SITING OF SUBSIDIZED HOUSING IN NEIGHBORHOODS: ASSESSING

ECONOMIC, NEIGHBORHOOD, AND SOCIAL EQUITY IMPACTS

A Dissertation

by

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ABSTRACT

Although the Low-Income Housing Tax Credit (LIHTC) program has grown into the largest subsidized housing program in the U.S., we have limited understanding about the performance of the program. This study explores the associations between LIHTC subsidized households and uneven geography of opportunities in the cities of Charlotte, North Carolina, and Cleveland, Ohio, to identify socioeconomic inequalities for subsidized households using a variety of methods. First, the dissertation employs the simple bivariate analysis, in terms of a location quotient (LQ), to examine the empirical evidence on inequitable opportunities. Based on the results of location quotients, this study suggests that current patterns of LIHTC developments may perpetuate inequitable opportunities for subsidized households through pushing them into the vicious circle of residential segregation and inequality.

This paper also explores impacts of the LIHTC program on nearby property values and neighborhood stability to contextualize the economic and neighborhood impacts of the program. To be more specific, this dissertation examined housing prices and housing turnover before and after the introduction of LIHTC developments into the neighborhood, based on housing sales data from 1996 to 2007. This data is merged with parcel-level data from Mecklenburg and Cuyahoga County. The study estimates an AITS-DID (Adjusted Interrupted Time Series-Difference in Differences) and an extended Cox hazard model with the difference-in-differences specification to clarify the direction of causality in the impacts of LIHTC developments. This research also

explores impacts on neighboring housing prices and neighborhood stability from LIHTC developments citywide and in neighborhoods stratified by income.

When it comes to estimating the relationships between the developments of LIHTC subsidized housing and surrounding housing prices, this study found that impacts of LIHTC developments varied across different housing market conditions (i.e., a "hot" and a "cold" market). The LIHTC developments had a negative impact on nearby property values in Charlotte while they had a positive impact in Cleveland. These results suggest that the LIHTC program may be implemented to revitalize or stimulate deteriorated areas, especially in depressed housing market conditions. In terms of examining the associations between the LIHTC developments and neighborhood stability, this study found significant negative impacts on stability of LIHTC developments in both cities, and the probability of housing turnover was significantly higher when LIHTC units were developed within the immediate neighborhood of each property. However, for the high-income submarket, there were strong spillover effects in Charlotte while there were no significant impacts in Cleveland. These results suggest that the vulnerability of neighborhood stability due to LIHTC development needs to be considered when implementing a successful subsidized housing program.

DEDICATION

       This dissertation is dedicated to my parents, Kwang-Joon Woo and In-Ja Yu, and my sister, Hae-Rin Woo, who have supported me with love and care through one of the arduous states of my life.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

Community opposition to subsidized housing developments has hindered the implementation of subsidized housing programs for nearly a century. These conflicts have been rooted in a negative perception of households receiving subsidies, which is often tied to attitudes toward tenant characteristics such as ethnicity and poverty status (Freeman & Botein, 2002). These negative attitudes toward subsidized residents have had the effect of excluding low-income families from "decent" neighborhoods. The core issue of "not in my backyard" (NIMBY) attitudes is based on fears of neighborhood deterioration, especially in terms of higher crime rates and the depreciation of nearby property values, due to the influx of "undesirable" households. Therefore, NIMBY attitudes have posed a significant barrier for the placement of subsidized housing, which has been a longstanding concern for policy makers (Freeman & Botein, 2002; Galster, Tatian, & Smith, 1999; Santiago, Galster, & Tatian, 2001).

Many studies suggested a significant lack of affordable housing across the country. According to Harvard University's Joint Center for Housing Studies, around one-third of total households spend nearly 30 percent of their income for housing and around half of the lowest-income households expend at least 50 percent of income for housing (University, 2004). Further, this situation, especially in terms of the burden for housing costs, has become worse nationwide for both homeowners and renters (Lee, 2008). As for homeowners, between 1990 and 2000, the percent of homeowners paying

at least 50 percent or more of their income for housing increased by 50 percent across the country, and this growth rate is over two times faster than that of overall homeowners (Simmons, 2005). Also, the distribution of low-income rental units shifted noticeably to higher priced units during the 1980s and 1990s, and the incomes of low-income renters have declined as rents have continued to rise since 2000 (Hockett, McElwee, Pelletiere, & Schwartz, 2005).

Why do neighborhoods vehemently oppose subsidized housing developments in spite of a most urgent situation, which is to resolve the significant lack of affordable housing? There are plenty of studies that have tried to explore the effect of subsidized housing policy by asking "Why Not In My Backyard?" NIMBY attitudes explicitly stem from specific concerns that subsidized housing developments will threaten the personal security of residents, cause deterioration in the quality of neighborhoods, and depreciate property values (Dear, 1992). Concerns about increasing crime in neighborhoods come from the characteristics of subsidized households, which are minorities and low-income families. The crime rates might be associated with poverty, income, and race. According to the theory of differential opportunity, uneven distributions of legitimate and illegitimate opportunities among classes cause unequal exposure to delinquency and criminality (Blau & Blau, 1982). The degree of delinquency and criminality varies according to the different social structures of communities (Blau & Blau, 1982). Specifically, three structural factors, low economic status, ethnic heterogeneity, and residential mobility, as described by Shaw and McKay (1969), result in the deterioration of communities, which lead to delinquency and criminality (Sampson & Wilson, 1995).

2

In this context, NIMBY attitudes toward subsidized households might be evident. Neighbors are also concerned about the decline of neighborhood quality due to the placement of subsidized housing developments (Dear, 1992; Kean & Ashley, 1991). The fears of the deterioration of the physical appearance of neighborhoods due to graffiti and garbage lead to an NIMBY sentiment (Dear, 1992; Kean & Ashley, 1991). Further, neighbors are reluctant to be subject to increased traffic, less parking availability, and damaged public spaces (Dear, 1992; Kean & Ashley, 1991). However, most of all, the core issues of NIMBY attitudes are fears of depreciation of property values due to the influx of undesirables into neighborhoods (Dear, 1992; Kean & Ashley, 1991; Nguyen, 2005; Pendall, 1999). Because housing prices are determined by the socioeconomic and environmental characteristics of neighborhoods, the concerns about personal security and neighborhood amenities have a tendency to arouse fears about depreciation of property values. In other words, NIMBY attitudes stem from a fear of a decline in housing prices that reflects other concerns such as personal security and neighborhood amenities, and ultimately represent the explicit reason of opposition to subsidized housing programs. Thus, the fears of neighbors have been a significant barrier to the implementation of subsidized housing in order to protect property values in desirable neighborhoods.

The NIMBY attitude has fueled debate and research on the external effects of subsidized housing developments on neighborhoods for several decades. Many previous studies have examined the impacts of subsidized housing programs on neighborhood property values to assess the effects of NIMBY attitudes. However, these findings have

3

been inconsistent. Some have found a negative impact of subsidized housing programs on nearby property values, while others have found a positive impact, or even no impact. In addition, there are few studies that focus on the relationship between subsidized housing programs and neighborhood stability, especially in terms of neighborhood housing turnover, as a proxy for attitudes toward subsidized households. The discrepancies of tenant characteristics among subsidized and non-subsidized housing may have a destabilizing effect on neighborhoods, causing existing residents to feel uncomfortable and desire to move. Thus, exploring the association between subsidized housing and neighborhood housing turnover would provide a better understanding of the impacts of subsidized housing developments on neighborhoods. Further, there are no studies to date examining housing turnover at the individual parcel level while taking into account the spatial characteristics of properties before and after the implementation of subsidized housing developments. This study addresses these gaps by examining how the spatial distribution of subsidized housing developments influences nearby property values and housing turnover. This research addresses a simple question: Does the Low Income Housing Tax Credit (LIHTC) subsidized housing development significantly impact 1) surrounding housing prices and 2) neighborhood stability in terms of housing duration?

The explicit reasons for opposition to subsidized housing programs, involving concerns about depreciation of property values, have been described above. However, the implicit cause of NIMBY attitudes must not be overlooked. Sharp conflicts between subsidized households and their neighbors have been rooted in a negative perception of

subsidized households, which fundamentally stems from the attitudes toward tenant characteristics such as ethnicity, poverty, and income level (Freeman & Botein, 2002). In other words, because subsidized housing is generally occupied by subsidized tenants who have different characteristics from non-subsidized communities in terms of sociodemographic characteristics, non-subsidized tenants have a tendency to resist the inflow of subsidized tenants. According to the study by Freeman and Botein (2002), people have a negative perception of the nondeserving poor, which refers to able-bodied nonelderly tenants in subsidized housing. The nondeserving poor is deemed as the symbol of idleness and the main culprit of high crime (Katz, 1993). This perception causes people to regard subsidized households as undesirable neighbors. Racial prejudice of nonwhites such as African-Americans and Latinos is another reason for resisting subsidized households because nonwhites are generally overrepresented in subsidized housing (Casey, 1992). The differences in education level would also be a factor that causes opposition. Well-educated people who live in desirable neighborhoods have a tendency to have reached a higher socioeconomic status (Freeman & Botein, 2002). The higher educational level of parents who have a higher socioeconomic status also tends to affect the educational attainments and the future socioeconomic status of their children (Galster & Killen, 1995). Thus, living in these sorts of desirable neighborhoods implies that members of the communities could maintain and bequeath their socioeconomic status. Therefore, the inflow of low-income neighbors may be an interruption in the enhancing of their socioeconomic status for the residents of desirable neighborhoods (Freeman & Botein, 2002).

One of the critical problems of the NIMBY attitudes is that this syndrome is easily translated into political action (Kean & Ashley, 1991). In other words, the NIMBY opposition translates local and national planning policies into barriers to housing programs for low-income families. For instance, massive public protests against the Moving to Opportunity program in Baltimore, Maryland showed that the first wave of participation in the national demonstration program was discontinued (Galster, 2003). The most destructive consequence of NIMBY opposition is to cause spatial disparities of subsidized housing developments. According to the political economy of race perspective, the urban spatial patterns and forms are shaped by both racism and the choices determined by local elites (Rohe & Freeman, 2001). In this context, the location of subsidized housing developments might be determined by NIMBY attitudes related to racism and the preference of local elites. Because subsidized households are regarded as undesirable neighbors due to their ethnicity and poverty, the NIMBY opposition of local elites may push subsidized housing into the undesirable and the least resistant neighborhoods (Rohe & Freeman, 2001).

In conjunction with exploring the impacts of subsidized housing developments, as a proxy for attitudes toward subsidized households, this study also addresses why the NIMBY attitude matters. The spatial disparities of subsidized housing due to NIMBY opposition ultimately cause barriers to the entry of subsidized households in desirable neighborhoods. This implies that subsidized households are isolated from the mainstream of social and economic opportunities for upward mobility. The objective of the national housing policy is to provide affordable housing, decent homes, and a

suitable environment for low-income families. The significance of this for low-income families cannot be overemphasized. The report of the Bipartisan Millennial Housing Commission (2002) underscores this significance: "Securing access to decent, affordable housing is fundamental to the American Dream. All Americans want to live in good-quality homes they can afford without sacrificing other basic needs. All Americans want to live in safe communities with ready access to job opportunities, good schools, and amenities. All parents want their children to grow up with positive role models and peer influences nearby. And the overwhelming majority of Americans want to purchase a home as a way to build wealth. The importance of helping more Americans satisfy these objectives cannot be overstated" (Bipartisan Millennial Housing Commission, 2002). However, because subsidized households are separated from opportunities for social needs to be met and access to resources due to the NIMBY attitudes, doubt can be cast on the effectiveness of housing policies for low-income families. Hence, by looking at the residential segregation and multidimensional social inequality based on previous literature, this study explores the associations between NIMBY opposition to subsidized housing programs and social inequalities.

1.1 Conceptual Framework and Hypotheses

The underlying research questions for this study consist of three parts. Does the LIHTC subsidized housing development significantly impact 1) surrounding housing prices and 2) neighborhood stability in terms of housing duration? In addition, 3) do NIMBY attitudes about subsidized households cause social inequalities for those

7

households? While exploring the relationships between NIMBY opposition to subsidized housing developments and social inequalities highly relies on theoretical contexts, investigating the impacts of subsidized housing developments is comprised of empirical analysis in this study (See Figure 1).
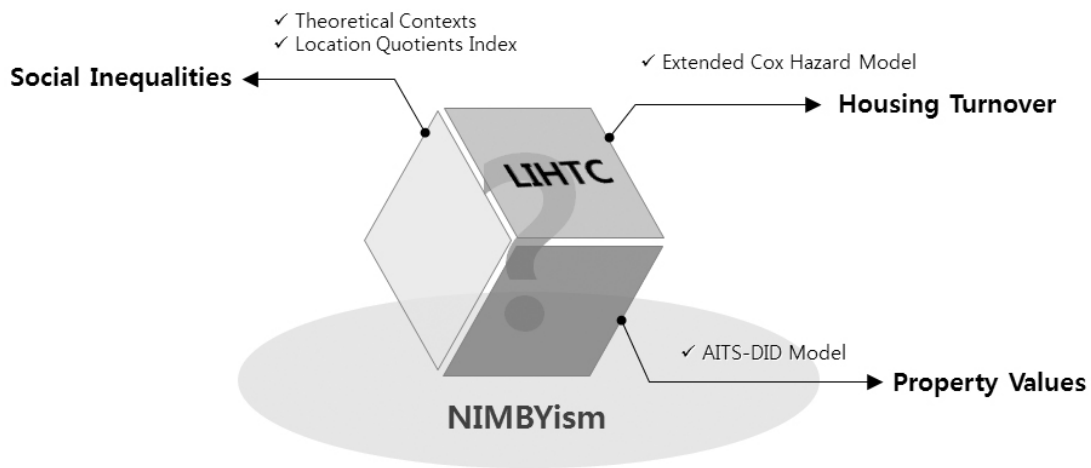
Figure 1. Research Questions

Estimating the impacts of subsidized housing is a complex process because there are several overarching factors in a subsidized housing development that could affect surrounding property values and housing turnover. The majority of prior studies failed to consider the important fact that the impacts of subsidized housing may vary according to the type of housing programs, the sociodemographic characteristics of neighborhoods, and the size of the subsidized housing developments. Also, the methodologies of previous studies do not take into account the direction of causality on the impacts of

8

subsidized housing developments. Thus, this research suggests a conceptual model that offers a comprehensive view in order to overcome the limitations of prior studies (See Figure 2).
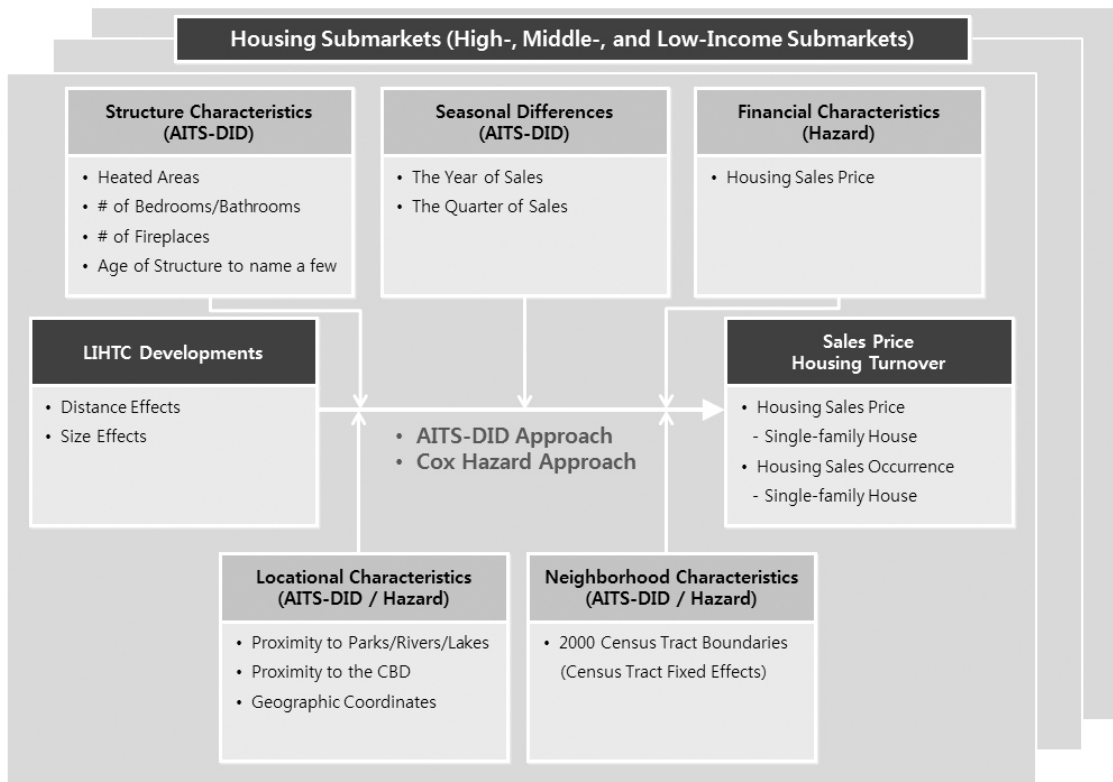
* For each research area, models are estimated separately for three types of housing submarkets stratified by family income

Figure 2. Conceptual Model for Empirical Analyses

The main features of this conceptual model—which also lead to testable research hypotheses—can be described as follows:

- Sales prices (or housing turnover ratios) for a single-family house will depreciate (or increase) when the subsidized housing is newly developed

within the neighborhood of a single-family house;

- Sales prices (or housing turnover ratios) for a single-family house will depreciate (or increase) when the size of subsidized housing is larger;

- Subsidized housing developments will exert a negative impact in high- and middle-income neighborhoods, while subsidized housing will exert a positive impact in low-income neighborhoods;

- Subsidized housing developments will exert a negative impact in a hot housing market, while subsidized housing will exert a positive impact in a cold housing market.

Specifically, this research examines the impacts of subsidized housing developments on nearby property values and housing turnovers in two cities during a period prior to the housing market crisis: Charlotte, North Carolina, and Cleveland, Ohio. Charlotte, a growing Sunbelt city, is representative of a "hot" housing market while Cleveland, a declining Rust Belt city, can be characterized as a "cold" market. By comparing neighboring property values and housing turnover in these two cities, this paper can assess whether the impact of subsidized housing developments varies between "hot" and "cold" markets. This research also compares the impacts of subsidized housing across different housing submarkets based on family income to determine whether impacts vary across low, middle, and high income neighborhoods. By identifying the associations among subsidized housing developments, property values,

and housing duration in neighborhoods varying by socioeconomic strata, this study will

provide insights into the impact of subsidized housing on neighborhoods.

This research employs the AITS-DID (Adjusted Interrupted Time Series-

Difference in Differences) model to examine the impact of subsidized housing programs

on nearby property values. The fundamental concept of the AITS-DID model continues

to be parallel to those of the hedonic price model (Koschinsky, 2009). However, to

identify the direction of causality on the impacts of subsidized housing developments,

the AITS-DID model estimates the levels and trends in coefficients in two kinds of

neighborhoods during two periods (Galster, 2004).

In addition, this study uses the extended Cox hazard model, which is a partial

likelihood estimation method, to explore the impact of subsidized housing programs on

neighborhood housing turnover. Housing sales are regarded as the hazard occurrence,

and the housing duration is specified with the duration of each property's transaction

measured in days between the first sale and the next sale during the research period (Kim

& Horner, 2003). The hazard model controls for both of these factors simultaneously.

This research will also clarify the direction of causality to capture the differentials in

levels of pre- and post-neighborhood stability associated with subsidized housing

developments by comparing control and impact sales (Galster, Tatian, & Smith, 1999;

Koschinsky, 2009; Schwartz, Ellen, Voicu, & Schill, 2006).

Finally, for each city, both the AITS-DID and extended Cox hazard models are

estimated separately for three types of neighborhoods stratified by family income to test

whether impacts of subsidized housing vary based on income heterogeneity. In the

11

sections that follow, the features of this conceptual model are specifically described along with the literature (Chapter III) that supports the conceptualization.

1.2 Dissertation Outline

This paper is organized as follows: Chapter I provides background information on the research topics and elaborates on the research questions and hypotheses under examination for the dissertation.

Chapter II focuses on the role of NIMBY attitudes for subsidized households. To be more specific, this chapter examines the multidimensional relationships between social forces and social inequality. In addition, compared to previous studies, this chapter investigates the links among social forces such as urban sprawl, residential segregation, poverty concentration, and multidimensional social inequality, especially by looking at the big picture of these inner mechanisms.

Chapter III examines the literature on the impacts of subsidized housing developments on neighborhoods. This literature review traces the development of spillover effects models, looks at the gap in previous methodologies, and assesses methodological reasons that support the value of employed models in this study. In addition, by looking at the theoretical perspective of the impacts of subsidized housing programs, this chapter determines several overarching factors in a subsidized housing development that could affect neighborhoods.

Chapter IV describes study areas and data sources. This chapter characterizes two contrasting research areas (Charlotte and Cleveland) and describes the sales,

property, LIHTC developments, location, and neighborhood data that are estimated with the models used in the study.

Chapter V outlines the research methodologies employed in this study. First, a simple bivariate analysis (location quotient) is described to examine the associations between the spatial location of subsidized housing and social inequalities. Second, the AITS-DID model exploring the relationships between subsidized housing developments and nearby property values is discussed in this chapter. Last, the extended Cox hazard model with the difference-in-differences specification is described to examine the relationship between subsidized housing developments and neighborhood stability.

Chapter VI interprets the results of three analyses. First, this chapter interprets the results of bivariate analysis exploring the associations between subsidized households and uneven geography of opportunities by identifying the sociodemographic characteristics of neighborhoods. Second, the results of the AITS-DID analyses are interpreted to estimate the impact of subsidized housing developments on neighboring housing prices in the two cities. Last, the results of the extended Cox hazard analyses are also reported to identify the impact of subsidized housing projects on neighborhood stability.

The final chapter discusses the important findings of the study and provides broad implications of the conclusions for subsidized housing developments.

CHAPTER II

LITERATURE REVIEW: A VICIOUS CIRCLE OF RESIDENTIAL SEGREGATION

AND INEQUALITY

Why does NIMBY opposition matter for subsidized households? Housing

developments may perpetuate social inequalities caused by uneven development, or may

reverse this situation by expanding and distributing housing options for low-income

families that make it possible to access better social and economic opportunities (Van

Zandt & Mhatre, 2009). However, current uneven development patterns of subsidized

housing due to NIMBY opposition may accelerate inequitable opportunities for the least

advantaged populations by pushing them into socially segregated and poverty

concentrated neighborhoods.

Social segregation in the U.S. has ignited a pattern of uneven urban development

for over half a century. This suburbanization pattern has brought some neighborhoods to

life and has contributed to the deterioration of others (Van Zandt & Mhatre, 2009). The

urban sprawl has induced the rich to move into suburbs, called "leaving the cities

behind," while the poor remain isolated in blighted central cities (Friedrichs, Galster, &

Musterd, 2003; Jargowsky, 2002; Van Zandt & Mhatre, 2009; Wilson, 2012). This

polarization is further accelerated by the forces involved in the "pull" of desirable

suburban characteristics and the "push" of undesirable inner urban area characteristics

(Jargowsky, 2002; Orfield, 1997). Specifically, the interrelated social forces among

sprawl, poverty concentration, and residential segregation have created pockets of both

problems and privilege in terms of inequitable opportunities in education, employment, and safety in metropolitan areas (Denton, 2006; Squires & Kubrin, 2005; Van Zandt & Mhatre, 2009). Van Zandt and Mhatre (2009) argued that this uneven geography of opportunities can be counteracted by expanding housing options and locational outcomes for the least advantaged. This argument is based on one significant premise that the geography of opportunities is largely influenced by the communities and neighborhoods in which people live (Briggs, 2005; Denton, 2006; Squires & Kubrin, 2005). The place matter is a significant key in order to explain the ecology of the uneven geography of opportunities because that where people live is significant for taking advantage of various opportunities (Abrams, 1955; Briggs, 2005; Van Zandt & Mhatre, 2009). For these reasons, the present situation on siting of subsidized households in undesirable neighborhoods due to NIMBY attitudes might play a key role in limiting them access to better social and economic opportunities.

When the place is combined with racial and class issues, the situation aggravates the inequitable opportunities, especially for the least advantaged. In other words, a residential segregation pattern that includes racial and income segregation results in the poor being isolated and deprived of opportunities to have their social needs met and access to resources. Residential segregation by race and income have been widely studied and the research has arrived at somewhat common results. Residential segregation of minorities, especially in the perspective of racial and income segregation, is the main culprit in creating a barrier in social opportunities and accelerating social isolation. Most of all, racial segregation, especially for African Americans, is the most

integral part of residential segregation, and has exacerbated the concentration of poverty (Briggs, 2005; Denton, 2006; Massey & Denton, 1988; Massey & Denton, 1989; Massey & Eggers, 1990). In this context, racial discrimination in the housing market has also determined the levels and trends of residential segregation, and ultimately racial discrimination has deprived minorities of housing opportunities (Galster, 1987). Income segregation is another significant factor in residential segregation. Residential segregation by income has expanded class divisions, and limits access to social resources (Briggs, 2005; Squires & Kubrin, 2005).

Taken together, several prior studies found that residential segregation by race and income causes spatial distribution of the disadvantaged, which means inequitable access to opportunities in terms of social needs and resources (Briggs, 2005; Squires & Kubrin, 2005). However, many previous studies separately focused on the link between residential segregation and inequitable opportunities in terms of employment, education, or safety. These studies tended to focus on particular perspectives of the relationship between segregation and opportunity. There are no studies that shed light on the links among social forces such as urban sprawl, residential segregation, poverty concentration, and multidimensional social inequality, especially by looking at the big picture of these inner mechanisms. Thus, in this chapter, this study takes into account the issue of urban inequality for subsidized households while investigating the multidimensional relationships of sprawl, residential segregation, concentrated poverty and various aspects of social and economic opportunities. This review explores how subsidized households may suffer from limited access to social opportunities.

2.1 Social Equity and Opportunities

Urban planners face an ethical conundrum when it comes to the expansion of affordable housing choices. Affluent citizens often oppose the spread of affordable housing within their communities – expressed through NIMBY behavior, while lower-income residents (who may or may not reside within the jurisdiction) clamor for better housing options and locational outcomes. The decision making of urban planners and policy makers to provide affordable housing options is related to this ethical concern. A political decision according to the socioeconomic context of planning determines whether or not some neighborhoods have benefits (Beatley, 1984). In this context, the distribution of benefits (how and to whom) is a key to answer the ethical questions of planners. Thus, before beginning the study on the multidimensional mechanisms of social segregation and fair opportunities, it is significant first to define social equity.

The literal meaning of equity is fairness, and the term of fairness is associated with the distributive perspective in society (Burton, 2000). Even though there are several interpretations of social equity or social justice, Rawls' theory of justice pinpoints the definition of social equity, especially in terms of distribution of benefits. Rawls (1971) offered the following interpretation on distributive justice: "All social primary goods – liberty and opportunity, income and wealth, and the bases of self-respect – are to be distributed equally unless an unequal distribution of any or all of these goods is to the advantage of the least favored (Rawls, 1999, p. 303)."

According to Rawls' difference principle, inequalities can only be permitted when distribution of primary goods is to the greatest benefit of the least advantaged. The

greatest for the least advantaged also has to be subject to conditions of two other principles, which are equal liberty and fair equality of opportunity. In this context, social equity is the process of reducing the gap of primary goods between the advantaged and the disadvantaged, especially when permitting positive discrimination in favor of disadvantaged groups (Burton, 2003). Hence, the role of planners and policy makers to achieve the objective of the national housing policy may be defined as trying to reduce the gap between the advantaged and the disadvantaged.

We need to clarify the terms disadvantaged groups and primary goods in order to provide an interpretation of social equity. First, according to Rawls' interpretation, social primary goods include liberty and opportunity, income and wealth, and the basis of self-respect. This implies that discrepancies in opportunity, income, and wealth could be reasonable proxies to grasp the spatial distribution of the disadvantaged (Beatley, 1984). Among those social primary goods, opportunity is the most significant factor to account for social equity because barriers to social and economic opportunities impede upward mobility of the least advantaged groups, especially in income and wealth (Massey, 2004). Uneven opportunities for the least advantaged groups reinforce disparity in wealth accumulation. For instance, lack of access to opportunities for a quality education, high-paying jobs, and safety from crime limits the opportunities for wealth accumulation. In reverse, the disparity in wealth may cause exposure to poor education quality, inadequate access to jobs, and high crime rates, especially in terms of the spatial location of the least advantaged groups. Restriction of social and economic opportunities perpetuates social stratification while impeding upward mobility (Massey, 2004). Hence,

looking at opportunities for upward mobility would be the most significant aspect for explaining social equity. Second, the distinction between the advantaged and the disadvantaged would be based on the possession of primary goods (Burton, 2003). From the perspective of the possession of primary goods, especially in terms of social and economic opportunities, this research defines the least advantaged groups as low-income families and/or minorities. In addition, it is axiomatic that subsidized households are also included to the least advantaged populations regarding their possession of primary goods.

2.2 Urban Sprawl and Segregation

A pattern of uneven urban development, that is urban sprawl, is not the only cause leading to social segregation, but it is a significant factor in explaining aspects of segregation. Denton (2006) suggested that the pattern of urban sprawl is one of the major causes of segregation along with other factors including housing discrimination, income differences, and residential preferences. This suburbanization pattern has brought some neighborhoods to life but has caused deterioration in others (Van Zandt & Mhatre, 2009). According to the definition of urban sprawl expounded by Squires (2002), urban sprawl reflects an "exclusionary pattern" in deteriorated cities (Jargowsky, 2002). The notoriety of this suburbanization pattern was accelerated by segregation by race and income. Regional development patterns, which are urban sprawl, restrict the poor and minorities, especially African Americans, from moving into desirable areas. In terms of metropolitan areas, most African Americans are isolated in the center cities (Denton, 2006). Although some African Americans were suburbanized in 2000, they were also

19

distributed in undesirable neighborhoods and are segregated from majorities such as

whites (Denton, 2006). This spatial pattern, segregation by race, remained high in both

the 1990s and 2000s, and is a pronounced pattern in the Rust Belt cities of the Northeast

and Midwest (Briggs, 2005; Massey, 2004). Even though some researchers suggested

racial segregation has declined over the past century, these results are limited to certain

small sunbelt areas with a small population of African Americans (Massey, 2004;

Squires & Kubrin, 2005). Income segregation has also increased since 1970 (Abramson,

Tobin, & VanderGoot, 1995; Fischer, 2003; Massey, Gross, & Eggers, 1991). Because

the income differences are continuing parallel to the role of race, the perpetuation of

income segregation along with racial segregation is not surprising. However, there is

considerable agreement among the priori studies that the role of race overwhelms those

of class in order to interpret social segregation (Briggs, 2005; Denton, 2006; Fainstein,

1993; Goldsmith, 2000; Massey & Eggers, 1990). Although the role of income class is a

significant factor for explaining spatial disparities, due to the fact that differences in

housing prices between center cities and suburbs, spatial patterns among races in the

same class show that African Americans are highly segregated compared to other races

(Denton, 2006). For example, the average African Americans earning more than $60,000

per a year are more segregated than the average whites earning less than $30,000 (Briggs,

2005; Logan, Oakley, & Stowell, 2003). Also, when we look at the long-term patterns of

poor neighborhoods where whites and African Americans live, the role of race is still a

more crucial factor than those of income. Specifically, between 1979 and 1990, 57

percent of (female-headed) African American families with an income below the poverty

line spent at least half of a ten-year span in poor neighborhoods compared to less than 30 percent of (female-headed) white families (Briggs, 2005). Furthermore, though some African Americans lived in non-poor neighborhoods at some time, they fell back into poor neighborhoods in repeated cycles over time; African Americans, regardless of the role of income, suffer from the long-term pattern of "recurrence" (Briggs, 2005). This implies that the role of race is the strongest factor accounting for social segregation.

Urban sprawl, specifically spatial disparities, exacerbates disparity in opportunities for the least advantaged groups by reinforcing racial and income segregation. However, the last key feature in urban sprawl to explain the uneven geography of opportunities is the poverty concentration. Squires and Kubrin (2005) suggest that urban sprawl, racial segregation, and concentrated poverty are interrelated social forces that account for uneven opportunities. Racial segregation, especially for African Americans, interacts with income segregation causing and intensifying spatial concentrations of poverty. These poverty concentrations are because the minority poor are clustered in racially homogenous and dense areas (Massey, 2001; Massey, 2004). Interestingly, Massey (2001) suggests a causal relationship between racial segregation and concentrated poverty. Specifically, the increase in racial segregation causes a decline in income level. Also, inequality is perpetuated and income segregation increases. This process results in the immigration of moderate households moving out to more affluent areas (Friedrichs, Galster, & Musterd, 2003), so poverty concentration is intensified. In this context, the interacting forces among urban sprawl, segregation by race and income, and poverty concentration reinforce the uneven geography of opportunities.

21

Current patterns of subsidized housing developments have contributed to this uneven geography of opportunities. Due to NIMBY opposition to subsidized households, large numbers of subsidized housing developments are located in central cities rather than in the suburbs. During the 1980s and 1990s, around 80 percent of subsidized housing units are sited in central cities (Freeman, 2004). Among those subsidized housing developments, a relatively large percent of LIHTC units are penetrating suburban areas compared to other subsidized housing units, but still around 60 percent of LIHTC units are located in central cities (Freeman, 2004). Freeman (2004) also found that severely disproportionate shares of African-American households exist in LIHTC neighborhoods compared to all metropolitan neighborhoods. Further, neighborhoods where LIHTC units were developed have higher poverty rates, lower median incomes, and lower median home values than metropolitan neighborhoods (Freeman, 2004; Rohe & Freeman, 2001). This shows that NIMBY attitudes on subsidized households, in conjunction with the interacting forces among urban sprawl, segregation by race and income, and poverty concentration, may perpetuate the uneven geography of opportunities.

2.3 Residential and Housing Segregation

The place matter is a significant key in order to explain the ecology of an uneven geography of opportunities because "location of housing is the centerpiece of opportunities" (Carr & Kutty, 2008). Although providing a decent home and suitable living environment for every American family is the ultimate objective for a national

housing policy, "decent home" may not guarantee a "suitable living environment" when fair opportunities are linked to the place matter (Denton, 2006; Massey & Denton, 1993). When we speculate about the association between neighborhoods and various opportunities, it is axiomatic that neighborhoods determine social and economic opportunities for upward mobility (Massey & Denton, 1993). Access to social and economic opportunities such as wealth accumulation, good quality schools, jobs, and safety from crime depends on the location of housing. The residential mobility, thus, continues to depend on the quality of a neighborhood in order to gain better opportunities (Massey, 2004). In this context, residential segregation builds barriers to various opportunities for upward mobility, especially for the least advantaged populations.

When the place matter in terms of housing location and neighborhoods is combined with the racial and class matters, the situation perpetuates the inequitable opportunities, especially for minorities. To be more specific, a residential segregation pattern that includes racial and income segregation forces the least advantaged groups to be isolated and deprived of opportunities to have social needs met and access to resources. Historically, it is the role of race and class that restricts equal opportunities with respect to wealth accumulation, employment, education, or safety. Most of all, the role of race, especially for African Americans, is a more influential factor than that of income to account for residential segregation patterns, albeit both race and income are mutual and bidirectional in general (Denton, 2006; Fainstein, 1993; Goldsmith, 2000; Massey & Eggers, 1990). Even though residential segregation cannot be explained by a

23

single process (Massey & Denton, 1988), we can extract main causes of residential

segregation from multidimensional social and economic processes. Prior studies share

common factors that account for residential segregation: urban sprawl, attitudes, and

discrimination (Denton, 2006; Galster, 1987). First, as mentioned earlier in the section

on Urban Sprawl and Segregation, urban sprawl causes the rich to move into suburbs

while leaving the poor isolated in impoverished central cities (Friedrichs, Galster, &

Musterd, 2003; Jargowsky, 2002; Van Zandt & Mhatre, 2009). A "push-pull" of regional

polarization shapes both pockets of problems and pockets of privilege, especially in

terms of inequitable opportunities in education, employment, safety, and exposure to

crime in metropolitan areas (Denton, 2006; Squires & Kubrin, 2005; Van Zandt &

Mhatre, 2009). Residential segregation accelerated by urban sprawl pushes poor and

minorities, especially African Americans, to be unwelcome in desirable areas. Although

some African Americans were suburbanized in 2000, they were still located in

undesirable neighborhoods and were segregated from the majority of whites (Denton,

2006). This means that it is inevitable that poor and minorities are isolated from the

mainstream of social and economic opportunities.

Second, anti-Black attitudes exacerbate residential segregation. In general, social

stigma rooted in a negative perception of minorities causes barriers to the entry of

African Americans into desirable neighborhoods. This phenomenon shares core

characteristics of a social disapproval of personal characteristics or beliefs which stem

from labels; African Americans may cause deterioration of neighborhoods in terms of

higher crime rates and the depreciation of nearby property values. In addition, social

stigma on subsidized households is also associated with these anti-Black (minorities)

attitudes. As a result, although white attitudes toward African Americans have become

more favorable over time (Denton, 2006), a deep-rooted stigma results in African

Americans being excluded from social and economic opportunities by forming

residential segregation. Further, NIMBY oppositions based on the stigma about

subsidized households, which is tied to attitudes toward subsidized households' ethnicity

and poverty, have also deprived subsidized households of fair opportunities. Last,

discrimination in the housing market might be a key cause of residential segregation.

Discrimination in the housing market fundamentally stems from the attitudes toward

characteristics of prospective residents, especially their race and ethnicity. In this context,

discrimination in housing is strongly associated with anti-Black attitudes. African

Americans have experienced difficulties in moving into desirable neighborhoods

because discriminatory barriers stem from preferences of class and race in the housing

market (Galster, 1987). Historically, the Federal Housing Administration (FHA) closed

their eyes to the discrimination in housing, especially for African Americans (Denton,

2006). Solely African-American areas were rampant for over half a century and the

construction of ghettos was completed by this peculiar atmosphere of society (Denton,

2006). Although discrimination in the housing market has declined since the 1948

Supreme Court decision, there is still subtle discrimination in the housing market

(Denton, 2006). There is also housing discrimination for subsidized households.

Landlords in desirable neighborhoods would regard Section 8 subsidized tenants as

undesirable neighbors. Thus, landlords refused to rent to any subsidized tenants or would

25

turn those tenants away for racially discriminatory reasons (Malaspina, 1996). As a result, discrimination in housing creates a clearly visible map of residential disparity, and this peculiar spatial pattern, that is residential segregation, limits the least advantaged access to desirable neighborhoods and various opportunities for upward mobility. Deprivations of housing opportunities result in obstacles for social and economic opportunities for upward mobility such as education, employment, safety, and exposure to crime.

Some researchers argued that residential segregation, especially by race, has decreased over the past century. However, their arguments are based on limited areas such as newer and smaller metropolitan cities where a small proportion of African Americans reside (Massey, 2004; Squires & Kubrin, 2005). In contrast, residential segregation has continued in the Rust Belt cities that include a disproportionate share of the African American population (Massey, 2004; Squires & Kubrin, 2005). Prior studies could not grasp accurate trends of residential segregation because of the limitations of employing the segregation indices. Different researchers used a different segregation index, so there are no consistent criteria in order to track trends of residential segregation in the U.S (Massey & Denton, 1988). However, Massey and Denton (1988) extracted five segregation indices through empirical analysis, and accounted for trends of residential segregation including multidimensional aspects, especially with respect to evenness, exposure, concentration, centralization, and clustering. They coined the term "hypersegregation," which is when each minority is segregated from other groups in terms of the five dimensions. Their results show that African Americans have been

hypersegregated from other neighborhoods which have been established in older industrial areas of the Northeast and Midwest. This implies that it is still inevitable for minorities, especially African Americans, to be isolated from access to social and economic opportunities under American Apartheid (Goldsmith, 2000; Massey, 2004; Massey & Denton, 1993).

Further, many studies suggest that the development pattern of subsidized housing has contributed to residential segregation (Galster, 1999; Massey & Kanaiaupuni, 1993; Rohe & Freeman, 2001). The discriminatory tenanting practices for subsidized housing programs have caused segregative site selection where subsidized housing developments were sited within undesirable neighborhoods (Bauman, 1987; Galster, 1999). Galster (1999) criticized these development patterns of public housing complexes as "a disgraceful legacy of blatant discrimination in the operation of our public housing program" (p. 125). According to the study of Goering, Kamely, and Richardson (1997) using a nationally representative sample of public housing developments for 1993, they found that African American tenants for public housing units continued to be located in segregated neighborhoods. In addition, Rohe and Freeman (2001) showed that public housing and LIHTC subsidized housing programs were developed in neighborhoods with a relatively high percent of minorities and poor households. They concluded that race and ethnicity plays a key role in the siting of subsidized households. It is axiomatic that subsidized households are isolated from desirable neighborhoods where access to social and economic opportunities is facilitated.

2.4 Housing Market Discrimination

As mentioned earlier in the section on Residential and Housing Segregation, discrimination in the housing market is a significant key that accounts for the association between residential segregation and uneven geography of opportunity. However, before we scrutinize discrimination in the housing market to explain residential segregation, we need to address two other hypotheses suggested as causes of residential segregation for over half a century. First, there is the class hypothesis, which suggests that residential segregation could be interpreted as the natural ecological segregation by income differences (Galster, 1987). Minorities, especially African Americans, could not move into desirable neighborhoods due to their lower income requiring lower housing prices, so residential segregation reflects not the role of race but the role of income (Denton, 2006; Galster, 1987; Massey, 2004). However, prior studies showed by empirical results that African Americans in the same class were more segregated compared to other groups in both the 1990s and the 2000s (Briggs, 2005; Denton, 2006; Massey, 2004; Massey & Eggers, 1990), so it may be hard to support the class hypothesis as an explanation for residential segregation. The class hypothesis could account for only a small fraction of residential segregation (Galster, 1987). The role of race overwhelms that of class in order to interpret residential segregation (Briggs, 2005; Denton, 2006; Fainstein, 1993; Goldsmith, 2000; Massey & Eggers, 1990). Second, according to the self-segregation hypothesis, residential segregation stems from the preference of African Americans. African Americans choose to live in segregated neighborhoods, by their own will, which consists of homogenous race components (Galster, 1987; Massey, 2004).

However, earlier studies produced contrary evidence to the self-segregation hypothesis. Charles (2003) showed that African Americans have weaker preferences for living in segregated neighborhoods compared to those of whites. According to Massey (2004), whites have a strong preference for living in homogenous neighborhoods. Whites even show a tendency to prefer all white neighborhoods. Strong preferences of whites for same-race neighborhoods are due to negative perceptions of African Americans (Massey, 2004). These prior results on racial preferences prove that the self-segregation hypothesis would not be supported as a cause of residential segregation.

Even though discrimination in the housing market has declined after being outlawed by the decision of the 1948 Supreme Court, discriminatory barriers in the housing market still remain a significant cause for reinforcing residential segregation in the U.S. (Denton, 2006; Massey, 2004). According to the discrimination theory, disadvantaged populations experience difficulties in moving into desirable neighborhoods because of discriminatory barriers that stem from preferences of class and race in the housing market (Galster, 1987). Housing discrimination could be explained by three distinct theories: agent prejudice, customer prejudice, and rip-off (Galster, 1987; Yinger, 1977). First, personal stereotypes of housing market agents and landlords of minorities cause discrimination in the housing market. Second, housing market agents and landlords discriminate against African Americans in order to maximize their profit by bowing to the preferences of white customers because white customers are reluctant to be integrated with African American residents. Last, housing market agents and landlords regard minorities as a potential source of extra profit, so

they swindle minorities (Galster, 1987). Even though the suggestions of agents may be less favorable, especially in terms of financial aspects, African Americans reluctantly accept their unfavorable information because of the fear of confronting discrimination (Galster, 1987). These three forces, based on distinctive theories, induce discriminatory barriers in the housing market. Galster (1987) proved empirically that residential segregation by race is significantly associated with discrimination in the housing market. Discrimination is especially pronounced in predominantly white neighborhoods.

Unfair treatment of the least advantaged populations in the housing market, especially in terms of providing less information, steering to more heavily minority areas, and block-busting by agents, restricts minority home-seekers from locating in desirable neighborhoods (Carr & Kutty, 2008; Krivo & Kaufman, 2004). Also, housing discrimination impedes the siting of subsidized households in desirable neighborhoods through negative attitudes toward subsidized tenants. Residential segregation, exacerbated by discrimination in the housing market, limits the least advantaged population access to good education, jobs, safety from crime, and wealth accumulation. In other words, it is discriminatory barriers in the housing market that restrict housing opportunity for the least advantaged populations, and ultimately restrains various opportunities for upward mobility that alleviates interracial economic disparities (Galster, 1987). It is inevitable that disadvantaged, underserved, or marginalized populations are isolated from the mainstream of social and economic opportunities.

2.5 Vicious Circle of Residential Segregation and Inequalities

Residential segregation, accelerated by urban sprawl and housing discrimination, gives body to both pockets of problems and pockets of privilege, especially in terms of inequitable opportunities for wealth accumulation, education, employment, safety, and exposure to crime in both metropolitan areas and suburbs (Denton, 2006; Squires & Kubrin, 2005). In addition, NIMBY attitudes due to the social stigma of marginalized populations, especially in terms of subsidized tenants, diminish social opportunities and locational outcomes. The mechanism of costs of residential segregation is multidimensional. First, residential segregation reinforces the wealth disparities of minorities (Carr & Kutty, 2008). Residential segregation prevents minorities from moving into desirable neighborhoods where the appreciation of home value is more likely. Because housing is the largest economic resource for creating wealth in most households, the deprivation of housing opportunities limits the wealth accumulation of the least advantaged (Carr & Kutty, 2008; Denton, 2006; Krivo & Kaufman, 2004; Massey, 2004; Van Zandt, 2003). Second, restriction of spatial mobility due to residential segregation and NIMBY opposition means that the least advantaged groups are isolated from the mainstream of society and opportunities. Specifically, the least advantaged groups face obstacles for accessing good quality schools, jobs, and low crime rate. Lastly, deprivation of social and economic opportunities for upward mobility is accelerated by poverty concentration due to interaction (concentration) effects. This poverty concentration results from the poverty of disadvantaged populations being clustered in racially homogenous and densely populated areas (Massey, 2001, 2004).

Thus, concentrated poverty intensifies obstacles to various opportunities because lack of

wealth and income, poor education, inadequate access to jobs, and high crime rates

interact with each other (Carr & Kutty, 2008).
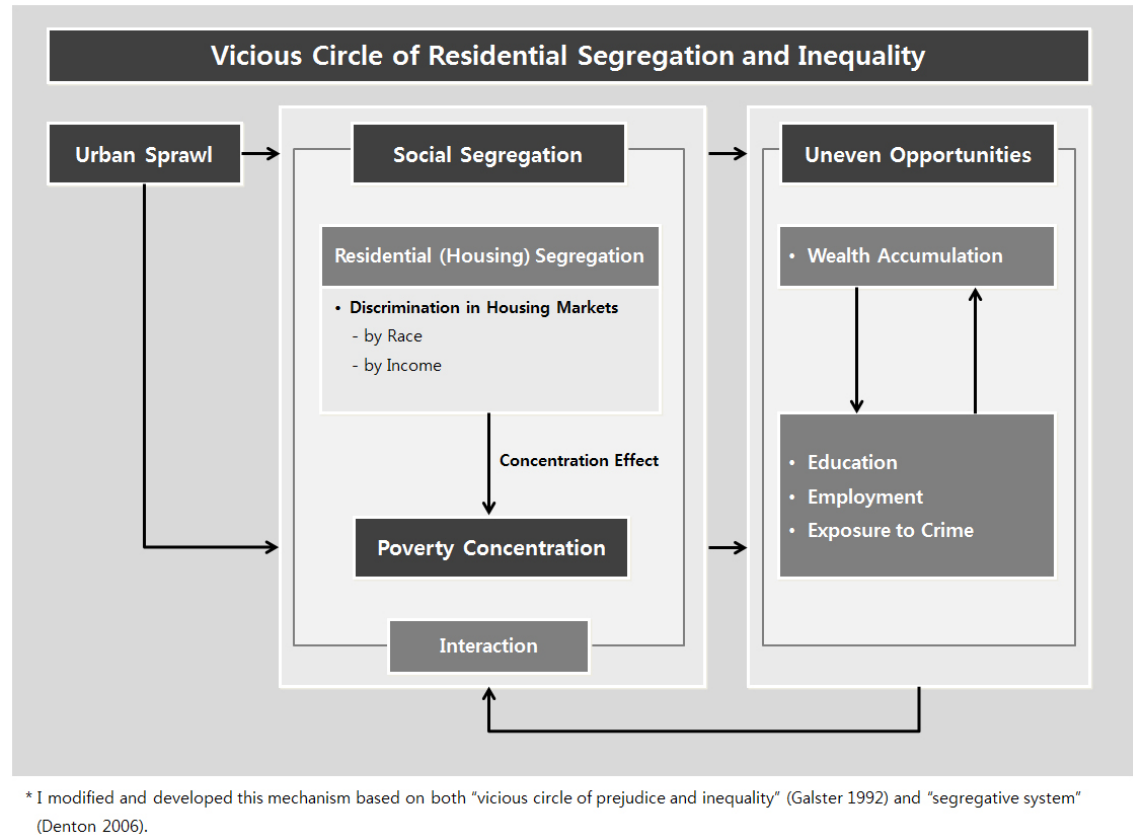
Figure 3. Vicious Circle of Residential Segregation and Inequality

Furthermore, the fact that the interrelated associations among residential

segregation, poverty concentration, and deprivation of social and economic opportunities

are mutual and bidirectional makes social inequality worse. To be more specific,

residential segregation intensifies concentrated poverty, and these interacting forces

prevent the least advantaged groups from accessing social and economic opportunities

for upward mobility. Conversely, lack of social and economic opportunities translates

into residential segregation. This mechanism, the "vicious circle of residential

segregation and inequality," is illustrated in Figure 3. The suggested mechanism is

modified and developed from both the "vicious circle of prejudice and inequality" and

the "segregative system" expounded by Galster (1992) and Denton (2006) respectively.

According to the vicious circle of prejudice and inequality, racial inequalities induce

prejudice, which causes segregation as well as discrimination in the housing market,

which also leads to segregation (Denton, 2006; Galster, 1992). While previous systems

only looked at the associations among social prejudice, segregation, and housing market

discrimination, the mechanism of this study suggests comprehensive views among urban

sprawl, residential segregation, poverty concentration, and multidimensional social

inequality. Further, interacting relationships, like a vicious circle, could also be detected

among social and economic opportunities, especially among wealth accumulation,

educational opportunities, and job opportunities in the suggested mechanism.

Deprivation of wealth creation due to a lack of housing opportunities limits the access of

the least advantaged groups to other opportunities such as good education and high-

paying jobs. Lack of educational opportunity also creates barriers to high-paying jobs.

Conversely, deprivation of educational and job opportunities leads to restrictions on

housing opportunities and wealth accumulation. This mechanism can also apply to the

uneven geography of opportunities for subsidized households. Even though the "location"

of housing is the centerpiece of socioeconomic opportunities, community opposition

33

expressed through NIMBY behavior has contributed to subsidized households being secluded from desirable neighborhoods. Current development patterns of subsidized housing may perpetuate inequitable opportunities for the least advantaged populations, especially in terms of subsidized households, by pushing them into a vicious circle of residential segregation and inequality. There is no room for doubt that breaking out of a vicious circle is the key to achieving social equity.

CHAPTER III

LITERATURE REVIEW: IMPACTS OF SUBSIDIZED HOUSING ON

NEIGHBORHOODS

NIMBYism is based on the common idea that neighborhoods will be negatively affected by proximity to subsidized housing households. Is the common wisdom true? Is this just a stereotype? There have been many prior studies that focused on the impact of subsidized housing on nearby property values in the last decade. These researches, however, have produced conflicting results. Some have found a negative impact of subsidized housing programs on neighborhoods, while others have found a positive impact, or even no impact. The reason for contradictory results could be due to two aspects. First, lack of methodological rigor induces confusing findings, and it casts doubt on the validity of prior results (Nguyen, 2005). Second, the impact of subsidized housing might be different under certain circumstances such as neighborhoods' characteristics and the housing submarket (Freeman & Botein, 2002). Exploring the specific circumstances would be possible when the validity of an analytic method is guaranteed. Further, even though many previous studies have explored the impacts of subsidized housing programs on neighborhood property values, there are few studies that focus on the relationship between subsidized housing programs and neighborhood stability, especially in terms of neighborhood housing turnover. Also, there are no studies to date examining housing turnover at the individual parcel level while taking into account the spatial characteristics of properties before and after the implementation of subsidized

housing developments. This chapter, thus, will focus on the review of prior researches in terms of the aspects of methodological rigor. In addition, another purpose of this review is to speculate on what previous studies have overlooked – overarching factors in subsidized housing developments that could affect neighborhood property values and housing turnover.

3.1 Different Impacts of Subsidized Housing on Neighborhoods

Many previous studies have examined the impacts of subsidized housing programs on neighborhood property values to assess the effects of NIMBY attitudes. However, their findings have been inconsistent. Table 1 provides the results of prior studies exploring the impact of subsidized housing on nearby property values, especially in terms of their study areas, the type of subsidized housing programs, and their findings. Several earlier studies prior to the middle 1990s used the test versus control area methodology. The findings from previous studies were mixed. For instance, Nourse (1963) investigated the relationships between public housing developments and neighborhood housing prices in St. Louis, Missouri. The author found that there were no significant impacts from two public housing projects while there was one positive impact from one project. Also, Schafer (1972) explored the impacts of the Below Market Interest Rate (BMIR) program in Los Angeles, California, and found that there was no statistically significant impact on neighborhood property values. After the middle 1990s, many studies employed the hedonic price model to scrutinize the impacts of subsidized housing developments. Cummings and Landis (1993) explored the impact of affordable

housing developments in San Mateo County, San Francisco County and Alameda County. They showed that affordable housing developments positively affected neighborhood property values in two projects and negatively in one project while there were insignificant relationships between affordable housing developments and property values within three other projects. Also, Lee, Culhane, and Wachter (1999) and Lyons and Loveridge (1993) looked at the impact of various subsidized housing developments in Philadelphia and Ramsey County, Minnesota, respectively. Their results showed that the impacts of subsidized housing developments might vary with different housing programs due to the unique nature of each program. However, these conflicting findings of previous studies did not provide convincing evidence on the impacts of subsidized housing developments due to the lack of methodological rigor, described in more detail in the end of the chapter. In conclusion, consistent results have not yet been reached with respect to the impact of subsidized housing programs on surrounding property values.

Table 1. Results of Prior Studies on Impacts of Subsidized Housing on nearby Property Values

Author(s)	Year	Study Area(s)	Program(s)	RM	Result(s)
Nourse	1963	- St. Louis	- Public Housing	T	- (+) in one site - None in two sites
Schafer	1972	- Los Angeles	- Below Market Interest Rate (BMIR) project	T	- None
Sedway & Associates	1983	- Marin County	- Low-income development	T	- None
Rabiega, Lin, & Robinson	1984	- Multnomah County	- Public Housing	P	- (+) impact
Cummings & & Landis	1993	- San Mateo County - San Francisco County - Alameda County	- Six BRIDGE Housing Affordable developments	C	- (+) within 1/8 miles: One site - (+) within 1/2 miles: One site - (-) within 1/2 miles: One site

Table 1. Continued

Author(s)	Year	Study Area(s)	Program(s)	RM	Result(s)
Lyons & Loveridge	1993	- Ramsey County	- Section 8 New Construction & Rehabilitation - Section 8 Existing Vouchers - Section 221 - Section 236 - BMIR project - Public Housing	C	- Section 8 Existing Vouchers, Section 236 & BMIR: None - Section 221 & Public Housing: (+) - Public Housing: (-) - Section 8 New Construction & Rehabilitation: Mixed
Goetz, Lam, & Heit	1996	- Minneapolis	- Community Development Corporation (CDC) developed subsidized project - Public Housing	C	- CDC project: (+) impact - Public Housing: (-) impacts
Galster, Tatian, & Smith	1999	- Baltimore County	- Section 8 tenant-based housing units	A	- (+) in higher-valued neighborhoods - (-) in lower-valued neighborhoods
Lee, Culhane, & Wachter	1999	- Philadelphia	- Public Housing - LIHTC - Section 8 Certificate & Voucher - Section 8 New Construction & Rehabilitation - Federal Housing Administration (FHA) Housing	C	- Public Housing: a modest (-) - LIHTC: a slight (-) - Section 8 Certificate & Voucher: a slight (-) - Section 8 New Construction & Rehabilitation: a modest (+) - FHA Housing: a modest (+)
Santiago, Galster, & Tatian	2001	- Denver	- Dispersed Rehabiliated Public Housing units	A	- (+) impact - (-) impact in black neighborhoods
Ezzet-Lofstrom & Murdoch	2006	- Dallas County	- LIHTC units	C	- (+) impact
Schwartz, Ellen, Voicu, & Schill	2006	- New York City	- Project-based Housing units	A	- (+) impact
Ellen & Voicu	2007	- New York City	- LIHTC units	A	- (+) impact
Koschinsky	2009	- Seattle, Washington	- Project- and tenant-based subsidized housing units	A	- (+) impact - Section 8 Voucher: (-) impact in higher-valued communities
Castells	2010	- Baltimore, Maryland	- Three HOPE VI complexes	D	- One complex: (+) - Other two complexes: None

RM: Research Methodology
T: Test versus Control Area
C: Cross Sectional
D: Difference-in-Differences
A: Adjusted Interrupted Time Series/Difference-in-Differences (AITS-DID)

Recent studies provided the clue that the impact of subsidized housing would be different according to the different characteristics of the program and unit and different neighborhood environments, even though these studies still have methodological flaws. Specifically, the impact of subsidized housing on nearby property values could be different due to (1) the different type of subsidized housing programs such as public housing, the LIHTC (Low-Income Housing Tax Credit), and the HCV (Housing Choice Voucher) programs, (2) the different characteristics of neighborhoods, (3) the size of subsidized housing complex, and (4) the design of subsidized housing units. This chapter scrutinizes what overarching factors in subsidized housing programs affect neighborhood property values and housing turnover.

3.1.1 Type of Subsidized Housing Programs

The old public housing program, a project-based subsidized housing program, had been excoriated as a major culprit of causing higher crime rates, depreciating nearby property values, and promoting white flight (Goldstein & Yancey, 1983; Lee, Culhane, & Wachter, 1999; McNulty & Holloway, 2000; Roncek, Bell, & Francik, 1981; Saltman, 1990). In 1986, the LIHTC program was established to address the need for more units of affordable housing. This program differs from previous housing programs due to the utilization of private equity in developing housing for low income families (Deng, 2009). Congress allocates federal tax credits to states based on state population, and then tax credits are assigned to developers by state housing finance agencies (HFAs) (Baum-Snow & Marion, 2009; Schwartz, 2010). Developers apply to HFAs for tax credits by

proposing specific projects, and then the size of tax credits for projects is determined

based on the development's cost and the proportion of units occupied by low-income

households (set-asides) (Baum-Snow & Marion, 2009; Schwartz, 2010). The minimum

requirements of set-asides are 20/50 and 40/60. To be more specific, either at least 20

percent of the units should be affordable to tenants earning below 50 percent of the

metropolitan area's median family income or at least 40 percent of units should be

occupied by tenants below 60 percent of the metropolitan area's median family income

(Baum-Snow & Marion, 2009; Schwartz, 2010). Since its implementation, the LIHTC

program has grown into the largest supply-based subsidized housing program in the U.S.

According to the HUD (Department of Housing and Urban Development) Report in the

LIHTC database, around 24,000 projects including about 1.8 million housing units have

been placed in service through this program between 1995 and 2011. In addition, Danter

Company (2009) suggested that the LIHTC program accounts for around one-sixth of all

multifamily housing built by 2006. LIHTC program accommodates more households

compared to the public housing program implemented 50 years earlier (Schwartz, 2010).

While several studies have examined the performance of the program in locating

low-income households in higher-income neighborhoods (Abt Associates, 2006;

McClure, 2006; Oakley, 2008; Van Zandt & Mhatre, 2009), few have assessed the

impacts of the LIHTC program on the surrounding neighborhoods. Some researchers

have argued that well-designed subsidized housing projects such as the LIHTC program

may contribute to the enhancement of neighborhood vitality (Schill, Ellen, Schwartz, &

Voicu, 2002). This expectation for a positive result from the LIHTC projects may

account for the reason why Congress has continued to support the production of the LIHTC program rather than distributing a tenant-based subsidy such as the HCV Program (Deng, 2009). However, further research is needed to assess LIHTC's impact on neighborhood stability, which is the aim of this paper. On the other hand, some scholars suggest that the HCV program, as a tenant-based subsidized housing program, provides low-income families more flexibility in choices of locations as well as unit types (Van Zandt & Mhatre, 2013). It has been believed that the HCV program is helpful to deconcentrate income and racial segregation. Thus, the anticipated impact of each subsidized housing program might be different due to the characteristics of each program. In these contexts, subsidized housing needs to be classified according to the characteristics and types in order to delicately analyze the impacts on neighborhoods.

Some have strived to analyze the different impacts of subsidized housing programs by direct comparison of each program. Deng (2007) compared the effects of HCV and LIHTC housing on neighborhood integration and school quality. She found that more voucher units were located in neighborhoods with a below-average percentage of African-Americans. She also noted that the school quality of LIHTC is better than that of the voucher, even though the differences are small. These findings imply that there are significant differences between the project-based and the tenant-based subsidized housing program, and it could make different impacts on neighborhoods.

3.1.2 Different Sociodemographic Characteristics of Neighborhoods

NIMBY attitudes on subsidized housing can be explained as opposition to the influx of undesirables into neighborhoods (Nguyen, 2005). Subsidized housing is deemed to have clear differences with the non-subsidized housing in terms of the tenant characteristics. In other words, because subsidized housing communities are generally occupied by subsidized tenants who have different characteristics from non-subsidized communities in terms of ethnicity, income, and education, non-subsidized tenants have a tendency to resist the inflow of subsidized tenants. The discrepancies of tenant characteristics between subsidized housing and non-subsidized housing would be a reason that affects the property values of neighborhoods. Thus, the impact of subsidized housing may vary according to the different characteristics and conditions of the neighborhood. This underscores the appropriateness of analyzing the impact of subsidized housing by stratifying neighborhoods according to sociodemographic characteristics such as ethnicity and income (Freeman & Botein, 2002). As the housing market is known for its distinctive characteristics, one of which is heterogeneity that stems from the immobility of housing and imperfect information between a buyer and seller, it is difficult to define the market as a single homogeneous one (Mhatre, 2010). However, the majority of previous studies failed to identify or stratify neighborhoods by these characteristics; hence, they have overlooked housing submarket heterogeneity, a critical characteristic of the housing market. Thus, the fact that the housing market is divided by several different submarkets leads to questions about the results of prior studies.

However, only a few studies focused on the classifications according to the neighborhood types to determine the impact of subsidized housing on neighborhoods. Galster and his colleagues (1999) found that Section 8 development had an upgrading impact on nearby property values in wealthier white-dominant census tracts, but it also had a destructive impact in lower-valued census tracts by stratifying the neighborhoods' racial composition and median home values. The same team of researchers, Santiago, Galster, and Tatian (2001), also found that the Housing Authority of the City and County of Denver (DHA) dispersed public housing units had a positive impact on nearby single-family housing prices in wealthier white census tracts. On the other hand, some researchers found the positive impact of subsidized housing on neighboring property values in both higher- and lower-income neighborhoods. Ellen and Voicu (2007) assessed the impact of LIHTC units on surrounding property values in New York City. They found that the LIHTC units had a positive impact on nearby property values in both lower- and higher-income neighborhoods. This impact was also significant in lower density neighborhoods than in higher density neighborhoods.

The majority of studies, however, failed to stratify by the characteristics of neighborhoods in order to assess the impact of subsidized housing on surrounding property values. Thus, it casts doubt on the validity of their results. In contrast, four teams' studies (Ellen & Voicu, 2007; Galster, Tatian, & Smith, 1999; Koschinsky, 2009; Santiago, Galster, & Tatian, 2001) attempted to assess the impact of subsidized housing on surrounding housing prices by stratifying the characteristics of neighborhoods such as racial composition, income level, and density, so their results are relatively reliable.

43

Thus, a few studies pinpoint the significance of controlling the neighborhood heterogeneity of housing in order to evaluate the impact of subsidized housing on neighborhoods.

3.1.3 Size of Subsidized Housing Developments

Most studies assessed the impact of subsidized housing on nearby property values by looking at the proximity between subsidized housing and market-rate housing. In other words, the analysis of proximity to subsidized housing complexes stems from the anticipation that the impact of the housing would be larger when the market-rate housing is closer to subsidized housing complexes. Ezzet-Lofstrom and Murdoch (2006) assessed the impact of LIHTC units on neighboring housing prices of single families in Dallas County, Texas. They focused on single-family houses sold within 1.5 miles of the sites chosen for LIHTC units, using three rings of 0.5, 1.0, and 1.5 miles to define the proximity to LIHTC projects. They found that LIHTC projects had a positive impact on housing prices of single families that were located within 0.5 mile of LIHTC units rather than a negative impact. Cummings and Landis (1993) looked at the impact of affordable housing developments in San Mateo County, San Francisco County and Alameda County by using the rings of 1/8 to 1/2 miles. They found that affordable housing had no significant impact on nearby housing values within 1/4 mile, but showed a negative impact at 1/2 mile. These studies analyzed the impact of subsidized housing according to the proximity. Other researchers categorized the same measure of proximity in feet: 500,

1,000, and 1,500 feet (Castells, 2010; Ellen & Voicu, 2007; Galster, Tatian, & Smith, 1999; Santiago, Galster, & Tatian, 2001; Schwartz, Ellen, Voicu, & Schill, 2006).

However, when it comes to estimating the impact of subsidized housing, one critical question arises about prior method that focuses on the proximity to subsidized housing: Is the impact of the closest subsidized housing complex necessarily the largest? Could the size of the complex also be a determining factor? It is axiomatic that the proximity to subsidized housing is not the only factor to determine the impact. The size of subsidized housing units should be considered with the proximity in order to assess the impact of subsidized housing. For example, suppose there are two market-rate houses with the same conditions such as housing characteristics, location characteristics, and neighborhood characteristics. However, if the size of subsidized housing complexes that are equidistant from each market-rate house is different, the impact will be different. In other words, larger subsidized housing complexes will have a larger impact on market-rate housing than smaller subsidized housing complexes. This fact implies that when it comes to determining the impact of subsidized housing, both the proximity and size of the complexes should be considered in tandem. A few studies attempted to estimate the impact of subsidized housing by considering the size of housing. Schwartz, Ellen, Voicu, and Schill (2006) looked at the external effects of place-based subsidized housing on neighboring property values by using rings of 500, 1,000, and 1,500 feet in New York City. They also included the size of subsidized projects in their model. They found that the placed-based subsidized housing had a positive external effect on nearby housing prices. This external effect increased with the size of subsidized projects and

45

decreased with the proportion of multifamily and rental units. Other researchers also tried to take the size of subsidized housing into account (Ellen & Voicu, 2007; Galster, Tatian, & Smith, 1999; Lee, Culhane, & Wachter, 1999; Santiago, Galster, & Tatian, 2001).

3.2 Limitations of Prior Methodologies

Several earlier studies prior to the middle 1990s attempted to determine whether or not subsidized housing impinges on surrounding property values. To do their research, they employed the test versus control area methodology. They selected control neighborhoods to compare with experiment neighborhoods that included subsidized housing. To be more specific, their methodologies explored two kinds of neighborhoods: one neighborhood including subsidized housing developments and another not including subsidized housing sites but having comparable sociodemographic characteristics (Nguyen, 2005). Then, housing prices in neighborhoods that contain subsidized housing developments were compared to those in other neighborhoods that do not have subsidized housing developments. Through this methodology, the results determined that there was no significant impact on neighboring property values, or that subsidized housing had a positive impact on the neighborhood. Sedway and Associates (1983) used this approach in order to analyze the impact of subsidized housing units in Marin County, California, and concluded that there was no significant impact on neighborhoods. MaRous (1996) conducted survey interviews with market analysis on four projects that included low-income housing units and market-rate housing units in Illinois, and

suggested that there was no evidence that low-income housing units have a destructive impact on market-rate housing units. However, earlier studies had significant flaws in terms of their methodology. There are no clear criteria to determine if the control neighborhoods are identical to the experimental neighborhoods (Freeman & Botein, 2002). Specifically, even though researcher tried to select comparable neighborhoods, there might be subtle differences that are not easily captured by the test versus control area approach. Further, this methodology cannot control other factors such as locational, environmental, and neighborhood characteristics that can affect property values (Nguyen, 2005). Thus, the findings of earlier research have been fundamentally criticized in terms of methodological rigor and validity.

However, after the middle 1990s, recent studies have offered conflicting results on earlier studies, as the methodological approach has been enhanced by employing a multiple regression analysis (Freeman & Botein, 2002; Nguyen, 2005). The findings are that subsidized housing detrimentally affects neighborhoods in certain circumstances, and these impacts are different in certain types of subsidized housing programs (Cummings & Landis, 1993; Ezzet-Lofstrom & Murdoch, 2006; Goetz, Lam, & Heitlinger, 1996; Lee, Culhane, & Wachter, 1999; Lyons & Loveridge, 1993). These studies, however, still have shown conflicting results in term of relationships between subsidized housing developments and nearby property values. In conclusion, consistent results have not yet been reached with respect to the impact of subsidized housing programs on surrounding property values.

The majority of prior studies use a multiple regression model in order to estimate

the impact of subsidized housing on surrounding property values. Especially, when the

dependent variable is the housing price, this methodology is known as the hedonic price

model. The hedonic price model controls for the various physical and environmental

characteristics of each housing, so it could elucidate the relationships between

subsidized housing and neighboring housing prices (Freeman & Botein, 2002; Nguyen,

2005). However, previous approaches based on the hedonic price model have suffered

from three critical drawbacks: housing market heterogeneity, causal direction on the

impacts of subsidized housing developments, and defining neighborhoods. First, as the

housing market is known for its distinctive characteristics, which are heterogeneity that

stems from the immobility of housing and imperfect information between a buyer and

seller, it is difficult to define the market as a homogeneous single one (Mhatre, 2010).

Thus, the fact that the housing market is divided by several different submarkets leads to

the question about the results of prior studies. Specifically, because prior studies assume

that the characteristics of regions and neighborhoods where housing is located are

identical, prior studies have a fatal flaw in terms of their methodology. Thus, several

studies confined their hedonic price models to a single neighborhood in order to

eliminate the need to distinguish their approach by different housing submarkets

(Freeman & Botein, 2002). However, a few studies have controlled difference

characteristics of neighborhood in their models (Ellen & Voicu, 2007; Galster, Tatian, &

Smith, 1999; Koschinsky, 2009; Santiago, Galster, & Tatian, 2001). Second, the

methodologies of prior studies also have a limitation with respect to lack of

consideration for the direction of causality. In other words, the majority of these studies

employed a cross-sectional approach in order to estimate the impact of subsidized

housing developments, so prior studies do not take the direction of causality into account.

For instance, is subsidized housing the cause of threatened neighborhood property values,

or are subsidized housing complexes placed only in distressed neighborhoods? At this

point, a few studies have prominent implications in terms of looking at the direction of

causality by applying a quasi-experimental research design to consider preexisting

neighborhood stability levels (Galster, Tatian, & Smith, 1999; Koschinsky, 2009;

Santiago, Galster, & Tatian, 2001; Schwartz, Ellen, Voicu, & Schill, 2006). They

developed the hedonic price model considering the change of single-family housing

sales price levels and trends. In other words, they looked at the impact of subsidized

housing units by using a pre/post and control/impact design that can capture the causal

direction of a changing impact before and after subsidized household occupancy. Thus,

these studies estimated the impact of subsidized housing by employing a robust quasi-

experimental research design in order to determine the causal direction between

subsidized housing and neighborhood property values. Last, when it comes to defining

the boundaries of neighborhoods, there are no clear criteria to determine the radii of

boundaries. Different researchers employed different criteria to define the radial distance

of neighborhood boundaries. In other words, several researchers set up different ring

boundaries in order to assess the impacts of subsidized housing on nearby property

values. For instance, the radial distances of neighborhoods are defined as 1,000 feet by

Koschinsky (2009), 1,500 feet by Castells (2010), 2,000 feet by (Schwartz, Ellen, Voicu,

49

& Schill, 2006), and 0.5 miles by (Cummings & Landis, 1993). In some studies, those

radial distances are classified as three distance bands: 500, 1,000, and 2000 feet (Galster,

Tatian, & Smith, 1999) or 750, 1,500, and 2,500 feet (Lee, 2008), or 0.5, 1.0, and 1.5

miles (Ezzet-Lofstrom & Murdoch, 2006). After setting up the boundaries, they focused

on single-family houses sold within rings chosen for subsidized housing units. However,

they did not provide clear criteria to define the radial distances of neighborhoods.

3.3 Implications of Prior Studies

Can we say simply that subsidized housing developments have a negative impact

on nearby property values? After reviewing prior studies, there are clues that the

different impacts of subsidized housing depend on certain circumstances. In other words,

the impact of subsidized housing may vary across neighborhoods according to the type

of subsidized housing programs, the characteristics of surrounding neighbors, and the

size of the subsidized housing. First, the characteristics of subsidized housing programs

are different from each other because of the unique nature of each program. Specifically,

the LIHTC program is a major supply-based housing policy in the U.S., which means

that this program focuses on providing affordable housing units and involves the merit of

a private market into the production process (Deng, 2009). On the other hand, the HCV

program is a demand-based housing policy, which means that it provides the choices of

locations for low-income households (Van Zandt & Mhatre, 2013). Thus, the impact of

each subsidized unit on surrounding neighborhoods would be different due to their own

characteristics. Second, the impact of subsidized housing on nearby property values

would be different according to the characteristics of neighborhoods where subsidized

housing are located. However, most studies failed to classify neighborhoods according to

characteristics such as racial composition, income, education, and crime level. Last, the

impact of subsidized housing on neighborhoods would vary with the size of subsidized

housing complexes. The impact would also be different if each subsidized housing

complex were larger. Thus, the size of subsidized housing needs to be considered in

order to assess the impact of subsidized housing developments.

Finally, when three aspects such as the type of program, neighborhood

environments, and size are considered with a robust methodology, the results of the

research would take a step toward figuring out the impact of subsidized housing on

nearby property values. However, the majority of prior studies are flawed in terms of

research methodologies. First, many previous studies have a limitation in terms of

lacking a look at the causal direction of the impacts of subsidized housing developments.

Thus, the results of the research could be developed by employing a pre/post and

control/impact research design in order to clarify the causal direction of changing

impacts before and after subsidized household occupancy. Second, the attributes of

housing market heterogeneity should be controlled in the analytic model in order to

unveil contradictory results on the impact of subsidized housing. The majority of studies

failed to distinguish different housing submarkets in their methodologies; their results

remained in question. Third, previous studies did not provide clear criteria to define the

boundaries of neighborhoods. Setting up the extent of subsidized housing's influence is

the first step in analyzing the impact of subsidized housing. Only after establishing well-

51

found boundaries of subsidized housing's influence, would the results of research be persuasive. Finally, the majority of research areas are limited to older northeastern cities (Freeman & Botein, 2002; Nguyen, 2005). Thus, it is hard for the results of prior studies to be generalizable to the entire country. This fact shows that research in the west and south need to be conducted in order to extend the research areas.

When three aspects such as the type of program, neighborhood environments, and size are considered with a robust methodology, the results of the research would provide a step toward figuring out the impact of subsidized housing on neighborhoods. Hence, this study will overcome some limitations of previous studies by devising multidimensional variables and applying a robust methodology. This research will shed light on a longstanding question: Does subsidized housing negatively affect neighborhoods?

3.4 Subsidized Housing and Neighborhood Stability

Previous studies have examined the impacts of subsidized housing programs on neighborhood property values to assess the effects of NIMBY attitudes, although findings have been inconsistent. However, there are few studies that focus on the relationship between subsidized housing programs and neighborhood stability, especially in terms of neighborhood housing turnover, as a proxy for attitudes toward subsidized households. NIMBY attitudes about subsidized housing can be explained as opposition to the influx of undesirables into neighborhoods (Nguyen, 2005). The discrepancies of tenant characteristics among subsidized and non-subsidized housing may have a

destabilizing effect on neighborhoods, causing existing residents to feel uncomfortable and desire to move.

In studies about subsidized housing and neighborhood stability, the term "neighborhood stability" has had a somewhat fluid definition and might be conceptually divided into two aspects: economic stability and residential stability (Ross, Reynolds, & Geis, 2000). Economic stability refers to the change in the socioeconomic characteristics of neighborhoods or residents with respect to household income, home ownership, or property values, to name a few. On the other hand, residential stability signifies the flux of residents into and out of neighborhoods over time regardless of their socioeconomic characteristics (Ross, Reynolds, & Geis, 2000). In this sense, exploring the housing durations in neighborhoods can be an indicator for capturing residential stability. Other scholars also suggested that when it comes to the stabilizing conditions in neighborhoods, especially in terms of socioeconomic characteristics such as improved physical environments, reduced social problems, and appreciation of property values, these are sometimes referred to as neighborhood health not neighborhood stability (Rohe & Stewart, 1996). However, in this study examining the associations between subsidized housing developments and housing turnovers, I will continue to use the term neighborhood stability because it is more commonly used (Rohe & Stewart, 1996).

Neighborhood stability is an integral element for communities as well as for individuals. According to the cohesiveness perspective, low housing turnover results in social integration by expanding the opportunities for knowing each other, sharing values and norms, participating in community organizations, and sustaining neighborhood

53

networks (Shaw & McKay, 1969; Van Zandt, 2003). On the other hand, high housing turnover induces neighborhood pathology in terms of social and economic problems. This restricts social ties and friendship networks among neighbors, and leads to the breakdown of informal social control (Ross, Reynolds, & Geis, 2000; Sampson, 1985; Sampson & Groves, 1989). High housing turnover also might threaten property value stability, and increase crime within the neighborhood. For these reasons, neighborhood stability is seen as a goal for most communities.

Although the discrepancies in characteristics between subsidized housing and non-subsidized housing tenants might be a significant reason for the deterioration of neighborhood stability, there are few empirical studies that focus on the associations between subsidized housing developments and neighborhood stability, especially in terms of housing turnovers. The majority of prior studies are limited to the relationships between subsidized housing programs and surrounding housing prices. Further, there are no studies to date examining housing turnover at the individual parcel level while taking into account the spatial characteristics of properties before and after the implementation of subsidized housing developments. This research addresses this gap by examining neighborhood stability and how the spatial distribution of subsidized housing developments influence housing turnover. This study will shed light on resolving questions about the relationship between subsidized housing and neighborhood housing turnovers.

CHAPTER IV

DATA AND DESCRIPTION

4.1 Study Areas

The study areas are the cities of Charlotte, North Carolina, and Cleveland, Ohio,

which are two comparable housing markets in the south and midwest, respectively (See

Figure 4). Previous research has focused largely on northeastern cities with a legacy of

public housing programs such as New York, Philadelphia, and Baltimore (Freeman &

Botein, 2002; Nguyen, 2005). Thus, the findings of this paper contribute to extending

research on subsidized housing beyond the Northeast Corridor, although the results may

not be representative of all areas in the U.S.
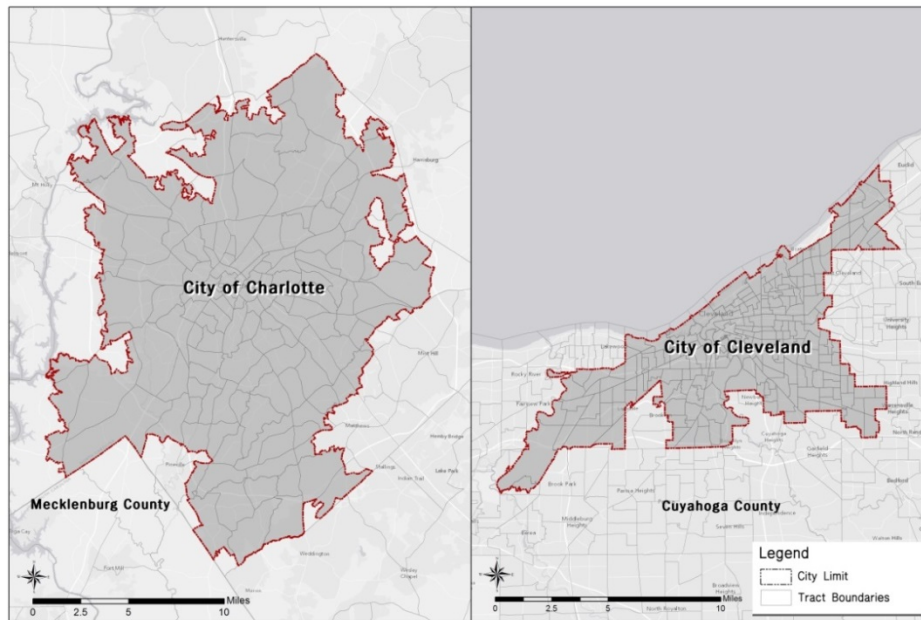
Figure 4. Study Areas: Cities of Charlotte and Cleveland

Charlotte is the 17th largest city in the U.S. (pop. 731,000 in 2010) and has experienced continuous rapid population growth for several decades (Delmelle, Thill, Furuseth, & Ludden, 2013). Although many cities in the state have suffered from the current economic recession, Charlotte remains one of the fastest growing cities (Rohe, Donegan, & Han, 2012). In contrast, Cleveland has struggled with population decline and neighborhood destabilization for many years due to deindustrialization (Koschinsky, 2009). Since its peak in the 1950s, the population of Cleveland has declined steeply from 914,000 to 397,000 in 2010. Mirroring this demographic decline of the city, housing market conditions also continue to be depressed.
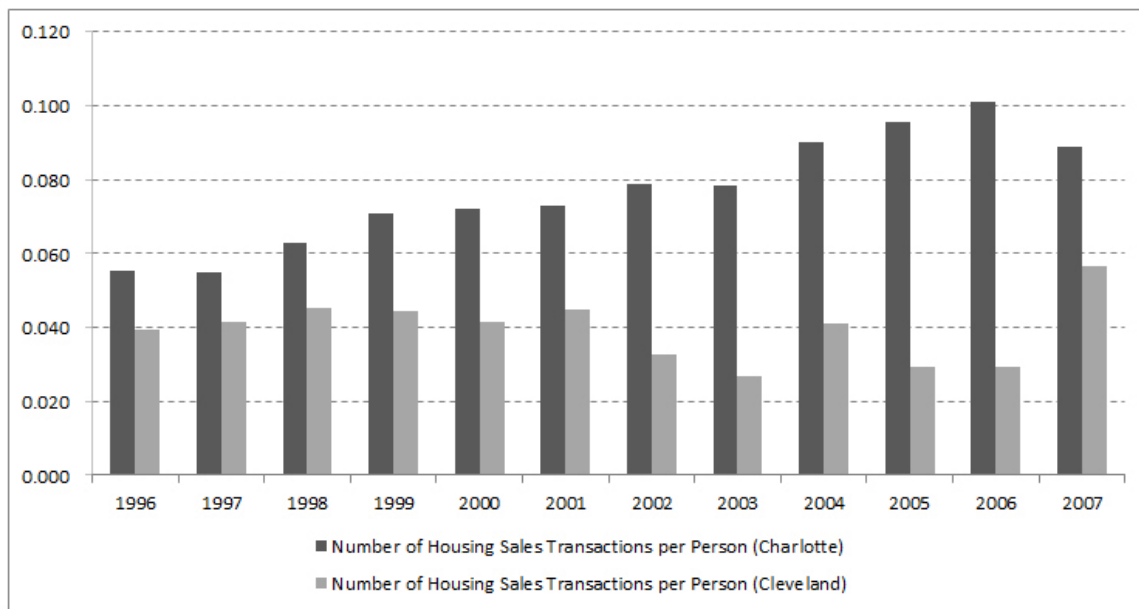
Source: Historic Sales Data for Charlotte and Cleveland (Mecklenburg County Assessor's Office and NEO CANDO)

Figure 5. Housing Market Trends in the Cities of Charlotte and Cleveland

Figure 5 shows the trend in housing sales transactions per person in Charlotte and

Cleveland from 1996 to 2007. In the Charlotte housing market, the number of housing

sales transactions per person increased gradually during this period (from 0.05 to 0.10).

In contrast, the Cleveland housing market fluctuated with fewer transactions per person

compared to Charlotte. The annual average number of housing sales transactions per

person in Cleveland between 1996 and 2007 was 0.04, while that in Charlotte was 0.08.

Hence, findings from this study comparing both housing markets account for the varying

impacts of subsidized housing developments between different housing market

conditions.

4.2 Data

This study assesses the impact of LIHTC subsidized housing developments based

on historic housing sales data from 1996 to 2007 for the cities of Charlotte and

Cleveland. This section describes the data sources and formats used in this study to

analyze the impact of LIHTC developments on nearby property values as well as

housing turnover.

4.2.1 Sales and Property Characteristics

The unit of analysis for this research is a single-family housing unit. Data for

housing duration and sales prices for Charlotte were drawn from the Mecklenburg

County Assessor's Office; similar data for Cleveland were obtained from the Northeast

Ohio Community and Neighborhood Data for Organizing (NEO CANDO), a publicly

available database provided by the Center on Urban Poverty and Community

Development at Case Western Reserve University. One of advantage of these data

compared to the Multiple Listing Services (MLS) data is that these data include all sales

transaction records while the MLS data only includes those records involving a realtor,

which may cause bias (Koschinsky, 2009). The data used in this study consists of all

repeat sales. To give an impression of the scope involved, the data for Charlotte includes

0.9 million records between 1990 and 2011 and those for Cleveland involves 2.0 million

records between 1975 and 2012. For the analysis in this study, the sales records for both

cities from 1996 to 2007 were extracted and linked to additional files containing

structure and parcel characteristics. Available structure characteristics of single-family

housing for Charlotte include heated areas, building age, number of bathrooms, number

of half bathrooms, number of bedrooms, number of fireplaces, heating sources (electric,

oil, and others), exterior types (brick/stone and others), and housing quality (the lowest

[below average] and highest [very good-excellent]). In contrast, available structure

characteristics for Cleveland include property sizes, heated areas, number of bathrooms,

number of half bathrooms, number of bedrooms, building age, housing quality (the

lowest [unsound-poor] and highest [very good-excellent]), exterior types (brick/stone

and others), and housing styles (bungalow, colonial, and others).

Compared to previous studies, this study conservatively applied the decision in

cleaning and handling the sales transaction data. First, for the study exploring the

associations between LIHTC developments and nearby property values, repeat sales

were excluded when sales transaction records were linked to structure and parcel

58

characteristics. The data for structure and parcel characteristics only included the characteristics at the latest transfer date, not historical records. Thus, repeat sales may be less precise than non-repeat sales in capturing the structure characteristic of each property (Koschinsky, 2009). For example, suppose there are two transactions for the same property between 1996 and 2007. However, structure characteristics of this property might have changed through new construction or major renovations before the sale. If we use (the latest) structure characteristics for this property, the structure information of the first (unrenovated) sales may be erroneous because the property for the first sale has the same renovated characteristics although it was not renovated. Also, missing records for sales prices and structure characteristics were excluded from the analysis. Further, we excluded all forced sales transactions in both cities. In the case of the city of Cleveland, transactions between warranty deeds were only selected to clarify arms-length transactions. In addition, low and high outliers in sales price and housing duration were excluded. The top and bottom 1 percent of the sample in sales prices was excluded to remove extremely low and high prices. To explore the relationships between LIHTC developments and housing turnover, the bottom 1 percent of the sample in housing duration was also excluded. Finally, census tracts with fewer than 10 properties were excluded from the analysis.

As a result, the final sample for examining the associations between the LIHTC programs and surrounding housing prices included 114,471 housing sales in Charlotte and 27,662 housing sales in Cleveland between 1996 and 2007. In addition, our final sample for examining the relationships between LIHTC projects and neighborhood

housing turnover included 59,882 housing transactions in Charlotte and 20,824 housing

transactions in Cleveland between 1996 and 2007.

4.2.2 LIHTC Developments

The Picture of Subsidized Households data was obtained from the U.S.

Department of Housing and Urban Development (HUD) to determine the characteristics

of LIHTC developments such as the size of the subsidized housing and their spatial

locations in the research areas. However, the location information in this data contained

many errors. The longitude and latitude coordinates of this data did not allow for

pinpointing the exact location of LIHTC developments. Hence, the location information

was not precise enough to analyze the impacts of LIHTC developments at the parcel

level because of the differences between the LIHTC locations in the data and actual

locations. This data also does not include the project completion dates needed to

determine the duration of each property's transaction before and after the LIHTC

projects were developed. Thus, we improved the information in this data by using

additional data obtained from the Mecklenburg County Integrated Data Store (IDS)

Public Reports, the Mecklenburg County GeoPortal, and the Ohio Housing Finance

Agency. For Charlotte, we reconfirmed all LIHTC projects and their locations by using

the Mecklenburg County GeoPortal, Google satellite imagery, and FindTheData.

Specifically, Mecklenburg County Geoportal provides extensive information, especially

in terms of property, environment, community information, and even building images

(maps.co.mecklenburg.nc.us). Also, FindTheData allows us to identify the addresses,

sizes, types and building images of LIHTC projects (www.findthedata.org). We also

determined the project completion dates through the Mecklenburg County IDS Public

Reports. For Cleveland, the LIHTC data set derived from the Ohio Housing Finance

Agency included information about locations and placed in service (PIS) dates. However,

we also reconfirmed all of these LIHTC projects and their locations by using Google

satellite imagery and FindTheData. As a result, there were 75 projects (4,718 units) in

Charlotte and 123 projects (8,603 units) in Cleveland (see Figure 6).
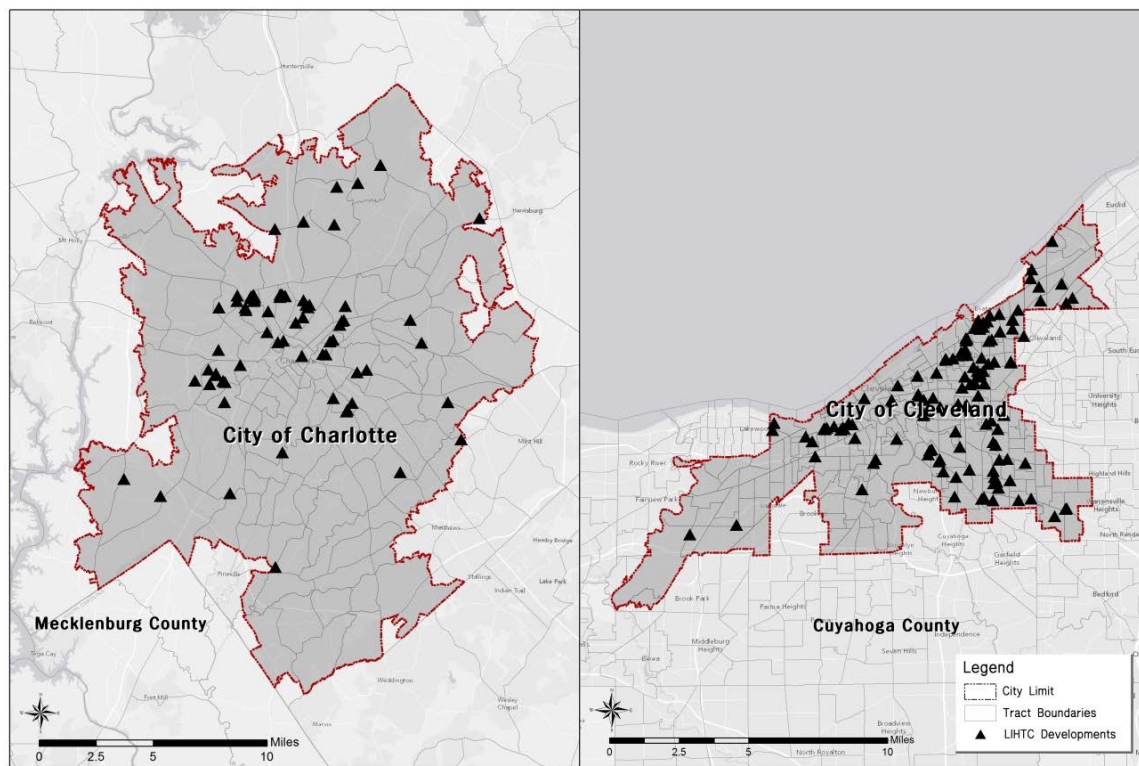
Source: Cities of Charlotte and Cleveland GIS Data Sets

Figure 6. LIHTC Developments in the Study Areas

4.2.2.1 Defining Proximity to LIHTC Developments

This study analyzed sales prices and housing duration before and after the implementation of LIHTC subsidized housing within a microneighborhood. This study defined a microneighborhood as concentric ring buffer areas of each property, which has been used in previous studies (Castells, 2010; Galster, Tatian, & Smith, 1999; Koschinsky, 2009; Lee, 2008; Schwartz, Ellen, Voicu, & Schill, 2006). Each property has its own microneighborhood that may include other properties within the radius of the property, based on Euclidean distance rings (i.e., 500 feet). Additionally, we identified the property as belonging to the "subsidized housing pocket," i.e., the influence area of LIHTC developments, when the boundaries of LIHTC developments fall within the microneighborhood of each property (Galster, Santiago, Smith, & Tatian, 1999). This is based on the perception that neighbors would recognize LIHTC units from the boundaries (edges) of the housing complexes, and not from the center point (centroid).

Many previous studies employed the centroid measurement to specify the distance between subsidized housing developments and each property. The measured distance from the center point of LIHTC parcels could be employed in other particular studies focused on small size developments. However, this approach is not appropriate to estimate the spillover effects of a large size development, which has the size over 500 feet from center point to the development boundary. For instance, even though each property is located right next to or in close proximity to the LIHTC development, the approach measured from the center point does not allow properties include the development within their microneighborhoods (See Figure 7). Hence, this approach

62

based on measurements from centroids is not reasonable to specify the subsidized housing pocket.
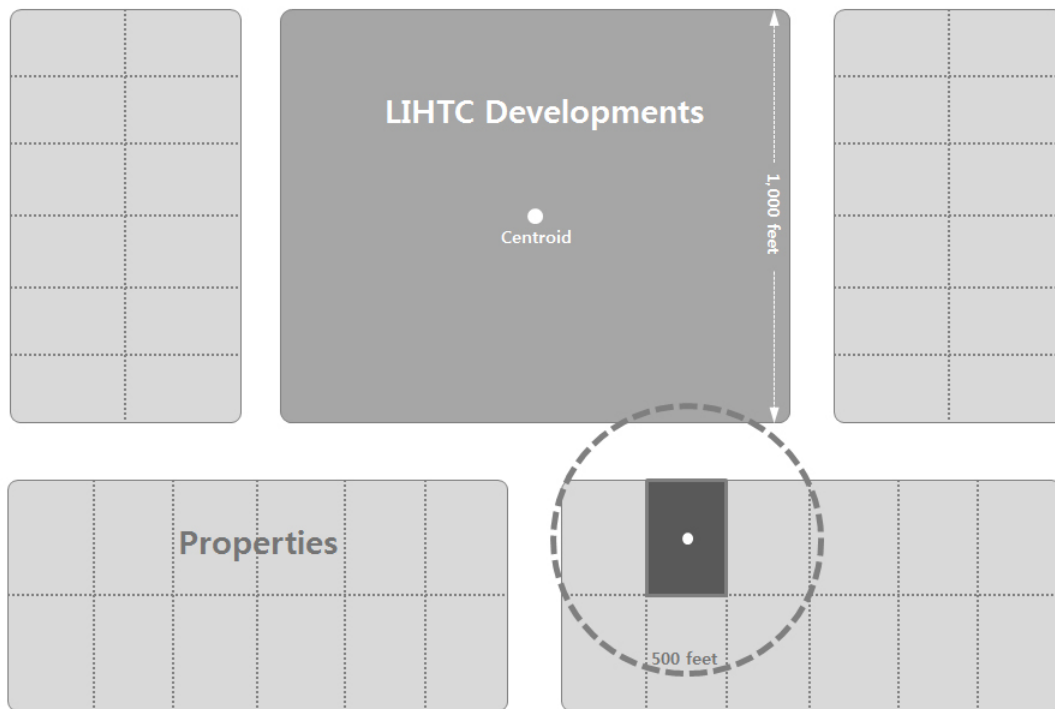
Figure 7. Definition of Microneighborhoods

The radial distance of microneighborhood boundaries is arbitrary and varies in different research; commonly used buffer distances are 1,000 feet, 1,500 feet, or 2,000 feet. Different researchers employed different criteria to define the radial distance of microneighborhood boundaries. For instance, microneighborhoods' radial distances are defined as 1,000 feet by Koschinsky (2009), 1,500 feet by Castells (2010), and 2,000 feet by Schwartz, Ellen, Voicu, and Schill (2006). In some studies, those radial distances

are classified as three distance bands: 500, 1,000, and 2000 feet (Galster, Tatian, & Smith, 1999) or 750, 1,500, and 2,500 feet (Lee, 2008). In this study, we used two microneighborhood boundaries: 0-500 feet and 500-2,000 feet. The inner ring aims to examine the change in sales prices and housing duration adjacent to LIHTC developments, which is termed an immediate neighborhood. The outer ring aims to explore the change in sales price and housing duration not adjacent to but sited in close proximity to LIHTC developments, which may be termed a functional neighborhood. These classifications of microneighborhoods are useful for examining different impacts on housing duration that might vary according to the proximity to LIHTC developments.

Some researchers criticize Euclidean buffers as not real urban space (Kobie & Lee, 2011). To define real neighborhood space, the face block measurement of proximity might be employed to define an immediate neighborhood (Kobie & Lee, 2011). However, when we employed the face block measurement of proximity, many properties did not include the LIHTC development within their microneighborhood although the LIHTC project was developed right next to their property. Thus, this approach is only useful for exploring spillover effects of small-scale units or projects (e.g., residential foreclosures, abandoned housing, to name a few), not for exploring those of large-scale developments.

4.2.3 Locational and Neighborhood Characteristics

Many previous studies employed the hedonic price model, especially in terms of the cross-sectional approach, to estimate the impact of subsidized housing programs on

neighborhoods. The typical variables to control neighborhood characteristics in their methodologies is that they included sociodemographic features derived from the decennial Census, especially in terms of income, poverty, race, unemployment, and education, to name a few. However, those sociodemographic characteristics do tend to be highly correlated with each other, so only limited features were used in their methodologies. To overcome this limitation, this study employed the AITS-DID approach to estimate the impacts of LIHTC developments on neighborhoods. The AITS-DID approach does not specify neighborhood characteristics directly (Koschinsky, 2009). This model uses census tract fixed effects to control for unobserved neighborhood characteristics. In addition, this approach includes trend surface variables (x-y coordinates or polynomial transformations of these coordinates) to explain the locational characteristics of each property. Incorporating the trend surface in empirical models explains or reduces spatial heterogeneity and spatial correlation because this approach explains the price of each property in terms of its geographic location vis-à-vis those of other properties (Ellen & Voicu, 2007; Galster, Santiago, Smith, & Tatian, 1999; Galster, Tatian, & Smith, 1999; Koschinsky, 2009; Schwartz, Ellen, Voicu, & Schill, 2006). Hence, the AITS-DID approach can isolate the impacts of LIHTC developments by controlling for locational and neighborhood characteristics, as well as housing structural characteristics.

In this study, the spatial fixed effects for capturing the unobserved neighborhood characteristics were derived from Year 2000 census tracts. The geographic coordinates of each property normalized by the distance to the Central Business District (CBD) were

calculated from the Mecklenburg and Cuyahoga County Parcel data, and the Census Transportation Planning Products (CTPP) 2000 Home-to-work Flows data. To be more specific, this study defined a CBD as a group of high-job-density census tracts. Job density was calculated as the number of jobs per square meter of land use in each census tract. The number of jobs for each census tract was derived from the CTPP 2000 Home-to-work flows and land area for each census tract was derived from the Census 2000 data. Additionally, this research used the Mecklenburg and Cuyahoga GIS Center data to account for the proximity to parks, rivers, and lakes.

4.2.4 Neighborhood Heterogeneity

Empirical models in this study are estimated separately for three types of neighborhoods stratified by family income, to test whether impacts of subsidized housing vary based on income heterogeneity. Housing submarkets could be defined in terms of ethnicity and income level. However, the study focused on the income levels of neighborhoods to signify the neighborhood's heterogeneity. Because LIHTC subsidized units are almost always occupied by households below the 30th percentile of the income distribution, the discrepancies in income levels of tenant characteristics between LIHTC households and neighbors would play a key role in allowing different spillover effects across neighborhoods.

The 2000 census data for median family income was used for measuring income heterogeneity based on census tract boundaries. Census tracts where the median family income was less than 80 percent of the city's median family income were defined as

low-income neighborhoods; census tracts with a median family income of 80 to 120 percent of the city's median family income were defined as middle-income neighborhoods; census tracts with a median family income higher than 120 percent of the city's median family income were defined as high income neighborhoods.[1]
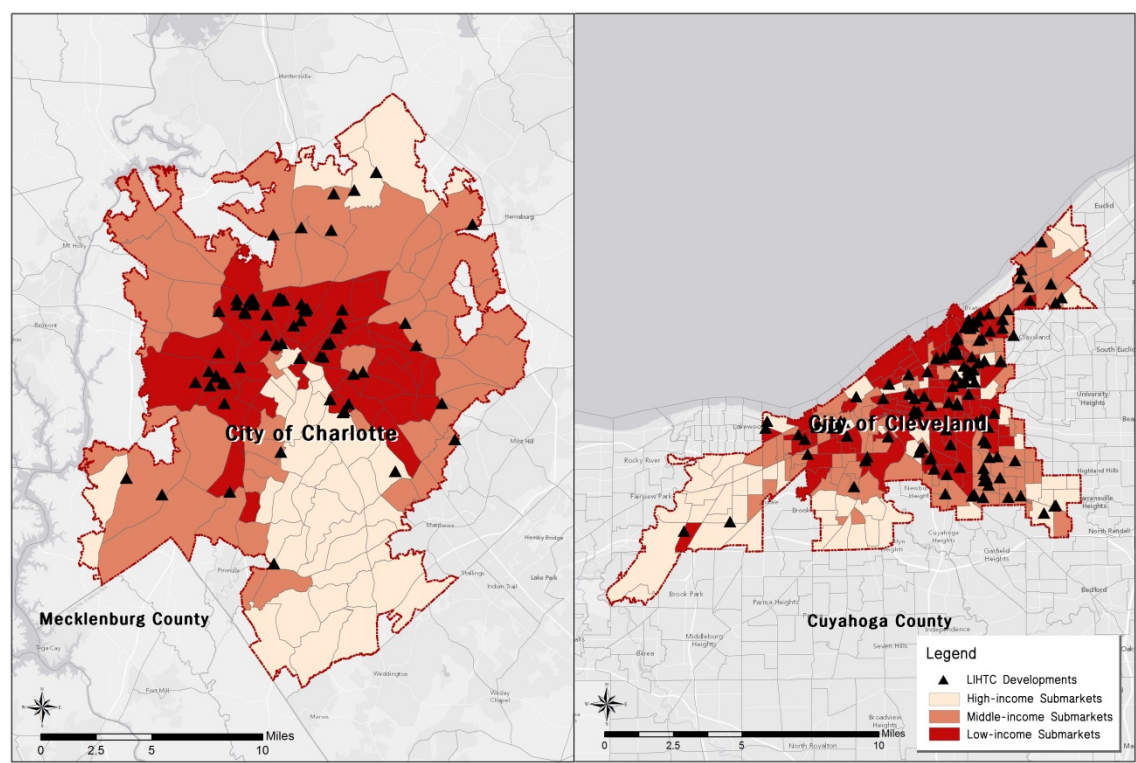
Source: Cities of Charlotte and Cleveland GIS Data Sets

Figure 8. LIHTC Developments in Neighborhood Heterogeneity

As seen in Figure 8, there is a difference between the spatial distribution of residents based on their family income between Charlotte and Cleveland. The city of

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[1] The HUD's 2000 median family income for the city of Charlotte was $56,500 and for the city of Cleveland was $30,300.

Charlotte has neighborhoods radiating in all directions from the Charlotte center city. High-income neighborhoods are distributed in a fan-shape from the center of city in the southern part of Charlotte, so low- and middle-income neighborhoods are shaped like a crescent in Charlotte. In contrast, the residential geography of Cleveland shows that low-income neighborhoods are concentrated in the center city while high-income neighborhoods are located at the edge of the city.

Table 2. Spatial Distribution of LIHTC Developments by Submarkets

Submarkets (by Income)	Charlotte		Cleveland	
	No. (%) of Projects	No. (%) of Units	No. (%) of Projects	No. (%) of Units
Low-income	59 (78.67)	3,447 (73.06)	59 (47.97)	5,105 (59.34)
Middle-income	12 (16.00)	830 (17.59)	46 (37.40)	2,645 (30.75)
High-income	4 (5.33)	441 (9.35)	18 (14.63)	853 (9.91)
Citywide	75 (100.00)	4,718 (100.00)	123 (100.00)	8,603 (100.00)

Table 2 presents the spatial distribution of LIHTC developments in both cities. Most LIHTC projects were developed in low- and middle-income neighborhoods. Around 79 percent of LIHTC projects and 73 percent of LIHTC units were located in low-income neighborhoods in Charlotte. Similarly, 48 percent of projects and 59 percent of units were sited in low-income neighborhoods in Cleveland.

4.3 Descriptive Statistics

       This study consists of an empirical analysis exploring the impacts of LIHTC developments on 1) nearby property values and 2) neighborhood housing turnover. The first analysis for examining the associations between LIHTC developments and neighboring housing prices used 114,471 housing sales in Charlotte and 27,634 housing sales in Cleveland between 1996 and 2007. Of these housing sales records, 7.2 percent (8,246 sales) were within 2,000 feet of the LIHTC developments in Charlotte and 28.9 percent (8,006 sales) were within 2,000 feet of the LIHTC developments in Cleveland. There were 125 census tracts for Charlotte and 192 census tracts for Cleveland with more than ten properties per census tracts. Table 3 presents the descriptive statistics on the structure and location characteristics of the final sample for the first analysis exploring the relationships between LIHTC projects and surrounding housing prices in Charlotte and Cleveland. The average sales price for Charlotte was around $195,000 at a heated area of 2,055 square feet. The average sales price for Cleveland was lower than that for Charlotte, around $74,000 at a heated area of 1,268 square feet. Almost 95 percent of sold homes were built before 1980 in Cleveland while only 20 percent of properties were built before 1980 in Charlotte. Around 26 percent of properties in Charlotte had a brick/stone exterior, but only 9 percent in Cleveland had a similar exterior. There were more sales in the sample with high housing qualities than low housing qualities in Charlotte; 2 percent of properties had high housing qualities and 1 percent had a low housing qualities. In contrast, there were more properties with low than high housing qualities in Cleveland; 7 percent of properties had low housing

qualities and less than 1 percent had high housing qualities. In terms of locational

characteristics, 7 percent of sales in Charlotte and 5 percent in Cleveland were located

within 250 feet from parks. The descriptive statistics implied that housing characteristics

for properties in Cleveland has deteriorated more than those in Charlotte. Furthermore,

around 50 percent of sales in both cities occurred between 2004 and 2007.

Table 3. Citywide Descriptive Statistics

Variable Definition and Unit	Charlotte				Cleveland			
	Mean	Std.Dev.	Min	Max	Mean	Std.Dev.	Min	Max
Dependent Variable								
Sales Price ($1,000)	194.95	142.71	23.50	1,039.50	73.74	37.41	3.50	239.90
Independent Variables								
Structural characteristics								
Heated Areas (sq ft)	2,055.77	904.84	414	13,580	1,268.10	344.21	390.00	8,023.00
Property Sizes (sq ft)	-	-	-	-	5,157.94	2,774.59	340.00	102,000.00
Building Age (years)	17.29	20.59	0.00	107.00	74.64	26.03	0.00	207.00
Number of Bedrooms (#)	3.31	0.67	1.00	44.00	2.97	0.78	1.00	10.00
Number of Full Bathrooms (#)	2.03	0.63	1.00	8.00	1.10	0.31	1.00	4.00
Number of Half Bathrooms (#)	0.57	0.57	0.00	11.00	0.14	0.36	0.00	10.00
Number of Fireplaces (#)	0.84	0.84	0.00	11.00	-	-	-	-
Binary: 1 = Electric Heating	0.11	0.31	0.00	1.00	-	-	-	-
Binary: 1 = Oil Heating Source	0.01	0.09	0.00	1.00	-	-	-	-
Binary: 1 = Brick/Stone Exterior	0.26	0.44	0.00	1.00	0.09	0.29	0.00	1.00
Binary: 1 = High-Housing	0.02	0.13	0.00	1.00	0.00	0.06	0.00	1.00
Binary: 1 = Low-Housing	0.01	0.09	0.00	1.00	0.07	0.26	0.00	1.00
Binary: 1 = Bungalow Housing	-	-	-	-	0.07	0.25	0.00	1.00
Binary: 1 = Colonial Housing	-	-	-	-	0.49	0.50	0.00	1.00
Locational Characteristics								
Binary: 1 = Parks 250 ft.	0.07	0.25	0.00	1.00	0.05	0.21	0.00	1.00
Binary: 1 = Rivers/Lakes 500 ft.	-		-	-	0.04	0.19	0.00	1.00
Year/Quarter Characteristics								
1997 (Sales Year)	0.04	0.20	0.00	1.00	0.06	0.24	0.00	1.00
1998 (Sales Year)	0.05	0.22	0.00	1.00	0.07	0.25	0.00	1.00
1999 (Sales Year)	0.06	0.24	0.00	1.00	0.07	0.26	0.00	1.00
2000 (Sales Year)	0.07	0.25	0.00	1.00	0.07	0.26	0.00	1.00
2001 (Sales Year)	0.07	0.26	0.00	1.00	0.08	0.27	0.00	1.00
2002 (Sales Year)	0.08	0.27	0.00	1.00	0.06	0.24	0.00	1.00
2003 (Sales Year)	0.09	0.28	0.00	1.00	0.09	0.29	0.00	1.00
2004 (Sales Year)	0.10	0.30	0.00	1.00	0.10	0.30	0.00	1.00
2005 (Sales Year)	0.12	0.32	0.00	1.00	0.13	0.33	0.00	1.00
2006 (Sales Year)	0.14	0.35	0.00	1.00	0.12	0.32	0.00	1.00
2007 (Sales Year)	0.14	0.35	0.00	1.00	0.10	0.30	0.00	1.00

Table 3. Continued

Variable Definition and Unit	Charlotte				Cleveland			
	Mean	Std.Dev.	Min	Max	Mean	Std.Dev.	Min	Max
April-June (Sales Quarter)	0.28	0.45	0.00	1.00	0.29	0.45	0.00	1.00
July-Sept (Sales Quarter)	0.28	0.45	0.00	1.00	0.27	0.45	0.00	1.00
Oct-Dec (Sales Quarter)	0.23	0.42	0.00	1.00	0.23	0.42	0.00	1.00
LIHTC Developments								
Within 500 ft. of LIHTC	0.01	0.10	0.00	1.00	0.03	0.17	0.00	1.00
Within 2,000 ft. of LIHTC	0.06	0.25	0.00	1.00	0.26	0.44	0.00	1.00

Empirical models for exploring the impacts of LIHTC developments on nearby property values were estimated separately for three types of neighborhoods stratified by family income. Table 4 shows the descriptive statistics on the sample for low-income neighborhoods in Charlotte and Cleveland. The analysis for low-income neighborhoods used 17,853 housing sales in Charlotte and 4,549 housing sales in Cleveland. Of these housing sales records, 25.9 percent (4,628 sales) were within 2,000 feet of the Charlotte LIHTC developments and 55.2 percent (2,511 sales) were within 2,000 feet of the Cleveland LIHTC developments. In addition, there were 47 census tracts for Charlotte and 62 census tracts for Cleveland with more than ten properties per census tracts. The average sales price for the low-income submarkets was around $113,000 at a heated area of 1,347 square feet in Charlotte, whereas in Cleveland the average sales price was around $62,000 at a heated area of 1,358 square feet. About 43 percent of properties in Charlotte had a brick/stone exterior, but only 4 percent in Cleveland had this exterior. The ratios for the low housing quality of sales were 21 percent in Cleveland, but only 4 percent in Charlotte. In contrast, the average ratio for the high housing quality of sales was below 1 percent in both cities. In terms of locational characteristic, 9 percent of sales in Charlotte and 4 percent in Cleveland were located within 250 feet from parks.

71

Table 4. Descriptive Statistics for Low-income Submarkets

Variable Definition and Unit	Charlotte				Cleveland			
	Mean	Std.Dev.	Min	Max	Mean	Std.Dev.	Min	Max
Dependent Variable								
Sales Price ($1,000)	112.84	78.78	23.50	1,025.00	61.72	42.32	3.50	239.00
Independent Variables								
Structural characteristics								
Heated Areas (sq ft)	1,346.62	440.73	414.00	5,193.00	1,357.95	386.30	456.00	8,023.00
Property Sizes (sq ft)	-	-	-	-	4,356.07	2,113.02	340.00	43,750.00
Building Age (years)	39.00	24.05	0.00	107.00	87.33	30.78	0.00	207.00
Number of Bedrooms (#)	2.86	0.57	1.00	10.00	3.14	0.92	1.00	10.00
Number of Full Bathrooms (#)	1.47	0.56	1.00	5.00	1.16	0.39	1.00	4.00
Number of Half Bathrooms (#)	0.28	0.46	0.00	11.00	0.14	0.35	0.00	2.00
Number of Fireplaces (#)	0.51	0.51	0.00	7.00	-	-	-	-
Binary: 1 = Electric Heating	0.12	0.32	0.00	1.00	-	-	-	-
Binary: 1 = Oil Heating Source	0.01	0.11	0.00	1.00	-	-	-	-
Binary: 1 = Brick/Stone Exterior	0.43	0.49	0.00	1.00	0.04	0.19	0.00	1.00
Binary: 1 = High-Housing	0.00	0.01	0.00	1.00	0.00	0.06	0.00	1.00
Binary: 1 = Low-Housing	0.04	0.19	0.00	1.00	0.21	0.40	0.00	1.00
Binary: 1 = Bungalow Housing	-	-	-	-	0.08	0.27	0.00	1.00
Binary: 1 = Colonial Housing	-	-	-	-	0.61	0.49	0.00	1.00
Locational Characteristics								
Binary: 1 = Parks 250 ft.	0.09	0.28	0.00	1.00	0.04	0.18	0.00	1.00
Binary: 1 = Rivers/Lakes 500 ft.	-	-	-	-	0.01	0.09	0.00	1.00
Year/Quarter Characteristics								
1997 (Sales Year)	0.04	0.20	0.00	1.00	0.06	0.23	0.00	1.00
1998 (Sales Year)	0.05	0.22	0.00	1.00	0.07	0.25	0.00	1.00
1999 (Sales Year)	0.06	0.24	0.00	1.00	0.06	0.25	0.00	1.00
2000 (Sales Year)	0.06	0.24	0.00	1.00	0.07	0.25	0.00	1.00
2001 (Sales Year)	0.06	0.25	0.00	1.00	0.08	0.27	0.00	1.00
2002 (Sales Year)	0.08	0.27	0.00	1.00	0.06	0.24	0.00	1.00
2003 (Sales Year)	0.08	0.27	0.00	1.00	0.09	0.29	0.00	1.00
2004 (Sales Year)	0.09	0.29	0.00	1.00	0.10	0.30	0.00	1.00
2005 (Sales Year)	0.11	0.32	0.00	1.00	0.14	0.35	0.00	1.00
2006 (Sales Year)	0.15	0.36	0.00	1.00	0.13	0.34	0.00	1.00
2007 (Sales Year)	0.17	0.37	0.00	1.00	0.09	0.29	0.00	1.00
April-June (Sales Quarter)	0.27	0.45	0.00	1.00	0.29	0.45	0.00	1.00
July-Sept (Sales Quarter)	0.27	0.44	0.00	1.00	0.26	0.44	0.00	1.00
Oct-Dec (Sales Quarter)	0.24	0.43	0.00	1.00	0.23	0.42	0.00	1.00
LIHTC Developments								
Within 500 ft. of LIHTC	0.04	0.21	0.00	1.00	0.08	0.27	0.00	1.00
Within 2,000 ft. of LIHTC	0.22	0.41	0.00	1.00	0.47	0.50	0.00	1.00

As seen in Table 5, the analysis for middle-income neighborhoods used 51,728 housing sales in Charlotte and 10,598 housing sales in Cleveland. Of these housing sales

records, 4.5 percent (2,328 sales) were within 2,000 feet of the Charlotte LIHTC

developments and 39.3 percent (4,163 sales) were within 2,000 feet of the Cleveland

LIHTC developments. In addition, forty-one census tracts including more than ten

properties were used in Charlotte and 82 census tracts were used in Cleveland. The

average sales price for Cleveland middle-income submarkets was again lower than that

for Charlotte: around $63,000 at a heated area of 1,288 square feet in Cleveland and

around $145,000 at a heated area of 1,775 square feet in Charlotte. The ratio of

brick/stone exteriors in Charlotte continues to be higher than Cleveland: 15 percent in

Charlotte and 4 percent in Cleveland. In terms of locational characteristic, 8 percent of

sales in Charlotte and 4 percent in Cleveland were located within 250 feet from parks.

Table 5. Descriptive Statistics for Middle-income Submarkets

Variable Definition and Unit	Charlotte				Cleveland			
	Mean	Std.Dev.	Min	Max	Mean	Std.Dev.	Min	Max
Dependent Variable								
Sales Price ($1,000)	144.76	75.12	23.50	1,013.00	63.22	34.10	3.50	237.00
Independent Variables								
Structural characteristics								
Heated Areas (sq ft)	1,774.90	613.95	451.00	8,380.00	1,288.45	336.39	390.00	6,089.00
Property Sizes (sq ft)	-	-	-	-	4,810.18	1,799.49	731.00	54,554.00
Building Age (years)	12.78	16.06	0.00	107.00	82.58	24.49	0.00	206.00
Number of Bedrooms (#)	3.16	0.49	1.00	9.00	3.05	0.78	1.00	10.00
Number of Full Bathrooms (#)	1.93	0.41	1.00	6.00	1.10	0.31	1.00	4.00
Number of Half Bathrooms (#)	0.54	0.51	0.00	10.00	0.11	0.32	0.00	3.00
Number of Fireplaces (#)	0.82	0.39	0.00	5.00	-	-	-	-
Binary: 1 = Electric Heating	0.13	0.34	0.00	1.00	-	-	-	-
Binary: 1 = Oil Heating Source	0.01	0.11	0.00	1.00	-	-	-	-
Binary: 1 = Brick/Stone Exterior	0.15	0.36	0.00	1.00	0.04	0.20	0.00	1.00
Binary: 1 = High-Housing	0.00	0.02	0.00	1.00	0.00	0.04	0.00	1.00
Binary: 1 = Low-Housing	0.00	0.07	0.00	1.00	0.09	0.28	0.00	1.00
Binary: 1 = Bungalow Housing	-	-	-	-	0.05	0.23	0.00	1.00
Binary: 1 = Colonial Housing	-	-	-	-	0.61	0.49	0.00	1.00

Table 5. Continued

Variable Definition and Unit	Charlotte				Cleveland			
	Mean	Std.Dev.	Min	Max	Mean	Std.Dev.	Min	Max
Locational Characteristics								
Binary: 1 = Parks 250 ft.	0.08	0.27	0.00	1.00	0.04	0.21	0.00	1.00
Binary: 1 = Rivers/Lakes 500 ft.	-	-	-	-	0.04	0.20	0.00	1.00
Year/Quarter Characteristics								
1997 (Sales Year)	0.04	0.19	0.00	1.00	0.06	0.23	0.00	1.00
1998 (Sales Year)	0.05	0.22	0.00	1.00	0.06	0.24	0.00	1.00
1999 (Sales Year)	0.07	0.25	0.00	1.00	0.07	0.26	0.00	1.00
2000 (Sales Year)	0.07	0.26	0.00	1.00	0.07	0.25	0.00	1.00
2001 (Sales Year)	0.08	0.26	0.00	1.00	0.08	0.27	0.00	1.00
2002 (Sales Year)	0.08	0.27	0.00	1.00	0.06	0.24	0.00	1.00
2003 (Sales Year)	0.08	0.28	0.00	1.00	0.08	0.28	0.00	1.00
2004 (Sales Year)	0.09	0.29	0.00	1.00	0.10	0.30	0.00	1.00
2005 (Sales Year)	0.11	0.32	0.00	1.00	0.13	0.34	0.00	1.00
2006 (Sales Year)	0.15	0.36	0.00	1.00	0.13	0.33	0.00	1.00
2007 (Sales Year)	0.14	0.35	0.00	1.00	0.11	0.31	0.00	1.00
April-June (Sales Quarter)	0.27	0.45	0.00	1.00	0.28	0.45	0.00	1.00
July-Sept (Sales Quarter)	0.27	0.45	0.00	1.00	0.26	0.44	0.00	1.00
Oct-Dec (Sales Quarter)	0.24	0.43	0.00	1.00	0.23	0.42	0.00	1.00
LIHTC Developments								
Within 500 ft. of LIHTC	0.01	0.06	0.00	1.00	0.03	0.18	0.00	1.00
Within 2,000 ft. of LIHTC	0.04	0.20	0.00	1.00	0.36	0.48	0.00	1.00

Table 6 presents the descriptive statistics on the sample for high-income neighborhoods in Charlotte and Cleveland. The analysis for high-income submarkets used 44,890 housing sales in Charlotte and 12,487 housing sales in Cleveland. Of these housing sales records, 2.9 percent (1,290 sales) were within 2,000 feet of the Charlotte LIHTC developments and 10.7 percent (1,332 sales) were within 2,000 feet of the Cleveland LIHTC developments. These ratios for LIHTC developments were relatively small compared to other housing submarkets such as low- and middle-income neighborhoods. This implied that LIHTC complexes are more likely to be located within distressed neighborhoods. There were 37 census tracts for Charlotte and 48 census tracts for Cleveland with more than ten properties per census tracts. The average sales price for

Charlotte was around $285,000 at a heated area of 2,660 square feet. Additionally, there

was large variation of sales prices in the high-income neighborhoods of Charlotte. In

contrast, the average sales price for Cleveland high-income submarkets was lower than

that for Charlotte, $87,000 at a heated area of 1,218 square feet. Cleveland's high-

income neighborhoods also showed that there was relatively small variation in housing

prices compared to Charlotte. About 31 percent of properties in Charlotte had

brick/stone exterior, but only 15 percent in Cleveland had those exteriors. There were

more sales in the sample with a high rather than low housing quality in Charlotte. In

terms of locational characteristic, 4 percent of sales in Charlotte and 5 percent in

Cleveland were located within 250 feet from parks.

Table 6. Descriptive Statistics for High-income Submarkets

Variable Definition and Unit	Charlotte				Cleveland			
	Mean	Std.Dev.	Min	Max	Mean	Std.Dev.	Min	Max
Dependent Variable								
Sales Price ($1,000)	285.45	170.84	23.50	1,039.50	87.05	33.68	3.50	239.90
Independent Variables								
Structural characteristics								
Heated Areas (sq ft)	2,660.19	959.15	534.00	13,580.00	1,218.10	325.61	440.00	5,766.00
Property Sizes (sq ft)	-	-	-	-	5,745.22	3,461.35	825.00	102,000.00
Building Age (years)	13.86	18.19	0.00	107.00	63.28	20.10	0.00	154.00
Number of Bedrooms (#)	3.66	0.71	1.00	44.00	2.83	0.69	1.00	8.00
Number of Full Bathrooms	2.36	0.68	1.00	8.00	1.07	0.27	1.00	4.00
Number of Half Bathrooms	0.71	0.50	0.00	10.00	0.16	0.39	0.00	10.00
Number of Fireplaces (#)	0.99	0.21	0.00	11.00	-	-	-	-
Binary: 1 = Electric Heating	0.07	0.26	0.00	1.00	-	-	-	-
Binary: 1 = Oil Heating	0.00	0.04	0.00	1.00	-	-	-	-
Binary: 1 = Brick/Stone	0.31	0.46	0.00	1.00	0.15	0.36	0.00	1.00
Binary: 1 = High-Housing	0.04	0.20	0.00	1.00	0.01	0.08	0.00	1.00
Binary: 1 = Low-Housing	0.00	0.02	0.00	1.00	0.01	0.10	0.00	1.00
Binary: 1 = Bungalow	-	-	-	-	0.07	0.26	0.00	1.00
Binary: 1 = Colonial Housing	-	-	-	-	0.36	0.48	0.00	1.00
Locational Characteristics								
Binary: 1 = Parks 250 ft.	0.04	0.20	0.00	1.00	0.05	0.22	0.00	1.00
Binary: 1 = Rivers/Lakes 500 ft.	-	-	-	-	0.04	0.21	0.00	1.00

Table 6. Continued

Variable Definition and Unit	Charlotte				Cleveland			
	Mean	Std.Dev.	Min	Max	Mean	Std.Dev.	Min	Max
Year/Quarter Characteristics								
1997 (Sales Year)	0.04	0.20	0.00	1.00	0.06	0.25	0.00	1.00
1998 (Sales Year)	0.05	0.23	0.00	1.00	0.07	0.26	0.00	1.00
1999 (Sales Year)	0.06	0.24	0.00	1.00	0.08	0.27	0.00	1.00
2000 (Sales Year)	0.07	0.25	0.00	1.00	0.07	0.26	0.00	1.00
2001 (Sales Year)	0.07	0.26	0.00	1.00	0.08	0.27	0.00	1.00
2002 (Sales Year)	0.08	0.27	0.00	1.00	0.06	0.25	0.00	1.00
2003 (Sales Year)	0.09	0.29	0.00	1.00	0.09	0.29	0.00	1.00
2004 (Sales Year)	0.11	0.31	0.00	1.00	0.10	0.30	0.00	1.00
2005 (Sales Year)	0.13	0.33	0.00	1.00	0.11	0.32	0.00	1.00
2006 (Sales Year)	0.14	0.34	0.00	1.00	0.10	0.31	0.00	1.00
2007 (Sales Year)	0.12	0.33	0.00	1.00	0.09	0.29	0.00	1.00
April-June (Sales Quarter)	0.29	0.45	0.00	1.00	0.29	0.45	0.00	1.00
July-Sept (Sales Quarter)	0.28	0.45	0.00	1.00	0.29	0.45	0.00	1.00
Oct-Dec (Sales Quarter)	0.23	0.42	0.00	1.00	0.23	0.42	0.00	1.00
LIHTC Developments								
Within 500 ft. of LIHTC	0.01	0.05	0.00	1.00	0.01	0.11	0.00	1.00
Within 2,000 ft. of LIHTC	0.03	0.16	0.00	1.00	0.10	0.29	0.00	1.00

This study also examines the impacts of LIHTC developments on neighborhood housing turnover. As seen in Table 7, the second analysis exploring the relationships between LIHTC developments and neighborhood housing turnover used 59,882 housing transactions in Charlotte and 20,824 housing transactions in Cleveland between 1996 and 2007. Among these housing transactions, 40.1 percent (23,974 properties) and 57.6 percent (11,989 properties) were censored (were not sold) during the research period in Charlotte and Cleveland, respectively. Additionally, in our final sample, 7.9 percent (4,702 properties) were within 2,000 feet of the Charlotte LIHTC projects and 35.1 percent (7,309 properties) were within 2,000 feet of the Cleveland LIHTC projects. Average housing duration including right-censored observations that sold after 2007 in Charlotte is around 1,210 days and that in Cleveland is around 1,230 days. Average standardized sales price in Charlotte is around 0.99 and that in Cleveland is about 0.96.

The housing sales price of each property was standardized by the average housing price of the same year with the housing sales price of each property to remove time dependency in this analysis (Kim & Horner, 2003). The standardized sales price variables are described in more detail in the methodology chapter. With respect to locational characteristics, 7 percent of sales in Charlotte and 5 percent in Cleveland were located within 250 feet from parks.

Table 7. Citywide Descriptive Statistics

Variable Definition and Unit	Charlotte				Cleveland			
	Mean	Std.Dev.	Min	Max	Mean	Std.Dev.	Min	Max
Dependent Variable								
Housing Duration (days)	1,213.16	1,009.86	1.00	4,381.00	1,231.15	1,040.77	3.00	4,373.00
Independent Variables								
Housing Price characteristics								
Standardized Sales Price	0.99	1.00	0.02	15.91	0.96	0.51	0.02	3.67
Locational Characteristics								
Binary: 1 = Parks 250 ft.	0.07	0.25	0.00	1.00	0.05	0.21	0.00	1.00
Binary: 1 = Rivers/Lakes 500 ft.	-	-	-	-	0.01	0.10	0.00	1.00
LIHTC Developments								
Within 500 ft. of LIHTC	0.01	0.10	0.00	1.00	0.04	0.20	0.00	1.00
Within 2,000 ft. of LIHTC	0.07	0.25	0.00	1.00	0.31	0.46	0.00	1.00

Empirical models for examining the impacts of LIHTC developments on neighborhood housing turnover are also estimated separately for three types of neighborhoods stratified by family income as they are in the models for exploring the impacts of LIHTC developments on nearby property values. Table 8 presents the descriptive statistics on the sample for low-income neighborhoods in Charlotte and Cleveland. The analysis for low-income submarkets used 9,604 housing sales in

Charlotte and 3,198 housing sales in Cleveland between 1996 and 2007. Of these

housing transactions, 26.6 percent (2,551 sales) were within 2,000 feet of the Charlotte

LIHTC projects and 75.6 percent (2,417 sales) were within 2,000 feet of the Cleveland

LIHTC projects. Average housing duration including right-censored observations in

Charlotte is around 1,020 days and that in Cleveland is around 1,070 days. Average

standardized sales price in Charlotte is around 0.46 and that in Cleveland is about 0.67.

In terms of locational characteristics, 8 percent of sales in Charlotte and 3 percent in

Cleveland were located within 250 feet from parks.

Table 8. Descriptive Statistics for Low-income Submarkets

Variable Definition and Unit	Charlotte				Cleveland			
	Mean	Std.Dev.	Min	Max	Mean	Std.Dev.	Min	Max
Dependent Variable								
Housing Duration (days)	1,021.72	998.25	1.00	4,333.00	1,069.82	990.14	5.00	4,317.00
Independent Variables								
Housing Price characteristics								
Standardized Sales Price	0.46	0.41	0.02	5.57	0.67	0.47	0.02	3.55
Locational Characteristics								
Binary: 1 = Parks 250 ft.	0.08	0.28	0.00	1.00	0.03	0.18	0.00	1.00
Binary: 1 = Rivers/Lakes 500 ft.	-	-	-	-	0.01	0.06	0.00	1.00
LIHTC Developments								
Within 500 ft. of LIHTC	0.04	0.20	0.00	1.00	0.11	0.31	0.00	1.00
Within 2,000 ft. of LIHTC	0.22	0.42	0.00	1.00	0.64	0.48	0.00	1.00

As seen in Table 9, the analysis for middle-income neighborhoods used 25,052

housing sales in Charlotte and 7,702 housing sales in Cleveland between 1996 and 2007.

Of these housing transactions, 5.04 percent (1,264 sales) were within 2,000 feet of the

Charlotte LIHTC projects and 48.5 percent (3,736 sales) were within 2,000 feet of the

Cleveland LIHTC projects. Average housing duration including right-censored

observations in Charlotte is about 1,185 days and that in Cleveland is about 1,130 days.

Compared to other housing submarkets such as low- and high-income neighborhoods,

average housing duration in the Charlotte middle-income submarket was longer than that

in Cleveland. Average standardized sales price in Charlotte is around 0.83 and that in

Cleveland is about 0.78. In addition, 8 percent of sales in Charlotte and 4 percent in

Cleveland were located within 250 feet from parks.

Table 9. Descriptive Statistics for Middle-income Submarkets

Variable Definition and Unit	Charlotte				Cleveland			
	Mean	Std.Dev.	Min	Max	Mean	Std.Dev.	Min	Max
Dependent Variable								
Housing Duration (days)	1,185.07	1,025.36	1.00	4,381.00	1,130.45	1,028.24	3.00	4,373.00
Independent Variables								
Housing Price characteristics								
Standardized Sales Price	0.83	0.97	0.02	11.17	0.78	0.40	0.03	3.67
Locational Characteristics								
Binary: 1 = Parks 250 ft.	0.08	0.28	0.00	1.00	0.04	0.20	0.00	1.00
Binary: 1 = Rivers/Lakes 500 ft.	-	-	-	-	0.03	0.16	0.00	1.00
LIHTC Developments								
Within 500 ft. of LIHTC	0.01	0.07	0.00	1.00	0.05	0.21	0.00	1.00
Within 2,000 ft. of LIHTC	0.05	0.21	0.00	1.00	0.44	0.50	0.00	1.00

Table 10 shows the descriptive statistics on the sample for high-income

neighborhoods in Charlotte and Cleveland. The analysis for high-income submarkets

used 25,226 housing sales in Charlotte and 9,924 housing sales in Cleveland between

1996 and 2007. Of these housing transactions, 3.52 percent (887 sales) were within

2,000 feet of the Charlotte LIHTC projects and 11.7 percent (1,156 sales) were within

2,000 feet of the Cleveland LIHTC projects. Compared to other housing submarkets such as low- and middle-income neighborhoods in both cities, there was small variation of impacts sales associated with the LIHTC developments in high-income neighborhoods. This implies that LIHTC developments are more likely to be located in deteriorated neighborhoods such as low- and middle-income submarkets. Average housing duration including right-censored observations in Charlotte is around 1,310 days and that in Cleveland is around 1,440 days. Average standardized sales price in Charlotte is around 1.36 and that in Cleveland is about 1.23. In addition, 4 percent of sales in Charlotte and 5 percent in Cleveland were located within 250 feet from parks.

Table 10. Descriptive Statistics for High-income Submarkets

Variable Definition and Unit	Charlotte				Cleveland			
	Mean	Std.Dev.	Min	Max	Mean	Std.Dev.	Min	Max
Dependent Variable								
Housing Duration (days)	1,309.29	986.74	1.00	4,381.00	1,435.46	1,049.38	10.00	4,371.00
Independent Variables								
Housing Price characteristics								
Standardized Sales Price	1.36	1.05	0.02	15.91	1.23	0.47	0.05	3.62
Locational Characteristics								
Binary: 1 = Parks 250 ft.	0.04	0.20	0.00	1.00	0.05	0.22	0.00	1.00
Binary: 1 = Rivers/Lakes 500 ft.	-	-	-	-	0.01	0.11	0.00	1.00
LIHTC Developments								
Within 500 ft. of LIHTC	0.01	0.05	0.00	1.00	0.01	0.11	0.00	1.00
Within 2,000 ft. of LIHTC	0.03	0.18	0.00	1.00	0.10	0.31	0.00	1.00

In sum, the descriptive statistics for both analyses have expected values. Average sales prices in Charlotte were higher than those in Cleveland. Also, there was a large variation of sales prices in Charlotte compared to the variation of sales prices in

Cleveland. The average sales price in high-income neighborhoods was higher than that in other neighborhoods such as low- and middle-income submarkets. Housing duration in Cleveland was longer than in Charlotte. Additionally, housing duration in high-income submarket was longer than that in other submarkets. In terms of LIHTC developments, the number of properties including LIHTC developments within the microneighborhood of each property in low- and middle-income neighborhoods was higher than in high-income neighborhoods. Furthermore, the structure characteristics of properties in Charlotte were better than those in Cleveland. Compared to Cleveland, the average heated areas and numbers of bedrooms in Charlotte were larger. The building age in Charlotte was also younger than in Cleveland. Furthermore, the structure characteristics of properties were better in high-income neighborhoods for both cities. For instance, the building age in low-income neighborhoods was older compared to other neighborhoods such as high- and middle-income submarkets. The ratio of low housing quality was higher in low-income submarkets while the ratio of high housing quality was higher in high-income submarkets.

CHAPTER V

METHODOLOGY

5.1 Analysis for Social Equity

5.1.1 Bivariate Analysis (Location Quotient)

Before we explore the impacts of LIHTC developments on neighborhoods, this study examines the associations between the spatial location of each LIHTC development and the sociodemographic characteristics of neighborhoods. We can explore the discrepancies between LIHTC subsidized households and geography of opportunities by identifying the sociodemographic characteristics of neighborhoods associated with locating of LIHTC projects and units. Identifying these relationships will shed light on examining the empirical evidence on the uneven geography of opportunities for subsidized households.

This study used simple bivariate analysis, especially in terms of a location quotient (LQ), to explore the associations between LIHTC developments and neighborhoods.

$$LQ_n = \frac{S_{ni}}{LS_n} \tag{1}$$

where S_{ni} is the share of LIHTC project n in neighborhood i and LS_n is the share of LIHTC project n at the local level (Malizia & Feser, 1998). The location quotient is a simple ratio that captures the proportion of LIHTC subsidized developments that are attributable to each neighborhood weighted by the number of LIHTC projects developed

82

(Van Zandt & Mhatre, 2009). Thus, we can identify the likelihood that neighborhoods with each sociodemographic characteristic will contain LIHTC developments, especially in terms of the scale of projects and units, compared to the overall probability of a neighborhood containing that type of subsidized housing development (Rohe & Freeman, 2001). Rohe and Freeman (2001) employed this index to account for the relationships between the neighborhood characteristics and the siting of subsidized housing developments at the census tract level. However, since they constructed this index in terms of whether or not each census tract received subsidized housing developments without considering the scale of subsidized housing developments, their index could not take into account the number of subsidized housing projects and units in each neighborhood. Thus, this study reconstitutes their index with a consideration of the total number of subsidized housing projects and units at the census tract level. The index was calculated by dividing the ratio of each category of the census tracts' sociodemographic characteristics to the total number of projects or units in each category by the ratio of all census tracts to the total number of projects or units in all census tracts. Ratios less than 1 mean that census tracts in a category are less likely to contain LIHTC projects and units than an even distribution of those among categories. Ratios over 1 mean that census tracts in a category are more likely to contain LIHTC projects and units than even a distribution of those (Rohe & Freeman, 2001). Thus, values less than 1.0 indicate that, compared to the city as a whole, neighborhoods (census tracts) in an income category have an underrepresentation of LIHTC projects and units, while values over 1.0 indicate an overrepresentation (Van Zandt & Mhatre, 2009).

5.2 Analysis for Neighborhood Impacts

5.2.1 Hedonic Price Model

The hedonic price model, derived from Rosen (1974), has wide use in exploring the multidimensional aspects of the housing market, especially with respect to the evaluation of housing prices. Etymologically, the term "hedonics" stems from the Greek word *hedonikos*, meaning pleasure (Chin & Chau, 2003). This word origin implies that the hedonic price model is used to estimate the determinants of housing prices by looking at the utility of housing units. Housing price is determined by supply and demand in common with the market mechanism. However, the housing market is unique due to the inherent characteristics of housing goods in terms of durability, high cost of supply, heterogeneity, and spatial fixity, compared to other consumer goods (Chin & Chau, 2003). According to Rosen's perspective (1974), because housing units are heterogeneous goods, the price of one unit is different from other housing units due to the different inherent attributes with respect to structural, neighborhood, and locational characteristics.

According to the hedonic price model, various attributes embedded in housing goods cannot be separated from each other and be traded as part of a house (Mhatre, 2010). Buying housing goods means shopping for a package of inherent attributes of housing goods which refers to implicit prices. Hence, the hedonic price model postulates that housing goods are traded as a bundle of inherent attributes (Chin & Chau, 2003; Rosen, 1974). The market price of a house is accounted for as a function of various

characteristics, especially in terms of structural, neighborhood, and locational characteristics:

$$P_h = f(S_h, N_h, L_h),$$ (2)

where P_h is the market price of a house, each S_h, N_h, and L_h is a vector of structural, neighborhood, and locational characteristics of a house, and e_h is the error term.

Housing price function is the summation of all implicit prices associated with various characteristics of a housing unit. In addition, the implicit price of each housing attribute is derived from a regression analysis; the implicit price represents the preference and willingness of a consumer to pay for the corresponding attributes (Chin & Chau, 2003; Li, 2011). To be more specific, structural characteristics include physical attributes of a house such as the size of the living area, number of bedrooms, number of bathrooms, number of fireplaces, age of the structure, and lot size area to name a few (Mhatre, 2010). Neighborhood characteristics comprise neighborhood qualities where a housing unit is located such as education level, homeownership level, poverty level, income level, racial composition, unemployment level, and so on. Last, locational characteristics involve the proximity to amenities or disamenities from a house such as parks, rivers, lakes, central business district, shopping centers, and so on.

According to Rosen's framework, the hedonic price model is based on several assumptions, most of all that the market operates under perfect competition (Chin & Chau, 2003). In other words, there are numerous market participants and they have perfect information on housing products and prices in order to achieve a price equilibrium (Chin & Chau, 2003; Mhatre, 2010). This assumption could be valid in

terms of numerous market participants because there are many buyers seeking housing

and developers supplying housing goods in the market. However, the condition of

perfect information and knowledge on housing products is hard to realize in reality.

Second, the hedonic price model works in market equilibrium, and there are no

interrelationships between the implicit prices of attributes (Chin & Chau, 2003; Li, 2011;

Mhatre, 2010). Market equilibrium is hard to assume due to the imperfections of reality

(Chin & Chau, 2003). Also, the assumption of no interrelationships between the implicit

prices of attributes is not plausible because it is clear that the implicit price of attributes

vary throughout all areas and property types (Chin & Chau, 2003; Mhatre, 2010).

Notwithstanding these controversial assumptions, the hedonic price model has been

widely employed to determine implicit prices, especially in terms of assessing the

externalities of amenities or disamenities on nearby property values. When the hedonic

price model is free of the misspecification of variables and accounting for all relevant

factors that capture the variance in sales price, the hedonic price model is more reliable

than other methods such as the sales comparison approach, contingent valuation, and

traditional appraisal techniques (Mhatre, 2010).

  Several prior studies employed the hedonic price model, especially in terms of

the cross-sectional approach, to estimate the impact of subsidized housing programs on

nearby property values. However, the lack of methodological rigor of prior studies

produces confusing findings, and it casts doubt on the validity of prior results (Nguyen,

2005). The methodologies of previous studies have fatal flaws in terms of two aspects.

First, one potential drawback of the hedonic price model is the problem of omitted

variables. In other words, if some relevant variables related to the property

characteristics are omitted or unmeasured by the model, the hedonic price model may

yield biased estimates (Schwartz, Ellen, Voicu, & Schill, 2006). Some researchers have

tried to employ a repeat sales analysis to overcome the problem of omitted variables. If

omitted variables are time-constant, we can eliminate these time-constant variables in

the repeat sales analysis through differencing (Wooldridge, 2009). However, this model

cannot explain variables that are time-constant or that change slowly (Schwartz, Ellen,

Voicu, & Schill, 2006; Wooldridge, 2009). Also, we can only include some property

data that transacts multiple times in the model, so this analysis suffers from the problem

of inherent selection bias (Schwartz, Ellen, Voicu, & Schill, 2006). Second, the

methodologies of previous studies have flaws in terms of the direction of causality

(Galster, Temkin, Walker, & Sawyer, 2004). In other words, they failed to account for

the causal direction in the impacts of subsidized housing developments, that is, whether

subsidized housing causes the depreciation of property values in neighborhoods, or

subsidized housing complexes are placed only in neighborhoods with declining housing

prices (Nguyen, 2005). The majority of prior studies fundamentally suffer from the

problem of selection bias because of failing to account for the lower preexisting price

levels of neighborhoods where subsidized housing was developed (Koschinsky, 2009).

5.2.2 AITS-DID (Adjusted Interrupted Time Series-Difference in Differences) Model

The direction of causality should be explained in the analytical model in order to

unveil contradictory results on the impact of subsidized housing that stem from the

methodological flaw. The methodologies of prior studies failed to distinguish the causal

direction of the impact of subsidized housing. The most recent quasi-experimental

research design, which is the AITS-DID (Adjusted Interrupted Time Series-Difference in

Differences) model, could shed light on the direction of causality. The AITS-DID model

was originally devised by Galster, Temkin, Walker, and Sawyer (2004) as the Adjusted

Interrupted Time Series (AITS) model and adjusted by Schwartz, Ellen, Voicu, and

Schill (2006) as the Difference in Differences (DID) model (Koschinsky, 2009). While

the DID model only focuses on the differences in housing price levels, the AITS model

measures the differences in both housing price levels as well as trends (Koschinsky,

2009). Even though there are some differences between both models, especially in terms

of controlling the levels and trends in housing prices, the logic of both empirical models

is very similar. In this context, Koschinsky (2009) coined the term "AITS-DID" model

in order to acknowledge both studies.

The AITS-DID model estimates the levels and trends in coefficients in two kinds

of neighborhoods during two periods (Galster, 2004). Specifically, this approach

compares housing price differentials in neighborhoods including subsidized housing

before and after it was developed with those in nearby neighborhoods where subsidized

housing was not developed for the same years (Galster, 2004; Koschinsky, 2009). The

heart of the AITS-DID model could be intuitively illustrated as in Figure 9.
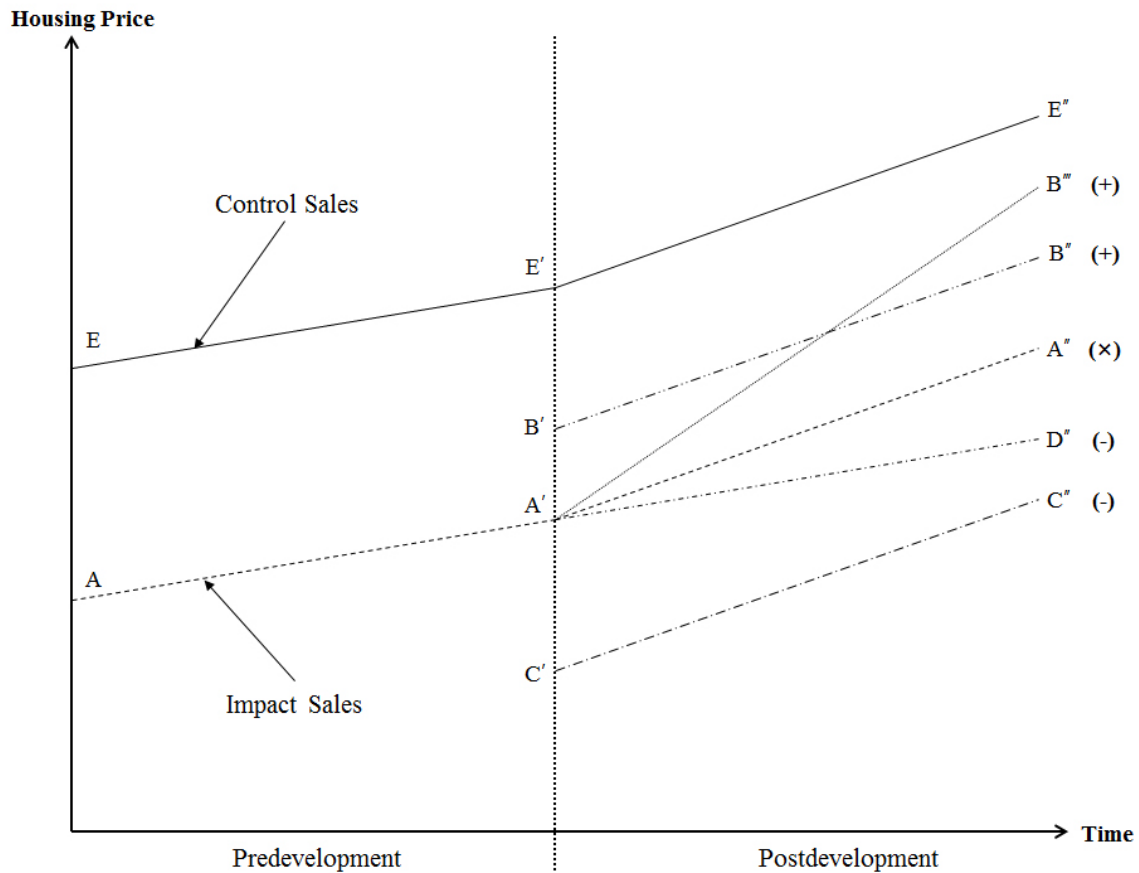
Figure 9. Illustration of Potential Impacts of Subsidized Housing on Nearby Property Values, Adapted from "The Effects of Affordable and Multifamily Housing on Market Values of Nearby Homes," by G. C. Galster, 2004, In A. Downs (Ed.), *Growth management and affordable housing: Do they conflict?* (pp. 176-211): Washington, D.C.: Brookings Institution Press.

The idea of the AITS-DID model stems from the core of the pre/post approach as well as the impact/control approach simultaneously. To be specific, this model captures the differentials in levels and trends of pre- and post-housing prices associated with the subsidized housing developments by comparing control and impact sales (Koschinsky, 2009; Lee, 2008). As seen in Figure 9, assume that housing price trends in control sales

89

are the line E-E'-E" while those in impact sales are the line A-A'-A". The primary

interest of the AITS-DID approach is a pre/post break in the trend of impact sales

compared with control sales. In this context, the estimated line A-A'-A'' points out that

there was no impact of subsidized housing because the housing price trend of post-

development in impact sales continues to be parallel with those in control sales, E-E'-E".

This also means that the housing price differential of post-development, A"-E", is not

changed when compared with the housing differential of predevelopment, A'-E' (Galster,

2004). However, if the housing price of post-development in impact sales shifted up (A-

A'-B'-B") or increased more steeply than those in the control sales (A-A'-B'''), then

this situation indicates a positive impact of subsidized housing (Galster, 2004). In

contrast, if the housing price of post-development in impact sales shifted down (A-A'-

C'-C'') or increased less steeply than those in the control sales (A-A'-D"), it signifies a

negative impact of subsidized housing (Galster, 2004).

The fundamental concept of the AITS-DID model is grounded in those of the

hedonic price model (Koschinsky, 2009). The centerpiece of the AITS-DID model is

estimating the implicit price for neighborhood attributes where subsidized housing units

are developed. However, this model controls for the locational and neighborhood

characteristics of properties through the spatial fixed effects, and clarifies the direction

of causality to capture the differentials in levels and trends of pre- and post-housing

prices associated with subsidized housing developments by comparing control and

impact sales. Thus, the baseline model in this study could be specified as:

$$\ln P_{\text{int}} = \alpha + \beta S_i + \gamma T_{it} + \delta L_i + \zeta N_n + \eta R_{it} + \varepsilon_{\text{int}}, \tag{3}$$

90

where $\ln P_{int}$ is the log of housing sales price of property i in neighborhood n at time t, that is transformed to a natural logarithmic functional form to reduce skew and pull in outliers. S_i is a vector of property related structural characteristics such as heated areas, number of fireplaces, number of full-bathrooms, half-bathrooms, bedrooms, and age, to name a few. The vector T_{it} is a set of time dummy variables for each property indicating the year and quarter in which the sale occurred in order to account for seasonal differences. The variable L_i includes the dummy variables of locational characteristics for each property such as proximity to parks (within 250 feet), rivers and lakes (within 500 feet), and the geographic coordinates of each property (normalized by the distance to the CBD) to capture any remaining locational attributes (Koschinsky, 2009). N_n is a set of census tract fixed effects capturing the unobserved and time-invariant neighborhood characteristics, which was specified in the Year 2000 census tracts. R_{it} is a vector of ring variables, which is the core of the analysis that captures housing price differentials before and after LIHTC projects were developed within a microneighborhood, described in more detail in the section describing independent variables. ε_{it} is an error term of the model. The coefficients α, β, γ, δ, ζ, and η are estimated employing traditional ordinary least squares (OLS) with a heteroskedasticity-robust standard error in order to address heteroskedasticity which might violate the assumption that the variance of the error term is the same across the housing submarket segmentations or space (Koschinsky, 2009; Wooldridge, 2009).

This study also explored the associations between subsidized housing and nearby property values by considering the size effects of subsidized housing. Specifically, the model for capturing the size effects of subsidized housing could be developed as:

$$\ln P_{\text{int}} = \alpha + \beta S_i + \gamma T_{it} + \delta L_i + \zeta N_n + \eta R_{it} + \mu M_{it} + \varepsilon_{\text{int}}, \tag{4}$$

where M_i is a vector of size variables that explores the size effects of newly developed subsidized housing, which is the total number of subsidized housing units within a microneighborhood after that subsidized housing was developed. Further, for each city, these models were estimated separately for three types of neighborhoods stratified by family income, to test whether impacts of subsidized housing vary based on income heterogeneity.

5.2.2.1 Dependent Variable

The dependent variable in this model is the sales price for single-family housing units (P_{int}). The natural log transformation is usually used when the dependent variable is a positive dollar amount (Wooldridge, 2009). When the range of the variable is broad, the natural log transformation can narrow this range. To be specific, taking logs for the variable (to the base e) can stabilize the variance of the variable when the variance increases remarkably as the value of the variable increases (Mhatre, 2010). Thus, the model using the natural log transformation as the dependent variable often satisfies the normality assumption. After we checked the dependent variable for normality using tests for kurtosis and skewness, the dependent variable was transformed using a natural log transformation. In sum, by using the algebraic properties of the logarithmic functions,

92

the percent change in the predicted value of the dependent variable (*y*) in case of a unit

change in the independent variables x_i could be specified as:

$$\% \Delta y = 100 \cdot [\exp(\beta_i \Delta x_i) - 1], \tag{5}$$

where $\beta_i \Delta x_i$ is the coefficient representing expected change in the value of the

independent variable *x* (Wooldridge, 2009).

5.2.2.2 Independent Variables

Independent variables consist of structural, locational, neighborhood, and the

LIHTC development characteristics of each property. The model for Charlotte includes

several structural characteristics (S_i) such as heated areas, building age, number of

bathrooms, number of half bathrooms, number of bedrooms, number of fireplaces,

heating sources (electric, oil, and others), exterior types (brick/stone and others), and

housing quality (the lowest [below average] and highest [very good-excellent]). Also,

the model for Cleveland uses property sizes, heated areas, number of bathrooms, number

of half bathrooms, number of bedrooms, building age, housing quality (the lowest

[unsound-poor] and highest [very good-excellent]), exterior types (brick/stone and

others), and housing styles (bungalow, colonial, and others). Those structural variables

were selected after testing for multicollinearity problems. Specifically, among various

structural characteristics, each variable which had a variance inflation factor (VIF) value

greater than 10 was excluded from the final variables. Further, after checking the

normality of each variable using tests for kurtosis and skewness, two variables (heated

areas and number of bedrooms) for Charlotte and three variables (property sizes, heated

areas, and number of bedrooms) for Cleveland were transformed using a natural log transformation. Also, the independent variable that is the age of a structure consists of quadratic functions to capture the marginal effect.

To control the locational (L_i) and neighborhood characteristics (N_n) of each property, the model includes spatial fixed effects variables, especially in terms of using the census tract fixed effects and geographic coordinates of each property. The census tract fixed effects were derived from Year 2000 census tracts. The x-y coordinates were normalized by the distance to the CBD. In addition, indicators for the proximity to parks in Charlotte and those for parks, rivers, and lakes in Cleveland were used to account for locational characteristics of properties. To account for seasonal differences for housing sales, independent variables included time dummy variables for each property indicating the year and quarter in which the sale occurred. To be more specific, time variables consisted of eleven indicators for the year of sale (with 1996 as the reference category) and three indicators for the quarter (with the first quarter as the reference category) in which the sale occurred.

The key variables comprise the vector of ring variables (R_{it}), which capture the differentials in levels and trends of pre- and post-housing prices relating to the LIHTC housing developments by comparing control and impacts sales (Galster, 2004; Koschinsky, 2009; Lee, 2008). Differences between impact and control sales are also controlled by spatial fixed effects, especially by trend surface (x-y coordinates) and census tract dummy variables (Koschinsky, 2009). The inherent concept of these

variables could be accounted for with two aspects: 1) control/impacts sales and; 2) pre/post differentials of housing prices.

First, all sales can be categorized into two groups: control sales and impact sales. Impact sales are defined as single-family housing units where subsidized housing is located within the property's microneighborhood. Control sales are properties where subsidized housing is not within the property's microneighborhood but located in the same census tract with impact sales (Koschinsky, 2009). Second, the ring variables measure the differentials in the levels and trends of housing prices in microneighborhoods including subsidized housing before and after its completion. Impact sales for housing prices and trends can be further divided into two categories according to the completion dates of subsidized housing: pre-impact sales and post-impact sales. Pre-impact sales are transactions that occurred prior to the development of subsidized housing while post-impact sales are sales that took place after subsidized housing was developed within their microneighborhoods.

The vector of ring variables includes four dummy variables for each of the two microneighborhoods for each property (0-500 feet and 500-2000 feet) in order to capture the differences in housing price levels and trends. Pre-impact sales for housing price levels (pre-price level) take on a value of one when there is or will be LIHTC developments within the microneighborhood of the residential property. The pre-impact sales capture the existing average price levels in microneighborhoods before subsidized housing is developed and reflect the inherent neighborhood price levels prior to subsidized housing. This variable measures the location effect that is not due to the

95

presence of subsidized housing developments. Post-impact sales for housing price levels (post-price level) take on a value of one when the residential property has a completed LIHTC development within the property's microneighborhood. The post-impact sales measure the levels of housing price in microneighborhoods after subsidized housing is developed. By specifying these two dummy variables, we can compare the differentials in housing price levels with control sales for each of the two microneighborhoods before and after subsidized housing was developed.

The vector of ring variables also includes two indicators for each of the two microneighborhoods in order to estimate the break in housing price trends. One variable signifies the distance in days between the date of sale and the beginning of the research period (pre-price trend) (Galster, Tatian, & Smith, 1999; Koschinsky, 2009). The other variable measures the distance in days between the date of sale and the completion date of subsidized housing (post-price trend) (Galster, Tatian, & Smith, 1999; Koschinsky, 2009; Schwartz, Ellen, Voicu, & Schill, 2006). For instance, the post-price trend variable is 1/365 if a sale includes the LIHTC development within microneighborhoods and occurs the day after the completion of LIHTC development; it is one if the sale occurs one year after the completion of LIHTC development; and so on. Therefore, the vector of ring variables allows us to compare the differentials in levels and trends of housing prices between impact sales and control sales for each of the two types of microneighborhoods before and after subsidized housing was developed. Further, the size variable (μ_{it}) that explores the size effects of newly developed LIHTC housing was

96

included as the independent variable. This variable describes the total number of LIHTC

units at the time of sale.

The associated coefficients ($\alpha, \beta, \gamma, \delta, \zeta, \eta,$ and μ) are estimated using traditional

OLS with robust standard errors to account for any heteroskedasticity. When the

variance of the unobservable error (ε_{int}) is not constant, the homoscedasticity

assumption is violated. Even though the issue of heteroskedasticity does not cause bias

or inconsistency in the OLS estimators, it makes the OLS estimator no longer BLUE

(Best Linear Unbiased Estimators) (Wooldridge, 2009). In other words, the statistics

used to test hypotheses are not valid due to the heteroskedasticity (Wooldridge, 2009).

After using the Breusch-Pagan test for heteroskedasticity (BP test) for our model in

Charlotte and Cleveland, we checked the presence of heteroskedasticity that might

violate the constant variance (See Table 11). Thus, our model does account for

heteroskedasticity by estimating robust standard errors.

Table 11. Breusch-Pagan Test for Heteroskedasticity

Models	Breusch-Pagan / Cook-Weisberg Test for Heteroskedasticity
	H_0: Constant Variance / Variables: Fitted Values of *ln*(Sales)
Charlotte	chi2(1) = 1908.52
	Prob > chi2 = 0.0000
Cleveland	chi2(1) = 5935.84
	Prob > chi2 = 0.0000

5.2.3 Extended Cox Hazard Model

Housing sales may be influenced by structural, locational, and neighborhood characteristics. In this context, we used the extended Cox hazard model, which is a partial likelihood estimation method, to explore the impact of subsidized housing programs on neighborhood housing turnover. Housing sales were regarded as a hazard occurrence, and the housing duration was specified with the duration between the first sale and the next sale (Kim & Horner, 2003). The hazard model controls for both of these factors simultaneously and this is a significant advantage of employing the hazard analysis; using OLS or logistic regression would result in the loss of observations since we cannot use dichotomous data for sales occurrence in the OLS regression, and cannot use housing duration in the logistic regression. The hazard model also allows the equation to assume time dependence without having to specify time; additionally, it could easily control both time-varying independent variables and time-invariant independent variables (Vittinghoff, Glidden, Shiboski, & McCulloch, 2005). If time-varying variables are considered in the Cox hazard model, the proportional hazard assumption is no longer satisfied (Kleinbaum & Klein, 2012). However, the Cox hazard model can still be used and is called the extended Cox hazard model (Kleinbaum & Klein, 2012). Another advantage of this approach is that after explicitly specifying the risk period, this model can handle certain types of censored observations, especially right-censored observations (Allison, 1984; Yamaguchi, 1991). For instance, censoring exists when an observation is not observed in its entirety during the risk period (1996 to 2007). When the observation is terminated before the hazard has occurred, this

98

observation is censored on the right at the end of the risk period. Right-censored

observations are those that sell after 2007 in this study.

This study also clarified the direction of causality to capture the differentials in

levels of pre- and post-neighborhood stability associated with subsidized housing

developments by comparing control and impact sales (Galster, Tatian, & Smith, 1999;

Koschinsky, 2009; Schwartz, Ellen, Voicu, & Schill, 2006). As a result, the extended

Cox hazard framework considering time-varying key variables, which are the change of

situation (newly developed) of subsidized housing over time, could be specified as:

$$h_{int} = h_0(t) \exp\left[\alpha P_i + \beta L_i + \gamma N_n + \theta R_{it}\right], \tag{6}$$

where h_{int} is the hazard rates that are a log-linear function of parameters for the effects

of co-variates for each property i at time t, and $h_0(t)$ is the baseline hazard function.

Each vector, F_i, L_i, and N_n which does not depend on time and R_{it} which depends on

time, and their coefficients are the parameters to be estimated. To be specific, P_i is a

vector of the housing price ratio of property i. The housing sales price of the ith property

in the kth year, is standardized by the average housing price in the kth year, in order to

remove time dependency (Kim & Horner, 2003). The variable L_i includes the dummy

variables of locational characteristics for each property such as proximity to parks

(within 250 feet), rivers and lakes (within 500 feet), and the geographic coordinates of

each property (normalized by the distance to the CBD) to capture any remaining

locational attributes (Koschinsky, 2009). N_n is a set of census tract fixed effects

capturing the unobserved and time-invariant neighborhood characteristics, which was

specified in the Year 2000 census tracts. R_{it} is a vector of ring variables that captures the

differentials of housing duration before and after subsidized housing was developed within a microneighborhood, described in more detail in the section describing independent variables and Appendix A.

This paper also scrutinized the relationships between neighborhood stability and subsidized housing by considering the size effects of subsidized housing. To be specific, the model for capturing the size effects of subsidized housing could be developed as:

$$h_{int} = h_0(t)\exp\left[\alpha P_i + \beta L_i + \gamma N_n + \theta R_{it} + \lambda M_{it}\right], \tag{7}$$

where M_{it} is a vector of size variables that explores the size effects of newly developed subsidized housing, which is the total number of subsidized housing units within a microneighborhood.

The main interest in the models is to estimate the coefficients θ, which relate to the effects of subsidized housing variables, and these coefficients can be estimated by using the following partial likelihood method:

$$Likelihood(\theta) = \prod_{i=1}^{l} \left\{ \exp\left[\sum_k \eta_k X_{ik}(t_i)\right] \middle/ \sum_{j \geq i} \exp\left[\sum_k \eta_k X_{jk}(t_i)\right] \right\}^{\delta_i}, \tag{8}$$

where $X_{i(j)k}(t)$, which may depend on time, refers to the value of the kth co-variate for individual property $i(j)$ at time t, and δ_i refers a dummy variable that takes the value of one when the ith property had an event (hazard) and zero if the ith property was censored. Furthermore, for each city, these models were estimated separately for three types of neighborhoods stratified by family income, to test whether impacts of subsidized housing vary based on income heterogeneity.

5.2.3.1 Dependent Variable

Our sample is considered as a flow sample because data on housing transactions were collected over time period (1996 to 2007) (Kim & Horner, 2003). The dependent variable in our model consists of two actual data in terms of the duration of sales nonoccurrence (housing duration) and hazard occurrence. Housing turnover was regarded as the hazard occurrence, and the housing duration was calculated as the duration of each property's transaction measured in days between the first sale and the next sale during the research period. If there was no next transaction for a given property during the research period, these observations were treated as a censored data in our models.

One way to describe the hazard data set is to plot the Kaplan-Meier (K-M) survivor functions, which is an empirical plot showing the probabilities of surviving the dependent variable, the hazard, for each unit of time (Kaplan & Meier, 1958).

$$S(t) = \prod_t \left[(n_t - d_t / n_t \right] \tag{9}$$

where let n_t represents the number of observations that have not failed (not sold) at the beginning of time period t, and d_t denotes the number of failure (the number of housing sales) that occur to these observations during time period t. The K-M estimator of surviving beyond time t (i.e., not having a sales occurrence before time t) is the product of survival probabilities in t (Poston, 2002).
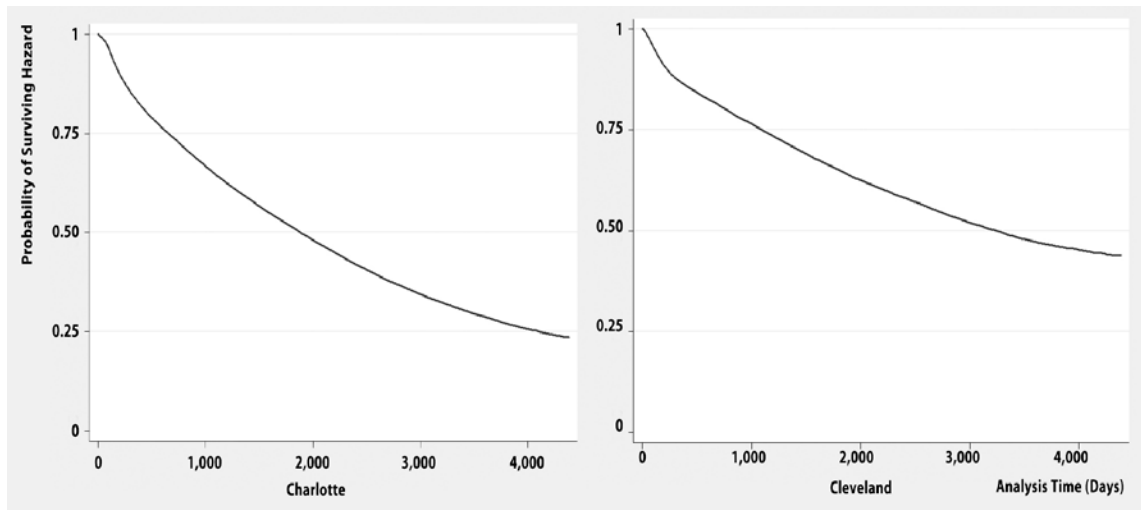
Figure 10. Probability of Surviving the Hazard of Housing Turnover

Figure 10 shows the probabilities of surviving the hazard of housing turnover for each day of analysis time in Charlotte and Cleveland. The K-M survivor curve for Charlotte steps down more rapidly than that for Cleveland. This step down is depicted in the K-M survivor curve above by showing that Charlotte decreases from a probability of near 1.0 of surviving the hazard of housing turnover to 0.5 by about the 1,800th day (5th year), while Cleveland decreases by the same probability, but by around the 3,300th day (9th year). Thus, there were clear differences for housing turnover between two cities in our sample; properties in Charlotte tend to turn over faster than those in Cleveland.

5.2.3.2 Independent Variables

Independent variables for this model include housing, locational, neighborhoods, and LIHTC development characteristics of each property. This model used the housing price variable (P_i) instead of employing housing structural characteristics. Housing

structure characteristics such as heated areas, lot size, number of full-bathrooms, number

of bedrooms, and building age might be related to housing turnovers. However, the

housing price variable captures many of the amenities related to the property itself,

especially in terms of housing structure characteristics. Hence, this study excluded

housing structure characteristics in our model to resolve multicollinearity problems (Kim

& Horner, 2003). Further, when it comes to using a housing price variable, this study

used housing price ratios instead of exact price values to deal with the time-dependent

nature of monetary variables (Kim & Horner, 2003). To remove time dependency from

housing prices, the housing sales price of the ith property in the kth year, is standardized

by the average housing price in the kth year, $\bar{p}_j$. It could be specified as:

$$\bar{x}_i = \frac{p_{ik}}{\bar{\bar{p}}_j} \tag{10}$$

To control the locational (L_i) and neighborhood characteristics (N_n) of each

property, the model includes spatial fixed effects variables, with respect to using census

tract fixed effects and geographic coordinates of each property. The census tract fixed

effects were derived from Year 2000 census tracts. The x-y coordinates were normalized

by the distance to the CBD. In addition, indicators for the proximity to parks in Charlotte

and those for parks, rivers, and lakes in Cleveland were used to account for locational

characteristics of properties.

The key variables comprise the vector of ring variables (R_{it}), which capture the

differentials in levels of pre- and post-housing turnover ratios relating to the subsidized

housing developments by comparing control and impact sales (Galster, 2004;

103

Koschinsky, 2009; Lee, 2008). Differences between impact and control sales are also controlled by spatial fixed effects (Koschinsky, 2009). Along with the logic of the AITS-DID model, the inherent concept of these variables in the extended Cox hazard model could be explained in terms of the following: 1) control/impact sales and; 2) pre/post differentials of hazard.

First, all sales can be categorized into two groups: control sales and impact sales. Impact sales are defined as housing transactions where subsidized housing is located within the property's microneighborhood. Control sales are transactions where subsidized housing is not within the property's microneighborhood but located in the same census tract with impact sales (Koschinsky, 2009). Second, the ring variables measure the differentials in the levels of hazard in microneighborhoods including subsidized housing before and after its completion. Impact sales can be further divided into two categories according to the completion dates of subsidized housing: pre-impact sales and post-impact sales. Pre-impact sales are transactions that occurred prior to the development of subsidized housing while post-impact sales are sales that took place after subsidized housing was developed within their microneighborhoods.

The vector of ring variables includes two dummy variables for each of the two microneighborhoods for each property (0-500 feet and 500-2000 feet) in order to capture the differences in hazard ratios. Pre-impact sales take on a value of one when there is or will be LIHTC developments within the microneighborhood of the residential property. The pre-impact sales capture the existing average hazard ratios in microneighborhoods before subsidized housing is developed, and reflect the inherent neighborhood stability

prior to subsidized housing. Post-impact sales take on a value of one when the residential

property has a completed LIHTC development within the property's microneighborhood.

The post-impact sales measure the levels of hazard in microneighborhoods after

subsidized housing is developed. Therefore, the vector of ring variables allows us to

compare the differentials in levels of housing turnover ratios between impact sales and

control sales for each of the two types of microneighborhoods before and after

subsidized housing was developed. Thus, the findings of this study assess the impacts of

the LIHTC program on neighborhood stability by constructing multidimensional

variables related to the impacts of subsidized housing in order to clarify the direction of

causality.

CHAPTER VI

RESULTS

6.1 Bivariate Analysis for Social Equity

The bivariate analysis in this chapter explored the associations between LIHTC

subsidized households and geography of opportunities by identifying the

sociodemographic characteristics of neighborhoods associated with locations of LIHTC

projects and units. As I described in the methodology chapter, this study employed

simple bivariate analysis, especially in terms of a location quotient (LQ), to examine the

empirical evidence of the uneven geography of opportunities for subsidized households.

This study employed 2000 decennial census data to identify the sociodemographic

characteristics of neighborhoods. Further, this paper focused on all LIHTC projects

developed between 2000 and 2007 in this analysis. Thus, by employing the location

quotient index, we can identify the likelihood that census tracts with certain

sociodemographic characteristics will receive LIHTC developments compared to the

overall probability of census tracts receiving LIHTC subsidized housing.

In terms of income levels in this analysis, this study stratified five types of

neighborhoods by family income. Census tracts where the median family income was

less than 50 percent of the city's median family income were defined as very low-

income neighborhoods; census tracts with a median family income of 50 to 80 percent of

the city's median family income were defined as low-income neighborhoods; census

tracts with a median family income of 80 to 100 percent of the city's median family

income were defined as moderate-income neighborhoods; census tracts with a median

family income of 100 to 120 percent of the city's median family income were defined as

middle-income neighborhoods; census tracts with a median family income of 120 to 140

percent of the city's median family income were defined as high-income neighborhoods;

census tracts with a median family income higher than 140 percent of the city's median

family income were defined as very high-income neighborhoods (Galster, Temkin,

Walker, & Sawyer, 2004).

Poverty rates were the proportion of people living under poverty by census tracts.

This study stratified five types of neighborhoods by poverty levels: poverty rates of less

than 10 percent, from 10 to 20 percent, from 20 to 30 percent, from 30 to 40 percent, and

over 40 percent in neighborhoods. With respect to defining the level of minorities (non-

white populations) and education in neighborhoods, this paper stratified five types of

census tracts respectively by minority and education rates: non-white population or

college degree holder rates of less than 20 percent, from 20 to 40 percent, from 40 to 60

percent, from 60 to 80 percent, and over 80 percent. Unemployment rates by census

tracts were also stratified by five types of neighborhoods: unemployment rates of less

than 5 percent, from 5 to 10 percent, from 10 to 15 percent, from 15 to 20 percent, and

over 20 percent. Median house value for each census tract was the proportion of city

median house value and stratified into six types of neighborhoods: median house value

of less than 50 percent, from 50 to 80 percent, from 80 to 100 percent, from 100 to 120

percent, from 120 to 140 percent, and over 140 percent.

Table 12 indicates that the likelihood that neighborhoods with income, poverty, and minority levels received LIHTC subsidized housing compared to overall probability of neighborhoods receiving LIHTC subsidized housing between 2000 and 2007. LIHTC developments were likely to be located in very low-income neighborhoods. This spatial pattern was clearly evident in both Charlotte and Cleveland. LIHTC housing projects and units were 3.35 times and 3.14 times respectively as likely to be developed in very low-income neighborhoods in Charlotte compared to the expected rate, which is a likelihood of even distribution. The census tract in the lowest income category had over 17 times and 11 times the probability of receiving a LIHTC project and unit than the census tract in the highest income category. Also, the likelihood of LIHTC projects and units being developed in very low-income neighborhoods in Cleveland were 1.63 times and 3.04 times, respectively, compared to the likelihood of even distribution. The index of LIHTC projects in Cleveland indicates that a large number of LIHTC projects were located in both very low-income and low-income neighborhoods, albeit the largest number of LIHTC units were sited in very low-income neighborhoods. This implies that the most LIHTC projects located in very low-income neighborhoods were large-scale developments.

Table 12 also illustrates that LIHTC developments are likely to be located in high poverty neighborhoods. This pattern was obvious for LIHTC developments in Cleveland. LIHTC projects in Cleveland were 1.85 times as likely to be located in over 40 percent poverty neighborhoods, and the total units of LIHTC projects were 2.33 times as likely to be sited in those neighborhoods. Moreover, the likelihood of LIHTC developments

108

being distributed in neighborhoods of the lowest poverty level was zero. This shows that there were no LIHTC developments in low poverty neighborhoods of Cleveland between 2000 and 2007. LIHTC developments in Charlotte were sited in neighborhoods where between 20 and 40 percent of the households were below the poverty line.

Table 12. Location Quotients of LIHTC Developments by Income, Poverty, and Minority Levels in Neighborhoods

	Charlotte		Cleveland	
	Projects	**Units**	**Projects**	**Units**
Projects (Units) by Income				
Very Low-income	3.35	3.14	1.63	3.04
Low-income	1.30	1.65	1.60	1.26
Moderate-income	0.24	0.16	1.46	1.46
Middle-income	1.32	0.85	0.70	0.33
High-income	0.00	0.00	0.13	0.15
Very High-income	0.19	0.27	0.28	0.09
Projects (Units) by Poverty Level				
0-10%	0.40	0.32	0.00	0.00
10-20%	0.99	1.45	0.18	0.15
20-30%	3.35	2.90	1.24	0.75
30-40%	2.55	2.55	1.79	1.80
Over 40%	0.00	0.00	1.85	2.33
Projects (Units) in Minority Neighborhoods				
0-20%	0.00	0.00	0.15	0.13
20-40%	0.66	0.57	0.68	0.40
40-60%	1.04	0.97	0.88	0.49
60-80%	1.12	0.64	0.94	2.60
Over 80%	2.86	3.32	1.70	1.54

LIHTC developments were also likely to be located in neighborhoods with a higher percent of minorities. To be specific, LIHTC developments were distributed in

neighborhoods with more than 80 percent minorities in both cities. The likelihood of

LIHTC projects and units in Charlotte being sited in neighborhoods of minorities

exceeding 80 percent were 2.86 times and 3.32 times, respectively, compared to the

expected rate, which is a likelihood of even distribution. Furthermore, LIHTC housing

complexes were not developed in neighborhoods of the category of lowest minorities

(less than 20 percent minorities) between 2000 and 2007. LIHTC projects in Cleveland

were 1.70 times as likely to be located in neighborhoods with over 80 percent minorities.

Also, LIHTC units were 1.54 times as likely to be developed in the category of highest

minorities (neighborhoods of over 80 percent minorities). The census tract in the

category of highest minorities had over 11 times the probability of receiving a LIHTC

project and unit than the census tract in the category of lowest minorities.

Table 13 indicates how the spatial distribution of LIHTC developments varies by

the percent of population with college education, unemployment, and median house

value in census tracts. LIHTC housing complexes in both cities were not developed in

neighborhoods of high education between 2000 and 2007. Also, LIHTC developments in

both cities were likely to be sited in neighborhoods where less educated populations

resided. This pattern was pronounced, especially in Charlotte. The likelihood of LIHTC

projects and units being sited in neighborhoods with less than a 20% education level

were 2.08 times and 2.30 times.

Furthermore, LIHTC developments were likely to be located in neighborhoods

with high unemployment levels. The likelihood of LIHTC projects and units in

Cleveland being sited in neighborhoods with more than a 20% unemployment rate were

2.34 times and 2.70 times. The census tract in the highest unemployment category had

over 29 times and 30 times the probability of receiving a LIHTC project and unit than

the census tract in the lowest unemployment category. In terms of Charlotte, LIHTC

development projects and units were 13.40 times and 12.69 times as likely to be located

in the neighborhoods of 10 to 15 percent unemployment levels.

Table 13. Location Quotients of LIHTC Developments by Education, Unemployment, and Housing Value Levels in Neighborhoods

	Charlotte		Cleveland	
	Projects	**Units**	**Projects**	**Units**
Projects (Units) by Education				
0-20%	2.08	2.30	1.28	1.24
20-40%	0.97	0.71	0.09	0.03
40-60%	0.19	0.27	1.01	2.07
60-80%	0.00	0.00	0.00	0.00
Over 80%	0.00	0.00	0.00	0.00
Projects (Units) by Unemployment				
0-5%	0.54	0.49	0.08	0.09
5-10%	2.55	3.04	0.44	0.92
10-15%	13.40	12.69	1.25	0.67
15-20%	0.00	0.00	1.73	1.47
Over 20%	0.00	0.00	2.34	2.70
Projects (Units) by Median House Value (% of City Median)				
0-50%	2.45	2.17	1.06	1.71
50-80%	1.44	1.79	1.87	1.40
80-100%	1.15	0.64	1.13	0.74
100-120%	0.46	0.75	0.67	1.29
120-140%	0.33	0.48	0.00	0.00
Over 140%	0.00	0.00	0.43	0.35

Table 13 also shows that LIHTC developments were likely to be located in neighborhoods of lower housing value. This spatial pattern was noticeable in both cities. The likelihood of LIHTC projects and units in Charlotte were 2.45 times and 2.17 times respectively as likely to be developed in neighborhoods of less than 50 percent of city median house value. The likelihood of LIHTC projects and units in Cleveland being sited in neighborhoods with 50 to 80 percent of median house value was 1.87 times and 1.40 times. In addition, the likelihood of LIHTC units in Cleveland being distributed in neighborhoods of less than 50 percent median house value was 1.71 times.

6.2 Impacts of LIHTC Developments on Nearby Property Values

The study in this section employed the AITS-DID approach to examine the relationships between LIHTC developments and nearby property values. The analysis assesses the impacts of the LIHTC program on neighboring housing prices by constructing multidimensional variables related to the impacts of subsidized housing in order to clarify the direction of causality. First, the analyses were conducted at the citywide level for Charlotte and Cleveland. Subsequently, for each city, models were estimated separately for three types of neighborhoods stratified by family income to test whether impacts of LIHTC developments vary based on income heterogeneity.

6.2.1 Citywide Results

Table 14 shows the results for the citywide models for Charlotte and Cleveland. I first present the results for Charlotte.

Table 14. Citywide Results

Variables	Citywide Results, Charlotte			Citywide Results, Cleveland		
	Beta	**Adj.Beta†**	**Robust Std. Err**	**Beta**	**Adj.Beta†**	**Robust Std. Err**
Pre-impact 0-500 feet	-0.099 ***	-9.404	0.035	-0.147 *	-13.681	0.076
Post-impact 0-500 feet	-0.059	-5.714	0.037	0.126	13.391	0.082
Pre-impact 500-2,000 feet	-0.050 ***	-4.851	0.011	-0.074 ***	-7.160	0.028
Post-impact 500-2,000 feet	-0.067 ***	-6.466	0.013	0.058 *	5.990	0.032
Pre-trend 0-500 feet	0.008 *	0.845	0.004	0.024 **	2.386	0.011
Post-trend 0-500 feet	0.011 **	1.107	0.005	-0.029 **	-2.906	0.012
Pre-trend 500-2,000 feet	0.004 ***	0.419	0.002	0.010 **	1.018	0.005
Post-trend 500-2,000 feet	0.008 ***	0.806	0.002	-0.005	-0.523	0.005
No. of LIHTC Units	0.000	-0.012	0.000	0.000	-0.005	0.000
Log Heated Areas	0.641 ***	0.641	0.005	0.381 ***	0.381	0.020
Log Property Sizes	-	-	-	0.091 ***	0.091	0.011
Building Age	-0.009 ***	-0.916	0.000	-0.013 ***	-1.307	0.001
Building Age^2	0.000 ***	0.010	0.000	0.000 ***	0.005	0.000
Log Number of Bedrooms	0.023 ***	0.023	0.008	0.070 ***	0.070	0.017
Number of Full Bathrooms	0.065 ***	6.763	0.003	0.018	1.779	0.013
Number of Half Bathrooms	0.004	0.360	0.002	0.037 ***	3.767	0.013
Number of Fireplaces	0.048 ***	4.959	0.003	-	-	-
Electric Heating Source	0.009 ***	0.877	0.003	-	-	-
Oil Heating Source	0.011	1.068	0.014	-	-	-
Brick/Stone Exterior Types	0.108 ***	11.450	0.003	0.051 ***	5.262	0.009
High-Housing Quality	0.211 ***	23.482	0.012	0.066	6.830	0.054
Low-Housing Quality	-0.073 ***	-7.008	0.022	-0.210 ***	-18.982	0.021
Bungalow Housing Style	-	-	-	0.059 ***	6.086	0.015
Colonial Housing Style	-	-	-	0.055 ***	5.628	0.008
Parks within 250 feet	-0.016 ***	-1.572	0.004	0.003	0.269	0.016
River/Lake within 500 feet	-	-	-	0.001	0.077	0.017
X, Y Coordinates (CBD)		Yes			Yes	
Census Tract Fixed Effects		Yes			Yes	
Seasonal Indicators		Yes			Yes	
Number of Observations			114,471			27,634
R^2			0.7623			0.4004

***Denotes a 1% significance level; **denotes a 5% significance level; *denotes a 10% significance level

† Adjustment = $100(e^\beta-1)$, except *Log* Heated Areas, *Log* Property Sizes, and *Log* Number of Bedrooms.

The model fits the data well and the variables included explain around 76.2

percent of the variance in the property values. For sales price, the model showed

expected coefficient signs for all structural variables. Properties with larger heated areas,

more bedrooms and bathrooms, younger building ages, higher housing qualities, and

brick/stone exterior types showed statistically significant higher sales prices ($p<0.01$).

For instance, when heated areas increased by 1 percent, housing prices increased by 0.64

percent, *ceteris paribus*. Also, when a house had a brick/stone exterior type, the housing

price increased by 11.45 percent, holding all other factors fixed.

The main substantive result analyzed with the AITS-DID model for Charlotte

was that the completion of LIHTC developments in a microneighborhood had a

significant negative effect on nearby property values (see Table 14 and Figure 11). The

coefficient of pre-impact variables showed negative signs. This indicates that the

housing price level is lower compared to the control area (i.e., outside the impact area

but in the same census tract) before the LIHTC projects are sited. Holding all other

factors constant, the housing price level for impact sales was 9.4 percent lower in the

inner ring (immediate neighborhood) and 4.9 percent lower in the outer ring (functional

neighborhood) compared to control properties located outside of the

microneighborhoods before LIHTC projects were developed. However, the gap in

housing price level between impact and control sales increased after the introduction of

LIHTC units into the microneighborhoods; the post-impact variable was statistically

significant only in the outer ring. After the LIHTC complexes were developed within

functional neighborhoods, the housing price level for impact sales was 6.5 percent lower

compared to control sales. This indicates that the gap in housing price levels increased

from -4.9 percent to -6.5 percent after the introduction of LIHTC units into the

functional neighborhoods. Price trend changes were far less substantial within immediate

and functional neighborhoods, averaging around a 0.9 percent and a 0.4 percent incline

before the development of LIHTC projects, and a 1.1 percent and a 0.8 percent incline,

respectively, after the development. The project size effect was not statistically

significant in Charlotte.
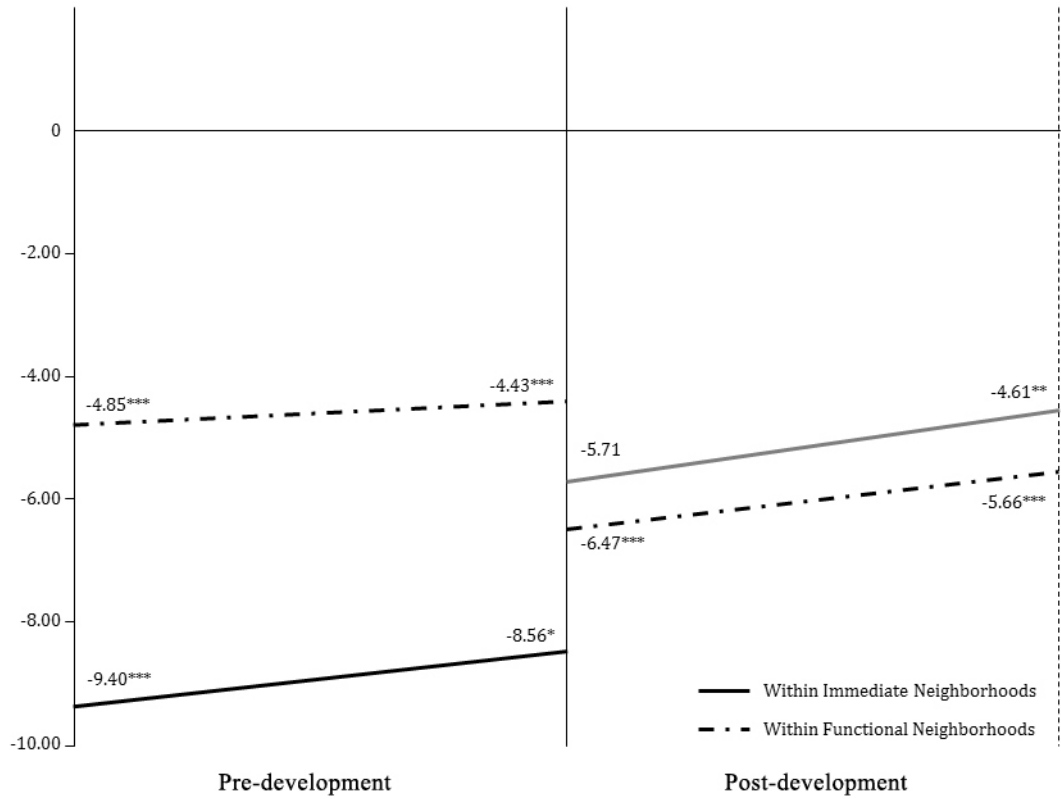
Figure 11. Citywide Results in Charlotte: Pre- and Post-Sales Price Levels and Trends

Cleveland's citywide model explained around 40.0 percent of the variance in the property values using the variables included. The model showed expected coefficient signs for all structural variables. For example, when heated areas increased by 1 percent, the housing prices increased by 0.38 percent, holding other factors fixed. In addition, when a house had a low-housing quality, the housing price decreased by 13.98 percent, *ceteris paribus*.

The results for Cleveland for LIHTC developments tell an opposite story to those for Charlotte. It is notable that the LIHTC developments in a microneighborhood had a positive impact on surrounding housing prices (see Table 14 and Figure 12). The coefficients for pre-impact variables showed negative signs, like those in Charlotte. The housing price level for impact sales was 13.7 percent lower in the inner ring and 7.2 percent lower in the outer ring compared to control sales located outside of the microneighborhoods before LIHTC projects were sited. The pre-existing housing price level of the control area prior to LIHTC developments was lower than that of the control area. However, after the LIHTC projects were developed in the immediate and functional neighborhoods, the housing price levels were 13.4 percent and 6.0 percent higher, respectively, than for control sales; however, the post-impact variables were statistically significant only in the functional neighborhoods. This indicates that the completion of the LIHTC developments significantly increased the level of housing price in neighborhoods, particularly within the functional neighborhood from -7.2 percent to 6.0 percent. Positive pre-price trends within immediate and functional neighborhoods contrast with declining post-price trends by around 2.9 percent and 0.5

percent, respectively. However, post-price trend variables were statistically significant only in the immediate neighborhoods. In addition, the association between the project size of the LIHTC and housing prices was not statistically significant in Cleveland.

In sum, the citywide results for Charlotte show that the introduction of the LIHTC developments had a negative impact on nearby property values. In contrast, the LIHTC developments for Cleveland positively affected surrounding housing prices. This suggests that local housing market conditions (i.e., hot and cold markets) may account for these differences in housing prices for these cities.
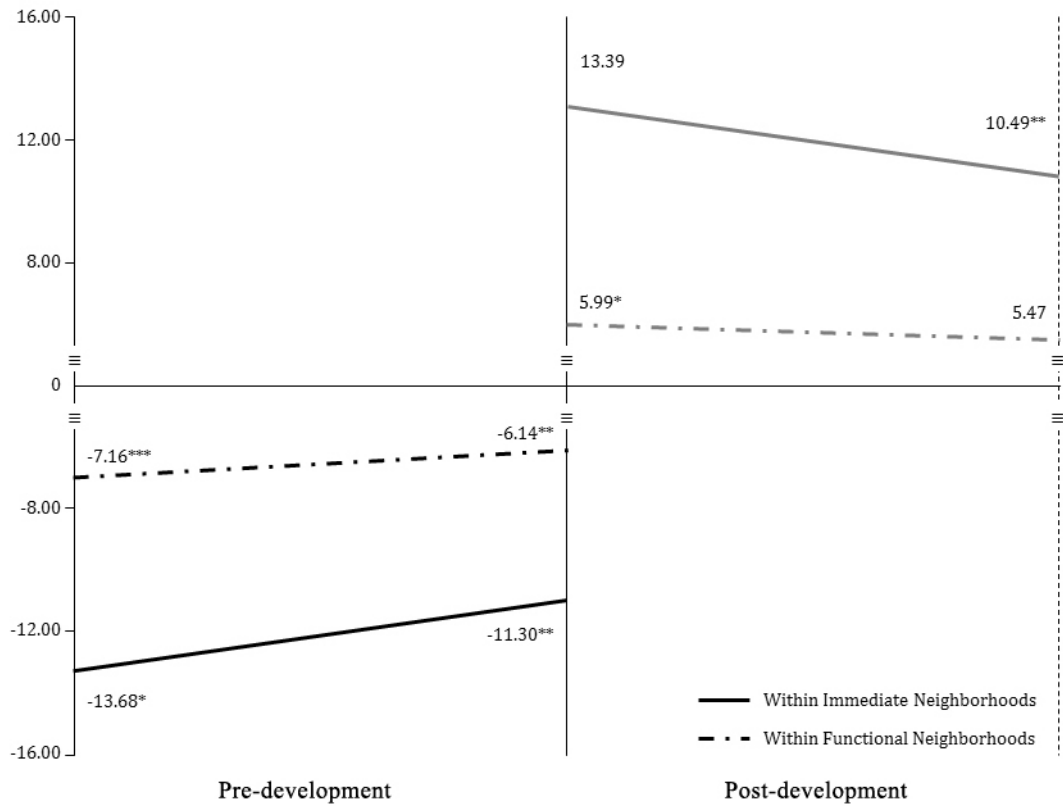
Figure 12. Citywide Results in Cleveland: Pre- and Post-Sales Price Levels and Trends

6.2.2 Neighborhood Heterogeneity Results

This study also examined how impacts of LIHTC developments vary according to housing submarket heterogeneity in terms of income levels. This section presents the results for low, middle, and high-income neighborhoods in Charlotte and Cleveland. The results suggested a mixed story according to neighborhood heterogeneity and contrasting housing market conditions.

Table 15. Results in Low-income Neighborhoods

Variables	Low-income Submarkets, Charlotte			Low-income Submarkets, Cleveland		
	Beta	Adj.Beta†	Robust Std. Err	Beta	Adj.Beta†	Robust Std. Err
Pre-impact 0-500 feet	-0.159 ***	-14.724	0.062	-0.179	-16.384	0.136
Post-impact 0-500 feet	0.043	4.429	0.065	0.157	17.011	0.132
Pre-impact 500-2,000 feet	-0.101 ***	-9.594	0.024	-0.069	-6.692	0.065
Post-impact 500-2,000 feet	0.012	1.167	0.026	0.114 *	12.062	0.065
Pre-trend 0-500 feet	0.005	0.507	0.007	0.020	2.053	0.016
Post-trend 0-500 feet	0.014 **	1.414	0.006	-0.018	-1.767	0.017
Pre-trend 500-2,000 feet	0.007 **	0.699	0.004	0.006	0.632	0.010
Post-trend 500-2,000 feet	0.005	0.498	0.003	0.003	0.327	0.009
No. of LIHTC Units	0.000 ***	-0.027	0.000	0.000	-0.022	0.000
Log Heated Areas	0.517 ***	0.517	0.018	0.327 ***	0.327	0.061
Log Property Sizes	-	-	-	0.093 ***	0.093	0.032
Building Age	-0.010 ***	-1.006	0.000	-0.018 ***	-1.784	0.001
Building Age^2	0.000 ***	0.011	0.000	0.000 ***	0.008	0.000
Log Number of Bedrooms	-0.041 **	-0.041	0.019	0.066	0.066	0.046
Number of Full Bathrooms	0.071 ***	7.362	0.009	-0.012	-1.144	0.032
Number of Half Bathrooms	0.026 ***	2.640	0.006	0.044	4.507	0.037
Number of Fireplaces	0.059 ***	6.130	0.006	-	-	-
Electric Heating Source	-0.016 **	-1.577	0.008	-	-	-
Oil Heating Source	0.058 *	5.932	0.032	-	-	-
Brick/Stone Exterior Types	0.080 ***	8.374	0.007	0.103 *	10.865	0.057
High-Housing Quality	0.366	44.144	0.381	0.419 ***	51.991	0.126
Low-Housing Quality	-0.023	-2.261	0.026	-0.127 ***	-11.958	0.032

Table 15. Continued

Variables	Low-income Submarkets, Charlotte			Low-income Submarkets, Cleveland		
	Beta	**Adj.Beta†**	**Robust Std. Err**	**Beta**	**Adj.Beta†**	**Robust Std. Err**
Bungalow Housing Style	-	-	-	0.026	2.624	0.047
Colonial Housing Style	-	-	-	0.028	2.790	0.029
Parks within 250 feet	-0.010	-0.960	0.010	0.112 *	11.815	0.062
River/Lake within 500 feet	-	-	-	-0.434 ***	-35.192	0.142
X, Y Coordinates (CBD)		Yes			Yes	
Census Tract Fixed Effects		Yes			Yes	
Seasonal Indicators		Yes			Yes	
Number of Observations			17,853			4,549
R^2			0.5772			0.3442

***Denotes a 1% significance level; **denotes a 5% significance level; *denotes a 10% significance level

† Adjustment = $100(e^\beta - 1)$, except *Log* Heated Areas, *Log* Property Sizes, and *Log* Number of Bedrooms.

Table 15 shows the results for low-income neighborhoods in Charlotte and

Cleveland. The Charlotte model explained around 57.7 percent of the variance in the

property values using the variables included. We can observe that the pre-impact

variables showed negative coefficients indicating that the housing price level for impact

sales was 14.7 percent lower in the inner ring and 9.6 percent lower in the outer ring

compared to control sales located outside of the microneighborhoods before LIHTC

projects were developed. However, the post-impact variables for low-income

neighborhoods in Charlotte were not statistically significant. Similar to the previous

models in terms of post-trend variables, post-price trend changes were far less

substantial within immediate neighborhoods, averaging around a 1.4 percent incline after

the development within immediate neighborhoods. However, pre-price trend changes for

immediate neighborhoods were not statistically significant. The association between the

project size of the LIHTC and housing prices was statistically significant ($p<0.01$). A one-unit increase in the number of LIHTC units at the time of sale decreased the housing price by 0.03 percent, *ceteris paribus*, in the low-income neighborhoods of Charlotte. This indicates that a larger number of LIHTC projects for low-income neighborhoods had larger negative impacts on surrounding property values in Charlotte.

The model for the low-income neighborhoods in Cleveland explained around 34.4 percent of the variance in the property values using the variables included. The results for Cleveland showed that the LIHTC developments in a functional neighborhood had a positive impact on neighboring housing prices. The post-impact variable for functional neighborhoods showed a positive coefficient. This indicates that the housing price level was higher compared to the control area after the LIHTC projects were sited. Holding all other factors constant, the housing price level for impact sales was 12.1 percent higher in the outer ring compared to control properties located outside of the microneighborhoods after LIHTC projects were developed. However, other variables related to LIHTC developments were not statistically significant.

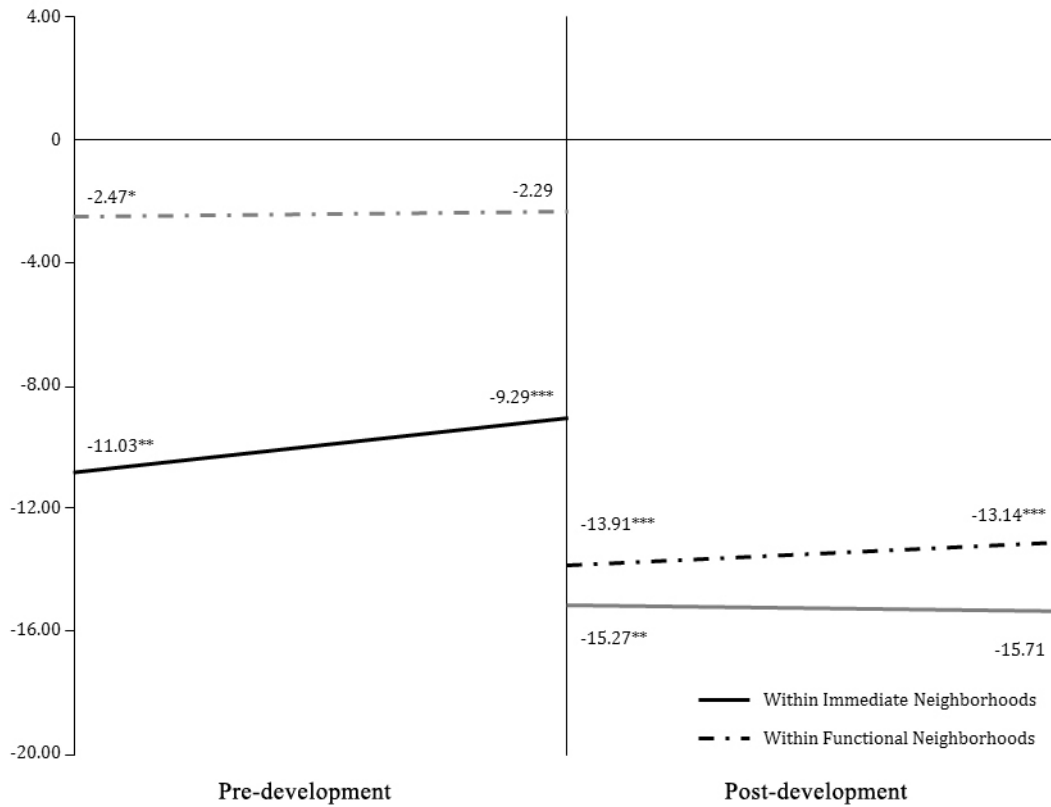**Table 16.** Results in Middle-income Neighborhoods

Variables	Middle-income Submarkets, Charlotte			Middle-income Submarkets, Cleveland		
	Beta	Adj.Beta†	Robust Std. Err	Beta	Adj.Beta†	Robust Std. Err
Pre-impact 0-500 feet	-0.117 **	-11.031	0.051	-0.007	-0.715	0.108
Post-impact 0-500 feet	-0.166 ***	-15.267	0.058	0.008	0.770	0.122
Pre-impact 500-2,000 feet	-0.025 *	-2.470	0.013	-0.038	-3.740	0.038
Post-impact 500-2,000 feet	-0.150 ***	-13.909	0.022	0.023	2.362	0.040
Pre-trend 0-500 feet	0.017 ***	1.746	0.007	0.020	1.995	0.018
Post-trend 0-500 feet	-0.004	-0.443	0.012	-0.034	-3.345	0.021
Pre-trend 500-2,000 feet	0.002	0.180	0.002	0.010	1.020	0.006
Post-trend 500-2,000 feet	0.008 ***	0.768	0.002	-0.008	-0.791	0.006
No. of LIHTC Units	0.001 ***	0.105	0.000	0.000	0.004	0.000
Log Heated Areas	0.604 ***	0.604	0.007	0.368 ***	0.368	0.035
Log Property Sizes	-	-	-	0.072 ***	0.072	0.023
Building Age	-0.011 ***	-1.084	0.000	-0.013 ***	-1.295	0.001
Building Age^2	0.000 ***	0.012	0.000	0.000 ***	0.004	0.000
Log Number of Bedrooms	0.051 ***	0.051	0.012	0.039	0.039	0.030
Number of Full Bathrooms	0.079 ***	8.231	0.006	0.013	1.335	0.021
Number of Half Bathrooms	-0.004	-0.378	0.003	0.053 ***	5.460	0.018
Number of Fireplaces	0.072 ***	7.478	0.004	-	-	-
Electric Heating Source	0.026 ***	2.632	0.003	-	-	-
Oil Heating Source	0.043 ***	4.356	0.016	-	-	-
Brick/Stone Exterior Types	0.101 ***	10.637	0.006	-0.026	-2.587	0.028
High-Housing Quality	0.409 ***	50.576	0.066	0.086	8.955	0.155
Low-Housing Quality	-0.278 ***	-24.247	0.035	-0.262 ***	-23.018	0.029
Bungalow Housing Style	-	-	-	-0.009	-0.944	0.030
Colonial Housing Style	-	-	-	0.062 ***	6.377	0.015
Parks within 250 feet	-0.020 ***	-2.012	0.004	-0.015	-1.529	0.030
River/Lake within 500 feet	-	-	-	0.040	4.044	0.030
X, Y Coordinates (CBD)		Yes			Yes	
Census Tract Fixed Effects		Yes			Yes	
Seasonal Indicators		Yes			Yes	
Number of Observations			51,728			10,598
R^2			0.5864			0.2877

***Denotes a 1% significance level; **denotes a 5% significance level; *denotes a 10% significance level

† Adjustment = $100(e^{\beta}-1)$, except *Log* Heated Areas, *Log* Property Sizes, and *Log* Number of Bedrooms.

Table 16 presents the results for middle-income neighborhoods in Charlotte and Cleveland. The model for Charlotte explained around 58.6 percent of the variance in the property values using the variables included. The core result for middle-income neighborhoods in Charlotte was that the LIHTC developments in a microneighborhood had a negative impact on neighboring housing prices (see Table 16 and Figure 13). Pre-impact variables showed negative signs in both immediate and functional neighborhoods indicating that the housing price levels were lower compared to the control sales before the LIHTC complexes were sited. Specifically, the housing price level for impact sales was 11.0 percent lower in the inner ring and 2.5 percent lower in the outer ring compared to control sales before LIHTC projects were developed. After the LIHTC complexes were developed in the microneighborhoods, however, the gaps in housing price level increased. To be more specific, after the introduction of LIHTC complexes into the immediate and functional neighborhoods, the housing price level for impacts sales was 15.3 percent and 13.9 percent lower than it was for those in the control sales, respectively. This indicates that the gaps in housing price increased from -11.0 percent to -15.3 percent within immediate neighborhoods and from -2.5 percent to -13.9 percent within functional neighborhoods after the LIHTC developments were sited. Post-price trend change for functional neighborhoods was statistically significant ($p<0.01$), indicating an average of around 0.8 percent incline after the development. It is noteworthy that building more units in LIHTC developments appears to mitigate the negative effects of LIHTC developments; a one-unit increase in the number of LIHTC units at the time of sale increased housing price by 0.1 percent, *ceteris paribus*. This

implies that although the introduction of LIHTC projects negatively affected

neighboring housing prices, the larger size of LIHTC developments mitigates those

spillover effects in the middle-income neighborhoods of Charlotte.

Figure 13. Results in Middle-income Neighborhoods, Charlotte: Pre- and Post-Sales Price Levels and Trends

For Cleveland, the R^2 for the middle-income neighborhoods was lower than that

for other models such as models for low- and high-income neighborhoods. The model

accounted for around 28.8 percent of the variance in the property values using the

variables included. Compared to other models, small numbers of structural variables were only statistically significant. Furthermore, the variables related to the introduction of LIHTC projects were not statistically significant in the middle-income neighborhoods of Cleveland.

Table 17. Results in High-income Neighborhoods

Variables	High-income Submarkets, Charlotte			High-income Submarkets, Cleveland		
	Beta	Adj.Beta†	Robust Std. Err	Beta	Adj.Beta†	Robust Std. Err
Pre-impact 0-500 feet	0.069	7.161	0.046	-0.181	-16.540	0.161
Post-impact 0-500 feet	0.034	3.444	0.069	0.381 **	46.328	0.192
Pre-impact 500-2,000 feet	0.037 **	3.753	0.017	-0.079	-7.618	0.065
Post-impact 500-2,000 feet	-0.041 **	-4.014	0.020	0.037	3.731	0.102
Pre-trend 0-500 feet	-0.012	-1.201	0.005	0.026	2.649	0.019
Post-trend 0-500 feet	-0.011	-1.136	0.012	-0.055 ***	-5.350	0.020
Pre-trend 500-2,000 feet	-0.008 ***	-0.785	0.002	0.008	0.759	0.011
Post-trend 500-2,000 feet	0.009 ***	0.872	0.002	-0.006	-0.564	0.012
No. of LIHTC Units	0.000 ***	-0.047	0.000	0.000	-0.009	0.001
Log Heated Areas	0.766 ***	0.766	0.009	0.434 ***	0.434	0.023
Log Property Sizes	-	-	-	0.097 ***	0.097	0.012
Building Age	-0.005 ***	-0.506	0.000	-0.010 ***	-0.958	0.001
Building Age^2	0.000 ***	0.008	0.000	0.000 ***	0.003	0.000
Log Number of Bedrooms	-0.010	-0.010	0.011	0.101 ***	0.101	0.018
Number of Full Bathrooms	0.037 ***	3.813	0.004	0.038 **	3.851	0.017
Number of Half Bathrooms	0.001	0.120	0.004	0.025	2.575	0.018
Number of Fireplaces	-0.040 ***	-3.938	0.010	-	-	-
Electric Heating Source	-0.009 *	-0.852	0.005	-	-	-
Oil Heating Source	-0.138 **	-12.877	0.063	-	-	-
Brick/Stone Exterior Types	0.126 ***	13.431	0.004	0.061 ***	6.333	0.008
High-Housing Quality	0.219 ***	24.422	0.012	-0.036	-3.531	0.059
Low-Housing Quality	0.299	34.840	0.206	-0.334 ***	-28.393	0.080
Bungalow Housing Style	-	-	-	0.130 ***	13.899	0.014
Colonial Housing Style	-	-	-	0.051 ***	5.265	0.009

Table 17. Continued

Variables	High-income Submarkets, Charlotte			High-income Submarkets, Cleveland		
	Beta	**Adj.Beta†**	**Robust Std. Err**	**Beta**	**Adj.Beta†**	**Robust Std. Err**
Parks within 250 feet	-0.021 ***	-2.110	0.008	-0.004	-0.434	0.016
River/Lake within 500 feet	-	-	-	0.029 *	2.979	0.017
X, Y Coordinates (CBD)		Yes			Yes	
Census Tract Fixed Effects		Yes			Yes	
Seasonal Indicators		Yes			Yes	
Number of Observations			44,890			12,487
R^2			0.6988			0.4327

***Denotes a 1% significance level; **denotes a 5% significance level; *denotes a 10% significance level

† Adjustment = $100(e^\beta-1)$, except *Log* Heated Areas, *Log* Property Sizes, and *Log* Number of Bedrooms.

In the high-income neighborhoods of Charlotte and Cleveland, the opposite results for the impacts of LIHTC developments between both cities were generally consistent with previous results (see Table 17). The LIHTC developments in a microneighborhood had a negative impact on surrounding housing prices in Charlotte while they had a positive impact in Cleveland. For Charlotte, we can observe that the pre-impact variables showed positive coefficients indicating that the pre-existing housing price level of impact areas prior to LIHTC developments was higher than that of the control areas; the pre-impact variable was statistically significant only in the functional neighborhoods. The pre-price level in high-income submarkets contrasts with that in other submarkets such as low- and middle-income neighborhoods in Charlotte. Specifically, the housing price level for impact sales was 3.8 percent higher in the functional neighborhoods compared to control sales located outside of the microneighborhoods before LIHTC projects were developed. However, the post-impact

variable for high-income neighborhoods showed a negative sign. After the LIHTC units were developed within functional neighborhoods, the housing price level for impact sales was 4.0 percent lower compared to control sales. This indicates that the gap in the housing price level increased from 3.8 percent to -4.0 percent after the introduction of LIHTC units into the functional neighborhoods of properties. Price trend changes were less substantial, averaging around a 0.8 percent decline before the LIHTC developments and a 0.9 percent incline after the development. The project size effect was also statistically significant ($p<0.01$), although the magnitude of this impact was not substantial; a one-unit increase in the number of LIHTC units at the time of sale decreased the housing price by 0.1 percent, *ceteris paribus*.

For Cleveland, pre-impact variables were not statistically significant. However, the post-impact variable for functional neighborhoods was statistically significant ($p<0.05$). To be more specific, the housing price level for impact sales was 46.3 percent higher in the immediate neighborhoods compared to control sales after LIHTC projects were developed. Post-price trend change for immediate neighborhoods was also statistically significant ($p<0.01$), indicating an average of around a 5.3 percent decline after the LIHTC developments.

6.3 Impacts of LIHTC Developments on Neighborhood Stability

The analyses in this section employed the extended Cox hazard approach with difference-in-differences specifications to explore the associations between LIHTC developments and neighborhood housing turnover. Most of all, the analyses were

conducted at the citywide level for both Charlotte and Cleveland. Subsequently, for each

city, models were estimated separately for three types of neighborhoods stratified by

family income to test whether impacts of LIHTC developments vary based on income

heterogeneity.

6.3.1 Citywide Results

Table 18 shows the key coefficients for the citywide models for Charlotte and

Cleveland. I first present the results for Charlotte.

Table 18. Citywide Results

Variables	Citywide Results, Charlotte			Citywide Results, Cleveland		
	Coefficient	z-score	Hazard Ratio	Coefficient	z-score	Hazard Ratio
Sales Price (Standardized)	-0.063***	-5.17	0.939	-1.639***	-25.28	0.194
Sales Price^2 (Standardized)	0.013***	10.56	1.013	0.392***	14.33	1.480
Pre-impact 0-500 feet	-0.193	-1.36	0.825	-0.405***	-3.43	0.667
Post-impact 0-500 feet	0.300**	2.01	1.350	0.573***	4.63	1.773
Pre-impact 500-2,000 feet	-0.321***	-5.10	0.726	-0.412***	-7.00	0.662
Post-impact 500-2,000 feet	0.240***	4.14	1.271	0.539***	10.40	1.714
No. of LIHTC Units	0.001	1.53	1.001	0.000	-1.52	1.000
Park within 250 feet	0.068***	3.12	1.070	0.098*	1.83	1.103
River/Lake within 500 feet	-	-	-	1.074***	14.27	2.928
X, Y Coordinates (CBD)	Yes			Yes		
Census Tract Fixed Effects	Yes			Yes		
Number of Observations			59,882			20,824
Log likelihood			-370499.27			-81768.169
Likelihood ratio χ^2			2,445.99***			3,252.42***

***Denotes a 1% significance level; **denotes a 5% significance level; *denotes a 10% significance level

127

For housing property values, the negative hazard coefficients indicate that sale prices of properties are inversely related to housing turnover rates; hence, more expensive properties tend to turn over more slowly on average. A one-unit increase in the annual average price ratio results in a 6.1 percent lower probability of housing turnover (hazard), keeping all other factors constant.[2] However, this marginal effect, which is the probability of housing turnover, increases by 1.3 percent as the annual average price ratio increases.

The completion of LIHTC developments in a microneighborhood had a significant spillover effect on neighborhood stability, as indicated by housing turnover, in Charlotte. Before the development of LIHTC projects within the microneighborhoods, the pre-impact variables show a negative hazard coefficient. This indicates that the probability of housing turnover is lower compared to the control area (i.e., outside the impact area but in the same census tract) before the LIHTC projects are sited; it is statistically significant only in the outer ring (500 to 2,000 feet). Holding all other factors constant, the probability of housing turnover for impact sales was 17.5 percent less than that for control sales. However, the probability of housing turnover significantly increased after the introduction of LIHTC units into the microneighborhoods. The probability of housing turnover located adjacent and in proximity to LIHTC developments was 35.0 percent higher in the inner ring (immediate neighborhood) and 27.1 percent higher in the outer ring (functional neighborhood) compared to control properties located outside of

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[2] If the values of the hazard coefficients are exponentiated, hazard ratios can be obtained. Thus, calculating $100(e^{\beta}-1)$ indicates the percentage change in the hazard with each one unit change in independent variables, termed hazard ratios (Allison, 1984).

the microneighborhoods after LIHTC projects were sited. However, the association between the project size of the LIHTC and housing turnover was not statistically significant in Charlotte.

The results for Cleveland tell a similar story to those for Charlotte. The coefficients for property values, like those in Charlotte, show that the probability of housing turnover is non-linear. However, the magnitude of property values on housing turnover is more substantial than other factors in the Cleveland housing market. For every additional one-unit in the annual average price ratio, the probability of housing turnover is reduced by 80.6 percent, but this marginal effect increases by 48.0 percent as the annual average price ratio increases. This implies that the housing sales price may be a primary determinant of the in- and out-migration of neighborhood residents in cities with depressed market conditions such as Cleveland.

For Cleveland, the probabilities of housing turnover in the two distance rings before and after LIHTC developments show the same signs as that of Charlotte. The probability of housing turnover was 33.3 percent lower in the inner ring and 33.8 percent lower in the outer ring compared to the control areas before the LIHTC was developed. However, after the LIHTC projects are sited in the immediate and functional neighborhoods, the hazards of housing turnover were about 1.8 times and 1.7 times greater than it was for those in the control areas, respectively. Thus, the gaps in turnover between impact and control areas that exist before the completion of the LIHTC projects are magnified afterward, from -33.3 percent to 77.3 percent within immediate neighborhoods and from -33.8 percent to 71.4 percent within functional neighborhoods.

This indicates that the completion of the LIHTC developments significantly increased the probability of housing turnover in neighborhoods, particularly within the immediate neighborhood. The relationship between the project size of the LIHTC and housing turnover, like that in Charlotte, was not statistically significant in Cleveland.

6.3.2 Neighborhood Heterogeneity Results

This study also examined how impacts of LIHTC developments vary according to housing submarket heterogeneity in terms of income levels. This section presents the results for low, middle, and high income neighborhoods in Charlotte and Cleveland. The results suggest a mixed story according to neighborhood heterogeneity and contrasting housing market conditions.

Table 19. Results in Low-income Neighborhoods

Variables	Low-income Submarkets, Charlotte			Low-income Submarkets, Cleveland		
	Coefficient	z-score	Hazard Ratio	Coefficient	z-score	Hazard Ratio
Sales Price (Standardized)	-1.123***	-12.74	0.325	-1.138***	-8.78	0.320
Sales Price^2 (Standardized)	0.289***	15.28	1.335	0.328***	5.65	1.388
Pre-impact 0-500 feet	-0.160	-0.71	0.852	-0.188	-1.00	0.829
Post-impact 0-500 feet	0.246	1.08	1.279	0.589***	3.25	1.803
Pre-impact 500-2,000 feet	-0.453***	-4.25	0.636	-0.404***	-3.49	0.667
Post-impact 500-2,000 feet	0.438***	4.37	1.550	0.669***	8.01	1.952
No. of LIHTC Units	0.000	0.90	1.000	0.000	-0.90	1.000
Park within 250 feet	-0.087*	-1.68	0.916	0.040	0.30	1.041
River/Lake within 500 feet	-	-	-	0.553*	1.92	1.738
X, Y Coordinates (CBD)	Yes			Yes		
Census Tract Fixed Effects	Yes			Yes		

Table 19. Continued

Variables	Low-income Submarkets, Charlotte			Low-income Submarkets, Cleveland		
	Coefficient	z-score	Hazard Ratio	Coefficient	z-score	Hazard Ratio
Number of Observations			9,604			3,198
Log likelihood			-46145.645			-13523.945
Likelihood ratio χ^2			849.30***			396.86***

***Denotes a 1% significance level; **denotes a 5% significance level; *denotes a 10% significance level

The results for low-income neighborhoods in Charlotte and Cleveland are presented in Table 19. For the low-income submarket in Charlotte, the coefficients for property values showed that the probability of housing turnover was non-linear. For every one unit increase in the annual price ratio, the probability of housing turnover was reduced by 67.5 percent, but the marginal effect increased by 33.5 percent as the annual price ratio increased. We can observe that the pre-impact variables showed negative coefficients and the coefficients for the post-impact variables were positive, indicating that the probabilities of housing turnover were lower compared to the control areas before LIHTC projects were developed and higher than the control areas after LIHTC developments were introduced. However, the probabilities of housing turnover were statistically significant only in the outer rings of Charlotte. For the low-income neighborhoods of Charlotte, the probability of housing turnover in the outer ring was 36.4 percent less than that for the control properties, before LIHTC was developed, and 55.0 percent higher than control properties after LIHTC was introduced. In sum, the probability of selling properties including completed LIHTC projects within their functional neighborhoods, not within immediate neighborhoods, significantly increased

in the low-income submarkets of Charlotte. For the low-income neighborhoods of Cleveland, the probability of housing turnover in the outer ring was 33.3 percent less than the control area before LIHTC housing. However, after the LIHTC projects are developed in the immediate and functional neighborhoods, the probabilities of housing turnover were about 1.8 times and 2.0 times greater than it was for those in the control area, respectively.

Table 20. Results in Middle-income Neighborhoods

Variables	Middle-income Submarkets, Charlotte			Middle-income Submarkets, Cleveland		
	Coefficient	z-score	Hazard Ratio	Coefficient	z-score	Hazard Ratio
Sales Price (Standardized)	0.296***	15.38	1.345	-1.802***	-16.45	0.165
Sales Price^2 (Standardized)	-0.013***	-6.08	0.987	0.425***	7.21	1.530
Pre-impact 0-500 feet	-0.317	-1.17	0.728	-0.659***	-3.68	0.517
Post-impact 0-500 feet	0.510*	1.86	1.665	0.632***	3.30	1.881
Pre-impact 500-2,000 feet	-0.204	-1.28	0.815	-0.577***	-6.86	0.562
Post-impact 500-2,000 feet	0.250***	2.51	1.284	0.612***	8.06	1.844
No. of LIHTC Units	0.001	0.42	1.001	0.000	-0.58	1.000
Park within 250 feet	0.124***	4.23	1.131	0.204***	2.47	1.227
River/Lake within 500 feet	-	-	-	0.924***	8.28	2.518
X, Y Coordinates (CBD)	Yes			Yes		
Census Tract Fixed Effects	Yes			Yes		
Number of Observations			25,052			7,702
Log likelihood			-144832.22			-32127.007
Likelihood ratio χ^2			1,471.60***			1,152.49***

***Denotes a 1% significance level; **denotes a 5% significance level; *denotes a 10% significance level

In the middle-income neighborhoods of Charlotte and Cleveland, the results were generally consistent among key variables (see Table 20). For the middle-income submarket in Charlotte, the sign of hazard coefficients for housing property values showed in the opposite direction. For every additional one unit in the annual average price ratio, the probability of housing turnover is increased by 34.5 percent, but the marginal effect decreased by 1.3 percent as the annual price ratio increased.

The post-impact variables show that the probability of selling properties was higher after the LIHTC projects were completed in both cities. For Charlotte, the presence of LIHTC developments within the properties' immediate neighborhood or inner ring resulted in about a 1.7 times higher chance of housing turnover, and developments within the properties' functional neighborhood or outer ring resulted in a 28.4 percent higher probability of turnover. The pre-impact variables were not statistically significant for Charlotte, although the coefficient maintained the same sign as other models. For Cleveland, the pre-impact variables showed a negative hazard coefficient, indicating that the probability of housing turnover was lower compared to control sales before the LIHTC subsidized housing was sited within the properties' microneighborhoods. However, after the LIHTC projects were developed, the probability of housing turnover was 88.1 percent higher within immediate neighborhoods and 84.4 percent higher within functional neighborhoods.

These results show that the likelihood of housing turnover in middle-income neighborhoods in both cities is sensitive to the influx of LIHTC subsidized households into microneighborhoods. This implies that spillover effects are consistent in the middle-

133

income submarket regardless of differences in housing market conditions (i.e., hot and cold markets).

Table 21. Results in High-income Neighborhoods

Variables	High-income Submarkets, Charlotte			High-income Submarkets, Cleveland		
	Coefficient	z-score	Hazard Ratio	Coefficient	z-score	Hazard Ratio
Sales Price (Standardized)	-0.388***	-22.56	0.679	-1.890***	-15.65	0.151
Sales Price^2 (Standardized)	0.029***	18.43	1.030	0.432***	10.13	1.541
Pre-impact 0-500 feet	-0.919***	-2.89	0.399	0.102	0.26	1.107
Post-impact 0-500 feet	0.897***	2.71	2.452	0.654*	1.74	1.923
Pre-impact 500-2,000 feet	-1.033***	-5.53	0.356	0.705***	3.39	2.023
Post-impact 500-2,000 feet	0.373***	2.77	1.452	-0.049	-0.32	0.952
No. of LIHTC Units	0.004***	4.12	1.004	-0.009***	-4.33	0.991
Park within 250 feet	0.022	0.52	1.022	0.024	0.30	1.025
River/Lake within 500 feet	-	-	-	1.366***	12.64	3.919
X, Y Coordinates (CBD)	Yes			Yes		
Census Tract Fixed Effects	Yes			Yes		
Number of Observations			25,226			9,924
Log likelihood			-142641.2			-26781.558
Likelihood ratio χ^2			1,269.10***			843.61***

***Denotes a 1% significance level; **denotes a 5% significance level; *denotes a 10% significance level

Table 21 shows the results for high income neighborhoods in Charlotte and Cleveland. For the high-income submarket in Charlotte, the coefficients for property values showed that the probability of housing turnover was non-linear. For every one unit increase in the annual price ratio, the probability of housing turnover is reduced by 32.1 percent, but the marginal effect increased by 3.0 percent as the annual price ratio

134

increased. It is notable that the hazard of housing turnover increased dramatically within the inner ring after the LIHTC was developed. Before the development of LIHTC projects, the probability of turnover was 60.1 percent lower than for control sales in the immediate neighborhood. After the introduction of subsidized housing, however, the probability of housing turnover was about 2.45 times greater than the control area. In addition, the probability of housing turnover in functional neighborhoods was 64.4 percent less than that for control sales, before LIHTC was introduced, and 45.2 percent higher than control sales after LIHTC was developed. In sum, the spillover effects on housing turnovers were much more substantial at closer proximities to LIHTC units after LIHTC projects were developed. Size effects of LIHTC developments were also statistically significant, although the magnitude of this impact was not substantial. A one-unit increase in the number of LIHTC projects at the time of sale resulted only in a 0.4 percent higher chance of housing turnover, *ceteris paribus*, in the high-income neighborhoods of Charlotte.

The results from the city of Cleveland tell a different story than those of Charlotte. The coefficients for property values, like those in Charlotte, showed that the probability of housing turnover was non-linear; for every additional one unit in the annual average price ratio, the probability of housing turnover was reduced by 84.9 percent, but this marginal effect increased by 54.1 percent as the annual average price ratio increased. Also, after the LIHTC was developed within immediate neighborhoods, the probability of housing turnover was about 92.3 percent higher than the control area. However, this impact was only statistically significant at the 90 percent level. The

135

probability of selling properties within functional neighborhoods after the LIHTC development was not statistically significant in the high-income neighborhoods of Cleveland. Interestingly, building more units in LIHTC developments appears to decrease the effects, although the magnitude of this size impact is not substantial; a one-unit increase in the number of LIHTC units at the time of sale results in only a 0.9 percent lower chance of housing turnover, *ceteris paribus*.

In sum, the results for the high-income submarket show that in Charlotte, high-income residents are sensitive to the influx of LIHTC households into neighborhoods, particularly into the immediate neighborhood. However, the introduction of LIHTC developments only appears to have a significant impact within the immediate neighborhood for the high-income submarket in Cleveland. Size effects of LIHTC developments showed that the project size was directly related to housing turnover rates in Charlotte, while that was inversely related to housing turnover rates in Cleveland.

CHAPTER VII

CONCLUSIONS

**7.1 Subsidized Households in the Vicious Circle of Residential Segregation and
Inequality**

   This study conceptualized, through simple bivariate analyses, the relationship

between the LIHTC projects and the sociodemographic conditions of neighborhoods

where projects were developed. The findings showed that the LIHTC program might

perpetuate the uneven geography of opportunities through the concentration of

disadvantages. The results demonstrated that LIHTC projects were more likely to be

developed in neighborhoods with relatively high percentages of poor households,

minorities, and unemployment. Furthermore, they were also likely to be sited in tracts

with relatively low-housing values, low-income, and less educated populations. Current

patterns of LIHTC developments due to NIMBY attitudes have contributed to the

residential segregation of subsidized households.

   As the major supply-based project for producing affordable housing units, the

LIHTC program can be a critical tool in the U.S. for the distribution of housing to

achieve better social and economic opportunities (Van Zandt & Mhatre, 2009). Because

the LIHTC developments involve a state-level planning process through the

development of Qualified Allocation Plans (QAPs) by state housing finance agencies

(HFAs), the LIHTC program allows even states without federal mandated planning or

consistent requirements to consider the distribution of subsidized housing units within

and across state areas (Van Zandt & Mhatre, 2009). Despite these flexibilities of the program to contribute to poverty deconcentration and dispersal, current development patterns of the LIHTC program has exacerbated disparity in social and economic opportunities for subsidized households by promoting the isolation of the least advantaged groups in undesirable neighborhoods.

Although the results of this study may not be generalizable to other U.S. cities since study areas are limited to only two cities, many previous studies provided empirical evidence that LIHTC projects across the country are developed in undesirable neighborhoods. Previous research has demonstrated that the LIHTC units are highly clustered in heavily urbanized areas (Van Zandt & Mhatre, 2009). Also, these clusters are strongly related to higher levels of the disadvantaged, especially in terms of high poverty, minorities, and inferior education opportunities (Van Zandt & Mhatre, 2009). Even though the LIHTC program is relatively more successful than other subsidized housing programs (i.e., public housing and HCV) at locating units in suburbs (McClure, 2006), a large number of LIHTC units is still located in undesirable neighborhoods such as central cities (Freeman, 2004). Moreover, LIHTC neighborhoods remain disadvantaged, especially in terms of higher poverty rates, lower median incomes, and lower median house values, compared to other metropolitan neighborhoods (Freeman, 2004).

By targeting undesirable neighborhoods due to NIMBYism, LIHTC developments have contributed to residential segregation (Rohe & Freeman, 2001). Furthermore, residential segregation that stemmed from NIMBY opposition may

perpetuate inequitable opportunities for subsidized households by pushing them into a vicious circle of residential segregation and inequality. First, restriction of spatial location of LIHTC developments due to residential segregation means that subsidized households are isolated from mainstream social and economic opportunities. To be more specific, subsidized households face obstacles for accessing opportunities for good education, employment, and safety from crime. Second, lack of access to opportunities for a quality education, high-paying jobs, and safety limits the opportunities for wealth accumulation. In reverse, the disparity in wealth causes exposure to poor education quality, inadequate access to jobs, and high crime rates, especially in terms of the spatial location of the least advantaged groups. The wealth disparities of subsidized households might leave them as disadvantaged, underserved, and marginalized populations. Last, deprivation of social and economic opportunities for upward mobility is accelerated by poverty concentration due to interaction and clustering effects.

In sum, the interrelated associations among residential segregation, poverty concentration, and deprivation of social and economic opportunities for subsidized households is mutual and bidirectional and makes social inequality worse. Residential segregation intensifies concentrated poverty, and these interacting forces prevent subsidized households from accessing social and economic opportunities for upward mobility. Conversely, lack of social and economic opportunities translates into residential segregation. Hence, subsidized households suffer from a vicious circle of residential segregation and inequality.

7.2 Impacts of the LIHTC Developments on Neighborhoods

This study examined empirical evidence for the NIMBY perception on subsidized developments, especially exploring the impacts of subsidized housing programs on 1) nearby property values and 2) neighborhood stability (housing turnovers) in two cities: Charlotte, North Carolina and Cleveland, Ohio. Major findings for two empirical analyses are summarized below in Table 22.

Table 22. Results on Property Values and Neighborhood Stability

Variables	Charlotte		Cleveland	
	Property Values	**Stability**	**Property Values**	**Stability**
Citywide Results				
Immediate Neighborhoods (0-500 feet)	-	Negative	-	Negative
Functional Neighborhoods (500-2,000 feet)	Negative	Negative	Positive	Negative
Low-income Submarkets				
Immediate Neighborhoods (0-500 feet)	-	-	-	Negative
Functional Neighborhoods (500-2,000 feet)	-	Negative	Positive	Negative
Middle-income Submarkets				
Immediate Neighborhoods (0-500 feet)	Negative	Negative	-	Negative
Functional Neighborhoods (500-2,000 feet)	Negative	Negative	-	Negative
High-income Submarkets				
Immediate Neighborhoods (0-500 feet)	-	Negative	Positive	Negative
Functional Neighborhoods (500-2,000 feet)	Negative	Negative	-	-

I first present the results for exploring the relationships between the LIHTC developments and neighboring housing prices. Citywide results suggested that the impacts of LIHTC developments varied across local housing market conditions. The developments of LIHTC projects had a negative impact on surrounding housing prices in the city of Charlotte. In contrast, LIHTC developments positively affected nearby property values in the city of Cleveland.

For Charlotte, the housing price level was lower compared to that of control sales after controlling for pre-existing housing price levels prior to LIHTC developments. These results are consistent with those found by Lee, Culhane, and Wachter (1999) in their research conducted for Philadelphia. However, the spillover effect was only significant within the properties' functional neighborhoods, and not within immediate neighborhoods. No statistically significant impacts within immediate neighborhoods might stem from the lack of variation of impact sales that is needed to explain the effect of this variable. Interestingly, the results for the Cleveland housing market tell a different story than those for Charlotte. After the LIHTC projects were developed in microneighborhoods, the housing price levels were higher compared to control sales. This implies that LIHTC developments generate upgrading effects in depressed housing market conditions. These positive effects might be related to the removal of disamenities. Specifically, LIHTC developments in urban neighborhoods may replace disamenties such as dilapidated and abandoned buildings, as well as other eyesores that reduce surrounding housing prices (Schwartz, Ellen, Voicu, & Schill, 2006). Furthermore, subsidized housing developments can be regarded as a tool for community revitalization.

Thus, these community developments might create positive external effects in the depressed housing market conditions. However, these upgrading effects were only significant within functional neighborhoods, like those in Charlotte.

The results also showed that the impacts of LIHTC projects vary across different housing submarkets. It is worth noting that spillover effects in low-income neighborhoods were not statistically significant in Charlotte. In addition, the results for the low-income submarkets in Cleveland showed that positive impacts due to LIHTC developments were only significant within the properties' functional neighborhoods, and not within immediate neighborhoods. This finding might lead to several possible conclusions. First, tenant characteristics between subsidized housing and non-subsidized housing may not be as noticeable in low-income submarkets. Thus, the response to the influx of LIHTC households into microneighborhoods might not be as sensitive in low-income submarkets compared to other neighborhoods. Second, low-income neighbors may have less information or lack awareness about the introduction of LIHTC households, due to lower education or income level (Kobie & Lee, 2011). Third, real estate agents may be less willing to provide this information to low-income neighbors and may not want to exert the same level of effort for low income clients compared to others due to the differences in commission (Galster, 1987; Kobie & Lee, 2011). Finally, even though LIHTC developments regarded as the tool for eliminating of disamenties might positively affect nearby property values, especially in the city of Cleveland, these upgrading effects may not be an impetus to significantly increased housing prices in low-income submarkets.

The findings for middle-income submarkets showed that spillover effects were significant in both immediate as well as functional neighborhoods for Charlotte. The influx of LIHTC subsidized households negatively affects surrounding housing prices under hot housing market conditions. Interestingly, the size effects of LIHTC projects were positive for middle-income submarkets in Charlotte. This implies that some degree of larger projects might mitigate the negative effects of LIHTC developments. The influx of subsidized households into neighborhoods contributes to housing price decreases, but larger projects rather than smaller projects may alleviate housing price decreases due to the removal of disamenities in middle-income neighborhoods of Charlotte. However, the impacts of LIHTC developments in middle-income neighborhoods were not statistically significant in the city of Cleveland, although the coefficient maintained the same sign (positive impacts) as the Cleveland citywide results. The result for Cleveland middle-income submarkets might lead to possible conclusions in two ways. First, the LIHTC developments in Cleveland might not generate upgrading (or negative) effects in middle-income neighborhoods based on my results. This study stratified Cleveland neighborhoods by comparing a neighborhoods' median family income to the city's median family income, and then we identified the middle-income neighborhoods in Cleveland. However, fundamentally, the city of Cleveland fully consists of poor neighborhoods compared to the metropolitan area. If we classified Cleveland neighborhoods by Cuyahoga County's median family income, we would see that the city of Cleveland has a higher proportion of low-income neighborhoods compared to the suburbs (See Figure 14). To be specific, of 192 census tracts in

Cleveland, around 87 percent (167 census tracts) are low-income neighborhoods and 12 percent (23 census tracts) are middle-income neighborhoods. This implies that middle-income submarkets in Cleveland defined by the city's median family income are inherently poor neighborhoods compared to Cuyahoga County. Thus, similar to the results for low-income submarkets, small discrepancies in characteristics between subsidized housing and non-subsidized housing tenants might be a reason for the insignificant impacts of LIHTC developments in Cleveland middle-income neighborhoods. In addition, upgrading effects due to eliminating of disamentieis may not be a significant reason to affect housing prices in the middle-income neighborhoods. Second, it is worthy to note that the R^2 for the middle-income neighborhoods in Cleveland was lower than that for other models such as models for low- and high-income submarkets. Given the homogeneity of the neighborhood characteristics within middle-income neighborhoods, it is not surprising that many of the independent variables were not significant in the results. This implies that the model may not explain the variance in the property values completely using the variables included. Lack of variations in explanatory variables may not account for the effects of LIHTC developments, especially in middle-income neighborhoods of Cleveland.
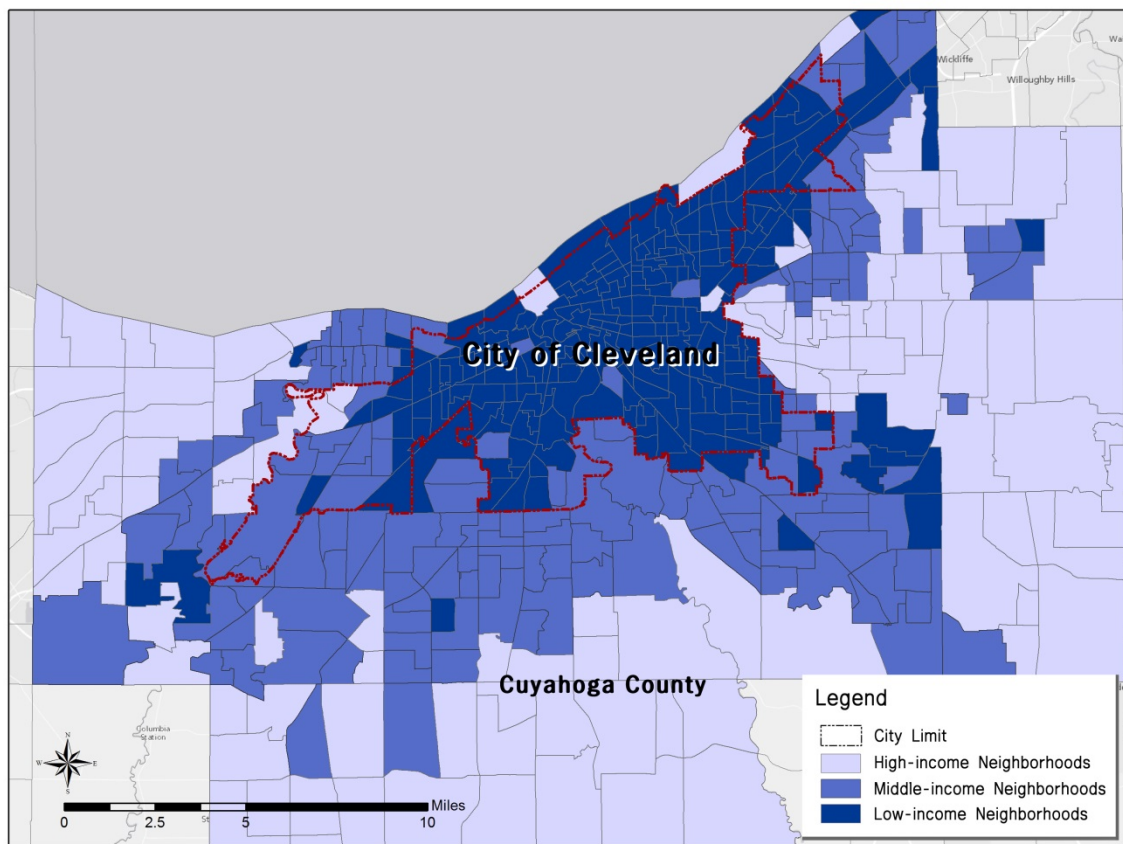
Figure 14. Neighborhood Stratifications by Cuyahoga County Median Family Income

The results for high-income submarkets suggested that the LIHTC projects had negative impacts on neighboring property values in Charlotte, while they had upgrading effects in Cleveland. The negative impacts due to LIHTC developments in Charlotte were only significant within the properties' functional neighborhoods, and not within immediate neighborhoods. This result for Charlotte might stem from a small variation of impact sales within immediate neighborhoods. Interestingly, the results for Cleveland showed strong positive impacts in immediate neighborhoods. These high upgrading effects in housing prices after the completion of LIHTC developments within immediate

neighborhoods of properties implies that LIHTC developments might be deemed as projects for community revitalization in depressed housing market conditions. In addition, the response to the removal of disamenities such as an abandoned building or a littered vacant lot might be more sensitive in high-income submarkets.

I last present the results for examining the associations between the LIHTC developments and neighborhood stability, especially in terms of housing turnover. The citywide results suggest that LIHTC developments generated significant spillover effects undermining neighborhood stability in the cities of Charlotte and Cleveland. These results are consistent with those found by Baum-Snow and Marion (2009). However, my study circumstantiated spillover effects of LIHTC more precisely because this study used parcel-level sales transaction data whereas previous studies only utilized spatially aggregate census data. The probability of housing turnover was higher than that of control sales after controlling for pre-existing turnover levels prior to LIHTC construction. The spillover effects were generally consistent in both the Charlotte and Cleveland housing markets. Although the completion of LIHTC projects encouraged higher housing turnover, housing prices appear to have a more influential role in determining housing turnover in Cleveland, which may be due to its depressed housing market conditions.

The findings also showed that the impacts of LIHTC developments vary across different housing submarkets. The results for high-income submarkets suggested strong negative impacts in immediate neighborhoods, especially in Charlotte. Exceptionally high housing turnover after the completion of LIHTC developments within immediate

146

neighborhoods of properties implies that neighbor attitudes about the entrance of LIHTC households would be more sensitive in high-income submarkets. It is also noteworthy that size effects of LIHTC developments were only significant in high-income submarkets of both cities. This signifies that high-income neighbors may be sensitive to the project size of developments. Building more units in LIHTC projects stimulated rapid housing turnovers in Charlotte, while increases in LIHTC units mitigated spillover effects of LIHTC developments in Cleveland. This implies that although the LIHTC developments accelerated housing turnover in both cities, larger projects rather than smaller projects in depressed housing market conditions like Cleveland might mitigate rapid housing turnovers due to the removal of disamenities such as dilapidated buildings and other eyesores. The results for middle-income submarkets showed that spillover effects were significant in both immediate as well as functional neighborhoods for both cities, with the influx of LIHTC subsidized households stimulating high housing turnovers in middle-income neighborhoods under both depressed and hot housing market conditions. Particularly, the probability of housing turnover was significantly higher when LIHTC units were developed within the immediate neighborhood of each property. Interestingly, the findings for the low-income submarkets in Charlotte showed that housing turnovers due to LIHTC completion were only significant within the properties' functional neighborhoods, and not within immediate neighborhoods. This finding might lead to several possible conclusions, similar to the results of previous analyses exploring the relationships between the LIHTC developments and nearby property values for low-income submarkets. Because of small discrepancies of tenant

147

characteristics between subsidized households and non-subsidized households, the response to the influx of LIHTC households into immediate neighborhoods might not be as sensitive in low-income submarkets compared to other neighborhoods. In addition, lack of information and awareness about the entrance of LIHTC households due to the lower education or income level of neighbors, as well as the unfavorable information of real estate agents might result in insignificant impacts of LIHTC developments within low-income submarkets (Galster, 1987; Kobie & Lee, 2011).

7.3 Policy Implications

The study supported findings that the influx of subsidized households into neighborhoods leads to higher housing turnover in both Charlotte and Cleveland. Increasing rates of housing turnover may indicate neighborhood instability. Rapid turnover may restrict social ties among neighbors and contribute to the breakdown of informal social control (Ross, Reynolds, & Geis, 2000; Sampson, 1985; Sampson & Groves, 1989). The flow of residents in and out of neighborhoods responding to the entrance of LIHTC developments might undermine social integration by depriving residents of the opportunities to know each other, share norms, and sustain neighborhood networks. In addition, neighborhood instability may increase crime and other social pathologies within the neighborhood (Ross, Reynolds, & Geis, 2000). Many studies support the notion that neighborhood instability is strongly related to high levels of crime, violent victimization and delinquency (Crutchfield, Geerken, & Gove, 1982; Sampson, 1985). Moreover, there is growing concern about neighborhood instability

148

when it is linked to the economic context of the neighborhood, especially in terms of poverty and income. The concurrence of high poverty levels and neighborhood instability may exacerbate neighborhood violent crime (Smith & Jarjoura, 1988). My results raise concerns about high rates of housing turnover in response to the development of LIHTC subsidized housing. Moreover, the fact that subsidized housing tends to be located in disadvantaged neighborhoods due to NIMBY behavior stimulates concerns about the exacerbation of neighborhood instability. This suggests that existing conditions related to neighborhood stability should be considered when placing LIHTC units in neighborhoods, and these conditions should be monitored in neighborhoods with LIHTC housing. Cities need to monitor stability within neighborhoods and ensure that increased turnover does not lead to additional destabilization in terms of property maintenance and upkeep. This may include the implementation of programs designed to ease the transition of new residents into the neighborhood.

When it comes to establishing the relationship between the developments of LIHTC subsidized housing and nearby property values, the impacts of LIHTC developments showed a contrast between different housing market conditions (i.e., hot or cold market). Charlotte, being a hot housing market, the influx of LIHTC subsidized households did lead to lower property values. However, a larger size of LIHTC developments mitigated those spillover effects, especially in the middle-income neighborhoods. Cleveland, being a depressed housing market, the predominant impact of LIHTC developments was an upgrading effect on nearby property values. These results showed that the impacts of LIHTC developments vary according to the local housing

149

market conditions. The LIHTC developments may generate a negative impact on surrounding property values, especially in the hot housing market condition. Because LIHTC subsidized units are almost always occupied by households below the 30th percentile of income distribution, neighbors regard the developments of LIHTC units as the influx of undesirables into neighborhoods. However, new LIHTC units may also represent amenity improvement by replacing dilapidated buildings and unsightly lots in the depressed housing market condition (Baum-Snow & Marion, 2009). These positive impacts for the removal of disamenities were strong in high-income neighborhoods in depressed housing markets.

The LIHTC developments caused high housing turnover and housing price decline in the hot housing market while contributing to high housing turnover and housing price increases in the depressed housing market. Based on the results of the study to explore the change in property values as well as housing turnover due to the LIHTC developments, we may identify the change in a neighborhood's socioeconomic characteristics as filtering down or gentrification. Based on the results for high housing turnover due to the LIHTC developments, the socioeconomic characteristics of new neighborhoods might be capitalized into housing prices (Baum-Snow & Marion, 2009). Negative spillover effects of LIHTC projects on housing prices may signify the influx of lower-income residents (filtering down). In contrast, positive spillover effects on property values may indicate the influx of wealthier residents into neighborhoods. These neighborhood changes following the LIHTC developments in a depressed housing market may indicate displacement of lower income residents by higher income

150

populations. The trend might be referred to as neighborhood gentrification. However, the definition of gentrification is complicated and even the basic definition and perspectives on gentrification are highly controversial among scholars; neighborhoods are gentrified due to some development patterns in lower income neighborhoods that result in higher rents and property values, and then, the increasing property values displaces many existing residents in lower income areas by making the area unaffordable (Lang, 1982). In addition, my results cannot identify whether or not the displacees make only short moves and thus remain in or near their original neighborhood (Lang, 1982). If the displacees remain in or near their original neighborhood, it might be difficult to regard this pattern as neighborhood gentrification. Hence, we could not make an impetuous decision about whether or not the neighborhoods where subsidized housing units are developed are "gentrified" due to the LIHTC developments. However, according to the results of this study, even with minimal insight one can conclude that the LIHTC developments positively affect nearby property values in the depressed housing market, whereas they negatively affect neighboring housing prices in the hot housing market condition. These results implied that the LIHTC program may be implemented to revitalize or stimulate deteriorated areas, especially in the depressed housing market.

There is, however, growing concern about current implementation of the LIHTC program. Current development patterns of LIHTC units have shown uneven geography of opportunity. The program has exacerbated disparity in social and economic opportunities for subsidized households by pushing them into the vicious circle of residential segregation and inequality. Current LIHTC regulations implemented by state

agencies overlook the issue of the concentration of subsidized households in undesirable neighborhoods. The lack of attention to this peculiar spatial pattern of LIHTC developments causes a serious gap in the federal effort to guard against residential segregation (Rohe & Freeman, 2001). Hence, this study suggests that the LIHTC program should be improved as a tool for the equitable redistribution of socioeconomic opportunities as well as the revitalization of neighborhoods. First, the LIHTC developments need to put a great deal of their effort into dispersing, rather than concentrating, subsidized housing units (Van Zandt & Mhatre, 2009). However, HUD's use of Qualified Census Tracts (QCTs) for identifying Difficult Development Areas (DDAs) may be related to the uneven geography of opportunities for subsidized households (Rohe & Freeman, 2001; Van Zandt & Mhatre, 2009). LIHTC developments in QCTs, which include tracts in which at least half of the households have incomes below 60 percent of area median income, allow developers to be paid larger tax credits. Specifically, if the LIHTC projects are developed in QCTs, the developer receives a "basis boost" of 130 percent (Schwartz, 2010). Even though the designation of QCTs contributes to the siting of LIHTC projects in places where the market might not normally support it, QCTs may cause the concentration of the disadvantaged in undesirable neighborhoods (Oakley, 2008; Rohe & Freeman, 2001; Van Zandt & Mhatre, 2009). Hence, the LIHTC program, as a dispersal tool, needs to be encouraged to develop in unaffordable markets (Van Zandt & Mhatre, 2009).

Second, the income-mixing between LIHTC developments and neighborhoods need to be facilitated to achieve the equitable redistribution of socioeconomic

opportunities and to stimulate the revitalization of neighborhoods. Although the program was designed to facilitate mixing of incomes, in practice nearly 85 percent of all units developed through 2002 were low-income (U.S. Department of Housing and Urban Development, 2005). Also, my study showed that LIHTC subsidized households are more likely to be located in neighborhoods with relatively high percentages of poor and low-income populations. Hence, tax credit regulations may be adjusted to produce affordable housing units where they are really needed (Van Zandt & Mhatre, 2009). Also, housing market conditions may be considered to distribute affordable housing units. Depressed housing markets need new units to revitalize communities and upgrade the housing stock, whereas hot housing markets (and high-income submarkets) need to be more accessible to low-income households (Van Zandt & Mhatre, 2009). According to the results of this study, LIHTC developments had strong upgrading effects in housing prices, due to the removal of disamenties in high-income neighborhoods of depressed housing market conditions. In addition, even in middle-income neighborhoods of hot housing market conditions, larger projects rather than smaller projects may mitigate the negative impacts of LIHTC developments. Thus, tax credit regulations might discourage a large proportion of LIHTC units from being located in disadvantaged neighborhoods to promote the deconcentration (Van Zandt & Mhatre, 2009). In contrast, LIHTC units need to be located in affluent neighborhoods to promote income-mixing and economic integration (Van Zandt & Mhatre, 2009). These suggestions on the locations of LIHTC units do not mean to proscribe the LIHTC developments in disadvantaged neighborhoods because it is not reasonable to expect that LIHTC developments are

153

evenly distributed across all neighborhood categories including different land values, residential environments, and community services (Rohe & Freeman, 2001). However, it is important for subsidized households to be provided a wider range of choices in residential opportunities. In addition, these approaches on siting of LIHTC developments might facilitate regional dispersal, achieve more equitable distributions of housing options for subsidized households, and ultimately sever the vicious circle of residential segregation and inequality for subsidized households.

7.4 Study Limitations

This dissertation has several limitations in terms of the issues on empirical methodologies and data sets. First, even though a large number of samples were used in this study, there were a small number of impact sales in immediate neighborhoods, especially in high-income submarkets. The lack of variation of impact sales associated with the LIHTC developments within 500 feet from single-family housing units is a principle problem in the empirical analyses of this study. In addition, a small variation of impact sales in high-income submarkets is associated with uneven geography of subsidized developments. Large numbers of LIHTC developments are more likely to be located in poor neighborhoods such as low- and middle-income submarkets rather than in wealthier neighborhoods. Hence, it is possible that potential positive or negative impacts of LIHTC developments might be missed, due to the lack of variation of impact sales that is needed to explain the effect of LIHTC projects.

Second, although the spatial fixed effect approach, especially in terms of using census tract fixed effects and geographic coordinates, partially accounts for spatial autocorrelation of the residuals, the imperfect control of the spatial autocorrelation might cause biased and/or inefficient estimates (Koschinsky, 2009).

Third, when it comes to understanding the relationships between the LIHTC developments and neighborhood stability, the findings for this study was unable to identify housing turnover stratified by housing types such as owner-occupied and renter-occupied units due to limitation in the data such as length of residence and distinguishing renters and homeowners. For example, housing turnovers in renter-occupied units might be greater in low-income neighborhoods. However, according to the findings, one can show the change of neighbors in terms of housing turnover due to LIHTC developments, regardless of the vulnerability of neighborhood stability between renters and homeowners. In spite of the results of this study, it would be intriguing for future studies to examine the relationships between subsidized housing and housing turnovers classified by housing types.

In addition, this study cannot identify multiple sales in a housing price between 1996 and 2007. In the analysis for exploring the relationships between the LIHTC developments and housing turnover, housing sales were regarded as the hazard occurrence, and then the housing duration was measured with the duration between the first sale and the next sale (Kim & Horner, 2003). Thus, if some properties were sold multiple times after the second sale during the risk period (1996 to 2007), the empirical

model in this study did not specify these properties. This problem might under- or over-estimate the impacts of LIHTC developments on neighborhood housing turnover.

7.5 Directions for Further Studies

Additional research is needed to understand better the conditions under which LIHTC developments may hurt or help neighborhoods. According to the Broken Windows Theory, individual perceptions on physical dilapidation stem from visual cues in communities (Massey & Denton, 1993). This paradigm implies that the visual design quality of subsidized housing might be a factor that affects neighborhoods. Schill and his colleagues (2002) have suggested that the design of developments may matter to the extent that the physical design is consistent with the neighborhood's visual character, but little if any research exists to test this.

The mixing of incomes within developments may need to be sensitive to the neighborhood context to help overcome concerns about the discrepancies between LIHTC residents and surrounding neighbors. HUD's partnership with the American Institute for Architects (AIA) in developing the Affordable Housing Design Advisor (www.designadvisor.org) offers recommendations for maintaining massing, setback, and other land development regulations to ensure consistency. Other researchers suggest that LIHTC program should do a better job of income mixing (Van Zandt & Mhatre, 2009). Although the program was designed to facilitate mixing of incomes, in practice nearly 85 percent of all units developed through 2002 were low-income (U.S. Department of Housing and Urban Development, 2005). The mixing of incomes within developments

156

may need to be sensitive to the neighborhood context to help overcome concerns about the discrepancies between LIHTC residents and surrounding neighbors. At the very least, cities need to monitor stability within neighborhoods and ensure that increased turnover does not lead to additional destabilization in terms of neighborhood crime rates. This may include the implementation of programs designed to ease the transition of new residents into the neighborhood.

The results on the studies on the cities of Charlotte and Cleveland suggest that the entrance of LIHTC developments may deteriorate neighborhood stability in terms of high rates of housing turnovers. Also, LIHTC developments may decrease housing prices in Charlotte and increase property values in Cleveland. However, it is possible that different subsidized housing programs, such as the HCV tenant-based subsidy program, might result in different spillover effects on neighborhoods. The HCV program, as a tenant-based subsidized housing program, in theory provides low-income families more flexibility in choices of locations as well as unit types (Van Zandt & Mhatre, 2013). The HCV program may help to deconcentrate income and racial segregation. Also, one primary characteristic of the HCV program compared to supply-based subsidized housing programs is that neighbors may not be as aware of the influx of HCV tenants into neighborhoods because there are no visual cues (Nguyen, 2005). In these contexts, the anticipated impact of the HCV program may be different due to the type of subsidized housing program. Thus, an extension of the study on the association between the HCV program and neighborhoods, compared with my results, would provide revealing insights into studies on spillover effects of subsidized housing programs.

While the results of this study are robust, I caution that the results may not be generalizable to other U.S. cities since the study examines only two U.S. cities. Additionally, although this study described Charlotte and Cleveland as having hot and depressed housing markets, respectively, these two cities may not be representative of housing market conditions in other cities due to the unique characteristics of each city. Thus, I suggest that future studies should further examine the association between neighborhoods and subsidized housing programs by exploring other cities, other housing market conditions, and other types of subsidized programs.

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161

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APPENDIX A: COX HAZARD MODEL WITH TIME-VARYING INDEPENDENT VARIABLES: EPISODE SPLITTING

Extended cox hazard model can easily control time-varying independent variables using episode splitting. In our empirical models, post-impact variables were treated as time-varying covariates because the LIHTC project can be developed with the housing duration between the first sale and the next sale of a property. In this situation, the hazard data set was reorganized to incorporate time-varying covariates using episode splitting (Alisson, 2004). For instance, consider a property i with two different values for a covariate (X_n: post-impact variable).

$$X_1 = 0 \text{ if } t < u$$
$$X_2 = 1 \text{ if } t \geq u$$

where u is the completion date of LIHTC developments, t is the date of sales, and T_i is the survival time.

Table A-1. Example of Episode Splitting

Record No.	Event (Sales Occurrence)	Survival Time	Entry Time	Post-impact Variables
Data Record for Property i (Before Episode Splitting)				
1	1	T_i	0	-
Data Record for Property i (After Episode Splitting)				
1	0	u	0	X_1 (=0)
2	1	T_i	u	X_2 (=1)

As seen in Table A-1, after episode splitting, the survival time (episode) for a property i was split into two sub-periods (Jenkins, 2005). Also, in the first episode, the post-impact variable takes on the value X_1, and in the second episode, the post-impact variable takes on the value X_2. This transformation of the hazard data set that is episode splitting was used to account for the cases that LIHTC projects were developed between the first sale and the next sale of properties.