial randomness can be rejected, which provides evidence that reinvestment in Charlotte is not a random process.

The LISA statistic is utilized to test for the location of statistically significant gentrification hot spots. To start, Figure 19 maps hot spots (statistically significant at the 95% confidence level, $p < 0.05$) identified by LISA statistics for 2002-2009 and 2010-17. While the typical application of LISA statistics display Low-Low, High-Low, High-High, and Low-High results, the objective of this question is to explore gentrification hot spots. To that end, only High-High clusters from the LISA results will be displayed on the ensuing maps. The red shades represent only High-High clusters identified by the LISA statistics or centroids of residential parcels with high reinvestment next to other similar areas. The gray shades denote centroids of residential parcels. The letters A-I label 9 reinvestment zones formed of multiple clusters found in Charlotte; the blue arrows mark the general direction the reinvestment clusters move from 2002-2009 to 2010-2017.

Findings in Figure 19 map 4 localized reinvestment clusters in east Charlotte during 2002-2009 that form an arch passing through the neighborhoods of NoDa (cluster A), Plaza Hills (cluster B), Plaza Midwood (cluster C), and Chantilly (cluster D). Cluster A, the area of NoDa, started to go into decline around the 1970s when the last textile mill closed. Known as a traditional a blue-collar community, the neighborhood started to change into one known for its various drug houses and adult movie theatres by the 1980s. In the middle of the 1980, a push by the Historic North Charlotte Neighborhood Association tried to revive the area. It wasn't until the 1990s that change started, with the neighborhood now taking on the labeled as Charlotte's art and entertainment district. As demonstrated with the SSI, this change brought a surge of highly educated young adults to the area. However, the neighborhood not only transformed with the population, but also with the built environment.

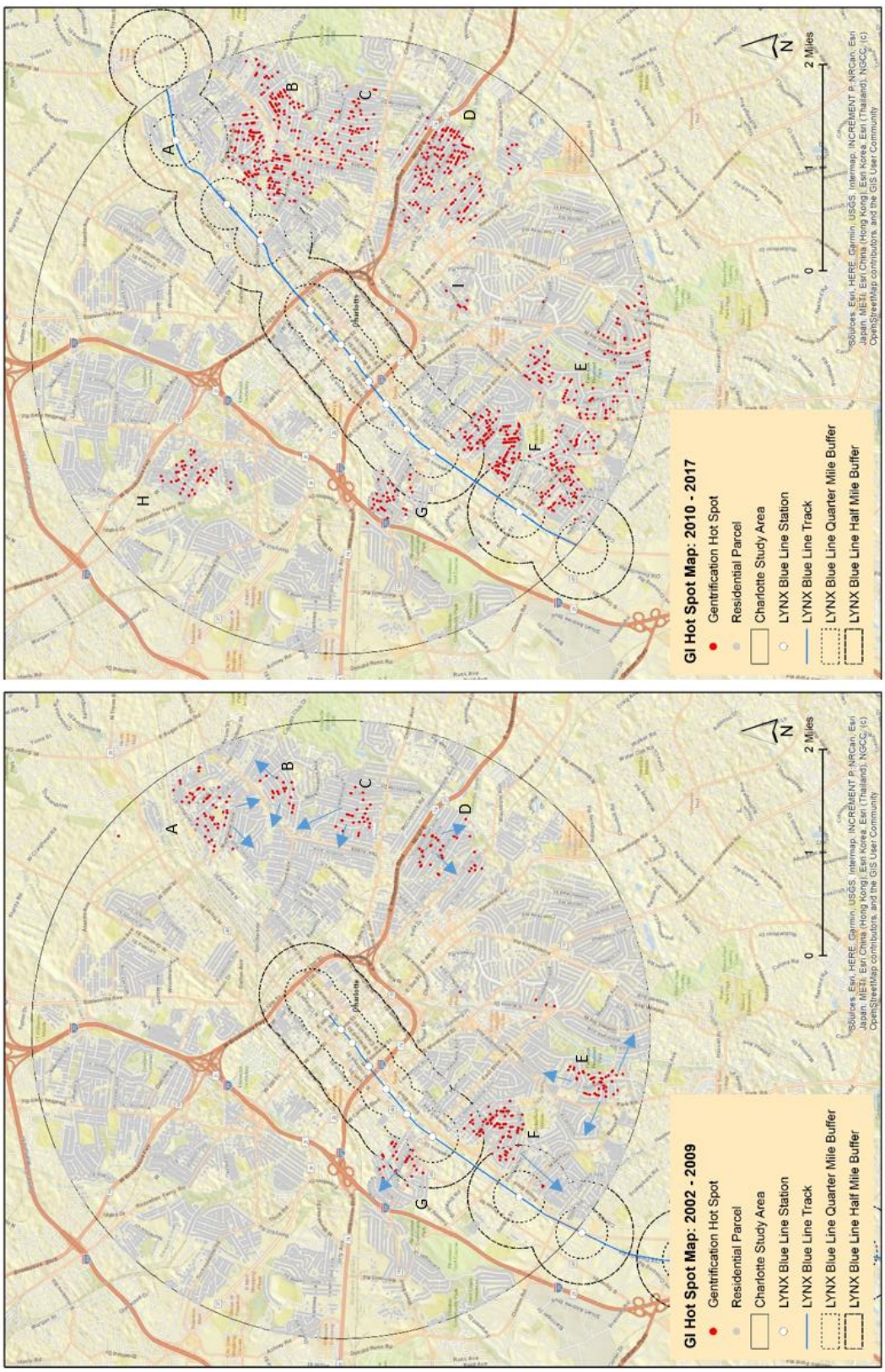


Figure 19. GI LISA hot spots for study area

Figure 20. NoDa luxury condominiums being constructed. Images obtained from Google Street View for 2008 and 2011.

Figure 21. NoDa luxury apartment complex constructed in heart of neighborhoods. Images obtained from Google Street View for 2008 and 2016

Figure 22. NoDa neighborhood gentrification with low income housing demolished for high density townhomes. Images obtained from Google Street View for 2016 and 201

Figure 23. NoDa neighborhood housing boom transforms neighborhood. Images obtained from Google Street View for 2008 and 2017

Figure 20 illustrates luxury condominiums that started to emerge in NoDa in 2008. The construction of luxury apartment complexes soon followed, Figure 21. At first, the apartments were constructed in the heart of NoDa near the neighborhood's amenities. However, towards the end of the study period, Figure 22, apartments have moved toward the edges of NoDa where a mixture of townhomes emerged. Along with luxury high-density construction, a single-family housing boom emerged inside the more residential portion of NoDa. Modest single-story bungalows were gutter/demolished and transformed into luxury homes, Figure 23. Despite reinvestment continuing in the NoDa area, the hot spot from 2002-2009 (cluster A) virtually disappears during 2010-2017. Instead of cluster A intensifying, the NoDa gentrification cluster drifts south into Villa Heights, Belmont and Optimist Park where it overwhelms these neighborhoods with rapid reinvestment in 2010-2017.

Optimist Park has seen substantial growth in access to transportation, retail shops, restaurants, housing developments, and urban amenities. The most notable investment into the region is the $60 million renovation of the previous textile mill Optimist Hall, Figure 24. While this is a new undertaking for Charlotte, Optimist Hall has been a project that is being created though a collaboration of Atlanta-based Paces Properties and White. This reinvestment has given east Charlotte a new center that has pulled both local residents and visitors to the region. Optimist Hall is situated in a very accessible location to both the new light rail and the highway. More importantly, Optimist Hall signaled to developers that the region is ripe to invest in high-density luxury townhomes and apartments. In the area, roughly 1,300 apartments and 500 townhomes have been developed since 2019. Townhomes sold here for more than $500,000, while in 2016, an

average home in the area sold for about $180,000. The concern is that the growth is occurring very close to a cluster of Habitat for Humanity homes that were built for lower-income populations in the Charlotte area, Figure 25. The constant growth has made long-term residents wary of how long they will be able to stay in the neighborhood.

Figure 24. Optimist Hall construction with high-density apartments. Images obtained from Google Street View from 2019.

Figure 25. Optimist Park neighborhood with high density apartment complexes built near light rail station. Images obtained from Google Street View from 2019.

The sustained reinvestment in these communities comes at a time when developers are labeling neighborhoods like Optimist Park or Villa Heights as being at the edge of NoDa, which suggests that homes inside NoDa proper may have become too expensive for reinvestment. Thus, to turn a profit, reinvestment moved into areas close enough to NoDa to still carry the *cache* of being part of the neighborhood, yet far enough away where the areas have not been touched too much by redevelopment. Any land, vacant or occupied, became fair game for investors to speculate where the next investment will occur. The dynamic occurring in Optimist Park and Villa Heights is captivating because gentrification is pushing up against the neighborhoods in two

directions. On the north, reinvestment is spilling over from the NoDa neighborhood, however, to the south, Villa Heights and Optimist Park are also feeling reinvestment pressure from Plaza Midwood.

The neighborhood of Plaza Midwood, cluster C in Figure 19, is another localized area that is undergoing gentrification in 2002-2009. The neighborhood of Plaza Midwood is situated to the east of Charlotte, where it is located directly to the east of the center of Charlotte with two boulevards. Central Avenue – running east to west – is a denser more commercial area of the neighborhood. The more residential street north south running street, The Plaza, is a predominantly single-family residential street that intersects Central Avenue. The major changes in the region have been seen in the area since 2005. Up until that time, The Plaza tended to be more blue collar workers and home to a larger Hispanic community. Changes started with the more commercial districts leasing their space to art type businesses. Then more higher density apartment complexes begam appearing along the east and west of the neighborhood that catered to a higher socio-economic class.

While the SSI insinuated that Plaza Midwood is not a core hot spot, the GI illustrates that Plaza Midwood experiences continual reinvestment. Between 2010-2017, the most iconic image of Plaza Midwood's reinvestment is a small one-story bar called the Thirsty Beaver. This neighborhood dive bar is highlighted by a beloved beaver character wearing a Stetson hat with cowboy boots. The beaver clutches his pint glass and tips his hat while welcoming visitors. Despite its low-key appearances, this establishment, which was surrounded by vacant lots in 2011, is now engulfed on three sides by a multi-story high-rise with 323 new apartments that opened in 2017, Figure 26. With owners who refused to sell, the Thirsty Beaver is a reminder of what Plaza

Midwood once was to residents, a quirky neighborhood where you can go to get away from the monotony of everyday life. With the influx of new apartment complexes, a new completion of residents started to emerge, and the area started to lose its edgy culture. Although developers have made a conscious effort that rising rents do not force people out of the neighborhood, which are around $1,200 in 2018, the residential portion of the area has started to change as well. Houses that were once three or four blocks away from Central Avenue, Figure 27, are now being torn down and rebuilt into luxury homes.

Figure 26. Plaza Midwood neighborhood high-end luxury apartments surrounding the local bar. Images obtained from Google Street View for 2011 and 2017

Figure 27. Plaza Midwood housing boom transforms neighborhood. Images obtained from Google Street View for 2008 and 2016

Although reinvestment hot spots inside cluster C emerge in the south east of the neighborhood, cluster C drifts to the northwest along The Plaza and Central Avenue from 2010 to 2017. The result is that the residential portion of Plaza Midwood is transforming

in a similar fashion as NoDa. As space inside the neighborhood is becoming too expensive for reinvestment, Villa Heights' and Optimist Park's proximity is close enough where reinvestment is able to offer residents access to one or both or Charlotte's most desirable neighborhoods for young professional workers.

In this way, Villa Heights undergoes rampant gentrification in 2010-2017 from both spillover effects from NoDa and Plaza Midwood. Demolitions of older homes made way for the construction of massive single-family homes and high density apartment complexes. No matter the location, homes in Villa Heights were found and transformed into a place that satisfied the needs of the growing workforce. Figure 28 represents two homes on the corner of Matheson Avenue and the Plaza, a dangerous corner of the street that sees constant traffic coming and going. Despite the poor location, these homes were finally transformed by incoming residents who were eager to be a part of east Charlotte's growing community.

Figure 28. Villa Height housing stock being transformed along Matheson Avenue. Google Street View for 2008 and 2019.

A third localized area of reinvestment occurring during 2002-2009 in east Charlotte is cluster B, Figure 19. Although the census tract labels this region as Shamrock, the reinvestment inside cluster B is occurring in a sparsely populated suburban neighborhood called Plaza Hills. While most of the attention is drawn to NoDa and Plaza Midwood, cluster B is an attractive area for many young professionals moving into the city as it is right between the amenities offered in NoDa and Plaza Midwood. What is surprising about this neighborhood is that very rarely has any mention of gentrification been discussed, yet the small neighborhood has seen a high intensity of sustained reinvestment between 2010-2017. The single-family home transformation that occurs in the neighborhood is quite dramatic with entire streets having older homes knocked down and rebuilt, Figure 29. The visual change to the neighborhood illustrates just how strong of a desire there was for living in this part of Charlotte. Plaza Hills, like Villa Heights, continues to see its older housing stock transformed to fill the needs of a growing population. Yet, little attention is being paid to affordable housing in the area.

Figure 29. Plaza Hills housing boom transforms two streets in neighborhood. Google Street View for 2008 and 2019.

The three localized clusters that emerged from 2002-2009, NoDa (cluster A), Plaza Hills (cluster B), and Plaza Midwood (cluster C), morphed into one major sustained reinvestment hot spot that completely changed east Charlotte's complexion from 2010 to 2017. Neighborhoods once clearly defined as artsy or edgy no longer have defined borders with affordable homes for those who want to be a part of that community. Instead, unique areas are being overshadowed by the growth of NoDa and Plaza Midwood that have hollowed out a once affordable housing stock, and replacing it with high-rise condos, luxury apartments and craftsman style homes. As this region becomes more affluent, the challenge will be whether this part of Charlotte can hold on to the character that drew people into these communities in the first place.

Another localized cluster of reinvestment occurring in east Charlotte is the neighborhood of Chantilly (cluster D). Jammed between Plaza Midwood and Meyers Park, Chantilly has become one of Charlotte's most desirable neighborhoods. Chantilly offers residents the appeal of a suburban neighborhood, without being in the suburbs. The neighborhood consists of 691 single-family homes with a small park, but no bars or stores. Despite the lack of amenities inside the neighborhood, Chantilly is rapidly transforming smaller, post-wartime houses into massive craftsman style homes, Figures 30 and 31. Although the neighborhood does not have the brand recognition as NoDa or Plaza Midwood, the neighborhood started to attract young professionals with young children and dual income, no kids-households (DINKs) in the early part of the study's time frame.

The impact is that Chantilly offers a unique case of reinvestment for the region. Anecdotally, redevelopment process inside Chantilly since 2006 involves Chantilly

residents transforming itself. Lacour (2016) identifies this process as the "Chantilly Shuffle" and elaborates on how current Chantilly residents who live in smaller post-war homes would arrange with neighbors to sell and rebuild larger home on nearby Chantilly lots. The sale, demolition, and rebuilt process eventually created a neighborhood where neighbors do not want to move. Instead, Chantilly emerges as a neighborhood where only the young and affluent can afford to purchase the new homes that are being flipped and sold in the $800,000s range by 2017.

Yet, Chantilly does not fit the traditional disinvestment/reinvestment framework that many areas in NoDa and Plaza Midwood illustrate. By comparing the average assessed value per sq foot before renovations in Chantilly and NoDa, two different stories emerge. NoDa, for instance, demonstrates a neighborhood that undergoes a dramatic transformation from a low average assessed value of $\$45/ft^2$ (2002) and $\$73/ft^2$ (2010) to a high average assessed value of $\$158/ft^2$ in 2017. Chantilly's average assessed value illustrates a neighborhood with a relatively high average assessed value of $\$145/ft^2$ (2002) and $\$120/ft^2$ (2010) to $\$194/ft^2$ in 2017. The implication is that Chantilly represents neighborhood transformation of a region that is already prospered. One that has higher socio-demographic residents already inside. However, these changes do have an impact. The impact is that these neighborhoods are transforming into a region that is becoming more exclusive and becoming more expensive.

Sustained reinvestment in this way acts as an indirect form of displacement where Chantilly is now too expensive for most to consider moving into the neighborhood. Moreover, the intensification of cluster D from 2002-2009 to 2010-2017 also demonstrates how secluded the Chantilly neighborhood is from the rest of east Charlotte.

Instead of reinvestment spilling over into neighboring Plaza Midwood, East Independence Blvd. acts as a barricade between the two. East Independence Blvd., however, also acts as the reason why the area is desirable. With close proximity to the center city and a major highway providing access to urban amenities, Chantilly's homes have undergone drastic renovations over the past 20 years.

Figure 30. Chantilly housing boom transforms suburban neighborhood. Google Street View for 2008 and 2019.

Figure 31. Chantilly housing boom transforms suburban neighborhood. Google Street View for 2011 and 2019.

From 2002 to 2009, three additional localized clusters of gentrification emerge in the southwestern Charlotte neighborhoods of Dilworth (clusters F, Figure 19), Freedom Park (cluster E), and Historic Wilmore (cluster G). Dilworth's cluster F is particularly interesting as this region has been heavily impacted by light rail construction. With the introduction of a new urban mass transit option, speculation steadily increased, Figures 32 and 33. Moreover, vacant or land not used was turned into luxury apartment or townhomes in and around the light rail corridor. With a focus on high-density transit-

oriented development, the South End has continued to be transformed into a neighborhood with easy access to Uptown Charlotte full of urban amenities.

The boom in the region started with the opening of a 23-story condo called the Arlington in 2002. According to the Charlotte Center Partners, this one investment signaled a new way of investments over the next 8 years where housing units (3,000) and residential units (5,000) were being built in the thousands. What was once a warehouse district not turned into a place that is home to tens of thousands of residences with an average income of roughly $65,000. Many of the residents who live in this area are part of the young professional class that work in the center city. In 2019, the average rent for an apartment, which is very competitive to find, is roughly $1,600 a month. This residential change in the region favored luxury apartments in the district, which in turn, increased the density and walkability of the region. The reinvestment in the South End also spilled over into the more residential portion of the neighborhood. Major roads such as Ideal Way, once lined with modest low-income homes, were being redeveloped into high-end luxury homes, Figures 34 and 35. However, this type of investment largely eliminated any type of affordable housing geared at the lower socio-economic residents in the Charlotte area.

Figure 32. Dilworth luxury apartments constructed near light rail part of South End boom. Google Street View for 2007 and 2009.

Figure 33. Dilworth luxury apartments constructed near light rail part of South End boom. Google Street View for 2014 and 2018.

Figure 34. Dilworth housing boom transforms suburban neighborhood. Google Street View for 2008 and 2019.

Figure 35. Dilworth housing boom transforms suburban neighborhood. Google Street View for 2008 and 2019.

Another cluster of sustained reinvestment is found just south of Dilworth. Freedom Park (cluster E) is a dense suburban neighborhood that offers a wide variety of amenities. Most of the economic activity is centered around East Blvd. The stretch of East Blvd. in Freedom Park, also known as Charlotte's "Restaurant Row", mostly features estate-like, single-family homes. The further south inside the neighborhood, the more multi-family and single-family houses emerge. Although the region is known for homes selling well into the millions, pockets of Freedom Park are drastically different from one another, particularly the low-density single-family homes west of the park itself. What makes this region particularly interesting is that as Freedom Park continues to be claimed

as Charlotte's premiere neighborhood, more and more people flock to the region. This surge of reinvestment has driven up housing prices in the neighborhood, which is also associated with a steady increase of demolitions in the region during 2010-2017. The patchwork nature of reinvestment occurring in Freedom Park has transformed any vestige of affordable homes into region that is beginning to look and feel similar to that of Charlotte' affluent southern wedge, Figure 36. Over the past 16 years, Freedom Park has increasingly become a place where affordable housing is hard to find.

Figure 36. Freedom park pockets of gentrification transforms suburban neighborhood. Google Street View for 2007 and 2016.

Similar to the east of Charlotte, reinvestment in clusters E and F coalesced from 2002-2009 to 2010-2017. However, instead of one of the clusters disappearing as seen with the NoDa cluster, cluster F intensifies around Dilworth and pushes south into neighboring Sedgefield. Sedgefield is also where clusters F and E fan out across the community. The surge in reinvestment is also associated with a high number of demolitions in the area. This type of reinvestment in an important indicator of changing housing sock that, in turn, has renewed gentrification concerns across this portion of Charlotte. As seen in Figures 37 and 38, Sedgefield's housing stock is now being replaced by a combination of luxury homes and high-end apartment complexes.


Figure 37. Sedgefield gentrification transforms suburban neighborhood. Google Street View for 2007 and 2016.

Figure 38. Sedgefield gentrification transforms suburban neighborhood. Google Street View for 2007 and 2016.

The final spatial cluster of gentrification emerging in Charlotte from 2002 to 2009 is the historic neighborhood of Wilmore (cluster G). Wilmore is one of the fastest growing neighborhoods in Charlotte, gaining popularity as a more affordable alternative to Dilworth. With several stops on the LYNX light rail and proximity to Charlotte's center city, Wilmore offers a setting in an historic neighborhood that offers a mix of refurbished bungalows that stand beside new homes that took the place of dilapidated properties that were torn down years before. The challenge in this area is that many elderly, low-income people continue to live in Wilmore, not wanting to move from the homes they grew up in.

As Wilmore's initial reinvestment was closer to the new light rail line, the reinvestment in 2010-2017 pushed deeper into the neighborhood. Reinvestment in Wilmore is no longer in the form of refurbished bungalows. Instead massive apartments

complexes are dotting the neighborhood. The dynamics occurring in Wilmore have gone from the very definition of poverty to places where a house once labeled a "ghetto shack" is now on the market for $500,000. Nowhere is the change in west Charlotte more dramatic than the community of Brookhill. This has been constantly battling reinvestment concerns with the plan to demolish a low-income community of Brookhill Village near the major highway I-77. The plan has been to tear down the older community and replace it with office space and luxury condominiums (Kaminer & Portillo, 2017). As Figure 39 depicts, the low-density low-income community of Brookhill has luxury apartment complexes being constructed across the street, buttressing against their neighborhood. As the neighborhoods of Wilmore and Dilworth continue to grow, communities such as Brookhill Village townhomes stand in direct opposition to what the future of the developers envision for the area. Yet, with little alternative for residents inside these homes, the future remains uncertain as to whether they will be able to stay put or eventually will have to move out.

Figure 39. Brookhill neighborhood housing boom raises fears of gentrification. Images obtained from Google Street View for 2016 and 2020.

Lastly, two smaller spatial clusters of reinvestment can be observed in the study area from 2010-2017. Cluster H appears near Johnson C. Smith, a private, historically Black university in Charlotte. The sustained reinvestment occurs at the intersection of three neighborhoods – Wesley Heights, Seversville, and Biddleville – that historically

were dilapidated and littered with abandoned homes. Many of these properties had housing values of roughly $10,000-$15,000. These same homes are now being resold for over $700,000. However, in these particular neighborhoods, the sight of a whiter population moving in and building half-million dollar houses evokes a controversial legacy. In the 1960s the urban renewal that followed Jim Crow segregation in Charlotte displaced several thousand Black community members. Many of those residents settled in areas near cluster H.

As Figure 40 indicates, contrary to Charlotte's City Council's evaluation of gentrification being an issue of class rather than race (CCCHNDC, 2014, June), these neighborhoods have seen drastic racial changes, Figure 41. Consistent with Freeman and Cai (2015), decaying, older housing stock and warehousing facilities have been transformed into the city's most desirable communities inside majority Black neighborhoods. Concerns of property tax increases and population displacement have been on the rise throughout Charlotte, where Black neighborhoods have been transformed by single-family residential development and luxury condos high-rises and townhomes. This concern is also occurring in Cherry (cluster H), another of Charlotte's historic Black communities.

Reinvestments in Cherry have drastically changed the complexion of the area. The introduction of The Metropolitan in the area of Midtown (Census tract 3) introduced high end retail to the area along with luxury condominiums in 2009. The goal of the development was to bring new box stores into that area that include Stables, Target, Best Buy, and Trader Joe's. This investment has been welcomed by city leaders, who took the opportunity to invest in sidewalks and the built environment to create green space

development in the area. Two additional investments, the Gold Line Streetcar and the Sugar Creek Greenway, add to the urban changes that are being seen in the region. The result is that in 2018, newer houses and luxury apartment complexes started to outnumber the traditional residents in the area. Many who lived in income adjusted homes.

Figure 40. Cherry neighborhood reinvestment. Images obtained from Google Street View for 2016 and 2020.

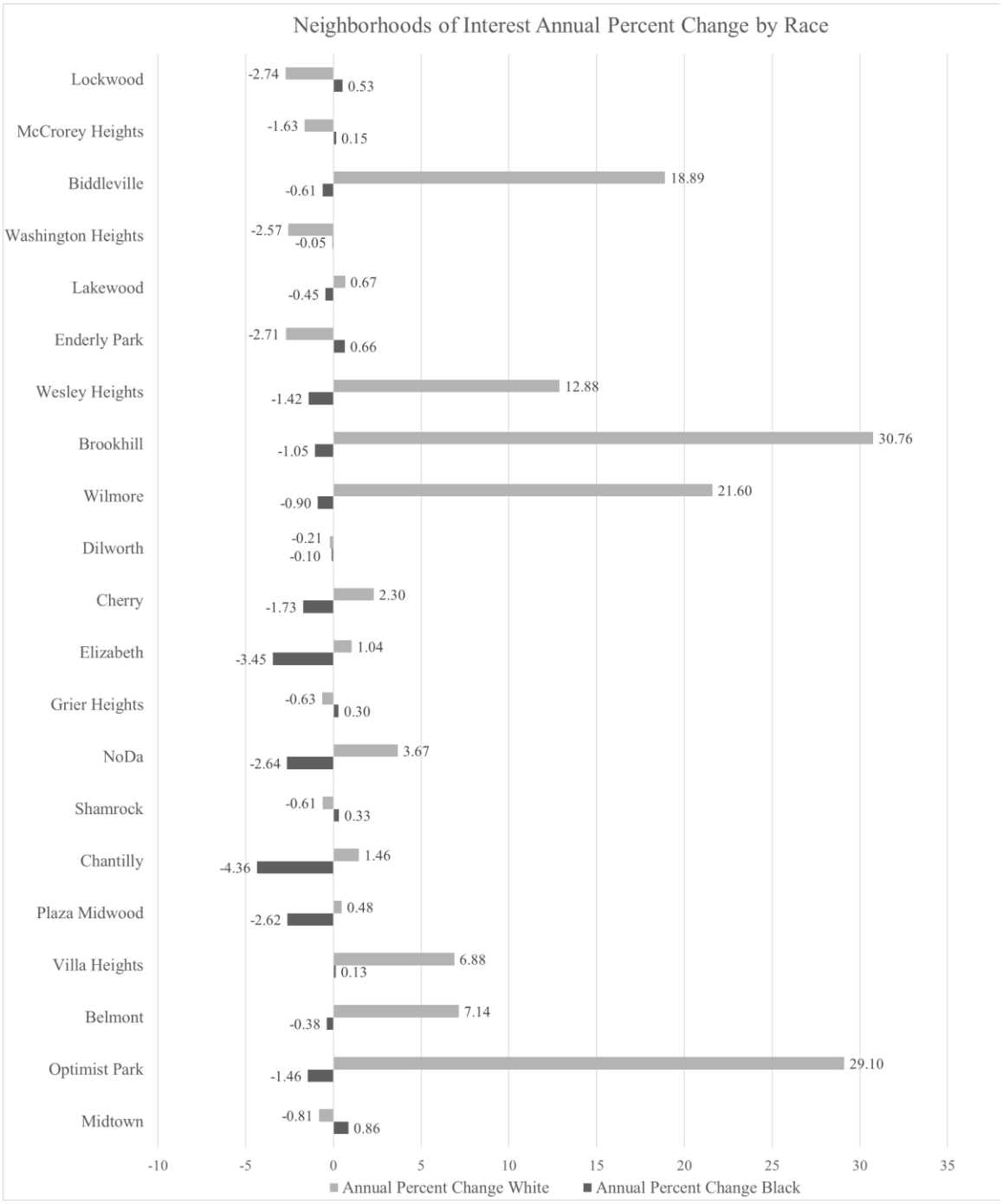


Figure 41 . Annual percent change by race in Charlotte neighborhoods of interest, 2000-2017

Although the two indices presented in this dissertation measure different outcomes (SSI highlights class turnover and GI identifies housing stock renovation/reinvestment), Figure 42 overlays GI hot spots, SSI results, and the neighborhoods of interests. The figure indicates certain areas experiencing reinvestment highlighted by the GI in Sedgefield (census tract 33), Dilworth (census tract 34), Shamrock/Plaza Hills (census tract 13) and Plaza Midwood (census tract 10) that the SSI does not capture. Additionally, the SSI does not capture reinvestment occurring near Johnson C. Smith (census tracts 45 & 47) or historic Wilmore (census tract 41), where the GI highlights a small cluster of sustained reinvestment happening.

Despite the SSI highlighting areas in Optimist Park (census tract 7), Belmont (census tract 8), Villa Heights (census tract 9), and NoDa (census tract 14) as undergoing high class turnover, the GI identifies a higher intensity of reinvestment occurring in Villa Heights compared to the other neighborhoods in the area. Conversely, the SSI captures high class turnover occurring in Midtown (census tract 3) Brookhill, (census tract 37), and Wesley Heights (census tract 41) neighborhoods, whereas the GI does not identify statistically significant reinvestment in these regions.

Given these mismatches, the GI offers a more precise manner to identify small clusters of changes consistent with gentrification in the study area. The GI more precisely traces the spread of gentrification as part of larger ensembles of neighborhood change that spills beyond the border of census units. In doing so, we can see how the overall change in Charlotte impacts vast portions of the region in a more dynamic way. This is particularly true for the neighborhoods of interests where it is important to see the localize impacts of reinvestment and how it has changed over time.

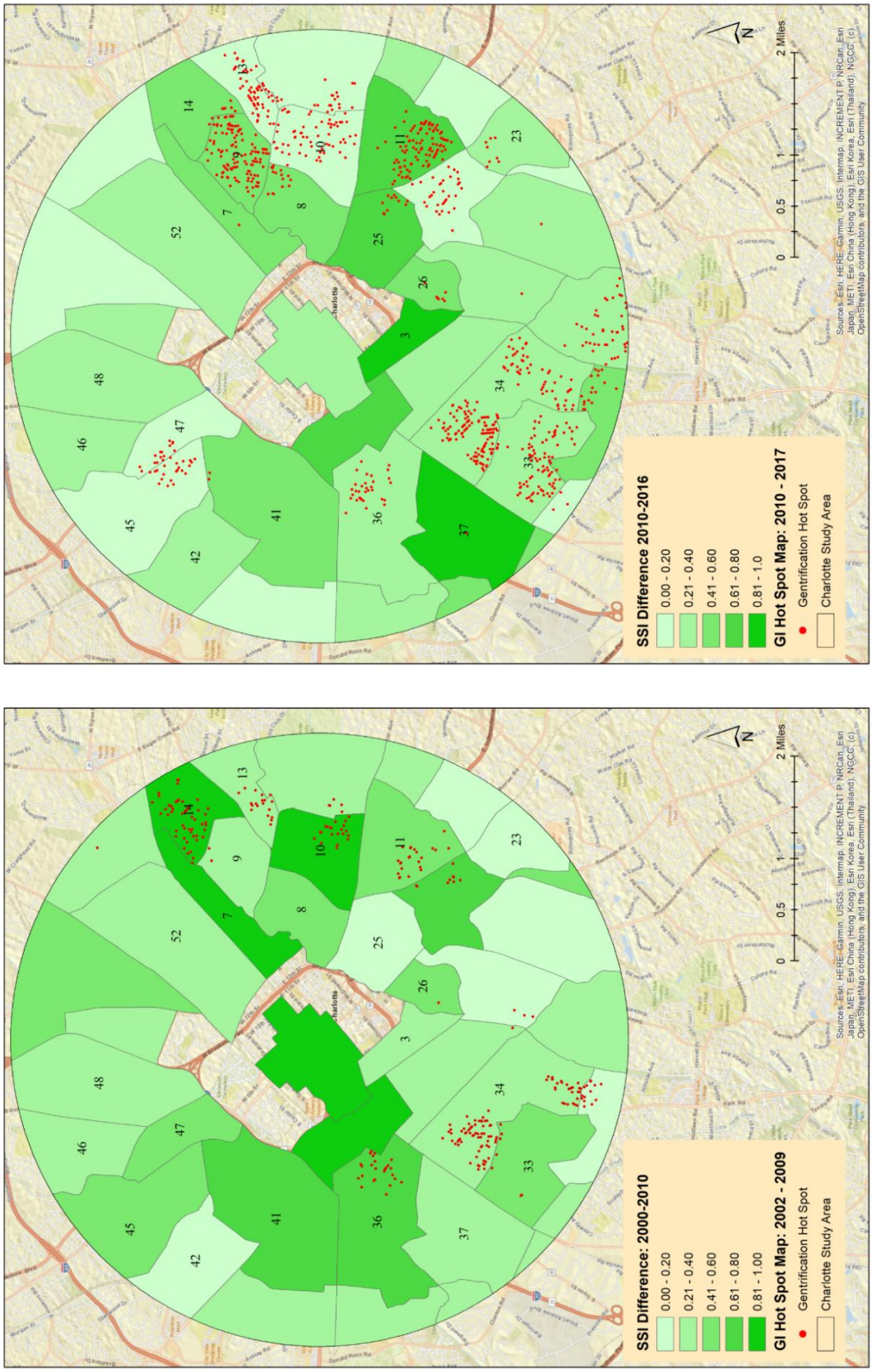


Figure 42. Combined SSI and GI hot spot map

5.2 Research Question 2 Results: Dynamic spatial pattern of gentrification

The GI's distribution a vast set of neighborhoods across the region in the study area. This raises the question of how the process of gentrification spread over time in the region. This question is addressed by examining the spatial extent and location of GI clusters from 2002 to 2017. To map the process, LISA results are first calculated, then the cluster maps are created to identify the investment for each year. The annual changes in location of the GI hot spots are described below.

From 2002-2017, the reinvestment clustering increased annually – a positive annual Moran's *I* with an increasing trend from 0.205 in 2002 to 0.460 in 2017, Table 12. Out of the 16 time periods, 13 years are significant statistically at the 95% confidence level, $p < 0.05$. Only three years do not yield statistically significant results: 2003, 2009, and 2013.

Table 12. Annual global Moran's *I*

Year	I	P-value	Year	I	P-value
2002	0.205*	0.003	2010	0.191*	0.060
2003	0.135	0.054	2011	0.540*	0.001
2004	0.134*	0.016	2012	0.236*	0.001
2005	0.103*	0.006	2013	0.023	0.059
2006	0.145*	0.340	2014	0.156*	0.049
2007	0.409*	0.001	2015	0.632*	0.001
2008	0.253*	0.002	2016	0.333*	0.001
2009	0.150	0.293	2017	0.460*	0.001

* significant at $p < 0.05$

To test for the existence of clustering of gentrification, the Moran's *I* statistic was calculated on the longitudinal changes in the GI. Figures 43-50 maps only hot spots identified by LISA statistics for 2002-2017. The red shades represent centroids of residential parcels with high reinvestment next to other similar areas. The gray shades represent centroids of residential parcels that have undergone statistically significant reinvestment in previous years. The letters A-I indicate Charlotte's 9 reinvestment clusters elaborated on in the previous section.

Over the course of 2002-2017, reinvestment started to emerge primarily to the East of the city in the Plaza Midwood neighborhood. The process takes a slight shift towards the Center City in 2003, but also becomes sparser across the study area. In 2004, reinvestment shifts to the south where clusters D (Chantilly), F (Dilworth), E (Freedom Park, and G (Wilmore) emerge for the first time. However, in 2005, cluster A flares up in NoDa. Although cluster A dominates the map, Historic Wilmore (cluster G) experiences sustained reinvestment as the pocket of reinvestment spreads towards the light rail line. Just as quickly as cluster A emerges, NoDa's reinvestment cluster cools in 2006. Although the East of Charlotte does not contain any hot spots, Dilworth's (cluster F) reinvestment heats up in the south along the East/West Boulevard light rail station's half-mile buffer. The radical shift from one end of the study area to the other effectively sets the stage for Charlotte's first reinvestment peak.

Before the great recession of 2008, Charlotte had 6 local clusters of reinvestment intensifying. NoDa's Cluster A in the northeast and Dilworth's cluster F in the southwest lead the way. Dilworth's reinvestment (cluster F) drifts south ever closer to the New Bern Light Rail Station and spreads along two main roads, Magnolia Avenue and Ideal Way.

Here, older residential communities are seeing the complexion of their neighborhood start to change. Massive single-family homes are emerging as islands of prosperity in a sea of run-down post-war housing. Freedom Park (cluster E), on the other hand, is experiencing reinvestment in parts of the suburban community where million-dollar mansions are replacing modest one-story homes. Freedom Park is rapidly transforming into an upscale community where living in the area is no longer an option for most residents of Charlotte. As Freedom Park is on its way to an upscale community, Wilmore (cluster G), experiences another wave of reinvestment inside the residential portion of the neighborhood. An area once labeled too dangerous to live is now becoming a magnet for residents looking for affordable bungalows close to the center city.

At the same time, cluster A reemerges in NoDa. The reinvestment in cluster A concentrates in the residential portion of the neighborhood and shifts south towards Optimist Park and north towards the outer edge of the community. The activity in East Charlotte is also heating up in Plaza Hills (cluster B) and Plaza Midwood (cluster C). During 2007, Plaza Hills (cluster B) sees a surge of reinvestment for the first time that transforms entire blocks with massive craftsman style homes. Although the same transformation is also occurring in Plaza Midwood (cluster c), reinvestment in this neighborhood is not as concentrated in 2007. As reinvestment starts to cool down in 2008 with the great recession, the dumbbell pattern of reinvestment continues in the east and southwest across Charlotte. The main difference is that Dilworth (cluster F) and Wilmore (cluster G) experience more concentrated sustained reinvestment, whereas east Charlotte's reinvestment sees Plaza Midwood (cluster C) and Plaza Hills (cluster B) drift west and merge at the border of their respective neighborhoods. Despite reinvestment

cooling considerably in 2009 across Charlotte, parts of Dilworth (cluster F), Chantilly (cluster D), and Plaza Midwood (cluster C) remain active during the nationwide recession.

While cluster A in NoDa reactivates in 2010, it quickly cools back down in 2011. Yet, concentrated reinvestment resurfaces in Dilworth (cluster F) in 2011 with a small pocket of reinvestment emerging in Chantilly (cluster D) and Wilmore (cluster F). With NoDa's cluster A remaining inactive in 2012, the two clusters of Chantilly (cluster D) and Dilworth (clusters F) experience a surge of activity. As reinvestment in Dilworth (cluster F) starts to fan to the north and south of the community, Chantilly (cluster D) experiences a strong concentration of reinvestment inside the neighborhood before cooling off in 2013. With sporadic reinvestment occurring in Plaza Midwood (cluster C) in 2013, the most dynamic activity occurs in Dilworth (cluster F). A wave of reinvestment surges south from Dilworth in 2013 where it dives into the Sedgefield community in 2014. However, in 2014, a small pocket of reinvestment emerges in the historical black community of Cherry (cluster I) for the first time. As 2014 ends, the second peak of citywide gentrification is about to begin.

Reinvestment lights up across Charlotte in 2015. With the central portions of NoDa (cluster A) and Plaza Midwood (cluster C) effectively gentrified, reinvestment pushes into Villa Heights and Plaza Hills where modern and craftsman style homes are being erected with near masterful efficiency. Chantilly (cluster D) experiences the same intensity of reinvestment with demolitions occurring at a higher rate than in almost any other neighborhood. Moving south to Dilworth (cluster F), a surge of reinvestment

concentrates between Ideal Way and East Blvd. A compact area of reinvestment also appears near Johnson C. Smith University. Cluster H emerges for the first time.

Despite the intensity of gentrification dipping across the region in 2016, East Charlotte continues to see dynamic reinvestment activity. As NoDa's original cluster A washes over the remnants of Villa Heights, reinvestment emerges further south into neighboring Belmont. Plaza Hills (cluster B), on the other hand, continues to experience neighborhood wide change south of The Plaza. At the same time, Dilworth's original cluster F continues to shift south more into Sedgefield. Additionally, in the north, cluster H disperses and pushes south into Seversville, a majority Black community near Wesley Heights.

The third peak of reinvestment is the most intense wave that hits Charlotte in 2017. East Charlotte's original clusters A (NoDa), B (Plaza Hills), and C (Plaza Midwood) converge where the four neighborhoods meet along The Plaza and Parkwood Avenue. Dilworth's original cluster F fans into the Sedgefield community and reemerges between Ideal Way and East Blvd. Chantilly (cluster D) reappears and drifts to the southeast portion of the neighborhood. The smaller clusters of historic Wilmore, Johnson C. Smith and Cherry also resurface with sustain reinvestment impacting a larger portion of these communities.

While Charlotte continues to experience gentrification, one of the city's biggest challenges will be to track and identify where spatial patterns are consistent with trends occurring on the ground. While the SSI does capture class turnover through socio-demographic data, this method misses year-by-year, more nuanced changes provided by the GI that captures reinvestment in residential properties using real estate administrative

data at the tax parcel level. At a time when urban areas are changing rapidly, and considering how to accommodate future growth, an understanding of outcomes based on the scale where gentrification unfolds is critical to crafting more effective public policy. However, the SSI's limitation should not dispel the importance of capturing class turnover through socio-demographic data. Instead, the findings indicate that identifying how gentrification unfolds requires a more holistic understanding of urban change. In this way, the SSI and GI are most effective in combination with each other to identify gentrification at multiple scales. Combined, these methods provide a richer context of place for gentrification analysis.

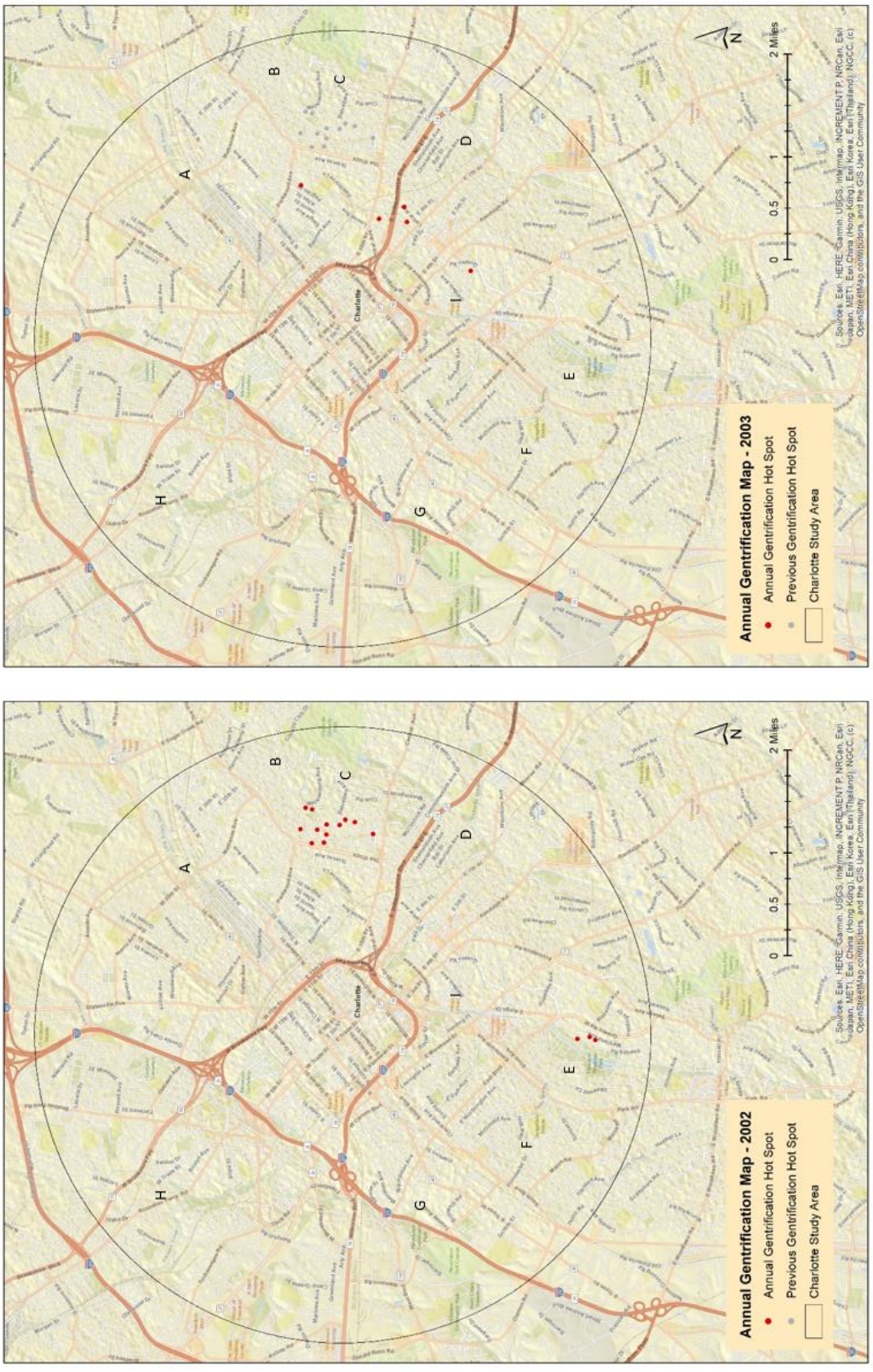


Figure 43. Annual GI hot spot maps: 2002–2003

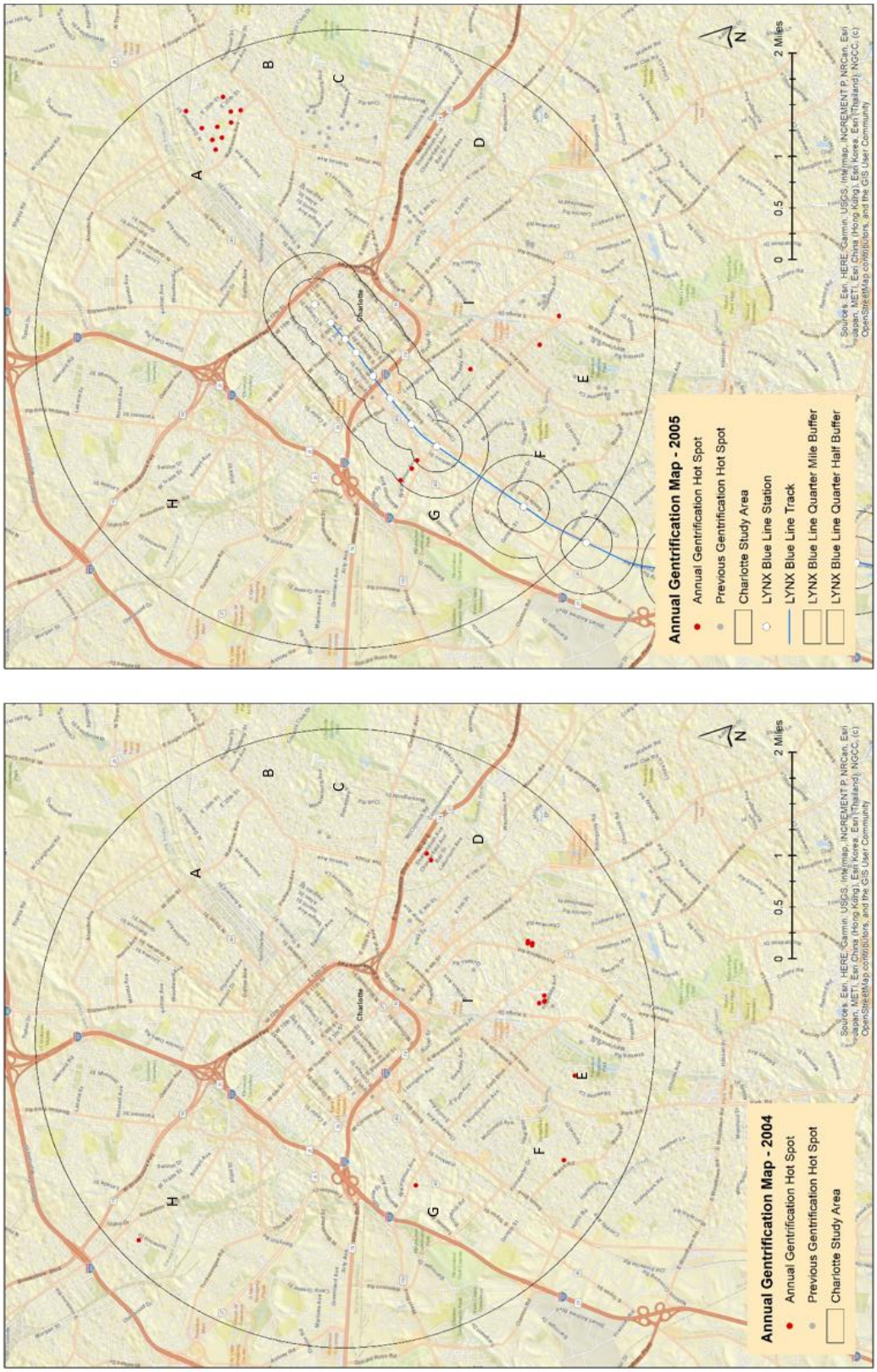


Figure 44. Annual GI hot spot maps: 2004-2005

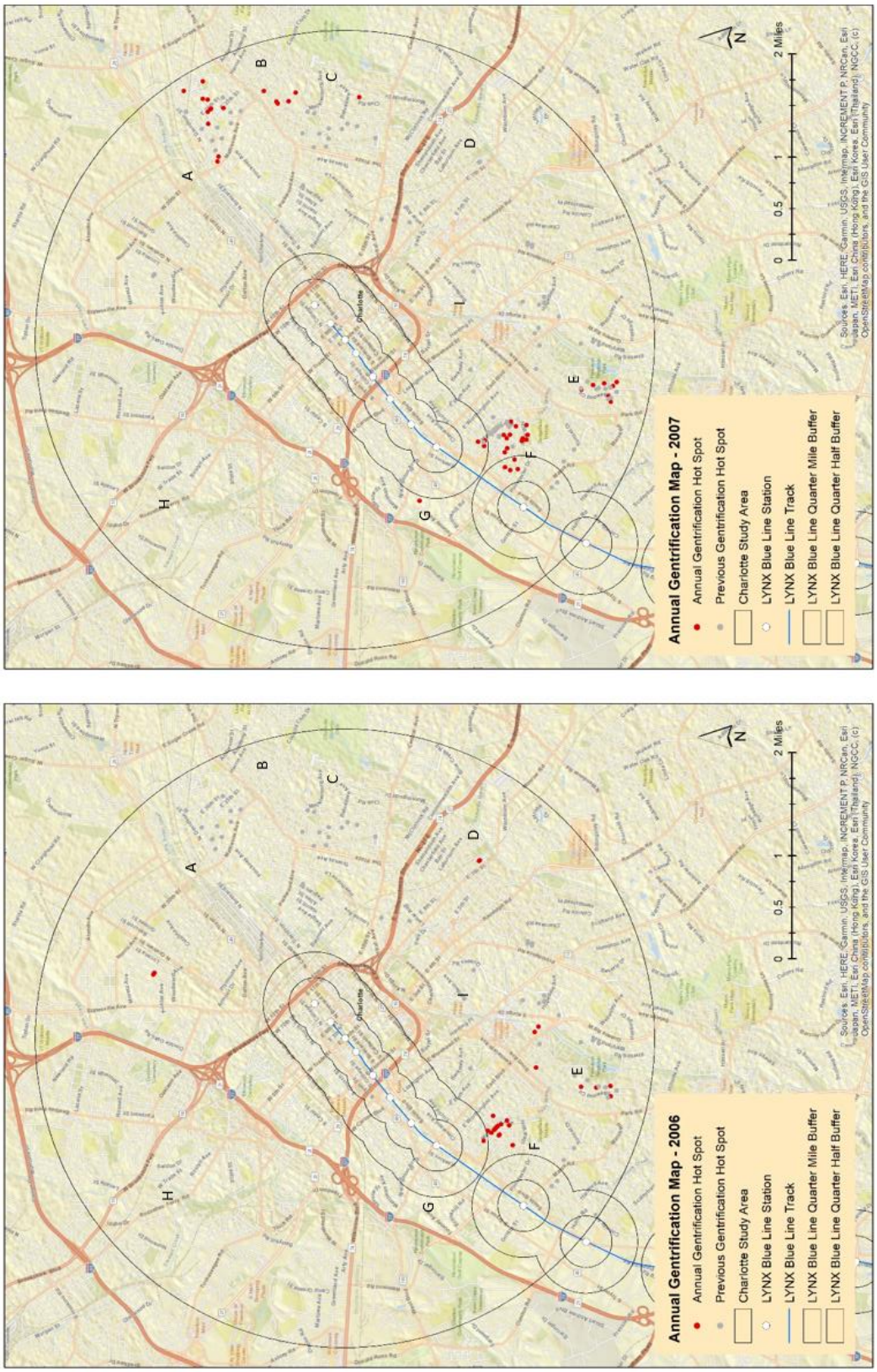


Figure 45. Annual GI hot spot maps: 2006-2007

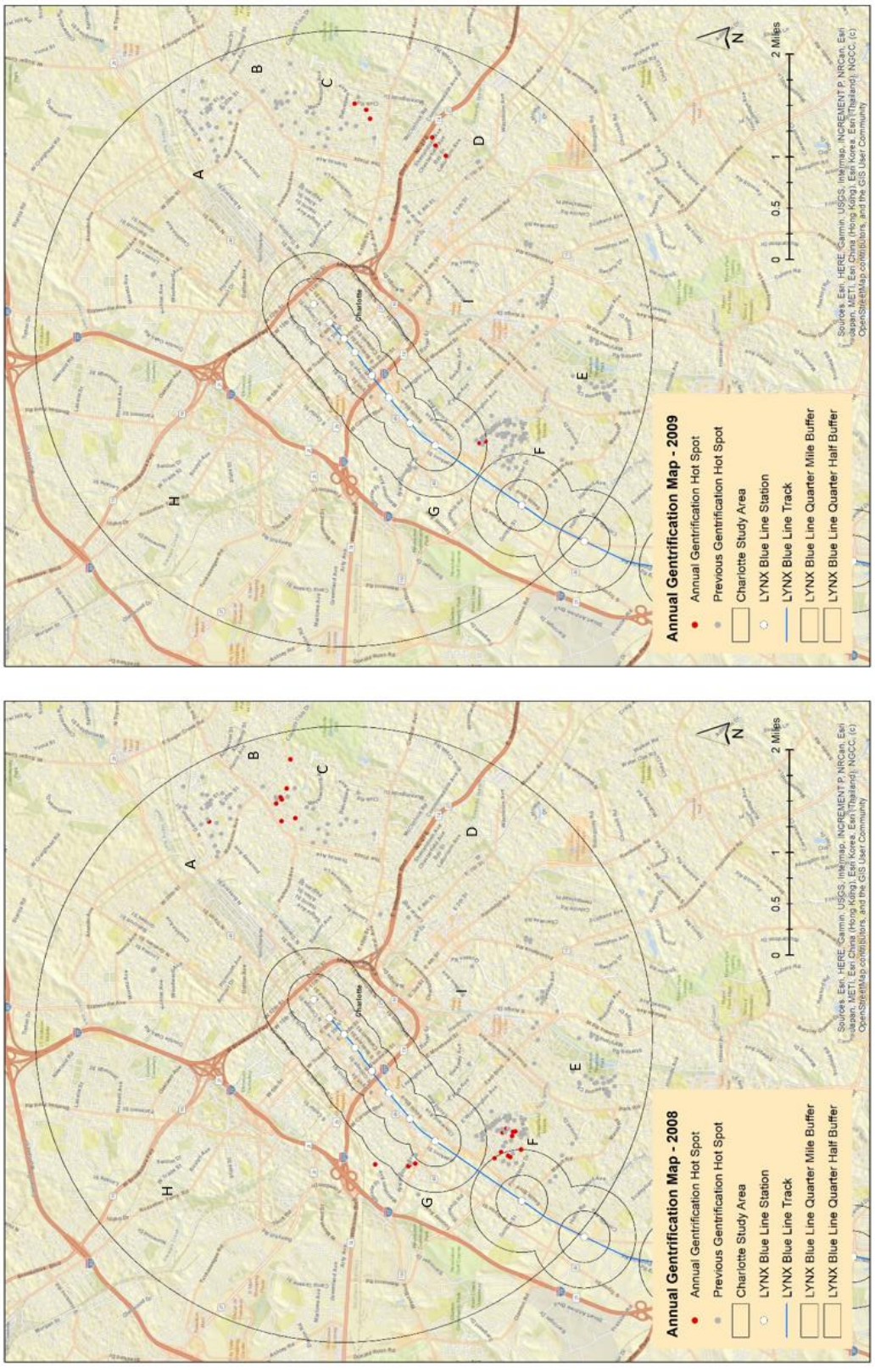


Figure 46. Annual GI hot spot maps: 2008-2009

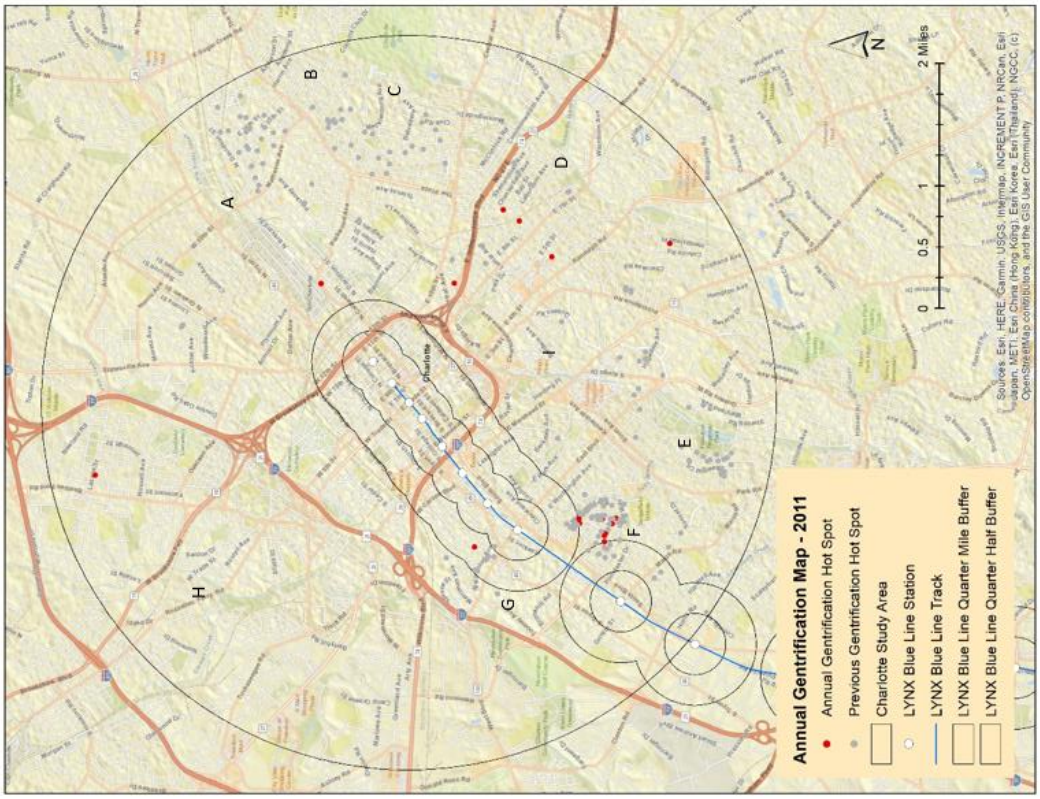


Figure 47. Annual GI hot spot maps: 2010-2011

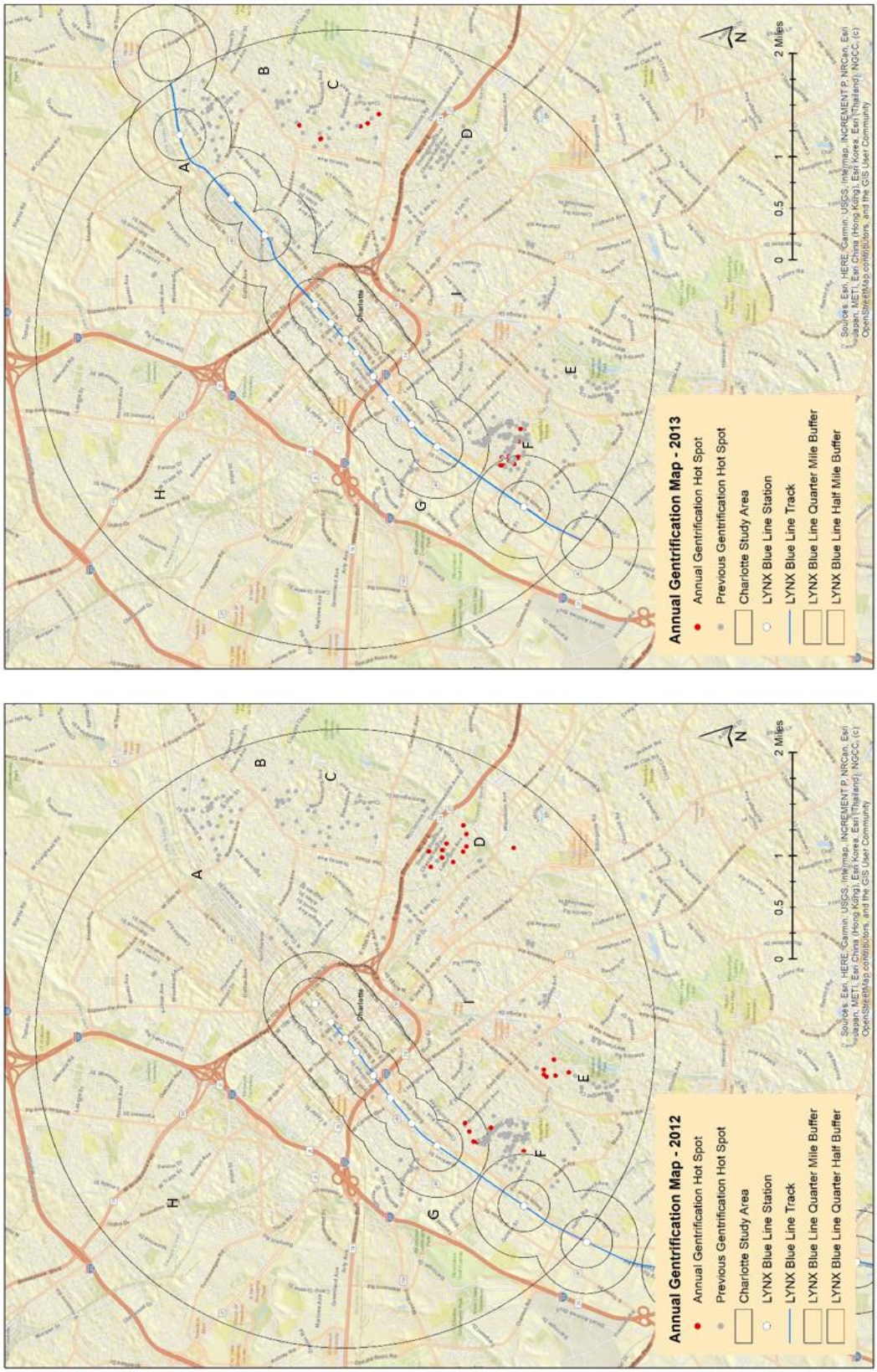


Figure 48. Annual GI hot spot maps: 2012-2013

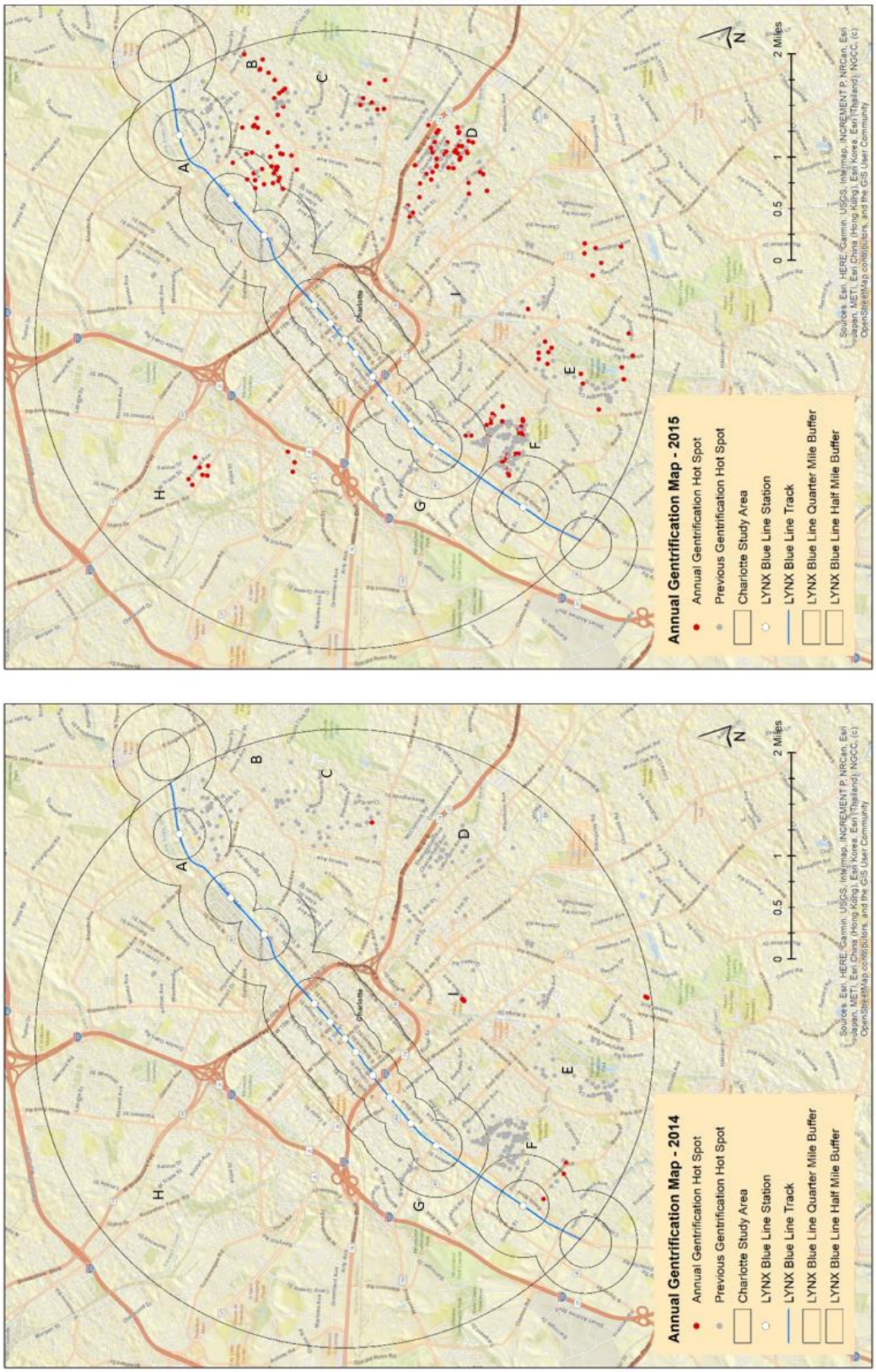


Figure 49. Annual GI hot spot maps: 2014-2015

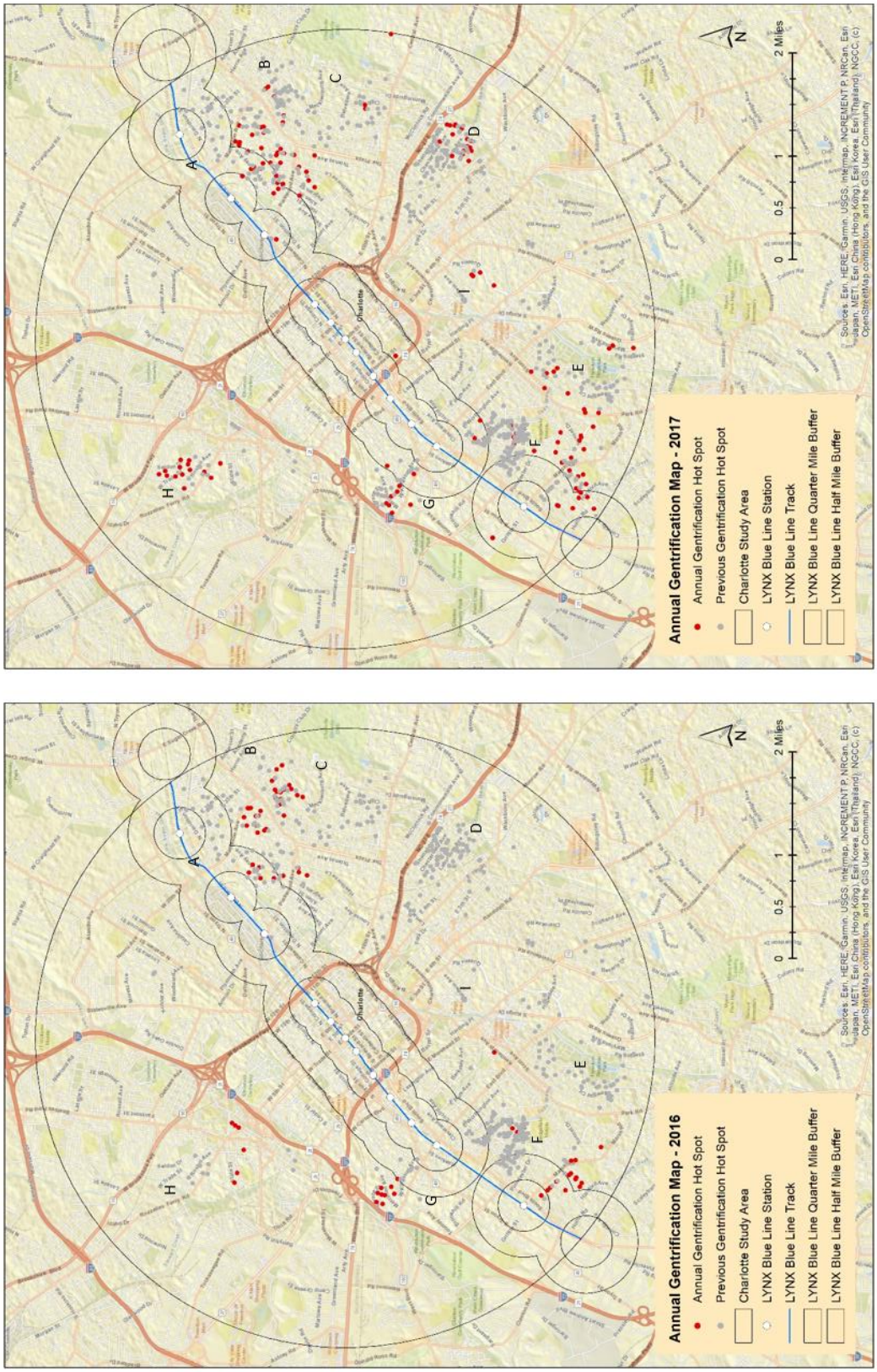


Figure 50. Annual GI hot spot maps: 2016-2017

5.3 Research Question 3: Differing spatial scales of gentrification

A comparison of spatial scales is used to determine what outcomes arise based on the granularity at which gentrification is measured. To address this question, the GI, at the tax parcel level, will be aggregated to two other spatial scales: census blocks and block groups. To test for statistically significant local clusters and compare the outcomes across spatial scales, the LISA statistic is utilized. Figure 51 maps hot spots identified by LISA statistics for 2002-2009 and 2010-2017. The red shades represent centroids of residential parcels with high reinvestment next to other similar areas.

To start, Figure 51c revisits parcel level findings from 2002-2009. LISA results identify 9 hot spot clusters across Charlotte labeled A-I. Using Figure 51c as our reference group, Figure 51b identifies LISA results based on census blocks from 2002-2009. Findings reveal that clusters A (NoDa), B (Plaza Hills), C (Plaza Midwood), D (Chantilly), and G (Wilmore) remain hot spots for census block areal units. However, when the same 5 clusters are examined in Figure 51a where the unit of observation is the census block group, LISA hot spots disappear. A similar process unfolds when cluster H (Johnson C. Smith) is examined. Although a hot spot is identified with the parcel level data in Figure 51c, the hot spot is no longer highlighted at the census block (Figure 51b) or block group (Figure 51a) level. While the block group level does pick up LISA hot spots near cluster F (Dilworth) and cluster E (Freedom Park), the census block and tax parcel levels provide a more precise measurement of gentrification patterns across Charlotte for 2002-2009.

Figure 51f identifies parcel level findings from 2010-2017. LISA results identify that the intensity of gentrification across Charlotte during this period surged in each of

the nine clusters. Similar to the pattern that emerged for 2002-2009, the census block groups pick up the general pattern of gentrification that emerges across the study area. However, at the block group level, cluster H (Johnson C. Smith), cluster H (Wilmore), cluster I (Cherry), and cluster D (Chantilly) no longer are highlighted as hot spots. Therefore, even as the intensity of gentrification increases across Charlotte during this time period, the block group level continues to provide imprecise measurements of known patterns of gentrification.

Detecting and examining outcomes based on the granularity at which gentrification is measured is an increasingly important topic when quantifying gentrification. Although errors concerned with aggerating data to multiple spatial scales is studied in many geography fields, few (if any) examine how this process affects gentrification analysis. For instance, when aggregating data to spatial units, error is introduced into the analysis by smoothing location variation. This, in turn, creates measurement errors. This then leads to invalid estimations that incorporates the newly aggregated spatial variables. Thus, gentrification research that wants to identify how the process unfolds can negatively impacted by errors associated through aggregation. Results show major disparities from gentrification hot spots calculated from parcel data, demonstrating errors in spatial aggregation can impact gentrification measurements that can lead to considerable underreporting of the magnitude of gentrification across the city.

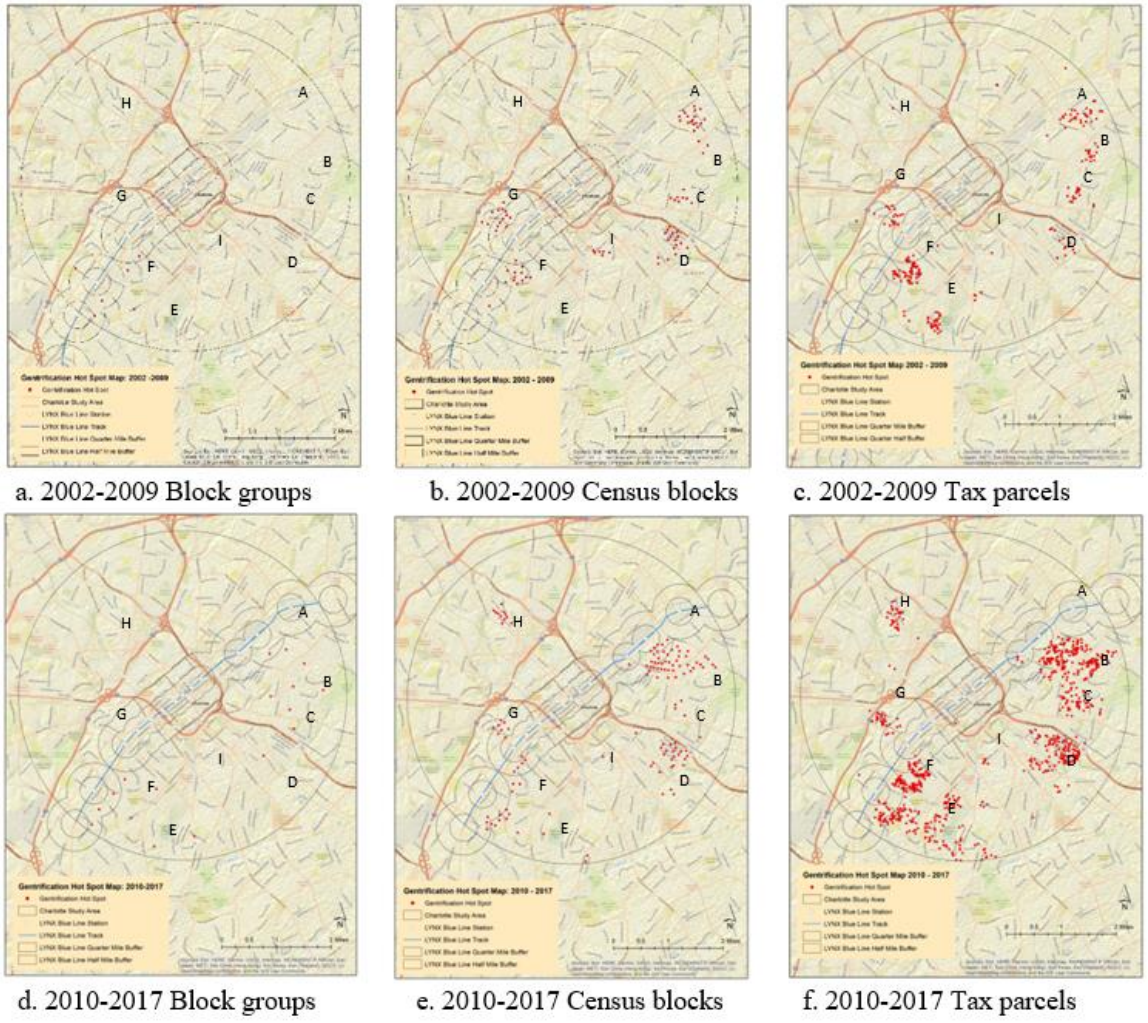


Figure 51. GI scale comparison

5.4 Research Question 4: Survival Analysis

A survival model is used as a confirmatory analysis to determine what factors drive the process of gentrification and its spatial distribution across the study area in Charlotte. The dependent variable tests the association between gentrification and changes in housing renovation, access to employment, proximity to light rail development, and other urban amenities. To assess whether the survival model adequately describes the data, it is important to check the proportional hazards assumption. The most common way to assess the assumption is with a diagnostic test that use Schoenfeld residuals. A non-significant test result supports the proportional hazard assumption, while the assumption is violated with a significant relationship. The Global Schoenfeld test returned a p-value of 0.29, non-statistically significant. Therefore, we can assume the assumption of proportional hazards has been met.

Identifying whether the model on a whole is significant, the Wald test, likelihood-ratio, and score log rank test are used. The purpose of the tests identifies if the betas in the model are 0 – the null hypothesis. Results identify that for each of the tests, the p-values are statistically significant. These results show a significant model, Table 13. Appendix B reports variance inflation factor results to assess multicollinearity in the model. No Variance Inflation Factors exceeded 10, with the largest being 4.041. To reduce the risk of omitted variable bias in the survival analysis, neighborhood profile areas fixed effects are incorporated as geographic fixed effects for the study area.

Table 13 also summarizes the multivariate survival analysis coefficients and hazard ratios from the model. A hazard ratio, reported under the column exp(coef) greater than one shows a variable that increases the probability of the event, whereas a result less

than one decreases the probability of the event. Therefore, if a hazard ratio is greater than 1, the likelihood of gentrification increases. Alternatively, a hazard ratio less than 1 decreases the likelihood of gentrification. If the ratio is 1, there is no effect.

Results indicate that several factors with a positive coefficient are significant predictors of gentrification. As expected, the older the age of a structure and homes having the lowest value per square foot increase the likelihood of gentrification. These results reinforce findings that identify the importance of an aging housing stock in the neighborhood change process (Walks & Maaranen, 2008). Another variable, spatial spillover, identifies the spatial spread of gentrification. The positive coefficient suggests that if a parcel is within an eighth of a mile of a gentrified property within the past 3 years, the chance that that parcel will gentrify increases. These results are important to highlight because from 2003-2017, each year is significant. This indicates a very strong spatial effect with gentrification occurring in the study area. These results align with what Helms (2003) speculated regarding the spatio-temporal dependent nature of residential redevelopment activity. For instance, Helms (2003) states that there is a feedback effect that causes a spillover effect from one house to another during redevelopment. This is certainly the case for NoDa or Sedgefield, two neighborhoods that have been dramatically impacted by the gentrification's spatial spillover effect overtime.

Table 13. Cox Survival analysis results

Variable	**coef**	**exp(coef)**	**se(coef)**	**z**	**Pr(>|z|)**
FAR	-0.0076	0.9925	0.0329	-0.2300	0.8184
Prox. to City Center	-0.0238	0.9765	0.0164	-1.4500	0.1469
Prox. to Schools	-0.0454	0.9557	0.0135	-3.3530	0.000801 ***
Quality Education	0.1870	1.2060	0.0161	11.6120	< 2e-16 ***
Prox. to Highways	0.2328	1.2620	0.0125	18.6720	< 2e-16 ***
Crime Rates	-0.0766	0.9262	0.0180	-4.2580	2.06e-05 ***
Age of Structure	0.7113	2.0370	0.0157	45.3400	< 2e-16 ***
Hist. Wesley Heights	0.3472	1.4150	0.1249	2.7800	0.005436 **
Hist. Hermitage	0.2368	1.2670	0.0626	3.7800	0.000157 ***
Hist. Wilmore	0.3054	1.3570	0.1188	2.5710	0.010138 *
Hist. Plaza Midwood	0.1030	0.9021	0.0625	1.6470	0.099571 .
Hist. Dilworth	0.6075	1.8360	0.0448	13.5640	< 2e-16 ***
Hist. 4th Ward	0.3003	1.3500	0.1184	2.5360	0.011226 *
Value of home Q1	0.6438	2.894	0.0915	10.829	< 2e-16 ***
Value of home Q2	-0.2912	0.6531	0.0154	-1.649	0.099148
Value of home Q3	-0.4592	0.9123	0.0315	-4.649	< 2e-16 ***
Blue Line, 5-10	-0.3166	0.7287	0.4354	-0.7270	0.4672
Blue Line, 10-15	-0.2870	0.7505	0.1794	-1.6000	0.1097
Blue Line, 15-20	-0.1964	0.8217	0.0797	-2.4650	0.013719 *
BL Extension, 5-10	0.1742	1.1900	0.2188	0.7960	0.4260
BL Extension, 10-15	-0.3610	0.6970	0.1124	-3.2120	0.001317 **
BL Extension, 15-20	-0.3062	0.7362	0.0573	-5.3410	9.25e-08 ***
Prox. to Commercial	0.1337	1.1430	0.0120	11.1730	< 2e-16 ***
JC Smith, 1/2 Mi	-0.1240	0.8834	0.0756	-1.6400	0.1010
JC Smith, 1 Mi	-0.2037	0.8157	0.0694	-2.9360	0.003321 **
JC Smith, 1 ½ Mi	-0.0818	0.9215	0.0556	-1.4710	0.1413
Green way, 1/4 Mi	0.1201	1.1280	0.0346	3.4750	0.000511 ***
Green way, 1/2 Mi	0.2416	1.2730	0.0320	7.5430	4.60e-14 ***

Green way, 1 Mi	0.0356	1.0360	0.0270	1.3180	0.1876
REGL Park, 1/4 Mi	0.5813	1.7880	0.0484	12.0200	< 2e-16 ***
REGL Park, 1/2 Mi	-0.6720	0.5107	0.0701	-9.5860	< 2e-16 ***
REGL Park, 1 Mi	-0.1661	0.8470	0.0349	-4.7570	1.96e-06 ***
Cmty Park, 1/4 Mi	-0.2013	0.8177	0.0501	-4.0160	5.91e-05 ***
Cmty Park, 1/2 Mi	-0.1070	0.8985	0.0369	-2.8970	0.003764 **
Cmty Park, 1 Mi	0.1011	1.1060	0.0269	3.7640	0.000167 ***
NHBRHD Park, 1/4 Mi	0.4704	1.6010	0.0272	17.2680	< 2e-16 ***
NHBRHD Park, 1/2 Mi	0.5664	1.7620	0.0276	20.5350	< 2e-16 ***
NHBRHD Park, 1 Mi	0.3845	1.4690	0.0342	11.2380	< 2e-16 ***
2002 Spatial Spillover	0.0166	1.0170	0.0300	0.5540	0.5798
2003 Spatial Spillover	6.6010	1600.0000	0.4998	14.1900	< 2e-16 ***
2004 Spatial Spillover	9.8320	18620.0000	3.5500	2.7690	0.005620 **
2005 Spatial Spillover	7.6010	2000.0000	0.4998	15.2060	< 2e-16 ***
2006 Spatial Spillover	4.8840	132.2000	0.2068	23.6200	< 2e-16 ***
2007 Spatial Spillover	1.3350	3.8000	0.1032	12.9380	< 2e-16 ***
2008 Spatial Spillover	3.2080	24.7300	0.0962	33.3490	< 2e-16 ***
2009 Spatial Spillover	1.7630	5.8300	0.0709	24.8560	< 2e-16 ***
2010 Spatial Spillover	1.1910	3.2910	0.0602	19.7780	< 2e-16 ***
2011 Spatial Spillover	0.9420	2.5650	0.0639	14.7490	< 2e-16 ***
2012 Spatial Spillover	0.4674	1.5960	0.0641	7.2970	2.93e-13 ***
2013 Spatial Spillover	0.5108	1.6670	0.0593	8.6170	< 2e-16 ***
2014 Spatial Spillover	0.4046	1.4990	0.0535	7.5660	3.85e-14 ***
2015 Spatial Spillover	0.1666	1.1810	0.0488	3.4130	0.000642 ***
2016 Spatial Spillover	0.3952	1.4850	0.0413	9.5680	< 2e-16 ***
2017 Spatial Spillover	0.1506	1.1630	0.0380	3.9680	7.25e-05 ***

Note: Neighborhood fixed effects are included but are not shown.

*** 0.001, ** 0.01, * 0.05, · 0.10

Likelihood ratio test= 12935 on 98 df, p=<2e-16

Wald test = 7958 on 98 df, p=<2e-16

Score (logrank) test = 21886 on 98 df, p=<2e-16

n= 595561, number of events= 5567

Additional urban amenities that significantly predict the likelihood of gentrification include proximity to neighborhood, community, and regional parks. Results reveal that neighborhood parks foster gentrification when parcels are within a quarter mile, half mile, or mile. Additionally, regional parks and community park also increase the likelihood of gentrification parcels in a quarter mile or mile, respectively. These results are important to highlight because, instead of only focusing on the location of parks (Rigolon & Nemeth, 2019), results reveal that park type and proximity impact the gentrification process. In particular, the results do not support Wolch et al.'s (2014) argument that only larger parks trigger gentrification. Instead, neighborhood parks, which are the smallest park size, tend to have more of a localized impact on gentrification than larger parks in Charlotte. This correlation suggests that neighborhood parks are a factor that increases the desirability of a neighborhood, which, in turn, may trigger gentrification.

Findings also demonstrate that parcels located in a quarter mile and located in a half mile of a greenway increases the chance of gentrification. These correlations are particularly interesting as there is a growing support by the public in Charlotte to continue developing its greenway trails. In 2015, several meetings gathered public option on the construction of Charlotte's future greenway development (Mecklenburg County Park & Recreation, 2015). Based on the survey, greenway trails were an expectation of residents to provide opportunities to reach destinations and achieve health/fitness goals (Mecklenburg County Park & Recreation, 2015). Although previous greenway research in Charlotte suggests the impact of greenways on property values would be too small to

adversely affect vulnerable households (Campbell & Munroe, 2007), the correlations here demonstrate that greenways do increase the likelihood of gentrification.

Findings also reveal an expected relationship between gentrification and historic areas. Results identify that parcels within a half mile of five historic districts in Charlotte (Wesley Heights, Fourth Ward, Hermitage Court, Dilworth, and Wilmore) increases the likelihood of gentrification. Although not highly statistically significant, Historic Plaza Midwood results (statistically significant at the 0.01 level) show an increase in the chance of gentrification These results align with previous studies that argue gentrification occurs in locations with desirable locations and historic housing (Chapple et al., 2017). The results also push the gentrification literature to take into consideration homes surrounding historic areas instead of focusing on the district itself (Been, Ellen, Gedal, Glaeser, & McCabe, 2016) by reporting how the areas around the historic areas are being impacted. These results suggest that houses on the outskirts of historical districts are just as desirable as those inside a designated historical area.

These results are noteworthy because they come at a time when multiple stakeholders in Charlotte are trying to protect its oldest and most historical areas. While the overarching goal is to keep the historic areas of Charlotte from being washed away, the goals may be harming the communities they intend to help. For instance, 2020 saw a new historic district was created in Charlotte: Oaklawn Park. This is one of Charlotte's best-preserved post-World War II suburbs. It was created for African American families in the latter days of racial segregation by Charles Ervin, the city's most prolific suburban developer (Hatchet, 2019). Oaklawn Park is part of the Beatties Ford Road corridor in west Charlotte, a quadrant of the city that is today known as the heart of African

American life, anchored by Johnson C. Smith University. Construction of Oaklawn Park, along with the University Park neighborhood and West Charlotte High School's current campus – all begun in 1954 – helped define the western part of Charlotte as "the black side of town" (Hanchett, 2019).

As Figure 42 illustrates, Oaklawn Park (Census tract 48) has not been impacted by gentrification during the study timeframe. However, the results point to an increasing body of literature that highlights the challenges of preserving historic areas. The literature points to many efforts, such as preserving neighborhoods, may in fact lead to gentrification in the future. On the one hand, the historic preservation saves the identity of the neighborhood, it also, on the other, leads to an increase in property values (Been, Ellen, Gedal, Glaeser, & McCabe, 2016) in addition to being a tool for urban revitalization (Ryberg-Webster, 2014) that brings in more tourists to the city (Gotham, 2005). While Charlotte is not New York City, work being done in this part of the country sheds light on the significant changes in socio-demographic shifts that come about in newly designated historic neighborhoods (McCabe & Ellen, 2016).

With Oaklawn Park being in an area of historically Black portion of the city, the Oaklawn Park Neighborhood Improvement Association approached City of Charlotte staff about establishing protections to maintain the character and architecture of the neighborhood due to development pressure in an around the area. These results bring up multiple complexities for local planners and city governments that are trying to balance the benefit of keeping historic areas intact with the realities of a changing socio-economic environment. While the hope of current and long-time residents can use this opportunity to discover the rich legacy of an historic community, the potential for heightened racial

tension that gentrification can create cannot be dismissed. The opportunity this research presents is using these results to stimulate discussion on how to best move forward so lower-income communities, particularly Charlotte's Black community, can preserve areas without being pushed out.

Proximity to highways and commercial areas are also significant and positively correlated with likelihood to increase gentrification. Access to highways and commercial areas confirm that accessibility matters to areas that are undergoing gentrification. What is surprising is that the highway variable is not a negative outcome. Instead, a positive coefficient shows that most of the disamenities associated with highways (pollution, noise, or congestion) does not prevent reinvestment in the area. The convenience of being close to a highway, particularly in the car centric layout of Charlotte, seems to offset this traditionally negative result.

As expected, proximity to high quality education increases the chance of a parcel to experience gentrification. Additionally, proximity to school is also as expected. For instance, the further a parcel is from a school, the chance of it experiencing gentrification decreases. The implication is that home buys or developers show a desire to live in school districts that are highly ranted. Placing a premium on areas in this way, particularly in a residential neighborhood, makes reinvestment more likely to occur in homes.

Two variables that are typically positive and significant in gentrification research are the FAR and distance to the city center. Yet, as the neighborhoods of Freedom Park and Chantilly demonstrate, larger homes in the Charlotte area are also being transformed as neighborhoods change. As such, FAR variable does not show statistical significance for the survival model. Another surprising result in the survival model is proximity to

center city. Although the direction of the sign is as predicted, negative, the variable is not statistically significant in the model. While this variable is a proxy for access to the city center urban amenities, Charlotte's low-density metro area means that proximity to the center city is not the major draw for housing in the region. Moreover, as Figure 42 illustrates, the direction of cluster D (Chantilly), cluster E (Freedom Park), cluster F (Dilworth), cluster G (Wilmore), and cluster H (Johnson C. Smith) diffuse away from the geographic center of Charlotte from 2010-2017. While this is a departure from traditional gentrification research, the non-significant variable does make sense given the spatiotemporal patterns of gentrification in the study area.

Results also indicate certain factors that are correlated with a decrease in the likelihood of gentrification. For parcels located in areas with high crime rates, the odds of gentrification occurring are reduced. These results reinforce that crime is a significant factor for where occurrences of gentrification take place (Ellen, Horn, & Reed, 2016). For instance, areas focused on reducing crime rates also experience increases in "high-income, college-educated, and white households choosing to move into both central city low-income and central city high-income neighborhoods" and, in select cities, "households are especially likely to move into the central city neighborhoods where crime is lowest" (Ellen, Horn, & Reed, 2016). Yet, the nature of the relationship between crime and gentrification is not yet fully understood and needs to be teased out further to identify how criminal activity evolves in a changing neighborhood. The theme in the analysis is that gentrification has a double edge effect where benefits in a neighborhood that has historically been disinvested may trigger gentrification.

Findings also reveal an unexpected relationship between light rail and gentrification. Results show that with the original segment of the LYNX Blue Line, parcels within a 10–15-minute walk from of the light rail station saw a decrease in the lower chance of gentrification. For the LYNX Blue Line Extension, parcels within a 10-15-minute walk, and 15-20 minute walk of a light rail station also saw a decrease in the chance of gentrification. The literature over the past decade has been mixed when it comes to identifying the relationship between transit investment and gentrification (Nilsson & Delmelle, 2018; Baker & Lee, 2017; Dong, 2017). However, findings in Charlotte are consistent with research that found the relationship with public transit and gentrification being negative by Khan in 2007.

Despite the lack of significance found in the results, debate around transit and gentrification continue in Charlotte as new light rail lines are being proposed (Wright, 2021). As Wright and Off (2021) report in the Charlotte Observer, this produces a fear in many neighborhoods that their home and neighborhoods identify are at risk. However, Charlotte's Urban Institute questions the assumption that as new transit line opens, gentrification in nearby neighborhoods should be a foregone conclusion (Portillo, 2019). Although perceptions that light rail hastens development along the line should not be downplayed, the effects of transit on neighborhoods are complex, context-specific, and depend on multiple factors. For instance, the GI implies that neighborhoods like Villa Heights, Optimist Park, and Plaza Hills were impacted by the spatial spillovers from reinvestments in surrounding neighborhoods (NoDa and Plaza Midwood). This process can also be seen in the South End of Charlotte where the neighborhood of Sedgefield is impacted by Dilworth. Since these processes of redevelopment are happening all around

the downtown of Charlotte, the light rail may not be the primary factor that drives these changes, although it may be an accelerator of the on-going trends. Instead, this points to the idea that neighborhood change is exogenous to the neighborhood itself. This would mean that the change going on in the neighborhood is, in fact, due to a non-linear change in other parts of the city, following in this respect a process more akin to the well-known systems dynamics.

Additional urban amenities that reduce the chance of gentrification occurring include parcels that are located in a quarter of a mile and half of a mile from a reginal park and parcels located within a half mile and mile of a regional park. For parcels located further away from a localized amenity, Johnson C. Smith University, the chance of gentrification decreases. Findings also show that, compared with parcels having the highest home values per square foot, parcels having homes with high values per square foot are less likely to gentrify.

Overall, the survival model reveals various factors that foster gentrification in Charlotte. The survival model confirms that neighborhood parks, greenways, and historical areas all increase the likelihood of gentrification. Indeed, in the 2002-2017 timeframe, older parcels that have low values per square foot also signal areas ripe for redevelopment. Developers or individuals that observe the success of earlier risk takers may follow suit and undertake redevelopment in the same neighborhood. These physical changes in the neighborhood, in turn, can foster changes that displace long-time residents. As parcels redevelop, sales for three to four times that of the original property are not uncommon. In this manner, the complexion of the neighborhood changes so that those who once lived there may no longer afford to be part of that place.

CHAPTER VI: SUMMARY & CONCLUSIONS

6.1 Summary

This research offers insights into the spatial and temporal dimensions of contemporary gentrification. Although a distinct bias exists towards researching gentrification in major urban areas, evidence from Charlotte details how the process of gentrification evolves over space and time. The analysis leverages multiple real estate administrative datasets over the course of 2002-2017 from the city of Charlotte's open data portal. Utilizing a complex dataset that combines multiple data types, this research formalizes a gentrification database for quantitative analysis to examine whether neighborhood change patterns in Charlotte can be classified as gentrified at an intra-urban scale.

To enhance the empirical gentrification literature, I first identify the magnitude and the location of gentrified neighborhoods in Charlotte using socio-demographic census data aggregated to the census tract. I then compare this approach with a nuanced method of identifying gentrified properties through tracking real estate investments at the parcel level. I next evaluate whether gentrified properties are clustered spatially. Additionally, I identify trajectories that spatial clusters of gentrified properties by revealing how the extent and location change between 2002-2017. Furthermore, I address how identifying gentrified areas at different spatial scales impacts results of identifying gentrified areas. Finally, I address what factors drive the spatial distribution of gentrified properties in Charlotte.

The main goal of the research examines the location and extent of gentrification in Charlotte. To capture these changes, an SSI identifies class turnover through socio-

demographic data, whereas the nuanced GI identifies reinvestment in residential properties using real estate administrative data. While both methods capture gentrification outcomes, the GI is more precise at pinpointing where gentrification occurs and how it diffuses overtime A key implication of this research is that it enhances Ley (1986) and Helms (2003, 2012) argument that states building permits can identify renovations consistent with gentrification. While Helms (2003, 2012) laid the groundwork for the use of residential building permits in gentrification analysis, this research identifies what type of residential building permit reinvestments are consistent with identifying gentrified areas. Finally, by overlaying the two, we can identify how the two approaches complement each other by highlighting how gentrification unfolds at different spatial scales. While comparing the two approaches is an important aspect of this dissertation, findings indicate that they are most effective when combined. In this respect, researchers can capture the long-term socio-demographic changes along with the annual reinvestment changes to have a more nuanced understanding of gentrification's impact in an urban area.

Another contribution of this research is identifying whether gentrification is a highly spatially localized process or whether it is a more widespread phenomenon. Utilizing the GI, results show that gentrification started as a spatially localized process in 7 Charlotte neighborhoods in 2002-2009 (Clusters A-H, Figure 19). Overtime, gentrification impacts a much more widespread portion of Charlotte from 2010-2017 (Clusters A-I, Figure 19). One fascinating aspect of the trajectory of gentrification in Charlotte is that the diffusion of gentrification occurs in a very spatially heterogenous way. Figure 19 identifies how the east side of Charlotte (clusters A-C), converge in

Belmont (census tract 8) and Villa Heights (census tract 9) by the end of the study period. However, gentrification also diffuses away from the center city on the west and southwest portion of the city (clusters F, G, H). In this way, the neighborhoods of Johnson C. Smith (census tract 47), Wilmore (census tract 36) and Sedgefield (census tract 33) are now being impacted by gentrification.

These results align with Hwang and Ling's (2016) argument that the latest waves of gentrification appear broader and more widespread than in the past. With U.S. New South cities developing in a manner that is fundamentally different from that occurring in more traditional central city neighborhoods found in northern cities, there is a need to investigate how the expression of uneven capital reinvestment can be measured from place to place. Moreover, as environmental amenities are correlated with gentrification, it is important to understand this type of relationship in New South cities to protect negative impacts from impacting marginalized communities. Yet, the ability to capture the spatial distribution of gentrification in this way is due to the use of alternative data sources that drill down inside neighborhoods. The use of the GI compliments the data limitations of spatial and temporal scale inherent in the SSI. Although the data is not real time, combining the GI and SSI pushes beyond traditional gentrification analysis to provide a glimpse into how gentrification unfolds at multiple spatial scales.

Another overarching objective of this analysis detects and examines outcomes based on the granularity at which gentrification is measured. Identifying errors brought about by spatial aggregation is studied in many geography fields. Yet, few studies examine how errors in spatial aggregation impact gentrification research. The importance of this is to keep in mind that when aggregating data to spatial units, error is introduced

into the analysis by smoothing location variation. In the analysis, results reveal major variances between hot spots calculated from parcel data, demonstrating that errors brought by spatial aggregation may lead to significant gentrification measurement errors, and considerable underreporting of the magnitude of gentrification across the city. Findings from this research identify that census blocks and tax parcels provide more precise measurements of gentrification.

The final objective of this research identifies factors that foster gentrification. Results confirm factors correlated with gentrification from previous studies. For instance, parcels with older homes, lower values per square foot, proximity to quality education, proximity to highways, and proximity to commercial areas all correlate with factors that increase the likelihood of gentrification. An additional contribution identifies that historical districts also correlate with factors that increase the likelihood of gentrification. However, the findings reveal that it is not just the historical district, but also the surrounding areas that are correlated with an increase in gentrification.

An important contribution of this research is highlighting the proximity to previously gentrified properties results, or the spatial lag variable. Results identify a very strong spatial effect, demonstrating that neighborhood effects do influence the spatial patterns of gentrification. These effects indicate that a parcel that gentrifies inside a neighborhood – up to three years in the past – has an impact on nearby parcels. Thus, increasing the chance that gentrification spreads in local spatial patterns.

As U.S. New South cities continue to redevelop, the low-density nature of Charlotte, combined with the latest urban redevelopment, continues to expand urban amenities (light rail, greenways, and parks) further from the city core. This, in turn,

allows developers or risk takers to find new frontiers to reinvest in areas that may not have experienced sustained reinvestment in the past. As change continues to expand outward from the central city neighborhoods, many communities in Charlotte continue to express concern for their potentially at-risk communities. For many minority communities in Charlotte, the root cause of their fear stems from public investments in the LYNX light rail.

While community members in Charlotte continue to highlight how their neighborhood may be threatened due to the impact of the light rail, the survival analysis identifies that light rail may not be the appropriate focus. Results revealed that light rail variables do not increase the likelihood of gentrification during the study timeframe. Although these results seem counterintuitive, findings are consistent with recent work that concludes a lack of effect of light rail and transit on gentrification (Baker & Lee, 2017; Dong, 2017; Khan, 2007). Moreover, the data from the GI implies that neighborhoods like Villa Heights, Optimist Park, and Plaza Hills were impacted by the spatial spillovers from reinvestments in surrounding neighborhoods (NoDa and Plaza Midwood).

What this process points to is how endogenous effects impact the Charlotte study area. Dietz (2002) expands on this idea by stating, “neighborhood formation is not a random or predetermined mechanism...[but itself] is an endogenous process”(p. 546) and, as Helms (2012 states, “discusses the inferential challenges presented by the concurrence of this nonsocial sorting into neighborhoods with the social interactions within neighborhoods” (p. 304). The implication is that investments, like the LYNX light rail, are happening where other investments are taking place. As such, the GI is capturing

reinvestments that create a feedback loop or spillover effect that influences other household reinvestment in an area. Therefore, the changes consistent with gentrification may not fully be explained by the LYNX light rail, but spillovers from reinvestments in neighboring areas.

An additional contribution from the analysis is that results identify that neighborhood parks, community parks, and greenways are correlate with factors that increase the likelihood of gentrification. This is particularly important because the results challenge Wolch et al. (2014) findings that small neighborhood parks do not have an impact on gentrification. Instead, neighborhood parks, which are the smallest park size, tend to have more of a localized impact on gentrification than larger parks in Charlotte. The implication is that in urban areas that are changing rapidly, even small amenities can have large effects. Yet, as environmental urban amenities continue to provide evidence that they can foster gentrification, how do planners and local governments implement these investments without harming those who they are intended to help?

The Charlotte Future 2040 Comprehensive Plan is guiding the Charlotte's growth over the next 20 years. The Plan is the foundation for strategic policy and equitable investment in infrastructure. It has a goal of addressing past injustices by bringing the city together around a set of shared goal. As the comprehensive plan moves forward with urban sustainability initiatives that include expanding parks, greenways, and historic areas, policy makers should be aware that these initiatives do not benefit all residents equally (Charlotte Future, 2021). Although this plan intents to monitory the region's most vulnerable populations, results demonstrate that the greatest gains from urban environmental amenities continue to accrue for the most well-off.

6.2 Limitations

This research, however, is subject to several limitations. The first is that the SSI and GI datasets present a historical depiction of the gentrification landscape. A major challenge with gentrification research is that we are constantly looking in the rearview mirror. Although we can see where gentrification has occurred, this kind of research unfortunately does not help those residents who have either been displaced or who have had their neighborhood changed. While the GI allows researchers to use annual data instead of ACS or decennial census data, the challenge remains as to how these data can be used in more predictive modeling instead of exploratory or explanatory modeling.

Another limitation is that the data collection process is very labor intensive. As previous gentrification researchers have pointed out, "While idea in terms of capturing the highly localized nature of gentrification, an analysis of the spatial extent of gentrification using [census] blocks or even parcels would be extremely time consuming and impracticable" (Heidkamp & Lucas, p. 113, 2006). Although time consuming is true, the fact that the vast majority of cities will have access to these types of data means that this type of analysis can now be ripe for research. One way that researchers may speed up the data collection process is by using automation with the building permits to quickly find the keywords in the descriptions. This will cut down on the time it takes to manually process the data and enable researchers to focus on analysis and interpretation.

Finally, how generalizable this case study is to the experience with other cities has yet to be determined. In what ways do cities across the U.S. New South experience gentrification dynamics? What has happened to the spatial distribution of gentrification over time in U.S. New South cities? These are questions worth investigating. Given the

national scope of gentrification on U.S. cities, comparisons can then be done to other Southern cities through the lens of gentrification.

6.3 Future research

Charlotte is just one case of U.S. New South urban areas considering how to accommodate future growth. The process of reinvestment and redevelopment in inner-ring suburban neighborhoods in the U.S. New South appears to be fundamentally different from that occurring in more traditional central city neighborhoods found in northern cities. The low-density nature of these cities supports the new-built gentrification literature that identifies how recent housing boom, redevelopment in inner-ring suburbs is not solely dependent on capital disinvestment in the suburban areas.

Despite the rise of studies that include resisting gentrification (Hubbard & Lees, 2018), further research must advocate what constitutes successful resistance strategies to gentrification in mid-sized cities. For instance, the growing anti-gentrification literature provides a wealth of information on how critical maps and data analytics have increased awareness of gentrification's impact across cities such as San Francisco and Madrid (Annunziata & Rivas, 2018). These works produce a counter narrative to the idea of urban living and help identify what constitutes successful resistance strategies (Lees, Annunziata, & Rivas-Alonso, 2018).

Linking results to this type of advocacy helps anti-gentrification actors and city governments implement strategies that are known to damper to spread of gentrification – activism at the grassroot level or land trusts focused on keeping the community intact (Choi et al., 2018). The challenge gentrification scholars are tasked with, however, is ensuring these anti-gentrification strategies are not incorporated into the processes they

intend to defend. Yet, utilizing data analytics to track and predict the heterogeneous nature of gentrification in this way, especially in mid-size cities, allows platforms to be created to fight for those at-risk of being displaced in our communities.

While the reliance of keywords in the description of building permits to generate the GI limits the scalability of the approach, there are automated ways this could be dealt with to make it more feasible. For instance, there are great natural language processing toolkits now available in Python and R that could help with the data cleaning process. With the ability to automate the data collection and cleaning, future work will be aimed at tracking parcel level gentrification to plot the changes over time. I also plan on using the methodology created in the research to compare other New South Cities, or any city that may be undergoing rapid development. Yet, a first step should be addressing the automation of the data collection process. This would streamline extracting data from the building permits and tax assessment that can make the method of the GI more practical for local governments to assess micro-trends.

Additional work is also needed to improve upon the spatial survival analysis. While survival analysis is used in the health or medical fields, the analysis is still new to the social sciences, particularly geography. This presents an opportunity to blend the growing fields of data science with GIScience to enhance this methodological framework to elevate survival modeling into the field of gentrification. The major barrier in spatial survival analysis is handling big data collected at multiple spatial scales. As a result, the code necessary to run a spatial survival analysis is a welcomed addition for future gentrification work.

While residential properties are a major component to gentrification research, non-residential properties can be included to study to gain a more compete understating of changes in neighborhood characteristics. In this way, key actors can be incorporated into the analysis that were not included in the scope of this research. For instance, research could include long time owners versus short term owners, national real estate investors versus local real estate agents, or local owners versus non-local owners. Each could add to the understanding to how and why gentrification would be more pronounced in one location over the other. What would be welcoming for future research is linking the GI results to datasets that can identity who is being displaced across study areas. Understanding where residents are moving away from and where they are moving to is an area of research that certainly warrants further investigation.

6.4 Final thoughts

With renewed calls by researchers across multiple disciplines to investigate gentrification at fine spatial resolutions, my research helps to better understand the temporal and spatial dynamics of gentrification. The information gained from this dissertation allows decision makers to create equitable, accurate, and effective policy in places that may have never known that gentrification was happening near them. I anticipate replicating this approach in other locales and engaging residents in addition to local experts to continue the discussion on gentrification's impact, particularly in cities that have been following the development model of U.S. New South cities. I also envision using these maps as a tool that aids affordably housing discussion.

Ultimately, urban areas are a combination of forces that create a desirable area of renewal and reinvestment. These areas require our analysis because the implication have

had negative impacts on residents living in these places. Although socio-economic and demographic data are readily available, urban environmental shocks rarely align with census time periods, which means researchers miss valuable information using temporally and spatially coarse data. With GIS becoming more readily available, gentrification researchers can now move beyond standard strategies to identify gentrification patterns.

While this type of analysis addresses the call to move beyond socio-demographic based measures for gentrification research, a word of caution is needed. The SSI's limitation should not dispel the importance of capturing class turnover through socio-demographic data. Gentrification, at the core, is still a "process that is fundamentally rooted in class and inherently geographic in its manifestations" (Wyly & Hammel, 1999, p. 716). As such, instead of leaving traditional gentrification analysis behind, I urge researchers to integrate socio-demographic data with alternative data sources. In doing so, we can build on the past to present a more complete view of how neighborhoods change.

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APPENDIX A

The following appendix explains steps taken to (a) identify the keywords in residential building permits that identify gentrification, (b) indicate a threshold where a physical transformation in a dwelling-unit would signal reinvestment high enough to trigger gentrification, and (c) validate the dataset to ensure the residential building permits were acted upon.

A1.1. Residential building permit dataset construction

The first step in generating the residential building permit dataset is to parse out which building permits are candidates for gentrification. Generally, a residential building permit is required for any construction, installation, repair, replacement or alteration costing more than $15,000 (Code Enforcement, 2020). A permit is also required, no matter what the cost, if the work involves the addition, repair or replacement of load bearing members or structures, the addition of plumbing, heating, air conditioning, electrical wiring, devices, appliances or equipment. Building permits expire 180 days after the issue date if no work has commenced. Permits also expire when work has started but discontinued for 365 days from the last inspection date. With these broad classifications for residential building permits, a large amount of data is available.

To ensure only residential building permits are included in the dataset, the initial coding scheme utilized the USDCcodeNU attribute found in each building permit. USDCcodeNU refers to the U.S. Department of Commerce (USDC) code that creates broad classifications for building permits. Table 4 (reproduced below) lists all potential USDC codes that can be used to classify any building permit issued during a calendar

year in the study area. To be considered in the final dataset, a residential building permit must have one of the following USDC codes: 101 - 105, 114, 115, 434, 645, 647, or 648. These codes represent reinvestments or demolitions in residential properties. Alternatively, USDC codes classified as 112, 213, 214, 318 – 329, 437, 438, 540, and 649 were removed from the dataset since they do not represent reinvestment or demolitions in residential properties consistent with gentrification.

Table 4. Building permit classification codes based on U.S. Department of Commerce

Classification	Code	Explanation-Example
New Residential	101	Single-family houses, detached
	102	Single-family houses, attached
	103	Two-family buildings
	104	Three-and four-family buildings
	105	Five-or-more family buildings
	112	Mobile Home
	114	Three-and-four family condos (no land for sale with unit)
	115	Five-or-more family condos (No land for sale with unit)
New Residential	213	Hotels, motels, and tourist cabins
	214	Rooming, Boarding, Fraternity, Sorority
New Nonresidential Buildings	318	Amusement, Social, Recreational
	319	Churches and other religious buildings
	320	Industrial, Factories, Manufacturing, and Printing Plants
	321	Parking Garages
	322	Services Stations and Repair Garages
	323	Hospitals, Clinics, Rest and Convalescent Homes, Clinics
	324	Offices, Banks, Medical Offices
	325	Public Works, Utilities, Sewage Disposal, Water Supply
	326	Schools, Libraries, Universities, Museums
	327	Stores, Restaurants Malls, Markets, Beauty Shops
	328	Other Nonresidential - Sheds, Barns, Post Offices, Jails
	329	Parks, Outdoor Stadiums, Marinas
Additions, Alterations, and	434	Residential
	437	Nonresidential

Conversions	438	Additions of residential garages and carports
	540	non-residential/Non-housekeeping to housekeeping
Demolitions of Buildings	645	Residential demolition
	647	Residential demolition
	648	Residential demolition
	649	All other buildings and structures demolition

With the initial coding scheme established, Figure 52 displays the 208,416 residential building permits issued for the study area between January 1, 2002 and December 31, 2017. One of the challenges with using residential building permits as a proxy for redevelopment is that not all permits issued between 2002-2017 are completed nor are they consistent with the process of gentrification. This concern brings up the possibility where gentrification has not occurred but the model picks it up. In other words, the possibility for false positives to emerge in the dataset is high. To reduce this risk, I used the *Project Description* attribute found on the application for building permit to understand what type of renovation occurred on each parcel, Figure 53.

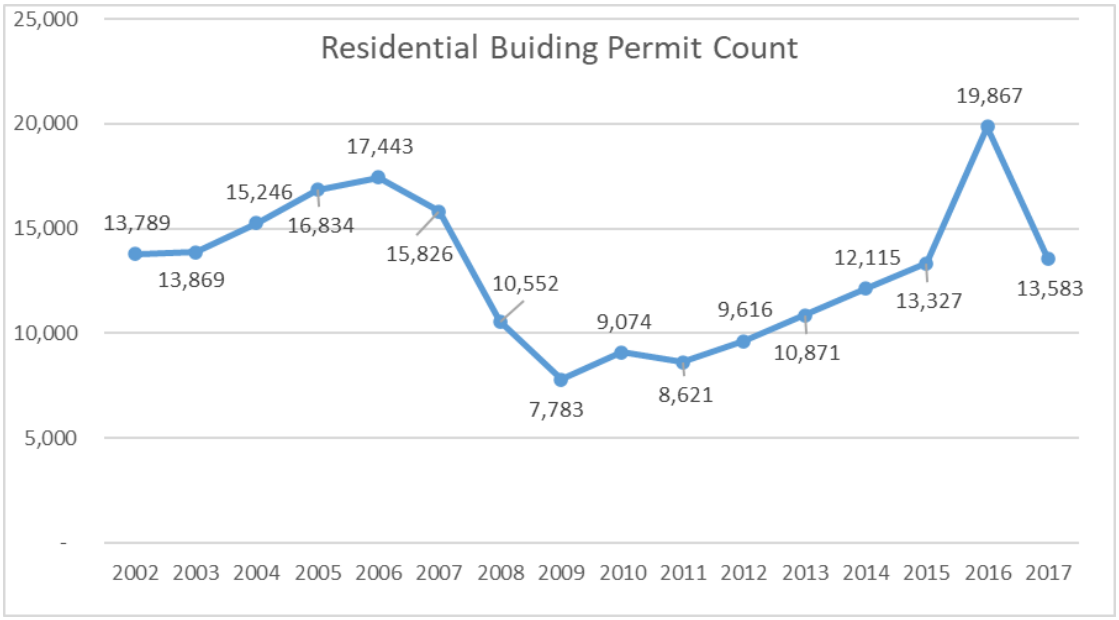
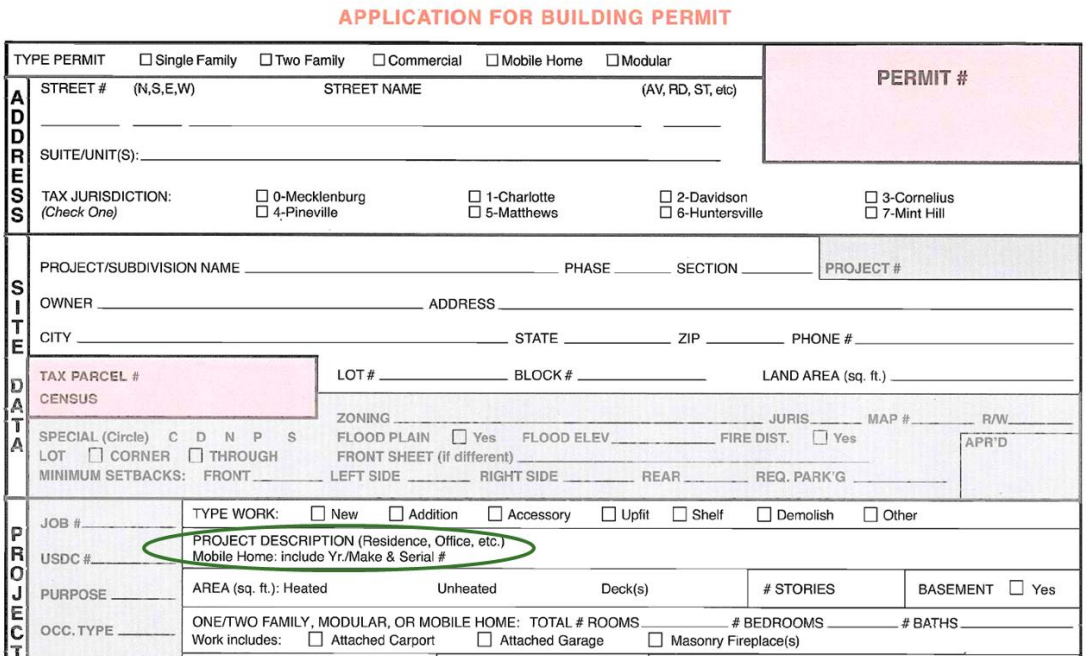


Figure 52. Annual residential building permits collected from 2002-2017 in study area



APPLICATION FOR BUILDING PERMIT

TYPE PERMIT ☐ Single Family ☐ Two Family ☐ Commercial ☐ Mobile Home ☐ Modular

PERMIT #

ADDRESS

STREET # (N,S,E,W) STREET NAME (AV, RD, ST, etc)

SUITE/UNIT(S):

TAX JURISDICTION: (Check One) ☐ 0-Mecklenburg ☐ 1-Charlotte ☐ 2-Davidson ☐ 3-Cornelius ☐ 4-Pineville ☐ 5-Matthews ☐ 6-Huntersville ☐ 7-Mint Hill

SITE DATA

PROJECT/SUBDIVISION NAME PHASE SECTION PROJECT #

OWNER ADDRESS

CITY STATE ZIP PHONE #

TAX PARCEL # CENSUS LOT # BLOCK # LAND AREA (sq. ft.)

ZONING JURIS MAP # R/W

SPECIAL (Circle) C D N P S FLOOD PLAIN ☐ Yes FLOOD ELEV FIRE DIST. ☐ Yes APR'D

LOT ☐ CORNER ☐ THROUGH FRONT SHEET (if different)

MINIMUM SETBACKS: FRONT LEFT SIDE RIGHT SIDE REAR REQ. PARK'G

PROJECT

JOB #

TYPE WORK: ☐ New ☐ Addition ☐ Accessory ☐ Upfit ☐ Shelf ☐ Demolish ☐ Other

USDC #

PROJECT DESCRIPTION (Residence, Office, etc.) Mobile Home: include Yr./Make & Serial #

PURPOSE

AREA (sq. ft.): Heated Unheated Deck(s) # STORIES BASEMENT ☐ Yes

OCC. TYPE

ONE/TWO FAMILY, MODULAR, OR MOBILE HOME: TOTAL # ROOMS # BEDROOMS # BATHS

Work includes: ☐ Attached Carport ☐ Attached Garage ☐ Masonry Fireplace(s)

Figure 53. Sample building permit highlighting where a project's description is found

	A	B	C	D	E	F
1	Address	XCoord	YCoord	Constructi	USDCCodeNu	Project_Na
2	1815 SPRAGUE AVE	1460136	541119	359,400	434	KUHLKIN/RES ADDTN-PLAN REV
3	1908 NASSAU BLVD	1460263	542766	268,277	101	MERIDIAN/NEW RES-PLAN REV
4	1421 NASSAU BLVD	1459653	540670	251,993	101	URBAN BLUE-NEW RES-PLAN REV
5	1621 TIPPAH AVE	1460475	541287	244,530	101	CENTRAL/NEW RES-PLAN REV
6	1647 TIPPAH AVE	1460502	541392	240,000	101	CENTRAL BUILDERS/NEW RES-PLAN REV
7	2212 BELVEDERE AVE	1461701	542051	226,900	101	RAM/NEW RES-PLAN REV
8	1833 SPRAGUE AVE	1460420	541007	210,600	101	CENTRAL/NEW RES-PLAN REV
9	1816 MECKLENBURG AVE	1460907	544224	206,650	101	PAINTED PLUM/NEW RES-PLAN REV
10	1425 NASSAU BLVD	1459738	540718	196,685	101	HOLTZMULLER/NEW RES-PLAN REV
11	1319 THOMAS AVE	1458811	540340	185,136	434	RES 2ND STORY ADDITION
12	1905 ASHLAND AVE	1461254	541456	181,000	101	LONGLEAF/NEW RES-PLAN REV
13	1322 PECAN AVE	1458591	540411	159,000	101	CENTRAL BLD/NEW RES-PLAN REV
14	1515 TIPPAH PARK CT	1461275	540141	139,042	101	JCB URBAN/NEW RES-PLAN REV

Figure 54. Sample project descriptions in dataset of residential building permits

As shown in Figure 54, the phrasing for Project Description, Project_Na in the dataset, varies from permit to permit. Instead of analyzing all building permits at one time, the first step in finding keywords that were consistent with gentrification was to analyze all residential building permits in one neighborhood in the study area. In this

way, residential building permits would be eliminated if the reinvestment was not consistent with the gentrification process. This method would then be replicated in each study area neighborhood to ensure consistency in constructing the final dataset.

A 1.2 Cherry Hill pilot neighborhood.

To identify gentrification keywords, the neighborhood of Cherry Hill was chosen because the area has seen considerable pressure from developers and new residents to redevelop (Portillo, 2015). Cherry Hill was also selected because it had a manageable number of parcels to observe in 2016, 660, and a high number of residential building permits issued in 2016, 91, Figure 55. Despite no academic study identifying what type of residential building permits are consistent with gentrification, the following details how I reduced the Cherry Hill residential building permits in 2016 from 91 to 43.

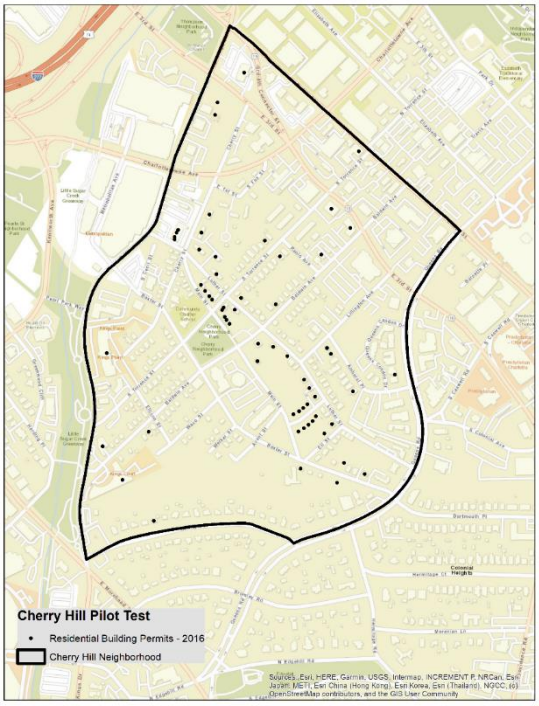
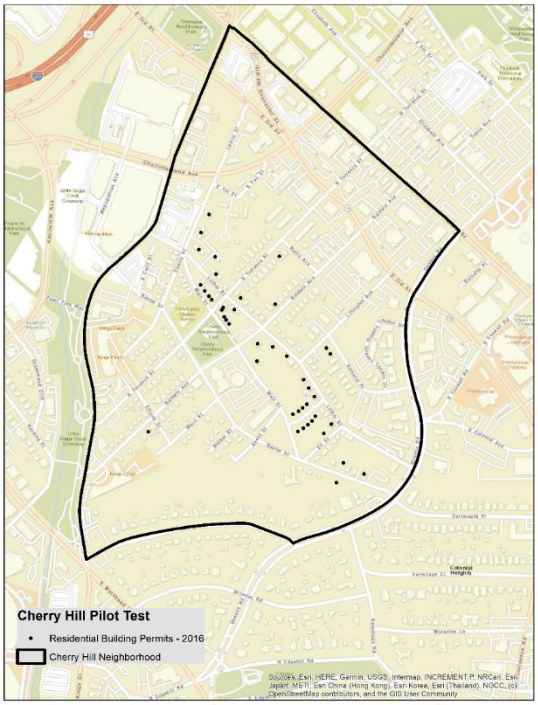
Cherry Hill residential building permits issued	Cherry Hill residential building permits after keyword reduction
	

Figure 55. Spatial distribution of residential building permits before and after keyword and threshold analysis for Cherry Hill in 2016

For the purpose of identifying residential building permits that would increase the footprint of the physical structure of a dwelling unit, the Mecklenburg County Code Enforcement Residential Plan Submittal Small Project Requirements packet (2018) acts as an initial guide. The information inside the packet assists residents to classify specific projects on building permits and to ensure that designs are compliant with the NC State Residential Code. The most useful section in the document for this analysis is the framing plan section, Figure 56.

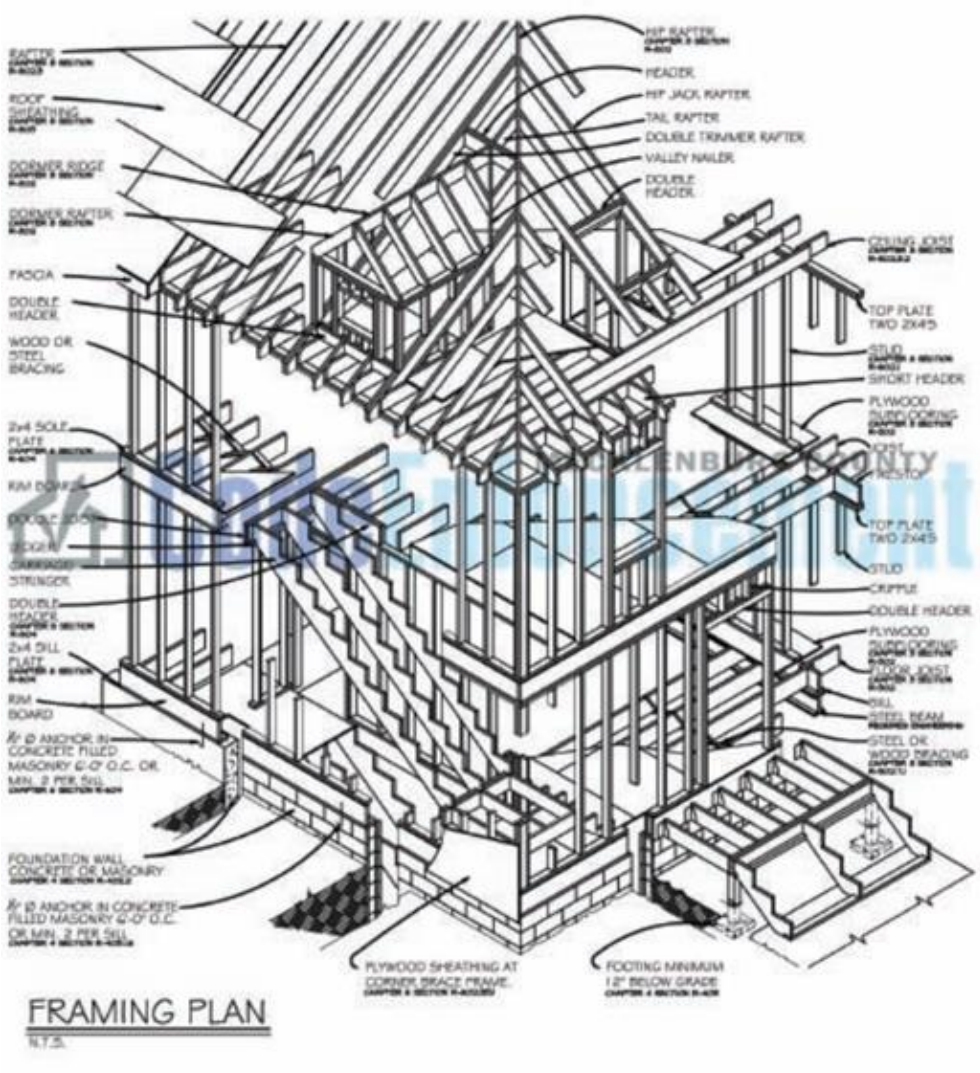


Figure 56. Mecklenburg County Code Enforcement Framing Plan

The framing plan describes structural components of a building that transfers all the weight imposed onto a structure into the ground. As shown in Figure 57, properties in Cherry Hill with residential building permits describing “foundation” or “band sill” do not demonstrate a visible change to the home. As such, these types of reinvestments would not be consistent with the property going through a gentrification process. Identifying load path repair projects as a stand-alone residential building permit eliminates keywords that do not increase the footprint of the physical structure of the dwelling unit or signal a new class reinvesting in the area. In this way, any residential building permit with the following words: “Pier”, “Joist”, “Studs”, “Siding”, “Sill”, Band Sill”, “Framing”, “Gable”, “Foundation”, or “Column” would not necessary be retained in the dataset. To be considered in the pilot Cherry Hill dataset, each framing plan description must be combined with at least one other keyword consistent with increasing the dwelling unit’s footprint to signal reinvestment high enough to trigger gentrification.

Keyword	GSV Image 2014	GSV Image 2017
Foundation		
Band Sill		

Figure 57. Residential building permit framing plan descriptions not included in Cherry Hill pilot study dataset

Although the framing plan removed 12 residential building permits from the Cherry Hill dataset, the next step required a more theoretical approach when deciding to keep or discard a residential building permit. To do so, I concentrated on two groups of words that constantly appeared in Cherry Hill's residential building permit project descriptions. The first group of words included: "porch", "deck", "patio", "laundry", "kitchen", "bathroom", "re-roof", "chimney", and "window". The second group included "move-on/move-off", "code repairs", "tree", "fire", "garage". With each term, I had to consider whether each reinvestment was consistent with the definition and process of gentrification.

Technically, a "porch", "deck", or "patio" does increase the dwelling unit's footprint. Yet, these terms alone do not signal that a new class of people are reinvesting in a home. Furthermore, these investments tend to not be heated, and therefore, not livable. They are also not counted towards the home's square footage. That same line of thinking can be used when considering the terms laundry, kitchen, or bathroom. Moreover, terms such as "window", "re-roof", or "chimney", are aimed at benefits such as increasing comfort, natural light, and safety, or reducing energy or cleaning costs. Although these types of reinvestments have construction costs up to $100,000, the focus on these residential building permits is more in line with upgrading the living space of current residents instead of bringing in a new class into the neighborhood.

The second group of keywords that appeared consistently in Cherry Hill's residential building permit project descriptions include: "move-on/move-off", "code repairs", "tree", "fire", "garage". The terms move-on/move-off referred to residential building permits that are required to relocate a structure from one parcel to another.

Unless a demolition permit was issued in conjunction with these terms (signaling a teardown of the dwelling unit), a “move-on/move-off” residential building permit generally referred to moving a portion of the home onto a truck trailer. Additionally, the keywords “code repairs”, “tree”, or “fire” described renovations to specific damages to a home. These reinvestments alone do not signal a new class of people moving into a neighborhood, nor do they increase the footprint of the building structure.

Keyword	GSV Image 2014	GSV Image 2017
Code Repair		
Porch		
Fire repair		

Figure 58. Residential building permit descriptions not included in Cherry Hill pilot study dataset

Figure 58 illustrates GSV images taken for a sample of residential building permits from Cherry Hill falling into the two groups discussed above. Each reinvestment did not change the complexion of the home consistent with gentrification processes. As a result, if residential building permits only had a project describing one of the terms in

these two groups, it was eliminated from the Cherry Hill dataset. Finally, “garage” appeared frequently in the project descriptions. Although eliminated in the initial coding scheme, some building permits issued had descriptions that used the word “garage”. Hence, any garage term found during the keyword search was eliminated from the final Cherry Hill dataset.

As an additional 14 residential building permits were removed from the pilot dataset in Cherry Hill, the remaining 65 residential building permits were the most challenging to categorize. These words included: “interior renovations”, “interior upfit”, “interior remodel”, “remodel”, “dormer”, “attic”, and “addition”. The challenge arose when deciding whether the reinvestment subtly improved on the existing dwelling unit or drastically repaired an old house into a new one. To understand the difference, I reached out to multiple residential general contractors and the City of Charlotte's Land Development Office to decipher what these terms meant. The general contractors contacted were Charlotte Remodeling LLC, Andrew Roby General Contractor, Kolby Construction Company and Northfield Construction Company (located outside of Charlotte).

Per my conversations with the contractors, these words did have distinct meaning and were not just semantics. Renovations, for instance, can often be subtle, improving on the existing building or house, or they can be drastic. However, the key is understanding that construction involving renovation often refers to restoring or repairing an existing structure. In other words, dilapidated or poorly maintained houses are sometimes considered to be in a state of disrepair. To renovate a house means to resurrect that

structure by replacing the old with the new. Alternatively, remodeling generally changes the appearance, structure, or function of a single room.

The inference from the contractors is that residential building permits labeled "interior renovations" would fit the requirements for projects consistent with gentrification. However, projects that were described as "remodeled" would be eliminated since gentrification does not deal with changing the design or appearance of a single room. Another term, "interior upfit" also described a similar process to remodeling. According to City of Charlotte's Land Development Office, an "interior upfit" refers to an improvement that is being prepared for a tenant to occupy that space. This may include either a remodel or alteration to the existing space. As Figure 59 illustrates, terms "remodel" and "upfit" do not visibly change or increase the footprint of the property. With no evidence that these terms illustrate a new class of people reinvesting in a neighborhood, these terms were eliminated from the Cherry Hill dataset.

Keyword	2014 GSV Image	2017 GSV Image
Remodel		
Upfit		

Figure 59. Residential building permit descriptions not included in Cherry Hill pilot study dataset

"Addition" proved to be one of the most challenging terms to classify. According to the contractors, additions simply refers to adding space. However, the type of space added is important. For instance, a conventional home addition is a multi-room structure built onto the side of a house and is permanently open to the main home. When built well enough, a house addition essentially blends into and becomes the home itself. This would be similar to building a mini house according to Northfield Construction Company.
A subset of addition is a room addition, which is a single room structure built onto the side of a house meant for a single function, such as a bedroom. A room addition, or house bump out as many permits described it, is an addition scaled far down, and sometimes only expands the size of a single room on the existing house. As these types of reinvestments would increase the physical footprint of the dwelling unit, certain room additions theoretically make sense to be considered for the Cherry Hill dataset.

However, not all additions are equal. For instance, a finished basement would be an addition that is not consistent with gentrification. Another term not associated with gentrification would be a sunroom. Smaller than a full-size addition, sunrooms are most often made of prefabricated materials such as aluminum and thermal-resistant glass and assembled on-site. For example, sunrooms can be built with oversized glass and other fenestration that it is not possible with a conventional addition. In this way, sunrooms are more in line with the terms "laundry" or "kitchen" and would not be considered in the final dataset.

Similarly, per my discussion with the City of Charlotte's Land Development Office, "dormer" or "attic" would not be consistent with gentrification. A dormer refers to a roofed structure, often containing a window, that projects vertically beyond the plane

of a pitched roof. Attics generally refers to a space of room just below the roof of a building. Although these types of reinvestments may signal a new loft being added, the City of Charlotte's Land Development Office mentioned that “dormer” or “attic” were more in line with upgrading a home similar to a porch or deck or could even be classified with terms in the framing plan. As such, seen in Figure 60, the residential building permits with “sunroom” or “attic” do not demonstrate a new class of people reinvesting in the Cherry Hill neighborhood. Therefore, additions labeled as dormer, attic, sunroom, or basement would not be included in the Cherry Hill dataset.

Keyword	2014 GSV Image	2017 GSV Image
Sunroom		
Attic		

Figure 60. Residential building permit descriptions not included in Cherry Hill pilot study dataset

A final challenge with reducing the number of residential building permits in Cherry Hill came when the project descriptions were street addresses or a list of abbreviations. Street addresses alone provided no indication of renovation for that dwelling unit. However, if a street address included phrases such as, “1412 Luther St. – Total Demo” or included “renovation”, “room addition”, or some key phrase that indicated they would increase the physical footprint of the building in line with the

gentrification process, the residential building permit remained. Otherwise it was discarded. However, multiple residential building permits contained project descriptions such as, “RES ADDTN/PLAN REVIEW”. These multiple phrased residential building permits were difficult to decipher because it is not possible to determine how much of the reinvestment would go toward each of the keywords. Whenever a description like this would arise, at least half of the keywords had to indicate a project that would increase the physical footprint of the dwelling unit to remain in the dataset. After these types of permits were flagged, each was manually checked through GSV to identify whether there was any sign of visible change consistent with gentrification. Otherwise the residential building permit would be discarded.

Keyword	2014 GSV Image	2017 GSV Image
Street address alone		
Street address with “demo”		
Res/Addtn/Plan Review		

Figure 61. Residential building permit descriptions with street address and multiple abbreviations for Cherry Hill pilot dataset in 2016

As Figure 61 illustrates, a street address alone in the residential building permit does not provide evidence that the reinvestment is consistent with gentrification. However, the street address with the term “demo” attached does illustrate that the complexion of the residence was changed. That type of reinvestment is precisely what the research is trying to capture, which is why street addresses with additional descriptors were kept in the final Cherry Hill dataset. However, after the residential building permit with abbreviations “RES ADDTN/PLAN REVIEW” was reviewed, it did not pass the initial screening because the reinvestments were not consistent with a new social class reinvesting in the area.

With an additional 8 Cherry Hill residential building permits eliminated, the remaining 57 residential building permits in 2016 had descriptions that included the phrases “Residential Renovation”, “New Residential”, “New Bedroom”, “New Modular Home”, “addition” plus “room” or “bump-out”, “Demolition”, “Total Demolition”. Some of these phrases, according to City of Charlotte's Land Development Office, had abbreviations that also captured the same intent. For instance, “Rev” or “Reno” stood for renovation, whereas “Addtn” or “add” were found with bedroom or residential, stood for addition. Demo was also an abbreviation for demolition.

The process of parsing out each keyword took much longer than expected for Cherry Hill because of the variety of the residential building descriptions. However, each of the keywords found in Table 6 under the column “included” signal a residential building permit that increases the footprint of the dwelling unit or highlights reinvestment consistent with the process of gentrification. Winnowing down the Cherry Hill residential building permits in this way helped identify what types of residential building permits

best highlight the process of gentrification. As such, residential building permits with these key words were kept in the Cherry Hill dataset.

Included	**Eliminated**		
New Modular Home	Tree Damage	Fire Damage	Sunroom
New Residential	Re-roof	Porch	Interior remodel
New Bedroom	Deck	Door	Remodeling
Residential Renovation	Patio	Ramp	Interior upfit
Rev or Reno	Chimney	Column	Dormer
Interior Renovation	Pier	Joist	Attic
Residential addition	Sill	Gable	
Addition, Addtn or add	Studs	Siding	
Demo	Foundation	Framing	
Demolition	Band Sill	Window	
Total Demolition	Code repairs	Move on/off	
	Garage	Bathroom	
	Laundry	Kitchen	

Table 14. Building permit keywords consistent with gentrification.

A.1.3 Identifying reinvestment threshold.

Although the total number of residential building permits for the 2016 Cherry Hill dataset were reduced from 91 to 57, a potential problem emerged when I searched the remaining residential building permits in Cherry Hill on GSV. As shown in Table 14, the keyword “renovation” highlighted a home that did not show any visible sign of reinvestment. However, as Figure 62 illustrates, this home was located across the street from homes that were torn down and rebuilt in a manner consistent with gentrification. The challenge this type of residential building permits raised was whether these types of renovations should be kept in the dataset.

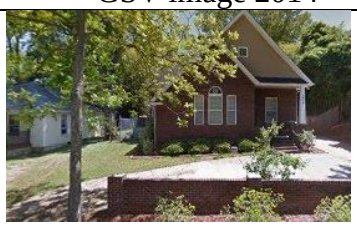
Keyword	GSV image 2014	GSV 2017
Renovation		

Figure 62. Cherry Hill home residential building permit and no visible change in 2016

Keyword	GSV image 2014	GSV 2017
Renovation		

Figure 63. Cherry Hill home residential building permit and no visible change in 2016

On the one hand, renovations theoretically represent reinvestments consistent with gentrification processes. On the other, there was no visible change to the dwelling unit. The factor that helped determine these cases, as seen in Figure 63, is the estimated amount reinvested in a home. For many residential building permits, the amount reinvested was not enough to indicate a residence would undergo a physical transformation or signal a new class of people moving into the area. Out of this observation, I created a rule. A residential building permit would be eliminated if the total reinvestment was not at least 20% of the current year's assessed home value. This rule only applies to reinvestments if it is not a new built.

The goal of the threshold rule is to eliminate properties that do not have enough reinvestment to signal gentrification. For instance, if the assessed value of a dwelling unit on a parcel was $100,000, then the residential building permit issued for that dwelling unit must be at least $20,000 to remain in the dataset. Although thresholds of 5% and 15% were experimented with, these lower thresholds allowed for too many residential

building permits that had a value of $5,000 - $15,000 remain in the dataset. These homes had a similar GSV result as seen in Figure 64.

Keyword	GSV image 2014	GSV 2017
Reinvestment threshold set at 5%		
Reinvestment threshold set at 15%		
Reinvestment threshold set at 25%		
Reinvestment threshold set at 35%		

Figure 64. Keyword renovation with reinvestment thresholds set at 5%, 15%, 25% and 35% of assessed value for Cherry Hill pilot dataset in 2016

Moreover, leaving the threshold at these levels increased the chance of false positives because the likelihood of reinvestments at that amount triggering gentrification is very low. Conversely, Figure 64 also illustrates that when a threshold of 25% and 35% of the assessed home value was used, it eliminated residential building permits that were likely to signal reinvestment consistent with gentrification. In other words, the chance of false negatives increased the higher I set the threshold. Therefore, I settled on 20% as a

discriminating characteristic of gentrification.

The assessed value of a property is retrieved from real properly tax record database. With the parcel ID numbers as a key, a spatial join between the tax assessment data and the building permit data allowed the calculation to be completed in a GIS. However, in a limited number of cases, no assessed value was reported. In instances like this, I flagged the residential building permit and manually checked the previous tax years to determine if the assessed value was provided. If there was an assessed value, that previous year's data was used. If no assessed value was provided, a potential vacant lot, I manually checked GSV to see if the reinvestment could be identified as consistent with gentrification. If so, the permit was left in the dataset. Otherwise it was discarded. With the threshold rule now in place, the total number of residential building permits was reduced for Cherry Hill in 2016 from 57 to 43.

A.1.4 Expanding keyword and threshold process.

After successfully reducing residential building permits in 2016 from 91 to 43, the next step expanded my keyword elimination and threshold process to include all years in Cherry Hill for the study year's timeframe – 2002-2017. Although I made attempts to automate the process of sifting through the residential building permits, constant misspellings, abbreviations, and combinations of keywords made it difficult to create an algorithm to assist in the process. This left me with a choice of searching for an automation process to help with the data reduction or manually reviewing each permit. Weighing the costs and benefits of spending more time coming up with an automated process, I decided that since this was the first attempt at creating a residential building permit dataset identifying gentrification, manually reviewing each residential building

permit would be the appropriate step to ensure future researchers can build off of this process.

Out of the 703 residential building permits issued for Cherry Hill between 2002-2017, 258 fit the keyword and threshold criteria established in the previous sections. Figure 65 displays the reinvestment trend after manually reviewing each residential building permit issued for Cherry Hill.

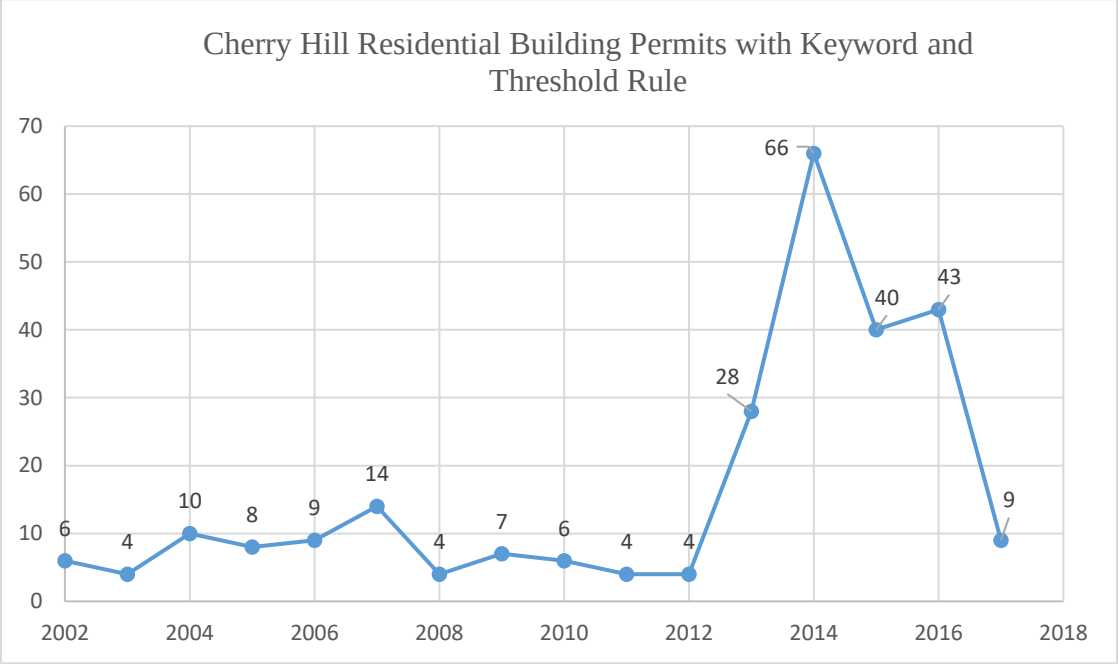


Figure 65. Annual residential building permits issued for Cherry Hill with keyword and threshold rule in place.

Reinvestment activity saw a gradual increase from 2002 to 2006. Although there was a small spike in 2007, the recession in 2008 cooled off any reinvestment activity in the neighborhood until 2013. Coming out of the recession, Cherry Hill saw a spike of real estate reinvestment from 2013-2016, which is consistent with media reports of gentrification concerns in the neighborhood (Dorsey, 2016; McShane, 2014). Although

these results had face validity, the next step was to ensure that the residential building permits issued are acted on reinvestments.

A.1.5 Data validation

A challenge with residential building permits is that the issuance of a permit may be an imprecise indicator of reinvestment activity. For instance, a residential building permit may be issued, but the house may never be worked on. Alternatively, the house may be demolished but not replaced with new construction. Hence, to ground truth the validity of the residential building permit dataset in Cherry Hill, I manually checked all residential building permits for neighborhood at the Mecklenburg County Code Enforcement website called Webpermit 7.3. On the code enforcement website, for each of the 258 Cherry Hill residential building permits, I typed in the permit ID, selected the permit, and verified whether or not the permit was "complete". Figure 66 provides an example of what a completed building permit verification would look like from the code enforcement website.

Results revealed that 237 out of 258, or 92%, of the residential building permits were listed as "complete" in the Cherry Hill neighborhood. The trend in Figure 67 demonstrates that the minimum "completed" rate occurred in 2008 with 75%. A follow up phone call to call to Mecklenburg County Code Enforcement Office verified that the "complete" status represents residential building permits have been acted upon and that the project was finished (Author's notes, 2019). The validation not only confirmed that residential building permits were issued for Cherry Hill, but also that the permits were acted upon. The importance of these results is that the keyword and threshold filtering process identified verifiable reinvestment activity. This validation process was repeated

for roughly 10% of the final dataset and revealed that 83% of the residential building permits were listed as complete during the study timeframe. The validation process helped illustrate that higher GI scores are consistent with properties that undergo transformations consistent with gentrification.

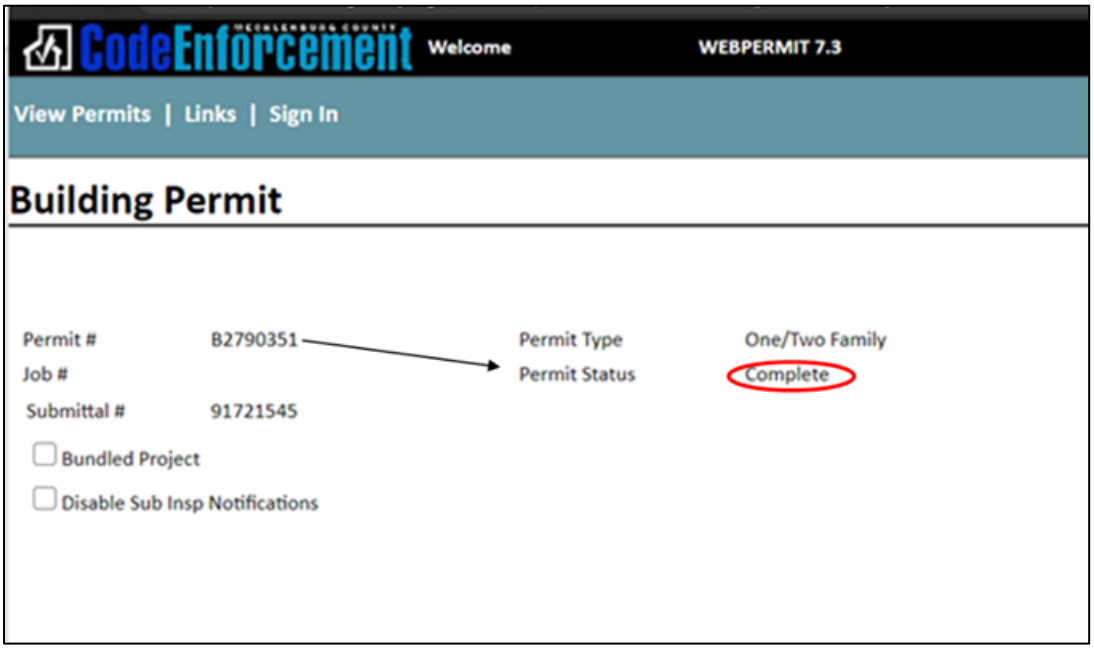


Figure 66. Residential building permit verification screenshot

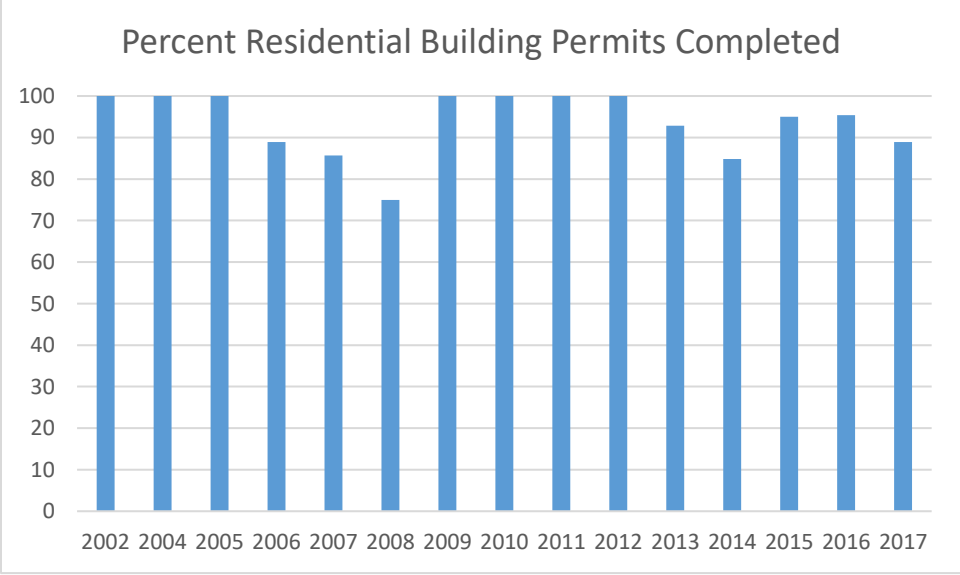


Figure 67. Percent residential building permits completed for Cherry Hill

APPENDIX B

Variable	Tolerance	VIF
Age of Structure	.860	1.162
FAR	.994	1.006
Proximity to city center	.305	3.277
Proximity to schools	.707	1.414
Quality Education	.421	2.375
Proximity to Highway	.294	3.400
Crime Rates	.736	1.358
Historic Wesley Heights	.782	1.278
Historic Hermitage	.823	1.215
Historic Wilmore	.766	1.306
Historic Plaza Midwood	.842	1.187
Historic Dilworth	.516	1.937
Historic 4th Ward	.637	1.571
Blue Line, 5 walk	.736	1.359
Blue Line, 5-10 walk	.677	1.476
Blue Line, 10-15 walk	.628	1.591
Blue Line Extension, 5 walk	.779	1.283
Blue Line Extension, 5-10 walk	.700	1.429
Blue Line Extension, 10-15 walk	.693	1.444
Proximity to Commercial	.560	1.786
JC Smith, Half Mile	.692	1.445
JC Smith, Mile	.673	1.486
JC Smith, Mile and half	.484	2.067
Greenway, Quarter Mile	.316	3.160
Greenway, Half Mile	.420	2.381
Greenway, Mile	.397	2.520
Neighborhood Park, 1/4 Mile	.438	2.282
Neighborhood Park, 1/2 Mile	.642	1.557
Neighborhood Park, 1 Mile	.582	1.718
Community Park, 1/4 Mile	.484	2.067
Community Park, 1/2 Mile	.476	2.103
Community Park, Mile	.560	1.787
Regional Park, Quarter Mile	.047	1.478
Regional Park, Half Mile	.054	1.510
Regional Park, Mile	.081	1.343
Value of home Dummy Q1	.513	2.384
Value of home Dummy Q2	.615	2.018

Value of home Dummy Q3	.413	1.398
2002 Spatial Spillover, 1/8 mile	.748	1.336
2003 Spatial Spillover, 1/8 mile	.549	2.843
2004 Spatial Spillover, 1/8 mile	.334	2.997
2005 Spatial Spillover, 1/8 mile	.301	3.320
2006 Spatial Spillover, 1/8 mile	.274	3.656
2007 Spatial Spillover, 1/8 mile	.247	4.041
2008 Spatial Spillover, 1/8 mile	.323	3.093
2009 Spatial Spillover, 1/8 mile	.474	2.112
2010 Spatial Spillover, 1/8 mile	.453	2.209
2011 Spatial Spillover, 1/8 mile	.472	2.120
2012 Spatial Spillover, 1/8 mile	.460	2.172
2013 Spatial Spillover, 1/8 mile	.396	2.526
2014 Spatial Spillover, 1/8 mile	.288	3.476
2015 Spatial Spillover, 1/8 mile	.283	3.535
2016 Spatial Spillover, 1/8 mile	.289	3.457
2017 Spatial Spillover, 1/8 mile	.290	3.452