# HOUSING CHOICE VOUCHER HOUSEHOLDS AND NEIGHBORHOOD QUALITY: A CASE STUDY OF HARRIS COUNTY, TEXAS

A Dissertation

by

HAN PARK

Submitted to the Office of Graduate and Professional Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

| | |
|---|---|
| Chair of Committee, | Shannon Van Zandt |
| Co-Chair of Committee, | Wei Li |
| Committee Members, | Cecilia Giusti |
| | Rebekka Dudensing |
| Head of Department, | Shannon Van Zandt |

August 2017

Major Subject: Urban and Regional Sciences

# ABSTRACT

Affordable housing programs are critical in increasing low-income citizens' quality of life. The Housing Choice Voucher (HCV) program, one of the major affordable housing programs since 1974, purportedly helps low-income tenants to attain better housing and neighborhood conditions by allowing households to rent units on the private rental market. The greatest advantage of the HCV program is that it offers voucher holders the possibility to choose rental units in their preferred areas. The primary aim of the HCV program is to ensure that subsidized households such as low-income families, senior citizens, and disabled people can reside in decent homes and in neighborhoods with good opportunities, as is the case for general renters.

By adopting a quasi-experimental design, this research assesses locational outcomes for income-qualified households in Harris County, Texas: one of the largest housing markets in the nation. It compares locational outcomes for a list of HCV holders' addresses to those of a list of households which qualified for HCV but remained on the waiting list. The findings indicate that the HCV program's Fair Market Rents (FMRs) and Income Limits (ILs) likely restricted HCV households to neighborhoods that are not significantly different from those to which households without vouchers have access. In other words, receiving an HCV subsidy does not notably change the locational outcomes of the recipient households. The comparison analysis between HCV tenants and waitlisted renters shows similar patterns concerning neighborhood-quality levels. This finding stands in contrast to a comparison between the neighborhoods that

are accessible to these recipients and those living in units provided by the Low Income Housing Tax Credit (LIHTC) program, as well as those neighborhoods in which average renters live.

This research aims to provide policy recommendations for planners and policy makers in order to guide practical strategies by which to improve the HCV program criteria and thereby help to alleviate current market constraints on HCV residents.

DEDICATION

To my parents.

# ACKNOWLEDGEMENTS

"I can do all things through Christ who strengthens me." - Philippians 4:13

I would like to thank my committee chairs, Dr. Shannon Van Zandt and Dr. Wei Li, and my committee members, Dr. Cecilia Giusti and Dr. Rebekka Dudensing, for their guidance and support throughout the course of this research. I would also like to thank my research supervisor, Dr. Walter Peacock, for his support and encouragement.

Thanks also go to my friends and colleagues and the department faculty and staff for making my time at Texas A&M University a great experience.

Finally, thanks to my mom, Ok Soon Bae, my dad, Sung Wook Park, my brothers, Min Hyoung Park and Jae Kyoung Park, and my late grandfather and grandmother.

# CONTRIBUTORS AND FUNDING SOURCES

## Contributors

This work was supervised by a dissertation committee consisting of Dr. Shannon Van Zandt [co-advisor], Dr. Wei Li [co-advisor], and Dr. Cecilia Giusti of the Department of Landscape Architecture and Urban Planning and Dr. Rebekka Dudensing of the Department of Agricultural Economics.

All work for the dissertation was completed by the student, under the advisement of Dr. Shannon Van Zandt and Dr. Wei Li of the Department of Landscape Architecture and Urban Planning.

## Funding Sources

Graduate study was supported by research and teaching assistantships from Texas A&M University. There are no outside funding contributions to acknowledge related to the research and compilation of this document.

# NOMENCLATURE

| | |
|---|---|
| HCV | Housing Choice Voucher |
| HUD | Housing and Urban Development |
| FMR | Fair Market Rent |
| IL | Income Limit |
| HCVW | Housing Choice Voucher Waitlist |
| LIHTC | Low Income Housing Tax Credit |
| GR | General Renter |
| HHA | Houston Housing Authority |
| ACS | American Community Survey |
| SOI | Source of Income |

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

# CHAPTER I

# INTRODUCTION

## 1.1 Background of Affordable Housing Programs

Numerous rental assistance programs have been designed to help low-income households to access decent housing units. The location of rental units is important to tenants as their quality of life can change depending on the neighborhood in which they reside. High-income households have significantly more location choices for future housing units in consideration of their preference and priorities, whereas the low-income counterparts experience constraints due to limited budget, low-levels of transportation accessibility, racial/ethnic stereotypes, and other socioeconomic factors. For example, it is tremendously challenging for many extremely low-income families to choose a rental unit that can meet their needs, which include good commuting possibilities to work or school, personal satisfaction with housing quality, and priorities for neighborhood amenities. Due to low-income households' limited range of options, it is common to observe segregation according to residents' background and differences in demographic, social, economic, and other factors.

In order to address the ongoing segregation problem and the inequities that are associated with it, the U.S. federal government and many local governments facilitated supportive housing policies and housing assistance programs. The most popular among such programs is Housing Choice Voucher (HCV), which assisted approximately 2.26 million households and 5.35 million people by 2016 (HUD, 2017a). The HCV program

is a demand-side affordable housing program that supports low-income households with housing vouchers. Another major housing program that has supported low-income individuals through the construction of affordable units is the Low Income Housing Tax Credit (LIHTC) program. This supply-side program created approximately 2.23 million low-income housing units and a total of 2.78 million housing units with 43,092 projects that were in service until 2014 (HUD, 2016a). These two large housing programs offered low-income renters an option to reside in less costly housing units, without which they may have suffered the burden of housing costs.

In addition to the general economic benefit, the HCV program has the advantage of not restricting renters' choices by any locational boundary. In theory, this locational flexibility makes it possible for HCV households to choose any housing unit that is available on the private rental market, although the gross rental cost should lie below the payment standard that is set by the U.S. Department of Housing and Urban Development (HUD). The HCV program expanded the availability of rental units and neighborhoods to extremely low-income, very low-income, and low-income households.

The main aims of this study are to evaluate whether the current HCV program helps voucher recipients to live in high-opportunity neighborhoods and to determine to what extent the program improves HCV holders' living conditions and quality of life. It assesses both how the HCV program's current criteria affect program tenants' residential choices and whether there are market constraints on those who seek an ideal rental unit. This research includes statistical and spatial analyses of neighborhood characteristics at the U.S. census block group level. The empirical analyses include the records of current

HCV tenants and the applicants that are on the HCV program waitlist, the dataset of another large affordable housing program (LIHTC), and the data of general renters that are available from the U.S. Census Bureau. In particular, this research focuses on the differences that the receipt of the HVC voucher causes in neighborhood opportunities within two groups: households with and without a voucher subsidy. These analyses are aimed towards developing suggestions for future policy implementation within the HCV program.

## 1.2 Housing Choice Vouchers

Local Public Housing Authorities (PHAs) facilitate the HCV program. As explained by HUD (2014a), the HCV program is a direct means by which to assist very low-income families, the elderly, and the disabled. The HCV program makes it possible for renters to afford decent, safe, and sanitary housing on the private rental market. This program provides families or individual participants with a voucher after being selected as recipients. Voucher holders can increase their possibility of finding a better home due to benefits provided by the voucher subsidy. The HCV subsidy is applicable to most housing types, such as single-family detached homes, townhouses, and apartments, even though many of the recipients live in multi-family residences, such as apartments or townhouses.

The Housing and Community Development Act of 1974 created the Section 8 Existing Housing program, which was the first national voucher program and brought about a shift from project-based to household-based assistance. All housing units of the

HCV program must be certified according to several conditions, such as good physical quality and a space standard, by which tenants are protected from deficient physical quality or overcrowded housing conditions. The HCV program aims to give renters access to better residential conditions, as long as tenants' maximum rent lies below the payment standard of a local PHA, which is set based on HUD's Fair Market Rent (FMR). By referring to the median rental price that is acquired from recently rented apartment data (Schwartz, 2014), HUD calculates FMRs annually in about 2,600 housing markets. Local PHAs have the authority to set their payment standard to a level that reflects their rental market conditions and establish their local payment standard within a range that lies between 90% and 110% of the published FMRs.[1]

Once a landlord accepts HCV tenants and they pay 30% of their household income, the voucher subsidy covers the gap between gross rent and 30% income. When renters whose gross rent is lower than the payment standard choose their rental unit, they are charged no extra costs other than the household's 30% income (McClure, 2005), while those whose gross rent exceeds the payment standard pay an additional amount (McClure, 2005). However, no renters can live in an HCV housing unit that requires voucher holders to pay more than 40% of their household income: the basic rent payment with 30% of their household income and the extra payment with 10% for the gap between a costly gross rent and the payment standard (HUD, 2001c). HUD (2017a)

[1] In addition, some areas are required to implement the Small Area FMRs according to ZIP code. In other areas, such as Harris County, PHAs may decide to follow hypothetical Small Area FMRs, as arranged by HUD.

reports that an average HCV recipient in 2016 paid $364 per month with an average subsidy from HUD of $760 per month.

A PHA should give at least 75% of the voucher subsidies out to extremely low-income households, which are those that earn less than 30% of the area's median income and form the top priority for local PHAs. Without their support, these vulnerable households would have remained in their original locations, which generally entail the country's worst housing conditions.

The HCV program offers its tenants flexible locational selection options, which leads to the expectation that the program's beneficiaries live in their preferable neighborhoods. However, despite the expected locational freedom that HCV offers, the voucher-program tenants appear to be clustered in neighborhoods with a high level of minority residents and a high overall level of disadvantage (Desmond & Perkins, 2016; Wang, Varady, & Wang, 2008; McClure, 2005; Turner, 1998).

Causes for HCV holders' geographical restrictions include the tight rental markets and landlords' objections. When rental-market demand is high, many landlords prefer to lease rental units to general renters in order to avoid additional steps that local PHAs require, such as rental-unit quality inspections and Housing Assistance Payments (HAP) contracts. Greenlee (2014) explains that landlords are concerned with losing money as a result of waiting for inspections to be complete and as accepting a voucher holder provides them with lower rent than the amount they would receive in the general rental market.

Due to these restrictions, voucher holders are often obliged to rent in publicly assisted housing units, such as those developed by LIHTC, rather than from private landlords, who may prefer to avoid HCV procedures or use the voucher as a proxy for screening criteria and refuse to rent to them. For example, Lens (2017) finds that many HCV recipients reside in LIHTC housing, which strengthens the concentration of poverty and limits voucher recipients' housing choices. Williamson, Smith, and Strambi-Kramer (2009) estimate that 16% of HCV holders live in LIHTC units in Florida, which is 10% of the total amount of LIHTC units that are occupied by HCV residents. In this sense, voucher holders' freedom is limited to geographical locations in which other housing assistance programs' units are available, which are often neighborhoods located within central cities that have high numbers of poor households and minorities. The limited location availability works against the goal of the Fair Housing Act of 1968, which was implemented in order to distribute assisted housing units to less racially concentrated areas than those of the public housing program.

Tight markets also restrict voucher holders' options. Market tightness is inversely related to voucher holders' success rates. HUD (2001a) measures the success rate as the ratio of the number of households that succeeded in using a voucher to lease housing over the number of households that received a voucher. According to the national estimates of success rates calculated by PHAs in large metropolitan areas over time (HUD, 2001a), the national success rate in the study areas was about 69% in 2000,

which lies very close to the 1985 to 1987 estimates of 68%.[2] However, the success rates became higher when New York City and the City of Los Angeles were excluded: 71 % in the 2000 estimate and 74% in the 1985 to 1987 estimates. These statistical results imply that it is remarkably difficult for HCV users to gain access to their ideal units in tight rental markets such as those in New York or Los Angeles, whereas they can do so with more ease in metropolitan areas with less competing rental demands. The success rates in New York City and the City of Los Angeles were respectively 57% and 47% in 2000, and 33% and 72% in the 1985 to 1987 estimate (HUD, 2001a). As market tightness is another factor by which to explain local markets' vacancy rates, renters are more likely to confront difficulties in finding their ideal unit in tight rental markets, despite the advantage of the HCV program's locational-selection option. The success rate is 80% in loose markets and decreases to 73% in moderate markets, 66% in tight markets, and 61% in very tight markets. For successful voucher holders, the average time between voucher issuance and actual lease date is 59 days in loose markets, 69 days in moderate markets, and 93 and 94 days respectively in tight and very tight markets (HUD, 2001a).

Some jurisdictions have anti-discrimination laws to protect voucher renters from being disfavored based on "source of income" (SOI) or on their status as recipients of the Section 8 HCV program. Tighe, Hatch, and Mead (2017) reviewed the literature regarding discrimination against voucher recipients and the potential of SOI anti-

[2] The success rates that were measured in 2000 by HUD (2001a) are the most recent research findings regarding the voucher program's success rate.

discrimination laws. They describe that many voucher holders did not move into higher-opportunity neighborhoods due to the local law, which allows landlords to discriminate against potential voucher tenants based on their SOIs. In a summary of their findings, the authors list 12 states with anti-discrimination laws based on SOI and which included the HCV program (e.g., Washington, D.C., Massachusetts, and Oregon) and three states in which these laws were implemented but which excluded the HCV program (e.g., California, Oklahoma, and Wisconsin). Conversely, they also found two states with laws that explicitly prohibited local governments from passing SOI discrimination ordinances (e.g., Texas and Indiana). Additionally, several local governments, such as Chicago (Bacon, 2005), New York City, and Seattle (Tighe, 2017), passed ordinances that prohibit the landlords' refusal of tenants based on their SOIs.

HUD (2001a) reports that the presence of anti-discrimination laws, including based on SOI, resulted in a 7 percentage point higher success rate than there where anti-discrimination laws are absent. The success rate becomes 12 percentage points greater when other factors are controlled. In addition, Freeman (2012) discovers that SOI anti-discrimination laws increased voucher utilization rates[3] by 5 percentage to 12 percentage

[3] The voucher utilization rate considers whether a voucher was ultimately used by a household (Freeman, 2012). Often, local PHAs may issue a voucher multiple times, as some voucher recipients cannot secure their rental unit, for various reasons. In such cases, another household takes over the voucher in order to secure its lease. HUD (2001b) describes that a PHA with a standard-level performance is expected to maintain its utilization rate at 95% or above. If PHAs fail to do so, HUD does not allocate new funds to them or issues a warning for a lower utilization rate, for instance below 90% (HUD, 2001b). On the other hand, the voucher success rate is calculated based on whether an individual household is able to successfully lease a house with the voucher subsidy (Freeman, 2012). When a household with a voucher cannot secure a rental unit by the time it expires, the voucher is regarded as a failure for the calculation of the success rate. However, if another household can secure their rental unit with the voucher at a later time, it is considered as a utilized voucher for the calculation of the utilization rate.

points. The results show that the voucher program is responsive to rental-housing market conditions. Often, voucher holders experienced tough rental conditions and became confined to minority and low-income clustered areas. Historically, the HCV program was not as effective as HUD anticipated when it was established with the purpose of bringing program recipients to neighborhoods with low levels of poverty or to communities with low levels of minority clusters (Schwartz, 2014). Therefore, this research assesses the HCV program and its residents' neighborhood characteristics and seeks to find reasons for why HCV recipients reside in certain types of neighborhoods.

## 1.3 Research Purpose

This research assesses the extent to which HCVs enable tenants to access high-quality neighborhoods compared to qualified households which have not yet been awarded a voucher. This study's findings may inform policy changes that can help the HCV program to achieve its intended locational outcomes. It assesses existing obstacles to household mobility for voucher holders.

By comparing the locational outcomes for a group of current HCV tenants to those of a control group of waitlisted households, this research assesses whether HCVs enable voucher holders to access types of neighborhoods that are significantly different from those that are accessible for non-voucher-holders. Furthermore, it assesses whether the neighborhoods in which HCV tenants are clustered are different from those in which LIHTC developments are clustered, which would suggest that HCV holders have options that extend beyond LIHTC developments. Moreover, this research assesses the quality of

neighborhood amenities from which HCV holders benefit compared to that of neighborhood amenities from which the population of average renters benefits. Finally, this research employs Poisson and negative binomial regression models to identify which neighborhood characteristics are most important in predicting HCV holders' spatial clusters.

## 1.4 Expected Implications for Policymakers

HCVs are intended to provide a flexible housing choice for subsidized families. Findings that they fail to realize their potential should prompt policy makers to revise policies in order to improve the range of options for such households. Findings may also provide local housing authorities with information about how these choices vary, compared to those that are available for other low-income households, as well as for average renters. Finally, a spatial analysis of tenant locations provides a better understanding of the quality of the neighborhoods in which tenants live by considering factors such as race/ethnicity distribution, age groups, household types, property values/rents, income levels, education, accessibility, employment, and green amenities. Housing policy makers and local governments can utilize the research results to increase social equity by considering individual jurisdictions' affordable housing statuses, as well as their housing-market constraints.

# CHAPTER II

# LITERATURE REVIEW

## 2.1 The HCV Program's Criteria and Residents' Mobility

Affordable housing programs are tools by which to help low-income renters in finding a better home. Housing is considered to be affordable if the housing-related cost burdens constitute less than 30% of a household's monthly income. If renters' gross rental costs are higher than 30% of their income, they are regarded as a burden because general households must pay for other necessities, such as food, clothes, transportation costs, and healthcare (HUD, 2014a).

HUD (2014a) explains how the HCV works and describes that "housing choice vouchers allow very low-income families to choose and lease safe, decent, and affordable privately-owned rental housing." HUD helps "very low-income families, the elderly, and the disabled to afford decent, safe, and sanitary housing in the private market", with an option for the tenants to choose their preferred unit among various residence types, including single-family homes, townhouses, and apartments. The program is administered by local PHAs and realized with funds from HUD.

The Community Reinvestment Act of 1974 marked a major change in how housing assistance is distributed. Rather than continuing to build high-density, inner-city public housing units without proper maintenance plans, such as Pruitt-Igoe in St. Louis and the Robert Taylor Homes in Chicago, HUD shifted to a direct-subsidy, mobility-based program. The HCV program provided rental vouchers that enabled renters to

search for a decent unit on the private rental market. This was viewed as a move by which to push HUD out of the construction business and promote the private market's role in the provision of public housing (McCarty, Perl, & Jones, 2014; Landis & McClure, 2010; Zeabart, 2004). The demand-side HCV program, which was created in 1974, assisted over two million tenants (Deng, 2007). The freedom of locational selection can offer HCV tenants the possibility to maximize many advantages, such as housing units' good physical quality, affluent neighborhood amenities, preferred demographic compositions in neighborhoods, and better accessibility to schools or commuting destinations (Deng, 2007; Katz, Turner, Brown, Cunningham, & Sawyer, 2003). Lens, Ellen, and O'Regan (2011) discovers that the voucher program's subsidy helped voucher households to live in neighborhoods with lower crime rates than those of its comparison groups, namely LIHTC, public housing tenants, and poor renters.

The location of affordable housing units plays a critical role in the rental assistance program's effectiveness. Both supply-side and demand-side programs are aimed at expanding the availability of affordable housing units in healthy neighborhoods and broadening opportunities for low-income households to live in safe communities with good schools, quality services, and employment opportunities (Katz et al., 2003). While these benefits are theoretically possible, in reality the HCV program is severely limited by the availability of affordable rental units in affluent areas, especially in neighborhoods with high-performing schools (Horn, Ellen, & Schwartz, 2014; Ellen & Horn, 2012), and the option for landlords to reject vouchers based on the SOI that is stated in the rental application.

### *2.1.1 Requirements for Low-Income Tenants*

The HCV and LIHTC programs each have different criteria for the receipt of housing assistance. While HCV requires that 75% of the recipients have an income at or below 30% of the Area Median Income (AMI), LIHTC requires that either 20% of the units are rented by households with an income at or below 50% of AMI, or that 40% are rented by people with an income at or below 60% of AMI. Based on these criteria, the LIHTC program can accommodate a smaller proportion of extremely low-income households than the HCV program, which entails that the latter is more supportive of extremely low-income households (Quigley, 2011; HUD, 2014a; O'Regan & Horn, 2013). Eligibility requirements and other criteria for the HCV program become more complicated in considering household size, bedroom number, and local payment standards.

### *2.1.2 HCV Criteria: Fair Market Rents and Income Limits*

Fair Market Rents (FMRs) set the payment standard against which potential rental units are compared. In general, voucher holders cannot rent units that have a higher rent than the FMR. HUD provides estimates and announces the FMR in order to establish the payment standard. It renews the FMR each year and defines 530 metropolitan areas and 2,045 nonmetropolitan county FMR areas (HUD, 2007). HUD provides information regarding FMR as well as qualifying Income Limits (ILs) by county.

Local housing authorities have the flexibility to make adjustments to the voucher values based on their budgets and the number of available vouchers. These adjustments may affect renters' mobility in their local area (Teater, 2009). Because FMRs limit acceptable rents, they effectively prevent low-income families from relocating to affluent neighborhoods as the rents in such areas are too high (McClure, 2013). Increasing FMRs may increase the amount of HCV householders entering into low-poverty neighborhoods but may also limit the number of beneficiaries if there is no increase in the total amount of subsidy, because the budget that is allocated to state and local governments is pre-determined.

Alternatively, Small Area FMRs can provide a flexible range of FMRs within a county, as FMRs are determined differently for each ZIP code. HUD publishes different levels of FMRs at the ZIP-code level, as the conditions of the rental markets vary. The voucher-program tenants can have a greater ability to move to opportunity neighborhoods with employment, public transit, and high-quality schools, while the Small Area FMRs enable HUD to reduce overpayment in lower-rent ZIP codes (HUD, 2017b).

### *2.1.3 HCV Tenants in LIHTC QCTs*

It is required that LIHTC units accept HCV recipients, though they are only available for voucher tenants, thereby reinforcing the poverty concentration within certain geographical areas. However, it continues to be unclear to what extent the LIHTC criteria affect the locational choices of potential and current HCV residents.

HUD publishes Qualified Census Tracts (QCTs) each year based on the proportion of residents in census tracts, using residents' income and a general area income level, or Area Median Gross Income (AMGI). These QCTs are designated by HUD in order to incentivize developers who construct LIHTC units in census tracts in which at least half of the households have an income that is lower than 60% of the AMGI or a minimum poverty rate of 25% (HUD, 2016b). In 1989, Congress passed a legislation that allowed the increase of tax credits by 30% if developers determine their LIHTC units within QCTs (Baum-Snow & Marion, 2009).

Williamson et al. (2009) approaches QCT problems in relation to the number of HCV holders and finds that the QCTs reinforced existing poverty concentrations. Given that many voucher holders find rental units that are easily available within LIHTC developments, the QCT benefit does not lead to poverty deconcentration. It is more likely that HCV holders occupy LIHTC units in QCTs than those in non-QCTs.

### *2.1.4 Summary of the HCV Program Criteria and Mobility*

The issue of whether the HCV's eligibility criteria limit voucher holders' locational selection remains unresolved. This study provides a logical perspective on eligibility requirements that limit voucher holders' selection in terms of rental location. It mainly focuses on current voucher program criteria that can prevent HCV residents from moving into neighborhoods that are likely to provide greater opportunities. The hypothesis is that HUD's income criterion affects voucher holders' locational selection in a way that they are more likely to find neighborhoods with a number of people who

fall into similar ranges of income levels. In addition, HUD’s rent threshold sets voucher holders' best available rental limit. The combined criteria of income and rent may restrict potential and current HCV program beneficiaries’ opportunities in social connection, economic profits, neighborhood amenities, and other benefits. The spatial-analysis section visually demonstrates where the current HCV program recipients reside in order to reveal the geographical constraints.

## 2.2 Neighborhood Quality

Where people live affects their quality of life. Natural and built environments, amenities, and facilities in neighborhoods affect residents' lifestyles, as people make many decisions based on the characteristics of where they reside, such as commuting patterns, children's education, weekend leisure activities, groceries, and shopping frequency. Most people’s life patterns are related to the features and peculiarities of their neighborhoods.

However, people with limited capacity, such as low-income households, choose residential locations within a tight budget. They have fewer options than middle-income or affluent families regarding the choice for residential units in their ideal neighborhood. Thus, neighborhood quality is an equity issue among citizens, which causes planners to carry significant duties. Urban planners’ task is to increase social equity in order to help those who are socially marginalized, such as people with low income, poor senior citizens, children with unstable families, and certain poor minorities.

Many neighborhood-defining factors that affect the quality of people's lives are not easily quantifiable, though some are. The following subsections introduce several quantified variables regarding neighborhood characteristics that are related to quality of life.

### *2.2.1 Quality Variables*

The HCV program supports its tenants by finding ways to increase their satisfaction with a proper location that meets their family's needs. However, the program does not require its recipients to move into neighborhoods with lower poverty concentrations than their current one. Thus, while voucher tenants tend to choose their neighborhoods for personal reasons, it is difficult for the HCV program to create diverse neighborhoods actively by means of the program subsidy only.

McClure (2010a) analyzes several neighborhood characteristics, namely poverty, housing availability, other affordable housing programs, employment, and education, in order to determine whether HCV program households live in high-opportunity neighborhoods. He analyzes the datasets at the country-wide census block group level. He defines high-opportunity neighborhoods as census block groups with low poverty concentration, sufficient affordable housing units, easy access to good jobs and schools, and low crime rates. However, the process of directly obtaining a "good" quality for jobs and schools from the Census Bureau's datasets is not straightforward. Additionally, as crime rates are unavailable at the Census Bureau, researchers may need to use proxy variables instead. For instance, low unemployment rates in the census block group stand

for neighborhoods with good job quality, and high levels of high-school completion can be a proxy for neighborhoods' potential of high-quality educational performance. Unfortunately, the Census Bureau does not publish any crime-related information. Therefore, McClure uses neighborhood attributes such as poverty rates, growth in poverty, rental units below the FMRs, the presence of other affordable housing program units, and minority proportion, as well as the proxies of good employment and good education variables in order to measure whether HCV program tenants resided in high-opportunity areas.

A survey conducted by Basolo (2013) in Orange County, California indicates that voucher tenants in this southern California county chose to move into neighborhoods with lower poverty rates and better school quality than previously, although the significance of improvement was minimal. However, employment rates dropped after tenants used voucher subsidy, which was discouraging. The Californian case provided no clear evidence indicating that HCV tenants move in view of better job opportunities.

Other scholars such as Talen and Koschinsky (2014) assert that the walk scores from walkscore.com can be used as a proxy for neighborhood accessibility, although the scores do not directly subsume pedestrian walking behaviors. However, the authors indicate that "low poverty" cannot be a valid measurement for good neighborhood quality because areas with low poverty rates can be suburban, unwalkable, or poorly serviced areas. Even though the walk scores do not include any measurement in terms of "the quality of amenities," the scores can be a valuable approximation of such a

measurement as they provide large-scale quantitative information. As a quantified value that shows the level of access to amenities, the walk score is positively associated with high quality of life, which can be measured by the housing units' prices (Cortright, 2009). Talen and Koschinsky (2014) use a combined variable of the subsidized housing over the accessibility, with many independent variables. The variables are the distance to brownfields, the distance to schools (high- and low-performing schools), housing price, land-use diversity, housing unit density, rental units, and percentage of African-American population as an indicator of the likeliness of living in urban areas.

Metzger (2014) shows that HCV tenants are more segregated in poor areas than their counterpart group of extremely low-income households. She also found that HCV tenants had higher racial segregation and were more spatially clustered in certain census tracts than the comparison group. Economic, racial, and spatial segregation is due to the combination of the preference of voucher holders and the unavailability of affordable rental housing in high-opportunity areas such as affluent and or white communities.

An analysis of first-time home buyers and changes in neighborhood conditions conducted by Van Zandt and Rohe (2006) employs seven neighborhood quality indicators. The strongest variables that are reflective of high neighborhood quality are associated with high median incomes and low poverty rates, followed by low percentages of female-headed households, high homeownership rates, and low unemployment rates. High median house values and low vacancy rates continue to be important indicators for high-quality neighborhoods but are relatively less indicative of good quality in neighborhoods.

McClure and Johnson (2015) use neighborhood-quality variables that were originally studied by Newman and Schnare (1997) to reexamine the relationship between federal-assisted rental housing programs and neighborhood quality. The neighborhood quality variables are median household income, percentage of population below poverty, percentage of unemployed workforce, percentage of minorities, median rent, and percentage of assisted housing. Many HCV tenants moved into the next higher-income neighborhoods from the poorest neighborhoods rather than into middle- or upper-income census tracts. While HCV tenants cannot entirely overcome the barrier of highly poverty-concentrated areas, general renter households can. Concerning unemployment, minority population, rent, and the presence of assisted housing, HCV and LIHTC offer somewhat improved residential locations compared to previous project-based affordable housing programs (e.g., public housing) but do not meet the market standard.

In the original paper, Newman and Schnare (1997) researched neighborhood quality with the following indicators: economic status (e.g., median household income, poverty rates, and unemployment rates), quality of housing stock (e.g., median gross rents), concentration of assisted housing, and racial and ethnic mix (e.g., minority rates). Especially, their research addresses the characteristics of "underclass" neighborhoods with such variables as high-school dropout rates, unemployment rates, amount of welfare recipients, and female household heads with children. They discovered that voucher holders, unlike other affordable housing project residents, were rarely found in neighborhoods with extremely low-income households, high unemployment rates, or high concentrations of minority households. On the other hand, there was little evidence

that the voucher program significantly supported voucher tenants in moving into middle- or high-income areas.

Mast (2010) employs a different method to measure neighborhood quality for individual census blocks, which is also known as new Bayesian estimates, by using existing survey results acquired from general renters and HCV renters who rated their homes and neighborhoods. He created new neighborhood quality indicators based on the results of surveys from American Housing Survey (AHS) that were conducted in 2001 and from HUD's Customer Satisfaction Survey (CSS) of HCV households that were carried out between 2000 and 2002. The original AHS results demonstrated that HCV residents had lower ratings of neighborhoods and higher crime perceptions, but higher ratings of homes, compared to all general renters. The CSS shows tenants' ratings of their neighborhood, home, and crime perceptions on a 0 to 10 scale. The author additionally employed auxiliary neighborhood quality variables to validate the Bayesian estimates and to compare their validity with the raw survey results. These additional neighborhood quality variables were as follows: median household income, percentage of families living below the poverty line, and census tracts qualifying for LIHTC.

The American Planning Association (APA, 2015) selects "Great Neighborhoods" following seven criteria, stating that a great neighborhood "a) has a variety of functional attributes that contribute to a resident's day-to-day living (i.e., residential, commercial, or mixed uses), b) accommodates multimodal transportation (i.e., pedestrians, bicyclists, or drivers), c) has design and architectural features that are visually interesting, d) encourages human contact and social activities, e) promotes community involvement

and maintains a secure environment, f) promotes sustainability and responds to climatic demands, and g) has a memorable character." Talen, Menozzi, and Schaefer (2015) indicate that APA's great-neighborhoods criteria overlooked affordability and social, racial, or ethnic diversity. Candidacy for great-neighborhood status should take the following measures into consideration: street patterns, mixed use (measured as a form of Walk Score in their article), neighborhood size, defined centers, clear but permeable edges, racial and economic diversity, housing types, housing values and rents, income, and education.

Many researchers have studied how the HCV program helps the program's recipients to move into neighborhoods with high opportunities. Buron, Levy, and Gallagher (2007) mention that housing voucher holders make it to high-opportunity neighborhoods that the HOPE VI program redeveloped from distressed areas. The authors indicate that voucher holders moved to lower-poverty and safer neighborhoods than the comparison renters who moved into other types of public housing. The reduced poverty rate affected voucher residents' positive perceptions about the quality of their new neighborhood. Most voucher recipients felt safer and expressed fewer problems with criminal activity in their new neighborhood. In addition, Feins and Patterson (2005) support the idea that voucher holders moved into neighborhoods with lower poverty concentration and greater neighborhood opportunities, as measured by several indicators, such as income, education, and owner-occupied housing. The authors define better neighborhoods as places where voucher holders have access to more pleasant living environments, better services, lower crime exposure, economically more self-sufficient

neighborhoods, and better quality of education. Furthermore, Zeabart (2004) explains that the primary goals of the HCV program are to disperse public housing residents throughout the metropolitan area and to reduce the overall racial segregation in a city. The Chicago Housing Authority focuses on fostering voucher tenants' access to low-poverty, low-minority neighborhoods. Its expectation is that the ideal voucher recipient would have good accessibility to better schools, safer neighborhoods, and more job opportunities by moving into less economically disadvantaged areas.

However, Turner (1998) indicates that the voucher program alone did not ensure its recipients to move to low-poverty neighborhoods. Particularly, the voucher program is not enough for minority families to get to neighborhoods with lower poverty rates. Thus, she asserted that housing counseling and search assistance would be able to improve the HCV program's performance. Living in high-poverty and distressed areas may have a negative influence on families with children, whereas moving to a healthy neighborhood with safe streets and playgrounds, good school quality, and mostly employed residents may have significant benefits for HCV holders. Wang et al. (2008) conducted an empirical hot-spot analysis, showing the difference between the HCV program residents' hotspots in 2000 and 2005. The authors found minimal evidence of HCV renters moving into suburbs and of the HCV program promoting poverty or minority deconcentration.

### *2.2.2 Summary of the Neighborhood Quality*

This study employs several neighborhood quality variables from previous research, adopting the criterion that those variables could explain neighborhood characteristics that affected residents' quality of life. Especially, neighborhood characteristics should be related to the explanation of quality of life for those who are underrepresented.

As existing studies identified many neighborhood quality variables, as summarized in Table 1, this study does not create new neighborhood quality variables. However, it can contribute to the existing literature by showing the significance levels of individual neighborhood quality variables that explain the locational decisions of renters who utilized a voucher subsidy.

**Table 1. Neighborhood Quality Variables and High Opportunity Neighborhoods**

| Neighborhood Quality Variable | Previous Study | High Opportunity Neighborhood |
|---|---|---|
| Poverty | McClure (2010a), Basolo (2013), Van Zandt & Rohe (2006), McClure & Johnson (2015), Newman & Schnare (1997), Mast (2010), Buron, Levy, & Gallagher (2007), Feins & Patterson (2005) | Low poverty rates |
| Employment | McClure (2010a), Van Zandt & Rohe (2006), McClure & Johnson (2015), Newman & Schnare (1997), Zeabart (2004), Turner (1998) | Easy access to jobs, high employment rates, low unemployment rates |
| Education | McClure (2010a), Feins & Patterson (2005), Zeabart (2004), Turner (1998) | High levels of high school completion, better schools |
| Accessibility to amenities | Talen & Koschinsky (2014) | High walkscore |
| Housing price | Cortright (2009), Van Zandt & Rohe (2006) | High price of housing, high median house value |
| Rent | McClure & Johnson (2015), Newman & Schnare (1997) | High median rent |
| Income | Metzger (2014), Van Zandt & Rohe (2006), McClure & Johnson (2015), Newman & Schnare (1997), Mast (2010), Feins & Patterson (2005) | Affluent neighborhoods, High median income, high median household income |
| Race | Metzger (2014), McClure & Johnson (2015), Newman & Schnare (1997) | White dominant neighborhoods, low percentage of minorities |
| Female-headed | Van Zandt & Rohe (2006) | Low percentage of female-headed households |
| homeownership | Van Zandt & Rohe (2006), Feins & Patterson (2005) | High homeownership rates |
| Housing availability | McClure (2010a) | Enough affordable housing units |
| Affordable housing programs | McClure (2010a), McClure & Johnson (2015), Newman & Schnare (1997) | Low percentage of assisted housing |
| Others | Feins & Patterson (2005) | More pleasant living environments, better services, lower crime exposures, economically more self-sufficient neighborhoods |
| | APA (2015) | Seven factors of “Great Neighborhoods” by APA |

## 2.3 Objection to Affordable Housing in Neighborhoods

Concerns about segregation derive from issues of inequality. Some neighborhoods host many affordable housing program residents while others accommodate only a few. The affordable housing program units are stereotyped as a cause for strengthening segregation because the majority of residents in affordable housing programs are low-income families and minorities, and who are concentrated in certain neighborhoods.

As most residents in affordable housing programs belong to minority groups, more affordable housing units that are permitted into previously minority-dominant neighborhoods intensified levels of segregation and increased inequality in cities. Squires and Kubrin (2005) found that racial/ethnic segregation raised concern about neighborhoods with poverty concentration and therefore economic inequality and would potentially result in the isolation of poor minority households.

Despite HCV's goal of deconcentrating poverty, many voucher renters continue to reside in distressed areas with high levels of poverty and many minority clusters, even after receipt of the voucher subsidy (Walter, Li, & Atherwood, 2015). Consequently, voucher holders continue to live in neighborhoods with few opportunities rather than to penetrate into neighborhoods with many opportunities, which can help low-income residents to access good jobs, good schools, and other amenities, which can in turn help them to achieve their full potential.

One of the issues regarding affordable housing program residents becoming concentrated in neighborhoods that provide few opportunities is that many residents

appear to be surrounded by similar types of residents regarding income levels or race/ethnicity, for instance. Kleit (2005) explains that people tend to have ties with those who are like themselves, for instance with similar housing tenure, life-cycle stages, children, ethnicity, or languages. Thus, it is common to acknowledge that cities have many communities in which the same types of residents live together according to social, economic, and demographic similarity. Krysan and Farley (2002) scrutinize the idea of separation between majority and minority residents, which appears to be consistently present in U.S. history. Black resident clusters are observed mainly due to the fears of white hostility, and white residents' preference for white-dominant neighborhoods also plays a significant role in the history of segregation. Therefore, residents in affordable housing either tend to find their residential location in places where they can easily identify as the common type of resident or are more likely to be geographically constrained by affordable-housing programs' policies or rules, such as LIHTC's QCT incentivization, which contributed to promoting the concentration of low-income tenants in already minority- and low-income-dominant neighborhoods.

### *2.3.1 Benefits of Diverse Neighborhoods*

What is the importance of diverse communities? What is the role of urban planners in preventing segregation in cities? The Code of Ethics and Professional Conduct that was drafted by the American Institute of Certified Planners (2005) states that "planners have a special responsibility to plan for the needs of the disadvantaged and to promote racial and economic integration." Tighe (2012) suggests that planners

and policy makers should "take a stronger proactive stance in the siting and development of affordable housing," which would allow socially excluded people to have greater access to many benefits, such as educational and economic opportunities. More specifically, this proactive stance includes not only great flexibility regarding zoning codes in local residential areas that limit multi-family development but also the set-up of inclusionary housing policies. The Charter of the New Urbanism (Congress for the New Urbanism, 2001) clearly declares that "Within neighborhoods, a broad range of housing types and price levels can bring people of diverse ages, races, and incomes into daily interaction, strengthening the personal and civic bonds essential to an authentic community."

### *2.3.2 Struggles against Stereotypes of Affordable Housing*

Many issues about residential segregation arise due to possible disadvantages to existing residents regarding economic profits, neighborhood safety, quality of schools, and the neighborhoods' aesthetic quality. Once a neighborhood accommodates socially excluded people in its community, existing residents become concerned about their family members and possible losses to their property value. Tighe (2012) analyzes stereotypes of communities with affordable housing units and identifies class (or income) and race as the two primary prejudices that people hold against affordable housing. She reveals that the association of poor/minority groups to affordable housing was the determinant of negative attitudes in discussions about potential affordable housing development. However, the opposition to affordable housing is against equity in

society and the legal framework that protects minority groups from discrimination, as stated in the Civil Rights Act and the Fair Housing Act.

### *2.3.3 The Effects of Affordable Housing on Neighborhoods*

One of the most oft-recurring myths about the influence of affordable housing on neighborhoods is the decline in property values due to the presence of affordable housing. Regarding this critical topic, many scholars have made an effort to estimate the effects of affordable housing on property values.

For instance, Nguyen (2005) reviews 17 studies that analyzed the association of affordable housing units to property values. The major issue was a widespread fear among existing residents who anticipated that the value of their homes would be detrimentally affected by the presence of affordable housing units in their neighborhood. The results of her research indicate that property values may indeed drop, but more importantly, that these depreciations depended upon many factors.

More specifically, she focused on the studies that applied the hedonic price estimation method, which reveals both positive and negative associations between affordable housing and property values. The level of property value declines is related to the following factors: design and management of affordable housing, compatibility between affordable housing units and a neighborhood, and the concentration level of affordable housing.

Another study on property values, which was completed by Macpherson and Sirmans (2001), shows the extent to which house price appreciation is affected by

diversity. They used the repeat sales model using the available Tampa and Orlando cases from 1970 through 1997. It is impossible to state that the association between affordable housing and property values is either positive or negative. As the authors show, house-price appreciation was more strongly related to the "change" in race/ethnicity than the "level" of composition itself. Overall, the property value changes due to affordable housing differ between particular cities and neighborhoods. In this sense, some neighborhoods may benefit from the presence of affordable housing, while others do not.

In addition to this concern about declines in property values, there are other controversial preconceptions regarding the adverse effects of affordable housing on neighborhoods once a neighborhood plans to have affordable houses. Freeman and Botein (2002) review previous studies about subsidized housing and its impacts on neighborhoods and discover that there were four general preconceptions about the negative impacts of affordable housing: property values, crime rates, racial transition, and poverty concentration. The authors found that the relationship between subsidized housing and property values or crime rates depended on neighborhood circumstances, with both positive and negative impacts. Additionally, contrary to prevailing prejudices, subsidized housing did not lead to any radical racial transition in neighborhoods. Regarding the poverty concentration issue, they conclude that future studies need to be developed with improved research skills, such as the inclusion of more control variables.

The research conducted by Ellen, Schwartz, Voicu, and Aschill (2007) reveals that affordable housing programs may increase neighborhood integration and minimize the disadvantages of existing residents' stereotypes toward affordable housing. They

analyzed four rental housing programs in New York City and found that not all housing programs had a negative influence on neighborhoods. In some cases, they found that affordable housing had a positive impact on surrounding communities. The impacts were highly sensitive to the scale of development projects. Moreover, the patterns of impact vary across the programs. For instance, the “Public housing for senior citizens” program had more positive effects on neighborhoods than the “Public housing for low-income families” program. The “Section 8 new construction and substantial rehabilitation" program had the most adverse effects amongst the four programs. Lastly, the “LIHTC” program had a positive impact on the surrounding neighborhoods. Their results imply that federal subsidy rental housing did not reduce surrounding property values as typically expected, which contrasts communities’ most prominent fear of reductions in property values.

In conclusion, it is not confirmed that affordable housing is necessarily detrimental to all neighborhoods. Rather, previous studies provide some potential for positive effects on neighborhoods from hosting new residents with diverse backgrounds.

#### *2.3.4 Summary of the HCV Program against Stereotypes and Objections*

Some of the reasons for objecting to accommodate new affordable housing units are the decline in property values in a neighborhood and a drop in neighborhood quality due to a sudden influx of new residents with a lower income status. Many previous researchers made an effort to provide information by which to show that the negative

influences on communities that host affordable housing units are not as concerning as existing residents thought.

However, there is little to no research that shows whether HCV program households actually found rental units within high-opportunity neighborhoods. The current research examines the features of neighborhoods in which many voucher holders reside. Furthermore, these features are compared with those of the neighborhoods in which households that are on the program's waiting list are located.

# CHAPTER III

# METHODOLOGY

## 3.1 Research Questions

This research aims to investigate whether the housing voucher program can help low-income households increase their opportunities to access neighborhood amenities. Specifically, it answers the following questions:

1. Are there any factors that prevent low-income households from becoming voucher holders? What are the voucher program's eligibility criteria? Are there any aspects of the current criteria that limit voucher holders in their selection of an ideal housing unit on the private rental market?
2. Are there significant differences between the neighborhood environments for current voucher holders and those for households on the HCV waitlist? Do HCV recipients settle in different neighborhoods than those in which LIHTC residents reside? Does the HCV program provide a different neighborhood quality to program tenants compared to that from which average general rental households benefit?
3. What are the relationships between the number of HCV program tenants and neighborhood characteristics? To what extent does each neighborhood quality influence the locational selection that voucher recipients make?

## 3.2 Analysis Framework

This research consists of three types of analysis, as summarized in Table 2.

**Table 2. Analysis Steps**

<table>
<tr><td rowspan="4">Spatial Analysis in Chapter 5</td><td colspan="3">HCV Tenants displayed with Block Group (BG) Characteristics and HCV Criteria</td></tr>
<tr><td>HCV Tenants</td><td>BG Characteristics</td><td>HCV Criteria</td></tr>
<tr><td rowspan="2">The Number of HCV Households in a BG</td><td>BG Median Rent</td><td>Fair Market Rent (FMR) Criteria for 2-Bedroom</td></tr>
<tr><td>BG Median Household Income</td><td>Income Limit (IL) Criteria for 4-Person Family for the 80% Low-Income Threshold</td></tr>
<tr><td rowspan="10">Cluster Analysis & Mean Comparison T-test in Chapter 6</td><td colspan="3">Clusters of Renter Groups</td></tr>
<tr><td>Method</td><td>HCV Renter Group</td><td>Other Renter Groups</td></tr>
<tr><td rowspan="3">Optimized Hot Spot Analysis in ArcGIS</td><td rowspan="3">The Number of HCV Households in a BG</td><td>The Number of HCVW Households in a BG</td></tr>
<tr><td>The Number of LIHTC Households in a BG</td></tr>
<tr><td>The Percentage of Renter Households in a BG</td></tr>
<tr><td colspan="3">Neighborhood Quality Mean T-tests compared between HCV and Other Groups</td></tr>
<tr><td>Method</td><td>HCV Renter Group</td><td>Other Renter Groups</td></tr>
<tr><td rowspan="3">Mean Comparison T-tests between Pairs of Renter Groups</td><td rowspan="3">Neighborhood Characteristics of selected BGs from the HCV Distribution</td><td>Neighborhood Characteristics of selected BGs from the HCVW Distribution</td></tr>
<tr><td>Neighborhood Characteristics of selected BGs from the LIHTC Distribution</td></tr>
<tr><td>Neighborhood Characteristics of selected BGs from the General Renter (GR) Distribution</td></tr>
<tr><td rowspan="5">Regression Analysis in Chapter 7</td><td colspan="3">Associations measured between HCV and Neighborhood Quality</td></tr>
<tr><td>Method</td><td>Dependent Variable</td><td>Independent Variables</td></tr>
<tr><td>Ordinary Least Squares Regression</td><td rowspan="3">The Number of HCV Households in a BG</td><td rowspan="3">Neighborhood Quality Variables in a BG</td></tr>
<tr><td>Poisson Regression</td></tr>
<tr><td>Negative Binomial Regression</td></tr>
</table>

The first analysis aims to identify the location of HCV households with regard to the HCV standards: FMRs and ILs. It assesses whether there is any association between the voucher program criteria and voucher holders' geographical selection outcome.

Specifically, the first analysis shows whether any particular locations of voucher holders' clusters are connected to the program's criteria of rent and income that confine voucher holders' access to certain places, such as low rental areas or poor neighborhoods.

The FMR standard for the two-bedroom unit is compared with census block groups' median rent. In addition, the IL standard for a four-person family in the 80% low-income group is compared with the census block groups' median household income. The number of HCV households in each block group is overlaid on top of these two comparisons: a) the FMR standard and the census block groups' median rent, and b) the IL standard and the census block groups' median household income. Both analyses aim to investigate whether most HCV households are located in limited neighborhoods, such as low-rent and/or low-income block groups, as a result of the HCV program's requirements.

The second analysis can be divided to a) cluster analysis and b) neighborhood-quality variable mean-comparison analysis. The second analysis, as a whole, assesses whether voucher holders' locational selection is concretely different from that of other renters. After the first analysis, which measures the geographic restriction of the voucher program criteria, voucher holders' locational outcomes become questionable if the characteristics of their chosen neighborhoods are different from those of low-income households that are eligible for voucher subsidy but remain on the waitlist. The second analysis can answer whether voucher holders' locational choices are different from those of waitlisted households' current addresses or whether voucher households have settled

in places with the same characteristics as waitlisted households. The second analysis is not only limited to a comparison between these groups but also draws a comparison with two other renter groups: LIHTC tenants and average renters.

Specifically, the second analysis chapter includes two sections. Firstly, the cluster analysis was conducted using "Optimized Hot Spot Analysis": a tool in ArcGIS. The hot-spot analysis visually represents the strength of clusters by considering the number of households of each renter group as well as the distances between census block group polygons. When a census block group with a large number of households lies close to other census block groups with a large numbers of households, the optimization system that is inherent in the hot-spot analysis tool of ArcGIS calculates statistical significances based on distances between the target and neighbored census block groups. The optimized hot-spot analysis displays hot spots and cold spots, which stand for clusters and dispersion, respectively.

Furthermore, in the second section of the analysis, mean comparison T-tests of the neighborhood characteristics were conducted between HCV tenants and other renters: HCV applicants on the waitlist, LIHTC residents, and general renters. All types of spatial data of the neighborhood characteristics were processed for census block groups. Data from the locations for individual HCV households and the program's waitlisted households were spatially identified with associated census block groups according to the block group identification codes that are given by the Houston Housing Authority (HHA). Most LIHTC development locations were spatially displayed by using the latitude and longitude coordinates provided by HUD. However, when the coordinates

were not provided by HUD, LIHTC locations were identified in Google Earth and Google Maps using the names of LIHTC developments. The number of LIHTC units was summed up at the block group level after all developments were spatially located in ArcGIS. General renter neighborhoods were selected based on the tenure percentages of individual block groups that were acquired from the 2014 American Community Survey's (ACS) five-year estimates. The block groups with high rates of renters, and more specifically those in the highest quartile and above the median, were selected for the clustered block groups of general renters.

When data for independent variables were available as database files, they were transferred to spatial datasets based on the corresponding locations in ArcGIS. All data could be spatially coded to individual census block groups in Harris County: the research area of this study.[4] The averages of neighborhood-quality variables were compared using mean comparison T-tests at the block group level between the HCV group and the other three renter groups: HCV waitlist households, LIHTC households, and general renters.

The third analysis assesses whether neighborhood characteristics have any association with the attraction of voucher tenants. Some characteristics from previous literature regarding high-opportunity neighborhoods may be strongly related to a number of voucher tenants, while others may have a weak relationship with the voucher program

[4] The research area is Harris County, Texas, where the City of Houston is located. Houston is a rapidly growing city with a number of minorities forming dominant race/ethnicity groups and a wide range of resident income levels, which can serve to show how voucher holders select their location in highly competitive rental markets versus regular renters. Voucher holders are mostly low-income groups and minorities, and the majority of the voucher program tenants in Harris County are non-Hispanic Black. Harris County has over 17,000 voucher households. A more detailed description of the county and its voucher holders are presented in chapter 4.

residents. The third analysis determines what types of high-opportunity neighborhood characteristics are directly related to voucher tenants' locational outcome.

The third analysis was executed by regression analyses in which the number of HCV households was regressed with neighborhood quality variables, including demographic, social, and economic variables, by using Ordinary Least Squares (OLS) regression models, Poisson regression model, and negative binomial regression model. These regression analyses can explain the associations between individual variables, which are the neighborhood characteristics in individual census block groups, and the dependent variable, which is the number of HCV households in the block groups. The regression models show the statistical significance of each neighborhood characteristic for the number of HCV households at the census block group level.

The correlations and Variance Inflation Factors (VIFs) among independent variables were measured to prevent high collinearity. The variables were chosen for the final regression models only when there were no significant correlations between independent variables. When variables had high collinearity with other variables, they were carefully excluded as multicollinearity would prevent the interpretation of the exact association level of independent variables to the dependent variable. All statistical analyses were conducted in Stata14, and spatial analyses were executed in ArcGIS 10.4, including ArcMap 10.4 and ArcCatalog 10.4.

## 3.3 Potential Issues with the HCV Criteria

### *3.3.1 Hypothesis*

The tightness in regional rental markets and the frugal budgets that are allocated to the HCV program have formed challenges to new voucher beneficiaries who received the subsidy, as well as to low-income renters who strived to be included in the voucher pool. Over 2 million low-income households and minorities use the voucher assistance to maximize better rental conditions and enjoy more amenity-rich environments. These households, in general, still need to overcome financial difficulties in purchasing other necessities such as groceries and in paying essential living costs such as transportation and education. It is extremely difficult for voucher holders to fully enjoy their residential mobility, especially when adverse market circumstances and future subsidies are uncertain. In a tight market, voucher holders may feel rushed to find a unit, lest it be rented by someone else. Many low-income households are currently waiting for the subsidy, and most of them are located in deficient housing units due to the subsidy's tight budget. Other low-income households do not even have an opportunity to apply for the HCV subsidy because housing authorities have insufficient funds to help new recipients.

The first hypothesis of this research is that some voucher requirements significantly limit housing quality for voucher holders. These qualifications and criteria form a barrier for HCV recipients in maximizing the benefits of voucher subsidy. The criteria confine HCV recipients to certain geographic areas.

### *3.3.2 Research Method*

This study analyzes the HCV program's payment standard determinant, or FMRs, and the program's tenant eligibility, or ILs. FMRs and ILs are the major factors limiting voucher recipients' unit selection (FMRs) and defining the characteristics of the voucher holder group (ILs). Considering the case of Harris County, the empirical analyses show the locations of current HCV users. The spatial analyses demonstrate the comparison between the characteristics of the HCV program, with the FMR of two bedrooms and the ILs of four-person households, and the census block group characteristics, with median rent and median income.

The analyses of these data address the following questions: Are there any specific constraints that prevent voucher recipients from maximizing the advantages of the program when program tenants search for their ideal unit and neighborhood? How have FMRs and ILs been changed throughout history?

Specifically, the spatial analyses in chapter 5 display the distribution of current voucher households with the median rent and the median income for individual census block groups. This analysis helps to determine whether constraints in the HCV program’s FMRs and ILs significantly influence tenants in how program residents select the location for their rental unit and neighborhood. The findings indicate that most voucher households were clustered within certain census block groups in which the block group’s median rent was lower than that of the two-bedroom FMR standard and in which the block group’s median income was lower than the four-person family’s 80% low-income group IL standard.

HCV and waiting list datasets were obtained from the HHA, and FMRs and ILs were acquired from HUD. The census block group's rent and income were available from the 2014 ACS data.

### *3.3.3 Research Formula*

In chapter 5, the HCV program's criteria of rent and income are compared with the census block groups' median rent and income, as shown in Table 3. HUD assigns the FMR for the program's subsidy and the IL to define residents' eligibility. The Census Bureau reports the ACS estimates of the median rent and income for block groups.

**Table 3. Rent and Income of the HCV Program Criteria and Census Block Groups**

| Classification | HCV Criteria of HUD | Census Block Groups |
|---|---|---|
| Rent | Two Bedroom Fair Market Rent | Median Rent |
| Income | Four Person Low-Income Household Income Limit | Median Income |

The number of HCV households in each block group is displayed with different circle-size symbols. These circles are shown on top of the map for the census block groups to represent whether the median rent or income of each block group lies above or below the HUD's FMR or IL.[5]

[5] The FMRs can directly limit voucher holders' choices by its upper rental limitation. The hypothesis of this research is that voucher holders experience a restriction in determining their rental unit within neighborhoods in which most units are rented at a lower cost than the FMRs. The ILs are the primary eligibility criterion of the voucher program for low-income households to become beneficiaries. The hypothesis of this research is that these low-income voucher tenants can overcome the geographic boundaries of similar income-level clusters by choosing rental unit out of such neighborhoods, where existing residents whose income is greater than themselves are located due to the benefits of the voucher subsidy.

## 3.4 Effect of the HCV Program on Residents' Access to Neighborhood Amenities

### *3.4.1 Hypothesis*

The second hypothesis of this research states that voucher holders reside in relatively more amenity-rich areas than renters who are waitlisted for the voucher program and who live in LIHTC developments and that they reside in places that have similar neighborhood characteristics to those of general renters. Specifically, the primary hypothesis states that the voucher program enables voucher recipients to reside in high-opportunity areas, compared to those in which the program's waitlisted households reside, which is the unique contribution of this research to the existing literature regarding HCV residents' location. In theory, voucher holders should be able to take advantage of the locational choice for a rental unit, which is the great merit of the HCV program, thereby making it possible for them to access neighborhoods with affluent amenities, unlike voucher-waitlisted households. In addition, HCV recipients have the freedom to choose a rental unit location, whereas LIHTC residents do not have much flexibility to do so. Thus, it can be expected that HCV renters live in many diverse places, unlike LIHTC residents. Lastly, the HCV program's subsidy allows voucher holders to live in places that have similar characteristics as those where general average renters live.

### *3.4.2 Research Method*

The comparative analyses indicate a difference in neighborhood characteristics between HCV renters and the three other renter groups: HCV Waitlisted renters (HCVW), LIHTC tenants, and General Renters (GR). Mean comparison T-tests indicate differences in the neighborhood quality variables in the highest quartile and the above-median block groups, based on each group's distribution by the frequency of their renter's presence in census block groups.

The HHA provided both the HCV and HCVW datasets upon request. The datasets regarding the LIHTC program and GR were sourced from HUD and 2014 five-year estimate from the ACS, respectively.

The optimized hot spot analysis that is installed at ArcGIS visualizes the differences in clusters' locations for all renter groups: HCV, HCVW, LIHTC, and GR. The clusters in different places imply that each renter group enjoys a different quality and quantity of amenities in neighborhoods.

The neighborhood quality at selected major census block groups was compared for each group. The major block groups in the highest quartile were selected for each renter group there where the number of renters in a group exceeded its 75th percentile distribution. Subsequently, the same analysis with the block groups that lay above the 50th percentile distribution strengthened the reliability of the comparison analyses.

The first step shows whether HCV recipients have greater opportunities in their neighborhoods than HCVW residents. The second phase demonstrates whether HCV recipients have different neighborhood characteristics than LIHTC's block groups. The

third demonstrates whether HCV recipients have similar neighborhood characteristics compared to GR.

The independent variables for the mean comparison tests are the neighborhood quality variables that were collected from a wide range of socio-economic datasets, namely: race/ethnicity distribution, age, household characteristics, property value, income, employment, education, accessibility, and green amenities in neighborhoods at the census block group level. The comparison analysis shows differences in pairs of renter groups in order to reveal the pattern of HCV recipients' data compared to that of other groups. The pairs, in order of appearance are as follows: HCV vs. HCVW, HCV vs. LIHTC, and HCV vs. GR.

### *3.4.3 Research Formula*

In chapter 6, the mean comparison T-tests were executed, which show whether the two sample means are statistically different based on the means and standard deviations of the two groups and the number of sample sizes.

The null hypothesis is as follows:

$$H_0: \mu_1 = \mu_i$$

The research hypothesis is as follows:

$$H_1: \mu_1 \neq \mu_i$$

The formula for the mean test is as follows:

$$t = (\bar{x}_1 - \bar{x}_i) - (\mu_1 - \mu_i) \Big/ \sqrt{{s_1^2}/{n_1} + {s_i^2}/{n_i}}$$

The null hypothesis states that the two unknown means, $\mu_1$and $\mu_i$ are equal. In the analysis, $x$ is a neighborhood quality variable, $s$ is the standard deviation of a neighborhood quality variable, and $n$ is the number of neighborhoods that have corresponding quality variables. Correspondingly, $\bar{x}_1$ and $\bar{x}_i$ are the means of the two samples, $s_1$ and $s_i$ are the standard deviations of the two samples, and $n_1$ and $n_i$ are the numbers of the sample sizes. The subscript 1 represent HCV households, the subscript $i$ ranges from 2 to 4, representing HCVW at 2, LIHTC at 3, and GR at 4. The comparisons were executed between HCV ($x_1$) and HCVW ($x_2$), HCV ($x_1$) and LIHTC ($x_3$), and HCV ($x_1$) and GR ($x_4$).

## 3.5 Dynamics of HCV Recipients' Location Choices

### *3.5.1 Hypothesis*

The third hypothesis is that some neighborhood quality variables are positively associated with attracting HCV renters, while others have an inverse effect. The significance of the influence on the number of HCV recipients differs among individual neighborhood quality variables.

### *3.5.2 Research Method*

The number of voucher holders for each census block group was statistically regressed using various types of regression models with different combinations of independent variables. The independent variables are from neighborhood quality

variables that were used in the comparison test and were obtained from various sources, such as the US Census Bureau, the Houston-Galveston Area Council (H-GAC), the city of Houston, and other public agencies.

The statistical analysis was conducted using regression models. The regression models can show the relationship of neighborhood characteristics to the number of voucher households with the statistical significance. After the OLS level-level regression model and the semi-regression model, Poisson regression model and negative binomial regression model were employed. The dependent variable, or the number of voucher households in census block groups, is countable, as is the set of positive integers along with zero values, so that more precise regression models such as Poisson and negative binomial analyses are utilizable for the countable outcome variable.

### *3.5.3 Research Formula*

Chapter 7 demonstrates the results of the regression analyses. The dependent variable, or the number of HCV households in each census block group ($Y$), was regressed with neighborhood quality independent variables in the corresponding block groups. The groups of independent variables are race/ethnicity ($Rac$), age ($Age$), household type ($HH$), property value ($Pro$), income ($Inc$), employment ($Emp$), education ($Edu$), accessibility ($Acc$), and green ($Gr$) variable groups.

$$Y = b_0 + b_i Rac_i + b_j Age_j + b_k HH_k + b_l Pro_l + b_m Inc_m + b_n Emp_n + b_o Edu_o + b_p Acc_p + b_q Gr_q + e$$

## 3.6 Research Area

The research area of this study is Harris County, Texas. Its county seat is Houston, which is the largest city in Texas and the fourth-largest city in the U.S. Figure 1 displays the boundaries of the City of Houston and Harris County.

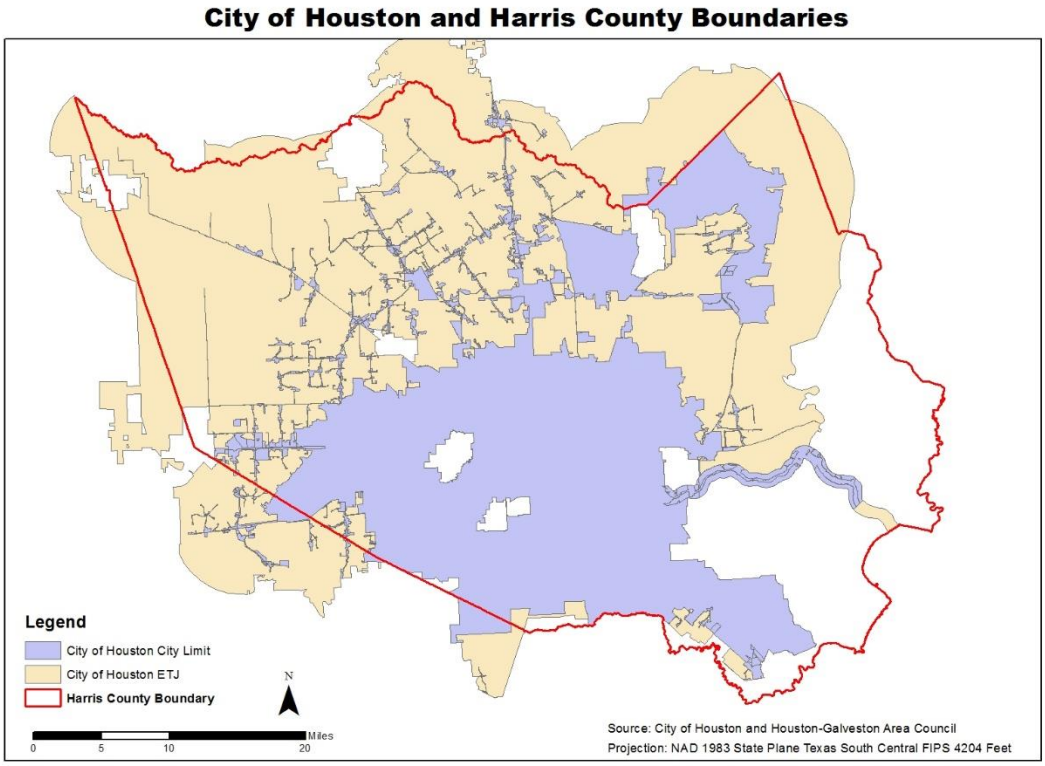


**Figure 1. Research Area: Harris County**

Harris County is the main county within the Houston Metropolitan Area, also known as Greater Houston. Its population is over 4.4 million (2014 estimate; Census Bureau), making it the largest county in Texas, as well as the country's third-largest county. It has a variety of racial/ethnic groups and diverse income groups, as shown in Table 4 and Table 5, including minorities and low-income families. The county's

population continuously increased, and its urban patterns have therefore changed dynamically. As a research area, Harris County provides in-depth research topics regarding the level of benefits that renters can attain from communities.

**Table 4. Population by Race/Ethnicity in Harris County**

| Classification | Population Estimate | |
|---|---|---|
| Race/Ethnicity | # of Population | Percentage |
| Non-Hispanic White | 1,369,752 | 32.1% |
| Non-Hispanic Black | 789,802 | 18.5% |
| Hispanic | 1,766,483 | 41.4% |
| Non-Hispanic Asian | 272,171 | 6.4% |
| Non-Hispanic Others | 71,400 | 1.7% |
| Total Population | 4,269,608 | 100.0% |
| Note: This table is made based on data from the 2014 ACS 5-year estimates. | | |

**Table 5. Household Income in Harris County**

| Household Income Estimate | Percentage |
|---|---|
| Less than $10,000 | 6.9% |
| $10,000 to $14,999 | 4.9% |
| $15,000 to $24,999 | 10.8% |
| $25,000 to $34,999 | 10.5% |
| $35,000 to $49,999 | 13.4% |
| $50,000 to $74,999 | 17.3% |
| $75,000 to $99,999 | 11.4% |
| $100,000 to $149,999 | 12.8% |
| $150,000 to $199,999 | 5.5% |
| $200,000 or more | 6.5% |
| Median income ($) | $53,822 |
| Mean income ($) | $79,900 |
| # of Total Households | 1,462,002 |
| Note: This table is made based on data from the 2014 ACS 5-year estimates. | |

This study offers an efficient source for housing policy makers who wish to estimate how well the HCV program helped its recipients to move into high-opportunity areas, compared to households under the same condition but without the voucher subsidy. The county's growth is mainly due to immigrants of diverse races/ethnicities at

different levels of income. Harris County is exemplary of the voucher program's recipients and their neighborhood quality within a dynamically growing region in the Sunbelt area.

## 3.7 Variables and Data Sources

A longitudinal approach in identifying the before- and after-effects of the HCV program is the best method by which to show how the voucher subsidy changes recipients' quality of life. However, due to the lack of longitudinal data that are available, this study conducts cross-sectional research through its comparisons between HCV renters and the other three renter groups, including HCVW households. The most recently available datasets were employed to reflect current patterns of the renter groups' behaviors and neighborhood characteristics.

The data for HCV and HCVW households were obtained from the HHA. The current HCV program's user data include specific characteristics of householders and general characteristics of households. The dataset also holds information regarding locations of the households at the census block group level, which makes it possible to conduct spatial analysis by using the location information. However, the waitlist data do not include general information about householders or households and only provide the current locations of the applicants at the census block group level. Thus, a cross-matching analysis was not feasible due to the lack of general information for the waitlist households. The LIHTC development information was obtained from the HUD website. The data include the specific locations of LIHTC developments in Harris County and the

number of units for each development. However, the individual LIHTC household characteristics were not available. Lastly, the general renter percentages at the block group level were acquired from the 2014 ACS five-year estimates.

Most neighborhood characteristic data were available from the U.S. Census Bureau, including the ACS and the Longitudinal Employer-Household Dynamics (LEHD) program. Other characteristics were obtained from local and regional governments such as Harris County, the City of Houston, and the H-GAC. The specific sources for individual variables are shown in Table 6.

Neighborhood quality variables are classified into nine groups. First, "Race/Ethnicity" includes *Hispanic*, *Non-Hispanic White*, *Non-Hispanic Black*, *Non-Hispanic Asian*, and *Non-Hispanic Others*. The hypothesis states that minority race/ethnicity groups are negatively related to the number of voucher residents if HUD's goal for the distribution of HCV recipients was achieved. Second, "Age" includes age groups with *Seniors* (65+) and *Children* (0-17).

Third, "Household Types" are *Single Person*, *Female-headed Households*, and *Female-headed Households with Children*. Fourth, "Property Values" are *Property Values* and *Median Rent*. The hypothesis states that the number of voucher holders is positively related to the property value and the median rent of census block groups if the voucher subsidy was able to move the program recipients to high-opportunity areas.

Fifth, "Income" includes *Median Household Income* and *Poverty Line*. The hypothesis states that the number of voucher holders is positively related to block groups' median household income, while it is inversely related to the percentage of

people who live below the poverty line. Sixth, "Employment" was measured by unemployment rates, which is *Unemployed*, and the total number of jobs, which is *WAC*. The hypothesis is that the voucher holders live in neighborhoods with a high job opportunity, so that the dependent variable is negatively associated with the unemployment rates and positively associated with the total number of jobs.

Seventh, "Education" was estimated with *Dropout*, which stands for high-school dropout rates, and *BachelorHigher*, which is measured by the percentage of people with a bachelor's degree or higher. The hypothesis states that the dependent variable is negatively associated with dropout rates and positively associated with the percentage of bachelor's degree or higher. Eighth, "Accessibility" was measured with *Bikeways*, *Bus Stops*, and *LRT Stations*. The hypothesis states that the number of HCV holders is positively related to the three variables, as HCV tenants are in need of various transportation methods besides driving, due to their weak economic power to purchase cars. These three variables show the degree to which residents can attain access to modes of transport.

Ninth, "Green Amenities" were measured using *Parks*. The hypothesis states that the dependent variable is positively associated with the acreage of parks. The descriptions and the sources of the variables are summarized in Table 6.

**Table 6. Variable Description**

| Variables | Variable Group | Variable Name | Variable Descriptions | Source |
|---|---|---|---|---|
| Dependent Variable | - | HCV | (#) HCV Households | HHA 2015 |
| Independent Variables: Neighborhood Quality Variables | Race/ Ethnicity | Population | (#) Total Population | ACS 2014 |
| | | Hispanic | (%) Hispanic | ACS 2014 |
| | | Non-Hispanic White | (%)Non-Hispanic White | ACS 2014 |
| | | Non-Hispanic Black | (%) Non-Hispanic Black | ACS 2014 |
| | | Non-Hispanic Asian | (%) Non-Hispanic Asian | ACS 2014 |
| | | Non-Hispanic Others | (%) Non-Hispanic Others | ACS 2014 |
| | Age | Seniors | (%) Age 65+ | ACS 2014 |
| | | Children | (%) Age 0-17 | ACS 2014 |
| | Household Types | Household | (#) Total Households | ACS 2014 |
| | | Renters | (%) Renter Household | ACS 2014 |
| | | Single Person Households | (%) Single Person Households / Total Households | ACS 2014 |
| | | Female-headed Households | (%) Female-headed Households / Total Households | ACS 2014 |
| | | Female-headed Households with Children | (%) Female-headed Households with Children 0-17 / Total Households | ACS 2014 |
| | Property Values | Property Values | ($10,000) Median Property Value | ACS 2014 |
| | | Median Rent | ($100) Median Gross Rent | ACS 2014 |
| | Income | Median Household Income | ($10,000) Median Household Income | ACS 2014 |
| | | Poverty Status | (%) Poverty Status / Total Households | ACS 2014 |
| | Employment | Unemployed | (%) Unemployment Rates among the Population 16 Years and Over | ACS 2014 |
| | | WAC | (#) Total Number of All Jobs | LEHD 2014 |
| | Education | Dropout | (%) High School Dropout Rates (16- to 19-year-olds who are not enrolled in school and are not high school graduates) | ACS 2014 |
| | | BachelorHigher | (%) Education Attainment with the Proportion of People Having a Bachelor's Degree or Higher / Population 25 Years or Older | ACS 2014 |
| | Accessibility | Bikeways | (ft) Bikeways | H-GAC 2015 |
| | | BUS_Stops | (#) Bus Stops | H-GAC 2015 |
| | | LRT_Stations | (#) LRT Stations | H-GAC 2015 |
| | Green Amenities | Parks | (acre) Park Areas | H-GAC 2015 |

# CHAPTER IV

# HCV TENANTS IN HARRIS COUNTY

## 4.1 HCV Household Descriptive Statistics

Table 7 shows the basic statistics for HCV tenants, which were acquired from the HHA in November 2015. The HHA dataset includes information on the block group identification code as well as on race/ethnicity, age, gender, disabled households, bedrooms, household size, and total gross income. The major race/ethnicity group is non-Hispanic Black, which comprise 88% of all HHA voucher recipients. Hispanic and non-Hispanic White constitute 6% and 4%, respectively. Both non-Hispanic Asian and non-Hispanic Others comprise approximately 1%.

The average age of the HCV householders was 47.21 with a standard deviation of 14.34. Female householders comprise 86%, while male householders make up 14%. Families with at least one disabled person constitute 26%. The HCV tenants live in an average of 2.25 bedroom houses for about 2.59 household members. Slightly more than half (57%) of the program tenants have one or more children. The average total gross income of the program households is about $13,850 with a standard deviation of $10,209.

**Table 7. Descriptive Statistics of Harris County HCV Tenants**

| Variables | N | mean | sd | max | min | p50 |
|---|---|---|---|---|---|---|
| Hispanic | 17,163 | 0.06 | 0.23 | 1 | 0 | 0 |
| NH_White | 17,163 | 0.04 | 0.20 | 1 | 0 | 0 |
| NH_Black | 17,163 | 0.88 | 0.32 | 1 | 0 | 1 |
| NH_Asian | 17,163 | 0.01 | 0.09 | 1 | 0 | 0 |
| NH_Others | 17,163 | 0.01 | 0.10 | 1 | 0 | 0 |
| Age | 17,163 | 47.21 | 14.34 | 106 | 15 | 45 |
| Female | 17,163 | 0.86 | 0.34 | 1 | 0 | 1 |
| Disabled | 17,163 | 0.26 | 0.44 | 1 | 0 | 0 |
| Unit Bed Rooms | 17,105 | 2.25 | 1.03 | 6 | 0 | 2 |
| Number In Family | 17,163 | 2.59 | 1.66 | 16 | 1 | 2 |
| Family with Children | 17,163 | 0.57 | 0.49 | 1 | 0 | 1 |
| Total Gross Income | 17,163 | $13,849.79 | $10,209.44 | $127,499[6] | 0 | $10,992 |

## 4.2 HCV Households by Race/Ethnicity

The breakdown by race/ethnicity of the HCV program households shows a noticeable discrepancy between the HCV tenants and the overall picture for Harris County (see Table 8). The largest race/ethnicity group among the HCV program users in Harris County is non-Hispanic Black, which comprises approximately 88% of the total. In contrast, the overall non-Hispanic Black population of the county is approximately 19% in reality.

The high percentage of non-Hispanic Black HCV vouchers implies that many non-Hispanic Black residents in Harris County are inversely related to the income level. The reason for this is that 75% of the HCV subsidy must be given out to those who

[6] There are some observations whose income is greater than the 80% threshold of the area median household income after the consideration of their family size. Many of these exceptional cases have a large number of family members. This research is conducted by including these datasets as the locations of voucher program recipients are important. However, it is important to note that several observations have higher income in the dataset although they are the households that were accepted to the voucher program when they applied for subsidy. Table 9 shows that these observations are less than 1% among the entire dataset (112 exceptional households of 17,163 total voucher households).

qualify for extreme low-income status, which is the 30% threshold of the AMI. The other 25% is for those with a low-income or very low-income status: low-income families who earn less than 80% of the AMI, but mostly very low-income families who earn less than 50% of the AMI.

The other race/ethnicity percentages of HCV tenants make up smaller proportions than the corresponding race/ethnicity percentages of the entire county. For instance, non-Hispanic Whites only make up 4% of the HCV program holders, while 32% of the entire county are identified as non-Hispanic White. Similarly, Hispanic and non-Hispanic Asians comprise about 6% and 2% of the HCV tenant group, while Hispanic and non-Hispanic Asian households are slightly over 40% and about 6% of the original population, respectively.

The three groups' smaller proportion among HCV recipients than the real population in the county can be explained, as these racial/ethnic groups may have a higher income status that prevents them from applying for the HCV program. They may not be aware of the program if they do not have any acquaintances who knew about the voucher program and encouraged them to apply for HCV.

**Table 8. Demographics of HCV Renters and County Population by Race/Ethnicity**

| Harris County | Number of HCV Householders | | Percentage of Population |
|---|---|---|---|
| Race/Ethnicity | # of Householders | Percentage | Percentage |
| Non-Hispanic White | 687 | 4.0% | 32.1% |
| Non-Hispanic Black | 15,144 | 88.2% | 18.5% |
| Hispanic | 989 | 5.8% | 41.4% |
| Non-Hispanic Asian | 156 | 0.9% | 6.4% |
| Non-Hispanic Others | 187 | 1.1% | 1.7% |
| Total | 17,163 | 100.0% | 100.0% |
| Note: This table is made based on the HCV data from the HHA in 2015 and the race/ethnicity percentage data from the 2014 ACS 5-year estimates. | | | |

Figure 37 to Figure 46 in the appendix represent HCV household distributions and the county's population by race/ethnicity at the block group level. The size of the circle symbols in the HCV household distribution figures are categorized based on the number of HCV households: 1-5, 6-10, 11-50, 51-100, and 101 or larger, when available. The four graded color schemes are used to represent the percentages of the first three race/ethnicity groups (non-Hispanic White, non-Hispanic Black, and Hispanic) at the block group level, with the following percentage sections: 0-25%, 25.01%-50%, 50.01%-75%, and 75.01%-100%. The other two race/ethnicity groups (non-Hispanic Asian and non-Hispanic Others) are also represented by the four graded color schemes, but those cut-points are defined by dividing the highest percentage for each group by four. The highest percentage for non-Hispanic Asians in a block group was 56%, and the highest percentage for non-Hispanic Others in a block group was 25.21%.

### *4.2.1 Non-Hispanic White*

Figure 37 and Figure 38 in the appendix show entirely different results between HCV distribution and the county's distribution of non-Hispanic Whites. The maximum number of non-Hispanic White HCV households in a block group was 75, and only few block groups have such non-Hispanic White HCV household clusters. Most of these block groups were identified within the central place in the City of Houston, which is located within Interstate 610 (I-610), as shown in Figure 37. In contrast, most of the non-Hispanic White demographic population in Harris County was identified in suburban

areas and in the western part of the city of Houston from the Interstate 45 (I-45) and State Highway 288 (SH 288), as displayed in Figure 38.

Both of these pictures show some contradictions between HCV renters and the general population. Most non-Hispanic Whites prefer to live in the suburban area or in affluent neighborhoods in the central city (Figure 38), while many of those subsidized households live in the central city, even though it does not contain many of such block groups.

### *4.2.2 Non-Hispanic Black*

Figure 39 and Figure 40 in the appendix show the distributions of non-Hispanic Black households with HCV subsidy and the general non-Hispanic Black population in the entire county. The maximum number of non-Hispanic Black HCV households in a block group is 291, and many block groups with a large number of non-Hispanic Black HCV holders were identified. Non-Hispanic Blacks form the largest race/ethnicity group among Harris County's HCV recipients. These block groups are located in almost all locations except suburban areas (Figure 39), which is consistent with the general non-Hispanic Black population distribution (Figure 40).

The non-Hispanic Black distribution contradicts the overall picture of non-Hispanic Whites, which shows the opposite distribution between HCV recipients and the general population. In the results of the non-Hispanic Black population, the voucher holders and the general population were similarly scattered over the county. This implies that non-Hispanic Black voucher holders are more likely to have a similar level of

neighborhood quality as other residents of the same race/ethnicity, regardless of their acceptance into the voucher program.

### *4.2.3 Hispanic*

Figure 41 and Figure 42 in the appendix show the Hispanic HCV household distribution and the general Hispanic population distribution. These two figures show nearly the same results as the non-Hispanic Black, except for the fact that the maximum number of Hispanic HCV holders in a block group was 26, which is lower than non-Hispanic Black and far smaller than non-Hispanic White, as previously described. The absolute number of Hispanic HCV households was so small that the circles in Figure 41 are not clearly identifiable.

Nonetheless, the pattern of the Hispanic HCV household clusters is sufficient to show agreement with the general Hispanic population distribution, which is shown in Figure 42. Most of the Hispanic HCV holders were clustered in those block groups, alongside I-45, as was the general Hispanic population. The two figures explain that the Hispanic voucher recipients may have a neighborhood quality that is similar to that from which the general Hispanic population benefits in their neighborhoods, as both groups show almost same patterns in terms of concentration and distribution.

### *4.2.4 Non-Hispanic Asian*

Figure 43 and Figure 44 in the appendix show the non-Hispanic Asian HCV household distribution and the general non-Hispanic Asian population distribution. The

population of non-Hispanic Asians with voucher subsidy is quite small, so that very few places have non-Hispanic Asian clusters. They are mostly located in the southwestern part of Harris County, namely Chinatown, which is identified in Google Maps, and some new developments near new subdivisions in the southwest. The clusters of non-Hispanic Asian are quite different from those of the three previous race/ethnicity groups, although this is difficult to determine given that the non-Hispanic Asian group is not the major racial and ethnic group in Harris County.

Compared with the results for the general population, the clusters of non-Hispanic Asian HCV households can be found in one of the non-Hispanic Asian populous areas. The maximum number of non-Hispanic Asian HCV households in a block group is 14, which is the smallest among the four groups thus far. The two comparison figures (Figure 43 and Figure 44) show that the non-Hispanic Asian HCV renters also live in those neighborhoods where they can see many non-Hispanic Asians. This implies that non-Hispanic Asian HCV recipients do not avoid neighborhoods in which they may have stayed without voucher subsidy.

### *4.2.5 Non-Hispanic Others*

Figure 45 and Figure 46 in the appendix show the other race/ethnicity groups, without the four groups that are discussed above. The absolute number of non-Hispanic Others is very small, reaching only 9. In addition, there is not a significant difference in the size of the circle symbols in Figure 45. However, the distribution of non-Hispanic Other HCV households is unique. They are broadly scattered over the entire county but

mostly located in the southwest, south, and north. An obvious cluster lies very close to one that mainly consists of non-Hispanic Asian HCV households, which is located in the southwest of Harris County.

The non-Hispanic Other HCV distribution is very different from that of the general non-Hispanic Other population. The census block groups with high percentages of general non-Hispanic Other population are randomly scattered, as shown in Figure 46. This implies that HCV households and the general population of non-Hispanic Others are quite different with regard to neighborhood quality. The non-Hispanic Other HCV households are more likely to be found in a certain geographic area, namely the southwest, while the general population of non-Hispanic Others is found in almost all areas of Harris County.

## 4.3 HCV Households by Income

In accordance with the IL standards that are provided by HUD, four types of income groups are categorized according to individual household size: extremely low-income group, very low-income group, low-income group, and others. The most dominant subgroup of HCV recipients is that of one-person households with an income of less than 30% of Harris County's median income. The number of HCV households in this subgroup is 5,237 out of 17,163, which comprises about 30%.

The 12,860 extremely low-income households take up three-quarters of the total voucher households. The HHA follows the 75% rule that is given by HUD and which prioritizes households at the poorest level (the extremely low-income group) that are

very urgently in need of the subsidy. There are 112 households that are categorized as a group above the 80% income limit. This is mainly because the HCV dataset that was used for this research was updated until the beginning of 2016, while the income limits that are applied to the breakdown in Table 9 were acquired from the 2014 HUD criteria. The results are summarized in Table 9 below.

**Table 9. Breakdown of the HCV Renters by Household Income and Household Size**

| Numbers in Family | Extremely Low-Income (30%) | Very Low-Income (50%) | Low-Income (80%) | Others (80% +) | Total |
|---|---|---|---|---|---|
| 1 | 5,237 | 962 | 149 | 20 | 6,368 |
| 2 | 1,814 | 911 | 231 | 31 | 2,987 |
| 3 | 2,147 | 670 | 306 | 28 | 3,151 |
| 4 | 1,718 | 381 | 201 | 19 | 2,319 |
| 5 | 1,116 | 140 | 111 | 8 | 1,375 |
| 6 | 469 | 37 | 45 | 4 | 555 |
| 7 | 225 | 11 | 20 | 2 | 258 |
| 8+ | 134 | 6 | 10 | 0 | 150 |
| Total | 12,860 | 3,118 | 1,073 | 112 | 17,163 |

Note: The group of "8+" includes families with more than 8 household members. The income groups for "8+" were categorized using the eight-person family IL standards.

# CHAPTER V

# HOUSING CHOICE VOUCHER CRITERIA

## 5.1 Fair Market Rents

Figure 2 shows the history of FMRs in Harris County from 1983 to 2015. The trend of FMRs shows a general increase over the past 22 years. For example, the FMR for two-bedroom rental units was $375 in 1983 and became $890 in 2015. Larger bedroom rental units are assigned with a higher FMR, while smaller ones are available with a lower FMR. In 2015, the efficiency[7] FMR was $599, while the four-bedroom FMR was $1,502.

As the rental market in Harris County has been in high demand for the last couple of decades due to an economic growth and the influx of residents from rural areas in Texas, other states, and foreign countries, the standard rental rate (the FMR that is set by HUD) increased in the same period, regardless of the room numbers in rental units.

[7] Efficiencies are typically small apartments that combine bedroom, living room, and kitchen, and which are generally occupied by a single person.

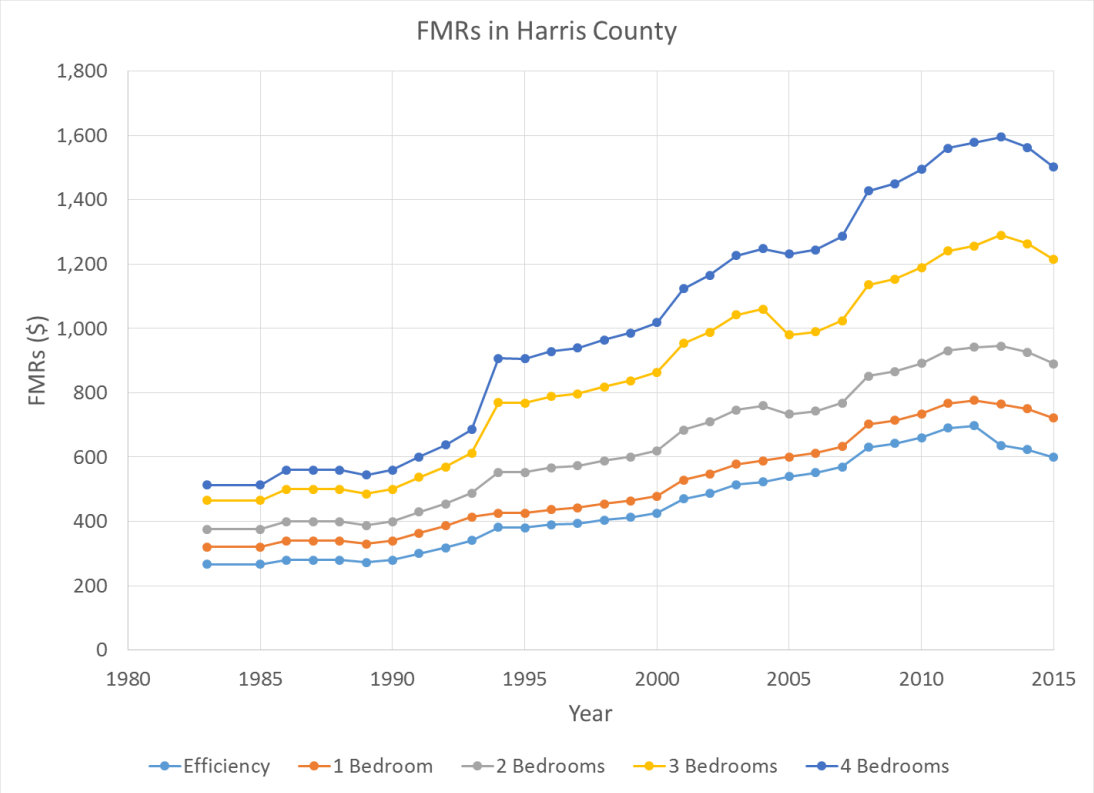


**Figure 2. FMRs in Harris County**

Note: This chart is made based on data available from HUD (2014b).

As shown in Figure 3, the FMR for two bedrooms has increased every year, with the exception of a few. The FMR had negative growth rates in four years within the 1983 to 2015 period: -3.00% in 1989, -3.55% in 2005, -2.01% in 2014, and -3.89% in 2015. Voucher holders receive the subsidy, which is the gap between the FMR and 30% of tenants' gross monthly income. Even though HCV recipients can live in a rental house with a gross rent that is higher than the FMR, residents must pay extra rent for the difference between the gross rent, which is higher than the FMR, and the associated FMR of HUD, as well as 30% of their income.

When FMRs increase, they provide more flexibility for individual recipients to choose rental unit from a number of housing units that are available on the rental market. However, given the condition of HUD's tight budget, increased FMRs create pressure for HUD to secure more funding with which to subsidize as many households as they assisted in the previous year.

When FMRs decrease, they make it more difficult for individual HCV recipients to choose an appropriate unit because the available rental market is reduced. This makes it very difficult for current HCV tenants to choose a decent unit due to the tight upper-rent limit. However, HUD can potentially raise the number of households in the future as a result of the reduced amount of subsidy that was assigned to individual households.

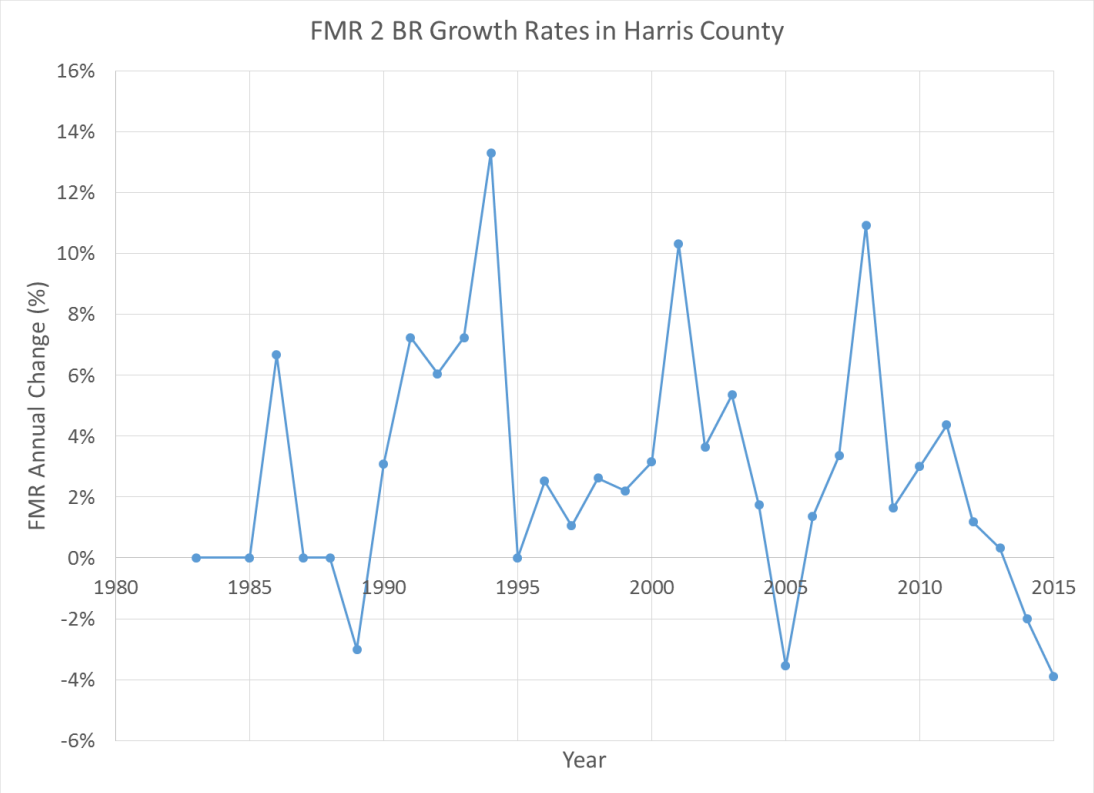


**Figure 3. Annual Growth Rates of FMRs for Two Bed Rooms in Harris County**

Note: This chart is made based on data available from HUD (2014b).

The FMR percentiles (%) in Harris County were changed as shown in Figure 4. These changes reflect the nationwide figures that were established by HUD, which sets the standard of the percentile for FMR by considering the rental costs that recent movers paid for decent units. For example, the 40th percentile means that the FMR is set at the 40th percentile of gross rents for typical and not-substandard rental units that are occupied by recent movers on the rental housing market.

The FMR percentile was at the 45th percentile in 1983 and had been stable until 1994. It dropped to the 40th percentile in 1995 and had been in the 40th percentile until

2000. It increased again to the 50th percentile in 2001 and remained at the same percentile until 2014. In 2015, it dropped back to the 40th percentile.

Given the condition that the sum of the HCV subsidy is the same for all recipients, higher FMR percentiles stand for a lower number of benefited households with a relatively large amount of subsidy allocated to each individual household. In contrast, lower FMR percentiles entail a greater number of benefited households with a relatively small amount of subsidy distributed to each individual household.

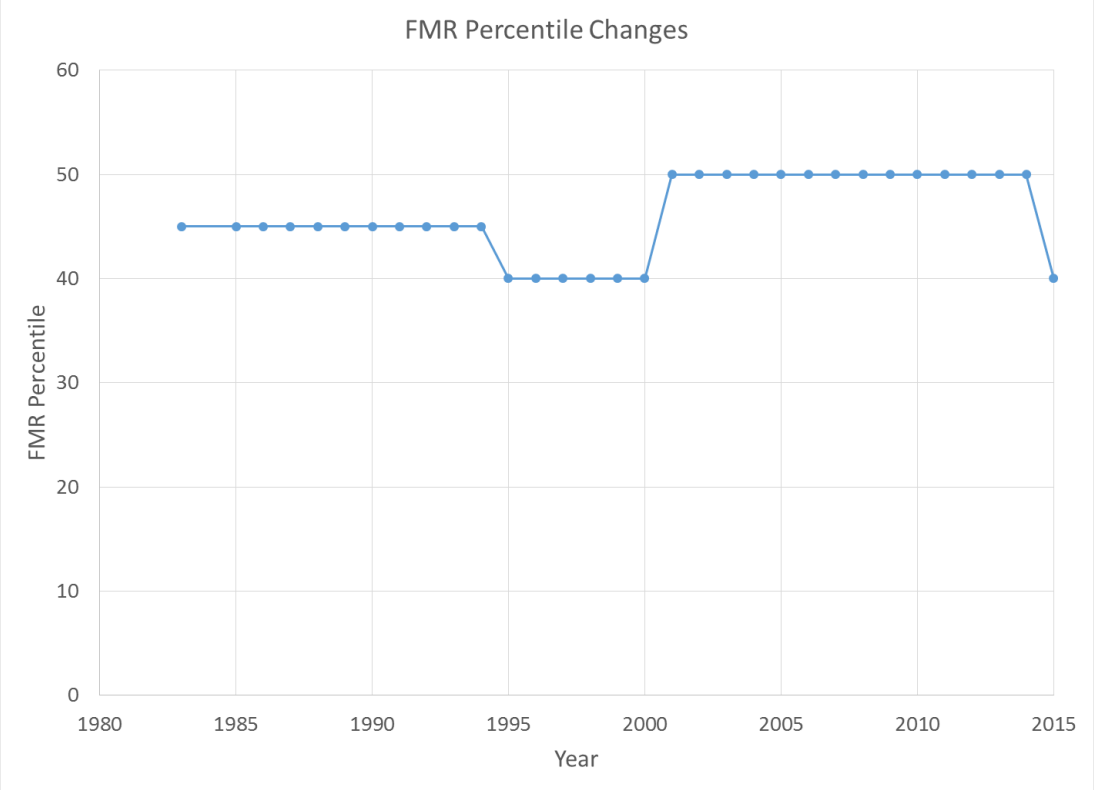


**Figure 4. Annual FMR Percentiles in Harris County**

Note: This chart is made based on data available from HUD (2014b).

## 5.2 Income Limits

Determining ILs is done by considering an area's Median Family Income (MFI). Individual ILs and MFIs are categorized by family size. ILs have 30 % extremely low-income family IL, 50% very low-income family IL, and 80% low-income family IL. These are calculated by using the area MFI and the individual family size to set the individual ILs.

Families with four persons are the standard among the ILs, which in Harris County have generally increased, as shown in Figure 5. The MFI in 1991 was $42,400 and became $66,600 in 2014. Families with an income of 50% of the MFI are defined as very low-income families. The 50% very-low income limit for four-person families was $33,300 in 2014. The ILs become higher as family members are added. The ILs by household size are $23,350 for one-person families, $26,650 for two-person families, $30,000 for three-person families, and $44,400 for eight-person family.

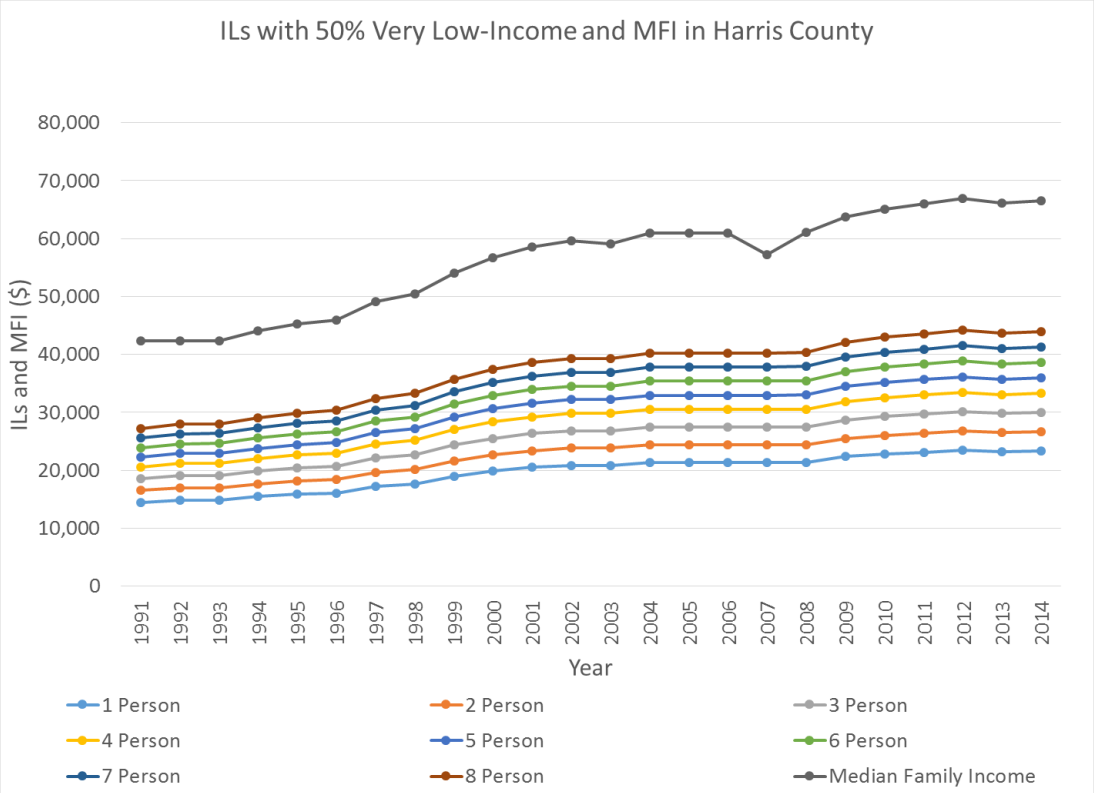


**Figure 5. ILs and MFI in Harris County: 50% Very Low-Income**

Note: This chart is made based on data available from HUD (2014c) and the 2014 ACS 5-year estimates.

When the changes in the annual growth rate between the 50% very low-income limit for four-person families and the MFI were compared from 1992 to 2014, the ILs and the MFI show a similar pattern, as identified from the comparison between Figure 6 and Figure 7. This is because ILs are determined based on the corresponding MFIs every year. The 50% very low-income limits are close to half of the MFI, with the exception of a few years, such as 2007, when the HUD maintained the same IL standard in order to accommodate many tenants despite the dropped MFI. By and large, the annual growth rates of the 50% very low-income limits followed the MFI annual growth rates.

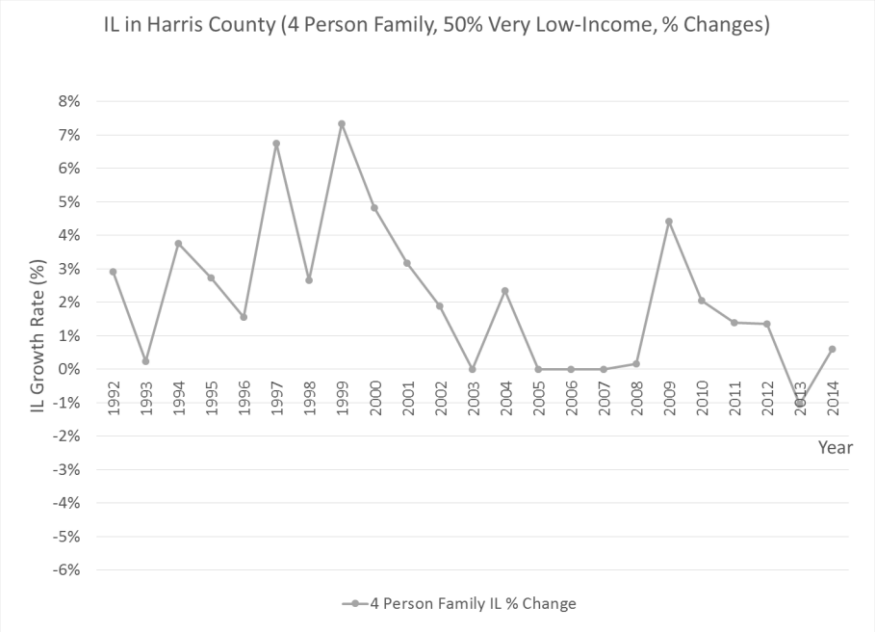


**Figure 6. Annual 4 Person Family IL Growth Rates: 50% Very Low-Income**

Note: This chart is made based on data available from HUD (2014c).

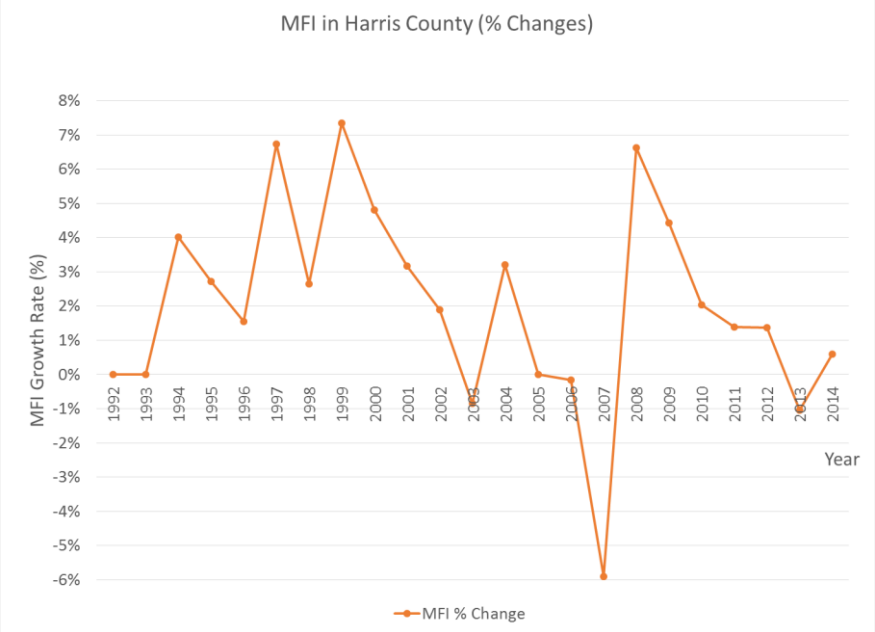


**Figure 7. Annual MFI Growth Rates in Harris County**

Note: This chart is made based on data available from the 2014 ACS 5-year estimates.

Families with an income of less than 30% of the MFI are defined as extremely low-income families, while families with an income of less than 80% of the MFI are defined as low-income families. As shown in Figure 8, the 30% extremely low-income limits were estimated since 1999, unlike the 50% very low-income limits and the 80% low-income limits, which were first estimated in 1991. The ILs for the 30% extremely low-income families show no significant difference until 2013 among ILs by household size. The only year in which some differences among ILs by household size were found is 2014. The one-person family IL was $14,000, while the four-person family IL increased to $23,850. The eight-person family IL in the same year was significantly higher, reaching $40,090. However, with the exception of some variations in ILs by household size in 2014, most of the ILs for 30% extremely low-income families are generally not significantly different over the past 25 years.

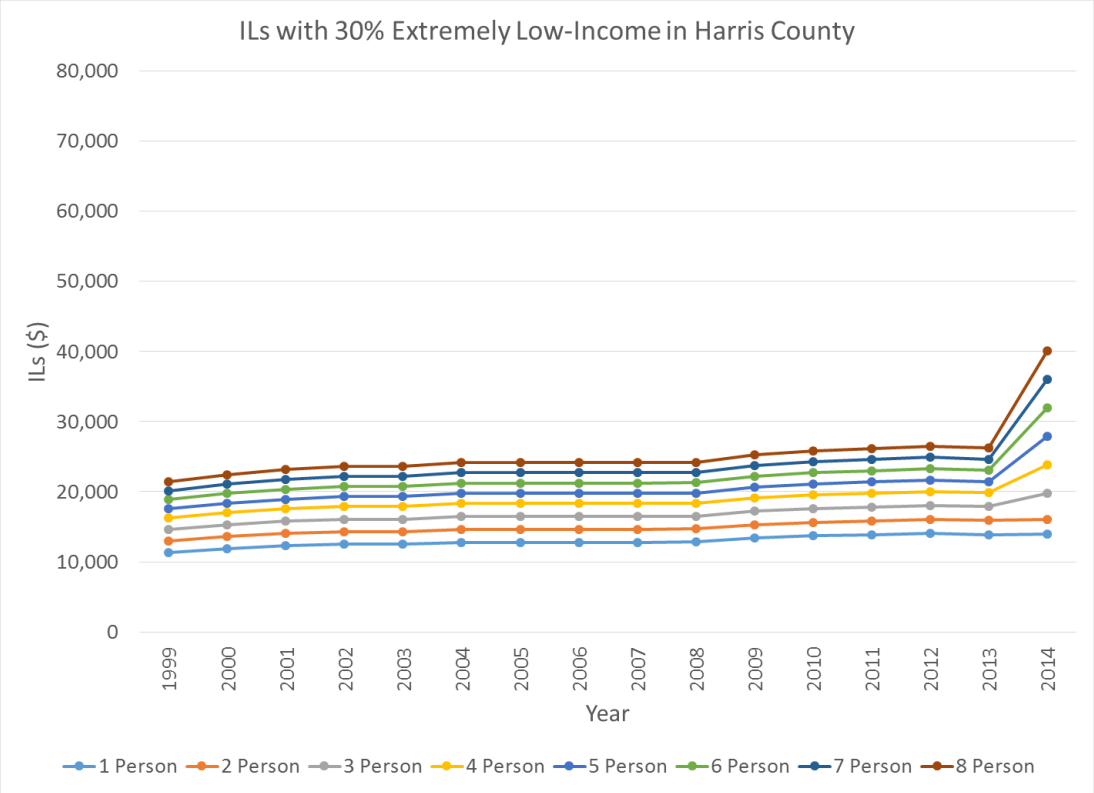


**Figure 8. ILs in Harris County: 30% Extremely Low-Income**

Note: In 1999, HUD began to release the IL for the 30% extremely low-income families. This chart is made based on data available from HUD (2014c).

The ILs for the 80% low-income families increased since 1991, as shown in Figure 9. Some variations among the ILs by household size were observed every year. The 80% low-income families are the most affluent group among possible HCV tenants, and the IL standard lies closest to the median income of the residents in Harris County among the three groups of 30%, 50%, and 80% who are eligible for the program subsidy. In 2014, the one-person family IL was $37,350, while the four-person family IL was set at $53,300. The eight-person family IL was $70,400 in the same year.

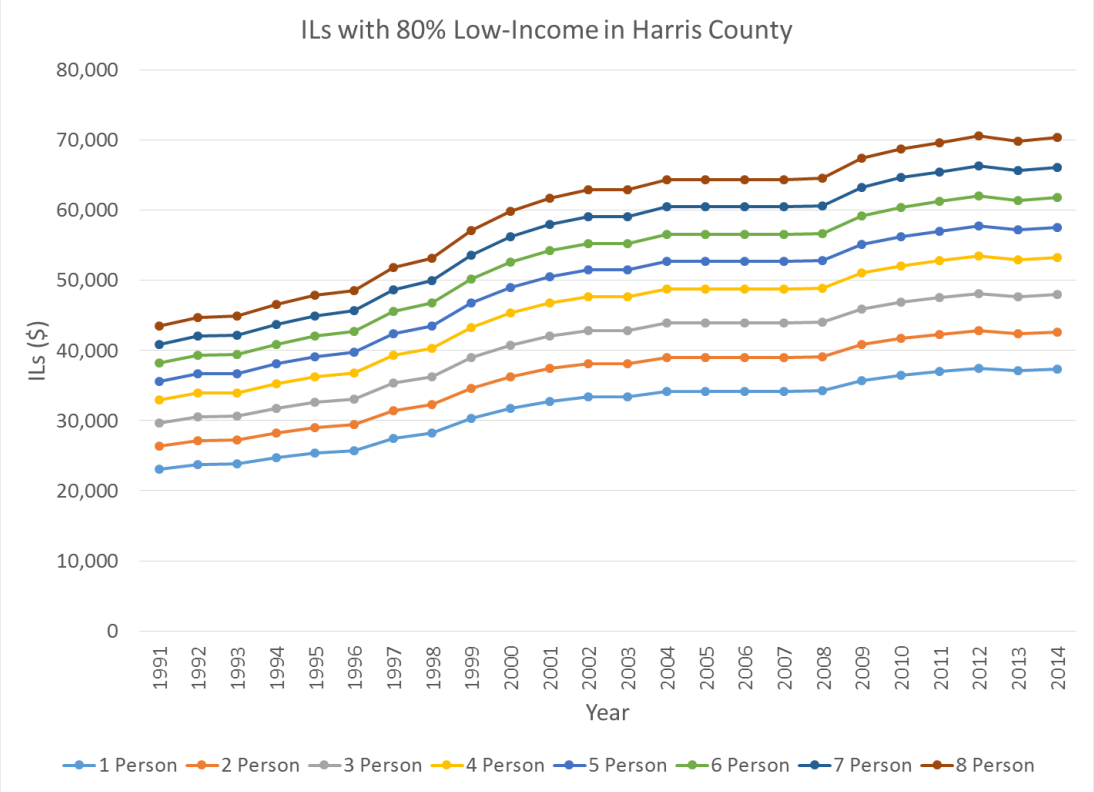


**Figure 9. ILs in Harris County: 80% Low-Income**

Note: This chart is made based on data available from HUD (2014c).

## 5.3 HCV Householders' Spatial Locations

The HCV program households are generally distributed to all Harris County block groups, with the exception of some places in which the HHA is not the main organization in charge of their subsidy assistance. The majority of the program tenants live in the City of Houston.

Despite the locational selection freedom that is given to HCV recipients, these voucher holders were clustered within HCV dominant block groups, as shown in Figure 10. There are many clusters of HCV users in the county, but the three largest were found in the southern part, directly below downtown Houston, the southwestern area of the county, and the north-central part of the county.

A zoom-in view of the central area of the county is shown in Figure 11 and facilitates the observation that census block groups with a large number of HCV users are condensed and continuous on the close-up map.

.

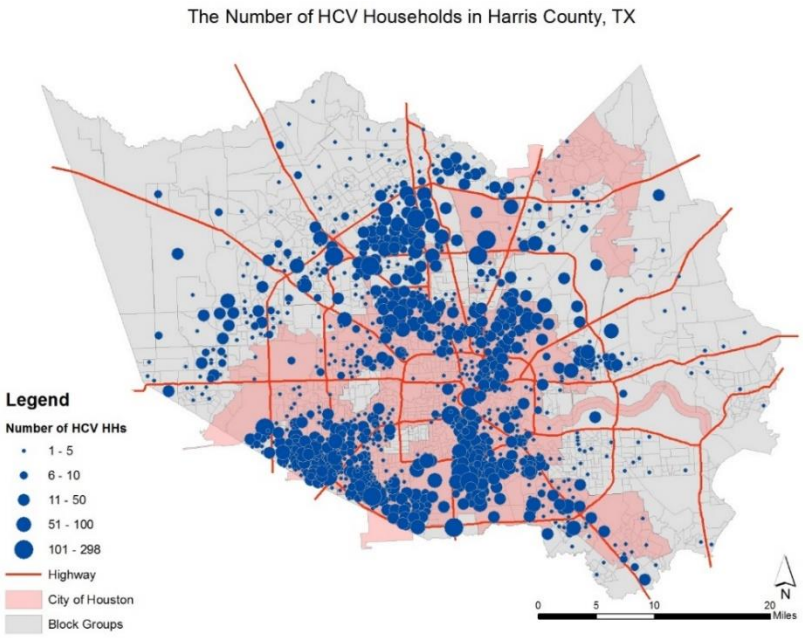


**Figure 10. The Number of HCV Households in Harris County**

Note: This map is made based on the HCV household dataset available from the HHA in 2015.

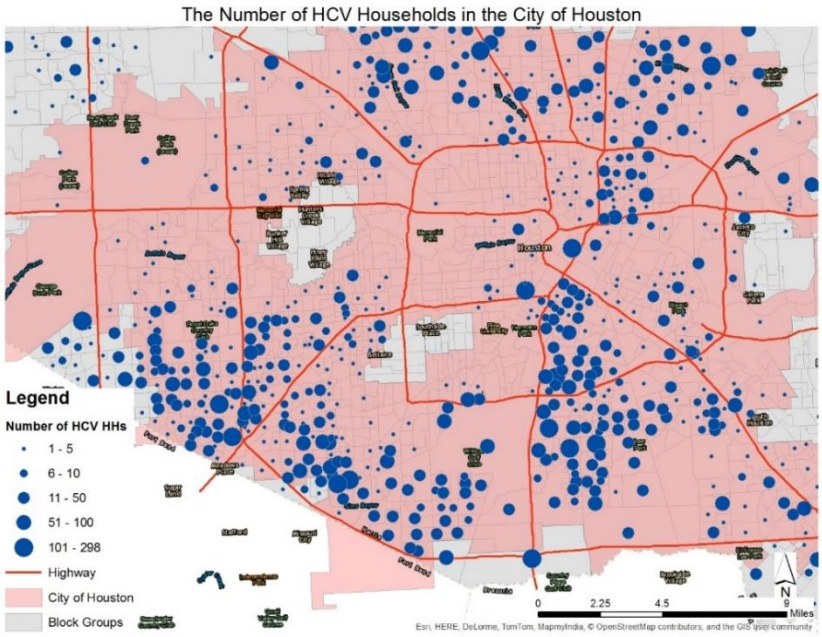


**Figure 11. Zoom-in View of HCV Households**

Note: This map is made based on the HCV household dataset available from the HHA in 2015.

Along with the figures of the HCV household distribution at the census block group level, the descriptive statistics of HCV households at the census block-group level were also estimated. Out of the 2,144 block groups in Harris County, 1,072 census block groups hosted more than one voucher household. The voucher program holders reside in half of county's census block groups, and the other half of the county's block groups have no voucher residents.

The average number of voucher households in the block group that has at least one voucher household was 15.2 with a standard deviation of 26.7. The median number of voucher households in each census block group was 6. The fact that the average number lies larger than the median number means that several census block groups have many voucher households, while others have only a few, thereby making the mean figure far larger than the median figure.

The maximum number of HCV households in the census block groups was 298, whereas the minimum number was 1. The basic statistics and the previous figures (Figure 10 and Figure 11) demonstrate that many HCV tenants were clustered within certain block groups and that these block groups were close to each other.

**Table 10. HCV Descriptive Statistics**

| Renter Group | N | Mean | S.D. | Max. | Min. | P25 | Med. | P75 |
|---|---|---|---|---|---|---|---|---|
| HCV HHs | 1,072 | 15.2 | 26.7 | 298 | 1 | 2 | 6 | 15.5 |
| Note: The total number of block groups in Harris County is 2,144. The source of the dataset is the HHA. These figures in the table are the descriptive statistics that are drawn from the census block groups within the boundary of Harris County that have at least an HCV household. | | | | | | | | |

## 5.4 Constraints of FMRs and ILs in Harris County

This section discusses some of the constraints of FMRs on HCV recipients in Harris County. The census block group median rents and the FMR for two bedrooms were compared. The two bedroom FMR was obtained from the 2014 HUD FMR standard, which was $926, as shown in Table 11.

**Table 11. FMRs by the Number of Bedroom in Harris County (2014 and 2015)**

| Year | Efficiency | 1 Bedroom | 2 Bedrooms | 3 Bedrooms | 4 Bedrooms |
|---|---|---|---|---|---|
| 2014 | 623 | 750 | 926 | 1,264 | 1,563 |
| 2015 | 599 | 721 | 890 | 1,215 | 1,502 |
| Note: This chart is made based on data available from HUD (2014b) and HUD (2015). | | | | | |

In Figure 12, dark brown and light yellow colors stand for census block groups with a higher and lower median rent than the FMR for two bedrooms, respectively. The median rents of the block groups in gray were not available from the 2014 ACS five-year estimates. Most census block groups with the median rent lower than $926, which is the 2014 FMR for two bedrooms, are located in the county's central area, which is mostly the City of Houston. Generally, the farther renters live from Houston, the higher the rent becomes. However, Figure 13 is a more detailed display of the central place and shows that some block groups inside downtown Houston, neighborhoods near Memorial Park, and the area of West University Place surrounded by the Houston Zoo and Rice University have higher median rents than the two-bedroom FMR.

The FMR for two bedrooms is the primary and standard FMR of HUD, which thereafter expands FMRs for other numbers of bedrooms. Figure 12 and Figure 13 show an overall image of Harris County's rental burdens, although individual households'

rental burden and FMRs for other numbers of bedrooms may be somewhat different from what these two figures show. Nonetheless, the figures provide a general overview of whether individual census block groups are affordable for HCV recipients.

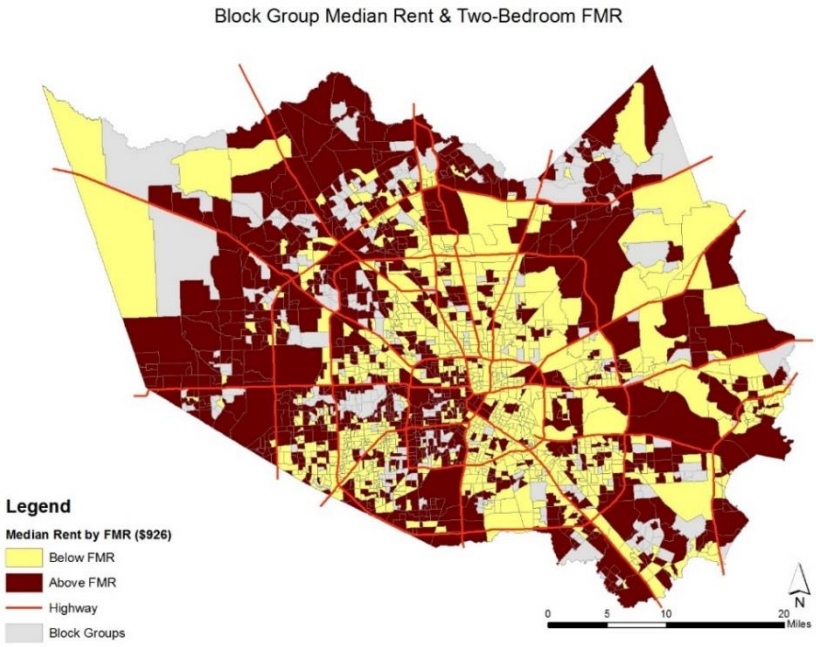


**Figure 12. Block Group Median Rent and FMR of 2 Bedrooms**

Note: This map is made based on the FMR dataset available from HUD (2014b)

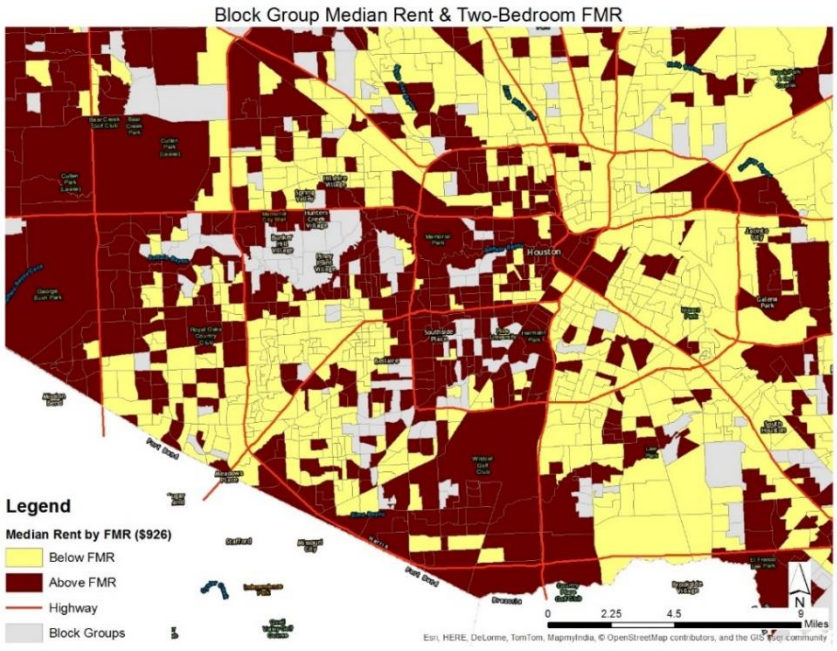


**Figure 13. Zoom-in View of Block Group Median Rents by FMR**

Note: This map is made based on the FMR dataset available from HUD (2014b)

The ILs are shown in Table 12, which is classified according to low-income groups and family sizes. The 80% low-income limit for four-persons is used as the comparison unit in order to show the degree to which the median incomes of census block groups are in contrast to the 80% low-income limit for four-persons. The IL numbers in Table 12 were available from HUD.

Four-person families are the base number for ILs when HUD estimates ILs, as the four-person 50% very low-income family IL threshold is calculated as approximately the half of the area's MFI. Subsequently, the ILs for other numbers of families were adjusted based on the four-person family IL, as the 30% extremely low-income family ILs and the 80% low-income family ILs roughly follow the 30% and 80% rules, with some adjustments. Overall, four-person family ILs are the standard for the following three income groups: 30% extremely low-income, 50% very low-income, and 80% low-income.

**Table 12. ILs by Family Size in Harris County (2014)**

| Income Limits (ILs) | | Persons in Family | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 Person | 2 Persons | 3 Persons | 4 Persons | 5 Person | 6 Persons | 7 Persons | 8 Persons |
| Income Groups | 30% | 14,000 | 16,000 | 19,790 | 23,850 | 27,910 | 31,970 | 36,030 | 40,090 |
| | 50% | 23,350 | 26,650 | 30,000 | 33,300 | 36,000 | 38,650 | 41,300 | 44,000 |
| | 80% | 37,350 | 42,650 | 48,000 | 53,300 | 57,600 | 61,850 | 66,100 | 70,400 |
| Note: This table is made based on data available from HUD (2014c). | | | | | | | | | |

As shown in Figure 14, the distribution of block group median-income levels with respect to the IL of the 80% low-income with four persons is more obvious than the distribution of block group median rents with respect to the FMR for two bedrooms, as previously shown in Figure 12. In Figure 14, dark brown indicates census block groups with a median household income above the IL of the 80% low-income for four persons. Light yellow indicates census block groups with a median household income below the IL of the 80% low-income for four persons. Most affluent families reside in the census block groups outside of the City of Houston, whereas poorer families reside in the census block groups inside of Houston.

With a close-up map for the detailed view of the central area of Harris County as shown in Figure 15, higher-income census block groups were found in these following places: downtown, Memorial Park, West University Place, and Bunker Hill Village. These block groups have higher median income than the comparison IL, which is from the 80% low-income for four persons.

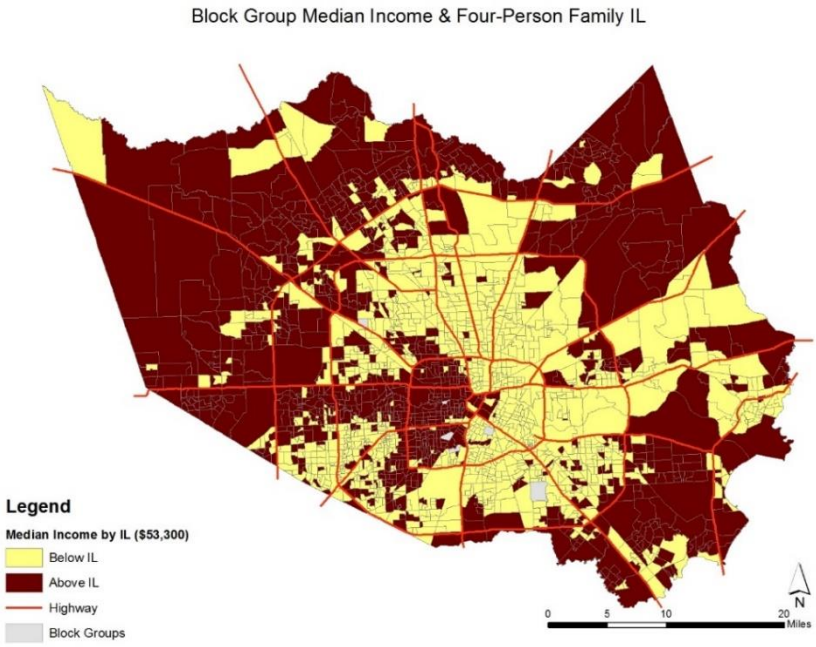


**Figure 14. Block Group Median Household Income and IL of 4 Person Family**

Note: This map is made based on the IL dataset available from HUD (2014c).

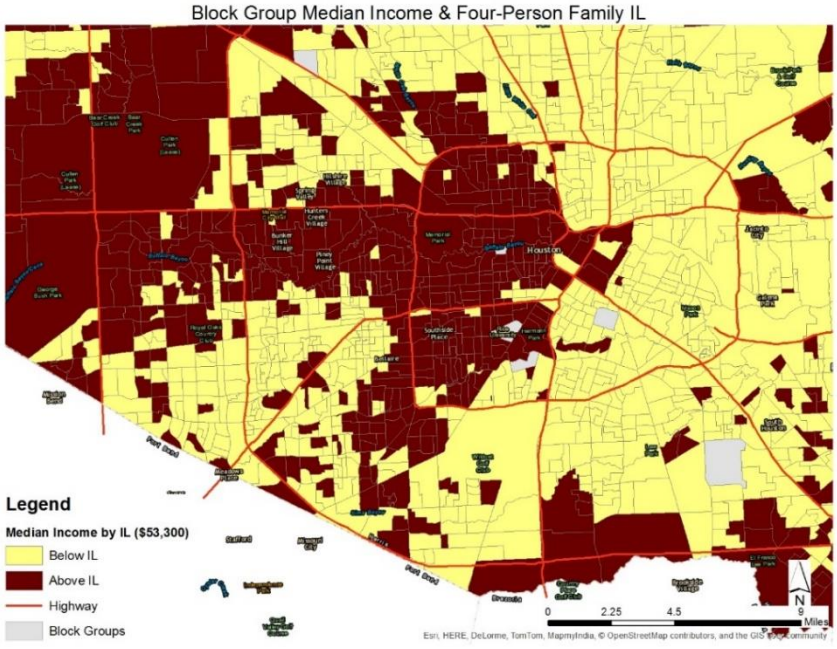


**Figure 15. Zoom-in View of Block Group Median Household Incomes by IL**

Note: This map is made based on the IL dataset available from HUD (2014c).

The voucher program households are concentrated in census block groups in which median rents are lower than the two-bedroom FMR, which is $926. Although some of the program tenants live in higher-rental areas, most of them are clustered within certain block groups in which median rents lie below the FMR. This is mainly because the voucher subsidy obliges these tenants to reside in rental units with rental costs that lie lower than the FMRs, so that tenants utilize their subsidy in places where they can easily find a unit, which are mostly accompanied by low rent. It is clear that the FMR criterion generally restricts HCV holders' locational selection freedom to choose places where rents are lower than the upper limit of the subsidy, as shown in Figure 16.

The same pattern is clearly observable in the central city, as displayed in Figure 17. Many voucher renters reside in census block groups where the median rents lie below the two-bedroom FMR standard. The result of voucher households living in block groups with median rents that lie lower than the FMR standard supports the opinion of McClure and Johnson (2015), who claim that the FMR limitation of voucher tenants' search is mainly due to the limited number of rental units on the market.

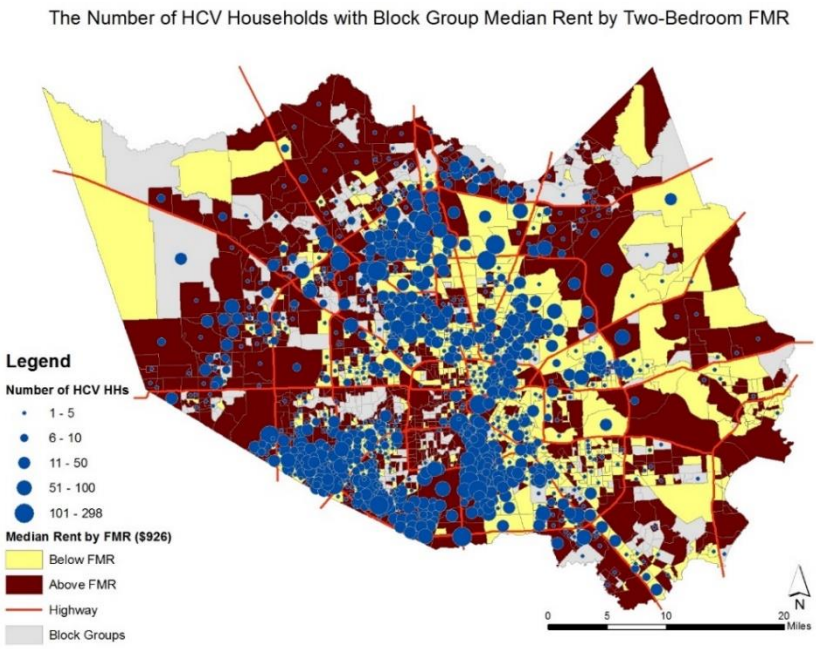


**Figure 16. HCV Households with FMR in Harris County**

Note: This map is made based on the HCV dataset from the HHA and the FMR dataset from HUD (2014b).

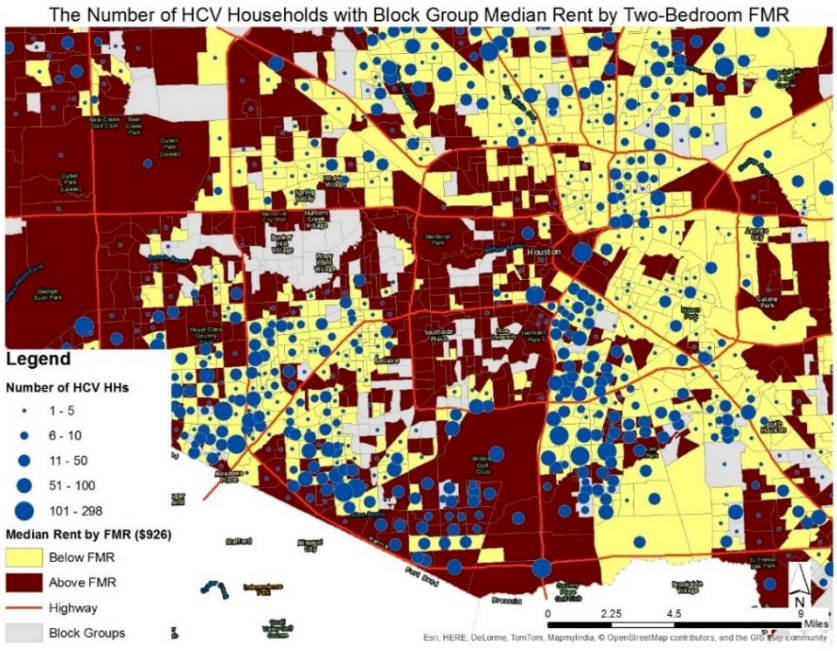


**Figure 17. Zoom-in View of HCV with FMR**

Note: This map is made based on the HCV dataset from the HHA and the FMR dataset from HUD (2014b).

Moreover, as shown in Figure 18, it is also clear that many voucher households reside in census block groups in which the median household income lies lower than the IL of the 80% low-income for four persons, which is $53,300. Again, despite HCV holders' locational freedom, almost all voucher residents located their rental units in places where their neighbors are similar themselves in terms of income level. Most voucher residents in Harris County are clustered together within the areas where the block group median household income is lower than $53,300, although this is partly because more low-cost rental units are available there, which may oblige HCV users to choose units near residents who form part of low-income households, like themselves.

This is also true when the number of HCV households is more specifically displayed with the census block group median incomes and the 80% low-income IL for four persons, as displayed in Figure 19. Almost all voucher clusters were found in census block groups in which low-income families are dominant, so that voucher residents are exposed to neighbors who fall into similar ranges of income levels.

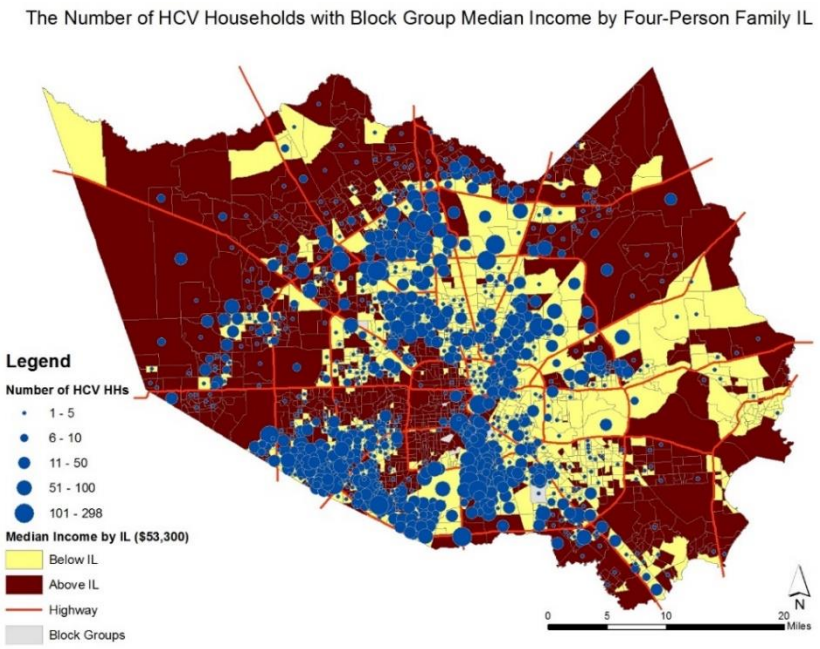


**Figure 18. HCV Households with IL in Harris County**

Note: This map is made based on the HCV dataset from the HHA and the IL dataset from HUD (2014c).

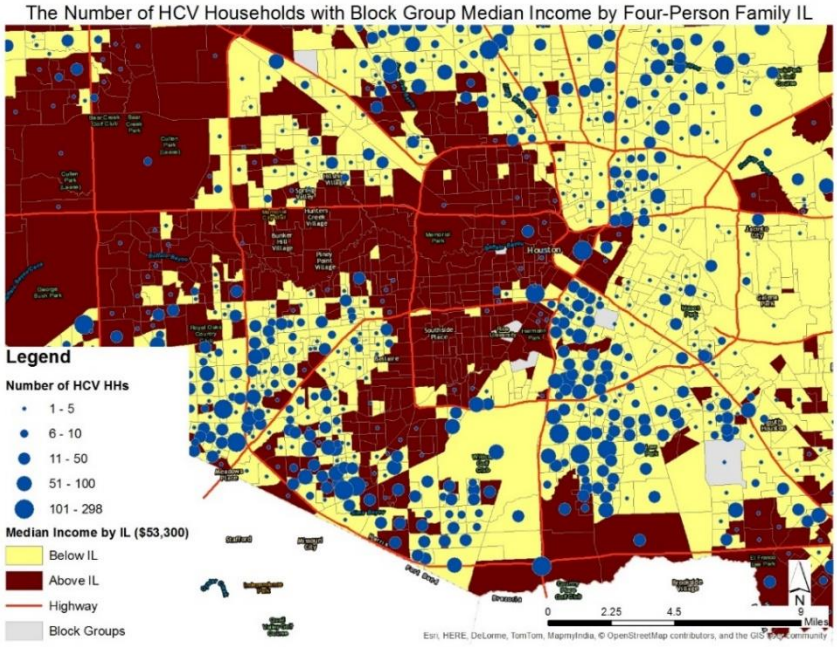


**Figure 19. Zoom-in View of HCV with IL**

Note: This map is made based on the HCV dataset from the HHA and the IL dataset from HUD (2014c).

## 5.5 Summary: Voucher Criteria

The results imply that two of the HCV criteria, namely rent and income, may affect the decision of HCV households in such a way that these criteria discourage voucher renters from overcoming geographic limitations. The criteria may restrict the voucher units within certain boundaries in which voucher holders can easily find an affordable rental unit and in which they find many of their future neighbors at the low-income level.

The maximum limits of the rent (FMRs) and the HCV recipient income classifications (ILs) are not only critical but also important factors for HUD and local housing authorities to consider in allocating their limited budget to residents who are in need of housing subsidies. HUD and local housing authorities should operate with their limited budget optimally in order to allocate their subsidy and prioritize their recipients for the most urgent low-income group. However, this research finds that many voucher holders are eventually trapped within certain geographic locations for both criteria: FMR and IL.

This chapter shows that both criteria may have an influence on voucher holders' decisions regarding their rental house location. Current voucher tenants appear to be located in neighborhoods with lower than the two-bedroom FMR and lower than the four-person family IL for 80% of the low-income threshold. This chapter explains the results with spatial locations of voucher holders and the two standards of the HCV program. The following chapter will assess whether these locations of voucher holders are significantly different from those of other renter groups in order to determine

whether the FMRs and ILs were the real factors confining voucher holders as the both criteria are jointly inherent only in the HCV program. The HCV waitlisted group does not have an FMR standard but has the same IL threshold as the HCV group. The LIHTC group does not have an FMR standard and also has a different IL threshold. The GR group has neither an FMR standard nor an IL rule.

# CHAPTER VI

# NEIGHBORHOOD QUALITY BY RENTER GROUP

## 6.1 Cluster Analysis

This chapter answers the question of whether HCV program recipients live in higher-opportunity areas than those who are on the program waitlist and who have already met the program's eligibility requirements. In theory, the voucher subsidy can enable voucher tenants to move into amenity-rich areas, unlike the waitlisted households that have not received subsidy yet. Therefore, this chapter explores whether the voucher subsidy indeed moves recipients to such locations in reality. If this is not the case, they would be located in neighborhoods similar to those in which waitlisted households are currently located. In addition to the primary comparison analysis between the HCV program recipients and the waitlisted households, the voucher holders' locations are compared with two other renter groups, namely the LIHTCs and GRs, which provides a deeper understanding of the influence of the subsidy, which is aimed at helping voucher beneficiaries to move into amenity-rich areas.

This chapter utilizes the spatial analysis in order to show the difference in location for each renter group. Foremost, spatial autocorrelation is an important issue in conducting spatial analysis and determines whether observations are independent of each other, as statistics rely on the independence among observations. If similar numbers of block groups' HCV recipients cluster together, there is a positive spatial autocorrelation in the HCV group. If dissimilar numbers of block groups' HCV recipients cluster

together, there is a negative spatial autocorrelation in the HCV group. Thus, this section analyzes whether the same types of renters cluster together at the block group level. This autocorrelation analysis shows whether renters in the same renter group live in specific census block groups, either as a clustering or random pattern.

A cluster analysis in ArcGIS enables reporting on whether there are particular patterns for the four individual renter groups: HCV, HCVW, LIHTC, and GR. The tool named "Optimized Hot Spot Analysis" displays "hot spots" that show census block groups in which individual renter groups are clustered.

This optimized hot spot analysis is a mapping-cluster toolset that the Environmental Systems Research Institute (ESRI) recently upgraded and released based on the original hot spot analysis tool in the ArcGIS software (ESRI, 2016). The application of the hot spot analysis was confirmed by Wang and Varady (2005), who employed this tool to show the advantages of hot spots in showing clusters of HCV households, in which they performed far better than other methods, such as dot representations or census tract representations. The authors found that the hot spot analysis has many recognizable advantages, including the strength of displaying a relatively more accurate picture of concentration and density variation. As the optimized hot spot analysis was recently developed by the ESRI, no study has yet employed this tool to planning research. However, as Wang et al. (2008) and Wang and Varady (2005) employed the hot spot analysis to voucher-program tenants' clusters, the optimized version of the hot spot analysis tool makes it more convenient for analysts to process analyses by using the optimized formulas that are inherent to it.

The optimized hot spot analysis in ArcGIS displays spatial clusters with levels of statistical significance, as shown in Figure 20. This analysis statistically identifies clusters when there is a large number of renters in a block group and a large number of renters in neighboring block groups. Therefore, the value, or the number for each renter group in a geographic boundary (named a "polygon" in ArcGIS and a "census block group" in this research), and the distances between the target polygon and each neighboring polygon are taken into consideration in the tool's definition of "clustering."

Hot spots are represented in red. This spatial-analysis tool is automatically optimized to define hot spots and to calculate the level of statistical significance with inherently set default figures in the tools' formulas. Hot spots stand for clustered block groups with a large number of renters.

The tool also identifies dispersed block groups with low values, which are called cold spots and are represented in blue. These block groups have fewer renters.

The rest of the block groups are considered as neutral distribution: the distribution between clustered and dispersed block groups. This categorization is not statistically significant and is treated as random. Census block groups in neutral distribution are represented in yellow. Figure 20 shows an example of how ArcGIS categorizes clusters, neutral zones, and dispersions into different types of color schemes and associated statistical significances.

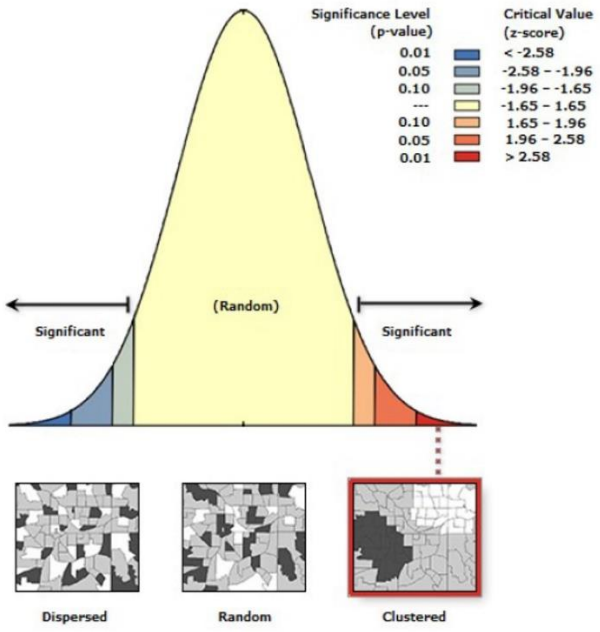


**Figure 20. Critical Values of Clusters**

Source: This figure is a captured image from the Optimized Hot Spot Analysis report of ArcGIS (ESRI, 2016).

Before conducting the optimized hot spot analysis, it should be confirmed whether there is a degree of spatial autocorrelation between census block groups with a different number of households. Table 13 shows the spatial-correlation test results. Large z-scores with p-values of less than .001 can be interpreted as follows: there is a lower than .1% likelihood that clustered patterns are the result of random chance. In other words, large z-scores with low p-values support spatial-cluster patterns with statistical significance within each renter group.

**Table 13. Spatial Autocorrelation Results**

| Categorization | HCV | HCVW | LIHTC | RENTER |
|---|---|---|---|---|
| Moran's Index | .061357 | .206186 | .013615 | .175359 |
| Expected Index | -.000934 | -.000530 | -.000467 | -.000467 |
| Variance | .000046 | .000017 | .000013 | .000013 |
| z-score | 9.188715 | 50.483852 | 3.931642 | 48.437207 |
| p-value | .000000 | .000000 | .000084 | .000000 |

In the figures from Figure 21 to Figure 24, the z-scores are used to show statistical significance levels. The featured census block groups with more than +2.58 or less than -2.58 are statistically significant at a 99% confidence level, as shown in the darkest red/blue scheme. The featured census block groups with +/- 1.96 to 2.58 are statistically significant at a 95% confidence level, as shown in the medium red/blue scheme. The featured census block groups with +/- 1.65 to 1.96 are statistically significant at a 90% confidence level, as shown in the lightest red/blue scheme. The block groups that are colored in yellow reflect clusters without any confidence in statistical significance.

Firstly, with regard to Figure 21, two main places are identified as clusters for HCV households in Harris County. One is in the central northern area near George Bush International Airport, and the other is in the central southern area within the intersection of Interstate Highway 69, Texas State Highway 288, and Sam Houston Parkway Toll Road.

Secondly, three large clusters for the HCVW renter groups are identifiable, as shown in Figure 22. Two of them are the same as the HCV clusters. However, the sizes of HCVW clusters became far larger than those of HCV clusters. Additionally, a new

hot spot is identified in the western area of the county, which is near Cullen Park and West Houston Airport.

Through the similarity in both groups' locations, it appears plausible that, while many households are waiting for voucher subsidy, current recipients continue to reside within close distances from HCVW residences. This implies that the neighborhood quality between the two renter groups is not significantly different.

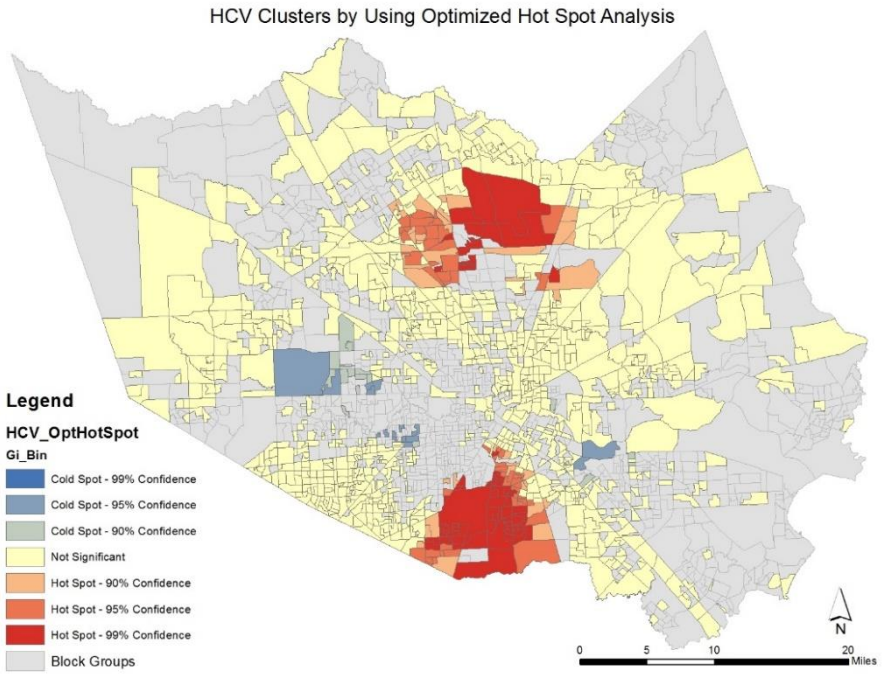


**Figure 21. HCV Clusters (Renter Group 1)**

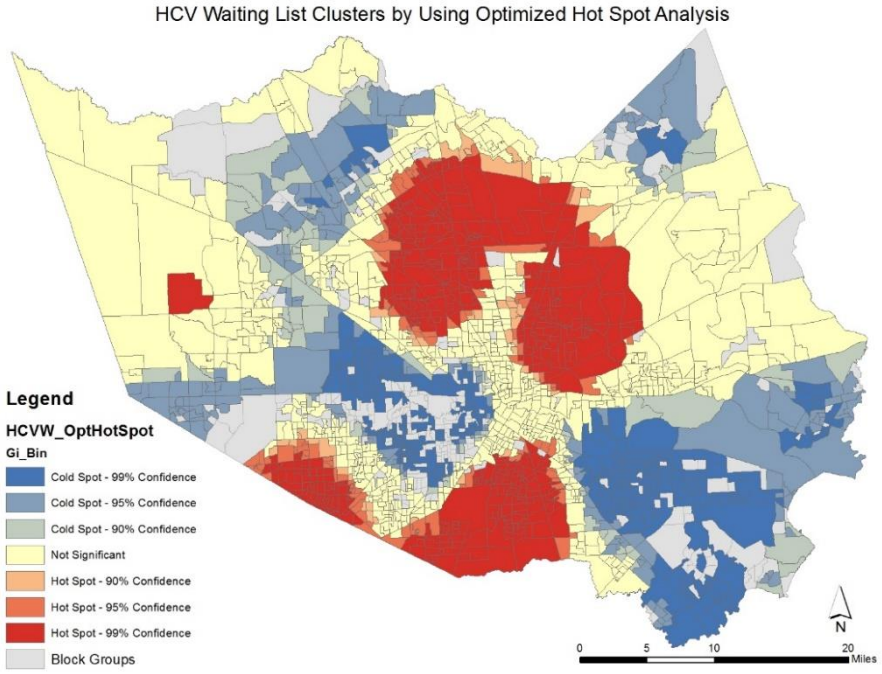


**Figure 22. HCVW Clusters (Renter Group 2)**

Thirdly, as shown in Figure 23, a single LIHTC cluster is identified in the county, the location of which is nearby the first HCV cluster near George Bush International Airport. By cross-referencing the LIHTC highest quartile distribution (Figure 30) with the HCV clusters (Figure 21), it appears obvious that there is a similar pattern in LIHTC and HCV residents' preferences for locations.

Finally, GR clusters became clearer, as shown in Figure 24, in contrast to the quartile distribution of the same group (Figure 32), which is too dispersed to clearly determine whether there is a cluster in the county. Five places are identified as clusters for this last group, which is quite dissimilar to the clusters of the three previous groups.

This cluster analysis reveals that there is a difference in the locational-selection preference of each renter group, through clear visual cluster locations. This section shows where each renter group is condensed or scattered in the county. The optimized hot spot analysis is employed to support the idea that there are some differences in preferences and constraints for each renter group, which contributes to the inequity in neighborhood quality among the four groups.

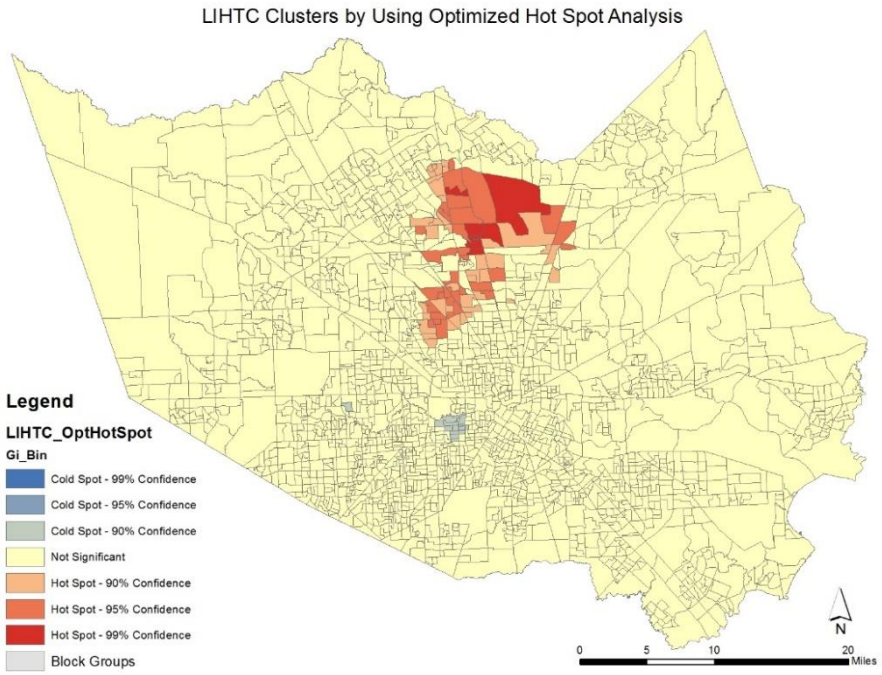


**Figure 23. LIHTC Clusters (Renter Group 3)**

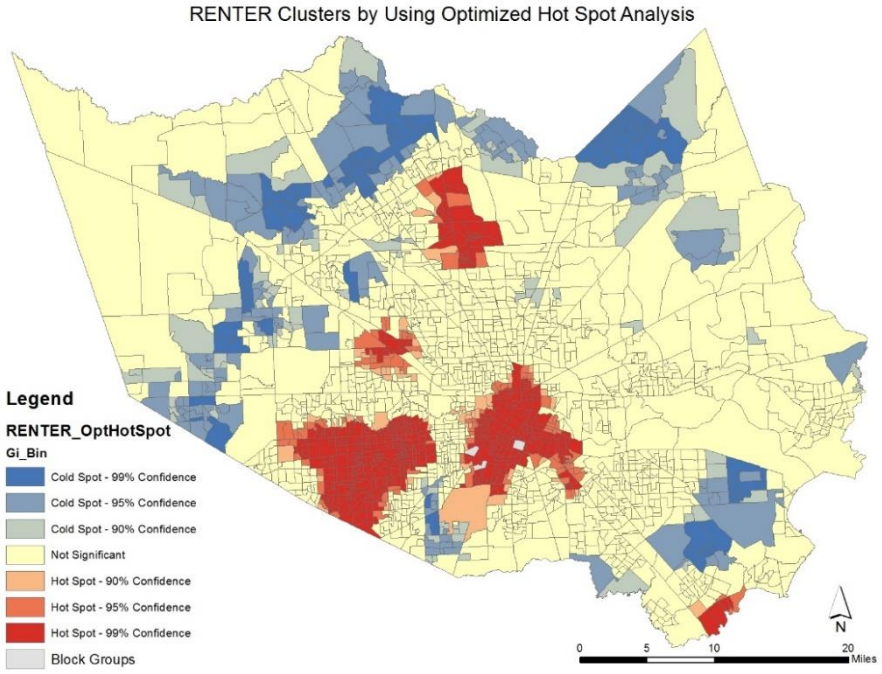


**Figure 24. GR Clusters (Renter Group 4)**

## 6.2 HCV vs. HCVW

Table 14 shows the descriptive statistics regarding the original datasets. Those figures are summarized for the census block groups in which a minimum of one HCV household or one HCVW household is present. The total number of block groups in Harris County is 2,144.

The total number of HCV households is 17,163, as obtained from the HHA in November 2015. The mean of the HCV households at block groups is 15.2, with a standard deviation of 26.7. The total number of HCVW households is 38,566, as obtained from the HHA in January 2016. The mean of the HCVW households at block groups is 18.0 with a standard deviation of 24.2.

This research utilizes all waitlisted households that the HHA manages. The HHA originally accepted 38,566 household applicants but activated only 20,000 households for the waitlist. In this research, all applicants are utilized to represent the waitlist group if these households reside within the boundary of Harris County. The main reason for including all households on the list is that there is no significant difference between the active waitlist and the whole waitlist in representing characteristics of HCVW households. Rather, a large number of observations is likely to deliver more precise results and show unbiased results for the waitlist households.

In order to make the comparison fair, only the household datasets that were available within the county boundary are used for both groups. Households that lie outside of the county's boundary are excluded.

**Table 14. HCV and HCVW Basic Descriptions**

| Renter Group | N | Mean | S.D. | Max. | Min. | P25 | Med. | P75 |
|---|---|---|---|---|---|---|---|---|
| HCV HHs | 1,072 | 15.2 | 26.7 | 298 | 1 | 2 | 6 | 15.5 |
| HCVW HHs | 1,888 | 18.0 | 24.2 | 260 | 1 | 3 | 9 | 24.0 |

Note: The total number of block groups in Harris County is 2,144.
The source of the two voucher datasets is the HHA, which covers most places in Harris County but not necessarily the entire county. The total numbers of households of the HCV group and the HCVW group that were originally obtained from the HHA are 17,163 and 38,566. The numbers of observations for the final datasets in this table after the exclusion of households outside of the Harris County boundary are 16,246 for the HCV group and 34,023 for the HCVW group, respectively.

Figure 25 and Figure 26 show the distribution of HCV tenants and HCVW households by their quartiles. The dark brown block groups show the highest quartile in the number of households for each renter group, and the dark yellow block groups show the second-highest quartile in the number of households for each renter group. The medium-level yellow block groups show the block groups within the 50th to 25th percentiles in the number of households for each renter group, while the lightest yellow block groups show the lowest quartile in the number of households for each renter group. Block groups in gray represent block groups in which no HCVs or HCVWs reside.

The block groups of the highest quartile for both groups are quite similar, which implies that it is highly likely that both renter groups in the top quartile share similar levels of neighborhood quality. In addition, the block groups that fall within the above-median range are also similarly located for both renter groups, which may support the claim that both renter groups have similar levels of neighborhood quality.

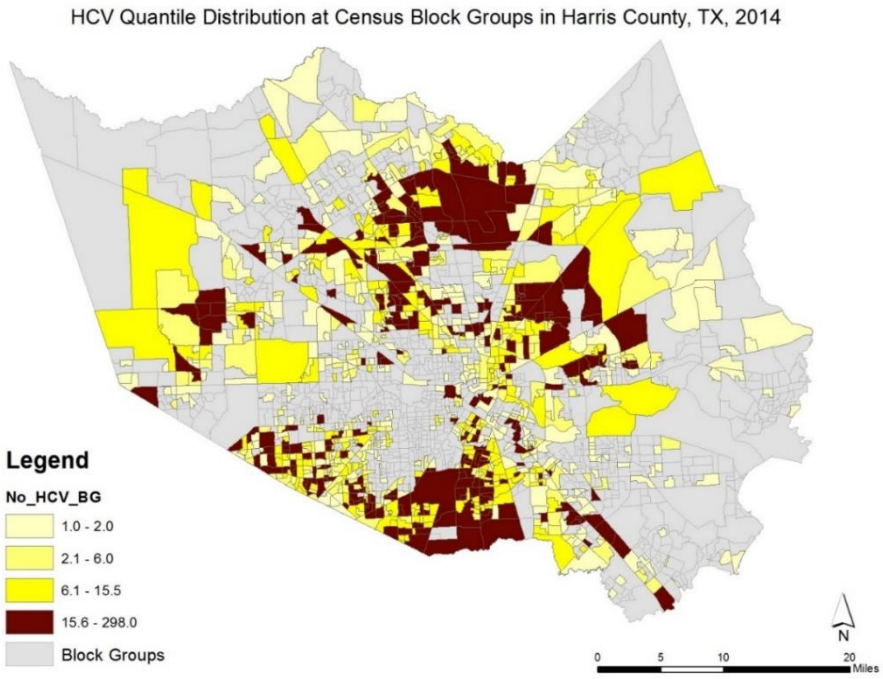


**Figure 25. HCV Distribution by Quartile**

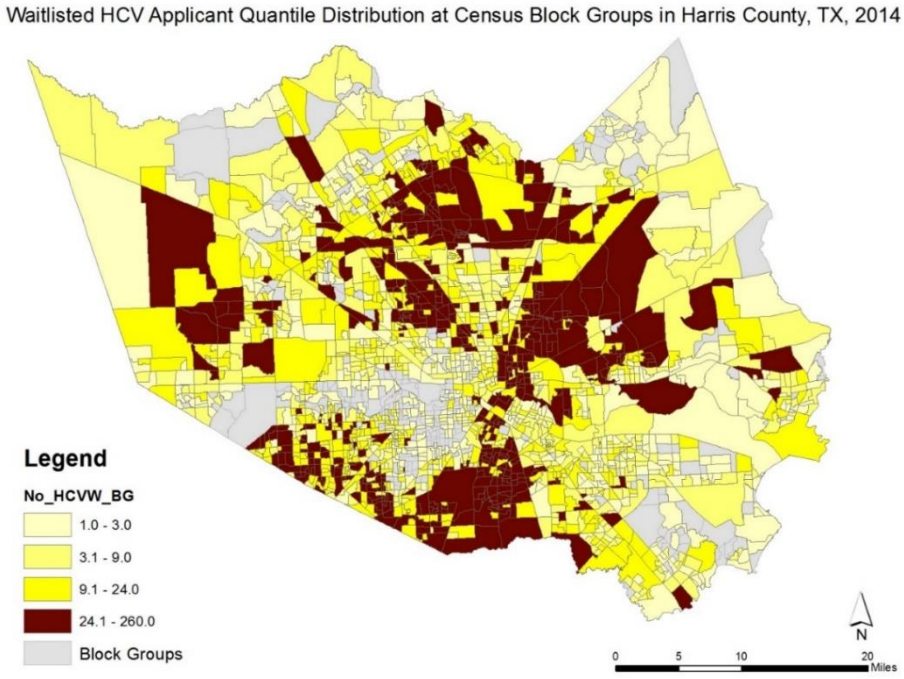


**Figure 26. HCVW Distribution by Quartile**

The distribution of HCV households at block groups is positively skewed, as shown in Figure 27. The mean of the HCV units in block groups is 15.2, but the median is 6, which means that only a few block groups have large numbers of HCV renters, while most block groups have few HCV renters.

The distribution of the HCVW group is also similar to the HCV distribution, which is positively skewed, as shown in Figure 28. The mean of the HCVW households in block groups is 18.0, but the median is 9. Similarly, few block groups have many HCVWs within the block group boundaries, whereas most block groups have very few HCVW households within the block group boundaries.

Figure 27 and Figure 28 show that most block groups have few HCV and HCVW renters, whereas few block groups have a large number of HCV and HCVW renters. The figures on the right side of both Figure 27 and Figure 28 explain that the 25th, 50th, and 75th percentiles are all made in small blue boxes. This means that most block groups have a low number of renters, so that the difference between the 25th, 50th, and 75th percentiles is negligible.

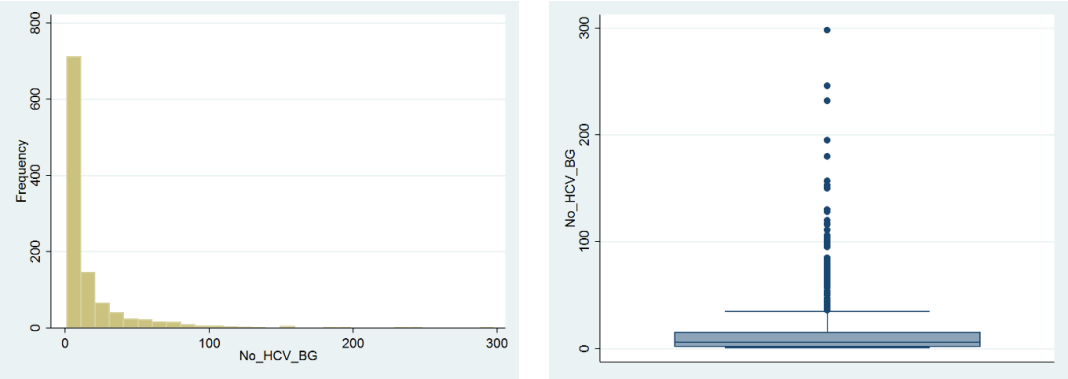


**Figure 27. Distribution of HCV by Block Group**

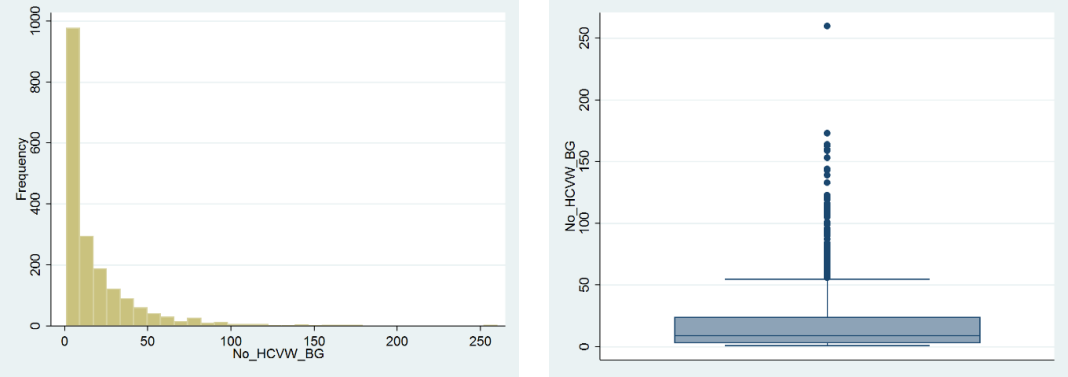


**Figure 28. Distribution of HCVW by Block Group**

Table 15 shows the basic statistics for the 75th percentile of HCV and HCVW. On average, 46.75 HCV households reside in their 268 highest quartile block groups. Similarly, an average of 49.20 HCVW households reside in their 477 highest quartile block groups. Therefore, it is observable that both renter groups' distributions are quite similar in terms of the number of average renters in their highest quartile block groups.

**Table 15. HCV and HCVW by Top 75th Percentile**

| HCV & HCVW | Block Groups | N | Mean | S.D. | Max. | Min. | P25 | Med. | P75 |
|---|---|---|---|---|---|---|---|---|---|
| HCV BGs | **Top 75th percentile BGs** | 268 | 46.75 | 38.52 | 298.0 | 16.0 | 22.0 | 34.0 | 58.5 |
| | Rest of the BGs | 804 | 4.62 | 3.82 | 15.0 | 1.0 | 1.0 | 3.0 | 7.0 |
| | Total | 1,072 | 15.15 | 26.72 | 298.0 | 1.0 | 2.0 | 6.0 | 15.5 |
| HCVW BGs | **Top 75th percentile BGs** | 477 | 49.20 | 30.25 | 260.0 | 24.0 | 29.0 | 39.0 | 58.0 |
| | Rest of the BGs | 1,411 | 7.49 | 6.08 | 23.0 | 1.0 | 3.0 | 5.0 | 11.0 |
| | Total | 1,888 | 18.02 | 24.23 | 260.0 | 1.0 | 3.0 | 9.0 | 24.0 |

Table 16 shows the basic statistics for the 50th percentile of HCV and HCVW. On average, 27.94 HCV households reside in their 538 above-median block groups. Similarly, an average of 31.97 HCVW households resides in their 957 above-median block groups. Therefore, it is also observable that both renter groups' distributions are quite similar in terms of the number of average renters in their above-median block groups.

**Table 16. HCV and HCVW by Median Value (Top 50th Percentile)**

| HCV & HCVW | Block Groups | N | Mean | S.D. | Max. | Min. | P25 | Med. | P50 |
|---|---|---|---|---|---|---|---|---|---|
| HCV BGs | **Top 50th percentile BGs** | 538 | 27.94 | 33.07 | 298.0 | 6.0 | 9.0 | 15.0 | 34.0 |
| | Rest of the BGs | 534 | 2.28 | 1.35 | 5.0 | 1.0 | 1.0 | 2.0 | 3.0 |
| | Total | 1,072 | 15.15 | 26.72 | 298.0 | 1.0 | 2.0 | 6.0 | 15.5 |
| HCVW BGs | **Top 50th percentile BGs** | 957 | 31.97 | 27.57 | 260.0 | 9.0 | 14.0 | 23.0 | 39.0 |
| | Rest of the BGs | 931 | 3.69 | 2.13 | 8.0 | 1.0 | 2.0 | 3.0 | 5.0 |
| | Total | 1,888 | 18.02 | 24.23 | 260.0 | 1.0 | 3.0 | 9.0 | 24.0 |

## 6.3 HCV vs. LIHTC

The LIHDC-development datasets were obtained from the HUD User website. It was possible to obtain information about LIHTC developments that were constructed until 2013 or expected to be completed by 2015. The total number of developments in Harris County is 235, among which 216 developments are displayed using latitude and longitude coordinates that were provided by the HUD website, while the other 19 development locations are identified using the name of each development.

These 19 locations are all multi-family developments, and easily identifiable from their addresses on Google Earth and Google Maps. The latitudes and longitudes for the 19 developments are matched in order to make the data complete for the LIHTC developments in Harris County: physical address, zip code, latitude, longitude, year, total number of units in LIHTC developments, low-income units in LIHTC developments, etc. Two examples of the 19 recent developments that were newly identified are shown in Figure 29.

**Figure 29. LIHTC Examples**

Note: Mariposa At Ella Boulevard (left) & Golden Bamboo Village, Phase III (right)
Source: These figures are captured images from Google Earth in 2016.

LIHTC developments are not present in all block groups. Among the 2,144 Harris County block groups, 1,967 block groups did not accommodate any LIHTC unit within their boundary. The descriptive statistics for all county block groups is summarized in Table 17.

**Table 17. LIHTC Basic Descriptions for all Block Groups**

| Renter Group | N | Mean | S.D. | Max. | Min. | P25 | Med. | P75 |
|---|---|---|---|---|---|---|---|---|
| LIHTC HHs | 2,144 | 17.3 | 72.8 | 940 | 0 | 0 | 0 | 0 |

The number of block groups with at least one unit is 177, which only makes up 8.26% of all block groups in Harris County. As most block groups do not have any LIHTC units, it is more important to focus on which block groups have some types of clusters among those that have at least one LIHTC unit. Table 18 shows the basic statistics of the LIHTC program, with the exception of block groups without LIHTC developments. Table 18 specifically shows the comparisons of the descriptive statistics for HCV and LIHTC from the block groups that hosted at least one HCV or LIHTC household.

**Table 18. HCV and LIHTC Basic Descriptions at the Block Group Level**

| Renter Group | N | Mean | S.D. | Max. | Min. | P25 | Med. | P75 |
|---|---|---|---|---|---|---|---|---|
| HCV HHs | 1,072 | 15.2 | 26.7 | 298 | 1 | 2 | 6 | 15.5 |
| LIHTC HHs | 177 | 209.3 | 155.1 | 940 | 6 | 116 | 166 | 250 |

Figure 30 shows the distribution of LIHTC units by their quartile. As previously shown in the HCV and HCVW distribution, the dark brown block groups are the highest quartile, the dark yellow block groups are the second-highest quartile, the medium-level

yellow block groups are the third quartile, and the lightest yellow are the bottom quartile among block groups with at least one LIHTC unit. The numbers of quartile thresholds are significantly larger than those of the previous two groups.

Especially in comparing the LIHTC (Figure 30) and the HCV (Figure 25) quartile distributions, the highest quartile block groups (dark brown) and the second-highest quartile block groups (dark yellow) are somewhat similar, but only a few number of block groups from the LIHTC features were available. Thus, it is necessary to run statistical analyses in order to make the comparison result clearer.

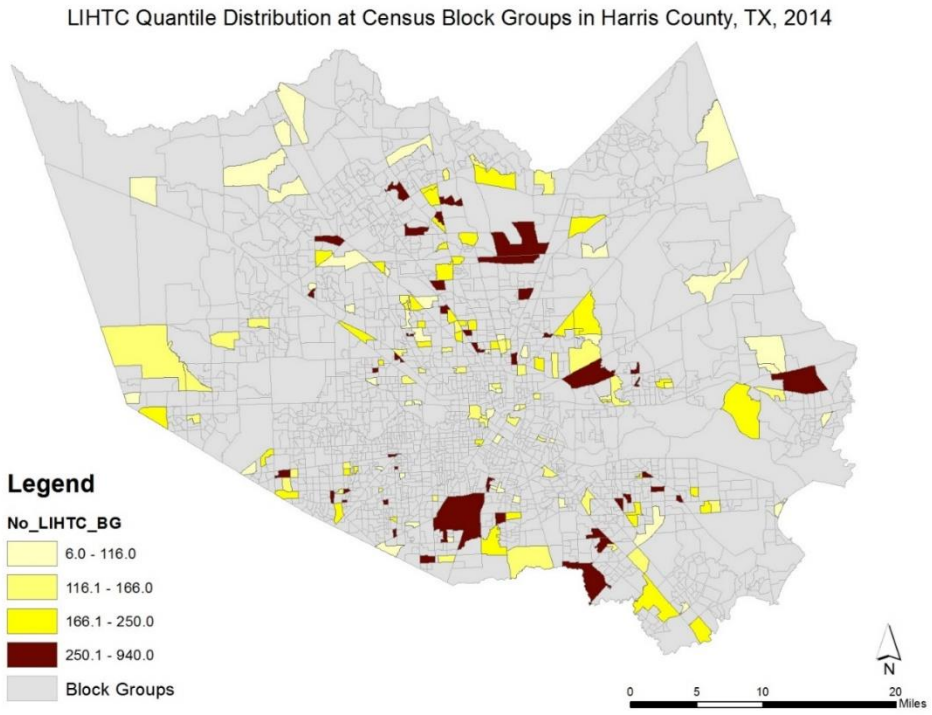


**Figure 30. LIHTC Distribution by Quartile**

The distribution of the number of LIHTC households at block groups is positively skewed, which is the same as the two previous renter groups. The mean of the number of LIHTC units in block groups is 209.3, but the median is 166. This positive skewness entails that some block groups have large numbers of LIHTC units, while most block groups have only a few.

The right side of the chart on Figure 31 displays a taller blue box, which includes the 25th, 50th, and 75th percentiles, which are represented on the bottom, center, and top lines of the blue box, respectively. This shows that the three quartile thresholds of the LIHTC renter group are more meaningful, unlike the previous two renter groups, which had similar figures among their three thresholds for the 25th, 50th, and 75th percentiles.

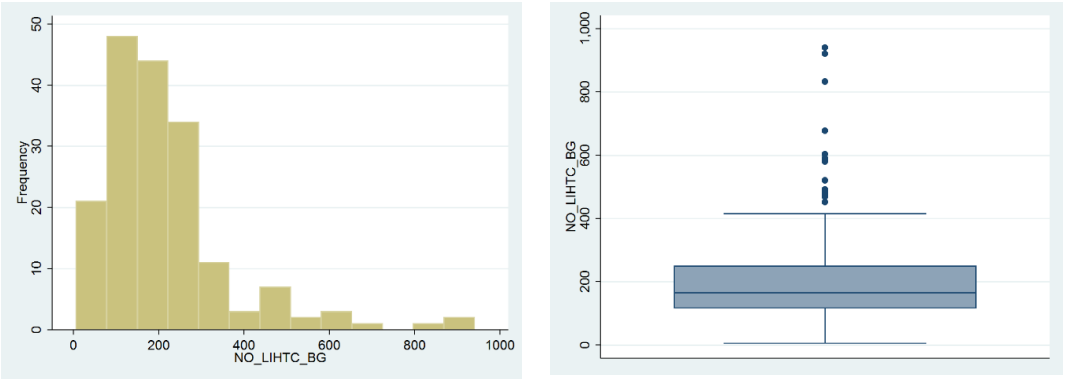


**Figure 31 Distribution of LIHTC by Block Group**

Table 19 shows the basic statistics for the 75th percentiles of HCV and LIHTC. Unlike the closeness between HCV and HCVW, these two renter groups have a wide gap in the number of renters at the highest quartile block groups. Whereas an average of 46.75 HCV households reside in their highest quartile block groups, an average of

400.19 LIHTC households reside in their highest quartile block groups. The LIHTC program's highest quartile block groups have about 8.6 times more households than their HCV counterparts.

**Table 19. HCV and LIHTC by Top 75th Percentile**

| HCV & LIHTC | Block Groups | N | Mean | S.D. | Max. | Min. | P25 | Med. | P75 |
|---|---|---|---|---|---|---|---|---|---|
| HCV BGs | **Top 75th percentile BGs** | 268 | 46.75 | 38.52 | 298.0 | 16.0 | 22.0 | 34.0 | 58.5 |
| | Rest of the BGs | 804 | 4.62 | 3.82 | 15.0 | 1.0 | 1.0 | 3.0 | 7.0 |
| | Total | 1,072 | 15.15 | 26.72 | 298.0 | 1.0 | 2.0 | 6.0 | 15.5 |
| LIHTC BGs | **Top 75th percentile BGs** | 47 | 400.19 | 175.69 | 940.0 | 250.0 | 268.0 | 326.0 | 489.0 |
| | Rest of the BGs | 130 | 140.34 | 61.06 | 248.0 | 6.0 | 96.0 | 144.0 | 181.0 |
| | Total | 177 | 209.34 | 155.06 | 940.0 | 6.0 | 116.0 | 166.0 | 250.0 |

Table 20 shows the basic statistics for the 50th percentiles of HCV and LIHTC. Similarly, there is a large difference between the numbers of renters at the above-median block groups for these two renter groups. The LIHTC program's above-median block groups have an average of 308.79 households that benefit from LIHTC assistance, which is about 11.1 times larger than their HCV counterparts.

**Table 20. HCV and LIHTC by Median Value (Top 50th Percentile)**

| HCV & LIHTC | Block Groups | N | Mean | S.D. | Max. | Min. | P25 | Med. | P50 |
|---|---|---|---|---|---|---|---|---|---|
| HCV BGs | **Top 50th percentile BGs** | 538 | 27.94 | 33.07 | 298.0 | 6.0 | 9.0 | 15.0 | 34.0 |
| | Rest of the BGs | 534 | 2.28 | 1.35 | 5.0 | 1.0 | 1.0 | 2.0 | 3.0 |
| | Total | 1,072 | 15.15 | 26.72 | 298.0 | 1.0 | 2.0 | 6.0 | 15.5 |
| LIHTC BGs | **Top 50th percentile BGs** | 90 | 308.79 | 159.80 | 940.0 | 166.0 | 212.0 | 250.0 | 326.0 |
| | Rest of the BGs | 87 | 106.46 | 41.53 | 165.0 | 6.0 | 80.0 | 115.0 | 144.0 |
| | Total | 177 | 209.34 | 155.06 | 940.0 | 6.0 | 116.0 | 166.0 | 250.0 |

## 6.4 HCV vs. GR

A total of 2,141 block groups had at least one household. Three block groups for which no housing unit for households exists were eliminated. Table 21 shows the basic statistics for the GR group at all census block groups with at least one residential unit.

**Table 21. GR Basic Descriptions for all Block Groups with a Residential Unit**

| Renter Group | N | Mean | S.D. | Max. | Min. | P25 | Med. | P75 |
|---|---|---|---|---|---|---|---|---|
| GR (%) | 2,141 | 43.9 | 29.5 | 100 | 0 | 19.6 | 39.0 | 67.3 |

Subsequently, the block groups for the GR group were narrowed down to 2,095 block groups by finding at least one renter in a block group. Therefore, an additional 46 block groups were eliminated as their residents are all homeowners. Table 22 shows the comparisons of the descriptive statistics for HCVs and GRs from the block groups that have at least one HCV household or GR. On average, 44.9% are renters in Harris County's block groups with a rental unit within each census block group.

**Table 22. HCV and GR Basic Descriptions at the Block Group Level**

| Renter Group | N | Mean | S.D. | Max. | Min. | P25 | Med. | P75 |
|---|---|---|---|---|---|---|---|---|
| HCV HHs (#) | 1,072 | 15.2 | 26.7 | 298 | 1 | 2 | 6 | 15.5 |
| GR (%) | 2,095 | 44.9 | 29.1 | 100 | 0.6 | 20.6 | 39.8 | 68.3 |

Figure 32 shows the distribution of the GR percentages by their quartile. As previously shown in the three previous renter groups, the dark brown block groups are the highest quartile, the dark yellow block groups are the second-highest quartile, the medium-level yellow block groups are the third quartile, and the lightest yellow are the bottom quartile among the block groups where there is at least one rental unit. The

percentage of the quartile thresholds are about 20%, 40%, and 68%, which is relatively proportional, unlike the three previous cases.

In comparing the GR percentage quartile distribution (Figure 32) to the HCV quartile distribution (Figure 25), both the highest quartile block groups (dark yellow) and the second-highest quartile block groups (dark yellow) are very different for the two renter groups. The visual observation between HCV and GR quartiles is a reason to subsequently run statistical analyses in order to find which neighborhood quality variables are different for the two groups and to what degree of significance. The HCV and GR groups have an evident difference in neighborhood quality, which does not support the idea that low-income HCV renters found their rental units similarly to GRs.

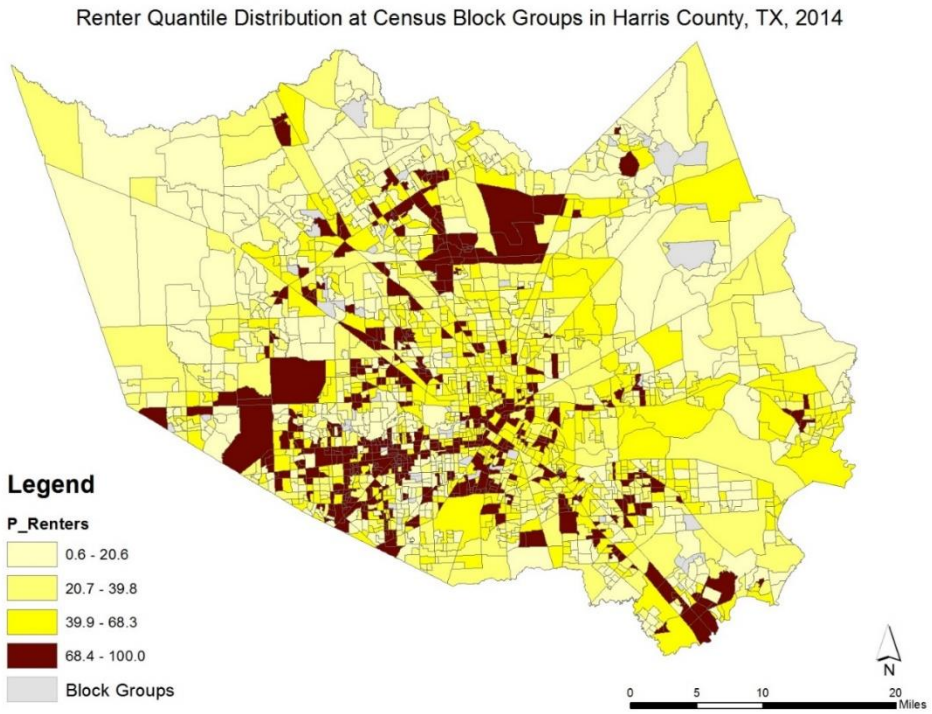


**Figure 32. GR Distribution by Quartile**

As displayed in Figure 33, the distribution of the GR group is relatively proportionately distributed over the chart, regardless of the percentage of renters in block groups. The mean of the GR percentages in block groups is 44.9%, and the median of the GR percentages in block groups is 39.8%. The similarity of the mean and median values represents the fact that the distribution is not very likely to be skewed. The GR group has a somewhat different figure than the three previous renter groups.

The right-side chart of Figure 33 also shows the tallest blue box among the four renter groups. This entails that the three quartile thresholds (the 25th, 50th, and 75th percentiles) of the GR group are meaningful, as the percentages of the cut-points lie relatively far apart. Therefore, block groups from the highest quartile, the second-highest

quartile, and the third quartile make up different subsets for the neighborhood quality analyses.

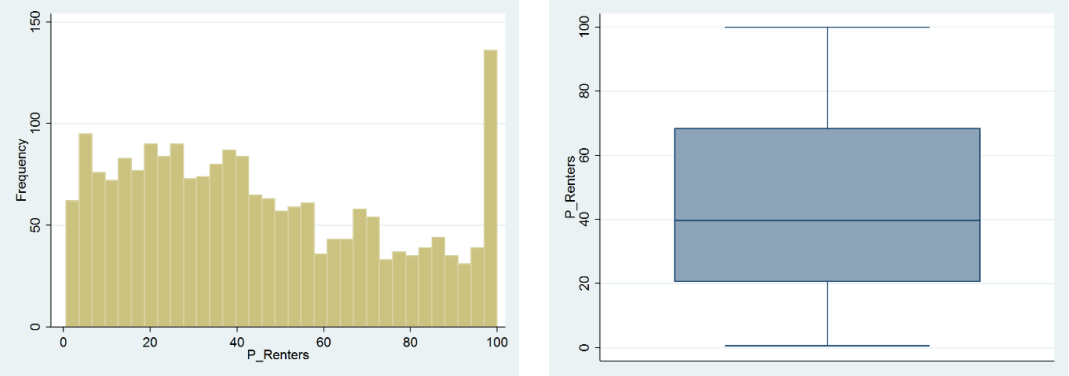


**Figure 33. Distribution of GR (%) by Block Group**

Table 23 shows the basic statistics for the 75th percentile of the HCV and GR groups. On average, 86.14% of residents are renters in the highest quartile block groups. These highest quartile block groups of the GR group are considered highly populated by renters. This entails that about 86 people out of 100 residents in these block groups are renters, while about 14 people are homeowners.

**Table 23. HCV and GR by Top 75th Percentile**

| HCV & GR | Block Groups | N | Mean | S.D. | Max. | Min. | P25 | Med. | P75 |
|---|---|---|---|---|---|---|---|---|---|
| HCV BGs (#) | **Top 75th percentile BGs** | 268 | 46.75 | 38.52 | 298.0 | 16.0 | 22.0 | 34.0 | 58.5 |
| | Rest of the BGs | 804 | 4.62 | 3.82 | 15.0 | 1.0 | 1.0 | 3.0 | 7.0 |
| | Total | 1,072 | 15.15 | 26.72 | 298.0 | 1.0 | 2.0 | 6.0 | 15.5 |
| GR BGs (%) | **Top 75th percentile BGs** | 524 | 86.14 | 10.94 | 100.0 | 68.3 | 76.1 | 86.4 | 97.1 |
| | Rest of the BGs | 1,571 | 31.09 | 18.16 | 68.3 | 0.6 | 15.8 | 30.0 | 45.0 |
| | Total | 2,095 | 44.86 | 29.08 | 100.0 | 0.6 | 20.6 | 39.8 | 68.3 |

Table 24 shows the basic statistics by the 50th percentile of the HCV and the GR groups. On average, 69.22% of residents in the GR group's above-median block groups are renters. In these above-median block groups, about 69 people out of 100 residents in each block group are renters, whereas about 31 people are homeowners.

**Table 24. HCV and GR by Median Value (Top 50th Percentile)**

| HCV & GR | Block Groups | N | Mean | S.D. | Max. | Min. | P25 | Med. | P50 |
|---|---|---|---|---|---|---|---|---|---|
| HCV BGs (#) | **Top 50th percentile BGs** | 538 | 27.94 | 33.07 | 298.0 | 6.0 | 9.0 | 15.0 | 34.0 |
| | Rest of the BGs | 534 | 2.28 | 1.35 | 5.0 | 1.0 | 1.0 | 2.0 | 3.0 |
| | Total | 1,072 | 15.15 | 26.72 | 298.0 | 1.0 | 2.0 | 6.0 | 15.5 |
| GR BGs (%) | **Top 50th percentile BGs** | 1,047 | 69.22 | 19.50 | 100.0 | 39.8 | 51.6 | 68.3 | 86.5 |
| | Rest of the BGs | 1,048 | 20.53 | 11.23 | 39.8 | 0.6 | 10.7 | 20.6 | 30.0 |
| | Total | 2,095 | 44.86 | 29.08 | 100.0 | 0.6 | 20.6 | 39.8 | 68.3 |

## 6.5 Summary: Mean Comparison T-test

Mean T-tests were conducted in order to compare differences in neighborhood quality variables between the census block groups with a large number of HCV households and those with a large number of other renter groups' households: HCVW, LIHTC, and GR. The block groups that are used for the four renter groups in this analysis are census block groups that are ranked higher than the 75th or the 50th percentile of the distribution of each renter group. The mean tests were executed with the three individual groups' mean comparisons: HCV-HCVW, HCV-LIHTC, and HCV-GR.

At the highest quartile block groups of each renter group, the mean comparison T-tests were conducted, as summarized in Table 25. Firstly, the HCV and HCVW groups do not show any significantly different statistics other than the variable *P_65*, which stands for the percentage of residents aged 65 and older. Specifically, the HCV block groups in the highest quartile have a -1.08% point difference to this senior age group when compared to the HCVW block groups in the highest quartile. Other than the senior percentage variable, none of the variables show any significant difference between the two renter groups at the .1 level. In conclusion, the characteristics of the neighborhoods in which the two renter groups strongly prefer to reside are very similar, with the exception of the senior percentage variable (*P_65*) which differed to a minimal degree.

Secondly, the results from the HCV and LIHTC mean comparison T-test show statistically significant differences in several neighborhood quality variables. The statistical differences between the two renter groups imply that HCV and LIHTC assistance affects their beneficiaries' choice of rental units from different types of neighborhoods, which may result in differences in the neighborhood quality of each renter group. This is mainly because LIHTC units are situated by developers rather than according to LIHTC renters' demand. Private developers who work on LIHTC projects should find proper investors who are able to invest sufficient money into the first phase of the development. Private-market players decide project locations based on their calculations and in such a way that they can maximize profits.

Although future LIHTC residents' preferences for project locations are minimal, residents' compositions of the LIHTC-program's recipient eligibility is a rational argument that accounts for why HCV and LIHTC residents made different locational choices. LIHTC developers must estimate the needs of future LIHTC residents whose incomes are lower than either 50% or 60% of the area median income. This income limit is different from that of the HCV program, which requires that 75% of the residents reach the 30% threshold of the area median income and extends the rest of HCV's beneficiaries' threshold up to 50% of the area median income or sometimes up to the 80% of the area median income. These HCV households are not only free regarding future housing locations but also regarding types of residential units and communities.

Specifically, HCV households are more likely to cluster in the block groups with more Non-Hispanic Blacks (*P_NHB*), fewer Hispanics (*P_HSP*), fewer children (*P_017*), more seniors (*P_65*), fewer renters (*P_Renters*), fewer female-headed household with children (*P_FHWC*), higher rent costs (*MED_RENT*), lower poverty rates (*P_POVERTY*), and higher education attainment (*P_BCHLRS*). Especially, the HCV renters live in higher-rent block groups than LIHTC renters. The poverty rates of HCV residents' block groups are lower than those of their LIHTC residents' counterparts. This implies that HCV renters' direct subsidy helps to push HCV households to high-rental cost units and less poverty-stricken neighborhoods, unlike LIHTC's lower-than-market-rate rent.

Thirdly, the HCV and GR comparison shows very different neighborhood quality patterns. Many neighborhood variables show statistical differences between the two

renter groups. Overall, HCV households reside in highly populated areas (*POP* and *HHs*), more Non-Hispanic Black dominant areas (see *P_NHB*, *P_NHW*, *P_NHA*, *P_NHO*, and *P_HSP*), less renter-clustered areas (*P_Renters*), fewer single-person household residential areas (*P_LivingAlone*), more female-headed household residential areas (*P_FHHders* and *P_FHWC*), lower median property value residential areas (*MED_PRPVAL*), but higher rent areas (*MED_RENT*), higher unemployed areas (*P_UNEMP*), lower high-school dropout areas (*P_DROPOUT*), as well as lower education-attainment areas (*P_BCHLRS*), and areas with lower accessibility to LRT stations (*LRTSt*).

Overall, the HCV program does not guarantee that HCV households achieve significant improvements in neighborhood quality by utilizing the voucher subsidy (HCV-HCVW). While HCV and HCVW households reside in neighborhoods with similar quality levels, there are some differences in the residential location choices between the two major housing programs: HCV and LIHTC. For example, voucher households tend to reside in the same race/ethnicity group of non-Hispanic Black dominant block groups. Additionally, HCV households found places where the median rent was $86 higher, the poverty rate was about 4% points lower, and the percentage of residents with bachelor's or higher degrees was 4% points higher (HCV-LIHTC). Furthermore, in comparison to the GR group, the tendency of attaching to the same race/ethnicity of HCV tenants is quite strong, with the non-Hispanic Black percentage in the highest quartile block groups being 21% points higher. The HCV tenants found

places with 28% points less renter clustering, $62,000 property value cheaper, but $33 more expensive rental cost areas (HCV-GR).

**Table 25. Mean Comparison T-tests of HCV, HCVW, LIHTC, and GR in Each Group's Top 75th Percentile (Highest Quartile) Census Block Groups**

| Neighborhood Quality | HCV – HCVW | | HCV – LIHTC | | HCV – GR | |
|---|---|---|---|---|---|---|
| Population | 233.31 | (158.18) | -252.92 | (326.88) | 844.23 *** | (107.72) |
| Pct. of NH-White | 0.20 | (0.97) | -1.13 | (1.94) | -10.17 *** | (1.45) |
| Pct. of NH-Black | -2.05 | (2.05) | 10.97 ** | (4.40) | 20.74 *** | (1.92) |
| Pct. of NH-Asian | 0.49 | (0.61) | 2.05 | (1.31) | -1.70 ** | (0.69) |
| Pct. of NH-Others | -0.03 | (0.15) | 0.08 | (0.28) | -0.44 ** | (0.19) |
| Pct. of Hispanic | 1.38 | (1.67) | -11.97 *** | (3.76) | -8.43 *** | (1.99) |
| Pct. of Ppl. aged under 17 | 0.81 | (0.64) | -3.40 *** | (1.31) | 2.93 *** | (0.78) |
| Pct. of Ppl. aged over 65 | -1.08 ** | (0.53) | 2.27 ** | (1.03) | 1.85 *** | (0.50) |
| Households | 75.96 | (46.39) | -89.21 | (97.23) | 161.94 *** | (35.18) |
| Pct. of Renters | 3.50 | (2.14) | -16.18 *** | (4.22) | -27.63 *** | (1.36) |
| Pct. of Ppl. living alone | 0.43 | (1.11) | 2.00 | (2.37) | -7.41 *** | (1.22) |
| Pct. of Female Householders | 0.05 | (0.91) | 0.15 | (1.91) | 4.82 *** | (0.94) |
| Pct. of FH with Children | 0.69 | (0.74) | -3.00 ** | (1.50) | 2.78 *** | (0.79) |
| Med. Property Val. ($10,000) | 0.33 | (0.40) | 0.45 | (0.79) | -6.22 *** | (0.98) |
| Med. Rent ($100) | -0.01 | (0.20) | 0.86 ** | (0.40) | 0.33 * | (0.19) |
| Med. Income ($10,000) | -0.13 | (0.14) | 0.42 | (0.26) | -0.00 | (0.14) |
| Pct. of Poverty | 1.31 | (1.10) | -4.49 ** | (2.28) | -0.32 | (1.17) |
| Pct. of Unemployed | -0.23 | (0.64) | -0.14 | (1.36) | 2.44 *** | (0.62) |
| No. of Jobs (WAC) | 219.22 | (246.98) | -711.76 | (597.96) | -469.09 | (296.89) |
| Pct. of Dropout | 0.36 | (1.18) | 0.47 | (2.44) | -4.96 *** | (1.53) |
| Pct. of Bachelors | 0.29 | (0.94) | 4.42 ** | (1.88) | -7.50 *** | (1.48) |
| No. Bus Stops | -0.33 | (0.55) | 0.05 | (1.08) | 0.73 | (0.49) |
| No. LRT Stations | -0.01 | (0.02) | -0.02 | (0.04) | -0.06 ** | (0.03) |
| Bikeways (ft) | 99.27 | (275.16) | 554.84 | (590.63) | -101.67 | (293.14) |
| Park (acre) | -7.48 | (11.62) | -16.77 | (12.04) | -20.32 | (29.39) |
| N | 745 (268+477) | | 315 (268+47) | | 792 (268+524) | |
| Note: Standard errors in parentheses; *: p<0.1, **: p<0.05, and ***: p<0.01 | | | | | | |

As shown in Table 26, once the block groups are extended to the median value cut-point, the mean comparison T-tests offer a bit more information, especially in the first comparison analysis between HCV-HCVW. The first T-test at the above-median block groups of the HCV program and the HCVW shows that HCV residents are more

likely to find non-Hispanic Black dominant neighborhoods (see *P_NHW*, *P_NHB*, *P_NHO*, and *P_HSP*). However, they are unlikely to eagerly find higher rental-cost neighborhoods (insignificant *MED_RENT*). The T-test of the HCV-HCVW renter groups at the 50th percentile cut-point includes more variables with statistical significance than those at the 75th percentile cut-point.

Secondly, the HCV-LIHTC T-test shows that HCV residents prefer to live in higher-rental areas (*MED_RENT*) with fewer under-poverty-line households (*P_Poverty*). A similar result was observed in the highest quartile block group T-test, with the same two major renter groups. This T-test made four additional variables statistically significant: population (*POP*), households (*HHs*), median income (*MED_INCOME*), and level of employment (*WAC*).

Lastly, the HCV-GR T-test at the above-median block groups shows almost the same results as the highest quartile block groups. The Non-Hispanic Asian group (*P_NHA*) and high-school dropout rates (*P_DROPOUT*) lost their statistical meaning, whereas the level of employment (*WAC*) earned new statistical meaning. Other than these, no variables radically changed.

**Table 26. Mean Comparison T-tests of HCV, HCVW, LIHTC, and GR in Each Group's Top 50th Percentile (Above-Median) Census Block Groups**

| Neighborhood Quality | HCV – HCVW | | HCV – LIHTC | | HCV – GR | |
|---|---|---|---|---|---|---|
| Population | 81.95 | (98.81) | -470.04 ** | (217.10) | 555.41 *** | (73.79) |
| Pct. of NH-White | -3.60 *** | (0.93) | -1.39 | (1.85) | -11.22 *** | (1.13) |
| Pct. of NH-Black | 6.81 *** | (1.46) | 7.02 ** | (3.21) | 18.43 *** | (1.39) |
| Pct. of NH-Asian | -0.33 | (0.45) | 1.52 | (0.96) | -0.45 | (0.46) |
| Pct. of NH-Others | -0.20 * | (0.12) | -0.14 | (0.21) | -0.38 *** | (0.13) |
| Pct. of Hispanic | -2.68 ** | (1.29) | -7.01 ** | (2.73) | -6.38 *** | (1.43) |
| Pct. of Ppl. aged under 17 | 0.38 | (0.46) | -3.92 *** | (0.96) | 2.09 *** | (0.52) |
| Pct. of Ppl. aged over 65 | 0.65 * | (0.36) | 3.02 *** | (0.78) | 1.20 *** | (0.36) |
| Households | 6.74 | (29.72) | -168.52 ** | (64.78) | 93.01 *** | (23.88) |
| Pct. of Renters | -1.99 | (1.54) | -17.52 *** | (3.15) | -17.50 *** | (1.21) |
| Pct. of Ppl. living alone | -0.78 | (0.79) | -0.16 | (1.62) | -5.80 *** | (0.83) |
| Pct. of Female Householders | 2.12 *** | (0.66) | -0.36 | (1.42) | 3.89 *** | (0.65) |
| Pct. of FH with Children | 1.30 ** | (0.50) | -3.94 *** | (1.08) | 2.49 *** | (0.53) |
| Med. Property Val. ($10,000) | -0.99 *** | (0.38) | 0.37 | (0.66) | -4.68 *** | (0.62) |
| Med. Rent ($100) | -0.07 | (0.15) | 0.65 ** | (0.29) | 0.26 ** | (0.13) |
| Med. Income ($10,000) | -0.25 ** | (0.11) | 0.58 *** | (0.21) | -0.16 | (0.11) |
| Pct. of Poverty | 1.19 | (0.77) | -5.92 *** | (1.63) | -0.17 | (0.79) |
| Pct. of Unemployed | 0.82 * | (0.42) | -0.32 | (0.92) | 1.85 *** | (0.41) |
| No. of Jobs (WAC) | -58.73 | (148.72) | -595.60 * | (334.48) | -434.06 ** | (208.42) |
| Pct. of Dropout | -0.24 | (0.87) | -0.46 | (1.75) | -1.47 | (0.96) |
| Pct. of Bachelors | -1.93 ** | (0.79) | 4.22 *** | (1.45) | -6.72 *** | (1.05) |
| No. Bus Stops | 0.51 | (0.36) | 0.36 | (0.75) | 0.13 | (0.38) |
| No. LRT Stations | -0.01 | (0.01) | 0.00 | (0.03) | -0.05 ** | (0.02) |
| Bikeways (ft) | -208.59 | (206.11) | 264.11 | (408.90) | -296.80 | (193.29) |
| Park (acre) | 4.49 | (16.87) | 9.88 | (37.94) | 8.29 | (18.39) |
| N | 1,495 (538+957) | | 628 (538+90) | | 1,585 (538+1,047) | |
| Note: Standard errors in parentheses; *: p<0.1, **: p<0.05, and ***: p<0.01 | | | | | | |

The results imply that the HCV program subsidy did not actively engage in moving voucher holders to different types of neighborhoods. Few neighborhood quality variables indicate that there is a significant difference between the two groups which are currently benefited and which are activated on the waitlist. Although voucher holders can save some amount of rent, the fact that they receive a certain amount of subsidy does not directly result in migrating voucher holders to new types of neighborhoods where they may benefit from other amenities or venture into different types of environments.

This result aligns with the longitudinal-analysis result from the southern Florida case that was conducted by Walter, Li, and Atherwood (2015), who claim that HCV recipients were highly clustered in neighborhoods with low opportunities and that the voucher assignment did not significantly relocate recipients towards attaining greater neighborhood opportunities.

The second T-test between HCV and LIHTC shows that voucher holders actually live in other neighborhoods than those in which LIHTC households are found, which can be explained by several indicators that are statistically significant. Limited locational freedom is available to LIHTC residents due to committed private developers. However, developers and their investors generally come from the private sector and seek to make profits, which greatly limits feasible neighborhood candidates in accessing LIHTC developments. This process of LIHTC developments leaves few options open for low-income residents who want to reside in such LIHTC development units.

The third T-test between the HCV and GR groups confirms that HCV recipients have very limited access to neighborhood quality compared to GRs. It was not negligible that most HCV renters form part of extremely low-income households, which comprise three-quarters of the entire HCV renter population, which in turn only makes up to 30% of the area median income. These HCV residents are far poorer than GRs. Furthermore, the rent of HCV users is limited by the cap that is determined by payment standard, whereas GRs are generally more relaxed in choosing rental units.

There are even renters with decent income only because they do not want to deal with the many financial documents that accompany homeownership. Other affluent

renters may find rental status more appropriate when they need to temporarily reside in their current housing unit, regardless of their possibility to afford owning a house. In some cases, they may be young generations who want to live in good neighborhoods despite the higher level of rental burdens, rather than be concerned with house management and pay high property taxes. These types of households rather want to continue to be renters, although their preference for neighborhoods lies closer to that of homeowners.

Additionally, the individual-level mean comparison T-test was conducted, which reveals differences in neighborhood characteristics from the perspective of individual households. As the mean comparison T-test includes a larger number of observations, which increased from 745 at the block group level analysis to 50,276 at the individual level analysis, T-values become far higher, even though the means and standard deviations are expected to differ.[8]

Through the results from most variables, the HCV households expect to have different neighborhood characteristics than their HCVW counterparts. Specifically, the HCV households anticipate encountering more people (*POP*) and households (*HHs*), and

---

[8] The formula of the mean test is as follows:

$$t = (\bar{x}_1 - \bar{x}_i) - (\mu_1 - \mu_i) \Big/ \sqrt{{s_1^2}/{n_1} + {s_i^2}/{n_i}}$$

Although it is expected that the values of the means ($\bar{x}$) and the standard deviations (*s*) change, a larger number of observations (*n*) have a far more significant influence on the overall T-values. Increased T-values contribute to statistical significance in the T-test.

including greater numbers of non-Hispanic Blacks (*P_NHB*) but smaller number of non-Hispanic Whites (*P_NHW*). Additionally, they may encounter a higher percentage of renters (*P_Renters*), people living alone (*P_LivingAlone*), female householders (*P_FHHders*), and female householders with children (*P_FHWC*). Unfortunately, HCV households reside in neighborhoods with lower median rents (*MED_RENT*), lower median incomes (*MED_INCOME*), higher poverty rates (*P_POVERTY*), and a higher percentage of unemployed people (*P_UNEMP*). Furthermore, HCV recipients live in neighborhoods with a higher percentage of high school dropouts (*P_DROPOUT*) and a lower percentage of people holding a bachelor's degree or higher (*P_BCHLRS*). In conclusion, from the individual HCV households' perspective, neighborhood opportunities are low compared to the characteristics that individual HCV waitlist households can expect from their neighborhoods.

**Table 27. Mean Comparison T-tests of HCV & HCVW at the Individual Household Level**

| | HCV - HCVW (Individual) | | HCV - HCVW (Census BG) | |
|---|---|---|---|---|
| Population | 171.69 *** | (19.06) | 233.31 | (158.18) |
| Pct. of NH-White | -1.95 *** | (0.15) | 0.20 | (0.97) |
| Pct. of NH-Black | 4.64 *** | (0.27) | -2.05 | (2.05) |
| Pct. of NH-Asian | 0.03 | (0.08) | 0.49 | (0.61) |
| Pct. of NH-Others | -0.01 | (0.02) | -0.03 | (0.15) |
| Pct. of Hispanic | -2.71 *** | (0.23) | 1.38 | (1.67) |
| Pct. of Ppl. aged under 17 | 0.83 *** | (0.08) | 0.81 | (0.64) |
| Pct. of Ppl. aged over 65 | -0.60 *** | (0.06) | -1.08 ** | (0.53) |
| Households | 70.59 *** | (5.69) | 75.96 | (46.39) |
| Pct. of Renters | 7.47 *** | (0.27) | 3.50 | (2.14) |
| Pct. of Ppl. living alone | 2.12 *** | (0.14) | 0.43 | (1.11) |
| Pct. of Female Householders | 1.62 *** | (0.13) | 0.05 | (0.91) |
| Pct. of FH with Children | 2.00 *** | (0.10) | 0.69 | (0.74) |
| Med. Property Val. ($10,000) | -0.07 | (0.06) | 0.33 | (0.40) |
| Med. Rent ($100) | -0.09 *** | (0.03) | -0.01 | (0.20) |
| Med. Income ($10,000) | -0.41 *** | (0.02) | -0.13 | (0.14) |
| Pct. of Poverty | 2.74 *** | (0.14) | 1.31 | (1.10) |
| Pct. of Unemployed | 0.69 *** | (0.08) | -0.23 | (0.64) |
| No. of Jobs (WAC) | 750.46 *** | (44.26) | 219.22 | (246.98) |
| Pct. of Dropout | 0.56 *** | (0.16) | 0.36 | (1.18) |
| Pct. of Bachelors | -0.93 *** | (0.13) | 0.29 | (0.94) |
| No. Bus Stops | 0.50 *** | (0.07) | -0.33 | (0.55) |
| No. LRT Stations | 0.01 *** | (0.00) | -0.01 | (0.02) |
| Bikeways (ft) | -46.39 | (41.31) | 99.27 | (275.16) |
| Park (acre) | -1.99 | (2.14) | -7.48 | (11.62) |
| N | 50,276 (16,246+34,030) | | 745 (268+477) | |
| Note: Standard errors in parentheses; *: p<0.1, **: p<0.05, and ***: p<0.01 | | | | |

# CHAPTER VII

# ASSOCIATIONS OF HCV HOUSEHOLDS AND NEIGHBORHOOD QUALITY

## 7.1 OLS Regression Analysis

The OLS regression analysis estimates the associations between the number of HCV households in block groups and the neighborhood quality variables. The dependent variable is the number of HCV households in a census block group. The independent variables are the neighborhood quality variables that were used in the comparison-analysis chapter. The unit of analysis is census block groups, and the observations are included only for census block groups with more than one voucher resident. The first and basic model without logarithm transformation is summarized and described in Appendix B.

The second OLS regression analysis[9] was estimated after dependent variables were transformed to log values. The original dependent variable has a skewness of 4.31 and a kurtosis of 30.31. However, the dependent variable in the model in Table 28 became more normally distributed after logarithm transformation. The log-dependent variable has a skewness of .36 and a kurtosis of 2.26. Under the same conditions as the

[9] The box-cox analysis shows that the θ value is -.0938, which lies closer to 0 than 1. This indicates that the log-transformed model shows a better fit than the level-level model. When a θ value is closer to 1, this indicates that a linear model is a better model. Additionally, the log likelihood is -2894.3997 when the null hypothesis is that θ = 0 (log-level model), whereas the log likelihood is -3980.351 when the null hypothesis is that θ = 1 (level-level model). The former log likelihood is larger than the latter log likelihood, which entails that the log-level model is more explanatory than the linear model.

first OLS model summarized in the appendix, the second OLS regression analysis resulted in some changes in statistical significance (see Table 28).

At this juncture, there continue to be seven independent variables with a significance level of up to the .1 level, while the following two variable, namely the percentage of female-headed household with children (*P_FHWC*) and the percentage of renters (*P_Renters*), lost statistical significance. However, the median-income variable (*MED_INCOME*) gained statistical significance at the .01 level. The coefficient of the median-income variable was -.1096, meaning that a $10,000 increase in the median income in a block group is associated with .1096 fewer HCV households in the block group.

The overall model fit increased from .2849 in the level-level model to .3691 in the log-level model, according to the r-squared value. The adjusted r-squared is also increased from .2682 in the level-level model to .3544 in the log-level model. Overall model fit was enhanced in the semi-log model that took the logarithm of the dependent variable. This means that the individual independent variables explain far more about the variance of the dependent variable in the semi-log model than about its variance in the level-level model.

**Table 28. OLS Regression Analysis 2: Log-Level Model**

| Variables | Coef. | Std. Err. | t | P>t |
|---|---|---|---|---|
| **Pct. of NH-Black** | **0.0257** | **0.0019** | **13.79** | **0.00** |
| Pct. of Ppl. aged under 17 | 0.0006 | 0.0066 | 0.09 | 0.93 |
| Pct. of Ppl. aged over 65 | -0.0010 | 0.0081 | -0.13 | 0.90 |
| **Households** | **0.0007** | **0.0001** | **9.23** | **0.00** |
| Pct. of Renters | 0.0038 | 0.0024 | 1.54 | 0.12 |
| Pct. of Ppl. living alone | -0.0015 | 0.0041 | -0.36 | 0.72 |
| Pct. of Female Householders | -0.0030 | 0.0039 | -0.76 | 0.45 |
| Pct. of FH with Children | 0.0097 | 0.0062 | 1.57 | 0.12 |
| **Med. Property Val. ($10,000)** | **0.0154** | **0.0089** | **1.72** | **0.09** |
| Med. Rent ($100) | 0.0066 | 0.0186 | 0.36 | 0.72 |
| **Med. Income ($10,000)** | **-0.1096** | **0.0382** | **-2.87** | **0.00** |
| Pct. of Poverty | -0.0038 | 0.0045 | -0.83 | 0.41 |
| Pct. of Unemployed | -0.0066 | 0.0060 | -1.10 | 0.27 |
| **No. of Jobs (WAC)** | **0.0000** | **0.0000** | **2.18** | **0.03** |
| Pct. of Dropout | -0.0020 | 0.0026 | -0.77 | 0.44 |
| **Pct. of Bachelors** | **-0.0094** | **0.0045** | **-2.08** | **0.04** |
| No. Bus Stops | 0.0042 | 0.0069 | 0.60 | 0.55 |
| **No. LRT Stations** | **-0.5791** | **0.2118** | **-2.73** | **0.01** |
| Bikeways (ft) | 0.0000 | 0.0000 | -0.32 | 0.75 |
| Park (acre) | 0.0001 | 0.0001 | 0.43 | 0.67 |
| **Intercept** | **0.9129** | **0.3932** | **2.32** | **0.02** |
| Dependent Variable: Log (# of HCV households in a Block Group)<br>Universe: Block groups where at least one HCV unit is present<br>N = 879<br>R-squared = .3691<br>Adj R-squared = .3544 | | | | |

## 7.2 Count Outcome Regression Analysis

Poisson regression analysis and negative binomial regression analysis were conducted for the further analyses. The OLS regressions are frequently used because of their convenience in interpreting OLS regression analysis results. However, count outcome regression analyses, such as Poisson regression analysis or negative binomial regression analysis, are preferred by analysts when the dependent variable of research models is countable, as general OLS regression models may mislead the results. Poisson regression is used for models with a dependent variable which is the number of

occurrences or counts of an event. Negative binomial regression is used for models with a dependent variable which is a nonnegative-count variable, which is similar to Poisson regression, though with an extra variation, namely over-dispersion in the dependent variable, which is greater than the variation of a true Poisson (StataCorp., 2015).

In this research, the dependent variable is the number of HCV households in a census block group, which is a countable outcome. The number of HCV households in the census block group cannot be a negative number and is always larger than or equal to zero. In this sense, the associations of the dependent variable with the independent variables that were used in the OLS regression analyses can be measured using Poisson regression models or negative binomial regression models.

The first measurement regards whether the dependent variable is Poisson distribution. Figure 34 shows that the distribution of the observed number of HCV households is similar to Poisson distribution after 25. The original datasets in Figure 34 have a similar curve to that of the Poisson distribution after 25, and a similar trend was truncated after 30 for brevity. However, there is a different distribution when the two curves are compared at the numbers below 25. This is problematic because the frequency of census block groups below 25 are high, as the cut-points for the quartiles were 15.5 at the 75th percentile, 6 at the 50th percentile, and 2 at the $25^{th}$ percentile, based on the basic statistics of the HCV households, which were demonstrated in chapter 6 (see Table 14).

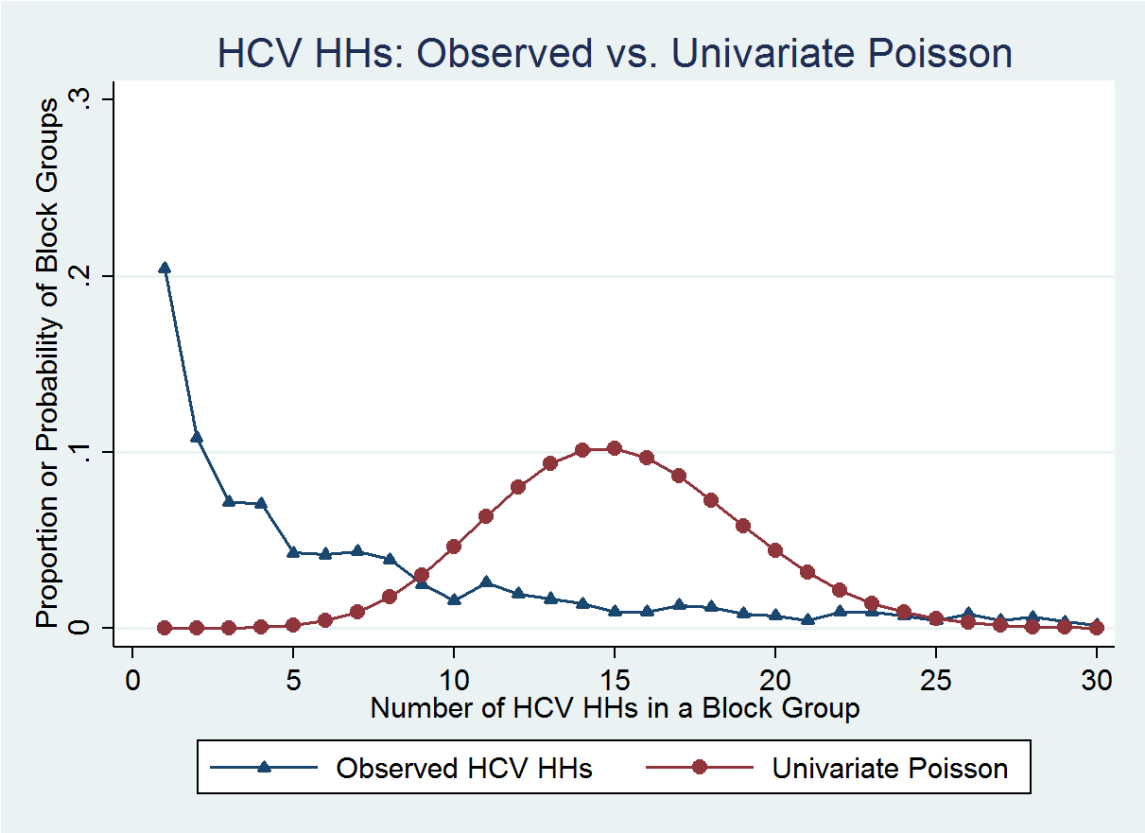


**Figure 34. Poisson Distribution**

Note: The chart is truncated where the number of HCV households in a block group is 30 for brevity.

Although it is difficult to determine whether the dependent variable is perfectly and theoretically Poisson-distributed, the dependent variable can be better explained if the associated independent variables are employed in a statistical regression model form. Therefore, Poisson regression models were conducted. However, this research model can be potentially moved to the next stage (negative binomial regression analysis) if there is over-dispersion in the dependent variable and if the coefficients of the individual variables in the two models (Poisson regression analysis and negative binomial analysis) are different. For now, in the Poisson regression analysis, the unit of analysis is still

census block groups, and the observations are included only when the number of HCV households is equal to or larger than one household in a census block group.

Many variables are statistically significant at the .05 level. The percentages of non-Hispanic Black (*P_NHB*), the number of households (*HHs*), the percentage of renters (*P_Renters*), the percentage of female-headed households with children (*P_FHWC*), median property value (*MED_PRPVAL*), and work opportunities (*WAC*) are all positively associated with the dependent variable, or the number of HCV households at the block group level and are statistically significant at the .5 level.

The percentage of people younger than 17 (*P_017*), people older than 65 (*P_65*), the percentage of female householders (*P_FHHders*), median income (*MED_INCOME*), the percentage of unemployment (*P_UNEMP*), the percentage of high-school dropout (*P_DROPOUT*), the percentage of high education (*P_BCHLRS*), and the number of LRT stations (*LRTSt*) are all negatively associated with the dependent variable, or the number of HCV households at the block group level and are statistically significant at up to the .1 level.

However, the Deviance goodness-of-fit and the Pearson goodness-of-fit explain that there is over-dispersion in the model. Although the individual independent variables and the statistical significance are good, it appears necessary to test the research model with a negative binomial regression analysis in the next step.

**Table 29. Poisson Regression Model**

| Variables | b | z | P>z | e^b | e^bStdX | SDofX |
|---|---|---|---|---|---|---|
| **Pct. of NH-Black** | **0.020** | **45.417** | **0.000** | **1.021** | **1.722** | **26.702** |
| **Pct. of Ppl. aged under 17** | **-0.003** | **-1.883** | **0.060** | **0.997** | **0.975** | **8.060** |
| **Pct. of Ppl. aged over 65** | **-0.004** | **-2.049** | **0.040** | **0.996** | **0.977** | **5.766** |
| **Households** | **0.001** | **52.332** | **0.000** | **1.001** | **1.490** | **538.633** |
| **Pct. of Renters** | **0.007** | **12.683** | **0.000** | **1.007** | **1.192** | **23.597** |
| Pct. of Ppl. living alone | 0.000 | -0.231 | 0.817 | 1.000 | 0.997 | 13.539 |
| **Pct. of Female Householders** | **-0.002** | **-2.116** | **0.034** | **0.998** | **0.975** | **11.881** |
| **Pct. of FH with Children** | **0.014** | **9.225** | **0.000** | **1.014** | **1.130** | **8.895** |
| **Med. Property Val. ($10,000)** | **0.031** | **13.833** | **0.000** | **1.031** | **1.221** | **6.536** |
| Med. Rent ($100) | 0.007 | 1.300 | 0.193 | 1.007 | 1.020 | 2.929 |
| **Med. Income ($10,000)** | **-0.157** | **-14.212** | **0.000** | **0.855** | **0.719** | **2.107** |
| Pct. of Poverty | 0.000 | -0.130 | 0.897 | 1.000 | 0.998 | 13.572 |
| **Pct. of Unemployed** | **-0.008** | **-6.054** | **0.000** | **0.992** | **0.944** | **7.370** |
| **No. of Jobs (WAC)** | **0.000** | **25.997** | **0.000** | **1.000** | **1.151** | **1887.148** |
| **Pct. of Dropout** | **-0.006** | **-7.990** | **0.000** | **0.995** | **0.924** | **14.411** |
| **Pct. of Bachelors** | **-0.010** | **-8.161** | **0.000** | **0.990** | **0.857** | **15.454** |
| No. Bus Stops | -0.002 | -1.157 | 0.247 | 0.998 | 0.988 | 6.463 |
| **No. LRT Stations** | **-0.753** | **-12.699** | **0.000** | **0.471** | **0.871** | **0.183** |
| Bikeways (ft) | 0.000 | -0.493 | 0.622 | 1.000 | 0.996 | 3618.467 |
| Park (acre) | 0.000 | -0.522 | 0.602 | 1.000 | 0.995 | 294.852 |
| **Intercept** | **1.487** | **14.122** | **0.000** | **.** | **.** | **.** |

Dependent Variable: # of HCV households in a Block Group
Universe: Block groups where at least one HCV unit is present
N = 879
Log Likelihood = -7884.9271
Pseudo R2 = .3856

b = raw coefficient
z = z-score for test of b=0
P>|z| = p-value for z-test
e^b = exp(b) = factor change in expected count for unit increase in X
e^bStdX = exp(b*SD of X) = change in expected count for SD increase in X
SDofX = standard deviation of X

* Poisson Goodness of Fit
- Deviance goodness-of-fit = 12512.78; Prob. > chi2(222) = 0.0000
- Pearson goodness-of-fit = 17418.62; Prob. > chi2(222) = 0.0000

Based on the Poisson regression model presented in Table 29, the expected distribution of the dependent variable lies far closer to the original numbers of the observed HCV households (see Figure 35). The Poisson regression model offers good explanation after approximately 20. However, the observed and Poisson regression models continue to have a discrepancy between the two curves (see the triangle curve for the original datasets and the hollow circle curve for the Poisson regression model).

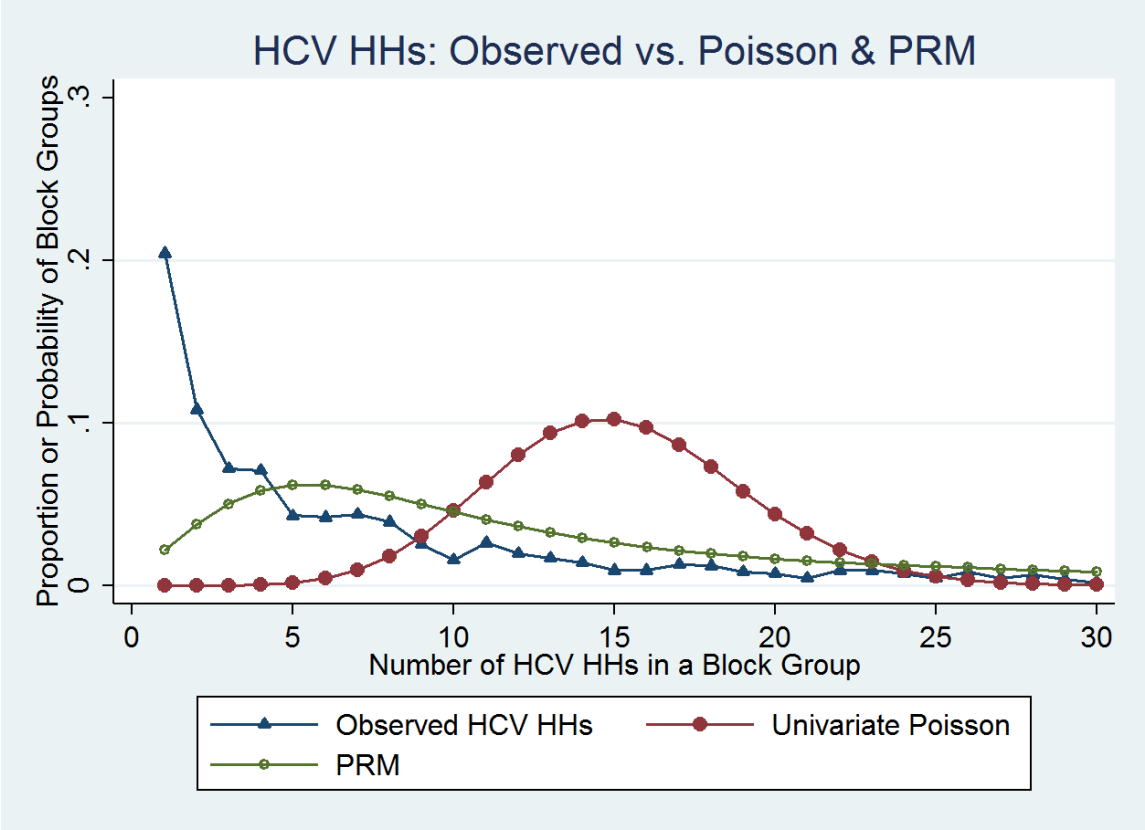


**Figure 35. Poisson Regression Model (PRM) Distribution**

Note: The chart is truncated where the number of HCV households in a block group is 30 for brevity.

The results of the negative binomial regression analysis lost some statistical significance from several individual variables, as summarized in Table 30. However, the Likelihood-Ratio (LR) test indicates that it is more reasonable to use the negative binomial analysis than Poisson regression models.

The percentage of non-Hispanic Black (*P_NHB*), household numbers (*HHs*), the percentage of renters (*P_Renters*), median property value (*MED_PRPVAL*), and work opportunities (*WAC*) are all positively associated with the dependent variable, or the number of HCV households, at the block group level. These variables are statistically significant up to the .1 level. The percentage of female-headed households with children (*P_FHWC*) lost statistical significance, which lies slightly outside of the .01 level.

The percentage of female householders (*P_FHHders*), median income (*MED_INCOME*), the percentage of high school dropout (*P_DROPOUT*), the percentage of high education (*P_BCHLRS*), and the number of LRT stations (*LRTSt*) are all negatively associated with the dependent variable, or the number of HCV households, at the block group level. These variables are statistically significant up to the .1 level. The percentage of people younger than 17 (*P_017*) and older than 65 (*P_65*), and the percentage of unemployment (*P_UNEMP*) lost statistical significance and lie outside of the .01 level.

**Table 30. Negative Binomial Regression Model**

| Variables | b | z | P>z | e^b | e^bStdX | SDofX |
|---|---|---|---|---|---|---|
| **Pct. of NH-Black** | **0.022** | **11.982** | **0.000** | **1.022** | **1.779** | **26.702** |
| Pct. of Ppl. aged under 17 | 0.004 | 0.670 | 0.503 | 1.004 | 1.034 | 8.060 |
| Pct. of Ppl. aged over 65 | 0.004 | 0.536 | 0.592 | 1.004 | 1.023 | 5.766 |
| **Households** | **0.001** | **9.316** | **0.000** | **1.001** | **1.499** | **538.633** |
| **Pct. of Renters** | **0.004** | **1.741** | **0.082** | **1.004** | **1.101** | **23.597** |
| Pct. of Ppl. living alone | 0.002 | 0.474 | 0.636 | 1.002 | 1.026 | 13.539 |
| **Pct. of Female Householders** | **-0.007** | **-1.844** | **0.065** | **0.993** | **0.920** | **11.881** |
| Pct. of FH with Children | 0.009 | 1.510 | 0.131 | 1.009 | 1.083 | 8.895 |
| **Med. Property Val. ($10,000)** | **0.028** | **3.221** | **0.001** | **1.029** | **1.202** | **6.536** |
| Med. Rent ($100) | 0.026 | 1.461 | 0.144 | 1.026 | 1.078 | 2.929 |
| **Med. Income ($10,000)** | **-0.165** | **-4.310** | **0.000** | **0.848** | **0.707** | **2.107** |
| Pct. of Poverty | 0.003 | 0.727 | 0.467 | 1.003 | 1.045 | 13.572 |
| Pct. of Unemployed | -0.006 | -1.100 | 0.271 | 0.994 | 0.954 | 7.370 |
| **No. of Jobs (WAC)** | **0.000** | **3.610** | **0.000** | **1.000** | **1.158** | **1887.148** |
| **Pct. of Dropout** | **-0.006** | **-2.303** | **0.021** | **0.994** | **0.921** | **14.411** |
| **Pct. of Bachelors** | **-0.008** | **-1.884** | **0.059** | **0.992** | **0.885** | **15.454** |
| No. Bus Stops | 0.000 | 0.036 | 0.971 | 1.000 | 1.002 | 6.463 |
| **No. LRT Stations** | **-0.899** | **-4.156** | **0.000** | **0.407** | **0.848** | **0.183** |
| Bikeways (ft) | 0.000 | -0.607 | 0.544 | 1.000 | 0.978 | 3618.467 |
| Park (acre) | 0.000 | -0.502 | 0.616 | 1.000 | 0.979 | 294.852 |
| **Intercept** | **1.344** | **3.755** | **0.000** | **.** | **.** | **.** |

Dependent Variable: # of HCV households in a Block Group
Universe: Block groups where at least one HCV unit is present
N = 879
Log Likelihood = -3028.8112
Pseudo R2 = .0714

Ln alpha is -0.0800; alpha is 0.9231.
LR test of alpha=0: 9712.23 Prob.>=LRX2 = 0.000

b = raw coefficient
z = z-score for test of b=0
P>|z| = p-value for z-test
e^b = exp(b) = factor change in expected count for unit increase in X
e^bStdX = exp(b*SD of X) = change in expected count for SD increase in X
SDofX = standard deviation of X

The truncated chart in Figure 36, in which the number of HCV households is equal to or lower than 30, shows that the expected distribution from the negative binomial regression model most precisely explains the originally observed HCV numbers. Although the negative binomial regression model does not always perfectly explain the numbers of original HCV households in block groups, especially if the numbers of HCV households are 1, 2, 4, and 10, it may explain the overall figure more accurately than the univariate Poisson model and the Poisson regression model.

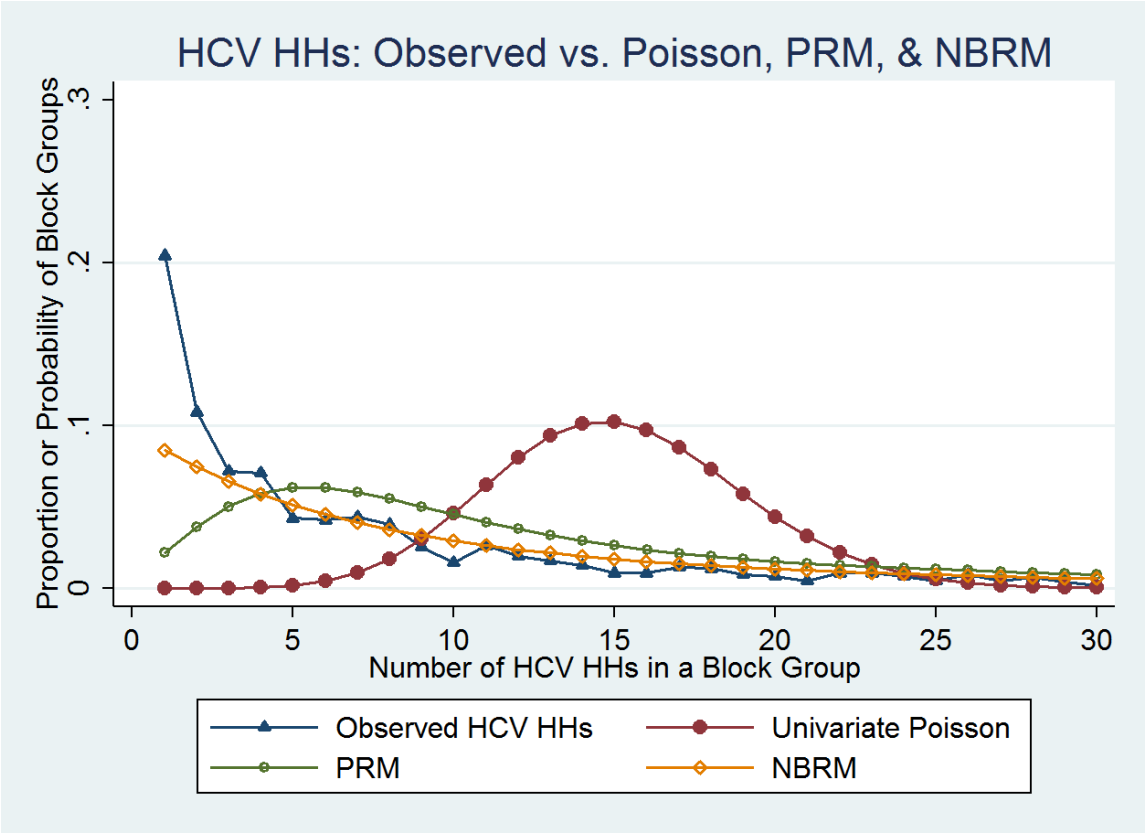


**Figure 36. Negative Binomial Regression Model (NBRM) Distribution**

Note: The chart is truncated where the number of HCV households in a block group is 30 for brevity.

## 7.3 Summary: Regression Analysis

This chapter on statistical analysis employs four different types of regression models: the OLS level-level model (in Appendix A), the OLS log-level model, the Poisson regression model, and the negative binomial regression model. The dependent variable of the four models is the number of HCV households in Harris County's census block groups with at least one HCV recipient within their boundary. The number of observations in the four models is 879. The four models explain the associations of neighborhood characteristics with the number of HCV households. The negative binomial analysis explains the variance in the dependent variable most accurately, followed by the Poisson, OLS log-level, and OLS level-level models.

Firstly, the OLS level-level model reveals many significant neighborhood characteristics, such as higher non-Hispanic Black percentages, more household numbers, more renters, and more job opportunities, which are positively associated with the number of HCV households. This first model, which is attached in the appendix, has the advantage of a simple interpretation of coefficients.

Secondly, the OLS log-level model is employed as the dependent variable has a high level of skewness. Although this second model reports results for the independent variables that are similar to those of the first model regarding statistical significance and the sign of the coefficients, its overall model-fit is 8.4% greater than that of the first model. The second OLS model with the logarithm demonstrates a better result than the first OLS model with the linear regression.

The Poisson regression model is introduced given that the dependent variable is countable without any negative values. The third Poisson model improves the overall model fit and confirms many statistically significant independent variables. However, due to over-dispersion in the dependent variable, this research adopts the negative-binomial regression model as its final model. The negative binomial regression model explains the overall research most precisely, so that the final model turns out to be the best regression model among the four models that are employed in this research.

# CHAPTER VIII

# CONCLUSION

## 8.1 Results

### *8.1.1 Criteria and HCV Households*

The amount of FMRs increased between 1983 and 2015. The increase in FMRs entails higher maximum-rent-limit standards, which may help voucher tenants to have greater possibilities of obtaining a decent rental unit. However, regarding the annual growth rate of FMRs, a fluctuation has taken place. The growth rates even recorded below-zero levels in certain years, such as 1989, 2005, and 2015. The negative annual growth rates of FMRs created problems for voucher households in the past and also made the rental market unpredictable, causing HCV users to become unsure about their future subsidy and feel concerned about their plans for the next moving-in unit.

The FMR percentile fluctuated in the program's history. It was the 45th percentile and dropped to the 40th percentile, then soared to the 50th percentile, and recently dropped back to the 40th percentile. Under the assumption that HUD's HCV subsidy operates with the same budget, an increasing percentile entails more subsidy to individual households but help to a lower number of voucher recipients, while a decreasing percentile represents less aid to individual households but a greater number of voucher beneficiaries. In this sense, the FMR-percentile threshold should be adjusted

carefully and changed moderately after careful consideration of the private rental market and HUD's target renters.

The ILs have also generally increased in the voucher program's history. The ILs of the 80% low-income group and the 50% very low-income group were set in 1991, and the IL of the 30% extremely low-income group was established in 1999. Even though the ILs of these three groups increased as the MFI increased, which is the primary determinant of the IL criteria, the annual growth rates of the ILs and the MFI were not always aligned. The IL standards needed some adjustments in the past, when there was a negative growth rate in MFI. HUD maintained a level of ILs similar to that of previous years in order to prevent renters with the same household income as their past year's income from being categorized into a higher-income level group, for instance from the extremely low-income group to the very low-income group or from the very low-income group to the low-income group. As local public housing agencies must accommodate at least 75% of their recipients from the extremely low-income household group, the ILs are a sensitive issue.

When the median gross rents and the median incomes in block groups are compared to the standard of the two-bedroom FMR and the four-person low-income group IL in order to determine where the current HCV households reside, the findings were as follows. Firstly, most HCV residents live in census block groups where the median gross rents are lower than the FMR standard. Secondly, and similarly but more apparently, the HCV program households are clustered with existing low-income households where the median income of the block group is lower than the standard of

the IL for the 80% low-income households. In summary, both criteria (FMRs and ILs) limit HCV recipients' locational choice to certain block groups in which HCV tenants can easily define themselves as similar to their neighbors, in low rental cost areas with many low-income households. This is a frustrating result given that the largest tenant-based subsidy program may be capable of providing its tenants with locational freedom on the private market, unlike project-based affordable housing programs such as Public Housing, LIHTC, and others. The HCV program should have ensured its tenants' freedom in choosing a decent unit anywhere within the private rental market.

### *8.1.2 Statistical Results: Comparison Analysis*

Mean comparison T-tests show differences between HCV tenants and other renter groups. The T-tests for mean comparisons in neighborhood quality variables were performed among the block groups over the top 75th (the highest quartile) and 50th (above-median) percentiles. These percentiles were computed after dropping missing or zero-renter block groups. Additionally, for the main comparison test, which is between HCV and HCVW, this research includes the individual household-level test.

Firstly, HCV and HCVW groups in the highest quartile block groups have similar neighborhood characteristics, with the exception of the senior proportion variable, which shows a minimal difference. The top 50th percentile comparison analysis reveals more neighborhood quality variables with differences between the HCV and HCVW residents that are statistically significant: lower non-Hispanic White, higher non-Hispanic Black, lower non-Hispanic Others, and lower Hispanic percentages, a higher

percentage of senior citizens, higher percentages of female-headed households and those with children, a lower level of median property value, a lower median income level, a higher percentage of unemployment, and a lower percentage of higher education. However, these differences are relatively minimal compared to HCV-LIHTC and HCV-GR in the above-50th-percentile block groups.

The comparisons between the HCV and HCVW groups suggest that households on the HCV program's waitlist would not significantly change the conditions of their place of residence after becoming voucher recipients in the future as a result of their receipt of the voucher subsidy only. It is also likely that current HCV tenants find their current rental unit within types of neighborhoods that are similar to those where they lived prior to voucher subsidy.

The HCV program did not significantly change the neighborhood quality for HCV recipients. However, the HCV program still benefits the participants as their disposable income increases. They would have had less flexibility with their income if they had chosen a similar rental unit with the same quality but without the subsidy. Another implication is that other socio-economic factors (stability, proximity to jobs, mental attachment to the community, children's education, friends, etc.) may influence their neighborhood choices more significantly. These factors are far beyond the capacity that the HCV program can control, and the HCV program alone would not be strong enough to prompt participants to upgrade their neighborhood quality. In addition, voucher holders may prioritize these factors in their current neighborhood more than the benefits that they can potentially achieve by simply moving to another neighborhood.

Another implication is that many low-income households, including extremely low-income households, do not prioritize neighborhood quality as their most urgent need. Additionally, one potential of the HCV program is that voucher holders may want to find somewhat different neighborhood styles based on the analyses, in which the research scope was expanded to the top 50th percentile or the individual household level. These 50th percentile and individual household level analyses found some discrepancy in neighborhood characteristics between the groups with and without subsidy.

Secondly, the comparison of the neighborhoods between HCV and LIHTC shows certain different characteristics. From the highest quartile block group comparison, HCV tenants are more likely to live in block groups that feature the following characteristics: a higher percentage of non-Hispanic Blacks, a lower percentage of renters, a lower percentage of poverty values, and a higher percentage of people holding a bachelor's degree or higher. This result implies that the HCV program households look for better environments due to the voucher subsidy, which gives them more flexibility in choosing their rental unit and neighborhood. On the other hand, the LIHTC renters moved into predetermined development places, thereby providing limited opportunities for residential areas to prospective residents.

Thirdly, the neighborhood quality comparison between HCV and GR shows very different pictures in both the highest quartile and the above-median block groups. Particularly, from the highest quartile block group mean T-test, the HCV program households slightly preferred their unit in neighborhoods where population and households were highly dense and where median rents were higher, mostly due to the

advantage of the subsidy. However, they preferred neighborhoods where the block group's median income was lower, as many low-income HCV tenants found their residential location within neighborhoods with many residents who, similar to themselves, were at the lower-income level.

Though HCV tenants were not significantly better off than HCVW residents, their residential-location selection differs from that of LIHTC residents. The main reason for this is that HCV is available to any places on the private rental market, while LIHTC developments are limited to certain places, partly due to the fact that developers designate their development sites beforehand, so that LIHTC tenants have limited options for neighborhood locations. Furthermore, HCV tenants manifested very different choices than GRs. The voucher tenants live in higher median-rent places with a higher percentage of non-Hispanic Blacks.

### *8.1.3 Statistical Results: Regression Analysis*

The regression analyses were conducted with the following four models: the OLS level-level model, the OLS log-level model, the Poisson regression model, and the negative binomial regression model. The OLS models are basic statistical models and widely used. The first model, or the OLS level-level model that is summarized in the appendix, identifies that a greater number of non-Hispanic Blacks, households, renters, female-headed households with children, higher property values, and more job opportunities were all positively associated with the number of HCV households.

However, a higher education level and accessibility to LRT stations were both negatively associated with the number of HCV households.

The second model, or the OLS log-level model, produces far stronger results regarding the overall model fit. Individual independent variables are similar to the previous model, but the second model also demonstrates that a higher income level and the number of HCV households were negatively associated. Although the statistical significance of the renter variable and the female-headed households with children variable became weaker, so that the two variables were no longer at the .1 level, the two variables' significance levels still lie close to .1. Moreover, the overall model fit, which improved in the second model, and the result from the box-cox test lead to the conclusion that it is more appropriate to use the semi-log model than the level-level model.

Some more individual variables became significant in the count outcome regression models: the Poisson regression analysis and the negative binomial regression analysis. Especially in the Poisson regression model, the age variables (younger than 17 and older than 65) were negatively associated with the number of HCV households. Additionally, more female householders, high unemployment rates, and high dropout rates were all negatively associated with the number of the HCV households.

Finally, the negative binomial regression analysis reports more meaningful figures, which confirms the advantages of employing this analysis over the Poisson regression analysis. The reason for this is that the dependent variable, or the number of HCV households in block groups, has over-dispersion at the statistically significant

level, which leads to the preference for the negative binomial regression analysis over the Poisson regression analysis. The expected outcome chart that demonstrates comparisons between the original data and the estimates from both models (the Poisson regression analysis and the negative binomial analysis) also shows that the negative binomial regression can produce a more precise result (see Figure 36).

## 8.2 Limitations and Recommendations

### *8.2.1 Limitations and Further Research*

This research was conducted using cross-sectional datasets. The comparisons between the HCV and HCVW groups can be more precise in tracing individual tenants at two different points in time. Specifically, based on the datasets of the characteristics of neighborhoods in which voucher holders live before and after the subsidy, this research would produce more accurate answers regarding whether voucher recipients truly made changes in neighborhood opportunities as a result of their receipt of the HCV subsidy.

This research accomplishes its goal by the provision of the HHA's local dataset. It is precise and accurate within the boundary of the City of Houston. However, given the fact that many low-income families are in desperate conditions waiting to receive housing subsidy and therefore apply to many other housing authorities, some HCV households in the City of Houston may not be included in this analysis. Moreover, households that lie outside of the City of Houston but inside of Harris County are not

accurately captured in the analysis chapters. This issue is the data limitation, and this research would be able to produce better results if the complete data collection were fulfilled from all of the local housing authorities in Harris County.

Individual HCV household surveys are an alternative for future research. Qualitative interviews by which to sample voucher recipients would lead to concrete conclusions in addition to current statistical analyses. Finding reasons for moving into current neighborhoods as opposed to previous residence areas or reasons for staying in current neighborhoods and not moving to other neighborhoods contributes to the vital importance in helping to understand why and how well the voucher program works in offering neighborhood opportunities to its recipients. Which priorities and preferences voucher recipients had in choosing a neighborhood may be significantly different from those of GRs. Thus, future in-depth surveys among current HCV recipients posing direct questions and gathering household information would make substantial progress in the quality of the future HCV program and for prospective program recipients who are currently on the waitlist.

### *8.2.2 Policy Recommendations*

This research results help urban planners, public policy makers, federal and local housing agency researchers, and citizens to understand the HCV program and its influence on neighborhood opportunities. The program's criteria restrict HCV tenants to areas with a low-level income and rent. The voucher program recipients do not reside in radically different locations from those where program waitlist households live.

Planners can help to create environments that include more diverse places such as mixed-income neighborhoods and racial/ethnic diverse communities. New Urbanism and Smart Growth explain that these types of neighborhoods are desirable to sustain and that HCV tenants may benefit from affluent neighborhood amenities in these neighborhoods. Mixed-neighborhoods can stimulate sustainable economic growth at the city and regional levels (Talen, 2010a; Leccese & McCormick, 2000; the United States Environmental Protection Agency, 2013). In order to increase the equity among city residents, urban planners must help housing policymakers to adjust the criteria of the program for smaller geographic areas. Additionally, urban planners need to give practical incentives to HCV tenants when they move into neighborhoods with more opportunities in order to fulfill HUD's goal of avoiding the concentration of minorities in some locations.

The FMRs and ILs for the entire county are not highly practical. Each neighborhood has a different level of rents and incomes. Users of HCV are clustered in certain areas with low rental costs in order to avoid extra payment, as well as in neighborhoods in which they may define themselves as very similar to other residents, rather than looking for different types of communities that can provide more opportunities through neighborhood amenities. A flexible administration strategy for FMRs and ILs at a smaller level, such as census tract or block group levels, would accelerate the disaggregation of HCV residents. This would make it possible for HCV residents to benefit from neighborhood quality and amenities in different places, and cities could provide a higher level of equity among their citizens. Overall, FMRs and ILs

should be more flexible based on neighborhood conditions (e.g., rental-market rates and poverty levels) in order to offer more realistic options to potential HCV tenants and to prevent racial/ethnic segregation.

The HCV program has almost four decades of history. Many extremely low-income households have been waiting for voucher subsidy for a long time. In reality, most low-income households suffer from the housing burden while they are waitlisted. Some housing authorities have closed the application for several years due to the limited budget. The long waiting time may frustrate many low-income households that are not even on the waitlist. The national data on 2016 HCV recipients (HUD, 2017a) show that current voucher holders waited for an average of 30 months to become beneficiaries. Even after subsidy receipt, these households have a very limited amount of time to find a rental unit. Thus, many HCV users select a housing unit within neighborhoods to which they are mentally attached. Other HCV recipients find neighborhoods that are generally very similar to those of their status quo, which gives them comfort.

Another recommendation is that increase in flexibility in the HCV program's funding can produce more realistic remedies to individual households after considering the local demand for affordable housing units and neighborhoods' income levels. The program can incentivize households that achieve the goal of moving into amenity-rich and mixed-income areas, rather than those that stay in the same neighborhood or in a similar one. Additionally, the cooperation among housing authorities within the same metropolitan area, such as data sharing, would provide more precise information to housing researchers, who would be able to evaluate the program in a more accurate way.

REFERENCES

Allmendinger, P. (2009) *Planning Theory*. MacMillan.

American Institute of Certified Planners (2005). *AICP Code of Ethics and Professional Conduct*. Revised On October 3, 2009 from https://www.planning.org/ethics/ethicscode.htm

American Planning Association (2015). *Great places in America: Neighborhoods*. Retrieved from https://www.planning.org/greatplaces/neighborhoods/characteristics.htm

Bacon, L. (2005). Godinez v. Sullivan-Lackey: Creating a Meaningful Choice for Housing Choice Voucher Holders. *DePaul L. Rev.*, 55, 1273.

Basolo, V. (2013). Examining mobility outcomes in the housing choice voucher program: Neighborhood poverty, employment, and public school quality. *Cityscape*, 135-153.

Baum-Snow, N., & Marion, J. (2009). The effects of low income housing tax credit developments on neighborhoods. *Journal of Public Economics*, 93(5), 654-666.

Buron, L., Levy, D., & Gallagher, M. (2007). Housing choice vouchers: How HOPE VI families fared in the private market. HOPE VI: Where Do we Go from Here? Brief 3. Washington, DC: The Urban Institute.

Charles, C. Z. (2003). The dynamics of racial residential segregation. *Annual Review of Sociology*, 167-207.

Congress for the New Urbanism (2001). *Charter of the New Urbanism*. Available at http://www.cnu.org/sites/www.cnu.org/files/charter_english1.pdf (accessed Oct. 17, 2014)

Cortright, J. (2009). Walking the walk: How walkability raises home values in U.S. cities. Washington, DC: *CEOs For Cities*.

Dawkins, C. (2013). The Spatial Pattern of Low Income Housing Tax Credit Properties: Implications for Fair Housing and Poverty Deconcentration Policies. *Journal of the American Planning Association*, 79(3), 222-234.

Deng, L. (2007). Comparing the effects of housing vouchers and low-income housing tax credits on neighborhood integration and school quality. *Journal of Planning Education and Research*, *27*(1), 20-35.

Desmond, M., & Perkins, K. L. (2016). Are Landlords Overcharging Housing Voucher Holders?. *City & Community*, 15(2), 137-162.

Ellen, I. G., and Horn, K. M. (2012) *Do Federally Assisted Households Have Access to High Performing Public Schools*? Rep. Washington, D.C.: PRRAC, 2012.

Ellen, I. G., Schwartz, A. E., Voicu, I., & Schill, M. H. (2007). Does federally subsidized rental housing depress neighborhood property values?. *Journal of Policy Analysis and Management*, *26*(2), 257-280.

Feins, J. D., & Patterson, R. (2005). Geographic Mobility in the Housing Choice Voucher Program: A Study of Families Entering the Program, 1995—2002. *Cityscape*, 21-47.

Freeman, L. (2012). The impact of source of income laws on voucher utilization. *Housing Policy Debate*, 22(2), 297-318.

Freeman, L. (2009). Neighbourhood diversity, metropolitan segregation and gentrification: what are the links in the US?. *Urban Studies*, *46*(10), 2079-2101.

Freeman, L., & Botein, H. (2002). Subsidized housing and neighborhood impacts: A theoretical discussion and review of the evidence. *Journal of Planning Literature*, 16(3), 359-378.

Friedman, S. (2008). Do declines in residential segregation mean stable neighborhood racial integration in metropolitan America? A research note. *Social Science Research*, 37(3), 920-933.

Goetz, E. G. (2011). Where have all the towers gone? The dismantling of public housing in US cities. *Journal of Urban Affairs*, 33(3), 267-287.

Goetz, E. G. (2003). *Clearing the way: Deconcentrating the poor in urban America*. The Urban Institute.

Greenlee, A. J. (2014). More than meets the market? Landlord agency in the Illinois housing choice voucher program. Housing Policy Debate, 24(3), 500-524.

Hollar, M., & Usowski, K. (2007). Low-income housing tax credit qualified census tracts. *Cityscape*, 153-159.

Horn, K. M., Ellen, I. G., & Schwartz, A. E. (2014). Do Housing Choice Voucher holders live near good schools?. *Journal of Housing Economics*, 23, 28-40.

Iceland, J. (2004). The multigroup entropy index (also known as Theil's H or the information theory index). *US Census Bureau. Retrieved July*, *31*, 2006.

Jacobs, J. (1961). *The death and life of great American cities*. Vintage.

Katz, B., Turner, M. A., Brown, K. D., Cunningham, M., & Sawyer, N. (2003). Rethinking local affordable housing strategies: lessons from 70 years of policy and practice. *Washington, DC: The Brookings Institute*.

Kleit, R. G. (2005). HOPE VI new communities: Neighborhood relationships in mixed-income housing. *Environment and Planning A*, 37(8), 1413.

Kleit, R. G. (2001). The role of neighborhood social networks in scattered-site public housing residents' search for jobs. *Housing Policy Debate*, 12(3), 541-573.

Krysan, M., & Farley, R. (2002). The residential preferences of blacks: Do they explain persistent segregation?. *Social Forces*, 80(3), 937-980.

Landis, J. D., & McClure, K. (2010). Rethinking federal housing policy. *Journal of the American Planning Association*, 76(3), 319-348.

Lang, B. J. (2012). Location incentives in the low-income housing tax credit: Are qualified census tracts necessary? *Journal of Housing Economics*, 21(2), 142-150.

Leccese, M., & McCormick, K. (2000). *Charter of the new urbanism*. McGraw-Hill Professional.

Lens, M. C. (2017). Extremely low-income households, housing affordability and the Great Recession. *Urban Studies*.

Lens, M. C., Ellen, I. G., & O'Regan, K. (2011). Do vouchers help low-income households live in safer neighborhoods? Evidence on the housing choice voucher program. *Cityscape*, 135-159.

Livingston, M., Kearns, A., & Bailey, N. (2013). Delivering Mixed Communities: The Relationship between Housing Tenure Mix and Social Mix in England's Neighbourhoods. *Housing Studies*, 28(7), 1056-1080.

Macpherson, D. A., & Sirmans, G. S. (2001). Neighborhood diversity and house-price appreciation. *The Journal of Real Estate Finance and Economics*, *22*(1), 81-97.

Maly, M. T. (2000). The neighborhood diversity index: a complementary measure of racial residential settlement. *Journal of Urban Affairs*, *22*(1), 37-47.

Mast, B. D. (2010). Measuring neighborhood quality with survey data: A Bayesian approach. *Cityscape*, 12(3), 123.

McCarty, M., Perl, L., & Jones, K. (2014). Overview of federal housing assistance programs and policy. *Congressional Research Service Report RL34591. Washington, DC: Congressional Research Service*.

McClure, K., & Johnson, B. (2015). Housing programs fail to deliver on neighborhood

quality, reexamined. *Housing Policy Debate*, 25(3), 463-496.

McClure, K. (2013). Which metropolitan areas work best for poverty deconcentration with Housing Choice Vouchers. *Cityscape*, 15(3), 209-236.

McClure, K. (2010a). The prospects for guiding housing choice voucher households to high-opportunity neighborhoods. *Cityscape*, 101-122.

McClure, K. (2010b). Are low-income housing tax credit developments locating where there is a shortage of affordable units?. *Housing Policy Debate*, 20(2), 153-171.

McClure, K. (2005). Rent burden in the housing choice voucher program. *Cityscape*, 5-20.

Metzger, M. W. (2014) The Reconcentration of Poverty: Patterns of Housing Voucher Use, 2000 to 2008, *Housing Policy Debate*, 24(3), 544-567.

Mumford, L. (1968) *The Urban Prospect*. New York: Harcourt Brace Jovanovich.

Newman, S. J., and Schnare, A. B. (1997). "… and a suitable living environment": The failure of housing programs to deliver on neighborhood quality. *Housing Policy Debate*, 8(4), 703-41.

Nguyen, M. T. (2005). Does affordable housing detrimentally affect property values? A review of the literature. *Journal of Planning Literature*, 20(1), 15-26.

Nyden, P., Maly, M., & Lukehart, J. (1997). The emergence of stable racially and ethnically diverse urban communities: A case study of nine US cities. *Housing Policy Debate*, 8(2), 491-534.

Oakley, D. (2008). Locational Patterns of Low-Income Housing Tax Credit Developments A Sociospatial Analysis of Four Metropolitan Areas. *Urban Affairs Review*, 43(5), 599-628.

O'Regan, K. M., & Horn, K. M. (2013). What Can We Learn About the Low-Income Housing Tax Credit Program by Looking at the Tenants?. *Housing Policy Debate*, 23(3), 597-613.

Quigley, J. (2011). Rental Housing Assistance. *Cityscape*, 13(2).

Quinn, L. M., & Pawasarat, J. (2003). *Racial integration in urban America: A block level analysis of African American and White housing patterns*. Employment and Training Institute, School of Continuing Education, University of Wisconsin-Milwaukee.

Reardon, S. F., & Firebaugh, G. (2002). Measures of multigroup segregation. *Sociological methodology*, 32(1), 33-67.

Schwartz, A. F. (2014). *Housing policy in the United States*. Routledge.

Squires, G. D., & Kubrin, C. E. (2005). Privileged places: Race, uneven development and the geography of opportunity in urban America. *Urban Studies*, 42(1), 47-68.

StataCorp. (2015). *Stata: Release 14*. Statistical Software. College Station, TX: StataCorp LLC.

Talen, E., Menozzi, S., & Schaefer, C. (2015). What is a "great neighborhood"? An analysis of APA's top-rated places. *Journal of the American Planning Association*, 81(2), 121-141.

Talen, E., & Koschinsky, J. (2014). The neighborhood quality of subsidized housing. *Journal of the American Planning Association*, 80(1), 67-82.

Talen, E. (2010a). Affordability in new urbanist development: Principle, practice, and strategy. *Journal of Urban Affairs*, 32(4), 489-510.

Talen, E. (2010b). The context of diversity: a study of six Chicago neighbourhoods. *Urban Studies*, 47(3), 486-513.

Talen, E. (2006). Neighborhood-level social diversity: insights from Chicago. *Journal of the American Planning Association*, *72*(4), 431-446.

Teater, B. (2009). Factors predicting residential mobility among the recipients of the Section 8 housing choice voucher program. *Journal of Sociology & Social Welfare*, 36, 159.

The City of Houston (2014), *The City of Houston Super Neighborhoods*. www.houstontx.gov/superneighborhoods/index.html

The Environmental Systems Research Institute (ESRI), Inc. (2016), *Optimized Hot Spot Analysis Website*. http://desktop.arcgis.com/en/arcmap/10.4/tools/spatial-statistics-toolbox/optimized-hot-spot-analysis.htm

The United States Census Bureau (2016), *American Factfinder Website*, www.census.gov

The United States Department of Housing and Urban Development (HUD) (2017a), *HUD Picture of Subsidized Households Website*. www.huduser.gov/portal/datasets/assthsg.html#2009-2016_query

The United States Department of Housing and Urban Development (HUD) (2017b), *HUD Small Area Fair Market Rents Website*. www.huduser.gov/portal/datasets/fmr/smallarea/index.html

The United States Department of Housing and Urban Development (HUD) (2016a),

*HUD Low-Income Housing Tax Credits Website*. www.huduser.gov/portal/datasets/lihtc.html#data

The United States Department of Housing and Urban Development (HUD) (2016b), Statutorily Mandated Designation of Difficult Development Areas and Qualified Census Tracts for 2017. *Federal Register*, Vol. 81, No. 200. https://www.huduser.gov/portal/Datasets/QCT/QCTDDA2017_Notice.pdf

The United States Department of Housing and Urban Development (HUD) (2015), *HUD Fair Market Rents Website*. www.huduser.gov/portal/datasets/fmr.html#2015

The United States Department of Housing and Urban Development (HUD) (2014a), *HUD Portal Website*. portal.hud.gov/hudportal/HUD

The United States Department of Housing and Urban Development (HUD) (2014b), *HUD Fair Market Rents Website*. www.huduser.gov/portal/datasets/fmr.html#2014

The United States Department of Housing and Urban Development (HUD) (2014c), *HUD Income Limits Website*. www.huduser.gov/portal/datasets/il.html#2014

The United States Department of Housing and Urban Development (HUD) (2007), *Fair Market Rents For The Section 8 Housing Assistance Payments Program*. http://www.huduser.org/portal/datasets/fmr.html

The United States Department of Housing and Urban Development (HUD) (2001a), *Study on Section 8 Voucher Success Rates*. https://www.huduser.gov/publications/pdf/sec8success.pdf

The United States Department of Housing and Urban Development (HUD) (2001b), "Chapter 24: Utilization." In *Housing Choice Voucher Program Guidebook*, available at: https://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/programs/hcv/forms/guidebook

The United States Department of Housing and Urban Development (HUD) (2001c), "Chapter 6: Calculating Rent and Hap Payments." In *Housing Choice Voucher Program Guidebook*, available at: https://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/programs/hcv/forms/guidebook

The United States Environmental Protection Agency (2013), *Smart Growth Principles*. Updated on October 30, 2013 from http://www.epa.gov/smartgrowth/about_sg.htm

Tighe, J. R., Hatch, M. E., & Mead, J. (2017). Source of Income Discrimination and Fair Housing Policy. *Journal of Planning Literature*, 32(1) 3-15.

Tighe, J. R. (2012). How race and class stereotyping shapes attitudes toward affordable housing. *Housing Studies*, 27(7), 962-983.

Turner, M. A. (1998). Moving out of poverty: Expanding mobility and choice through tenant-based housing assistance. *Housing policy debate*, 9(2), 373-394.

Van Zandt, S., & Rohe, W. M. (2006). Do First-Time Home Buyers Improve Their Neighborhood Quality?. *Journal of Urban Affairs*, 28(5), 491-510.

Walter, R. J., Li, Y., & Atherwood, S. (2015). Moving to opportunity? An examination of housing choice vouchers on urban poverty deconcentration in South Florida. *Housing Studies*, 30(7), 1064-1091.

Wang, X., Varady, D., & Wang, Y. (2008). Measuring the deconcentration of housing choice voucher program recipients in eight US metropolitan areas using hot spot analysis. *Cityscape*, 65-90.

Wang, X., & Varady, D. P. (2005). Using hot-spot analysis to study the clustering of section 8 housing voucher families. *Housing Studies*, 20(1), 29-48.

Williamson, A. R., Smith, M. T., & Strambi-Kramer, M. (2009). Housing choice vouchers, the low-income housing tax credit, and the federal poverty deconcentration goal. *Urban Affairs Review*, 45(1), 119-132.

Zeabart, K. L. (2004). Requiring a true choice in housing choice voucher programs. *Ind. LJ*, 79, 767.

APPENDIX A. HCV HHS & GENERAL POPULATION BY RACE/ETHNICITY

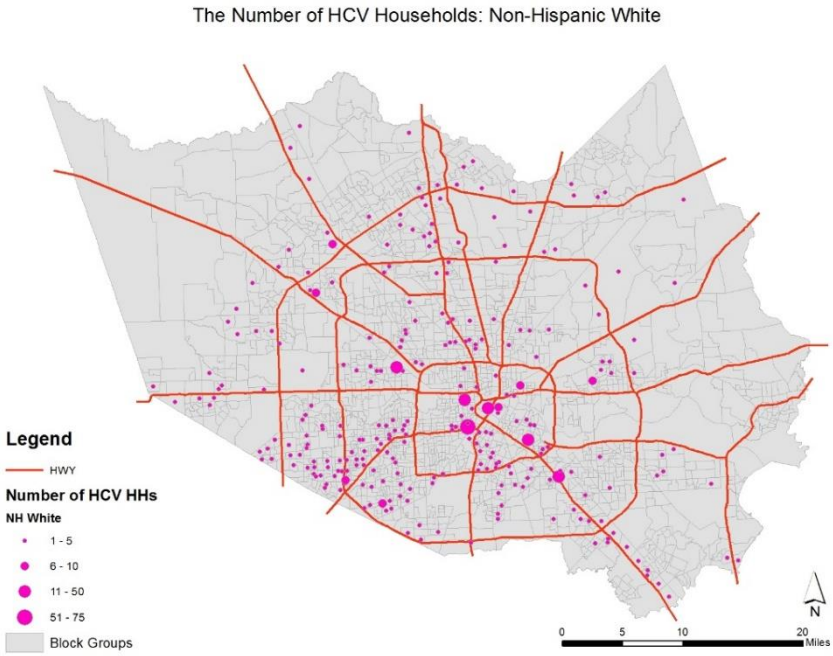


**Figure 37. Non-Hispanic White HCV Household Distribution**

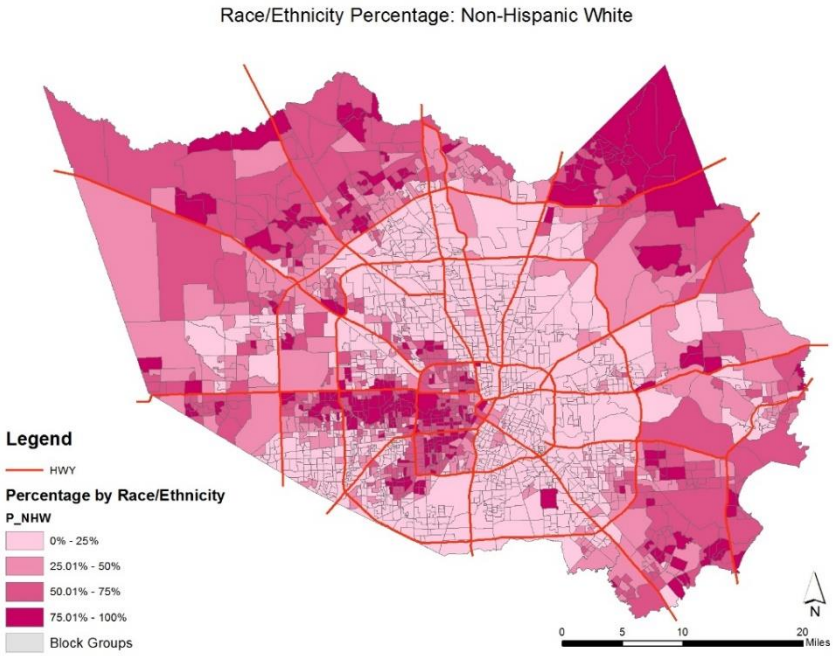


**Figure 38. Non-Hispanic White Population Percentages**

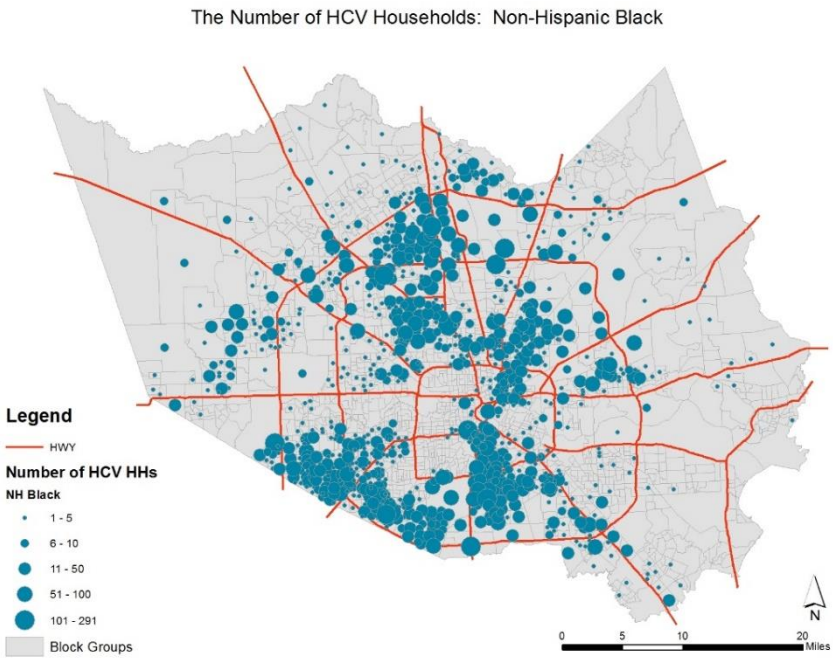


**Figure 39. Non-Hispanic Black HCV Household Distribution**

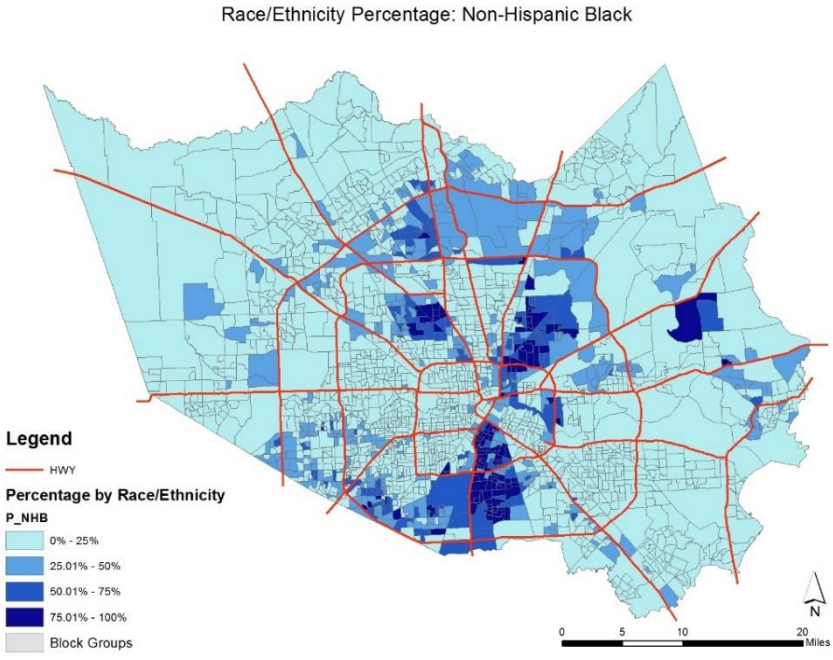


**Figure 40. Non-Hispanic Black Population Percentages**

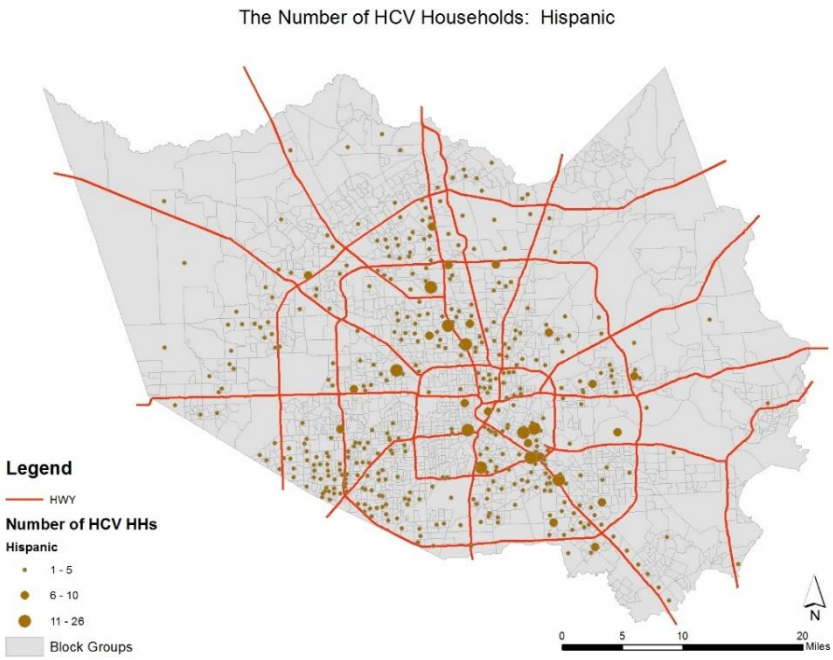


**Figure 41. Hispanic HCV Household Distribution**

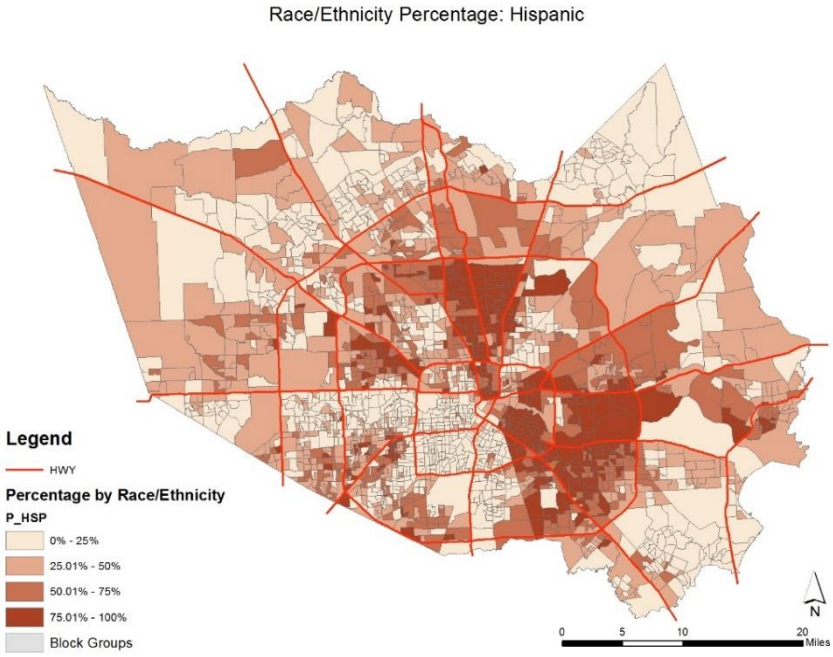


**Figure 42. Hispanic Population Percentages**

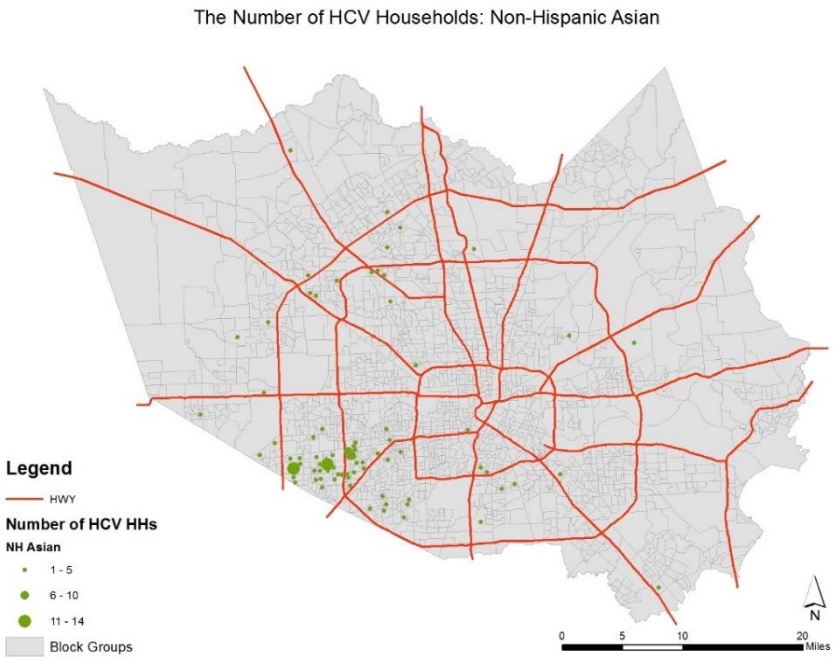


**Figure 43. Non-Hispanic Asian HCV Household Distribution**

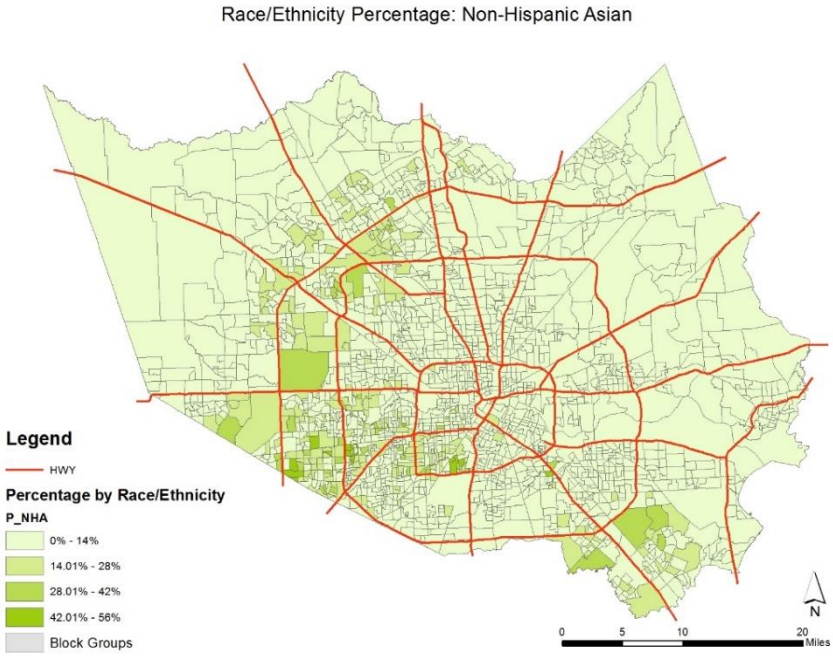


**Figure 44. Non-Hispanic Asian Population Percentages**

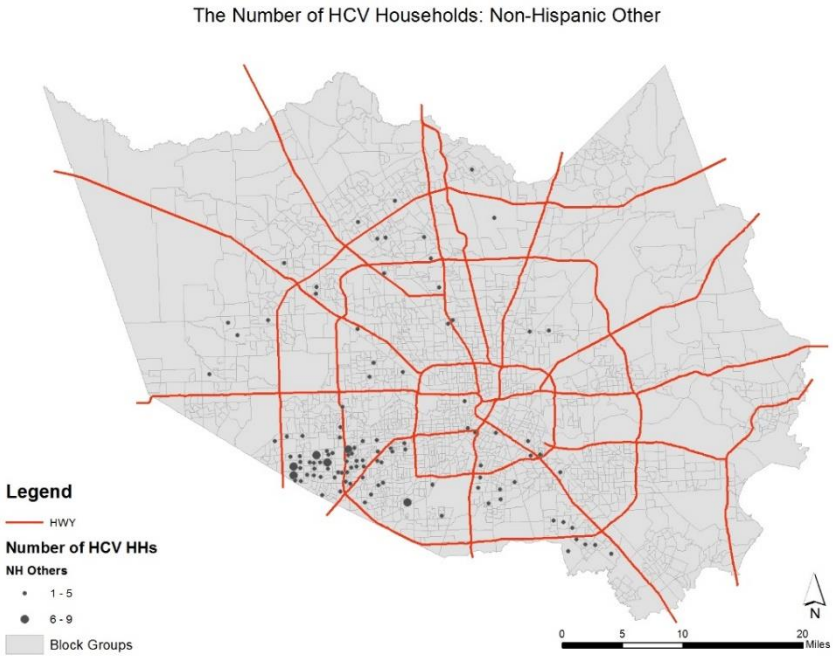


**Figure 45. Non-Hispanic Other HCV Household Distribution**

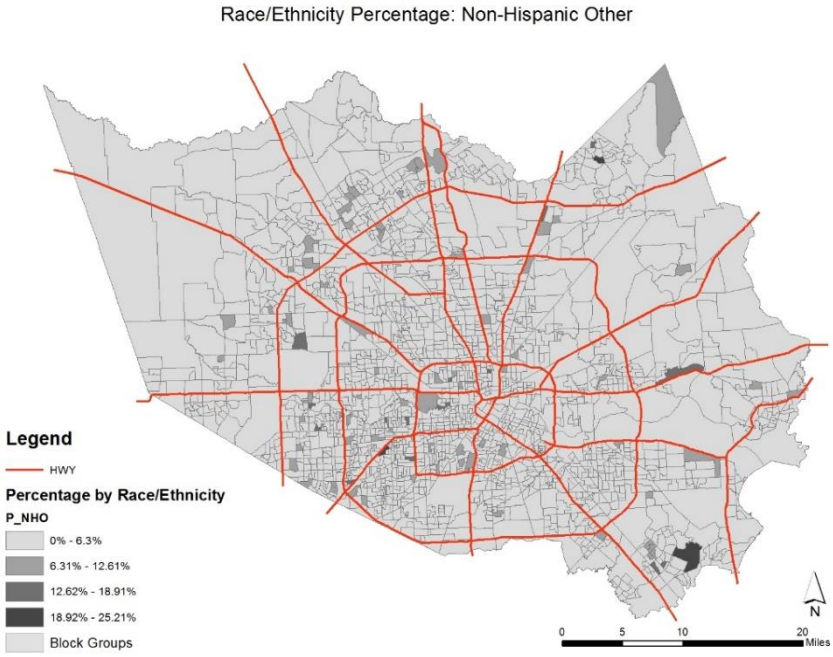


**Figure 46. Non-Hispanic Other Population Percentages**

## APPENDIX B. LEVEL-LEVEL OLS MODEL

The linear OLS regression model results offer some insights into several neighborhood quality variables that were statistically significant at the .05 level. The percentage of non-Hispanic Blacks (*P_NHB*) has a coefficient of .341 at the .01 level, which entails that one percentage point increase in the non-Hispanic Black population in a census block group is associated with an increase of about .341 HCV households in the census block group.

The number of households (*HHs*) is also positively associated with the number of HCV households. The coefficient is .0127. One household increase is associated with about .0127 more HCV households in census block groups, and the coefficient is statistically significant at the .01 level. The number of households (*HHs*) is highly correlated with the population variable (*POP*). Either variable can control the size of a block group. The hypothesis was that the greater number of households or population in a block group, the larger the number of HCV households in that block group. This HHs variable controls the effect of the size of households or the population within each block group, so that the regression analysis can report a pure association that other individual variables have with the dependent variable.

The renter percentage (*P_Renters*) is also positively associated with the number of HCV households. The coefficient is .1112 and statistically significant at the .05 level. One percentage point increase in renter numbers in a block group is associated with about .1112 more HCV households in the block group.

The variable of female-headed households with children (*P_FHWC*) is also positively associated with the number of HCV households. The coefficient is .2854 and statistically significant at the .05 level. One female-headed household with children in a block group is associated with about .2854 more HCV households in the block group.

Median property value (*MED_PRPVAL*) is also positively associated with the number of HCV households. A $10,000 increase in the median property value in a block group is associated with about .5212 more HCV households, and the coefficient is statistically significant at the .01 level.

The employment opportunity (*WAC*) is also positively related to more HCV households at the block group level. The coefficient is .0029 and statistically significant at the .01 level. Specifically, one job-opportunity increase is associated with .0029 more HCV households at the block group level.

High-level education (*P_BCHLRS*) is negatively associated with HCV residents. The coefficient of the percentage of people with an education attainment of a bachelor's degree or higher in a block group is -.1873, meaning that a one-person increase with high education status is associated with about .1873 fewer HCV households at the .05 statistical significance level.

The number of LRT stations (*LRTSt*) in a block group is negatively associated with the number of HCV households in the block group. One LRT station increase is related to about 10.1215 fewer HCV households at the block group level. Voucher recipients live in block groups with limited accessibility to LRT stations. The coefficient is statistically significant at the .05 level.

The overall model fit is .2849 according to the r-squared value and is estimated as .2682 by the adjusted r-squared value. The total number of observations is 879, which means that 879 census block groups in Harris County accommodate one HCV household or more within the block group boundary.

**Table 31. OLS Regression Analysis 1: Level-Level Model**

| Variables | Coef. | Std. Err. | t | P>t |
|---|---|---|---|---|
| **Pct. of NH-Black** | **0.3410** | **0.0393** | **8.68** | **0.00** |
| Pct. of Ppl. aged under 17 | 0.0636 | 0.1392 | 0.46 | 0.65 |
| Pct. of Ppl. aged over 65 | 0.0608 | 0.1703 | 0.36 | 0.72 |
| **Households** | **0.0127** | **0.0017** | **7.60** | **0.00** |
| **Pct. of Renters** | **0.1112** | **0.0514** | **2.17** | **0.03** |
| Pct. of Ppl. living alone | 0.0523 | 0.0866 | 0.60 | 0.55 |
| Pct. of Female Householders | 0.0450 | 0.0827 | 0.54 | 0.59 |
| **Pct. of FH with Children** | **0.2854** | **0.1304** | **2.19** | **0.03** |
| **Med. Property Val. ($10,000)** | **0.5212** | **0.1881** | **2.77** | **0.01** |
| Med. Rent ($100) | 0.1839 | 0.3919 | 0.47 | 0.64 |
| Med. Income ($10,000) | -1.1412 | 0.8051 | -1.42 | 0.16 |
| Pct. of Poverty | 0.0684 | 0.0953 | 0.72 | 0.47 |
| Pct. of Unemployed | -0.0497 | 0.1270 | -0.39 | 0.70 |
| **No. of Jobs (WAC)** | **0.0029** | **0.0004** | **6.41** | **0.00** |
| Pct. of Dropout | -0.0640 | 0.0546 | -1.17 | 0.24 |
| **Pct. of Bachelors** | **-0.1873** | **0.0952** | **-1.97** | **0.05** |
| No. Bus Stops | -0.0231 | 0.1462 | -0.16 | 0.88 |
| **No. LRT Stations** | **-10.1215** | **4.4640** | **-2.27** | **0.02** |
| Bikeways (ft) | -0.0001 | 0.0002 | -0.36 | 0.72 |
| Park (acre) | -0.0035 | 0.0030 | -1.17 | 0.24 |
| **Intercept** | **-20.9814** | **8.2888** | **-2.53** | **0.01** |
| Dependent Variable: # of HCV households in a Block Group<br>Universe: Block groups where at least one HCV unit is present<br>N = 879<br>R-squared = .2849<br>Adj R-squared = .2682 | | | | |