# ANALYZING HOUSING MARKET DYNAMICS AND NEIGHBORHOOD CHANGE: A CASE STUDY OF CHARLOTTE, NORTH CAROLINA

by

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ABSTRACT

PROVIDENCE F. ADU. Analyzing Housing Market Dynamics and Neighborhood Change: A Case Study of Charlotte, North Carolina. (Under the direction of DR. ISABELLE NILSSON and DR. ELIZABETH DELMELLE)

This research analyzes different aspects of housing market dynamics and policies, focusing on the implications for inequality, housing cost, access to housing, and neighborhood change. Chapter two examines exclusionary screening criteria in online rental listings, revealing patterns of discrimination against individuals of lower socio-economic status. Chapter three analyzes the relationship between neighborhood characteristics and housing renovation activity over a ten-year period, highlighting the influence of factors such as housing age, homeownership rates, and median household income on housing renovation activity in neighborhoods. Chapter four explores the effects of housing code violations on neighborhood home sales prices and rental rates, highlighting the relationship between housing code enforcement and affordability. These chapters underscore the importance of targeted policy interventions to address housing barriers and promote equitable housing opportunities.

# DEDICATION

This dissertation is dedicated to my parents, John Boobi Adu and Martha Ayiwa.

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# CHAPTER 1: INTRODUCTION

Studies on neighborhood change have highlighted that neighborhood change is a complex process that involves multiple actors, including real estate developers, local government, public and private investors, financial institutions, and residents (Delmelle, 2021). These actors operate at different scales to effect change in their neighborhoods. The changes that occur can be physical or socioeconomic and can happen within or between neighborhoods. Theories on neighborhood change have described different forms of neighborhood change, some of which include gentrification, white flight, urban revitalization, and neighborhood filtering (Crowder, 2000; Galster, 1996; Kolko, 2007; Ratcliff, 1945; Smith, 1987). Some of the neighborhood change processes can be observed and measured, while others are unobservable and unmeasurable. Data-driven mapping strategies that leverage novel and traditional datasets and advanced methodological approaches have been vital in understanding and extracting meaning from different neighborhood change processes.

From a housing market perspective, neighborhood change is driven by both urban policy and private actors. Federal policies, such as the United States Housing Act of 1937 and the Housing Act of 1949, have historically played a role in driving neighborhood change aimed at dealing with urban housing problems such as urban blight, urban decay, poverty concentrations, and housing abandonment (Hunt, 2005; Lang & Sohmer, 2000). Post-federal-government devolution, local governments have adopted different strategies to address housing problems, some of which provoke neighborhood change. Neoliberal approaches that advocate for a competitive and unrestricted free market have been used by some local governments to achieve urban and economic development goals (Brenner & Theodore, 2002; Drozdz, 2014). However, these

approaches allow private actors, such as corporate landlords, to impact urban neighborhood change processes.

Recent research has highlighted the presence of private actors in the form of corporate landlords who dominate the rental housing market (Inglis & McElroy, 2019; Raymond et al., 2016). The presence of corporate landlords does have implications for housing affordability as well as other neighborhood outcomes, such as neighborhood gentrification (Aalbers, 2019). In Atlanta, for example, corporate landlords have been associated with high eviction rates of tenants (Raymond et al., 2016). As corporate landlords in the rental housing market aim to maximize profit, their pattern of investment in terms of where most of their housing portfolios are and their advertisement language, for example, can signal an underlying observable and measurable neighborhood change process, including how tenants sort into different neighborhoods (Delmelle, 2021; Delmelle & Nilsson, 2021).

Another critical aspect of the neighborhood change process is the movement of capital into neighborhoods and its effect on neighborhood outcomes. Theories of gentrification posit that the movement of capital into neighborhoods is one of the drivers and signals of a neighborhood undergoing gentrification (Smith, 1979). From a housing perspective, the movement of capital can be exhibited through housing renovation activity or new residential construction. As private actors in the housing market undertake such investment, their collective impact does have implications for neighborhood change.

Furthermore, local government regulatory tools and policies have historically been a critical driver of neighborhood change. Tools such as zoning and land use planning can shape neighborhood change. As local governments use regulatory tools to guide growth and development in their jurisdictions, the potential of these tools to shape housing market outcomes

exists. Regulatory tools such as housing code enforcement have already been linked to increasing housing costs (Bartram, 2019). Thus, local government urban regulatory policy plays a central role in shaping neighborhood outcomes, including a neighborhood's housing market.

This research contributes to understanding the effects of local government urban regulatory policy and actions of private actors on a neighborhood's housing market using the fast-growing city of Charlotte, North Carolina, as a case study. The research also creates a framework that shows how spatial statistics tools, natural language processing techniques, and novel and traditional data can be used to understand the relationship between urban policy, private actors, a neighborhood's housing market, and neighborhood change.

Chapter two of this research examines private actors in the rental housing market and their impact on neighborhood outcomes. The analysis focuses on how exclusionary criteria used in online rental advertisements vary spatially and how they potentially impact neighborhood outcomes. It also focuses on how various factors such as race, income, and platform (Zillow vs. Craigslist) influence the presence of exclusionary criteria in rental advertisements.

Chapter three situates private actors' actions within the scope of a neighborhood's changing characteristics and their effects on a neighborhood's capital investment exhibited through housing renovation activity. The analysis employs 10-year longitudinal parcel-level permitting data on housing renovation activity, housing and neighborhood-specific variables, and spatial statistical techniques to assess if a change in a neighborhood's prevailing characteristics influences housing renovation activity.

Chapter four analyzes the effects of local government regulatory policies on a neighborhood's housing market, specifically housing code violations that are resolved with repairs.

The chapter hypothesizes that housing code violations, when solved with repairs, will significantly affect a neighborhood's housing market by increasing home sales and rental prices or contribute to the loss of affordable housing as landlords withdraw their property from the housing market. To test this hypothesis, the research uses longitudinal data on home sales prices, gross rent, housing code violations, and other housing and neighborhood-specific variables. It employs spatial statistics techniques to model their longitudinal relationships.

These three research chapters collectively contribute to our understanding of neighborhood housing markets analyzed through the lens of private investments and practices and urban regulatory policy adopted by local governments in fast-growing cities like Charlotte. Furthermore, these chapters create a framework that shows how spatial statistics tools, natural language processing techniques, and novel and traditional data can be used to understand the relationship between a neighborhood's housing market and neighborhood change.

# CHAPTER 2: SPATIAL VARIATIONS IN EXCLUSIONARY CRITERIA FROM ONLINE RENTAL ADVERTISEMENTS

## 2.1 Introduction

More than 30 years have passed since the 1986 extension of the Fair Housing Act, meant to strengthen its 1968 predecessor, made discrimination in the housing market on the basis of race, color, religion, disability, or sexual orientation illegal. Despite these laws, discrimination remains a widespread practice (Schwemm, 2006; Hanson & Hawley, 2011), contributing to the perpetuation of segregation by race and income observed throughout many US cities (Rosen, 2014). While a large body of literature has focused on racial discrimination in the rental housing market including the motivation and mechanisms used by landlords to discriminate (e.g. Ondrich et al., 1999; Hanson & Hawley, 2011; Hanson & Hawley, 2014), other, less explicit, and often legal forms of discrimination exist that serve to restrict housing options and contribute to the spatial reproduction of poverty and inequality. Many of these restrictions, or exclusionary criteria, are aimed at predominantly lower-income and minority renters with discredited backgrounds such as criminal backgrounds, prior evictions, poor or no credit history, those possessing housing vouchers, or not meeting a minimum income requirement, for example (Rosen, 2021; Reosti, 2020).

To date, there has been limited systematic examination of the extent to which exclusionary screening processes are present in the rental housing market, and how these practices vary spatially, according to the racial or income makeup of a city. This is likely due to the relative lack of data on rental housing markets in general. However, the movement towards online rental platforms and data science methods have enabled some recent breakthroughs in quantifying elements of the rental housing market (Boeing & Waddell 2017; Boeing 2020; Costa et al., 2021; Hess et al., 2021).

In this article, we build upon this progress and develop a method for analyzing the extent to which categorial exclusionary criteria are present in rental listings obtained from Zillow and Craigslist, in a case study of listings in the fast-growing, competitive housing market of Charlotte, North Carolina. We apply natural language processing techniques to facilitate an analysis of terms that exclude groups of potential renters from obtaining housing (e.g. no criminal backgrounds, no prior evictions, minimum incomes, minimum credit scores, etc.) and we compare the pervasiveness of these terms by the race and income at the neighborhood level. This analysis sheds light onto some of the struggles associated with finding housing, especially in a competitive market such as Charlotte, and adds to the growing literature onto the barriers faced by low-income and minority residents in securing housing (Rosen, 2021).

## 2.2 Background

### *2.2.1 Discrimination in Rental Housing Market*

From a legal standpoint, discrimination in housing occurs when an individual is denied access to housing due to their race, color, national origin, familial status, religion, ethnicity, disability, or sexual orientation. The 1968 Fair Housing Act made it illegal for real estate agents or landlords to explicitly discriminate according to these characteristics. Nonetheless, there exist techniques for circumventing this law that serve to prevent a person from residing in a home or neighborhood of his or her choosing. Research has demonstrated that discrimination, or the unequal treatment of otherwise equally qualified individuals because of their association with some group - remains a widespread practice by landlords (Ondrich et al., 1999). The implications of these are far reaching - individuals are less able to obtain access to the neighborhood and its associated opportunities of their choosing, potentially diminishing their economic and educational

prospects. When discrimination occurs systematically across racial or socioeconomic groups, patterns of inequality and segregation are perpetuated (Langowski et al., 2020).

With respect to the rental housing market, landlords may be motivated to be 'discriminant' when seeking out tenants for their properties - they would ideally prefer to rent to an individual or household who appears least likely to miss a rent payment, to be disruptive, to cause damage to their property, or to break a lease, for example (Hulchanski, 1994). To minimize the possibility of leasing to an 'inferior tenant' (Galster, 1992), landlords often enact a type of heuristic to restrict their rental units to individuals belonging to a group whose collective characteristics are correlated with being a bad tenant. This practice is referred to as statistical discrimination - where an individual is judged based on the average of the group it belongs to, rather than the characteristics of him or herself (Phelps, 1972; Hulchanski, 1994). In an increasingly digital rental market, statistical discrimination is often manifest through algorithmic proxies that screen applicants based on a set of exclusionary criteria (Rosen et al., 2021). These seemingly objective criteria are designed to fall within legal boundaries and are therefore more regularly used by larger and corporate landlords (Decker, 2021; Rosen et al., 2021). In our analysis, we use the more encompassing, categorical exclusionary criteria term as some of these restrictions are not rooted in statistical association, but based more on preference or perceptions of groups of people.

One example of statistical discrimination is a minimum income requirement - on average, those with lower incomes might be more likely to miss rent payments, but that does not speak to the unique circumstance of each individual. Housing voucher holders are often stigmatized and perceived as high risk, though in reality their rental payments are guaranteed to be on-time and may therefore be desirable in lower-income submarkets (Rosen, 2014). Research has shown that higher-rent landlords are more likely to avoid voucher holders because of their associated stigma

(Phillips, 2017). Consequently, voucher holders tend to be concentrated in poorer neighborhoods with more minority residents than non-voucher holders (Deluca et al., 2013; Metzger, 2014). In places where source of income discrimination is illegal, the location of housing voucher recipients is more dispersed (Freeman, 2012; Metzger, 2014; Tighe et al., 2014). Further examples of exclusionary criteria used by landlords include criminal backgrounds (Clark, 2007), previous rental history including any prior evictions (Porton et al., 2020), and minimum credit scores (Reosti, 2020).

The restriction of housing options to those with discredited backgrounds has been shown to induce significant mental and monetary costs with respect to the housing search process (Reosti, 2021). As a result, they are often relegated to substandard housing in disadvantaged neighborhoods, thus perpetuating their cycle of disadvantage. More broadly, the use of exclusionary criteria ultimately shapes residential sorting patterns by inserting the desires of landlords into the location choice process. In the rental housing market, these decisions are far from operating in a way that tenants maximize their preferences for homes and neighborhoods according to their budget. Rather, landlords select tenants that meet their desired criteria (Evans et al., 2019). The more competitive the housing market, the greater power a landlord has in filtering applicants. Recently, the presence of corporate landlords in cities has grown rapidly because of the mortgage crisis, as they purchased large quantities of foreclosed or real-estate owned properties concentrated in lower-income and minority neighborhoods, or those areas that were prime targets for predatory mortgages (Fields, 2018). These landlords have been shown to largely rely on rigid algorithmic processes to screen or exclude potential tenants, as compared to smaller landlords who use more seemingly subjective criteria, or gut feelings (Decker et al., 2021; Rosen et al., 2021).

*2.2.2 Discrimination in Digital Rental Platforms*

There exist complexities when it comes to regulating discrimination on digital rental platforms like Realtor.com, Apartment.com, Zillow, and Craigslist. Whereas the Federal Fair Housing Act makes it illegal to print, publish or advertise listings with discriminatory languages, federal policies like the Communication Decency Act of 1996 protects digital housing platforms from liability of user generated content (Oliveri, 2009). This contradiction in the Federal Fair Housing Act and the Communication Decency Act means that discriminatory advertisements find their way onto digital rental platforms.

Recently, several studies have used web-scraping and text analysis techniques to analyze online rental listings. This work has shown that rental advertisement language differs in predominantly White versus minority neighborhoods. In the case of Seattle, rental advertisements scraped from Craigslist showed that in White neighborhoods, the history and culture of the neighborhood were emphasized, while in non-White neighborhoods, terms emphasized the availability of bus transit and fewer neighborhood amenities (Kennedy et al., 2021). Delmelle and Nilsson (2021) reached similar conclusions in the case of single-family property listings in Charlotte, North Carolina: housing advertisements from neighborhoods with a recent influx of White residents highlighted urban amenities and the name of the neighborhood, while in neighborhoods with predominantly Black homebuyers, schools were less likely to be mentioned. In an analysis of Craigslist rental listings, Besbris et al. (2021) found exclusionary criteria to be more prevalent in poorer and minority neighborhoods.

Research has also revealed that online rental listings vary in their geographic distribution. Predominantly White neighborhoods have a larger share of advertised listings, suggesting that online listings and information are segregated along class and racial lines (Boeing 2020; Boeing

et al., 2021; Brannon 2017). This implies that access to rental information is unequal to all individuals, making online housing markets unevenly segmented. Thus, whereas listings might not explicitly discriminate in language, where listings are advertised in a digital space contributes to discrimination as they overly represent the wealthier, educated and predominantly White communities. Furthermore, the amount of information contained in listings varies by location as it is not illegal for landlords to selectively share information on rental housing advertisements. Minorities tend to have less information when searching for properties to rent. As these discriminatory patterns persist, digital platforms risk reproducing historical patterns of residential segregation (Boeing et al., 2021). Recent research has also uncovered differences in online rental platforms. For example, Craigslist and apartments.com are used as a source for more affordable rental housing opportunities (Costa et al., 2021; Hess et al., 2021).

While this emerging stream of research has revealed differences in terms of the location of online listings and their language, there remains a gap in understanding how they may contribute to restricting certain populations from obtaining housing or neighborhoods of their choosing based on the stated exclusionary criteria. As online listings are often the first source of information tenants use to evaluate prospective units and neighborhoods (Krysan & Crowder, 2017), the concentration of these criteria in particular neighborhoods could serve to steer away populations most impacted by them, those who are more often lower-income and minority, and therefore contribute to perpetuating patterns of segregation. We also examine whether differences exist between two popular platforms: Craigslist and Zillow on the prevalence and spatial variation in exclusionary criteria.

## 2.3 Data, Geographic Scope, and Methods

### *2.3.1 Study Area*

The geographic scope of this research is Charlotte, North Carolina, the largest city in the state, and one of the fastest growing in the country. Charlotte is the 16th largest city in the United States, with a population of approximately 880,000 that is projected to reach 2.7 million by 2030 (US Census Bureau, 2019). Growth in the city has been characterized by strong gentrification trends towards the center city, as the city's financial and banking industries have grown, while poverty and lower-wage jobs have moved away from this core (Delmelle et al., 2020).

As Charlotte rapidly grows, there is pressure on its housing market as demand has outpaced supply, resulting in rising rental and owner-occupied housing prices. Consequently, the current average and median rental and real estate prices have reached an all-time high (Childress Klein Center for Real Estate, 2020). Therefore, the city has explored multiple policy interventions. For example, the city's latest 2040 comprehensive plan recommended modifying its current zoning to allow for more affordable housing options (Charlotte 2040 comprehensive plan, 2020). Coupled with this affordable housing crisis has been the rise of corporate landlords (Portillo & Lane, 2021) who have been noted for squeezing renters with threats of eviction and court filings (Raymond et al., 2016) as they advance profit seeking goals. Nationwide, the rise of corporate landlords followed the housing market crash as investors purchased large quantities of homes in foreclosure, often in areas of high poverty, or those that were targets of predatory lenders. These often out-of-state investors have therefore turned neighborhoods that were largely owner-occupied into renter-occupied, arguably leading to neighborhood destabilization (Fields, 2018; Seymour & Akers, 2021).

As Charlotte grapples with affordable housing crisis and homelessness in the city, there have been calls to address issues of discrimination in the housing market (Lindstrom, 2019). Apart from the standard 1968 fair housing policy against discrimination, the city has no substantive anti-housing discriminatory policy, thus exposing renters to subtle discriminatory practices.

### *2.3.2 Rental Data - Web Scraping Procedure*

We designed a Python-based web scraper to acquire rental listings from Zillow and Craigslist. The scraper was run daily between March 3rd, 2021 and November 17th, 2021, capturing rental listings that were posted on both platforms. During the 260-day period, a total of 51,155 rental listings were acquired. For each rental listing, we collected the price, bedrooms, bathrooms, description text, address, zip code, neighborhood, square footage, and the URL.

### *2.3.3 Data Cleaning*

Craigslist and Zillow do not prevent users from posting rental advertisements multiple times and they allow users to make changes or update their rental listings after they have been posted. Also, some users post their advertisements on both platforms. Because of this, there were duplicate listings in the initial set of 51,155, so we filtered out only those that had distinct addresses. Because users frequently made small changes to their text to make their listing appear more often, filtering by both distinct address and text still resulted in a large amount of redundancy. We therefore opted to keep only one listing per address, including when there were multiple units in an apartment complex.

Further, since these rental listings are user generated, there were some inaccuracies in the collected sample. In some instances, home sales listings found their way into the rental listings category, and there were price outliers (rentals listed at $179,000 or $70, for example), or

extremely high values for square footage, number of bedrooms and bathrooms. All of these outliers were removed in the cleaning process. In subsequent text cleaning steps, we removed stop words, punctuations, multiple white spaces, and weblinks, converted the text to lower case, and changed key words to their singular form, for example, ‘evictions’ to ‘eviction’ and ‘felonies’ to ‘felony’, etc.

After removing duplicates and cleaning the initial dataset, a total of 10,146 rental listings remained. These were next geocoded to a census tract and listings that fell outside of the Charlotte city limits were removed, further reducing the sample to 8616 listings. Among these, 7175 were from Zillow while 1442 listings were from Craigslist (see Table 2.1 for descriptive statistics on rental listings). Briefly, the Table shows that Zillow listings have a higher mean rent as compared to Craigslist, while the size of properties on Craigslist was smaller. The median monthly rent per square foot was then very similar between the two platforms.

**Table 2.1**. Descriptive statistics of original rental listings and rental listings with unique addresses.

| Descriptive Statistics | Original Datasets | Unique Address | Charlotte Listings | Zillow Listings | Craigslist Listings |
|---|---|---|---|---|---|
| Count of listings | 51155 | 10146 | 8616 | 7175 | 1442 |
| Mean Rent | $1462 | $1745 | $1783 | $1908 | $1294 |
| Median Rent | $1355 | $1695.0 | $1750 | $1800 | $1150 |
| Median Square ft | 1355 ft | 1456 ft | 1540 ft | 1595 ft | 1120 ft |

| | | | | | |
|---|---|---|---|---|---|
| Median Rent/square ft | $1.30 | $1.15 | $1.14 | $1.13 | $1.20 |
| Mean Bedrooms | 2.09 | 2.82 | 2.91 | 3.0 | 2.43 |
| Mean Bathrooms | 1.65 | 1.88 | 1.91 | 1.92 | 1.84 |

*2.3.4 Discriminatory Language Analysis*

To assess spatial variations in exclusionary criteria across the city tracts, we began by creating a list of terms and phrases that could potentially represent a barrier for individuals seeking to rent properties, especially those of lower socioeconomic status including ex-convicts, low-income earners, and minorities. These terms were informed by the literature and refined by an initial exploration of terms in our corpus and included[1]: credit scores, credit report, credit history, housing vouchers, section 8, proof of income, income to debt ratio, pay stubs, criminal background checks, criminal history, felony, misdemeanor, unemployment, eviction, homeowners association (HOA). For each term from our list, a column was created in our database containing the number of times for which the term appeared, enabling us to visualize the extent to which the words varied spatially for individual rental listings by census tract. Our initial exploratory text analysis (bi-gram modeling) also identified a list of frequently occurring corporate landlords[2] in our corpus and so we subsequently flagged listings that indicated a property was associated with one of those.

[1] Our exploratory text analysis included examining frequent word counts, exploratory topic modeling, and bi-gram modeling to ensure that no additional, frequently mentioned term was missed.
[2] We identified the following corporate landlords in our corpus: Invitation Homes, Main Street Renewal, Tricon Residential, Progress Residential, HomeRiver Group, American Homes 4 Rent, Mynd Property Management, First Key Homes LLC

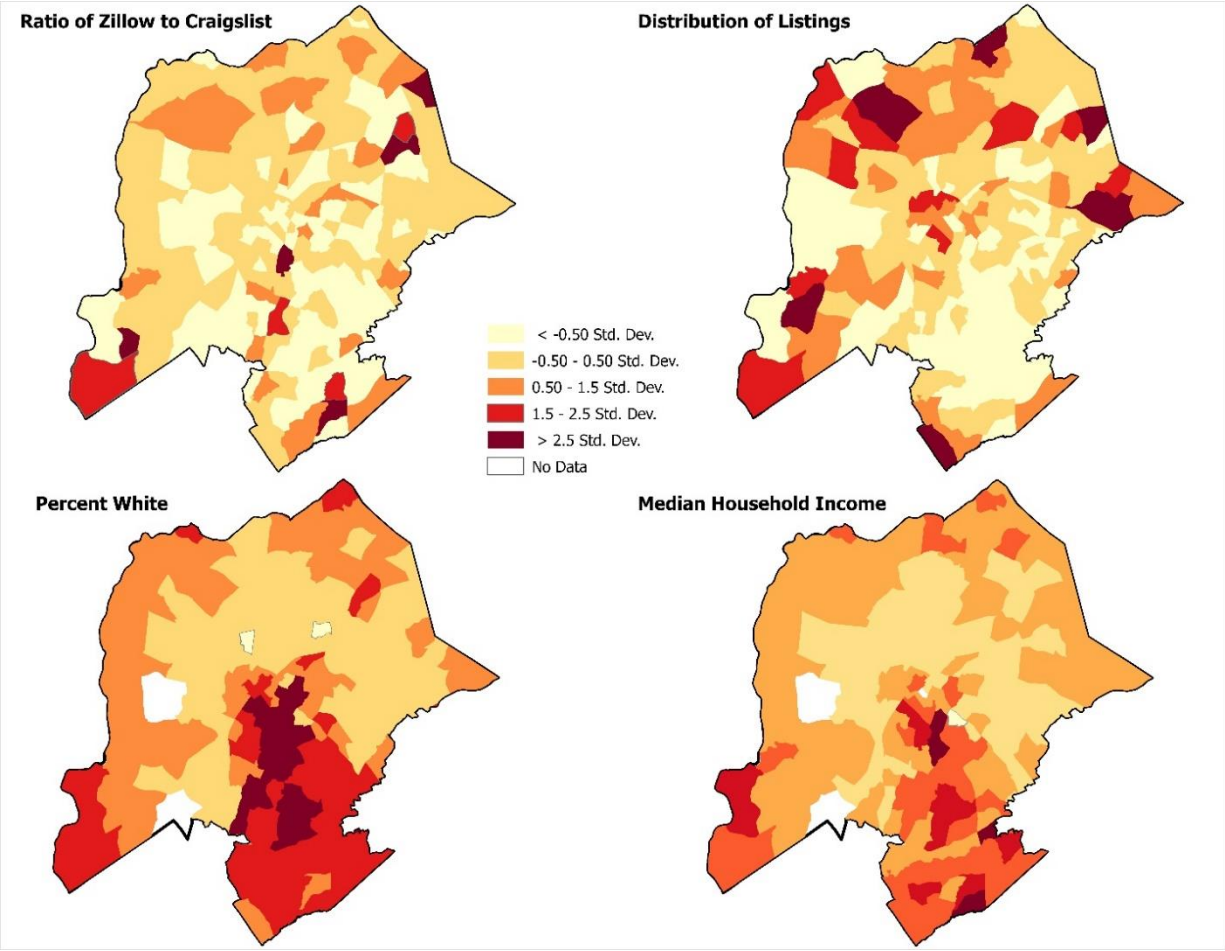
*2.3.5 Analytical Approach*

To determine if the exclusionary criteria varied by race and income in the city, thereby acting as a potential barrier for entry into a neighborhood, we performed a simple linear regression on the share of listings in each tract containing each criterion by the share of White residents and the median household income of the tract, both obtained from the 2015-2019 American Community Survey. Because of significant multicollinearity in the race and income variables, attributed to high levels of segregation in the city (see Figure 1), we had to place these two variables in separate models. Note that our objective was to examine how these terms varied specifically with race and income and was not intended to explore all possible factors that explain their spatial variation.

## 2.4 Results

In our corpus of 8616 property listings, we tallied 19,460 exclusionary criteria, given that a single listing could contain multiple terms. When exclusionary criteria were not explicitly listed, a follow-up on the advertising agency website sometimes indicated that these conditions still applied even when agencies stated that they upheld '*equal housing'* standards. These included conditions requiring no prior evictions, no criminal record, and a consumer credit report and public record check that *"discloses the applicant's character, general reputation, personal characteristics and mode of living"*. This indicates that even when a listing does not explicitly state exclusionary criteria in their advertisement, they still have a potential to be a barrier at some stage during the renting process. Our analysis also revealed that corporate landlords do not advertise on Craigslist and were only present on Zillow. These landlords systematically listed nearly all exclusionary criteria (except for HOA and Housing Voucher) in every listing. A map illustrating the spatial distribution of listings by platform and the race and income distributions across the city is shown in Figure 2.1. According to the Figure, the overall distribution of listings is higher in the outer ring of the city, areas of higher shares of minorities and lower incomes, avoiding the so-called 'wedge of wealth', extending south from the center city. A concentration of listings is also shown in the central business district, directly in the center of the maps – these listings are notably less prevalent on Zillow as compared to Craigslist.

Figure 2.1 Spatial distribution of a) the ratio of Zillow to Craigslist listings; b) All listings; c) Percent White; d) Median Household Income in Charlotte, NC.




We now turn to the analysis of each exclusionary criteria. The spatial distribution, represented as the share of listings mentioning the criteria, normalized by the total number of listings in each tract is shown in Figure 2. As can be seen in the Figure, minimum credit scores, no criminal backgrounds, no prior evictions, and minimum income requirements are the most listed exclusionary criteria. These were most common in poorer, minority neighborhoods of the outer ring of the city which represents some of the oldest suburban or single-family neighborhoods within the broader metropolitan area. The mentioning of HOAs and housing voucher restrictions were much less common – largely due to the fact that they were not systematically included in the

corporate landlord listings, and they also follow distinct spatial patterns.

Figure 2.2 Spatial distribution of each exclusionary criterion in Charlotte, NC

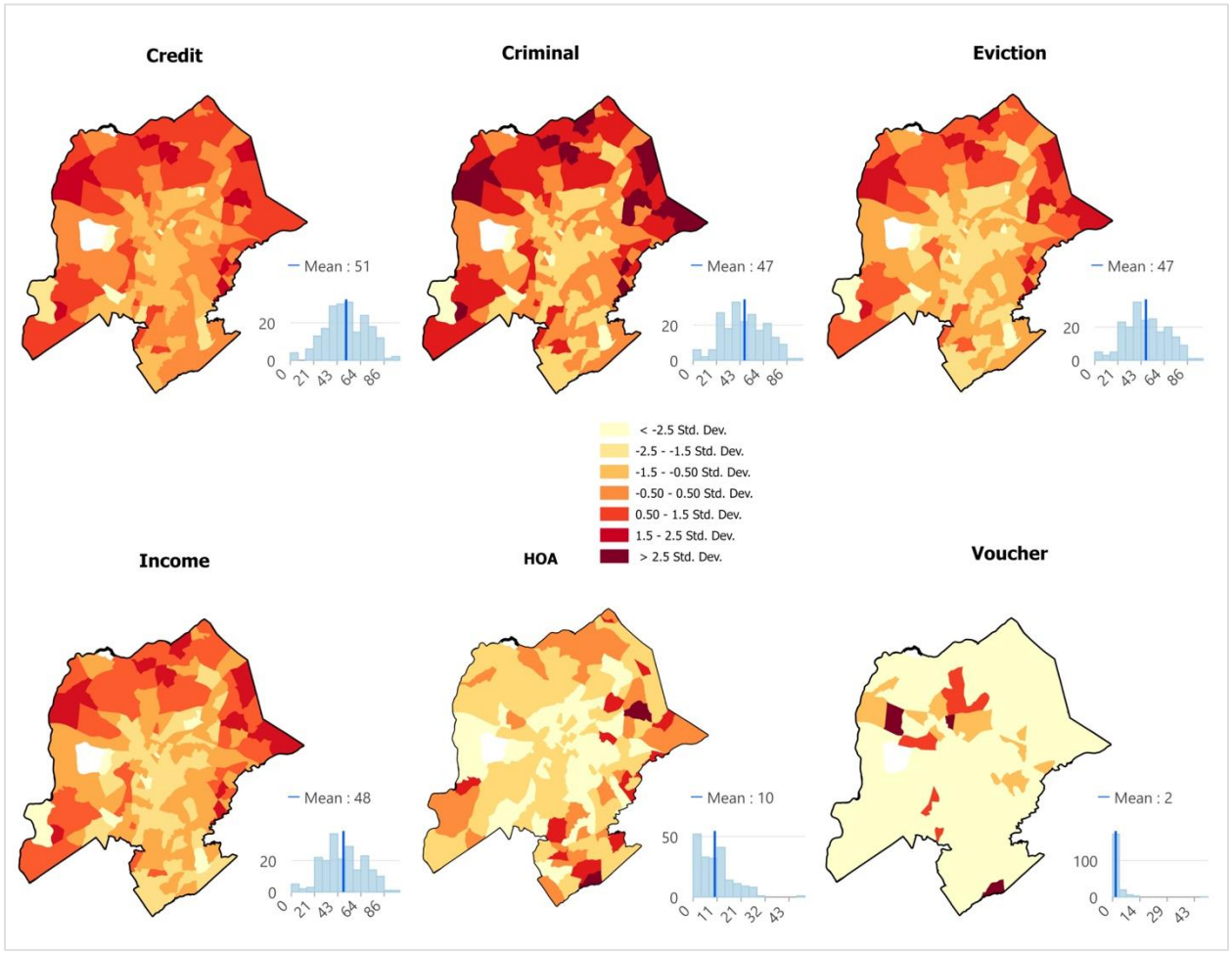



Table 2.2 shows the results of our simple linear regressions with the share of each criterion and the percent White and the median household income of each tract for all listings combined and then separated between Zillow and Craigslist. Overall, we find criminal backgrounds, credit scores, housing vouchers, evictions, and minimum income restrictions to be less common in Whiter neighborhoods, and therefore, more pervasive in minority neighborhoods. Minimum credit scores were present in nearly 50% of all listings. Corroborating the maps in Figure 2.2, housing voucher restrictions were mentioned the least frequently, explicitly stated in only 1.5% of our

sample. However, the population that relies upon vouchers will typically be excluded based on minimum income restrictions. alone

Homeowners Associations (HOAs) show the opposite spatial pattern, more concentrated in Whiter and wealthier neighborhoods. While HOAs may not be as intuitively exclusionary as some of the other terms in our list, their mandatory fees - often for amenities largely catered towards wealthier and Whiter residents such as golf courses - and their additional covenants (Strahilevitz, 2006), have led researchers to reveal that HOA neighborhoods tend to be more racially segregated and affluent than nearby neighborhoods (Meltzer, 2013; Clarke & Freedman, 2019). As is the case in most fast-growing, southern, US cities, HOAs are increasingly popular in Charlotte both in the rental and mortgage housing market. HOAs are small neighborhood groups who fight for and maintain the interest of its members such as maintaining safety and security of their respective neighborhoods. Historically, HOAs are known for perpetuating discriminatory acts in housing markets with strategies like deed restrictions that prevented minorities from accessing specific neighborhoods. The powers of HOAs include having the capability of requiring minimum credit scores in the mortgage market (Business insider, 2020).

Next, we turn to distinctions between the two platforms with respect to exclusionary criteria. As noted, a major difference between them is the lack of corporate landlords on Craigslist and their abundance on Zillow; we tallied 4212 listings (59%) from a corporate entity. In general, the spatial patterns of Zillow mirror the overall listings combined, which largely reflects the high concentration of these corporate landlords in poorer and minority neighborhoods and who systematically include most restrictions as part of their automated screening processes. By comparison, Craigslist then tends to feature smaller or independent landlords, and consequently has some distinction in the spatial patterns of its exclusionary criteria. First, explicit restrictions on

housing voucher holders from Craigslist advertisements are more common in higher-income neighborhoods, and second, restrictions on those with prior evictions are higher in Whiter neighborhoods; both are the opposite of what we observe from Zillow. It should be recognized that the share of listings that contained housing voucher restrictions on Craigslist was quite small (2% of the sample). Like Zillow, minimum credit scores, minimum income, criminal background, and prior evictions were the most mentioned exclusionary criteria. The exclusionary criteria on Craigslist varies less systematically by race and income, given the few statistically significant relationships.

Table 2.2 Relationship between exclusionary criteria and share of White residents and median income by census tract. *Significant at <= 0.05

| | Criminal Background | Credit Score | Housing Voucher | HOA | Evictions | Minimum Income | All Terms Combined |
|---|---|---|---|---|---|---|---|
| All Listings | | | | | | | |
| n (8616) | 4491 | 4811 | 137 | 929 | 4507 | 4585 | 19460 |
| % White | -0.20 $p = 0.00$* | -0.17 $p = 0.00$* | -0.02 $p = 0.05$ | 0.04 $p = 0.07$ | -0.19 $p = 0.00$* | -0.20 $p = 0.00$* | -0.75 $p = 0.00$* |
| Median Income ($ 1,000) | -0.07 $p = 0.05$ | -0.06 $p = 0.07$ | 0.000 $p = 0.86$ | 0.06 $p = 0.00$* | -0.07 $p = 0.06$ | -0.07 $p = 0.05$ | -0.02 $p = 0.16$ |
| Zillow | | | | | | | |
| n (7174) | 3997 | 4265 | 125 | 915 | 4012 | 4072 | 17386 |
| % White | -0.30 $p = 0.00$* | -0.25 $p = 0.00$* | -0.05 $p = 0.00$* | 0.05 $p = 0.07$ | -0.29 $p = 0.00$* | -0.29 $p = 0.00$* | -1.12 $p = 0.00$* |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Median Income ($ 1,000) | -0.01 $p = 0.01$* | -0.09 $p = 0.03$* | -0.02 $p = 0.00$* | 0.08 $p = 0.00$* | -0.11 $p =0.01$* | -0.11 $p = 0.00$* | -0.37 $p =0.04$* |
| Craigslist | | | | | | | |
| n (1442) | 494 | 546 | 12 | 14 | 495 | 513 | 2074 |
| % White | 0.13 $p = 0.09$ | 0.09 $p = 0.29$ | -0.02 $p = 0.44$ | 0.02 $p = 0.10$ | 0.13 $p = 0.01$* | 0.12 $p = 0.12$ | 0.52 $p = 0.11$ |
| Median Income ($ 1,000) | 0.05 $p = 0.37$ | 0.02 $p = 0.80$ | 0.50 $p = 0.00$* | 0.01 $p = 0.12$ | 0.05 $p = 0.40$ | 0.04 $p = 0.42$ | 0.02 $p = 0.325$ |

## 2.5 Discussion and Conclusions

Our analysis of spatial variations in exclusionary criteria from online rental listings obtained from Craigslist and Zillow affirms several themes that have recently emerged in the literature. First, our automated text analysis procedure, based on a sample of web-scraped rental listings, yielded similar conclusions to those reached by Rosen et al.'s (2021) in-depth interviews of screening practices by landlords. We found that corporate landlords, who only advertised on Zillow and not Craigslist, systematically included restrictions on minimum credit scores, incomes, criminal backgrounds, and prior evictions. As the share of holdings by these entities was larger in more minority and lower-income neighborhoods – an artifact of the housing market crash and disparities in predatory lending (Seymour & Akers, 2021) – the concentration of these exclusionary criteria mentioned in listings followed. As mentioned by Rosen et al. (2021) and Decker (2021), the reliance on these legally observable, and seemingly objective traits for screening potential tenants enables larger, and often out-of-state landlords to skirt fair housing laws, though by using

criteria that are largely correlated with race, they ultimately perpetuate longstanding patterns of inequity and segregation. By concentrating in minority and lower-income neighborhoods where housing is typically more affordable, these exclusionary criteria could be a contributing factor to the rise in homelessness observed in a tight housing market such as Charlotte (Anderson & Jarrett, 2021). The fact that corporate landlords do not advertise on Craigslist, which prior research has suggested is a clear source for more affordable rental housing opportunities (Costa et al., 2021; Hess et al., 2021), suggests that analyses of rental housing markets that exclusively rely on this platform may be missing a significant element of the rental landscape.

We also found some evidence that restrictions on housing choice voucher holders differ by platform – higher in wealthier neighborhoods on Craigslist, but more common in minority and poorer neighborhoods on Zillow. This could be explained by the notion that voucher holders have a greater stigma in higher-income neighborhoods and face greater restrictions by smaller landlords who rely more on 'gut' instincts than algorithmic proxies to screen applicants (Rosen et al., 2021; Decker, 2021). Corporate landlords did not systematically exclude voucher holders as was the case with minimum credit scores, incomes, prior evictions, or criminal background restrictions, but it is likely that most voucher holders would be excluded by minimum income requirements alone, which typically asked prospective renters for three times the monthly rent. Overall, the share of listings that contained explicit language barring voucher holders was quite limited. With a rise in corporate landlords nationally, this finding suggests that barring restrictions on housing voucher holders without tackling these other sources of categorical exclusion is unlikely to make a dent in the struggle for poor and minority residents, or those more likely to have discredited backgrounds, in securing housing.

We found listings with additional HOA requirements that often include further applications, fees, or background checks to be more common on Zillow (in 12% of listings versus <1% for Craigslist), and more frequent in higher-income neighborhoods. HOAs place an additional cost burden beyond the stated monthly rent and their presence in higher-income neighborhoods could exacerbate patterns of income segregation (Clarke & Freedman, 2019).

Overall, when examining our sample of listings combined between Zillow and Craigslist, our results align with those of Besbris et al. (2021) who noted that the presence of exclusionary terms in rental listings in multiple large cities across the country was more common in poorer and minority neighborhoods. However, when we distinguish between the two platforms, our results indicate that this relationship no longer holds true – for Craigslist, we find no significant relationship in the collective presence of these terms with race and income, but for Zillow, our results are upheld. Additional probing of our data points to the significant influence of corporate landlords in explaining this finding - their dramatically increasing presence in poorer and minority neighborhoods, mechanisms for selecting tenants, and differences in online advertising may be quietly transforming the housing landscape. At a minimum, our results suggest the need for further analyses in other cities to determine the uniqueness of Charlotte with respect to these results, and importantly, the consequences to renters in securing housing.

In the case of Charlotte, source of income discrimination remains legal, and remedying this would be one solution. However, further addressing housing obstacles for those with other discredited backgrounds also needs to be resolved. An example of such a policy can be found in Minneapolis' inclusive renter protection ordinance (Minneapolis City of Lakes 2019). Implementing such policies would improve accessibility to multiple housing options for low-income households.

This research demonstrated a framework for evaluating online rental listings for exclusionary language – a method that may be more easily extensible to other study areas for comparisons that are less labor-intensive than in-depth interviews and surveys - though without the benefit of additional context. However, working with volunteered geographic information data from digital platforms such as Zillow and Craigslist also come with challenges. First, data from these digital platforms are only as good as the user's input. Hence, the data that was web scraped needed rigorous cleaning especially since we were dealing with unstructured data. User input that did not include the correct address meant that those listings could not be geocoded and included in our analysis. In instances where the address entered was correctly, but did not match the actual location of the listing, errors persisted in our analysis. Further, since we were web scraping rental listings from two platforms, we do not have the complete rental landscape picture for the city. Overall, however, the application of natural language processing to these data should offer housing policy researchers and planners valuable tools for monitoring discrimination in the local housing market.

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# CHAPTER THREE: ANALYZING THE EFFECTS OF CHANGE IN NEIGHBORHOOD CHARACTERISTICS ON HOUSING RENOVATION ACTIVITY

## 3.1 Introduction

Housing renovations[3] constitute a significant portion of housing investments and are one of the many signs of a neighborhood undergoing some form of change. According to the Harvard LIRA project, Americans spend more than $500 billion every year on residential renovations and repairs. Homeowners may undertake renovations and repairs for multiple reasons, including the need for housing to suit their personal preference or aspiration and the economic benefit of tapping into housing equity as housing appreciates after renovations. For government agencies, ensuring housing renovations is a means for maintaining housing quality in their jurisdictions and a fiscal strategy to boost their local economy through improvement in property tax revenue (Helms, 2003). Government agencies encourage investments in housing renovations using incentive grants such as housing and home improvement assistance. Such city-wide efforts by government agencies and a homeowner's investment decisions to renovate combine to improve the quality of existing housing stock and the desirability of neighborhoods. For example, new residents who prefer newer and higher quality housing may be attracted to renovated houses, albeit potentially displacing existing residents.

In neighborhood change research, one of the signs of the process of gentrification is demographic changes, which are preceded by the movement of capital exhibited through housing and neighborhood investments such as renovations, repairs, and rehabilitation of existing homes (Helms, 2003). While neighborhoods that are declining may experience the physical deterioration of their existing housing stock, neighborhoods that are potentially gentrifying may experience an

[3] This paper uses the terms renovations, remodel, repairs, replacement, rehabilitation, alteration, maintenance, and refurbishment synonymously highlighting lasting capital investment in a house.

increase in housing renovations that upgrade their existing housing. Smith (1979), for example, describes the restructuring of urban space as productive capital returns to an area with builders, developers, government agencies, and mortgage lenders playing a significant role. Housing renovation activity thus represents a key aspect of a neighborhood's change process that is important to understand.

Despite the theoretical significance of housing renovation activity in neighborhood change processes, little empirical analysis has been done to explain the longitudinal relationship that exists between housing renovations and neighborhood change. Some of the previous empirical research has looked at housing renovations from different perspectives: Mayer (1981), for example, looked at housing renovation decisions in the rental housing market, Helbers and McDowell (1982) discussed what determines expenditure on housing renovations, Ding et al. (2000) used hedonic modeling to analyze the effects of housing renovations on values of adjacent properties, Helms (2012) modeled neighborhood effects in housing renovations, and Irwin (2019) explicated spatial spillovers that arise from housing renovations. While most of the research has analyzed the motivations behind housing renovation activity under different lenses, few of them have looked at the longitudinal effects of housing renovations on neighborhood change processes.

Using Charlotte, a mid-size urbanizing city, as a case study, this article advances our understanding of the role of housing renovations in neighborhood change processes by using longitudinal parcel level permitting data at a fine spatial and temporal resolution to ascertain if a change in a neighborhood's prevailing characteristics influences the movement of capital exhibited through housing renovations. By doing so, insights would be gained through understanding patterns of capital movement into different neighborhoods, especially in fast-growing cities in the New South, and how that interacts with a neighborhood's characteristics as they change.

The next section of this paper presents the background of the motivations behind housing renovation, factors that influence the movement of capital, and known empirical relationships that exist between neighborhood change and housing renovations. Section three outlines the data, study area, and method used in the study, section four presents and discusses the results from various analyses, and section five concludes.

## 3.2 Background

### 3.2.1 Factors Influencing Housing Renovations

Housing renovations are one of the visible signs of housing investments and are seen as one of the indicators of a neighborhood undergoing change. As renovations in a specific neighborhood increase, their cumulative effects have the potential of increasing the general housing quality. Thus, the more an area sees more investments in housing renovation, the more its housing quality potentially improves (Mayer, 1981). The decision for housing renovation can be influenced by multiple factors. For example, for the private homeowner, housing renovation decision could stem from expected consequences of renovations such as cost saving on energy, increase in housing value, social and environmental benefits such as comfort, safety and conveniences, and aesthetic aspiration (Kerr et al., 2018; Liu et al., 2022). Demographic characteristics such as the homeowner's education status, age, occupation status as well as the owner's family dynamics influence the decision to renovate (Azizi et al., 2019; Kerr et al., 2018; Liu et al., 2022; Mendelsohn, 1977; Plaut & Plaut, 2010). Other factors include the owner's commitment to the neighborhood, the physical characteristics of the house, which could include the age of the house, perception of the house, that is, whether it is perceived to be in good condition or not, as well as the location of the house (Azizi et al., 2019).

From an economic perspective, one of the fundamental motivations behind housing renovations is the associated economic returns on investment (Mayer, 1981). The economic incentive associated with the rise in housing value and the accompanying rent that can be earned from a renovated property encourages renovations among profit-maximizing landlords (DeGiovanni, 1984; Ding et al., 2000). Housing renovations may also be a speculative response to impending amenity construction that might, in turn, increase property values and housing demand in an area (Billings, 2015). Additionally, for homeowners who intend to maximize returns on investment, renovations might precede housing sales, and quality improvement to existing housing contributes to the rise in housing prices, hence maximizing home sales value (McMillen & Thorsnes, 2006). For example, Ding et al. (2000) find housing renovations positively impact property values in both low-income and predominantly non-minority neighborhoods. Helms (2003) finds that amenity-rich areas close to central business districts tend to have more housing renovations. Such renovation response to amenities can also be a signal of gentrification in previously disinvested neighborhoods that experience increased renovations over time. As housing renovation improves housing quality in a neighborhood, the effect of such improvements contributes to the increased desirability of neighborhoods by new residents who may prefer newer and improved housing (Glass, 1964; Helms, 2003; Smith, 1982). Hence, for the profit-maximizing landlord who might be interested in higher rent or for a homeowner who may be interested in a higher sales price of their house, housing renovation is a crucial step in maximizing the economic return on investment.

For government agencies, housing renovations could be a fiscal strategy to increase revenue and a regulatory tool to halt neighborhood decline. Generally, abandoned and dilapidated houses are one of the major signs of urban decline. Such physical dilapidation of a city's or a

neighborhood's housing is a disamenity that can depress neighboring housing and property values (Han, 2014; Shlay & Whitman, 2006). Dilapidation of a city's housing leading to abandonment can cost local governments thousands of dollars if not remedied. To prevent this, one of the key strategies local governments use is to encourage housing rehabilitation (Goetz et al., 1998). This strategy can come in the form of incentives such as home improvement assistance or the use of regulatory tools such as housing code violations (Von Hoffman, 2008). If a city's housing quality declines, it discourages private investment in a nearby property, affects a city's tax base, causes neighboring property value declines, and hurts the security and maintenance of a neighborhood (Goetz et al., 1998; Shlay & Whitman. Hence, for local government, encouraging renovations and ensuring housing is in good condition is a better way to improve their fiscal health (Simons et al., 2003). Housing that gets renovated improves a local government's fiscal health in multiple ways. First, when housing gets renovated, it translates into a boost in tax revenue since local governments can reappraise renovated properties and charge higher property taxes (Goetz et al., 1998). For neighborhoods in a city's jurisdiction, while abandoned properties depress property values, renovated housing positively impacts property values (Ding et al., 2000). Consequently, neighborhoods that see a rise in property values tend to attract more private investment as investors tend to seek higher returns on investments (Goetz et al., 1998; Simmons-Mosley, 2003). Additionally, as renovation activity increases, local government gets to earn more from sales taxes on renovation-related materials (Goetz et al., 1998).

### 3.2.2 Movement of Capital

The movement of Capital into a neighborhood can be understood from two key theories of neighborhood change. The filtering theory initiated by Ratcliff (1945) and the rent gap theory as explicated by Smith (1979). The filtering theory describes two main neighborhood change

processes: The first process focuses on the evolving life cycle of housing units, including their quality and price (Lowry, 1960). The second process focuses on the occupancy cycle of individual households as their housing quality changes in response to changes in their income and housing prices (Galster, 1996; Myers, 1975). Taken together, the filtering process describes housing occupancy changes from the upper-income group to the lower-income group as housing prices and quality decline (Ratcliff, 1945). The process of housing decline is a function of the landlord or homeowner's decision to invest a decreasing amount of capital to maintain or renovate aging housing (Temkin & Rohe, 1996). Hence, as a neighborhood's housing stock ages and housing quality deteriorates, housing maintenance and renovations decline. The filtering theory goes on to posit that, as landlords make these disinvestment decisions, and there is the availability of newly constructed housing, individuals who are in the upper-income group move to occupy the newly constructed housing. This mobility decision makes available old housing for individuals of lower income groups (Myers, 1975; Temkin & Rohe, 1996).

The rent gap theory describes the difference between capitalized ground rent that can be earned from a future land use and actual ground rent that is being earned under the present land use (Smith, 1979, 2005). The future land use represents the highest and best use for the prevailing neighborhood or area. In the context of housing, a landlord earns ground rent from tenants while owner-occupiers earn ground rent from the sale of their property. When a neighborhood's potential capitalized ground rent is determined to be profitable, investors will aim to maximize that economic opportunity or take advantage of the rent gap (Smith, 1979). Essentially, an investor or a landlord forecasts the potential revenue that could be earned if the present use is changed for a range of investment options. Towards that end, if an additional capital investment would guarantee capitalized ground rent beyond the prevailing ground rent, an economic decision to

change the present use to bolster ground rent is undertaken. The economic decision to maximize ground rent leads to a neighborhood undergoing gentrification. The rent gap in an existing use increases as a property owner chooses not to invest in either renovations or maintenance. The consequential decision to neglect renovations or maintenance exacerbates the rate at which a property deteriorates, which then influences the ground rent negatively (Clark, 1995). Thus, the more disinvestment increases, the more likely there is for the actual capitalized ground rent to decrease hence the rent gap. Investments that aim to take advantage of the rent gap can come in the form of new construction, demolition, or renovations. In the case of residential improvements, social upgrading tends to follow investments that have taken place, hence gentrification (Clark, 1995).

Filtering and rent gaps highlight the theory of housing investments and disinvestment in neighborhoods as well as the accompanying social and spatial mobility. They show how the movement of capital in the form of new residential construction or renovation is critical in shaping neighborhood outcomes. Smith (1979) emphasizes how the process of filtering precedes neighborhood gentrification. As a landlord or homeowner decides to invest decreasing amounts of capital in their property as observed in both the filtering and rent gap theory, it creates a precondition for existing housing to be abandoned as in the case of filtering, or eventually redeveloped, demolished, or renovated to the highest and best use as in the case of rent gap theory. In the case of housing renovations, these two theories somewhat explain potential motivations for investments involving housing renovations. First, it could be a strategy to halt housing decline in a neighborhood. Second, it could be a signal of a neighborhood change consistent with gentrification as capital investment is made to an existing property to optimize its capitalized ground rent. Movement of capital in the form of housing renovations is, therefore, a critical piece

of neighborhood change which is predicated on a neighborhood's characteristics, including its housing and socio-economic characteristics.

### 3.2.3 Housing Renovations Case Studies

Housing renovations have been researched from multiple perspectives. Some of the early studies were from Mendelsohn (1977) who found that home value, housing age, income, race, and owner occupier's age are key determinants of housing renovations. Thus, housing renovations were found to be a function of both the physical characteristics of a house and the social characteristics of the owner. Following Mendelsohn's studies, multiple housing renovation studies have discussed the physical and socio-economic factors that influence housing renovations. Mayer (1981) tested a series of hypotheses on property owners' decision to invest in housing renovation. His basic model stipulated that housing renovation is dependent on capital stock adjustment by a landlord aiming to maximize his profit. Thus, there exists an optimal level of capital stock for prevailing market conditions for which the profit of a landlord is maximized. Hence, the landlord's decision to undertake housing renovations is predicated on the difference between the current capital stock level and the optimal capital stock level. Testing these assumptions with Berkley data, Mayer found that when it comes to neighborhood characteristics, landlords undertake more rehabilitation if the neighborhood has favorable characteristics. Neighborhood characteristics such as sidewalks, curbs, and gutters that are in good condition had a significant impact on renovation activity. However, complex relationships exist between some neighborhood characteristics such as crime. For example, Mayer suggested that although it's counterintuitive, higher crime may increase renovation activity if tenants are willing to pay more for improved security. Hence, the optimal level of capital for maximizing a landlord's profit depends on neighborhood characteristics. Following a similar line of research, Plaut and Plaut (2010) used American

Housing Survey data in a logistic regression model to analyze households' decisions to renovate or move. They found that there exists a relationship between housing renovations and housing variables such as value of unit, personal and household variables including education level and race, number of bedrooms, level of property taxes, and neighborhood characteristics. Neighborhood characteristics, together with other variables, play a significant influence on renovation activity. O'Loughlin and Munski (1979) also studied renovation activities in two New Orleans neighborhoods; in their survey, they found that neighborhood characteristics such as proximity to urban services, and attraction of historic buildings were key determinants in renovations of old homes.

Much of the housing renovation research has also discussed the spatial dependence and spatial spillovers that come with housing renovations (Helms, 2012; Ioannides, 2002; Munneke & Womack, 2015). Homeowners may interpret renovation activity in their neighborhood as a signal of positive property appreciation in their area and may also speculatively renovate to tap into future benefits of improved housing in the neighborhood, either for renting or selling. Helms (2012), for example, modeled the feedback effects of urban housing renovation activity using parcel-level microdata data on housing and neighborhood characteristics. He found that renovation activity is likely to be spatially multiplied showing that endogenous spatial neighborhood effects motivate the process of renovation. As households in a particular neighborhood engage in renovation activity, it encourages neighboring households to also renovate their homes. Hence, renovation activity is influenced not only by the conditions of the housing units themselves but also by the spatial interaction in the neighborhood within which the renovation activity has taken place. Ioannides (2002) similarly assessed the extent to which a homeowner’s decision to renovate is dependent on their neighbor’s renovation decision. He found that social interactions have a

significant impact on the maintenance behavior of individual homeowners as owners are influenced by the actions of their neighbors. Lastly, Munneke and Womack (2015) modeled the decision of whether to tear down or renovate using data on single-family residential sales transactions in Miami, Florida. From their empirical model, they found that location is key when it comes to renovations or tear-downs. Proximity to the coastline and central business district had a significant impact on the likelihood of renovations. Highlighting the impact of spatial spillovers, they found that renovation activity tends to cluster in regions where prior renovation activities have taken place.

From the literature, it is understood that housing renovations are influenced by multiple factors including the owner's personal aspirations, income, race, housing characteristics, and potential economic benefits both from an individual homeowner's perspective and a government's perspective. From a theoretical perspective, renovations may be analyzed through the lens of the rent gap theory and the filtering theory. While a landlord's decision to disinvest may deteriorate existing housing, there is a contrasting decision to invest by renovating to take advantage of a prevailing rent gap. Multiple case studies have modeled housing renovations from different perspectives. Prominent among them is the explanation of the spatial feedback effects associated with housing renovation. What the majority of the studies have not done is to look at longitudinal relationships between renovations and neighborhood change. In this article, we fill this missing gap by exploring the relationship between change in a neighborhood's characteristics and housing renovation activity.

## 3.3 Methods

### 3.3.1 Study Area

The study area for this research is the city of Charlotte, North Carolina, which is the largest city in the State of North Carolina. With a population of 874,579 according to the 2020 US Census, Charlotte's population has increased by 18.4% since 2010, making Charlotte the 16th largest city in the US and one of the fastest-growing cities in the US as well (US Census Bureau, 2022). As a mid-size fast-growing in the New South, Charlotte is a major commerce center hosting big corporations, real estate agencies, and technology companies. The size of the city's banking industry makes Charlotte the second biggest financial industry city after New York. Charlotte is also home to one of the biggest universities in the state of North Carolina and has the largest public school system in the state (Bacot, 2008). Charlotte has a relatively unregulated housing market which makes it easier to build new housing compared to many cities in the northeastern and western US, hence being able to keep housing relatively affordable. The presence of corporations and high-level institutions, coupled with a relatively friendly housing market as compared to northeastern cities such as New York and California, makes Charlotte an attractive destination for capital investments and out-of-state and city residents. As Charlotte sees rapid growth and urbanization, there is an accompanying movement of capital into different parts of the city visible in both housing and commercial developments.

Geographically, Charlotte, like, most southern cities, grew along racial and class lines due to segregation-induced growth patterns from historical events such as urban renewal, zoning, suburbanization, and redlining (Hanchett, 2020). Charlotte's growth pattern has created a class divide within the city, leading to what has popularly been known in the city as the Wedge (predominantly white part of the city) and the Crescent (predominantly minority part of the city).

The city's demographic comprises 46.7% White, 35.5% Black, 6.6% Asian, and 14.6% Hispanic (US Census Bureau 2020). Albeit a diverse population, different parts of the city are predominated by different racial groups. The westward part of the city is predominantly minority, eastward part of the city, owing to the presence of the university, is somewhat diverse with the presence of a student population. The central part of the city, known as Uptown, is home to most of the big corporations. South of the Uptown is the wealthy enclave, also known as the wedge, which is predominantly white.

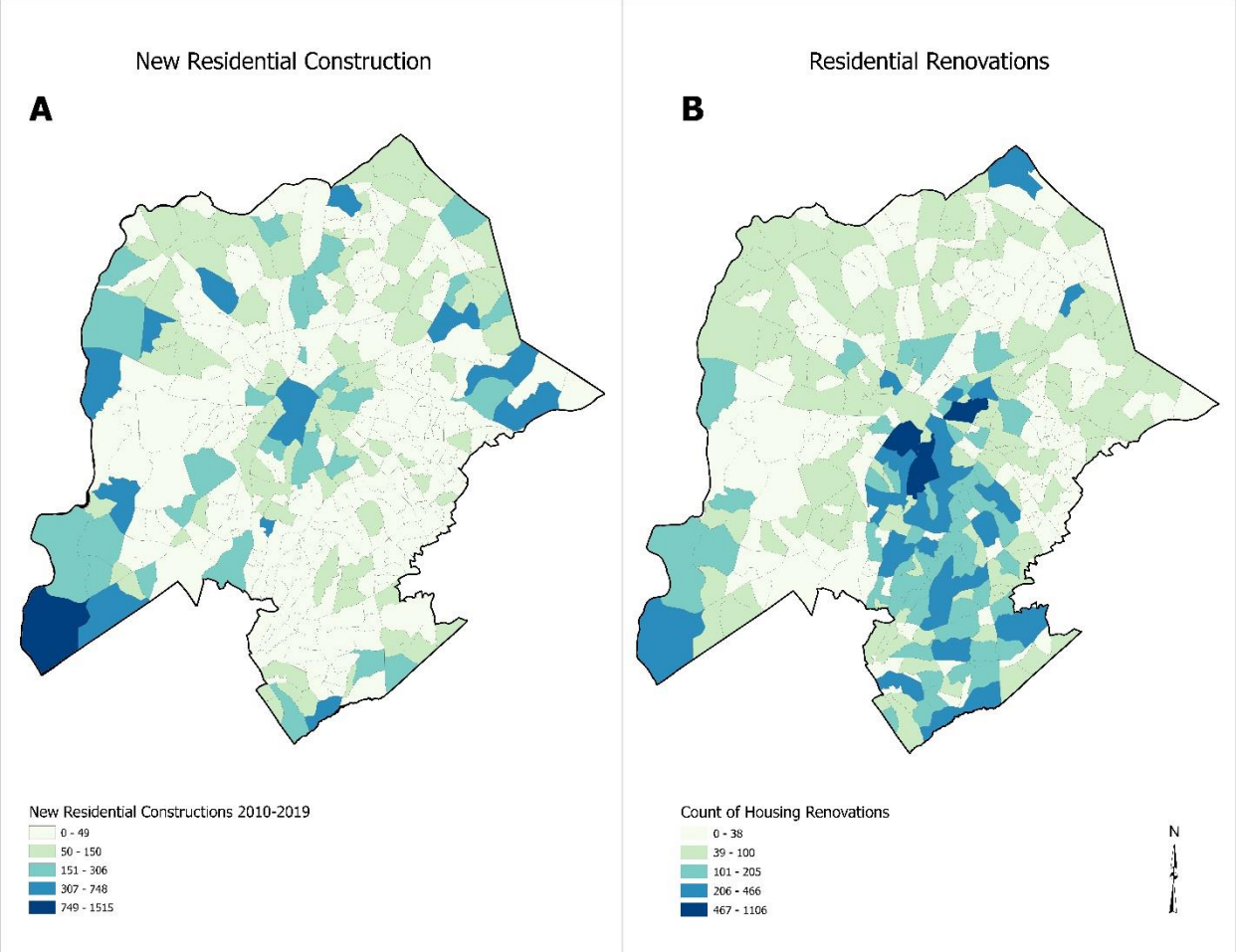
The city of Charlotte government is part of the Charlotte-Mecklenburg County consolidated government. Charlotte's government structure consists of a mayor and 11 elected council members who make up the Charlotte city council (City of Charlotte 2023). The City Council of Charlotte sets policies, enacts zoning ordinances, hires a city manager and a city attorney, approves rezoning, provides resolutions and orders, and approves all the financial operations of the city, including the budget from the city manager (City of Charlotte 2023).

Over the years, the city of Charlotte, through its economic development goals, has made concerted efforts to attract economic investments in the city. These efforts have reflected investments in infrastructure, housing, small businesses, and the revitalization of Charlotte's center city. Through the city of Charlotte's Capital Investment Plan (CIP), the city engages in multiple public-private partnerships under the city council's neighborhood and economic development priorities to provide housing (City of Charlotte 2023). For example, the 924 West Sugar Creek Apartment is a $5.3 million public-private partnership for apartment construction (Ely, 2018). Furthermore, through the city's Tax-Increment Grant (TIG) program, the city covers public infrastructure costs for new real estate development in the city. The city provided a $25 million TIG for a private developer to cover the cost of a new parking deck (Fahey, 2020). Additionally,

the city also uses its Synthetic Tax Increment Grant (STIG) program, which does not require the creation of a Tax Increment Financing District, to pursue its economic development and land use planning goals. Through the STIG, the city has provided funding for private investors such as CF Hippolyta, dba Amazon ($9 million) for roadway and infrastructure improvements along Interstate 485 at Tuckasegee Road, Wilkinson Blvd, and Todd Road. The city has also supported housing projects, including the Double Oaks Redevelopment (up to $3.6 million) and Midtown/Pearl Park Redevelopment project (City of Charlotte, 2023).

With housing and infrastructural investments and capital flowing in the city, Charlotte has become an attractive and desirable destination for new residents including the creative class. Charlotte ranks in the top 10 for new couples to live and work (Rent.com, 2021), and ranks number nine in the top moving destinations in all cities (Penske Truck Rental, 2022). As Charlotte grows with new residents arriving and gentrification pressures growing in the city's urban core, there is a need for the housing market to respond to the growing demand for housing. The Charlotte housing market has naturally responded with the supply of new residential construction, densification, as well as renovation of existing units. An initial exploration of new residential constructions, however, has shown there is no distinct pattern for where residential development occurs (see Fig 3.1). A lot of the new construction is concentrated around the Uptown area, around the university in the northeast portion of the city, and in the southwest parts of the city. All of which exhibit different socioeconomic characteristics. In preliminary analyses, we find that new construction is, as expected, mainly driven by the availability of vacant land. However, an initial exploration of housing renovation activity shows some strong spatial patterns (see Fig 1.1). This calls for further investigation if there is a relationship between neighborhood characteristics and housing renovations in Charlotte.

Figure 3.1 Spatial distribution of (A) new residential constructions; (B) housing renovations




### 3.3.2 Data

Charlotte-Mecklenburg County requires developers and homeowners to acquire appropriate permits for any construction, repair, renovations, alterations, or change in use of an existing property. Permits are not required if the total cost for the proposed work is $15,000 or less. However, alterations that include a change in the plumbing system, heating or air conditioning system, replacement of electrical systems, and replacement load-bearing structures and are less than $15,000 would still require permitting. The Charlotte-Mecklenburg County building permit

application requires information such as the permit type, location where a permit is being undertaken, total cost of the work, tax parcel number, and type of work which indicates whether the permit is for new construction, demolition, or renovation. The Charlotte-Mecklenburg County open data portal maintains a GIS database that captures all permits issued for housing renovations within the county. For each housing renovation activity, the database reports information such as the date for which a permit was issued and the date of completion of the related project, the permit type, the US Department of Commerce code for the permit type, the owner's address, and the zoning code.

To quantitatively capture housing renovation activity, we used the permitting data from Charlotte Mecklenburg County which spans the years 2010 through to 2019. During this period, a total of 33,357 residential renovations were reported by Charlotte Mecklenburg County, with an average of 2,813 residential renovation permits issued yearly. The year 2011 had the lowest count, with a total of 3,535 renovations, while the year 2018 had the highest count, with a total of 4,459 renovations. Ideally, the dollar amount associated with each renovation would provide additional insights into how much capital in dollars is invested in each neighborhood. However, Charlotte-Mecklenburg County does not report the dollar amount associated with renovations in the permitting data. Hence the analysis focused on the number of renovation activities undertaken every year.

The Charlotte-Mecklenburg County also maintains a GIS database for property records. The database contains the county’s real estate tax records including parcels and housing units that sit on the parcel. It reports information such as sales price if the property has been sold in the past, land value, total appraised value of a housing unit, the year in which the housing unit was built, legal description, ownership, building square footage, and building type. Housing-specific

variables, including sales price, net building value, total housing units, and year built from the database, were used as explanatory variables. Net building value was computed as the difference between the land value and the total value of a housing unit. Buildings that are 30 years and over were identified following a similar specification (Nilsson & Delmelle, 2018). Total housing units were included to account for the fact that locations that have more housing units potentially have more housing renovations. In addition to the housing-specific variables, the American Community Survey's 5-year estimates data on income, race, and tenure from 2010 through to 2019 were included as explanatory variables.

The unit of analysis in this study is Neighborhood Profile Areas (NPAs). NPAs are geographies that are modified from US census block groups by the City of Charlotte and the University of North Carolina's Urban Institute, which captures the contours of Charlotte neighborhoods. These modifications are based on feedback on neighborhood boundaries from community organizations and community leaders in Charlotte. These NPAs allow for granular neighborhood-by-neighborhood analysis and have been utilized in multiple empirical research (Currie & Sorensen, 2019; Delmelle et al., 2017; Delmelle & Thill, 2014). There is a total of 462 NPAs in Mecklenburg County with 402 NPAs within the city of Charlotte city limits.

### 3.3.3 Dependent Variable

The dependent variable in this study is housing renovations which is conceptualized as the cumulative residential renovations made in each NPA within the city of Charlotte city limits from 2010 to 2019. This conceptualization helps capture the aggregate impact of renovation activity throughout the 10 years in each NPA.

### 3.3.4 Explanatory Variables

The covariates in this study are median household income (MHINCOME), percent white (WHITE), percent owner occupied (OWNER), percent buildings 30 years and over (BLDGAGE), and total housing units (HUNITS). For each of these variables, their averages for the first five years (2010-2014) and the last five years (2015-2019) are calculated, and the difference between the averages is then computed for the final regression. This step helps ascertain if there has been a significant change in the explanatory variable over the 10 years. If the difference between the average of the first five years and the last five years is zero, then it suggests that there has not been any change in the variable over the years. If the difference is positive, it indicates that there has been an increase in the variable, and if the difference is negative, it suggests a decline in the variable. Following a similar specification as (Immergluck, 1999), the initial levels of the explanatory variables, that is 2010 values, are included together with the average changes. This is because the change in renovation activity may be related to initial levels of neighborhood characteristics. For example, gentrifiable neighborhoods that were initially majority minority may see an increase in renovation activity as housing investments increase in the early phase of gentrification.

Income is measured using the median household income in each NPA. Median income at the NPA level provides an indication of how well households within that NPA are doing financially. The median income in Charlotte as of 2021, according to the US Census Bureau, was $68,367. Individuals with high incomes would be expected to have more resources to invest in renovations. This variable is expected to have positive effects on the dependent variable.

Racial composition is used as an indicator of the level of diversity in each NPA. Literature has also highlighted the relationship between a neighborhood's level of segregation for multiple

outcomes, including the level of investment, disinvestment, and economic well-being. Change in racial composition has also been used as an indicator of neighborhood change consistent with gentrification. Considering race and other socio-economic variables such as education attainment are highly correlated, especially in a segregated city like Charlotte, racial composition explains the level of economic opportunity, the presence of the creative class, as well as financial stability in an NPA. The percentage of residents who are white in each NPA is used to measure the effects of change in a neighborhood's racial composition on housing renovation activity. This variable is expected to have positive effects on the dependent variable.

Tenure is measured using the percentage of housing units that are owner-occupied in each NPA. According to the US Census Bureau, the homeownership rate in Charlotte as of the year 2022 was 50.8%. Neighborhoods with a large of homeowners provide a good indication of how stable the neighborhood is. It also shows how committed residents in the neighborhood are to ensuring the neighborhood quality as neighborhood quality can potentially affect property values. These two factors, neighborhood stability, and neighborhood quality can combine to influence the number of renovations that take place in a neighborhood. Hence this variable is expected to have positive effects on a neighborhood's renovation activity.

Housing units that are 30 years or over were computed as a fraction of all housing in each NPA. The age of a housing unit can indicate the extent of deterioration as features in the unit, such as plumbing and electrical systems, may be reaching the end of their lifecycle (Helbers & McDowell, 1982). Hence, old housing units would generally be expected to require more renovations than newer housing units. To this end, neighborhoods with older housing units are more likely to see more renovations.

Table 3.1 Statistical summary of dependent variable and potential effects of explanatory variables

| Statistic | Mean | St. Dev. | The expected sign of the coefficient |
|---|---|---|---|
| RENOVATIONS (DV) | 74.259 | 100.47 | |
| **Δ**WHITE (%) | -3.008 | 9.018 | + |
| WHITE2010 (%) | 46.413 | 30.454 | + |
| **Δ**BLDGAGE (%) | -2.531 | 4.429 | + |
| BLDGAGE2010 (%) | 61.035 | 33.136 | - |
| **Δ**OWNER (%) | -4.193 | 8.305 | + |
| OWNER2010 (%) | 59.727 | 28.904 | + |
| **Δ**MHINCOME ( in $) | 6,412.194 | 12,883.880 | + |
| MHINCOME2010 ( in $) | 58,730.390 | 33,080.170 | + |
| ΔHUNITS (Σ) | 96.635 | 177.145 | + |
| HUNITS2010 (Σ) | 863.870 | 520.695 | + |

**Note:** Five-year average difference between variables is indicated by **Δ**. Median values are represented by

3.3.5 Empirical Model

To measure the effects of change in a neighborhood's characteristics on housing renovation, the first step is estimating an Ordinary Least Squares (OLS) regression model. The OLS model is specified as follows:

Where is the dependent variable housing renovations, is the intercept, is the coefficient of a vector of neighborhood characteristics and is the error term.

The literature has shown that housing renovation can exhibit spatial dependence since renovation activity in one area can be influenced by renovation activity in a neighboring area (Helms, 2012; Munneke & Womack, 2015). Hence, using traditional Ordinary Least Square regression (OLS) may not account for the spatial dependency that may potentially be inherent in the renovation activity across NPAs. The presence of spatial dependency is therefore tested by looking at the residual of the estimated OLS regression. While tests such as Moran's I on the residuals on the estimated OLS regression may indicate the presence of spatial dependence, it does not show which

spatial model is appropriate (i.e., spatial lag or spatial error model). Hence, following Baltagi et al. (2003), a test for the presence of spatial autocorrelation is undertaken on the residuals of the estimated OLS model. The test from Baltagi et al. (2003), also known as the Baltagi, Song, and Koh Lagrange Multiplier (LM) test has a null hypothesis that there is no spatial autocorrelation in the residuals of the OLS regression model. Thus, a rejection of the null hypothesis indicates the presence of spatial autocorrelation.

The LM test gives two spatial models to choose from to account for spatial dependence: spatial lag and spatial error as indicated above. The LM test also consists of two versions: the standard LM and the Robust LM test for spatial dependence. Initial specifications of all four tests are undertaken in R using the lmtest package by Zeileis and Hothorn (2002). Table 3.2 shows the results of the specification.

Table 3.2 Specification for both standard and robust tests for spatial lag and spatial error test

| **Test** | **Test Statistic** | **p-value** |
|---|---|---|
| LM test for spatial error dependence | 16.22 | 5.64e-05 |
| LM test for spatial lag dependence | 21.115 | 4.325e-06 |
| Robust LM test for spatial error dependence | 2.2142 | 0.1367 |
| Robust LM test for spatial lag dependence | 7.1095 | 0.007668 |

Both versions of the test indicate that a spatial lag model may better represent the data generating process, particularly since the robust version of the test is statistically insignificant for the spatial error model.

The Spatial Lag Model (SLM) extends traditional ordinary least squares regression to explain the relationship between the dependent variable and the explanatory variables by including a spatially lagged term of the dependent variable among the covariates. The SLM is specified as follows:

Where  is the dependent variable, which is the number of housing renovations for the *i*th NPA,  is the intercept,  is a vector of explanatory variables with coefficients ,  is the spatial autoregressive coefficient which represents the strength of the spatial dependence such that when  > 0, it signifies a positive spatial dependence. is the spatial lag term such that  for each observation is weighted by its spatial neighborhoods using a spatial weight matrix . The spatial weight matrix used is a Queen Contiguity weight matrix with row standardization.  is the error term representing random or unexplained error for the *i*th observation.

## 3.4 Results

As discussed above, we estimated the effects of change in a neighborhood's characteristics on the number of housing renovations in the NPA over 10 years (RENOVATIONS) using SLM, as this model accounts for spatial dependence in housing renovation activity. Table 3.3 shows the regression results of SLM.

Table 3.3 Spatial Lag Model (SLM) Estimation Results

| | RENOVATIONS |
|---|---|
| WHITE | 0.438 |
| | (0.369) |
| WHITE2010 | - 0.049 |
| | (0.167) |
| BLDGAGE | - 3.279*** |
| | (0.773) |
| BLDGAGE2010 | 0.656*** |
| | (0.103) |
| OWNER | 0.012 |
| | (0.416) |
| OWNER2010 | 0.504*** |
| | (0.145) |
| MHINCOME | 0.001*** |
| | (0.0003) |
| MHINCOME2010 | 0.001*** |
| | (0.0002) |
| HUNITS | -0.008 |
| | (0.020) |
| HUNITS2010 | 0.112*** |
| | (0.006) |
| CONSTANT | -181.872*** |
| | (12.357) |
| Log Likelihood | - 2,098.856 |
| $sigma^2$ | 3,254.649 |
| Akaike Inf. Crit. | 4,223.712 |
| Wald Test | 12.715*** (df = 1) |
| LR Test | 16.847*** (df = 1) |

| | |
|---|---|
| *Notes:* | $^{*}$p<0.1, $^{**}$p<0.05, $^{***}$p<0.01 |
| | : 0.174, LR test value: 15.227, p-value: 9.532e-05 |
| | Asymptotic standard error: 0.051, z-value: 3.438, p-value: 0.001 |
| | Wald statistic: 11.819, p-value: 0.001 |

The model reports six statistically significant and four non-significant variables. Out of the six significant variables, only two refer to the initial values in 2010, namely percent owner-occupiers (OWNER2010) and median household income (MHINCOME2010). The remaining significant variables are all differences in five-year averages over the ten years.

We begin the interpretation of the coefficients with the average change in the percent of housing units that are 30 years and over (BLDGAGE). It has a statistically significant negative effect on housing renovation activity. For this variable, a percentage point increase in the share of units that are 30 years or older between 2010-2014 and 2015-2019 is associated with 3.279 fewer renovations in 2019 *ceteris paribus*. Literature on housing renovation has suggested housing age should have positive effects on renovation activity (Mayer, 1981). However, considering this variable looks at the average difference over the ten years, it could explain why this effect is negative. Table 3.1 shows that the average of the average change in percent of buildings that are 30 years and over is -2.521, suggesting that over the years, the share of buildings that are 30 years and over has declined on average. Hence, since fewer older buildings exist, it explains why there have been fewer housing renovation activities with this change variable. This could be especially true in a fast-urbanizing city like Charlotte, where there has been an increasing supply of new residential construction, which then increases the existing housing stock while making the share of older houses smaller. The initial levels of this variable in 2010, however, support the central hypothesis that building age should have positive effects on housing renovation activity. For this variable (BLDGAGE2010), a one percentage point increase in the share of housing units that were

30 years or older in 2010 is associated with an additional 0.6 renovated units in the neighborhood in 2019. That is, the larger the share of older homes, the more renovations.

As for homeownership, the initial variable in 2010 (OWNER2010) was positive and statistically significant. For every percentage point increase in the share of homeowners, housing renovations increase by 0.5. It is expected that as the percentage of homeowners increases, renovation activity will correspondingly increase. The effects of homeowners for the initial levels are consistent with the central hypothesis. Table 3.1 shows that the homeownership rate in Charlotte has declined by approximately 4%. The effect of this average difference on housing renovations is not statistically significant.

The five-year average difference and the initial values of median household income both have positive and significant effects on housing renovation activity. For these two variables (MHINCOME and MHINCOM2010), their unit changes when you hold all other variables constant, is associated with a 0.001 unit increase in housing renovations. Table 3.1 shows that, on average, median household income has increased by $6,412 across the city since 2010. As a neighborhood's household income increases, it is not unexpected if housing renovation activity increases. First, in high-income neighborhoods, wealthy households do have the resources to invest in housing renovation. Spatial feedback effects associated with housing renovations can be experienced afterward. As with an increase in median sales price, if not the rich getting richer, an increase in median household income may signal socio-economic changes consistent with gentrification. As gentrification pressure increases and wealthy residents take over previously disinvested neighborhoods, it could reflect in a neighborhood's median household income and consequently its renovation activity.

As for a total housing unit, the model shows that the initial levels of housing units (HUNITS2010) are positive and statistically significant, as expected. Neighborhoods with more housing units are expected to have more housing units. The magnitude of this effect on housing renovation activity is 0.11 for every change in housing units, holding all the other variables constant. Between 2010 and 2019, Table 1.1 shows that, on average, 96.635 housing units were added to the existing housing stock. However, the five-year average change in housing units did not have statistically significant effects on housing renovation activity.

Finally, the spatial autoregressive coefficient, , which represents the strength of the spatial dependence, is a statistically significant with a value of 0.174, signifying a positive spatial dependence. This suggests that when it comes to housing renovation activity, there is evidence of spatial clustering, as renovation activity in one neighborhood tends to be spatially correlated to renovation activity in an adjacent neighborhood. This finding confirms the spatial feedback effects of housing renovations that have been found in other studies (Helms, 2012; Munneke & Womack, 2015).

## 3.5 Discussion and Conclusion

In this study, we modeled the effects of change in a neighborhood's characteristics on housing renovation activity. Housing renovations is one of the indicators of housing investments and the movement of capital into a neighborhood. Socio-economic and housing characteristic transformation signals the process of neighborhood change. This research sought to understand the longitudinal relationship that exists between housing renovation activity and changes in neighborhood characteristics.

Using a Spatial Lag Model (SLM), our results show that average change in median household income, initial levels of median household income, initial levels of homeownership, initial levels of share of old houses, and the initial levels of total housing units are positively associated with housing renovations. Change in the share of old homes was negatively associated with housing renovations. Other neighborhood characteristics, such as an average change in percent white, initial levels of percent white, and change in total housing units, turned out to be statistically insignificant. Taken together, the results suggest that neighborhoods with high-income individuals, more homeowners, older homes in the beginning of the study period, and more housing units, as well as neighborhoods that exhibit an increase in the share of individuals with high income, experience more housing renovations. However, a neighborhood's racial composition, change in the neighborhood's racial composition, change in a neighborhood's homeownership rates, and average change in housing units do not affect housing renovation activity.

The average change in shared old houses has statistically significant negative effects on housing renovations. It is important to note that, on average, the share of older buildings declined during the study period (see Table 3.1). Conversely, the initial levels of share of old houses had statistically significant positive effects on housing renovation. This suggests that in the beginning of the study period, neighborhoods with a large share of older homes experienced more renovations and hence were not in need of renovations over the coming decade. Another explanation lies in the increase in new residential development in this fast-growing city with entirely new neighborhoods being built and infill development taking place in more established neighborhoods, lowering the age share of older homes in neighborhoods over time.

Finally, housing renovation activity was proven to exhibit spatial feedback effects; previous research highlighted this effect, and findings from this research emphasized this effect.

The results of our analysis have multiple policy implications for policy makers, including urban planners and local government in general. The findings of this research suggest that housing renovation activity is closely tied to a neighborhood's prevailing characteristics and may have implications for understanding neighborhood change processes, including gentrification. Given the positive association between increases in median household income and housing renovation activity, policymakers should pay particular attention to neighborhoods that have experienced income growth as well as enormous rises in median household income over the decade and the gentrification pressures that may exist for existing residents.

Furthermore, considering the spatial feedback effects associated with housing renovations, local governments should prioritize the use of geospatial information tools in understanding neighborhood change processes in their jurisdiction. The framework used in this research can be used to better understand the evolving nature of neighborhoods as it relates to housing renovations. Data-driven decisions can incorporate similar approaches used in this research as part of early warning systems to mitigate the potential of gentrification and displacement.

The modeling of the effects of change in neighborhood characteristics on housing renovation activity in our model does have some limitations. For example, the dependent variable was specified for the count of housing renovations in each neighborhood for the ten-year study period. An additional layer of understanding would have been attained if the dollar amount associated with each renovation activity was ascertained. Future research can look into the actual dollar amount invested in housing renovations in different neighborhoods and how that responds to changes in a neighborhood's characteristics.

Overall, this research adds to the understanding of how housing renovation activity responds to a neighborhood's characteristics and changes in a neighborhood's characteristics. The framework used in this research can be generalized to other cities as far as neighborhood change and renovations are concerned.

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# CHAPTER FOUR: ANALYZING THE EFFECTS OF HOUSING CODE VIOLATIONS ON HOUSING COST

## 4.1 Introduction

Housing code enforcement is one regulatory tool that allows local governments to regulate unsafe, unsanitary, overcrowded, nuisance, and obsolete housing conditions in their jurisdiction. Unregulated housing conditions threaten housing occupants' public health, welfare, and safety if not taken care of. Additionally, the deterioration of housing stock without the necessary intervention often contributes to a neighborhood's blight. Unregulated housing conditions may also contribute to the deterioration of existing housing stock, impacting the general housing supply. Housing code enforcement, therefore, is one of the regulatory means local governments use to maintain housing and alter the outlook of neighborhoods in their jurisdiction.

However, the pattern of housing code enforcement and the outcome of such enforcement can potentially impact trends in a neighborhood's housing market. Various research has described the general consequences of housing code enforcement on neighborhoods. Although intended for maintaining and regulating housing conditions, housing code enforcement can have adverse effects. For example, a study in San Antonio revealed that the aggressive use of code enforcement - which resulted in 607 orders to vacate and demolish - contributed to the displacement of low-income residents (Way et al., 2021). In a study in Chicago, housing code compliance resulted in rent increases, impacting affordable housing options for renters (Bartram, 2019a). Rigorous housing code enforcement, thus, can create adverse outcomes such as increased maintenance costs for landlords, rising housing costs for renters, evictions of low-income tenants, reduction in affordable housing stock, and abandonment of rental properties by landlords (Bartram, 2019a; Hartman et al., 1974; Sternlieb & Burchell, 1973; Tucker, 2017).

The extant research has focused on effective strategies for housing code enforcement, the consequences of housing code enforcement for low-income individuals, and landlords' attitudes toward housing code enforcement. Bartram (2019a), for example, assessed the impact of resolved and unresolved housing code violations on rents and home sale prices. Tucker (2017) discussed the consequences of building codes and rigorous code enforcement on housing prices and the displacement of low-income households. Evans-Cowley (2006), on the other hand, looked at how housing code enforcement can be strategically used to stimulate neighborhood improvement and redevelopment.

Research is still needed on how housing code violations that lead to repairs provoke changes in prevailing home sales and rent prices. Such research would contribute to understanding how code enforcement as a regulatory tool can achieve specific housing and neighborhood quality goals. It would also highlight the use of housing code enforcement as an agent of neighborhood change.

Towards this end, this research examines the longitudinal trajectory of housing code enforcement from 2010 to 2019 in Charlotte, North Carolina. It investigates how home sales and rent prices respond to housing code violations resolved with repairs. To investigate these relationships, this research hypothesizes that housing code violations resolved with repairs have two primary outcomes: renovations/revitalization or removal of property from the market. In the case of renovations/revitalization, the renovations would potentially lead to increased housing costs, which could also translate to the loss of affordable housing. On the other hand, if a landlord removes their rental property from the housing market, this could lead to the loss of affordable housing and the displacement of residents in such housing. From a neighborhood change

perspective, increasing housing costs could signal gentrification with an associated displacement of existing residents in tight housing markets with a high demand for housing.

To test this hypothesis, two fundamental research questions will be answered: First, are housing violations predominant in a specific type of neighborhood, and if so, what are the socio-economic characteristics of these neighborhoods? Second, how have home sales and rental prices in neighborhoods that have experienced housing code violations that have been resolved with repairs changed over time?

The remainder of this paper is structure as follows: Section 2 reviews the literature on housing code enforcement and neighborhood change, housing code enforcement and housing cost, and housing code enforcement case studies. Section 3 details the research design, including the data, study area, and methodology. Section 4 presents the study's results, while Section 5 presents the conclusion and discussion.

## 4.2 Background

### 4.2.1 Housing Code Enforcement and Neighborhood Change

Studies on neighborhood change have discussed multiple government policies that hold the potential to trigger neighborhood outcomes such as gentrification, urban renewal, redevelopment, displacement, neighborhood decline, and poverty concentration (Bryant Jr & McGee Jr, 1983; Cummings & Snider, 1984; Hochstenbach, 2017). Included in these policies are housing codes and housing code enforcement. As cities try to maintain their existing housing stock, environment, zoning, public health, and safety, they adopt code enforcement as outlined by their legal regulations and ordinances to maintain their set standards (Bryant Jr & McGee Jr, 1983; Gribetz & Grad, 1966; Miller, 1982). Although intended to maintain housing standards, housing code enforcement has

been identified as one of the agents of neighborhood change that can, for example, shape neighborhood sorting (Bartram, 2019b). The operationalization of housing code enforcement can reinforce spatial inequality as building inspectors use their discretion in ways that replicate historic patterns of discrimination (Bartram, 2019b).

Housing code enforcement has been described as a capital-preserving tool that local government leverages to ensure structures, including housing in its jurisdictions, are used for a long time (Colean, 1953). This could especially be true considering housing structures are a source of revenue for local governments through property taxes. Housing code enforcement has also been alleged to be a slum removal tool that local government turns to renew neighborhoods in their jurisdiction (Colean, 1953; Gribetz & Grad, 1966; Tucker, 2017). Dilapidated and abandoned housing can potentially depress property values in the private housing market while limiting a local authority's revenue regarding property taxes (Ding et al., 2000; Han, 2014). Poor housing maintenance can send discouraging messages and signals of neglect and abandonment to potential residents and neighbors (Ioannides, 2002). In situations like this, code enforcement becomes a tool an agency can leverage to eliminate deteriorating or dilapidated structures.

The extant research has also shown that since local governments' resources for code enforcement are limited, code enforcement, although intended to be applied citywide, is prioritized in specific areas of cities. Here, the strategy is that with limited resources, local governments target 'grey areas' of cities to optimize code enforcement, especially regarding housing code enforcement (Elliott Jr & Quinn, 1983; Grigsby, 1971). Thus, code enforcement excludes or under-enforces in low-income and affluent neighborhoods in cities and focuses on areas of the city that are neither low-income nor affluent. This is mainly because, for the low-income areas, primarily characterized by, for example, high vacancy rates, vandalism of vacant housing, and abandoned housing, code

enforcement would hardly change neighborhood outcomes as deteriorated housing in these areas cannot be brought up to standard with code enforcement (Elliott Jr & Quinn, 1983; Grigsby, 1971). Tucker (2017) emphasizes that housing codes are rarely enforced in very low-income areas. In affluent areas, the predominance of single-family homeowners who maintain their homes means housing standards are almost always in good condition or up to standard, hence relatively fewer violations (Howe, 1981).

The selective capability of housing code enforcement by local governments shows that code enforcement can be used as a tool for specific local government objectives. In Charleston, South Carolina, local governments used code enforcement to condemn vacant properties and renovate them for affordable housing (PolicyLink, 2002). The local government in Washington DC's Columbia Heights Neighborhood allegedly targeted multifamily housing units in a gentrifying town near a newly developed transit center with code violations (PolicyLink, 2002). Cummings and Snider (1984) discussed how the city government of Dallas cooperated with private investors to redevelop areas in the city's central business using housing code enforcement. In San Antonio, housing code violations led to the demolition of single-family homes and the displacement of vulnerable residents (Way et al., 2021). Housing code enforcement, therefore, can be used as an agent of neighborhood change. While it can be used to renew neighborhoods and reclaim vacant properties for affordable housing, it can also be used as a displacement tool to provoke neighborhood gentrification. Tucker (2017) highlights that code enforcement is a tool of choice for politicians who campaign to clean up and eliminate substandard housing.

If housing code enforcement is targeted at specific areas of a city, it has the potential to perpetuate spatial disparities. Areas of a city where code enforcement is active and housing is up to code have the potential to exhibit a neighborhood trajectory of growth compared to the areas

where housing is in bad condition. Here, code enforcement has the potential to bid up the rent as housing that has been kept up to code would be preferred by middle-income earners who are willing to pay more for good housing conditions, including internalizing redistributed maintenance costs that have been passed on by landlords (Ackerman, 1971). Furthermore, research has already shown that stringent code enforcement in specific neighborhoods can be a subtle strategy by local governments to attract the creative class and thus provoke neighborhood change consistent with gentrification (Beauregard, 1986; Betancur, 2002).

Bartram (2019a) emphasizes how the current patterns of housing code enforcement and subsequent resolutions threaten to reinforce the divide between low-income and affluent families while contributing to the loss of affordability. The makeup of a neighborhood and the status of the homeowner contribute to the pattern of housing code enforcement (Bartram, 2019b). Neighborhoods with more owner-occupiers tend to have fewer housing code violations as opposed to neighborhoods with renter occupiers (Rose & Harris, 2022). Here, owner-occupiers are less likely to send official complaints about violations in their existing housing unless their neighbors are issuing such complaints to city authorities. On the other hand, Renter occupiers somewhat use code violation complaints to compel landlords who might neglect repairs to fix problems in their units. However, tenants who fear retaliation from landlords may not issue complaints about code violations (Desmond, 2016). Ownership type in a neighborhood also plays a significant role in the pattern of housing code enforcement. When you compare housing code violations among absentee landlords, resident landlords, and owner-occupiers, properties of absentee landlords tend to have more housing code violations than properties of resident landlords. In contrast, owner-occupiers have the lowest violations among all their categories (Rose & Harris, 2022).

### 4.2.2 Housing Code Enforcement and Housing Cost

The outcome of housing code violations can have dire consequences on residents and households. Housing code enforcement has been linked to eviction, homelessness, loss of affordable housing, abandonment, and high cost of housing (Desmond, 2016; Greif, 2018; Grigsby, 1971; Hartman et al., 1974; Ross, 1996; Tucker, 2017). Strictly undertaking code enforcement in neighborhoods where housing is mostly in deplorable states, maintenance costs are high, and there is increasing abandonment can have negative consequences for the vulnerable, the poor, and landlords. Stringent code enforcement in such neighborhoods might lead to landlords withdrawing their rental housing from the market, thus limiting affordable housing options for the vulnerable and the poor (Ackerman, 1971; Grigsby, 1971; Komesar, 1972; Ross, 1996). So-called slum landlords in neighborhoods with primarily deplorable housing are less likely to keep up with minimum code standards, as any additional investment in housing to keep their housing up to code would hurt their profits. Grigsby (1986) highlights slum landlords who cannot afford all maintenance and thus skip repairs while extracting rent. Here, if the discounted present value of maintenance cost imposed by code enforcement exceeds expected future capital from the housing, landlords may abandon or withdraw their housing (Ackerman, 1971; Grigsby, 1971; Komesar, 1972; Meyers, 1974; Ross, 1996). Research has highlighted rent increases from landlords to cover the cost of housing maintenance (DeLuca et al., 2013; Hartman et al., 1974; Tucker, 2017). In some instances, landlords would undertake repairs and deduct the cost of the repairs from the tenant's rent (PolicyLink, 2002). When housing code violations require additional maintenance, slum landlords would only keep their housing up to code with additional maintenance costs if they can recoup those maintenance costs through government assistance or redistribution of the cost to poor tenants (Komesar, 1972; Meyers, 1974). In the case of redistribution of maintenance costs, it

places an additional strain on the poor, who are already cost-burdened with housing expenses (Ross, 1996). While code enforcement promises to ensure safety and health and improve the general condition of housing, the result of rigorous enforcement is usually the opposite. In a bid to upgrade housing, somewhat substandard housing that was providing housing alternatives for the poor gets withdrawn from the housing market. Housing code has been acknowledged as presenting more barriers to affordable housing as it raises housing cost (Kean & Ashley, 1991). Thus, housing code enforcement severely affects the housing options of low-income families. In New York, for example, a group of banks who were weary of local government prosecution for housing code violations suggested that they intended to remove their housing stock from the market, a move that would have taken away housing for thousands of families (Tucker, 2017).

From a landlord's perspective, housing code enforcement and costs related to remedying the violations place additional strain on their budget. Landlords and homeowners perceive housing code enforcement as burdensome and a cost that must be recouped through rent or housing sales. DeLuca et al. (2013) highlighted landlord's unwillingness and infeasibility to participate in housing voucher programs as the voucher program requires landlords to maintain a specific housing standard before they can participate. For these landlords, keeping their housing up to code presents an additional expense, which is not economically feasible, thus making them unable to participate in the voucher program. Here, housing codes potentially eliminate acceptable, affordable housing from the market. In the event of a housing code violation, the landlords would have to bear the brunt of the legal consequence, even before any form of cost related to remedying the violation is passed on to a tenant or buyer. Greif (2018) discussed the challenges landlords who own multiple properties face regarding regulatory policies and their intended consequences for poor tenants. Landlords face legal challenges such as property seizure, property liens, and other

financial penalties if their bills related to the penalty go unpaid. Such challenges contribute to landlords passing the cost to tenants and engaging in deviant practices that allow them to skirt financial responsibility, including a change in ownership (Greif, 2018). In Charlotte, for example, as the city government decided to crack down on multiple offenders of the city's housing code, some landlords suggested that if they are not able to pass on the cost to the immediate renters, they will raise rents in multiple properties to cover the cost of code violation fines (Portillo,2018). As it has been discussed above, when it is legally permissible, some landlords would exit business and take their housing from the market or abandon their property, thus contributing to the declining availability of affordable housing as well as neighborhood blight (Ackerman, 1971; Greif, 2018; Grigsby, 1971; Kean & Ashley, 1991; Ross, 1996).

Some of the housing repairs and maintenance regulation requirements, such as the 20-50 requirement, are one of the key contributors to large expenditures associated with housing code violation repairs (Listokin & Hattis, 2005; Tucker, 2017). Such requirements mandate repairs made to existing housing to meet threshold standards. If 25-50 percent of the house is being repaired, that portion of the existing unit must conform to prevailing zoning standards. On the other hand, if more than 50 percent of the housing is being repaired, the entire housing must conform to current standards for new construction in the zone. Research has also highlighted the lag of housing codes behind cutting-edge technologies and innovations that may make housing repairs cheaper (Listokin & Hattis, 2005). Cost-effective technologies that may make housing less expensive may be prohibited by building regulations or codes. Such standards make housing code violations that lead to repairs expensive for landlords, who then pass on the cost of such repairs to residents or buyers during housing sales.

In terms of housing sales prices, Noam (1982) suggests that housing code enforcement may lead to direct and indirect effects on the housing market. Studies have shown that housing quality plays a critical role in shaping housing prices (Clauretie & Daneshvary, 2009; Kain & Quigley, 1997; Miller et al., 2018). When properties are in good condition, they get a premium on the housing market, while properties that are in need of repairs get discounted on the housing market (Kain & Quigley, 1997). Bartram (2019a) adds that housing violations that are not resolved impact housing sale prices negatively. Suggesting that house code-related repairs that improve housing quality impact property prices depending on the prevailing market condition (Miller et al., 2018). If the result of enforcement translates into increasing the cost of housing, then such price increases will affect prevailing neighboring housing, especially considering the spatial feedback effects associated with housing activity (Helms, 2012).

### 4.2.3 Housing Code Enforcement: Case Studies

Housing code enforcement has been studied and analyzed quantitatively and qualitatively. Some of the earlier studies were from Ackerman (1971), who studied income redistribution and regulation of slum landlords on behalf of the poor by looking at the economic benefits and the ethical considerations of government interventions in slum rental markets using housing code enforcement. In his conclusions, Ackerman (1971) suggested that while code enforcement is not a solution for everything, it is relatively a better solution than negative income tax policies. Imposing a fair burden on landlords, such as compelling them to undertake improvements using code enforcement, will redistribute some of their profits to poor tenants through improved housing conditions. Thus, the poor tenant's right to a decent home would involve an obligation by the government to ensure that the landlords redistribute some of their income. If applied comprehensively, such an approach will improve housing quality for the poor without raising rents.

Komesar (1972) criticized Ackerman's theorization, suggesting the effects of compelling landlords to undertake improvements through housing code enforcement without a return on investment may adversely affect low-income renters. The landlord's decision to continue renting is dependent on the return on investment, which will be affected by additional costs imposed by code enforcement. Furthermore, should landlords remove their property from the rental housing market, it will impact the supply of housing units. Both Ackerman (1971) and Komesar (1972) used theoretical models to explain the relationship between house code enforcement and economic outcomes for low-income families.

Grigsby (1971), on the other hand, analyzed the economic aspects of housing code enforcement, focusing on three basic questions: the purpose of housing code enforcement, its actual impact in different market environments, and alternatives to traditional code enforcement. According to Grigsby (1971), the ultimate purpose of code enforcement is to improve community well-being; for this reason, housing code enforcement should focus on tenant satisfaction. He identified three market environments: an outer city with good housing with no indication of decay, the middle ring of the city with emerging decay, and an inner city containing a mix of housing, with most of them requiring substantial investment. Grigsby (1971) acknowledged that strict enforcement in the inner city without any accompanying government subsidies would lead to the abandonment of housing by landlords, which, in the end, would exacerbate housing problems. Hence, as an alternative to traditional approaches, code enforcement should be more nuanced and flexible, and effective enforcement should focus on creating an enabling environment for housing maintenance to take place before legal measures related to code enforcement are applied.

Some early research also discussed the need for adaptive housing code enforcement in the face of housing shortages. Gribetz and Grad (1966) suggested that as housing supply declines and

shortages emerge, local governments become landlords of uneconomical buildings should the private market fail to maintain them to meet housing needs. Recent studies highlighted local governments taking over vacant and abandoned housing and converting them into affordable housing to halt neighborhood blight (PolicyLink, 2002)

On the other hand, Hartman et al. (1974) looked at municipal code enforcement and the low-income tenants. They highlighted how municipal housing code enforcement harms low-income residents through rent increases, eviction, and minimal availability of low-rent housing stock. They, therefore, suggest several solutions that will help mitigate the negative effects of housing code enforcement. The need for a comprehensive and coordinated approach to housing code enforcement rent assistance for low-income families should housing code enforcement lead to a rent increase, rent control to stabilize rents to protect tenants, and as suggested by Gribetz and Grad (1966) and highlighted by PolicyLink (2002), change in owners to individuals or organizations who are willing to meet housing code standards in situations where landlords are unwilling to keep housing to up code.

Ross (1996) further discussed the need for strategic housing code enforcement, highlighting the potential negative outcomes rigorous code enforcement can have for urban decline. Ross (1996) emphasized how aggressive housing code enforcement in specific neighborhoods can lead to landlords abandoning their property and the consequential effects of such abandonment on neighboring property values. Hence, Ross advocated for moderate strategic housing code enforcement that can be coordinated with other policies, such as zoning and housing subsidies, to deal effectively with urban decline.

Studies by Elliott Jr and Quinn (1983) used econometric methods to study concentrated code enforcement. They discussed targeted and non-uniform code enforcement and their potential

outcomes across different neighborhoods. Jr. and Quinn (1983) examined neighborhood selection criteria regarding housing code enforcement. They discussed the triage strategy, where neighborhood conditions dictate housing code enforcement. In this strategy, housing code enforcement excludes the best and the worst neighborhoods and focuses on neighborhoods that are in the middle in terms of housing deterioration. They also discussed the worst first selection strategy, where housing code enforcement is targeted at the most deplorable neighborhoods with the majority of low-income residents first. Using a probit model, they found neighborhood characteristics such as race, the share of owner-occupiers, rent, number of housing units, median income, and race were key factors in neighborhood selection. They also modeled the effects of a neighborhood's crime rate on housing code enforcement and concluded that neighborhoods with high crime rates minimize the effectiveness of housing code enforcement.

Some recent studies on housing code enforcement have been from Bartram (2019a), who analyzed the relationship between housing code violations and housing prices in Chicago. Bartram (2019a) modeled the effects of resolved and unresolved housing code violations on housing sales prices and rent. The results showed that when housing code violations are resolved, they increase rental prices but have no significant impact on residential sales prices. However, unresolved housing code violations decrease residential sales prices but do not significantly impact rental prices. Emphasizing how building codes burden homeowners who may not have the financial means to afford housing code violation-related repairs and renters who may be rent-burdened as housing code violation-related repairs increase rental prices.

Bartram (2019b) also studied the selective allocation of code violations by building inspectors in Chicago. The study analyzed patterns of housing code enforcement by building inspectors. Using binomial regression to model building inspectors' behaviors when enforcing

housing codes, the results showed that building inspectors tend to be lenient toward low-income owners-occupiers and strictly enforce housing codes when it comes to professional landlords who own large residential units. Bartram (2019b) emphasized the relationship between income, building size, race, ownership status, and housing code violations.

Much of the literature on housing code enforcement appeared in the 1990s. It focused on analyzing how housing code enforcement is being operationalized by government agencies, neighborhoods where it is being enforced, and the effects of such enforcement on neighborhoods and households. A common theme in this literature has been the realization that housing code enforcement can shift the housing market through increasing housing prices or rental rates. Much of the literature has theorized and discussed the consequences of such shifts, especially for low-income families and neighborhoods, including gentrification, displacement, and even neighborhood revitalization. Other aspects of the literature have also investigated the approach adopted by government agencies and building inspectors when implementing code enforcement, including discriminatory strategies and approaches. In terms of methodology, most of the case study literature focused on descriptive, legal, and theoretical aspects of housing code enforcement and less on the quantitative modeling of the effects of housing code enforcement on neighborhoods. Only a few studies utilized quantitative modeling to study the effects of housing code enforcement on neighborhoods. This leaves a research gap in understanding the longitudinal effects of housing code enforcement on neighborhoods, especially in fast-growing newer cities like Charlotte, North Carolina.

## 4.3 Methods

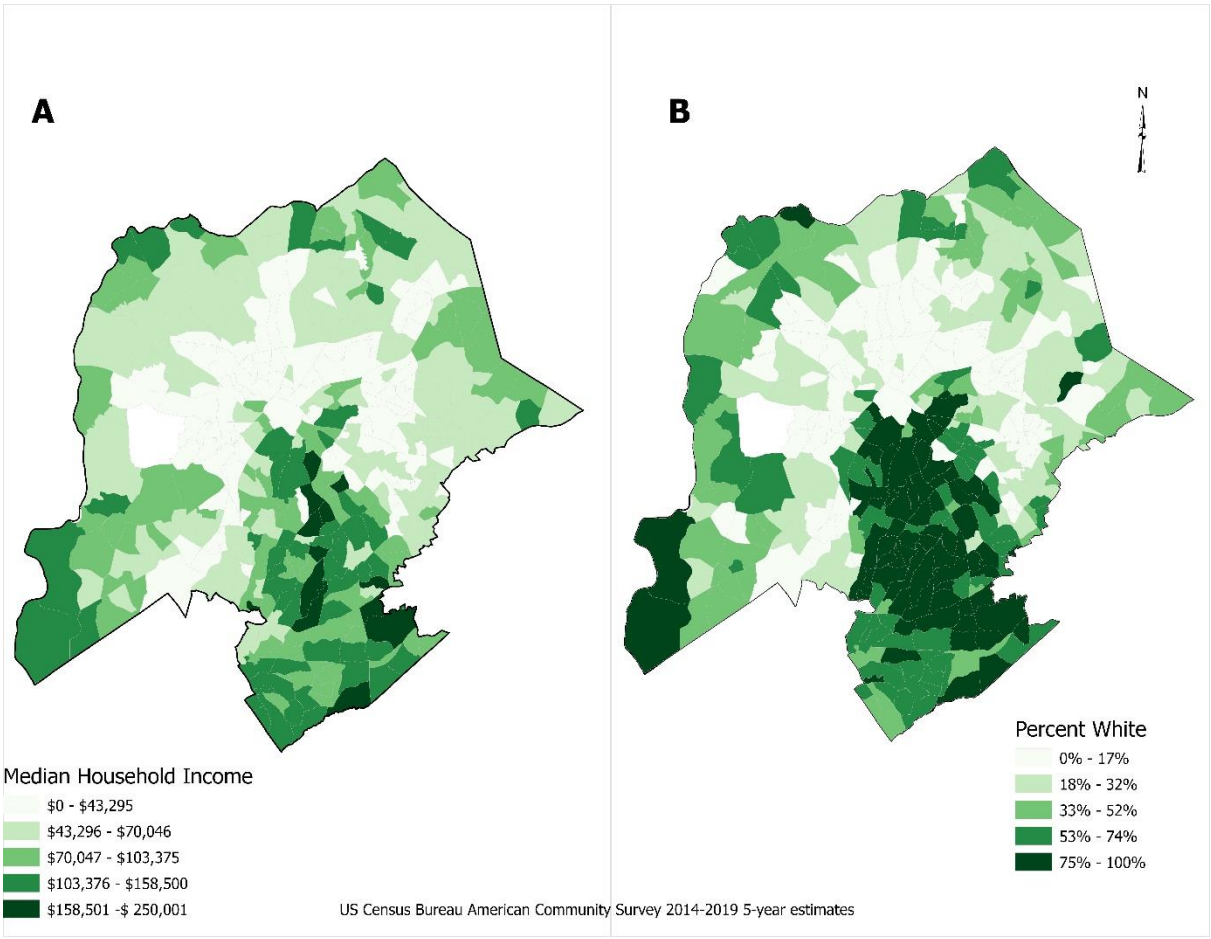
### 4.3.1 Study Area

The study area in the research is Charlotte, North Carolina. Charlotte is a mid-size southeastern city with a population of 874,579. It is one of the newer cities in the Southeastern that has experienced rapid growth in the last two decades. Between 2000 and 2020, the city's population increased by more than 60%, making it one of the fastest-growing cities and the 16th largest in the US. The city is home to major financial, insurance, real estate, and education institutions, making it a desirable and popular destination for families and individuals. US News ranks Charlotte eighth when it comes to the best places to live in the US. Penske Truck Rental data shows Charlotte is among the top nine moving destinations in the US. Charlotte has also been a major destination for millennials, receiving the highest influx of millennials of any city in the US in 2015. Charlotte had an average of 53 new residents moving to the city during the COVID-19 pandemic (Johnson.et al., 2022). The influx of residents puts pressure on Charlotte's already tight housing market, resulting in high rental and home sale prices. The average home sales prices in the city increased by 79% between 2013 and 2023 (Charlotte QoL, 2023).

Charlotte is a racially diverse city with 46.7% white, 35.5% black, 6.6% Asian, and 14.6% Hispanic, according to the US Census Bureau. However, geographic patterns in the city were shaped by historic policies and outcomes such as redlining and urban renewal, causing a divide along the income and racial lines. Different racial groups are spatially concentrated in different parts of the city. The southern part of the city is predominantly white and wealthy (Figure 4.1). The Black population is predominantly concentrated in the northern and western parts of the city; these areas also tend to be occupied by old industrial land uses, as well as the city of Charlottes

Douglas International Airport. The central part of the city, also known as Uptown, is the hub for banks, insurance companies, technology firms, and other Fortune 500 companies.

Figure 4.1 Spatial distribution of (A) median household income; (B) percent white residents




While Charlotte has long been a segregated city, its government has been committed to reversing historic patterns of segregation and disinvestment through its policies. The most recent one has been the implementation of the Charlotte2040 comprehensive plan geared toward equitable development. The city government has also been investing in different parts of the city, one of the most prominent ones being the city's new Lynx Light Rail.

Coupled with this has been the renewed national interest of young professionals to live in urban centers and surrounding neighborhoods, especially in the fastest-growing cities (Delmelle, 2017; Dunn, 2017). In Charlotte, this trend has drawn new residents to neighborhoods such as NoDa, Plaza  Midwood, Cherry, Wilmore, and Grier Heights, which used to be predominantly minority (Dunn, 2017). While previously minority neighborhoods saw an influx of new residents, mostly white and wealthy, gentrification pressures in these neighborhoods grew. Some of the outcome of such pressures is the increase in rental and home sale prices,  housing renovations, suburbanization of low-income families, as well as increased 311 calls to eliminate neighborhood neglect such as housing code violations,  nuisance violations, and so-called 'bad properties' from the neighborhoods (Delmelle et al., 2021; Dunn, 2017).

As gentrification pressures grow and Charlotte's housing market responds accordingly, Charlotte presents an ideal case study of how a city government's regulatory policies affect neighborhood outcomes. As one of the fastest-growing cities in the US with a hot housing market, Charlotte is ideal for understanding the dynamics between housing code enforcement and the effects on a neighborhood's home sales and housing prices.

This research uses Neighborhood Profile Areas in Charlotte as the unit of analysis to assess the relationship between code enforcement as a regulatory tool and its impact on a neighborhood's home sales and housing prices. Neighborhood Profile Areas are geographies modified from US census block groups by the City of Charlotte and the University of North Carolina (UNC) Urban Institute based on feedback on neighborhood boundaries from community organizations and community leaders in Charlotte.

### 4.3.2 City of Charlotte Housing Code Enforcement Process

The Housing and Neighborhood Services (HNS) of Charlotte, as mandated by the city's highest governing body, the City Council, is responsible for enforcing the city's code for housing. Pursuant to Article 6 of Chapter 160A of the North Carolina General Statutes, the fundamental goal of the housing code, as defined in the city of Charlotte's ordinance book, is to protect the health, safety, or welfare of the city's citizens as well as the peace and dignity of the city. The General Statutes recognize the presence of housing in the city's jurisdiction, which is dilapidated, deteriorated, fire hazards, lacking ventilation, light, and sanitary facilities, as well as other calamities that make them unfit for human habitation. Hence, there is a need for an ordinance that guides the elimination of blighted housing in neighborhoods and standards that help arrest, remedy, and prevent the deterioration of existing housing.

To achieve the housing standards through guidance, the housing code provides a set of minimum standards that need to be followed. The minimum standard falls into categories of space and use, light and ventilation, exit requirements, plumbing facilities, heating facilities, electrical facilities, structural standards, property maintenance, and insulation. The minimum standards apply to all residential housing – single-family and multifamily dwellings- and commercial housing, including rooming houses and lodging establishments. Violation of the housing code notices to the HNS is initiated through tenants' complaints, field observation by a housing code inspector, police, fire services, petition, and other public agency referrals.

Once the HNS receives a housing violation notice, a designated housing inspector schedules an inspection with the property owner. During the inspection process, the housing inspector undertakes a comprehensive inspection, including assessing the house's interior, exterior, attic, and crawlspace. In the event of a housing violation, a legal notice is sent to the property

owner, which details the violation's presence and a scheduled hearing for the violation to be disputed or submission of evidence that the code violation has been corrected. Suppose the violation poses an immediate threat or danger to housing occupants, for example, housing with unsafe wiring, fire hazards, or no heating equipment during winter. In that case, the property owner has 48 hours to correct the violation. For violations that are immediate threats or dangers but are not addressed within 48 hours, housing occupants become eligible for Charlotte's city's emergency relocation program.

For non-emergency violations, which go through a hearing, a finding of fact and order are issued after the hearing process. This finding of fact details the specifics of the violation, and the order directs if there should be a repair or demolition of the housing within 30 days after the hearing. There is a demolition order if the housing deteriorates; that is, if the cost of correcting the code violation is less than 65% of the tax value of the house. On the other hand, if the house is dilapidated, that is, if the cost of correcting the code violation exceeds 65% of the tax value of the house, there will be a demolition order.

Failure to correct the violation after the 30-day compliance window results in issuing a civil penalty, a uniform citation, or in-rem remedy with the city council. Property owners who do not respond to requests to correct the violation or cannot be located are issued a notice of civil penalty, which details the amount they are fined, $100 per day after the 30-day compliance window. Property owners who are non-compliant and can be reached are issued a uniform citation in an environmental court, which is usually served in person by a police officer. Lastly, suppose notice of civil penalty and uniform citation fails to bring the housing into compliance. In that case, the case is sent to the city council for in-rem repair or in-rem demolition approval. After the city council approves either the in-rem repair or the in-rem demolition, a lien is placed on the property

by the city government if the property owner fails to refund the city for the total cost of the repair or demolition.

### 4.3.3 Data

This research uses longitudinal data from the Charlote-Mecklenburg County and the US Census Bureau from 2010 to 2019. The data from Charlotte-Mecklenburg County include permitting data for new residential construction, residential demolitions, and residential renovations, as well data for buildings that are 30 years and over, home sales prices, housing units, and housing code violations. The data from Charlotte-Mecklenburg is point-level, which captures different housing-related characteristics at a granular level. The data from the US Census Bureau includes the share of homeowners, the share of white residents, median household income, and gross rent. The US Census Bureau data is census block group data aggregated or grouped within each NPA. For each variable, the five-year average difference is included with the variable at the beginning of the decade, that is, 2010. Table 4.1 summarizes the data used in this research and their sources.

Table 4.1 Description of Data and their Sources

| Dimension | Description | Source |
|---|---|---|
| Race | Percentage of population self-identified as Minority. | *US Census Bureau* |
| Household Income | Median Household Income | *US Census Bureau* |
| Homeownership | Percentage of housing units that are owner-occupied. | *US Census Bureau* |
| Gross Rent | Median Gross rent | *US Census Bureau* |

| | | |
|---|---|---|
| Residential Demolitions | The concentration of residential demolitions | *Mecklenburg County Code Enforcement* |
| Residential New Construction | The concentration of residential units permitted for new construction | *Mecklenburg County Code Enforcement* |
| Residential Renovation | Concentration of residential units permitted for renovation | *Mecklenburg County Code Enforcement* |
| Housing Code Violations | Share of residential housing code violations that were resolved with repairs | *Mecklenburg County Code Enforcement* |
| Housing Units | Share of housing units that are 30 years or over | *Mecklenburg County Tax Parcels* |
| Homes Sales | The median sales price of home | *Mecklenburg County Register of Deeds* |

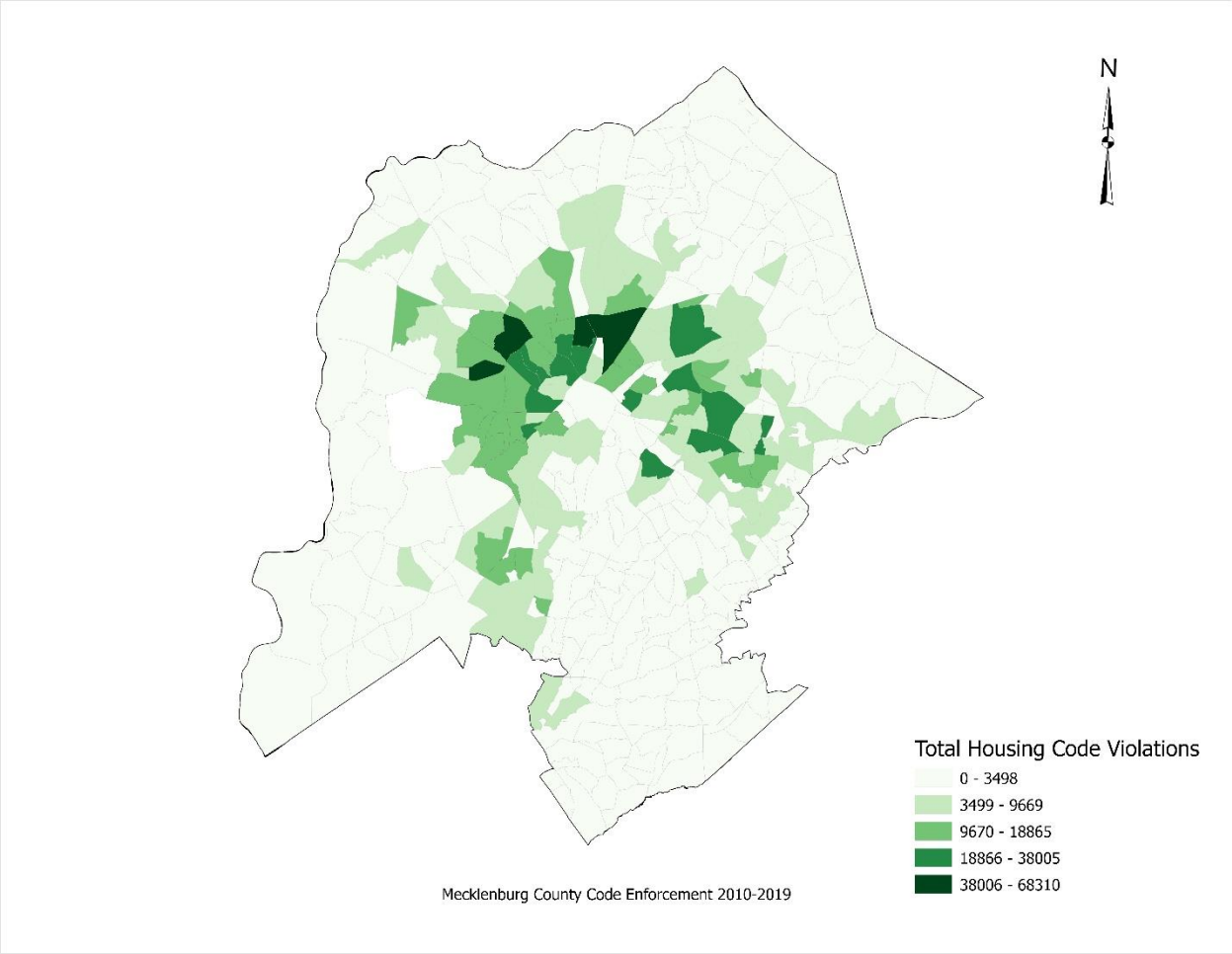
### 4.3.4 Housing Code Violations Data

The Charlotte-Mecklenburg County maintains a public database for all code violations issued by the city of Charlotte Code enforcement team. Some of the key variables in the housing code violation database include the property address, property parcel ID, inspection notes that describe the details of the specific code violation, the case origin that details how the housing code violation was initiated, either through a compliant, field observation by an inspector, police, fire service, or a public agency and the case type, which reports the type of regulatory code – zoning, housing, nuisance, or commercial- which is being violated, and the outcome of the code violation.

The research focused on residential housing code violations resolved with repairs. For this reason, all code violation case types were considered if they relate to one of the following land use types in the database: Attached Residential, Single Family, and Multi-Family, and eventually resolved with repairs. Duplicate violations in the database were excluded using the unique case

numbers and inspector's notes. Those two variables were used to remove duplicates because one building holds the potential to have multiple violations. By focusing on the case number and the inspector's notes, buildings with multiple violations are retained for further analysis. For each year (2010-2019), code violations are geocoded using ESRI's ArcGIS Pro for further co-variate spatial analysis. Only code violations within Charlotte's city limit were considered for further analysis. Figure 4.2 shows the distribution of housing code violations resolved with repairs in Charlotte.

Figure 4.2 Spatial distribution of the total number of housing code violations from 2010 to 2019



### 4.3.5 Dependent Variable

Two regression models are estimated to investigate the effects of housing code violations resolved with repairs on change in home sales and rent prices. The first dependent variable is the change in gross rent between 2010 and 2019. Gross rent reflects trends in the housing market; as a housing market becomes tight with housing demand exceeding housing supply, desirable neighborhoods experience a hike in gross rents. Similarly, previously undesirable neighborhoods that experience an influx of affluent individuals and the creative class eventually experience rent hikes. According to the literature, housing code violations can potentially increase prevailing rent prices as landlords aim to pass the cost of repairs on to tenants.

The second dependent variable is the change in median sales prices in each NPA between 2010 and 2019. The literature has shown that housing code violations that lead to repair can impact home sales prices in different ways. First, sellers may want to pass on the cost related to repairs or renovations to potential buyers after addressing a violation. Second, considering the spatial feedback effects associated with home sales prices, as housing code violations resolved with repairs increase home sales prices, neighborhood properties may also see appreciation in their home sale prices. Two regression models are estimated to assess the effect of housing code violations on changes in home sales and rental prices.

### 4.3.6 Independent Variables

The first independent variable is housing code violations that were resolved with repairs. The literature has shown that if a housing code violation is resolved with repairs, it potentially increases housing costs as home sellers or landlords try to pass on the cost to buyers or renters.

Thus, housing violations that lead to repairs are expected to impact a neighborhood's home sales price or rental rates.

Other independent variables in the model capture a neighborhood's characteristics and thus may impact home sales or rental rates. These variables help control other neighborhood characteristics that may impact home sales or rental rates. This included a neighborhood's share of white residents. Like all other independent variables, the share of white residents and the five-year average difference of the share of white residents are included in the model. As discussed above, as gentrification pressure grows in Charlotte, rental and home sales prices will most likely increase; hence, it is important to control for this variable.

The median income in each NPA can also impact home sales and rental prices, especially in a city like Charlotte. Neighborhoods with clusters of high-income earners tend to have the city's most expensive houses and highest rental rates. Additionally, as a neighborhood's makeup tilts toward the proportion of high-income earners, it most likely would affect rental rates and home sales prices. A change in such a proportion may indicate an increase in, for example, the creative class or individuals of higher socio-economic status, hence affecting prices.

Homeownership is an economic indicator of how affluent a neighborhood has become. While having a mortgage could potentially be a financial burden, homeowners who can afford their mortgages hold the potential to build generational wealth. The concentration of such financially stable households has positive outcomes, including neighborhood investments that tend to stabilize their neighborhoods. Neighborhoods with more homeowners tend to be relatively stable and robust to decline or change. A neighborhood's level of homeownership can, therefore, shape its housing market in terms of prevailing prices for home sales and rental rates.

Housing units that are 30 years or older have the potential to impact home sales or rental rates in different ways. In historic districts, older housing tends to have higher sales prices because of the historic nature of those buildings. On the other hand, houses 30 years or older may require maintenance or renovation to keep them in good condition. In terms of structural characteristics, older buildings are more likely to have more housing code violations than newer housing. For this reason, the older a house, the more likely its sales price will be lower, or its rental rate will be less. Therefore, the model includes the share of older buildings to control for its effects on home sales and rental prices in each NPA.

New residential constructions correspond to new single-family or multifamily housing on vacant parcels, previously underdeveloped parcels, or replacement housing previously demolished structures. Patterns of new residential construction may provide information on where people choose to live, which is impacted by multiple factors, including the availability of amenities, affordable, developable lands, and the prevailing trends in the housing market. Housing construction accumulates to show the level of direct investment being made into a neighborhood. Neighborhoods going through upgrading might experience an increase in new housing construction, which can increase the general property values in such neighborhoods. Furthermore, newly constructed housing may have higher sales value or rental rates as compared to older housing. Hence, new residential constructions are included in the model to control sales and rental prices.

Residential renovation refers to additions, alterations, or conversions to single-family or multi-family structures. Such renovations or alterations include remodeling, façade renewal, wall or roof repair, or any enhancement that improves or upgrades the quality of an existing housing. Renovation that precedes sales or renting of housing might be a market-oriented strategy aimed at

garnering more profit or increasing rent. Renovation might reflect an owner's desire to invest in a housing property, especially since housing is one of the biggest investments individuals make in the US. Renovation can thus be a function of profit-maximizing strategy in the case of landlords or incumbent homeowners. Housing renovations have been linked to gentrification in multiple studies. The extent of renovations may show the flow of capital investments in a neighborhood, which can impact its housing market, including its sales prices and rental rates. Hence, this variable is included to control for a neighborhood's sales and rental prices.

Residential demolitions refer to the removal of single-family or multifamily structures. Residential demolitions can also be a tool that helps protect existing property values. Residential demolitions remake a neighborhood's landscape as abandoned, virtually uninhabitable, undesirable, hazardous, and severely dilapidated structures are removed. The presence of such undesirable structures can be a disamenity that depresses adjacent property values. In such instances, residential demolition is a tool that helps ameliorate these potential disamenity threats. Residential demolitions might also be driven by redevelopment and upgrading goals that demolish old and dilapidated housing stock to build newer houses. Increasing residential demolishing may be associated with gentrification as neighborhoods that are seeing appreciation tend to tear down buildings to develop new ones. Residential demolitions are included in the model to control their neighborhood effects on home sales and rental prices.

Table 4.2 Statistical summary of dependent and independent variables.

| Statistic | Mean | St. Dev. |
|---|---|---|
| $\Delta$WHITE (%) | -3.008 | 9.018 |
| WHITE2010 (%) | 46.413 | 30.454 |

| | | |
|---|---|---|
| **Δ**BLDGAGE (%) | -2.531 | 4.429 |
| BLDGAGE2010 (%) | 61.035 | 33.136 |
| **Δ**OWNER (%) | -4.193 | 8.305 |
| OWNER2010 (%) | 59.727 | 28.904 |
| **Δ**MHINCOME ( in $) | 6,412.194 | 12,883.880 |
| MHINCOME2010 ( in $) | 58,730.390 | 33,080.170 |
| **Δ** DEMOLITIONS () | 0.057 | 0.32 |
| DEMOLITIONS2010 (%) | 0.092 | 0.59 |
| **Δ** CONSTRUCTIONS (%) | 0.140 | 3.85 |
| CONSTRUCTIONS2010 (%) | 0.474 | 1.50 |
| **Δ**RENOVATIONS (%) | 0.135 | 3.03 |
| RENOVATIONS2010 (%) | 0.822 | 1.188 |
| **Δ**SALES ( in $) | 17209.69 | 33522.53 |
| SALES2010 ( in $) | 105472 | 86062 |
| **Δ**GROSSRENT ( in $) | 161.116 | 302.955 |
| GROSSRENT2010 ( in $) | 817.435 | 419.994 |
| **Δ** HOUSINGVIOLATIONS | -21.554 | 538.861 |
| HOUSINGVIOLATIONS2010 | 549.450 | 1311.276 |

**Note:** **Δ** indicates the five-year average difference between variables. Median values are represented by

### 4.3.7 Econometric Model

This research uses a spatial autoregressive model to measure the effects of housing code violations resolved with repairs and other neighborhood variables on change in housing sales prices and rental rates. The literature has shown the potential for housing code violations to be spatially concentrated. The likelihood of spatially concentrated housing code violations also means that the pattern of home sales affected by housing code violations could be spatially dependent. The benefit of using a spatial model is that it allows for a more accurate estimation of the spatial effects of the independent variable on the dependent variable and captures the influence of nearby observations on each other. To estimate these potential effects, this research first estimates an Ordinary Least Square regression, which is specified as:

Where  represents the dependent variable change in home sales or gross rent between 2010 and 2019,  is the intercept,  is the coefficient of a vector of neighborhood characteristics including housing code violations,  and  is the error term.

The residual of the OLS model is used to test for the structural spatial dependency that may exist. The Moran's I statistic allows you to test structural and spatial dependency in the residuals of non-spatial models, the OLS model in this research. The null hypothesis for this model is that there is no spatial dependency; hence, rejecting this null hypothesis shows that there is evidence of spatial dependence, and therefore, a spatial model is needed to capture the true spatial relationship between the dependent and independent variables. If there is evidence of spatial dependence, a spatial lag model will be used to model the spatial relationship between the variables. However, the type of Spatial Lag Model (Spatial Lag or Spatial Error) model depends

on Baltagi et al. (2003) test specification results (see results section for further discussion). From the initial analysis, the Spatial Lag is preferred instead of Spatial Error. The Spatial Lag model is specified as follows:

Where  is the dependent variable, change in home sales or gross rent between 2010 and 2019 in location *i,* the average value of  which is the intercept is $\mu$. The vector of neighborhood variables, including housing code violations, is represented by  with each one of them having the coefficient . The spatial autoregressive parameter is $\rho$, which explains the degree to which the values of  are influenced by the dependent variable in its neighborhood locations.  is the spatial lag term where represents spatial weights between the current location *i* and each neighboring location *j,* and  is the dependent variable in the current location. The spatial weight matrix used  for this research is the Queen Contiguity matrix with row standardization.

4.4 Results

As discussed above, this research sought to model the effects of housing code violations that were resolved with repairs on change home sales and gross rent. The model controlled for other neighborhood variables, including a neighborhood's income, building age, new residential construction, and residential demolition. It is critical to point out that other neighborhood variables, including the share of white residents, the share of homeowners, and the share of residential renovations, were also controlled as they all have the potential to impact change in home sales and gross rent. However, in a highly segregated city like Charlotte, variables such as income, race, and homeownership are highly correlated, so the initial model suffered from multicollinearity, thus making it difficult to separate their individual effects on change in home sales and rental prices.

Consequently, race and homeownership were excluded from the final model except for a neighborhood's median income. Further, housing renovation at the neighborhood level was excluded from the final model to avoid the problem of endogeneity. Housing renovations most likely directly affect changes in home sales and gross rent, hence the potential endogeneity problems.

After estimating a non-spatial OLS model, a Moran's I test was undertaken to test for spatial dependence in change in home sale prices and gross rent. Following the Moran's I test, the null hypothesis of no spatial dependence was rejected, suggesting that a spatial model is needed to account for spatial dependence.

The choice of a spatial model, whether Spatial Error Model (SEM) or Spatial Lag Model (SLM), was undertaken using the Baltagi et al. (2003) Lagrange Multiplier (LM) specification test. This LM specification test was necessary because there is no theoretical justification for selecting either SEM or SLM as the appropriate model. Without theoretical justification, the SEM or SLM model whose result is significant is chosen. Table 4.3 reports the results of the LM specification test. From the model, SEM and SLM tests are both significant, hence the need for robust forms of the LM specification test for both the SEM and SLM. After the robust test, the robust form of the SEM is marginally significant, while the SLM is most significant. Hence, the SLM was selected as the appropriate model.

Table 4.3. Model Specification Tests Results

| Test | Test Statistic | p-value |
|---|---|---|
| LM test for spatial error dependence | 6.1719 | 0.01298 |
| LM test for spatial lag dependence | 19.919 | 0.00000808 |
| Robust LM test for spatial error dependence | 3.8323 | 0.05027 |
| Robust LM test for spatial lag dependence | 17.579 | 0.00002756 |

4.4.1 Housing Code Violations and Home Sales Prices

The first SLM model corresponds to the effects of housing code violations that led to repairs and other neighborhood variables on change in home sales prices. After accounting for spatial dependence, the SLM reports six statistically significant variables except for average changes in new residential construction, residential demolitions in the base year, and housing code violations resolved with repairs in the base year (2010). Table 4.4 reports the results of the SLM regression. All the variables have statistically positive effects on home sale prices except for the value for housing code violation repairs at the beginning, which was negative albeit statistically insignificant.

Table 4.4. Factors Influencing Home Sales Prices (Spatial Lag Model)

| Test of Spatial Dependency | |
|---|---|
| | Dependent variable: |
| | Sales Price |
| ΔMHINCOME | 263.931*** |
| | (33.831) |
| MHINCOME2010 | 0.390*** |
| | (0.046) |
| ΔCONSTRUCTION | 1.304 |
| | (3.485) |
| CONSTRUCTION 2010 | 310.580** |
| | (129.345) |
| ΔBLDGAGE | 142.645*** |
| | (17.625) |
| BLDGAGE2010 | 204.081*** |
| | (43.230) |

| | |
|---|---|
| ΔDEMOLITIONS | 35.652** |
| | (15.842) |
| DEMOLITIONS2010 | 616.319 |
| | (1,122.186) |
| ΔHOUSINGVIOLATIONS | 5.078** |
| | (2.551) |
| HOUSINGVIOLATIONS2010 | -1.571 |
| | (1.173) |
| Constant | -28,833.490*** |
| | (4,408.930) |
| Observations | 401 |
| Log Likelihood | -4,634.556 |
| sigma2 | 631,512,962.000 |
| Akaike Inf. Crit. | 9,295.112 |
| Wald Test | 19.805*** (df = 1) |
| LR Test | 18.624*** (df = 1) |
| Note: | *p<0.1; **p<0.05; ***p<0.01 |

In terms of the model itself, the spatial autoregressive parameter Rho (ρ), which indicates the extent of the spatial dependence, was 0.276, suggesting a positive spatial autocorrelation. Thus, homes in nearby neighborhoods tend to have similar changes in home sales prices. Holding all variables constant, if the change in home sales price in a specific neighborhood increase, the change home sales in a nearby neighborhood increase as well.

The five-year average difference between median household income at the neighborhood level also positively affected change in home sales prices. For every unit increase in the change in median household income, change in home sales go by approximately $263.93 on average, holding all other variables constant, suggesting that as a neighborhood experiences an average change in its share of upper-income households, the prevailing change in home prices increase. This effect is also similar to home income at the beginning of the study period. Holding all variables constant,

a unit increase in the median income at the beginning of the study period increases change in home sales prices by $0.390. When it comes to income, the median household income at the beginning of the year and the average change in median household income increase change in home sales prices.

As for new residential construction, when you hold all other variables constant, only the share of new residential construction at the beginning of the decade increases change in home sales prices. Change in home sales prices saw an additional $1.3 positive increase for every unit change in new residential construction in 2010. The five-year average change for this variable is not statistically significant.

When it comes to buildings that are thirty years and over, both the five-year average change and the value at the beginning of the decade have statistically significant positive effects on change in home sales prices. For the five-year average, when you hold all the other variables constant, a unit increase results in change in home sales price significantly increasing by $142.645, while the share of old homes at the beginning of the decade significantly increases change in home sales prices by $204.081. The value at the beginning of the has a higher magnitude on change in home sale prices than the five-year average difference.

For neighborhoods that experience housing demolitions, when you look at the five-year average difference, for every unit change, change in home sale prices increase by $35.652, suggesting that neighborhoods that experience an increase in housing demolitions tend to have higher change in home sale prices. This trend is somewhat counterintuitive as increasing demolitions in a neighborhood may signal neighborhood decline. However, when you consider demolitions within the context of neighborhood revitalization, increased demolitions in

neighborhood may be in response to the movement of capital into a neighborhood or gentrification that increases neighborhood home sale prices.

Focusing on the main variable of interest, which is housing code violations that led to repairs, the coefficient for this variable at the beginning of the decade is not statistically significant. However, when it comes to the five-year average difference, for every percentage point increase in the change variable, change in home sales prices significantly go up by $5.078, suggesting that neighborhoods with more housing code violations resolved with repairs tend to experience relative increases in home sale prices over time. Efforts aimed at addressing housing code violations, such as repairs or renovations, may significantly improve housing quality, which can then impact neighboring property values.

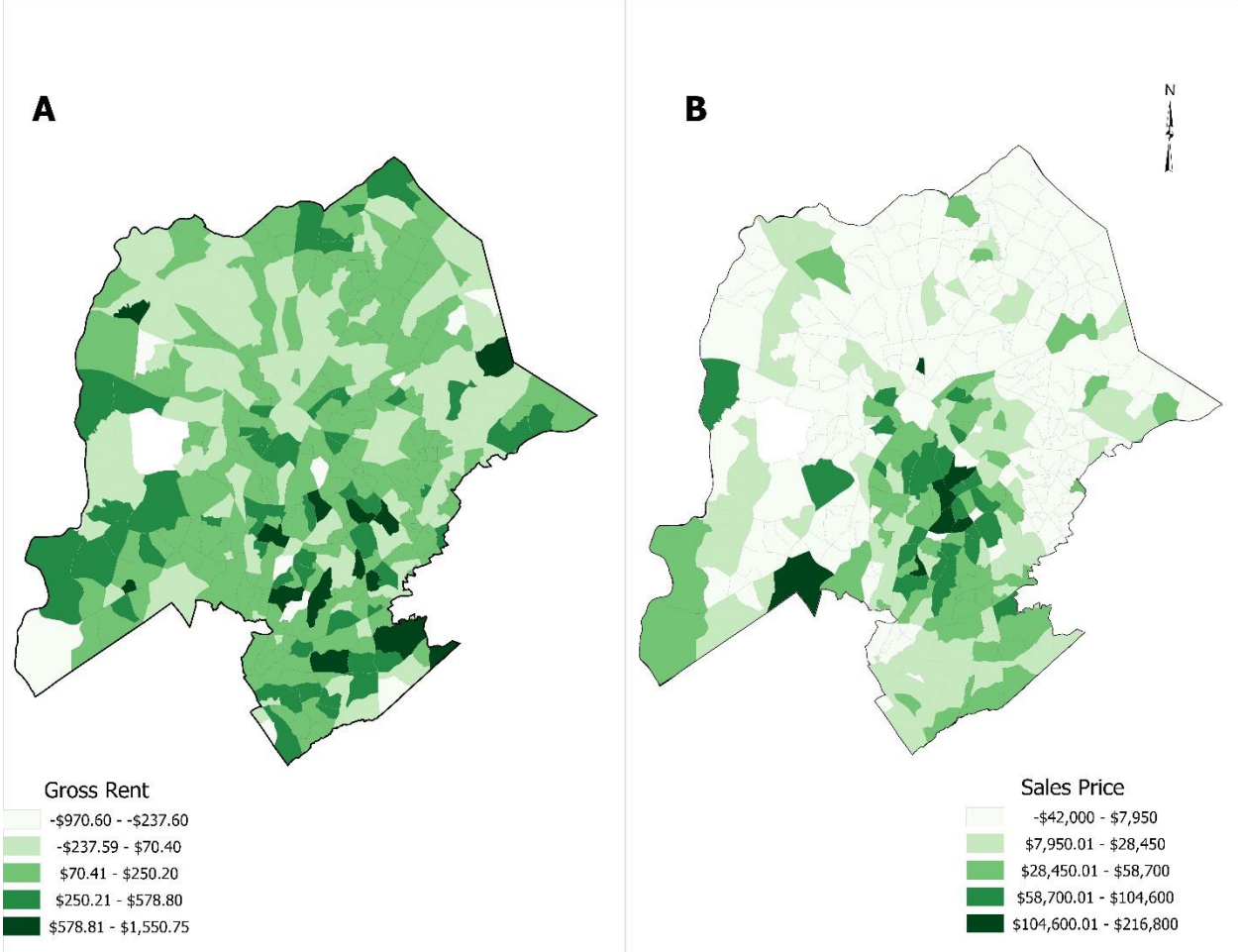
4.4.2 Housing Code Violations and Rental Prices

The second model examined the effects of housing code violations resolved with repairs and other neighborhood variables on change in gross rent. Like the first model, only median household income was retained among the variables since variables such as race and homeownership are very highly correlated and would bias the estimated effects on change in gross rent because of multicollinearity. Further, housing renovations were excluded because of the endogeneity that exists with housing renovations and rental rates.

Following the first model, a Moran's I test was undertaken on the residuals of the OLS model to assess the presence of spatial dependency in the change in neighborhood gross rent. After Moran's I test for spatial autocorrelation in the residuals, the null hypothesis of no spatial autocorrelation could not be rejected, suggesting that a spatial model is not needed to model the

relationship between the covariates and change in gross rent. Thus, the OLS model is appropriate for estimating the effects of neighborhood and housing-specific variables on change in gross rent.

Figure 4.3 Spatial distribution of (A) change in gross rent; (B) change in sales prices




The summary of the OLS mode is reported in Table 4.5. The OLS model reports an overall adjusted R squared of 0.05, showing that the independent variables included in the model explain only 5% of the variations in the dependent variable. This shows a potentially weak relationship between changes in gross rent and the independent variables. However, this weak relationship between the change in gross rent and the independent variables is somewhat expected, especially within the context of Charlotte. In Charlotte's hot housing market, variations in the change in gross

rents across neighborhoods is not concentrated to a specific part of the city but rather spread across the city (see Figure 4.3 A). In other words, there is no strong pattern in change in gross rent which corresponds to other strong patterns of housing, demographic, or socioeconomic variables (as seen for example in Figure 4.1 and 4.2). The change in home sales prices on the other hand shows a strong correlation with patterns shown in the independent variables in Figure 4.1 and 4.2 with a concentration in the southern wedge of the city which is and has been characterized by high incomes and a high percent of white residents for a long time.

Table 4.5. Factors Influencing Gross Rent Prices (Linear Regression Model)

| Regression Model Summary | |
|---|---|
| | Dependent variable: |
| | Gross Rent |
| **Δ**MHINCOME | 0.883*** |
| | (0.286) |
| MHINCOME2010 | 0.001*** |
| | (0.0004) |
| **Δ**CONSTRUCTION | -0.031 |
| | (0.030) |
| CONSTRUCTION2010 | 0.317 |
| | (1.130) |
| **Δ**BLDGAGE | 0.022 |
| | (0.154) |
| BLDGAGE 2010 | 0.025 |
| | (0.367) |
| **Δ**DEMOLITIONS | 0.096 |
| | (0.136) |
| DEMOLITIONS 2010 | 8.868 |
| | (10.446) |
| **Δ**HOUSINGVIOLATIONS | -0.001 |
| | (0.022) |

| | |
|---|---|
| HOUSINGVIOLATIONS2010 | -0.009 |
| | (0.010) |
| Constant | 50.124 |
| | (37.914) |
| Observations | 401 |
| R2 | 0.056 |
| Adjusted R2 | 0.032 |
| Residual Std. Error | 219.823 (df = 390) |
| F Statistic | 2.317** (df = 10; 390) |
| Note: | *p<0.1; **p<0.05; ***p<0.01 |

Among all the covariates, only a neighborhood's median income had a statistically significant effect on change in gross rent. For a unit change in the five-year average difference in median income, change in gross rent goes up by $0.88, holding all variables constant. This effect is statistically significant, suggesting that changes in a neighborhood's income notably affect change in gross rent, with high income likely associated with higher change in gross rent. Similarly, when it comes to the median income at the beginning of the decade, a unit change results in a $0.001 increase in change in gross rent when you hold all other variables constant. Thus, underscoring the importance of a neighborhood's economic status when it comes to changes in rental prices.

For a neighborhood's five-year average difference in housing code violations that led to repairs and share of housing code violations that were resolved with repairs at the beginning of the year, they both did not have a statistically significant effect on change in gross rent. As highlighted above, in Charlotte, there are very small variations in change in gross rents across neighborhoods partly due to its hot housing market; hence, housing code violations resolved with repairs are less likely to significantly impact changes in rental prices in specific neighborhoods, contrary to what has been observed in previous studies. Over the past decade Charlotte has experienced significant

growth in supply of apartments with numbers surpassing national trends. Regardless of this increase in supply of housing, rental prices still remain high in the city especially in Uptown and South End (Wheeler, 2023). This suggests that the prevailing housing market conditions matter for housing code violations resolved with repairs to affect change in rental prices. In a housing market where price variation is limited, such an effect may be limited. Further, the state of North Carolina has no rent control measures, and for this reason, for a market like Charlotte, the forces of demand and supply shape rental prices, which may not necessarily be induced by price increases induced by repairs from housing code violations.

## 4.5 Discussion and Conclusions

Housing code enforcement is one of the regulatory tools used by local government agencies to maintain housing in their jurisdictions and eliminate blighted housing. This paper sought to analyze the effects of housing code violations that were resolved with repairs, alongside other neighborhood-specific variables, including changing income profiles, housing demolitions, and new residential construction in a neighborhood on change in home sales prices and rental rates over ten years. Using the fast-growing Charlotte, North Carolina, as a case study, the research began by linking longitudinal housing code violations data, home sales data, gross rent data, and other covariates to Neighborhood Profile Areas (NPA) in Charlotte. Afterward, an Ordinary Least Square regression was estimated to model the relationship between change in home sale price, change in gross rents, housing code violations and the other covariates. Considering the potential spatial dependency that may arise with changes in home sales prices and rental rates, a Moran's I test for spatial autocorrelation in the residuals of a non-spatial model was undertaken. Afterward, a Spatial Lag Model (SLM) was estimated to account for any spatial dependency.

Starting with the first model, the results suggest that median household income, housing code violations, new residential construction, and buildings that are 30 years old and over positively affect change in a neighborhood's home sales prices. Notably, the five-year average change in housing code violations that resolved to repairs had a statistically significant effect on change in home sales prices, indicating that neighborhoods that experience more housing code violations solved with repairs tend to have higher change in home sales prices. This result is consistent with the expectations that sellers would most likely pass on the cost of undertaking code violations related repairs to buyers. This finding also aligns with suggestions from Clauretie and Daneshvary (2009) and Miller et al. (2018) that efforts to improve housing quality or prevent the deterioration of housing through regulation can significantly impact the housing market. Essentially, when housing is in good condition, it gets a premium, as Kain and Quigley (1997) highlighted. Contrary to studies conducted by Bartram (2019a), housing code violation resolved with repairs indeed contribute to increasing home sales prices. On the other hand, this finding aligns with previous studies that suggested that housing code violation improvements increase home sales prices (Miller et al., 2018; Noam, 1982).

Within Charlotte's context, it is important to factor in Charlotte's highly segregated neighborhoods when translating these findings. Housing code violations were highly concentrated in predominantly low-income and minority neighborhoods in Charlotte. Previous studies have highlighted the likelihood of low income and minority residents to be cost burdened, spend less on housing improvements, live in lower value and substandard homes and therefore they tend to be cited more for housing code violations (Conley, 2010; McCabe, 2016; Sampson & Winter, 2016; Satter, 2009). While it is not clear if the city government's housing code enforcements were targeted to specific low-income and minority neighborhoods to, for example, arrest neighborhood

decline, the potential effects of housing code violations related to repairs on home values may signal multiple outcomes. First, such appreciation may contribute to or signal gentrification pressures as housing in these neighborhoods is forced to keep up with the desired housing standards of the creative class who may want to move into these previously disinvested neighborhoods. Thus, gentrification pressures, including increasing home sales prices, especially in a hot housing market like Charlotte, may create problems for longstanding low-income homeowners who may face displacements due to increasing property taxes.

Another key finding from this study is the strong spatial feedback effects associated with home sales prices. In Charlotte's hot housing market, the findings suggest that nearby homes tend to have similar changes in home sale prices. Hence, as housing code violations resolved with repairs increase change in home sales prices, nearby properties feel the effects of such shocks. While change in these home price increases, their effect on nearby housing may signify positive outcomes, especially as homeowners build additional housing equity through housing appreciation, it is important to consider the broader implications for affordability and equity. Bartram (2019a) decries this implication within the context of resolved housing code violations increasing rental prices. However, this implication is also true for increasing home sales prices. Code violations resolved with repairs that increase change in home prices can exacerbate the divide between the rich and the poor by limiting housing options available for low and middle-income households who may want to own a home. However, within Charlotte's context, since code violations are predominantly in minority neighborhoods, home sale price appreciations may limit economic mobility for low-income households who may want to own a home in their neighborhood and build wealth over time. Furthermore, if low-income households get priced out

of the housing market as home sales prices increase, it may force them to sort in other low-income neighborhoods, limiting their economic mobility opportunities.

The second model looked at the effects of housing code violations resolved with repairs and their effect on change in rental prices. Unlike the change in home sale prices, the change in gross rents did not exhibit spatial dependence. Therefore, a spatial model was not necessary to model the relationship between change in gross rents and the other covariates; hence, an OLS model was estimated. After controlling for neighborhood-specific variables, the model showed that housing code violations resolved with repairs did not affect change in gross rent. This finding is inconsistent with previous studies, which suggested that landlords pass on the cost of housing code violation-related repairs to tenants. However, this finding should be analyzed within the context of Charlotte's housing market. Generally, in Charlotte, changes in rental prices are almost uniform, with little variation among neighborhoods. While some neighborhoods have higher rental prices, there are very few neighborhoods with low change in rental rates. Even in the predominantly low-income neighborhoods where most of the housing code violations were concentrated, the rental rates were not extremely low compared to the other parts of the city. Hence, the prevailing rental rates reflect the market rates being charged in general, regardless of the price impact associated with housing code-related repairs. Furthermore, a key characteristic of the change in gross rent prices in this research was that they did not exhibit spatial dependency, further emphasizing the homogeneity in Charlotte's housing market and its very few variations in the prevailing change in gross rent across NPAs. Another potential factor that may have contributed to the change in gross rent not being impacted is the share of housing units that are rental units as opposed to owner-occupier units. While this research's scope did not separate rental housing units

from owner-occupier units, the sample of housing units that had code violations and were repaired, if not enough sample, may have contributed to change in gross rents not being impacted.

The findings from this paper leave room for multiple policy implications. First, while it is important for local government agencies to strengthen housing code enforcement efforts to eliminate blight and maintain housing quality in their jurisdictions, such efforts should be operationalized through the lens of equity and affordability. For low-income households who get priced out of the housing market as home prices increase, the local government must put in place measures that do not restrict their economic mobility.

The initial analysis of the pattern of housing code enforcement showed that housing code violations were disproportionately concentrated in low-income and minority neighborhoods. Again, while it is not clear if this skewed concentration of code violations in low-income and minority neighborhoods was by design, policymakers need to ensure that house code enforcement efforts are equitable and do not disproportionately burden low-income and minority households. First by creating a financial burden related to housing code enforcement repairs and second by pricing households out of the housing market as home prices increase. As housing code violations are resolved with repairs increase, and the housing market responds, there is the risk of reduced housing affordability for middle- and low-income households. Policymakers should, therefore, balance housing code enforcement efforts with housing affordability preservation strategies.

Furthermore, as home prices increase and gentrification pressures are exacerbated, particularly for low-income residents, policymakers should implement strategies and enhance programs, such as homeownership programs, to help deal with negative outcomes such as gentrification pressures while promoting housing stability and reduced displacement for low-income households.

Lastly, as this research has shown, data-driven policy decision-making can be key for local governments to understand the housing market dynamics in their jurisdictions. Thus, local governments should utilize data-driven strategies to analyze the impact of housing code enforcement and how such efforts can lead to differing outcomes for different neighborhoods and income groups. By regularly monitoring and analyzing the effects of such a regulatory tool, the negative outcomes associated with code enforcement could be signaled early and addressed.

This paper is not without limitations, and the findings should be interpreted within the context of these limitations. First, the findings may not be generalizable to other cities, considering Charlotte's unique characteristics as a newer city in the South with a hot housing market and segregation along income and racial lines. These unique factors may significantly impact the dynamics of Charlotte's housing market and how housing code violations are operationalized, making it a unique case. However, the findings may still be generalized to cities that share characteristics like Charlotte's.

Lastly, to analyze the effects of housing code violations resolved with repairs on gross rent, the study relied on gross rent estimates from the American Community Survey (ACS) 5-year estimates, which may not accurately reflect prevailing rental prices due to the time lag of the ACS estimates.

In conclusion, this research fills a gap by using longitudinal data that covers the span of 10 years to model the effects of housing code violations resolved with repair on home sales prices and rental rates. The findings contribute to our understanding of the spatial feedback effects associated with home sales prices and how code violations resolved with repairs may increase home sales prices. The study found limited evidence of the effects of housing code violations on rental rates, possibly due to the uniformity of rental rates in a hot housing market like Charlotte.

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# CHAPTER 5: CONCLUSION

## 5.1 Findings

This research shows the interconnected nature of local government regulatory policy, private actors, neighborhood change, and urban housing market dynamics. The analysis of the three papers contributes to the existing literature on how actions from private actors and local government regulatory policy can, directly and indirectly, impact the housing market dynamics and neighborhood change. The existing literature has also been extended by showing how natural language processing techniques, advanced spatial statistics tools, and novel and traditional datasets can be leveraged in spatial analysis to model the impact of government policies and the actions of private actors. The results of the analysis have broad implications for policymakers who need to address housing discrimination, spatial inequalities, neighborhood gentrification pressures, loss of affordable housing, and the disparate impact of government policy, as well as the actions of private actors. The results highlight the significant effect of tenant screening, housing code violations, and housing renovation activity on spatial disparities, affordable housing, discrimination, housing access, equity, and home sale prices.

Chapter two analyzed spatial variations in exclusionary screening criteria in online rental listing web scraped from Craigslist and Zillow. The research explored the prevalence of terms in rental listing that act as barriers to those seeking to rent, especially individuals of lower socio-economic status. The study found the predominance of corporate landlords, primarily advertising on Zillow, systematically included restrictions on minimum credit scores, income, criminal history, Homeowners Association (HOA) requirements, and prior evictions, particularly in low-income

and minority-predominant neighborhoods. The findings also highlighted restrictions on housing choice vouchers, which were more common in wealthier neighborhoods on Craigslist. This suggests that voucher holders experience more stigma in higher-income neighborhoods and may encounter barriers with smaller landlords who mainly advertise on Craigslist. While corporate landlords did not explicitly include housing voucher requirements, they most likely excluded voucher holders with minimum income requirements, which are typically set at three times the monthly rent. The results highlight the significant impact of how exclusionary criteria used in the rental housing market can perpetuate patterns of inequality and segregation. Thus, there is a need for policy intervention to address housing barriers for low-income individuals.

Chapter three analyzed the relationship between neighborhood characteristics changes and housing renovation activity over ten years (2010-2019). The research used a Spatial Lag Model (SLM) to account for spatial dependency in housing renovation activity. Results suggest that neighborhoods with older homes at the beginning of the decade tended to experience more housing renovation activity. Neighborhoods with higher levels of homeownership were associated with increased renovation activity at the beginning of the decade. Furthermore, neighborhoods with high median household income levels saw more renovation activity in terms of average five-year average difference at the beginning of the decade. Other neighborhood characteristics, including the average difference in the share of white residents, homeownership rates, and total housing units, did not significantly influence housing renovation activity. Finally, housing renovation activity at the neighborhood level is spatially dependent. Thus, if one neighborhood is experiencing a lot of housing renovations, nearby neighborhoods are more likely to follow suit, showing that housing renovation activity in one neighborhood can influence housing renovation in nearby neighborhoods (i.e., spillover effects). Overall, the results highlight the importance of

neighborhood characteristics in shaping renovation. The findings emphasize the need for policymakers to pay attention to neighborhood change dynamics that may impact housing investment and contribute to gentrification and displacement pressures.

Chapter four analyzed the effects of housing code violations resolved with repairs on changes in home sales prices and rental rates over ten years in Charlotte, North Carolina. The model used in this research controlled for various neighborhood variables such as income, building age, new residential construction, and residential demolitions. Using a Spatial Lag Model (SLM) to account for spatial dependence in change in home sales prices and gross rent, the model showed that, on average, housing code violations resolved with repairs positively affected changes in home sales prices as neighborhoods that experience more housing code violations see higher changes in sales prices. However, this effect was not observed in changing rental prices, which remained rather uniform or random across neighborhoods in Charlotte partly due to Charlotte's hot housing market with a lot of new construction of multifamily housing units taking place across the city. The findings suggest that while housing code enforcement may help arrest urban decline and keep housing safe, it has potential implications for housing affordability and equity, especially regarding gentrification pressures, economic mobility for low-income households, and how code enforcement is operationalized across different neighborhoods. This research also emphasizes the importance of data-driven policy decision-making to understand housing market dynamics and address the negative outcomes of housing code enforcement.

In conclusion, the three chapters of this dissertation underscore the critical role of policymakers in addressing inequality in housing while minimizing the disparate impact of policies such as housing code enforcement and the action of private actors in the housing market on

individuals and neighborhoods. From highlighting exclusionary criteria in the rental housing market to analyzing the effects of housing code violation and housing renovation activity on neighborhood dynamics, this dissertation emphasizes the need for data-driven targeted interventions to ensure equitable growth and access in housing markets.

## 5.2 Policy Implications

The findings of this research have several implications for policymakers, particularly for local government officials. Beginning with exclusionary screening criteria in the rental housing market, policies could be implemented to regulate and address the legal yet discriminatory and disparate impact of screening practices in the housing market. Furthermore, efforts to expand affordable housing options for low-income individuals and those with housing vouchers should be strengthened. It is important for policymakers to undertake initiatives that prohibit Source of Income discrimination in the Charlotte housing market. Currently, landlords in Charlotte who receive city of Charlotte development subsidies are prohibited from discriminating based on Source of Income. Extending this policy to the entire Charlotte housing market would increase housing options for individuals who hold housing vouchers. An example of such an initiative can be seen in the District of Columbia and several counties in Maryland including Montgomery and Howard County where Source of Income discrimination have been made illegal (Equal Rights Center, 2009:2013). Similarly, in Minneapolis, the city's Inclusive Renter Protection Ordinance prohibits Source of Income discrimination while advocating for inclusive tenant screening. The ordinance sets specific guidelines for tenant screening when assessing tenant's criminal, credit, and rental history (Minneapolis City of Lakes, 2019). For example, landlords cannot screen for evictions that were entered more than three years before the rental application date. They also

cannot use eviction proceedings that were dismissed or those that resulted in judgment in favor of the tenant. Similarly, landlords cannot solely screen credit scores or insufficient credit history; they can only consider credit history if it is relevant to the potential tenant's ability to pay rent. When it comes to criminal background checks, landlords can only consider misdemeanors if the sentencing was within the last three years and felonies within last seven years. For certain felonies, landlord cannot consider them if the sentencing was older than 10 years. The U.S. Department of Housing and Urban Development issued guidance in 2016 on how housing providers can comply with fair housing rules while considering criminal history in tenant screening to reduce the disparate impact of criminal background checks (U.S. Department of Housing and Urban Development, 2016). Such guidance should be extended to other screening criteria to minimize the disparate impact tenant screening may have on individuals with discredited backgrounds. Lastly, with the emergence of corporate landlords in rental housing, actions of these landlords that may create adverse outcomes for low-income residents, such as increased evictions, should be monitored and addressed.

Regarding changes in a neighborhood's characteristics and their effect on housing renovation activity, policymakers should carefully design interventions that help mitigate the effects of the activity on existing residents who may deal with gentrification pressures associated with it. Data collection methods should be improved to track and distinguish potential gentrification-based renovation initiated by landlords from owner-occupied-based renovation. Afterward, policymakers should ensure that housing activity related to gentrification-induced renovation benefits existing residents by improving housing quality while minimizing the potential outcome of displacement to help achieve inclusive development. Furthermore, since the effects of housing renovation activity could be spatially multiplied (i.e., through spillover effects), early

warning systems designed to track neighborhood change that can potentially lead to displacement should incorporate instances of housing renovation activity to help predict neighborhoods that are at the frontiers of change. For example, the city of Charlotte's model that seeks to track vulnerability to displacement can incorporate housing renovation activity together with other socio-economic and demographic variables to analyze vulnerability to displacement.

When it comes to housing code violation and their effects on changes in home sale prices, policymakers must balance the benefits of housing code enforcement in maintaining housing safety and arresting urban decay with the potential negative consequences on housing affordability and inequity. In addition to the city's online portal that reports all data on housing code violation activity in the city of Charlotte, it is important for the city government to assess and analyze patterns of housing code enforcement to determine if targeted or concentrated code enforcement creates a disparate impact on low-income neighborhoods. Especially considering the fact that low-income and minority homeowners are more likely to be cost-burdened, spend less on housing repairs, live in substandard and lower-value homes, and thus are more likely to be cited for housing code violations. Additionally, changes in home sales prices due to housing code violations related to repairs can contribute to increasing property values, resulting in more property tax burden on existing homeowners. In a hot housing market like Charlotte's, where corporate investors are actively offering cash incentives to buy more single-family properties from homeowners (Wilson 2022; Dukes, 2023), housing code violations increasing changes in home sales prices can be an additional barrier to new buyers entering the housing market. It can also impact economic mobility for low-income or minority residents wanting to enter the housing market and own a home. Hence, programs that incentivize homeowners to fix violations without adding additional cost to housing should be enhanced. Paying to address housing code violations without any form of assistance

from the local government may mean an increased financial burden on existing homeowners, especially low-income and minority homeowners. For instance, in Syracuse, New York, efforts to arrest old and deteriorating housing stock through housing code enforcement included tax incentives for owner-occupied residents to undertake repairs (Ramsey & Zolna, 1990). Such efforts ensure that housing code violations resolved with repairs do not translate into increasing housing costs as the enforcing agencies somewhat internalize the cost.

## 5.3 Limitations and Future Research

The findings of this research are not without limitations, and the results should be interpreted with these limitations in mind. When analyzing spatial variations in exclusionary criteria in rental listings, the study exclusively focuses on listings from Zillow and Craigslist. The platform bias associated with sampling rental listings may contribute to missing a significant portion of the rental housing market. Thus, by focusing primarily on two platforms, the analysis may have yet to fully capture the entire rental housing market landscape to gain a comprehensive understanding of the spatial variations that exist with the exclusionary criteria. Furthermore, while natural language processing provides valuable information about practices in the rental housing market, it still lacks context regarding information that may have been obtained through in-depth interviews or surveys with rent seekers and may not capture the subtleties associated with discriminatory practices in the rental housing market. Additionally, data collected from online rental platforms are as good as the user input, and for this reason, errors associated with rental listings, including, for example, addresses for geocoding, may have persisted in the web scraped for further analysis. Furthermore, the data used for this research covered eight (8) months, which may limit more nuanced analysis associated with exclusionary criteria in the rental housing market.

Future research can improve this research by incorporating longitudinal data from different platforms that would provide a more comprehensive picture of the rental housing market instead of solely relying on Craigslist and Zillow. Lastly, future research can also leverage novel data sources, such as longitudinal new movers' data from DataAxel together with rental data, to model the relationship between screening practices and changing neighborhood characteristics to assess whether neighborhood sorting patterns along income and racial/ethnic characteristics have been influenced by landlord's screening practices.

When modeling the effects of change in neighborhood characteristics on housing renovation activity, the analysis focuses on the total count of renovation activity in each neighborhood; however, without data limitation, an additional layer of understanding would have been achieved if how much is invested in terms of dollar amount was analyzed. Furthermore, the data used in the analysis did not distinguish between renovation activity undertaken by owner-occupied residents and landlords; such a distinction would have allowed a proper understanding of the motivations behind renovation activity. That is, if the renovation was in response to, for example, gentrification pressures, where landlords are upgrading their property to attract the creative class and garner more profit, or if owner-occupied residents were undertaking a renovation to satisfy their personal preference or stay up to date with what their neighborhoods are doing. Future studies can improve this research by incorporating the dollar amount associated with housing renovation activity. Furthermore, a nuanced analysis can be gleaned from modeling that varies ownership type together with a mixed-method approach that incorporates qualitative approaches such as interviews or surveys to ascertain the motivation behind housing renovation activity. Lastly, considering that housing renovation activity was positively associated with higher income neighborhoods, which suggests that wealthier neighborhoods tend to have more renovation

activity, future research can assess if housing renovation activity reflects neighborhood change patterns such as super gentrification (Lees, 2003). Such an analysis would provide valuable insights into whether housing renovation activity contributes to the widening gap between affluent and low-income neighborhoods. Analysis of the effects of housing code violations resolved with repairs on the change in home sales prices and gross rents focused on neighborhood averages instead of individual housing units. However, using neighborhood averages may mask variations between housing units being analyzed and it could also overlook significant relationship between housing cost and housing code violations resolved with repairs. Furthermore, with neighborhood averages, granularity is lost regarding the relationship between the dependent and independent variables. Analyzing the effects of housing code violations at a more granular level could provide a nuanced understanding of the relationship between the dependent and independent variables. For example, the analysis found housing code violation resolved with repairs had no significant effects on rents. Using microlevel data on individual housing units to model the relationship could result in a different outcome. In addition, the analysis relied on longitudinal American Community Survey (ACS) data, which may have limitations due to potential time lags in the estimates. In a fast-growing housing market where housing costs are rapidly increasing, like Charlotte, ACS estimates may be geographically biased with unreliable local estimates and high uncertainty (Bazuin & Fraser, 2013; Boeing & Waddell, 2017; Folch et al., 2016). Lastly, in terms of generalizability, the analysis findings may not be generalizable to other cities due to the unique characteristics of Charlotte for its hot housing market, specific patterns of income and racial segregation, and its status as a newer in the southeastern US. Instead of focusing on only neighborhood averages, future research could conduct property-specific analysis while leveraging alternative data sources that are up to date, such as rental data from Zillow, to estimate the

relationship between housing code violations resolved with repairs and changes in home sales prices and gross rents. Furthermore, considering the unique characteristics of Charlotte, future research should investigate comparative analyses with other cities to assess the generalizability of the findings beyond Charlotte.

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