HOUSING ASSISTANCE AND CHILDREN'S EDUCATIONAL ATTAINMENT: A LONGITUDINAL STUDY

By

SARAH GOLD

A dissertation submitted to the

School of Graduate Studies

Rutgers, The State University of New Jersey

In partial fulfillment of the requirements

For the degree of

Doctor of Philosophy

Graduate Program in Social Work

Written under the direction of

Lenna Nepomnyaschy, PhD

And approved by

_____

_____

_____

_____

_____

New Brunswick, New Jersey

May, 2018

ABSTRACT OF THE DISSERTATION

Housing assistance and children's educational attainment: a longitudinal study

by SARAH GOLD

Dissertation Director:

Lenna Nepomnyaschy

Existing research on the effects of housing assistance on high school completion is limited and the pathways between such assistance and high school completion have not been fully explored. The current study uses 39 years of national longitudinal survey data from the Panel Study of Income Dynamics (PSID), the PSID's Assisted Housing Database, and census tract data from the Longitudinal Tract Database to better understand, first, the association between housing assistance and high school completion and, second, the pathways through which this association may operate. All analyses examine both the effects of any housing assistance and these effects by housing assistance type (public housing and vouchers). Pathways analyzed include neighborhood disadvantage, residential stability, housing cost burden, and residential crowding. The current study also explores whether the timing and duration of housing assistance receipt inform the relationship between housing assistance and high school completion. Because of the longitudinal structure of the data, pathways can be examined using both random

and fixed effects models, allowing for comparisons to be made both between and within children.

Results indicate that receiving a voucher at any point during childhood is associated with an increased likelihood of completing high school compared to not receiving any housing assistance. Children who receive a voucher have access to neighborhoods with similar levels of disadvantage as other low-income children whose families do not have housing assistance; they also are less likely to experience residential crowding or housing cost burdens. Children living in public housing reside in more disadvantaged neighborhoods than children without housing assistance but experience increased residential stability and reduced housing cost burden and crowding.

Findings suggest that housing vouchers may be important tools for increasing low-income children's probability of completing high school. Drawing on existing literature, vouchers that are targeted for use in low-poverty neighborhoods and to families with young children may be particularly effective for improving child and family well-being. Because neighborhood disadvantage was the only pathway in which vouchers outperformed public housing, investments in neighborhoods in which public housing is located may also improve children's educational attainment.

Acknowledgements

I would like to thank the Rutgers Schools of Graduate Studies and Social Work and the Teaching Assistance and Graduate Assistant Professional Development Fund for financial support to obtain and be trained on the Panel Study for Income Dynamics (PSID). I would also like to thank the PSID team for their technical support as I worked on my dissertation. Without this funding and technical support, this project would not have been possible.

I am incredibly grateful to all the people who have supported me in so many ways throughout this process. My dissertation committee members, Lenna Nepomnyaschy, Ayse Akincigil, Laura Curran, Keren Horn, and Paul Jargowsky, contributed their time and invaluable insights throughout my dissertation process. I would particularly like to thank Lenna Nepomnyaschy, my mentor and dissertation chair, for her constant support as she pushed me to become a better scholar and teacher, and the countless hours she spent discussing and providing feedback on my work and coaching me through the doctoral program.

I would like to thank all my friends and colleagues at Rutgers, in Lambertville, and beyond for their support. Kate held me accountable to my goals these past few years; Jenn saved me months and months of frustration by helping me with census tract data; Sangeeta, Emily, Laura, Kristen, Filomena, Lauren, Amanda, and Sarah have supported and reassured me and also helped me have fun throughout this process. I am also grateful to Adriene Mishler and Brené Brown for helping me show up in my life, both on and off the mat.

This whole journey would not have been possible without the support of my family. My mom provided me with endless emotional support and encouragement. My dad has continually reassured me of my capabilities and listened to me talk (far too much, I'm sure) about my work. Emily has offered me support and wisdom throughout this entire program. Paul has kept me laughing every step of the way (and let me stay with him even in busy season). My big cousin Staci has supplied me with tea, wine, weekend refuges, and made me feel like my work habits were at least semi-sane. My grandma, aunts, uncles, and cousins have cheered me along every step of the way. I love you all.

Table of Contents

Abstract of the Dissertation ii
Acknowledgements iv
List of Figures x
List of Tables xi
Chapter 1: Introduction 1
Motivation 1
Research Questions 3
Housing Policy Background 4
Overview 4
Public Housing 5
Vouchers 8
Summary 11
Theoretical Framework: Pathways between Housing Assistance and High School Completion 12
Neighborhood Disadvantage 12
Residential Stability 16
Crowding 18
Reduced Housing Cost Burden 21
Summary 22
Chapter 2: Literature Review 24
Housing Assistance and Educational Attainment 24
Effects of Public Housing on Children's Educational Outcomes 25
Effects of Receiving Housing Vouchers on Children's Educational Outcomes 27
Timing and Duration of Housing Assistance Receipt 28
Housing Assistance and Neighborhood Disadvantage 29
Housing Assistance and Residential Stability 30
Housing Assistance and Crowding 32
Housing Assistance and Housing Cost Burden 33
Methodological Challenges 35
Hypotheses 37
Contribution of the Proposed Study 39
Chapter 3: Methodology 40

Data 40
Panel Study of Income Dynamics 40
PSID Assisted Housing Database 42
PSID Geocoded Data 45
Census Tract Data 45
Sample 46
Structure of Subsequent Five Chapters 47
Chapter 4: Housing Assistance and Educational Attainment 48
Research Question 48
Sample 48
Measures 48
Housing Assistance 48
High School Completion 52
Covariates 53
Analytic Strategy 53
Estimating Causal Effects 54
Models Estimated 56
Results 57
Descriptive Statistics 57
Multivariate Results 65
Sensitivity Analyses 74
Summary of Results 75
Chapter 5: Housing Assistance and Neighborhood Disadvantage 77
Research Question 77
Measures 77
Housing Assistance 77
Neighborhood Disadvantage 78
Covariates 79
Analytic Strategy 80
Results 81
Descriptive Results 81
Multivariate Results 85
Sensitivity Analyses 100
Summary of Results 101

Chapter 6: Housing Assistance and Residential Stability 103
Research Question 103
Measures 103
Residential Stability 103
Housing Assistance 104
Covariates 104
Analytic Strategy 105
Results 107
Descriptive Statistics 107
Multivariate Analyses 112
Sensitivity Analyses 120
Summary of Results 122
Chapter 7: Housing Assistance and Residential Crowding 124
Research Question 124
Measures 124
Crowding 124
Housing Assistance 125
Covariates 125
Analytic Strategy 126
Results 128
Descriptive Results 128
Multivariate Results 132
Sensitivity Analyses 145
Summary of Results 146
Chapter 8: Housing Assistance and Housing Cost Burden 147
Research Question 147
Measures 147
Housing Cost Burden 147
Housing Assistance 147
Covariates 148
Analytic Strategy 149
Results 151
Descriptive Results 151
Multivariate Results 155

Sensitivity Analyses 163
Summary of Results 165
Chapter 9: Discussion 166
Summary of Results 166
Housing Assistance and High School Completion 166
Pathways between Housing Assistance and High School Completion 169
Tying Together the Overarching Research Question and Pathways 174
Limitations 176
Implications 179
Future Research 181
References 184
Appendices 190

List of Figures

Figure 1: Research questions 3
Figure 2: Probability of completing high school by housing assistance type 60
Figure 3: Probability of living in a high poverty neighborhood by any housing assistance 86
Figure 4: Probability of living in a high poverty/high minority neighborhood by any housing assistance 87
Figure 5: Probability of living in a high poverty neighborhood by housing assistance type 92
Figure 6: Probability of living in a high poverty/high minority neighborhood by housing assistance type 93
Figure 7: Probability of moving by any housing assistance 115
Figure 8: Probability of moving by housing assistance type 117
Figure 9: Probability of crowding by any housing assistance 133
Figure 10: Probability of severe crowding by any housing assistance 134
Figure 11: Probability of crowding by housing assistance type 140
Figure 12: Probability of severe crowding by housing assistance type 140
Figure 13: Housing cost burden by year born 151
Figure 14: Probability of housing cost burden by any housing assistance 156
Figure 15: Probability of housing cost burden by housing assistance type 157

List of Tables

Table 1: Descriptive statistics: housing assistance prevalence (n=1,069) 58
Table 2: Housing assistance receipt at developmental stages (n=1,069) 58
Table 3: Years of housing assistance (n=1,069) 59
Table 4: Number of years receiving assistance (birth through age 15), among those who received assistance (n=396) 59
Table 5: Descriptive statistics and statistical tests by housing assistance receipt 63
Table 6: OLS models of high school completion on housing assistance (n=1,069) 68
Table 7: OLS models of timing of housing assistance & high school completion (n=1,069) 71
Table 8: Augmented inverse probability weighted models of high school completion on housing assistance (n=1,069) 73
Table 9: Housing assistance and neighborhood disadvantage, descriptive statistics and significance tests by housing assistance receipt (n=14,489, with observations on 1,783 children) 83
Table 10: Linear models of any housing assistance and census tract level poverty rates (n=14,489, with observations on 1,783 children) 88
Table 11: Linear models of any housing assistance and census tract level high poverty (n=14,489, with observations on 1,783 children) 89
Table 12: Linear models of any housing assistance and census tract level high poverty & high minority (n=14,489, with observations on 1,783 children) 90
Table 13: Linear models of type of housing assistance and census tract level poverty rates (n=14,489, with observations on 1,783 children) 94
Table 14: Linear models of type of housing assistance and census tract level high poverty (n=14,489, with observations on 1,783 children) 96
Table 15: Linear models of type of housing assistance and census tract level high poverty & high minority (n=14,489, with observations on 1,783 children) 98
Table 16: Mother's education by housing assistance type 101
Table 17: Housing assistance and residential stability, descriptive statistics and statistical tests by housing assistance receipt (n=14,121, with observations on 1,890 children) ... 110
Table 18: Linear models of housing assistance and residential moves, multivariate analyses (n=14,121, with observations on 1,890 children) 113
Table 19: Linear models of type of housing assistance and residential moves, multivariate regression analyses (n=14,121, with observations on 1,890 children) 118
Table 20: Housing assistance and residential crowding, descriptive statistics and statistical tests by housing assistance receipt (n=13,858, with observations on 1,768 children) 130
Table 21: Linear models of any housing assistance and crowding (n=13,858, with observations on 1,768 children) 135
Table 22: Linear models of any housing assistance and severe crowding (n=13,858, with observations on 1,768 children) 137
Table 23: Linear models of housing assistance types and crowding (n=13,858, with observations on 1,768 children) 141
Table 24: Linear models of housing assistance types and severe crowding (n=13,858, with observations on 1,768 children) 143

Table 25. Housing assistance and housing cost burden, descriptive statistics and statistical tests by housing assistance receipt (n=12,975, with observations on 1,767 children) ... 153
Table 26. Linear models of any housing assistance and housing cost burden (n=12,975, with observations on 1,767 children)..... 159
Table 27. Linear models of housing assistance (by type) and housing cost burden (n=12,975, with observations on 1,767 children) 161

Chapter 1: Introduction

Motivation

More than eight million households in the United States spend over half their household income on housing (Rice & Sard, 2009). Ninety-eight percent of these households are low-income, with incomes at or below 80% of the state median income (Rice & Sard, 2009). For the five million families with housing assistance (Rice & Sard, 2009), however, housing is far more affordable because costs are kept to approximately one-third of family income. Housing assistance programs can improve the lives of millions of people by providing families with affordable, safe, and decent homes and access to opportunities and resources that lead to positive long-term outcomes. One such potential outcome is high school completion.

High school completion is an important predictor of future employment, wages, health, and well-being (Rumberger, 2011), but high school completion statistics reveal large racial and economic disparities. While, on average, about 17% of students do not complete high school, for children who are poor, black, or Hispanic, these rates are much higher, at about 25% (National Center for Education Statistics, 2015). The lower high school completion rate among these groups, compared to the national average, has persisted since the mid-twentieth century (Murnane, 2013). Housing assistance has the potential to increase educational attainment and reduce these stark and persistent racial and economic disparities.

Because housing assistance impacts where low-income families live, it can be used to help low-income families access more advantaged neighborhoods with better schools. This is particularly important for minority and poor children who often live in

doubly segregated neighborhoods, marked by both racial and economic segregation (Orfield, Kucsera, & Siefel-Hawley, 2012). Schools in these neighborhoods tend to have fewer resources, harsher student discipline, less experienced teachers, and other characteristics that are associated with poor student outcomes and low graduation rates (Orfield et al., 2012).

Housing assistance can also help improve educational attainment through other pathways. Housing assistance can promote residential stability and staying in the same school reduces the risk of dropping out (Haveman, Wolfe, & Spaulding, 1991). Additionally, families who receive housing assistance may be less likely to experience crowding (Currie & Yelowitz, 2000) which is associated with lower educational performance (Goux & Maurin, 2005; Solari & Mare, 2012). Lastly, receiving assistance limits families' housing expenditures to about a third of their income (Dastrup, McDonnell, & Reina, 2011), reducing their housing cost burden, which may permit families the flexibility to allocate funds towards education-promoting activities. This financial subsidy may reduce the need for children to leave school and join the workforce.

Based on this evidence, housing assistance could be an important policy tool to reduce economic and racial inequalities in high school completion. Still, the association between receiving housing assistance and high school completion is not clearly understood. This dissertation examines the associations between different types of housing assistance (public housing and vouchers) and high school completion; whether the timing and duration of housing assistance impact these associations; and the pathways

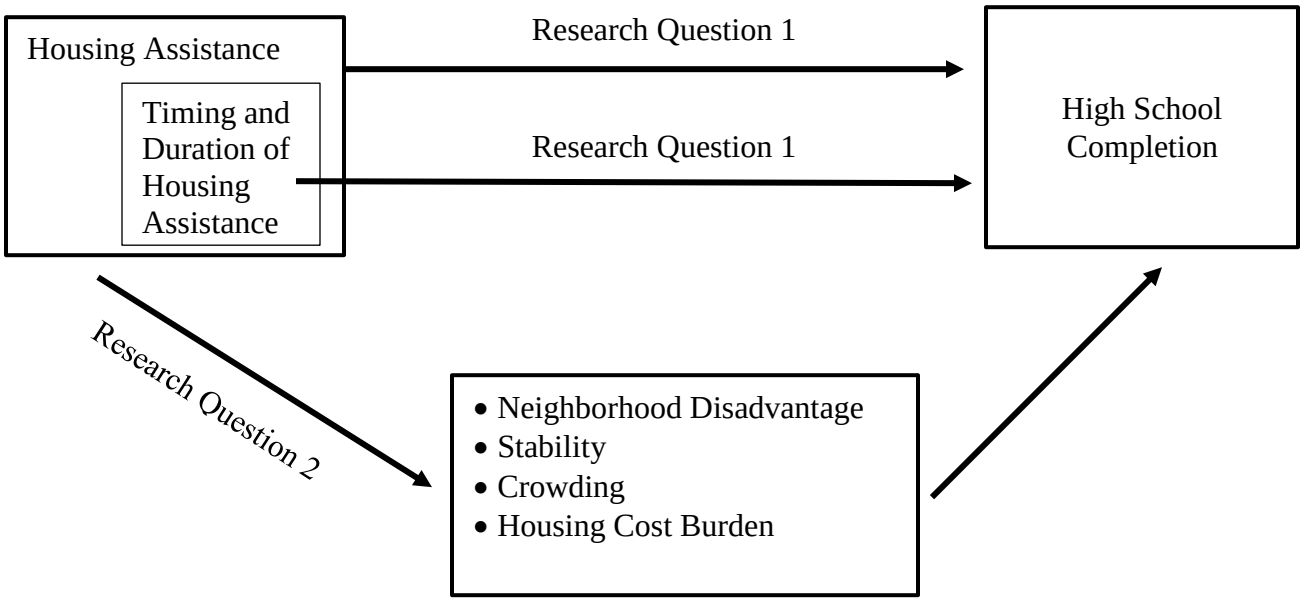
through which this association may operate. The results of this research can help inform housing assistance policy to maximize its impact on educational attainment.

Research Questions

This dissertation aims to answer several research questions:

1. What is the association between different types of housing assistance and high school completion? Does the timing and duration of housing assistance receipt matter? Specifically, does the association between housing assistance and high school completion vary by the number of years spent in each type of housing and by the child's developmental stage at the time of assistance receipt?
2. Through which pathways might the association between housing assistance and high school completion operate? Is housing assistance associated with neighborhood disadvantage, stability, crowding, and housing cost burden?

Figure 1: Research questions



Housing Policy Background

Overview

The federal government initially created affordable housing programs through the Housing Act of 1937 as a response to the Great Depression (Olsen & Zabel, 2014). The goal of the Housing Act of 1937 was "to remedy the acute shortage of decent, safe, and sanitary dwellings" (United States Congress, 1937) and the Housing Act of 1949 aimed for "the elimination of substandard and inadequate housing" (United States Congress, 1949). From their inception, federal affordable housing programs have been means-tested, not universal, meaning that families must meet income restrictions to qualify for assistance. In order to be eligible for assistance, families must be low-income, with incomes less than 80% of the area median income, though some programs require that families be very low income (with incomes less than half the area median income) (Center on Budget and Policy Priorities, 2015). The country's affordable housing programs are not entitlements, however, and, thus, do not provide assistance to all eligible households (Olsen, 2003). Only about a quarter of all eligible families receive housing assistance (Congressional Budget Office, 2015). Today, about 5.3 million households receive assistance through all federal housing programs (U.S. Department of Housing and Urban Development, 2015), costing $36 billion dollars or 1.1% of all federal expenditures (Falk, 2014).

There are eight types of housing assistance currently funded by HUD: Public Housing, Housing Choice Vouchers, Mod Rehab, Section 8, Section 236, Multi-family Other, LIHTC, and HOME. This study focuses on the two largest means-tested programs that provide direct subsidies to families and have been in existence consistently over the

course of the study (1970 to 2009): public housing and Housing Choice Vouchers (HCVs). Public housing is owned and operated by the government through local public housing authorities (PHAs). In contrast, HCVs provide families with subsidies to rent homes in privately-owned buildings. This section begins with an overview of the scope of these two programs and then discusses their histories, starting with background on public housing. Voucher policies stem from the country's experience with public housing and, therefore, are discussed in the latter part of this section.

Public Housing

The government began building and managing affordable housing through the Housing Act of 1937 (Stoloff, 2004). This early public housing was meant to alleviate the negative effects of macroeconomic forces on families and served primarily two-parent, working class families (Vale, 2000). The families' household heads tended to be temporarily out of work because of the Great Depression or unable to find housing due to the housing shortage after World War II (Vale, 2000). Public housing provided families with reasonable rental payments, capped at 20% of their incomes, and aimed to provide higher quality housing in terms of safety and sanitation (United States Congress, 1937). Early public housing projects were racially segregated with separate buildings for blacks and whites and with more public housing designated for whites than blacks (Massey & Denton, 1993). In 1944, 26% of public housing tenants were minorities (Atlas & Dreier, 1994).

While housing created through the Act of 1937 served working class families, the Housing Act of 1949 targeted public housing assistance to very low-income families

(Von Hoffman, 2000). This act worked in tandem with urban renewal. Whites were concerned about the possible encroachment of minority slums on central business districts; as these slums were cleared through urban renewal, public housing was used to house displaced minority families (Massey & Kanaiaupuni, 1993). In sum, this act aimed to use public housing to raise housing standards, clear slums, and improve blighted urban areas (Von Hoffman, 2000). While local officials attempted to build this public housing away from slum areas, they were met with resistance by whites in city councils and, as a result, public housing was often built in or near the neighborhoods where the slums had been located (Massey & Kanaiaupuni, 1993). Massey and Kanaiaupuni (1993) argue that while these areas typically already experienced concentrated poverty, public housing itself had an independent effect on neighborhoods, increasing the concentration of poverty. The continued prioritization of serving the very poor in the 1960s and the movement away from serving working class families further contributed to concentrated poverty (Stoloff, 2004; M.A. Turner, Popkin, & Rawlings, 2009). The 1960s also marked the beginning of the racial integration of housing projects with the Civil Rights Act of 1964. Simultaneously, families who could move out of housing projects did so, either by using federal mortgage programs to move to the suburbs or independently moving into the private market (Stoloff, 2004).

In this decade, disinvestment in public housing occurred as federal funding shifted towards vouchers. Through the 1960s, the government paid project development costs and tenants and local taxes paid operating costs, but the public housing stock was aging and had fallen into disrepair (Stoloff, 2004). Public housing authorities both raised rents and decreased services in attempts to make the projects financially soluble (Stoloff,

2004). Then, in 1969, the federal government increased funding for operating support to maintain the quality of units without charging residents excessive rents (Olsen, 2003).

In 1973, President Nixon placed a moratorium on all new construction of public housing and began plans to shift the federal government's involvement in affordable housing to Section 8 programs (Stoloff, 2004). These programs would fund vouchers and privately-owned affordable housing, moving the government away from building and managing affordable housing (Stoloff, 2004). In the late 1970s, however, public housing funding was reinstated based on the view that it was a proven program that would create permanently affordable housing whereas the long-term results of Section 8 were unknown (Stoloff, 2004). This movement was short-lived. Since 1981, there has not been large-scale funding of public housing and by the 1990s, the public housing high-rises built in the mid-1900s had largely fallen into disrepair (Stoloff, 2004). Meanwhile, in 1981, to help close budget gaps, tenants' rents were raised to 30% of their income (Stoloff, 2004). Through 1992 HOPE VI legislation, the most distressed public housing and nearly all high-rise housing projects, with the exception of those in highly dense cities such as New York, were demolished and replaced by low-rise, mixed-income housing and vouchers for families who did not move into the newly developed mixed-income housing (Fogel, Smith, & Williamson, 2008).

Currently, according to data from the U.S. Department of Housing and Urban Development (2015), the public housing program serves the very poor and minorities: Of all public housing residents, 90% had very low incomes (below 50% of the area median family income). Blacks and Hispanics account for three quarters of all public housing residents. Families living in public housing tend to live in both high minority census

tracts, with an average of 62% of minority residents, and high poverty tracts, with average poverty rates of 34%. The average annual household income of families living in public housing was $14,066. Families typically spent about a year and a half on a waiting list to receive public housing and had lived in public housing for, on average, 12 years. In 2012, when national data on housing authority waiting lists was last collected, only 4% of agencies reported that no families were waiting for public housing (Public and Affordable Housing Research Corporation, 2016). It is estimated that about 1.64 million families were waiting for assistance, not including families that would have signed up for assistance through the 6% of housing authorities that had closed their waiting lists (Public and Affordable Housing Research Corporation, 2016).

Public housing is delivered through in-kind provision of housing which is developed and operated by local Public Housing Authorities. In 2013, the average monthly rent for a public housing unit was $779, of which families paid about $297 and HUD paid $482 (U.S. Department of Housing and Urban Development, 2015). The public housing program is financed through discretionary spending by the federal government and costs about $7 billion a year (Congressional Budget Office, 2015). According to the U.S. Department of Housing and Urban Development (2015), in 2013, more than 1.1 million units of public housing served almost 2.3 million people.

Vouchers

The movement from public housing to vouchers began in the 1970s and changed the government's role in affordable housing from building and managing housing to supporting housing provision in the private market. Vouchers subsidize families' housing

in the private market and are portable beyond neighborhood boundaries, allowing families to access different geographic areas. The first voucher program in the United States was the Experimental Housing Allowance Program (EHAP), which began in 1971. EHAP was a demonstration program which provided housing allowances to about 50,000 eligible families from 1971 through 1980 and showed that this type of voucher program could both preserve existing housing stock and help families access better neighborhoods (U.S. Department of Housing and Urban Development, n.d.).

The Section 8 program was developed in 1974, in the midst of the EHAP demonstration. Section 8 provided two types of assistance: project-based for families living in privately-owned buildings funded or rehabilitated using Section 8 funds and portable tenant-based certificates (U.S. Department of Housing and Urban Development, n.d.). Families living in Section 8 place-based housing or with a Section 8 certificate paid 30% of their income towards housing. In 1987, another tenant-based program, housing vouchers, was developed through the Housing and Community Development Act. Unlike Section 8 certificates, these vouchers did not have fair market rent limitations and provided families with a predetermined amount of assistance, meaning that they could pay more or less than 30% of their income towards housing (U.S. Department of Housing and Urban Development, n.d.).

Efforts to make the voucher and certificate programs more uniform began in the 1990s and, in 1998, the Quality Housing and Work Responsibility Act merged the certificate and voucher programs to create the HCV program (U.S. Department of Housing and Urban Development, n.d.). This program required payment standards based on fair market rent (FMR) and specified that families pay 30% of their income towards

rent (U.S. Department of Housing and Urban Development, n.d.). Families with vouchers in the HCV program also have the option to spend up to 40% of their income on rent.

Currently, the HCV program specifies that 75% of new households receiving vouchers must be extremely low-income, with incomes less than 30% of the area median income or the poverty line (Center on Budget and Policy Priorities, 2015). PHAs are required to verify that units paid for with vouchers meet federal quality standards (Center on Budget and Policy Priorities, 2015). Additionally, 20% of vouchers can be tied to a specific property or used for the construction or rehabilitation of a home (Center on Budget and Policy Priorities, 2015).

According to data from the U.S. Department of Housing and Urban Development (2015), the HCV program largely serves very low-income and minority families: nearly all (95%) families with HCVs are very low-income and about two-thirds are black or Hispanic. In the census tracts in which HCVs are used, about a quarter of residents are poor and over half are minorities. Households receiving HCVs had average annual incomes of $13,446 in 2013. Families typically spent about 30 months on the waiting list for a housing voucher and have received vouchers for about 11 years. There is high demand for HCVs. Nearly half of all public housing authorities' waiting lists for HCVs were closed in 2012 and about 2.76 million families were on waiting lists (Public and Affordable Housing Research Corporation, 2016). Only 1% of public housing authorities reported that they did not have anyone waiting for a HCV (Public and Affordable Housing Research Corporation, 2016).

The HCV program is financed through discretionary spending. The program is administered through local Public Housing Authorities which provide households with

vouchers to be used in the private market. The average monthly rent for a unit was $1,125, with about $359 paid by families and $766 paid by HUD (U.S. Department of Housing and Urban Development, 2015). This program costs about $18 billion a year (Congressional Budget Office, 2015) and serves about 5.2 million people in over 2.4 million units (U.S. Department of Housing and Urban Development, 2015).

Summary

Housing assistance programs help about five million families in the United States access affordable housing. They do not, however, reach all families in need. It is estimated that 19 million households qualify for housing assistance and that nearly 8 million households without housing assistance spend more than half their income on housing (Public and Affordable Housing Research Corporation, 2016). While the number of low-income families paying more than half their income on housing is growing, only one of every four households eligible for housing assistance receives it (Rice & Sard, 2009). Still, though housing costs are increasing, federal spending on low-income housing has fallen (Rice & Sard, 2009). If funded as entitlement programs, the HCV and public housing programs could provide affordable housing to the millions of eligible families not currently receiving assistance. Having safe, decent, and adequate housing can provide families with a stable platform from which they can grow, improving family, child, and adult outcomes across a wide range of indicators.

Theoretical Framework: Pathways between Housing Assistance and High School Completion

This section discusses the theoretical frameworks through which receiving housing assistance may affect children's educational attainment. As explained in the housing policies background section, these mechanisms were incorporated into the conceptualization of the public housing and voucher programs to varying degrees. While there are a multitude of pathways through which this association may operate, the four pathways examined in this study are neighborhood disadvantage, residential stability, crowding, and housing cost burden. This section explores the theories related to each pathway and the ways in which these pathways may differ depending on the type of housing assistance a family receives.

Neighborhood Disadvantage

Families receiving housing assistance are at risk of living in poor neighborhoods that are racially and economically segregated. These families could be confined to such neighborhoods due to the location of public housing and landlords who accept housing vouchers. Based on the design of the voucher program, however, families should be able to use their voucher to access neighborhoods with more desirable characteristics. Low-income families who do not receive housing assistance have the opportunity to access housing in more advantaged neighborhoods because their housing options are not limited to public housing or voucher-accepting landlords but they may have trouble affording housing in such neighborhoods. Living in disadvantaged neighborhoods, which are often marked by resource deprivation at the community level and social factors such as

unemployment and social isolation, can negatively shape children's educational outcomes (W. J. Wilson, 1987).

Neighborhood disadvantage influences school characteristics. Children living in households receiving housing assistance are more likely to live near low-performing schools than are children in low-income households without housing assistance (Ellen & Horn, 2012) and these conditions could contribute to worse educational outcomes for children. Schools are largely representative of their neighborhood's attributes (Benson & Borman, 2010). In turn, the socioeconomic characteristics of children's neighborhoods have been shown to impact both children's reading levels when they first enter school and whether or not they maintain their educational growth over the summer (Benson & Borman, 2010). The impact of neighborhood socioeconomic characteristics depends on children's individual characteristics. The effects of living in disadvantaged neighborhoods on educational attainment are more deleterious for black adolescents living in single-parent families than those living in other family types (Crowder & South, 2003). This effect also applies to low-income white adolescents compared to those from higher income families (Crowder & South, 2003).

Social factors, such as neighborhood unemployment and social isolation, may also affect children's educational attainment through the theory of the place-based "underclass." In the "underclass," people live in neighborhoods marked by poverty, racial segregation, concentrated joblessness, social isolation, a lack of interaction with job holders, and connections to social networks for jobs (W. J. Wilson, 1987). Youth living in such neighborhoods frequently have limited exposure to people with high educational attainment who can demonstrate the positive effects of education. Furthermore, as

Sharkey (2013) finds, families are often in poverty for multiple generations. Therefore, the lack of exposure to the benefits of education may persist across generations.

Families may experience neighborhood disadvantage differently depending on the type of housing assistance they receive. Families living in public housing are restricted to the existing public housing stock and public housing has been found to contribute to concentrated poverty (Massey & Kanaiaupuni, 1993), which is a factor in neighborhood disadvantage. While the HOPE VI program demolished many of the high-rise public housing projects in the late 1990s, evidence from both before and after these demolitions indicates that public housing is typically located in distressed neighborhoods (McClure & Johnson, 2014; Newman & Schnare, 1997). Based on the design of these programs, families with vouchers can theoretically use them to move to more economically and racially integrated neighborhoods with better schools than families with public housing. This would suggest that voucher programs, compared to public housing, may provide children with improved educational opportunities. However, this may not actually work as designed (with the exception of vouchers provided through experimental programs or those resulting from lawsuits). The literature suggests that children receiving a traditional HCV are able to access neighborhoods that are more advantaged than neighborhoods in which public housing is located but not different from those accessed by other low-income families (see review by Owens, 2017). Despite the potential positive effects of vouchers, the literature suggests that, compared to families living in place-based housing (e.g., public housing) and low-income families without housing assistance, voucher holders are likely to live near lower performing schools (Horn, Ellen, & Schwartz, 2014). While voucher holders live near lower performing schools than both these types of

households, the literature suggests that children receiving any type of housing assistance at all are more likely to live near lower performing schools than low-income families without housing assistance (Ellen & Horn, 2012). While the outcome variable for these two studies is school quality, not individual children's educational performance, performance rates are calculated based on students' results on math and English standardized tests (Ellen & Horn, 2012; Horn et al., 2014).

Alternatively, there is some evidence from recent ethnographic research suggesting that families *without* housing assistance may live in the most disadvantaged neighborhoods (Desmond, 2016) and, thus, be relegated to more poorly performing schools. It is possible that the differences between the results of this research and previously discussed studies can be accounted for by the level of poverty a family experiences. While low-income families without housing assistance, on average, have access to better performing schools than families with housing assistance (Ellen & Horn, 2012), families in deep poverty may live near worse schools than families with housing assistance. Therefore, families receiving housing assistance could live in neighborhoods with worse schools than the average low-income family but have access to better schools than families in deep poverty. Additionally, these extremely low-income families may have experienced reductions in other types of benefits, particularly due to 1996 welfare reform, which could contribute to the most economically disadvantaged families living in neighborhoods that have deteriorated over time.

Residential Stability

Housing assistance can provide families with residential stability in both the short- and long-term. This assistance, regardless of type, aims to make housing more affordable for low-income households by limiting rental payments to 30% of household income. In the shorter-term, these payment caps can protect families against financial shocks, such as job loss and illness, which often lead to forced moves or evictions among families without housing assistance (Desmond, An, Winkler, & Ferriss, 2013; Desmond, Gershenson, & Kiviat, 2015). This protection is outlined in guidelines from the Department of Housing and Urban Development (HUD) which state that PHAs will adjust rents in the event of income decreases due to a range of circumstances including employment changes, death in the family, or loss of other earnings and for increased expenses (e.g., medical, childcare, transportation, or education costs) (Department of Housing and Urban Development, 2002). In the longer-term, families receiving housing assistance are likely to have increased financial stability which, in turn, promotes residential stability. There are, however, components of the design of the public housing and voucher programs that may influence the association between housing assistance and residential stability.

Differences by Housing Assistance Type

It is anticipated that, while both public housing and housing vouchers will be associated with increased residential stability, the effect sizes of the programs may differ. Both vouchers and public housing provide families with rental subsidies, meaning that they may not need to move in the event of income loss because their rents would be

adjusted based on these changes (Department of Housing and Urban Development, 2002). However, families receiving public housing are restricted to living in certain housing units while families with vouchers can use their assistance to move. Thus, the effect of receiving public housing on residential stability may be larger than the effect of receiving a voucher.

When families receive public housing, they must initially move into a public housing unit. However, after that move, their residential mobility is limited because they cannot move to a new home in the private market while retaining their housing assistance. Thus, it is anticipated that living in public housing will be strongly associated with increased residential stability compared to not receiving housing assistance. Program statistics indicate that families often stay in public housing for extended periods of time; they live, on average, in such housing for 12 years (U.S. Department of Housing and Urban Development, 2015). Additionally, about 90% of families stay in public housing from any given year to the next (e.g., 87% in 2015, 91% in 2009, and 90% in 2000) (U.S. Department of Housing and Urban Development, 2015).

Families who receive a voucher can initially use their voucher either to pay for their current residence or to move to a new home. While the initial receipt of a voucher is not necessarily accompanied by a move, the majority of families receiving a voucher do immediately use it to move to a new home and some families move again using their voucher (Feins & Patterson, 2005). However, the majority of families with vouchers are not planning moves; one study shows that, among voucher-holders, at least 75% did not have a move planned (Basolo, 2013). Families can theoretically take their voucher and move into another PHA's jurisdiction but these moves are highly uncommon, with less

than 10% of families making such moves (Climaco, Rodger, Feins, & Lam, 2008). When portability moves do occur, they are most likely to be made by extremely low-income voucher holders and minority-headed households (Climaco et al., 2008). Further, when families move with their HCVs, they often move to less disadvantaged neighborhoods compared to the neighborhood from which they moved (Basolo, 2013; Climaco et al., 2008; Feins & Patterson, 2005). On the other hand, families with a voucher may also experience residential stability because it can be challenging to find acceptable housing due to limited affordable housing stock and landlord resistance to accepting vouchers (Tighe, Hatch, & Mead, 2017). Uniquely, compared to receiving public housing or not receiving housing assistance, if rents rise above the amount HUD is willing to pay in an area (the Fair Market Rent), the landlord could plausibly decide to seek a market-rate tenant. Additionally, voucher-holders are permitted to spend up to 40% of their income on housing when they initially use their voucher and commonly do so in order to access larger housing units or more desirable neighborhoods (Dawkins & Jeon, 2017). Because housing cost burdens are not always reduced when a family uses a voucher (Dawkins & Jeon, 2017), families with vouchers may experience a greater likelihood of moving than families receiving other types of assistance. In sum, it is anticipated that vouchers will promote residential stability among families, compared to not receiving assistance, but that the effect size will not be as large as that for public housing.

Crowding

Families who receive housing assistance should be less likely to experience crowding because of guidelines for public housing and vouchers which stipulate the

number of bedrooms a family needs, based on family size and composition. Children whose families receive housing assistance experience less crowded housing conditions than children in families who do not receive assistance (Currie & Yelowitz, 2000). Crowding is associated with negative educational indicators including having to repeat a grade among elementary and middle schoolers (Goux & Maurin, 2005) and poor reading and math performance (Solari & Mare, 2012). Living in less crowded housing may provide children more space in which to complete homework, keep their school materials organized, have quiet spaces in which to concentrate, and bedrooms where they can have regular and appropriate bedtimes, all of which can improve their academic performance. Further, crowding is also associated with poor health conditions due to disease transmission (Leventhal & Newman, 2010). Being sick can cause children to have increased absences from, and fall behind in, school.

Improving housing conditions, including reducing crowding, is at the core of housing assistance programs in the United States which began as a response to poor housing conditions. The primary purpose of the Housing Act of 1937 was "to remedy the acute shortage of decent, safe, and sanitary dwellings" (United States Congress, 1937). Building on that foundation, federal guidelines for housing assistance specify the number of bedrooms required by families with different compositions. For families receiving vouchers, the unit must have at least a living room, kitchen, and bathroom and a minimum of one bedroom or living/sleeping room for every two persons (U.S. Department of Housing and Urban Development, 2001). Children of opposite sexes, other than very young children, should not occupy the same bedroom (U.S. Department of Housing and Urban Development, 2001). Similarly, federal-level public housing

guidelines mandate that no more than two people share a bedroom (U.S. Department of Housing and Urban Development, 2003). Because of these guidelines, families receiving housing assistance, regardless of type, should not experience crowding. Thus, it is not hypothesized that the probability of crowding would differ by housing assistance type.

While guidelines are in place to prevent crowding among families receiving housing assistance, it is still possible that they could still experience crowding. Crowding is common among poor and near-poor families with children: About 20% of each of these groups experience crowded housing (Holupka & Newman, 2011). Crowding may occur for many reasons, not all of which are negative, and families receiving housing assistance are not immune from experiencing crowding. The varied reasons for crowding mean that this experience can vary dramatically depending on circumstance; it is possible for crowding spells to be, for example, temporary and positive. For example, household sizes can change through births, marriages and cohabitation. As these changes occur, families may be unable to immediately afford to move to a larger home, potentially leading to spells of crowding. Household sizes can also grow through doubling up where multiple families live in the same household because they cannot afford to pay for housing independently. Because this is often a response to economic hardship (Seltzer, Lau, & Bianchi, 2012), it has significant economic benefits for families with young children (Pilkauskas, Garfinkel, & McLanahan, 2014). Crowding may also occur if families move to more expensive neighborhoods with positive qualities such as better schools, low crime rates, or access to transportation and have to live in smaller quarters to afford these moves. On the other hand, it is possible that families who access these more advantaged neighborhoods may find that other family members seek to double up with them in order

to also have access to these neighborhoods. Families receiving a voucher may be more likely than families living in public housing to experience crowding for this reason, though such accommodations could be in violation of the HCV program. Similarly, families living in public housing may also find that they have family members or friends who seek to double up with them because of the perceived stability of public housing. As with doubling up within the voucher program, this would also be a violation of the public housing lease.

Reduced Housing Cost Burden

Low-income families are very likely to experience extreme housing cost burdens: over 60% of these families spend more than 50% of their income on housing (Holupka & Newman, 2011). For these families, receiving housing assistance alleviates their housing cost burden and may act as an income boost. This may mean that families have more financial resources to devote to activities that can improve their children's educational outcomes such as better food, child care, afterschool enrichment, books in the home, and other educational materials. For example, lower housing cost expenditures are associated with reduced food insecurity; reducing food insecurity, in turn, may increase children's academic performance (Fletcher, Andreyeva, & Busch, 2009). Furthermore, since parents receiving housing assistance may not need to work as much as would be necessary to afford market rate rents, they could have more time to support their children's learning. An additional benefit of receiving housing assistance may manifest as children grow older: children in families with lower housing cost burdens from receiving housing

assistance may have less incentive to drop out of school and enter the workforce (Forget, 2011).

Receiving any type of housing assistance may reduce families' housing cost burdens compared to renting in the private market without a subsidy. Both programs subsidize both families' rent and utility payments. The Department of Housing and Urban Development (HUD) allocates utility allowances for both these programs, regardless of who directly pays utilities, either the landlord, public housing authority, or tenant (Dastrup et al., 2011). These utility allowances generally keep families' total housing costs – rent plus utilities – to 30% of their household income (Dastrup et al., 2011). Thus, it is likely that families receiving any type of housing assistance, compared to families without housing assistance, will be able to allocate more resources towards their children's education; however, there may be differences in benefits by housing assistance type. Families with vouchers are permitted to pay up to 40% of their incomes towards housing, compared to 30% in public housing, and families with vouchers have been found to spend a greater percentage of their income on housing than families in public housing (Mast, 2012). Thus, families with a voucher may allocate a greater proportion of their household income towards housing, and be more likely to experience housing cost burdens, than families living in public housing.

Summary

Housing assistance may affect children's educational outcomes and this relationship may differ by assistance type (public housing and vouchers). Overall, receiving any type of housing assistance, rather than none, may be better for low-income

children's educational outcomes. Regardless of the type of housing assistance they receive, families with assistance have the opportunity to allocate a greater share of their resources towards their children's educations, live in less crowded homes, and have more residential stability. It is also possible that housing vouchers, as compared to public housing and, potentially, to not receiving any assistance, could provide families with access to more advantaged neighborhoods with better schools and amenities that could promote children's educational attainment.

Chapter 2: Literature Review

This literature review first explores the existing research on the association between housing assistance and educational attainment and the importance of timing and duration of housing assistance receipt. Then, the literature on four potential pathways (neighborhood disadvantage, residential stability, crowding, and housing cost burden) between housing assistance and high school completion is discussed. Lastly, the methodological challenges seen in the literature and contributions of the current study are outlined.

Housing Assistance and Educational Attainment

Existing research on the effects of housing assistance on educational outcomes is sparse and the results do not provide conclusive answers. Housing assistance is typically defined by program type (public housing, housing voucher, Low Income Housing Tax Credit-financed buildings, place-based Section 8, and other smaller programs) but the bulk of the literature on housing assistance and education focuses on public housing and vouchers. Prior work in this area either examines student-level educational outcomes or the quality of the schools in children's neighborhoods. The differences between the outcome variables are important as school quality may be an inadequate proxy for a child's individual educational success especially given the growing school choice movement through which the schools children attend are decoupled from the neighborhood in which a child lives. Another concern with the current body of research is that reference groups often include families receiving some type of housing assistance. For example, in studies of the effects of public housing, the comparison group includes

those with vouchers and those not receiving assistance (e.g., Newman & Harkness, 2000).

Effects of Public Housing on Children's Educational Outcomes

Two studies find that living in public housing may have positive effects on children's educational outcomes (Currie & Yelowitz, 2000; Newman & Harkness, 2000). Currie and Yelowitz (2000) examine the effects of public housing on housing quality and educational attainment using the Current Population Survey (to measure public housing receipt) and the Census's Public Use Microdata Samples (to measure being held back). They restrict their sample to families with two children between the ages of six and seventeen and household incomes below $50,000 (Currie & Yelowitz, 2000). Initial regression models do not show an association between public housing and crowding or being held back (Currie & Yelowitz, 2000). However, models using a two-stage instrumental variable strategy show that children living in public housing are less likely to experience crowding and are less likely to be held back in school than those not living in public housing (Currie & Yelowitz, 2000). Sensitivity tests show that this association is particularly important for boys, as compared to girls (Currie & Yelowitz, 2000). This study has some possible measurement error for being held back: due to data limitations, the researchers were only able to identify children who had been held back multiple times (Currie & Yelowitz, 2000). Thus, the study may be conservative in its estimates as it does not include students who had only been held back once (Currie & Yelowitz, 2000). Additionally, being held back a grade may not be the best measure of student

achievement as the decision to retain may not be made based solely on student achievement but with a focus on cost for the district (Corman, 2003).

Newman and Harkness (2000) provide a theoretically and methodologically detailed analysis of the relationship between living in place-based housing assistance (public housing or privately-owned developments for which developers received subsidies) and educational attainment. Educational attainment is measured in three ways: years of education, high school completion, and post-secondary education (Newman & Harkness, 2000). Instrumented models show that the relationships between public housing and all three education outcomes are positive, though not statistically significant (Newman & Harkness, 2000). This study also analyzes the timing and duration of housing assistance receipt and finds that when and for how long a child receives assistance is not associated with educational outcomes. While the findings of this paper are not statistically significant, it makes important contributions to the field for its in-depth detailing of the advanced methods used to answer the research questions and the use of the Panel Survey of Income Dynamics' geocoded Assisted Housing Database to reduce self-report bias of housing assistance receipt (Newman & Harkness, 2000). Still, this study is limited because it examines only one type of place-based housing assistance and because the comparison group includes those with vouchers and those not receiving assistance (Newman & Harkness, 2000). Further, though the sample size is not expressly stated in the study, it appears that it is quite small.

Effects of Receiving Housing Vouchers on Children's Educational Outcomes

There has been little literature examining the effects of receiving vouchers on children's educational attainment. One large study using administrative data from a randomized voucher program in Chicago finds that receiving a housing voucher has no significant effect on high school completion (Jacob, Kapustin, & Ludwig, 2015) Two studies have examined the associations of voucher receipt with the quality of schools in children's neighborhoods. Ellen and Horn (2012) use data from the Department of Housing and Urban Development and the Department of Education to describe the elementary schools closest to households receiving housing assistance. They find that households with housing vouchers are more likely to live near lower-performing schools than low-income households without housing assistance (Ellen & Horn, 2012). Additionally, families with vouchers do not live near better schools than families with other types of housing assistance (Ellen & Horn, 2012). Importantly, this study examines multiple categories of housing assistance: public housing, Low Income Housing Tax Credit projects, place-based Section 8 vouchers, and Housing Choice Vouchers (Ellen & Horn, 2012). A limitation of this study is the focus on school quality rather than individual-level educational outcomes because it is unknown whether all children attend the schools near them and school quality may not be a strong proxy for individual educational performance (Ellen & Horn, 2012).

Jacob (2003) analyzes data from the demolition of some of Chicago's high-rise public housing projects where families whose buildings were demolished were given housing vouchers (Jacob, 2003). This study examines the quality of schools for children whose families were given vouchers compared to those who remained in public housing

and finds that children whose families received housing vouchers had access to similar quality schools as the children remaining in public housing (Jacob, 2003). While the focus of this study is on school quality, it also examines individual-level outcomes and shows a small increase in the dropout rate among older children in families who moved out of public housing with a voucher but no impact on the academic achievement of younger children (Jacob, 2003).

Timing and Duration of Housing Assistance Receipt

It is unclear whether the timing and duration of housing assistance impact the relationship between housing assistance and high school completion. For older children, moving out of public housing with a voucher was associated with a small increase in dropping out but there was no effect for younger children (Jacob, 2003). Additional research finds that families may use their vouchers to move to neighborhoods with better schools when their children are entering kindergarten (Ellen, Horn, & Schwartz, 2016). Newman and Harkness (2000) hypothesize that when and for how long children's families receive housing assistance could influence children's educational attainment but find that timing and duration of place-based housing assistance receipt are not significantly associated with educational attainment. The conflicting findings of these studies suggest that more research is needed in this area. Thus, the expectations of the effects of timing and duration are ambiguous.

Housing Assistance and Neighborhood Disadvantage

Descriptive analyses using federal administrative data on all housing assistance programs have examined the performance of housing assistance programs in providing access to quality neighborhoods compared to households receiving welfare (e.g., McClure & Johnson, 2014; Newman & Schnare, 1997). These studies provide evidence that public housing is typically located in more distressed neighborhoods than units in which other poor households live and that voucher holders and families living in Low-Income Housing Tax Credit (LIHTC)-financed housing are able to access slightly better neighborhoods than other poor households but are not consistently able to move to middle- and upper-income areas (McClure & Johnson, 2014; Newman & Schnare, 1997).

Additional studies using data from local housing authorities align with these findings. HCVs provide access to neighborhoods that compare favorably to those of families living in public housing but not to those of other low-income households (see review by Owens, 2017). Unless they are participating in either experimental programs or programs resulting from lawsuits that require moves to neighborhoods with certain characteristics, such as Moving to Opportunity (MTO), the Baltimore Housing Mobility Program (BHMP), or Gautreaux, it is less common for voucher-holders to access neighborhoods that are significantly different from other low-income households in terms of minority and poverty concentration (see review by Owens, 2017). Programs such as MTO and the BHMP, which require moves to low-poverty neighborhoods, do appear to be successful in helping families make these moves. Long-term findings from the MTO show that families who were required to use their housing voucher in low-poverty neighborhoods, regardless of whether they were provided with mobility counseling, still

lived in low-poverty neighborhoods ten to fifteen years after enrollment in MTO (Sanbonmatsu et al., 2011). Similarly, long-term findings from the BHMP show that families who moved through the program lived in neighborhoods with lower poverty rates and reduced racial segregation (Engdahl, 2009).

Housing Assistance and Residential Stability

In spite of the potential important connection between housing assistance receipt and residential stability, little has been written on this topic. Heintze, Berger, Naidich, and Meyers (2006) use two waves of cross-sectional nationally-representative data (collected in 1997 and 1999) from the National Survey of America's Families to examine the association between self-reported housing assistance and residential stability among low-income single female-headed households. The authors find that families without housing assistance spend an average of 27.6 months in their housing unit, compared to 34.0 months for public housing residents and 34.5 months for families with vouchers (Heintze et al., 2006). This study uses a two-stage instrumental variable approach to account for the potential endogeneity of housing assistance receipt and residential stability. Their instrument in analyses examining the association between housing assistance and stability is a ratio of the number of federally subsidized units (both vouchers and public housing) to the number of poor families in the state lagged two to three years prior to the two waves of the survey (Heintze et al., 2006). The instrumented results show that receiving any type of housing assistance is associated with a 7.8-month increase in tenancy length and that the association is stronger for vouchers than public housing (Heintze et al., 2006). A subsequent paper by this group, also using data from the National Survey of America's Families and a similar analytic strategy, finds that

receiving any housing assistance is associated with increased stability, though the effect size is very small (Berger, Heintze, Naidich, & Meyers, 2008). Additional analyses examining housing assistance by type find that vouchers, but not public housing, are associated with a small increase in stability (Berger et al., 2008). This paper has a slightly different sample which may explain the inconsistent findings of these two papers, in spite of using the same dataset and similar analytic strategies.

Another study uses a classic experimental design to explore the relationship between housing vouchers and mobility among primarily single female-headed households receiving welfare (Wood, Turnham, & Mills, 2008). The sample includes welfare participants who were randomly assigned to either the intervention (housing voucher receipt) or control group (no voucher). However, those in the control group could obtain a voucher by remaining on the Public Housing Authority's waiting list and 40% did so over the course of the study. Additionally, 7% of the sample at baseline was receiving public housing; those assigned to the control group were permitted to continue their receipt of this assistance and those assigned to the experimental group were provided a voucher. Voucher receipt was documented with data from HUD's Public Housing Information Center. Over the five-year study period, the authors find that families in the intervention group moved less frequently (1.5 moves) than families in the control group (2.3 moves). However, since the control group also contains families that received either public housing or a voucher over the course of the study, the results of this experiment may underestimate the true effect of the intervention.

The literature examining the association between housing assistance and residential stability suggests that vouchers have a positive effect on residential stability

compared to not receiving any housing assistance but there is not a clear consensus on the effects of public housing receipt on residential stability.

Housing Assistance and Crowding

There is limited research on the association between housing assistance and crowding. Two studies examine the association of receiving housing vouchers with crowding among a group of welfare-eligible households. The first is of the Welfare to Work Voucher Program which funded about 50,000 housing vouchers for families receiving, or eligible to receive, welfare. Three and a half years after initially receiving a housing voucher, families experienced less crowding than prior to having a voucher (Abt Associates Inc. et al., 2006). The second study, which only contains descriptive analyses of families that had received Temporary Assistance to Needy Families (TANF), finds that, after exiting from the TANF program, families who received housing assistance experienced less crowding than those without assistance (Mancuso, Lieberman, Lindler, & Moses, 2003). Because multivariate analyses controlling for various sociodemographic characteristics that may affect the relationship between housing assistance and crowding were not conducted, it is not possible to draw conclusions about the association between housing assistance and crowding. Additionally, it is unclear whether housing assistance refers to a specific program (e.g., vouchers or public housing) or all housing assistance programs.

The limited research available on public housing also shows that this type of assistance is associated with reduced crowding. The two studies (Berger et al., 2008; Currie & Yelowitz, 2000) examining the association between public housing and

crowding are methodologically rigorous, aiming to control for selection into housing assistance receipt by using two-stage instrumental variable techniques. Berger et al. (2008) use cross-sectional data from the National Survey of America's Families and find that unit-based housing assistance is also associated with reduced crowding in this sample of low-income, single mothers. While the statistical methodology used in this paper is rigorous, the data used are cross-sectional which does not allow for temporal ordering of the variables. Thus, it is unclear whether receiving housing assistance causes the reduction in crowding. Using the Survey of Income and Program Participation (SIPP), Currie and Yelowitz (2000) find that children living in public housing experience less crowding than do other families in the SIPP panel. This study is limited by the small number of public housing residents in the sample (n=86).

In sum, prior research shows that housing assistance is associated with reduced crowding but is inconclusive because these studies either use cross-sectional data or examine longitudinal data over a very short time period. The studies examining the association between vouchers and crowding have either been of voucher programs targeted to specific populations (e.g. single mothers moving off welfare) or geographies.

Housing Assistance and Housing Cost Burden

Housing assistance program guidelines restrict housing costs to between 30 and 40% of total household income at the time families begin renting with assistance. In the public housing program, housing costs are limited to 30% of total household income, with an option to pay a set rent, rather than rent adjusted based on income. Families who rent with vouchers are permitted to pay up to 40% of their household income on rent

when they first lease-up in the HCV program. This flexibility is permitted to provide families access to neighborhoods with slightly higher rents. Over time, however, as rents increase and families' incomes change, households in the HCV program can experience rents that exceed 40% of their household income.

Literature on housing cost burdens among families receiving housing assistance focuses primarily on households with vouchers though one study also examines public housing. A descriptive study of nearly the entire population of HCV holders finds that over a third (38%) of households were cost-burdened, spending more than 30% of their income on housing; while high, this rate had decreased from 47% two years earlier (McClure, 2005). Descriptive analyses of 2009 Public and Indian Housing Information Center (PIC) data from HUD find similar results: about 31% of voucher holders experience housing cost burden; this study also analyzes public housing tenants and finds that only 3.2% are cost burdened (Mast, 2012). These studies show that housing cost burden is common among households with vouchers but the results are purely descriptive. The study does not examine the effects of a voucher on housing cost burden. However, other analyses using more robust statistical methods have examined housing cost burden among voucher holders. Findings from Markov chain analyses, which can be used to predict housing cost burden over time, indicate that housing cost burden among voucher-holders increases for years after admission to the program though there is significant movement in and out of cost burden categories (normal, medium, and high) (Mast, 2014). The Moving to Opportunity experiment, which randomly assigned households to receive vouchers, can provide insight into the possible causal relationship between vouchers and housing cost burden. Multivariate results from this experiment

show that vouchers had no effect on housing cost burden (Comey, Popkin, & Franks, 2012).

Several factors appear to exacerbate housing cost burden among voucher-holders. Household characteristics such as having little income, a large household size, children, or a single female head of household are associated with having a higher housing cost burden (McClure, 2005). For example, the housing cost burden rate among single-female headed households with a voucher is 43% (McClure, 2005). Living in the south is also associated with a high housing cost burden, perhaps because families have less income from other sources due to low levels of welfare payments (McClure, 2005). Additionally, living in a region with a tight housing market can also increase the likelihood of experiencing a housing cost burden (Comey et al., 2012).

In sum, housing cost burden is common among voucher-holders and receiving a voucher does not appear to reduce the likelihood of experiencing this burden. Only one study examines housing cost burden among public housing and finds that, in this program, housing cost burden is extremely uncommon. No studies examine the potential causal relationship between public housing and housing cost burden. Additionally, because housing cost burden is particularly common among households with children, more research could be done exploring the associations between vouchers and public housing in a sample limited only to households with children.

Methodological Challenges

The existing studies highlight the methodological challenges of exploring the relationship between receiving housing assistance and educational outcomes. These

challenges occur in both measuring the independent and dependent variables as well as in the nature of longitudinal data. An additional concern is selection bias, whereby families who select into housing assistance may differ from families without assistance and these unmeasured differences may also be associated with children's educational outcomes.

Accurately measuring the receipt of housing assistance can be challenging as self-reports are often unreliable (Shroder, 2002). For example, there is a tendency for people to over-report living in public housing (Shroder, 2002). Misrepresentation of housing assistance receipt is found across multiple datasets including the Survey of Income and Program Participation, the Current Population Survey, and the American Housing Survey (Shroder, 2002).

Selection bias is also a concern when comparing families who receive housing assistance to those who do not. Families who receive housing assistance may be systematically different from those without it. This can be addressed by using instrumental variable models, as seen in Currie and Yelowitz (2000) and Newman and Harkness (2000). Currie and Yelowitz (2000) use sex composition of the children in the household as an instrument for public housing participation. They selected this instrument because it was correlated with public housing but not their two dependent variables, educational attainment and housing quality (Currie & Yelowitz, 2000). They deemed this an appropriate instrument because HUD rules dictate the number of bedrooms for which a family is eligible (e.g., a family with a boy/girl combination receives a larger unit than a family with two children of the same sex) (Currie & Yelowitz, 2000). Additionally, families with a sex composition entitling them to a larger unit are more likely to live in public housing (Currie & Yelowitz, 2000). Newman and

Harkness (2000) use a county-level measure of assisted housing availability per income-eligible households in that county.

Studies have been limited by data availability because few datasets include measures of both housing assistance and child-level outcomes. Consequently, multiple studies use school quality as a proxy for children's education (Ellen & Horn, 2012; Horn et al., 2014; Jacob, 2003). While school quality is calculated based on children's aggregated test scores, it is important to examine how housing assistance impacts individual, child-level education outcomes. Because housing assistance throughout childhood may matter for high school completion, examining this relationship requires rich longitudinal data.

Finally, as with any study design based on longitudinal data, attrition bias is a concern if respondents do not drop out of the study randomly (Miller & Hollist, 2007). Families that are unreachable for follow-up interviews are likely different from those who participate in each wave of data collection. Attrition bias can reduce both internal and external validity of analyses, creating biased estimates of the associations of interest as well as reducing the generalizability of the results (Miller & Hollist, 2007).

Hypotheses

Based on the theoretical discussion and the prior literature reviewed in the two sections above, the analyses will address the following hypotheses:

1) Children who receive either a voucher or live in public housing will be more likely to complete high school than other low-income children who do not receive housing assistance. Because of the flexibility afforded by a voucher, it is

anticipated that the effect size of receiving a voucher on high school completion will be larger than that for public housing.

2) Receiving either type of housing assistance for a short time will have a positive impact on high school completion compared to not receiving any assistance. The importance of timing of assistance receipt is unclear but receiving this assistance during early childhood may have the largest effect on high school completion because it may boost families into more stable economic situations.
3) Children in families renting with a voucher will access neighborhoods with similar levels of disadvantage as children without assistance. Children living in public housing are anticipated to live in more disadvantaged neighborhoods than children without assistance.
4) Children receiving either a voucher or public housing will experience increased residential stability though the effect size will be larger for children in public housing.
5) Children whose families either receive a voucher or live in public housing will experience less crowding than children in families without housing assistance.
6) Children living in public housing will experience reduced housing cost burdens compared to children in families without assistance. It is unclear whether children whose families rent with a voucher will be less likely to experience housing cost burdens.

Contribution of the Proposed Study

This study contributes to the existing literature both in terms of the research questions explored and the methods used to explore these questions. First, this project aims to clarify the association between housing assistance (overall and by assistance type) and high school completion. Second, this project fills a gap in the literature by examining the mechanisms through which housing assistance can impact educational outcomes. The type of housing assistance received may operate differently in terms of neighborhood disadvantage, housing stability, residential crowding, and housing cost burden. Furthermore, this study uses a nationally representative, longitudinal dataset with rich measures of child and family characteristics. Because of concerns about conceptualizing an instrument that is truly an exogenous shock, related only to the independent and not dependent variable in the study, the current study utilizes augmented inverse probability weighting to address selection bias and concerns about endogeneity for Question 1. For Question 2, fixed effects models examining changes within children over time address selection bias and endogeneity. This study also addresses concerns about measurement error associated with self-reported housing assistance receipt by using the Panel Study of Income Dynamics (PSID)'s Assisted Housing Database (AHD) which has geocoded all housing to determine whether or not the family lives in assisted housing. Through these methodological and substantive contributions, the current study may provide insight into the various ways in which housing assistance may be associated with high school completion.

Chapter 3: Methodology

This chapter describes the shared methodology for all research questions. As certain aspects of the research methods and measures vary by research question, subsequent chapters will provide detailed information about the measures and methods specifically used for each of those questions. These chapters will also include results for each question.

Data

Panel Study of Income Dynamics

This project utilizes the Panel Study of Income Dynamics (PSID) which is a large, nationally representative panel survey. Data collection for the PSID began in 1968 and initially oversampled low-income families with the intent to study poverty and evaluate President Lyndon Johnson's War on Poverty (Panel Study of Income Dynamics, 2015). The original PSID sample drew from two sources: the U.S. Census Bureaus' Survey of Economic Opportunity (SEO) and the University of Michigan's Survey Research Center (SRC). The SEO sample was comprised of 1,872 low-income families and the SRC sample was a nationally representative sample of 2,930 families; combined, these two samples formed a national probability sample of families. Thus, the initial sample included about 18,000 individuals in 5,000 families. Since the first wave of data collection, the sample has grown to about 24,000 individuals in 10,000 families.

PSID sample growth has occurred in multiple ways over the survey waves. One way in which the sample has grown is when sample persons, those who were living in PSID families when the survey began in 1968, gave birth to or adopted individuals (Panel

Study of Income Dynamics, 2015). About 300-400 children are born into the PSID sample each year. In addition to sample growth from these births and adoptions, the sample has also grown from the addition of a Latino sample (only followed from 1990 through 1996 because it did not represent all immigrant groups), a refresher sample of nationally representative immigrants (beginning in 1997) and household split-offs. A household split-off occurs when a sample person creates her own independent household. When a sample person creates her own family unit, any children she may have, by birth or adoption, are included in the PSID as sample persons and will be followed throughout their lives. The sample person's spouse is included in the PSID sample but is not considered to be a sample person; in the event that the sample person and her spouse divorce, the spouse will not be followed to his new household, unless one of the couple's children (who would be a sample person) is living in that household. However, children in these new households have only been followed since 1993. Family members who move to an institution such as college, prison, the military, or a nursing home are considered to have an institutional status and are still regarded as part of their original household unit, not as independent units. Due to significant sample growth and limited funding, the sample was reduced from about 8,500 families in 1996 to roughly 6,300 families in 1997; most of these cuts were made to the SEO sample though this sample has continued to grow through household split-offs.

From 1968 through 1997, PSID participants were interviewed annually; since 1997, interviews have been biannual (Panel Study of Income Dynamics, 2015). In the current study, in order to maintain the same number of observations across participants, regardless of the year they were born, data from every year for the first six years of the

child's life and then data from every other year will be used; this represents the number of waves at which children born latest in the sample were observed.

As with all longitudinal studies, concerns about attrition must be addressed. The PSID's policies addressing attrition have changed over time. From 1968 through 1991, only persons who had been interviewed in the previous wave were eligible to be interviewed in the next wave of interviews. This meant that people who were unable to be located in one wave were dropped from the sample unless they later joined another sample person's family unit. However, in 1992, new strategies were implemented in order to bring persons back into the sample. In this year, recontact efforts were made for original sample persons who had been nonresponsive in any wave prior to 1991. Due to the effectiveness of this strategy, beginning in 1993, efforts were made to recontact individuals who were lost in a previous wave (Panel Study of Income Dynamics, 2015). However, if the family was lost in two consecutive waves, they would no longer be followed. The numbers of families and individuals by sample type across the years studied in this project are detailed in Appendix 1.

PSID Assisted Housing Database

In addition to the detailed longitudinal data available in the main PSID, the PSID's restricted-use Assisted Housing Database (PSID-AHD) provides information on housing assistance for all family units in the PSID. The PSID-AHD has matched standardized addresses for each family unit from 1968 through 2009 to records of assisted housing. Housing units are classified as assisted if they are subsidized by either the state or federal government or if they are being rented using housing vouchers

(Newman & Schnare, 1997). The first category of assisted housing units are project-based and include those subsidized by HUD such as Section 8 New Construction and Substantial Rehabilitation, Low-Income Housing Tax Credit (LIHTC) projects, state-subsidized rental units, and housing developed using Rural Rental Housing Loans (Newman & Schnare, 1997). The second category includes vouchers from either the federal Section 8 program or other voucher programs (Newman & Schnare, 1997). The categories outlined by Newman and Schnare (1997) have been modified to align with this study's research questions. These modifications are discussed in detail for each question in the relevant measures sections of this dissertation.

The PSID-AHD was created by matching PSID families' addresses to a database of eight data sources (Newman & Schnare, 1997). These data sources were: the HUD Form 951 address file, the HUD CFS file, the Federal Rental Rehabilitation program, the National Housing Trust database, the HUD certificate and voucher file, the Farmers Home Administration, State housing finance agencies and departments of housing, and a LIHTC survey (Newman & Schnare, 1997). The PSID-AHD database was created through a multistep process which began with compiling all of the data from these sources, then proceeded to address validation through both the U.S. Postal Service and phone calls to property owners, housing agencies, and managers, and then went on to eliminate duplicate units (Newman & Schnare, 1997). Using these validated addresses from the PSID-AHD is important because housing assistance receipt is often misreported, both whether or not assistance was received and the type of assistance received (Shroder, 2002). For example, it is common for people receiving a housing voucher or living in project-based assistance (e.g., a Section 8 New Construction and Substantial

Rehabilitation project) to incorrectly report themselves as living in public housing (Shroder, 2002). For the purposes of this dissertation, these false-positive self-reports could lead to an over-count of people living in public housing and undercount of people receiving vouchers.

The LIHTC and other place-based housing programs are consolidated into one category in the Panel Study of Income Dynamics (2014) coding scheme. However, for this study, LIHTC developments and other project-based housing (other than public housing) were coded as receiving other housing assistance because of substantive differences between these funding sources compared to vouchers and public housing and concerns that these policies do not span the length of the study (e.g., the LIHTC program started in 1986, 16 years into the current study). Because of the heterogeneity of these programs, it would be difficult to draw conclusions about the role of specific place-based assisted housing policies from analyses including these housing units (Panel Study of Income Dynamics, 2014).

In this study, housing assistance is measured only from the PSID-AHD because of data limitations and bias in respondent self-reports of housing assistance receipt. While interview respondents do answer items about receiving a housing voucher or living in public housing, self-report of housing assistance receipt has been shown to be unreliable (Shroder, 2002). Furthermore, the PSID's measurement of housing assistance has varied over the years. Respondents were asked if their dwelling unit was in a public housing project in interviews from 1968 through 1972 and again from 1986 through the most recently collected data in 2013, but not for the years in between. For voucher receipt, respondents were asked if the government paid part of their rent from 1986 through 2013,

but not in prior years. Thus, self-report data for housing assistance receipt is not available for multiple years of interest.

PSID Geocoded Data

This study uses the 2010 Census geocode file which includes data from the 1968 through the 2013 wave geocoded to 2010 census tract boundaries. Addresses were collected by the PSID to mail materials to families. Addresses were geocoded by PSID staff using the SAS 9.4 proc geocode process.

There were several problems in geocoding families' addresses. According to PSID documentation, a substantial number of addresses were for post office boxes, rural routes, or general delivery, rather than the family's residence. Additionally, some of the address information provided by families was inaccurate or unable to be geocoded. From 1968 through 1985, respondents' physical address at the time of the interview was not preserved. To estimate addresses at these waves, the address file closest to the date of the interview was geocoded. Thus, because the geocoding of the PSID is imperfect, matches with census tract-level characteristics also reflect those imperfections.

Census Tract Data

Census-tract level data on all households and individuals in the United States are collected through the Census every ten years. Contextual data (census tract characteristics) from the 1970, 1980, 1990, and 2000 Census datasets were obtained from the Longitudinal Tract Database (LTDB) (Logan, Xu, & Stults, 2017). In these data, all tracts from 1970 through 2000 are assigned to 2010 census tract boundaries, allowing

these data to be merged into the PSID. Variables used from this data are: percentage of persons white, percentage of all persons in households with incomes below the federal poverty threshold, and median household rent. Because the Census is administered every ten years, Census data is applied to the nine years following each Census (e.g., data from the 1970 Census are assigned to all years from 1970 to 1979).

Sample

The sample for all research questions in this study is limited to children born between 1970 and 1992 in low-income, renter families. Sample sizes vary based on analyses and are detailed in the each research question's sample description. Families are categorized as low-income if their average income (from the child's birth through age fifteen) is at or below 200% of the federal poverty threshold. This permanent measure accounts for income fluctuation over time. It is also appropriate to use a permanent measure because families often spend years on waiting lists for housing assistance so may be less likely to add their name to a waiting list if they are experiencing a short spell of poverty. A detailed explanation of the permanent income calculation can be found in the next paragraph. The sample is further restricted to those whose families were interviewed at all waves from the child's birth through age 15 and at age 21. This restriction is used because from 1970 through 1991, families who were not interviewed in a given year were ineligible to be interviewed in subsequent years (Panel Study of Income Dynamics, 2015). While 1992 changes to the study procedure did mean some of these families were able to be recontacted and followed at that time (Panel Study of Income Dynamics, 2015), the missing data from these youths' childhoods is critical for

these analyses. The sample size varies in the analyses for each pathway due to variations in missing data on the dependent variables.

As mentioned, the sample will be limited to children whose families had average incomes at or below 200% of the federal poverty threshold from the child's birth through age 15. To calculate these average incomes, first, families' income to poverty ratio for each year from the child's birth through age 15 is calculated accounting for family size. Then, their income to poverty ratio across these years is averaged. Families with an average income at or below 200% of the federal poverty threshold are included in the sample.

Structure of Subsequent Five Chapters

The next five chapters examine each research question separately. Chapters are structured with 1) statement of the specific questions answered in the chapters; 2) measures; 3) analytic strategy; 4) results; 5) sensitivity analyses; and 6) summary of results. The findings from each chapter will be synthesized in the discussion in Chapter 9.

Chapter 4: Housing Assistance and Educational Attainment

Research Question

This section explores the association between housing assistance receipt and high school completion. First, is receiving any housing assistance associated with high school completion? Second, does this association vary depending on which type of assistance (public housing or voucher) was received? Third, does when the housing assistance was received during childhood received impact this association? Lastly, does the duration of housing assistance matter for this association?

Sample

The sample for these analyses includes 1,069 children born between 1970 and 1992 to families that reported renting their home at at least one wave from birth to age 15 and had permanent incomes at or below 200% of the federal poverty line.

Measures

Housing Assistance

For this question, housing assistance is measured in several ways to address the importance of any housing assistance and the timing and duration of assistance. Each measure accounts for housing assistance receipt over the first fifteen years of the child's life. In the main model, examining the association between housing assistance receipt and high school completion, housing assistance is measured categorically: no housing assistance, public housing only, voucher only, and combination of assistance/other

assistance program. Children are coded as having had a combination of assistance if they received assistance from more than one program from birth to age 15.

Housing assistance is measured using the PSID-AHD, described in detail in Chapter 3. For the purposes of this study, Chapter 3. For the purposes of this study, housing assistance is coded categorically (1=did not receive any housing (1=did not receive any housing assistance; 2=received a housing voucher from a local or federal program; 3=lived in federal program; 3=lived in public housing; 4=combination of a voucher and public housing; and 5=other housing housing; and 5=other housing assistance). This coding scheme is based on the Assisted Housing Database Codebook Housing Database Codebook (Panel Study of Income Dynamics, 2014). From 1995 through 2009, addresses were through 2009, addresses were coded into five categories: no match for the year using the coding scheme (did not coding scheme (did not receive assistance); public housing; other project-based housing, including LIHTC; tenant- including LIHTC; tenant-based housing, primarily vouchers; and farmers home, state-assisted housing (Panel Study of assisted housing (Panel Study of Income Dynamics, 2014). From 1970 through 1994, addresses were coded into seven addresses were coded into seven categories: no match for that year using this coding scheme (did not receive scheme (did not receive assistance); LIHTC; public housing; other federal subsidies; state subsidies; Farmers Home subsidies; Farmers Home Administration Subsidies; and unknown (Panel Study of Income Dynamics, 2014).

Income Dynamics, 2014).

Appendix 2 illustrates the sorting of each of these response choices into the present study's categories for this variable. Families are coded as receiving either a voucher or living in public housing if they experienced one of these conditions in at least one year of data collection from the child's birth through age fifteen. Housing assistance is measured up to age 15 to encompass all three stages of childhood (early, middle, and late) (Brooks-Gunn, Duncan, & Maritato, 1997).

Duration of Housing Assistance

In addition to measuring whether a child's family *ever* received housing assistance from the child's birth through age fifteen, another measure of housing assistance in these analyses is the duration of assistance. The number of years receiving any housing assistance is constructed to include all children who received housing assistance, whether one type or a combination. Two additional continuous variables are constructed in order to examine the association of duration of housing assistance receipt with high school completion and to assess the differences between housing assistance types: years living in public housing and years receiving a housing voucher. These constructs measure the number of years during which a family received assistance and are created by summing the number of years in which housing assistance was received from the child's birth through age fifteen. The reference category for the number of years of each type of assistance is zero years receiving that assistance. It is important to note that if a child never received a given type of housing assistance, it is possible that they received some other type of assistance. For example, even though a child may not have received a voucher, they could have lived in public housing.

Timing of Housing Assistance

In addition to understanding the importance of ever having received housing assistance and the length of time for which that housing assistance was received, it is also critical to understand the role of timing in the relationship between receiving assistance and high school graduation (Newman & Harkness, 2000). There are several possible ways to model timing of assistance and, in order to fully understand the impact of timing, multiple strategies are tested.

First, the timing of assistance is examined based on three stages of childhood. These three stages, (1) early childhood: birth through age five; (2) middle childhood: ages six through ten; and (3) later childhood: ages eleven through fifteen, reflect childhood developmental stages that have been identified as important in prior literature because children experience major transitions during these periods (Brooks-Gunn et al., 1997). Children who received housing assistance during at least one year in a developmental stage will be coded as having received housing assistance during that stage.

Two sets of models are run to understand whether receiving housing assistance in each of these periods individually is of particular importance. In the first set, a series of dummy variables are created: housing assistance in early childhood (1=yes, 0=no), middle childhood (1=yes, 0=no), and late childhood (1=yes, 0=no). Next, models use a categorical measure of housing assistance indicating every possible combination of housing assistance receipt (0=no assistance; 1=early; 2=middle; 3=later; 4=early and middle; 5=early and later; 6=middle and later 7=all stages).

Second, recent research indicates that age 12 may be a particularly important developmental milestone (Chetty, Hendren, & Katz, 2016). Thus, timing is also explored as childhood (younger than age 12) and adolescence (age 12 and older). Again, these variables are explored both categorically (0=no housing assistance; 1=housing assistance in childhood only; 2=housing assistance in adolescence only; 3=housing assistance in both childhood and adolescence) and using dummy variables for housing assistance in childhood (1=yes, 0=no) and housing assistance in adolescence (1=yes, 0=no).

High School Completion

High school completion, the outcome in this study, is measured as a dichotomous variable (1=youth completed high school; 0=youth did not complete high school). In order to account for the biannual interview schedule, this variable is coded based on data collected when the youth was 21 or 22. Age 21 (or 22) data for each youth are used because youth receiving special education services are able to stay in school either until age 21 or until they graduate, whichever comes first (United States Congress, 2004). The high school completion variable is recoded from the item asking how many years of schooling were completed. If the value for this variable is greater than or equal to twelve, the youth is coded as having completed high school; if the value is less than twelve, the individual is coded as having dropped out of high school.

Youth who pass the General Educational Development (GED) are coded as having completed high school as is the convention in literature in this area (Rumberger & Lim, 2009).[1] This decision was made primarily due to data limitations: the PSID does not differentiate between GED attainment and high school graduation. This is a limitation of

[1] High school graduation typically includes only receiving a high school diploma while high school completion includes either receiving a high school diploma and GED attainment (Rumberger & Lim, 2009).

the study because the literature shows that high school diplomas and GEDs are not equivalent: those with GEDs have lower performance on psychometrics tests, lower wages, and attend different types of postsecondary education than people with high school diplomas (Cameron & Heckman, 1993).

Covariates

A rich set of individual, family, and census tract variables are included as covariates in these analyses. All covariates are measured as the child's birth in an effort to ensure that they occurred prior to treatment (housing assistance receipt).

At the child-level, sex and low birthweight are included in all models. Additionally, because availability (and type) of housing assistance and likelihood of completing high school may vary across the time period included in the study (1970 through 2009), the year in which the child was born is also controlled for.

A set of variables indicating the socioeconomic status of the family, all measured at the time of the child's birth, is also included. These variables include the mother's education (less than high school, high school, and some college or higher) and age, the head of household's race, if the mother had formed her own independent household (regardless of partnership status), if there was a male head of house, whether the family was receiving cash assistance, and the household's income to poverty ratio.

Because there is local variation in both housing assistance receipt and high school completion, several geographic indicators are included. These variables include the region in which the child was born (Northeast, Midwest, South, and West) and several

census tract measures (percentage of population in poverty, percentage of population that is minority, and median rent).

Analytic Strategy

Models are estimated using both logistic and ordinary least squares (OLS) linear probability models (LPM) regression. Because the results from the models are similar, the results from the linear probability models are presented. Compared to results from logistic regression models, OLS results are easier to interpret, more flexible with interaction effects (Ai and Norton 2003), and allow for more clear comparison of coefficients across models (Karlson, Holm, and Breen 2012). Importantly, OLS models typically provide unbiased estimates of dichotomous outcomes when the probability is between 0.2 and 0.8 (Angrist and Pischke 2008, Hellevik 2009, Von Hippel 2015).

Estimating Causal Effects

Endogeneity is a concern with the current study and can interfere with making causal claims. Because the data used in this study are not from a random experiment, there are several statistical techniques that can be used to address endogeneity and estimate causal effects. Three such approaches, instrumental variables, propensity score matching, and inverse probability weighting (IPW), were considered for the current study. Each approach is discussed below.

In an instrumental variable approach, an instrument serves as an exogenous shock. This instrument must be associated only with the independent, not dependent, variable (Elwert, 2016). Prior research examining the association between housing

assistance and educational attainment has used county-level measure of assisted housing availability per income-eligible households (Newman & Harkness, 2000) and sex composition of the children in the household (Currie & Yelowitz, 2000) as instruments. There are two limitations to using similar approaches in the current study. First, it is very challenging conceptually to conceive of an instrument that is truly an exogenous shock because housing and neighborhoods are highly correlated with, and inform, school quality and student achievement. Further, reverse causality is an issue because the quality of schools affect the housing market (e.g., Kane, Riegg, & Staiger, 2006). Second, replicating the instruments used in prior research would be challenging with the current study design. Both sex composition of the children in the household and availability of housing assistance at the county level can, and would be expected to, change between the time of the child's birth and when they completed high school. Because an instrumental variable should be measured before the independent variable, these possible instruments do not seem strong. Based on these concerns, using an instrumental variable strategy is not appropriate for the current study.

Propensity score matching (PSM) aims to ensure that the comparison group in regression analyses is truly comparable to the treated group and, thus, can act as a control group. However, there are several concerns with this approach. It is typical for PSM to use one-to-one matching (Austin, 2011). When used in this manner, only observations that can be matched are kept. This is a limitation of this method, particularly for this study. Because only about a third of the sample received any type of housing assistance during childhood and a third of the sample would be matched to that group, the final third

would not be included in the analyses, significantly reducing the sample size. Further, it is rare for data to be balanced enough to ensure strong matches (King & Nielson, 2016).

Inverse probability weighting (IPW) addresses concerns about PSM while still reducing selection bias and helping move towards estimating causal effects by removing potential confounders (Hernán & Robins, 2006). IPW strategies weight observations based on their propensity scores, allowing all observations to remain in the analytic sample. IPW, first, uses a logistic regression model to predict the probability of treatment exposure for each person. This predicted probability is then used as a weight in subsequent analyses. A concern about using this weighting method is that it can increase random error in the estimates and bias standard errors downward (Freedman & Berk, 2008). Another concern is that treated observations that have very low propensity scores may have outsized weights (Austin & Stuart, 2015).

In spite of its limitations, IPW appears to be the best fit for the current study: it is a more rigorous technique than PSM and a strong alternative to using an instrumental variable. To improve the estimation of IPW models, models are estimated using Stata 13's teffects aipw command which utilizes augmented inverse-probability weights (AIPW), a doubly robust approach that predicts both the treatment and outcome and addresses model misspecification (StataCorp., 2013).

Models Estimated

Several models are estimated to explore the association between housing assistance and high school completion. The first four models are estimated using OLS regression with robust standard errors (clustered at the household level, to adjust for

multiple children in a household). The first model examines the association between any housing assistance and high school completion. The second model tests the association between housing assistance type (which allows for the comparison of public housing only and voucher only to receiving no housing assistance). The third model explores the years of receiving any type of housing assistance and high school completion. Next, the fourth model examines the association between the years of each type of housing assistance and high school completion.

Further models use OLS estimation to discern whether the timing of housing assistance receipt predicts high school completion. The associations between housing assistance receipt at each stage of childhood (early, middle, and late), combinations of stages of childhood, any housing assistance in childhood and adolescence, and housing assistance type in childhood and adolescence, and high school completion are estimated.

Lastly, additional models are estimated using AIPW. These models examine the associations between any housing assistance, public housing, and vouchers and high school completion.

Results

Descriptive Statistics

Table 1 presents descriptive statistics of housing assistance receipt for the sample. The sample includes 1,069 children of whom just over a third (37.0%) received housing assistance. This assistance was primarily distributed between two housing programs: public housing and vouchers. Assistance types, however, are not mutually exclusive – children could have received more than one type of assistance over childhood. Of the

sample, 18.4% lived in public housing at some point during childhood while 20.9% received a housing voucher. About 5% of the sample received another type of assistance such as through a local assistance program or living in a Low-Income Housing Tax Credit-financed building.

Table 1: Descriptive statistics: housing assistance prevalence (n=1,069)

Housing Assistance Prevalence (birth through age 15)	%	n
Any Housing Assistance	37.04	396
Public Housing	13.10	140
Voucher	14.78	158
Another Type of Housing Assistance	9.17	98

Table 2 presents housing assistance receipt during each developmental stage. Children were somewhat more likely to live in households receiving housing assistance when they were in early childhood (23.4%) or late childhood (24.9%) compared to middle childhood (17.5%). Similarly, children are more likely to live in a household receiving housing assistance during childhood (through age 11), 29.4%, than during adolescence (ages 12 through 15), 21.6%.

Table 2: Housing assistance receipt at developmental stages (n=1,069)

Housing Assistance Receipt at Developmental Stages	%
Early Childhood (through age 5)	23.39
Middle Childhood (ages 6-10)	17.49
Late Childhood (ages 11-15)	24.98
Pre-adolescence (through age 11)	29.37
Adolescence (ages 12-15)	21.61

Table 3 presents the average years of housing assistance receipt for the full sample. The mean number of years of housing assistance receipt is 1.6 (SD=2.8) with variation by program [0.9 years in public housing (SD=2.4) and 0.6 years with a voucher (SD=1.5)]. Because most children in the sample do not receive any type of housing assistance, the median number of years of housing assistance receipt for housing assistance overall and each type of assistance is 0. The mean number of years without housing assistance in the sample is 9.4 (median=11). Table 4 presents the length of time receiving housing assistance among those who received housing assistance (n=396). As shown, the duration of assistance receipt varied. The average duration of housing assistance receipt was 4.4 years (SD=3.0). There were differences in duration of assistance by type: in public housing, average duration was 2.5 years (SD=3.5) compared to 1.6 years (SD=2.2) for vouchers.

Table 3: Years of housing assistance (n=1,069)

Years of Assistance	Mean	SD	Median
Average Years with Any Housing Assistance	1.63	2.82	0.0
Average Years with Public Housing	0.92	2.37	0.0
Average Years with a Voucher	0.60	1.55	0.0
Average Years with Another Type of Housing Assistance	0.11	0.58	0.0
Average Years without Housing Assistance	9.36	2.82	11.0

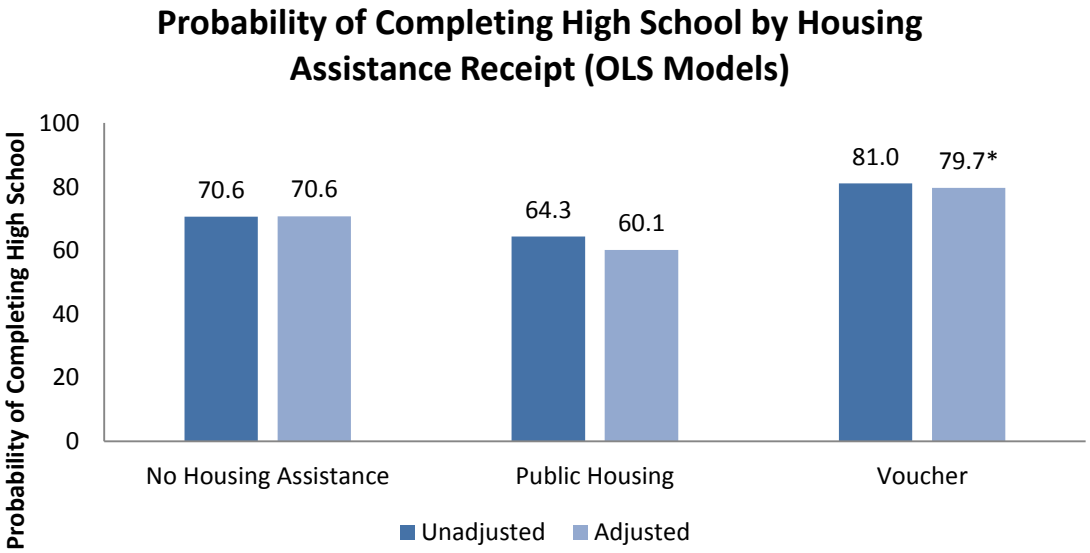
Table 4: Number of years receiving assistance (birth through age 15), among those who received assistance (n=396)

Number of Years Receiving Assistance, if Any Assistance was Received (n=396)		
	Mean	**SD**
Any Housing Assistance	4.41	3.04
Any Public Housing	2.49	3.35
Any Voucher	1.62	2.20
Any Other Housing Assistance	0.30	0.92

High School Completion

Descriptively, the probability of completing high school varies by housing assistance status in childhood, as seen in Figure 2. Among children who did not receive housing assistance, without adjusting for possible confounders, 70.6% completed high school. This percentage remains the same when adjusted for possible confounding factors. Among children who lived in public housing at some point during childhood, and did not receive any other type of housing assistance, 64.3% completed high school (60.1% after adjusting for confounders). Among children who received only a voucher during childhood, high school completion rates were higher than in the full sample and among public housing recipients: 81.0% in unadjusted models and 79.7% in adjusted models.

Figure 2: Probability of completing high school by housing assistance type



*Notes: These analyses test the difference in high school completion by housing assistance types. Unadjusted probabilities are from bivariate OLS analyses and adjusted probabilities control for baseline family, child, and neighborhood characteristics. *p<0.05*

Other Characteristics

Descriptive statistics are presented in Table 5. The full sample is fairly disadvantaged with about half (50.1%) of the children's mothers having less than a high school degree at the time of the child's birth and household incomes at birth that were just over the poverty line (with an income to poverty ratio of, on average, 1.1). Half (50.0%) of the children were born to single mothers. Mothers had an average age of 30.0 years old at birth. About three-quarters (74.9%) of the sample is non-Hispanic black and 21.1% non-Hispanic white.

Children in the sample were most likely to be living in the South at the time of birth (52.3%) followed by the Midwest (26.5%), Northeast (10.9%), and West (10.4%). This distribution is reflective of the inclusion of the Survey of Economic Opportunity sample which oversamples low-income families and poverty rates in the South are higher than other regions of the country. At birth, children lived in census tracts where about a quarter (24.8%) of the population lived in poverty. About two-fifths (41.9%) of the population in the census tracts were white and the median rent was $143.66. There is significant variation in median rents over time and place. For example, the median rent in 1970 for the sample was $73.69 compared to $274.30 in 1992. Children born in the West had the highest median rents at birth ($188.00) while children born in the South had the lowest ($131.43).

Children who received housing assistance differed on several characteristics from children who did not receive housing assistance. Children in families with housing assistance were more likely to be black and, at birth, to have been living with a single mother and receive cash assistance. They were also more likely to live in a poor

household, in a poor and less white census tract with a higher median rent. There is no significant difference in the likelihood of completing high school between these groups.

There were also significant differences between children who received only public housing and those who received only a voucher. Children receiving a voucher were significantly more likely to complete high school than those who lived in public housing. Children who received public housing at some point in childhood lived in census tracts at birth with poverty rates twice those of children who received a voucher at some point during childhood. The mean rent in the census tracts of children who lived in public housing at some point was also slightly higher than that for children who received a voucher at some point.

Table 5: Descriptive statistics and statistical tests by housing assistance receipt

	Full Sample (n=1,069)	SD	Any Housing Assistance (n=396)	SD	No Housing Assistance (n=673)	SD	Sig. Test (Compar-ing Any HA w/ None)	Public Housing Only (n=140)	SD	Voucher Only (n=158)	SD	Sig. Test (Compar-ing Voucher w/ Public Housing)
Completed High School	71.56		72.23		70.58			64.29		81.01		*
Baseline Covariates												
Female	50.61		52.27		49.63			51.43		53.80		
Low Birth Weight	3.09		3.54		2.82			‡		‡		
Mom's Education												
Less than High School	50.05		50.76		49.63			61.43		46.20		
HS	27.32		24.75		28.83			18.57		28.48		
Some College of Higher	22.64		24.49		21.55			20.00		25.32		
Mom was Head or Wife of Her Own Household	47.99		58.08		42.05		*	56.43		56.96		
Male Head of Household	23.95		26.01		22.73			23.57		29.11		
Race							*					
White, non-Hispanic	21.05		8.59		28.38			‡		13.92		
Black, non-Hispanic	74.93		88.89		66.72			93.57		81.65		
Other	4.02		‡		4.90			‡		‡		
Region							*					
Northeast	10.85		11.11		10.70			12.14		‡		
Midwest	26.47		16.92		32.10			12.14		21.52		
South	52.29		61.62		46.81			67.14		56.86		
West	10.38		10.35		10.40			‡		12.66		
Received Cash Assistance	31.34		36.62		28.23		*	34.29		37.97		
Mom's Age	29.97	10.73	30.22	10.97	29.83	10.59		29.38	10.01	30.17	11.03	
Income to Poverty Ratio	1.10	0.79	1.00	0.75	1.16	0.80	*	0.96	0.66	1.05	0.80	

Mean % in Poverty (Census Tract)	24.83	14.29	27.76	15.91	23.10	12.95	*	31.59	16.47	23.34	15.05	*
Mean % White (Census Tract)	41.93	37.90	33.40	34.90	46.95	38.72	*	29.59	33.69	40.14	36.16	
Median Rent (Census Tract)	143.66	93.45	151.72	98.03	138.92	90.39	*	112.55	80.43	176.26	108.42	*

*Notes: *p<0.05, **p<0.01, ***p<0.001; ‡ sample size too small to report*

Multivariate Results

Table 6 presents the multivariate results of models exploring the association between housing assistance (any and by type) and high school completion. All models are estimated using OLS regression with robust standard errors (to address having multiple children in a family). Model 1 estimates the association between receiving any housing assistance and high school completion. In this model, housing assistance receipt is not a significant predictor of high school completion: children who received any type of housing assistance during childhood are no more or less likely to complete high school than comparable low-income children who did not receive housing assistance at some point during childhood.

Model 2 explores the association between the type of housing assistance received (public housing only, voucher only, compared to no housing assistance) and high school completion. In this model, receiving a voucher only is associated with a 9 percentage point increase in high school completion compared to not receiving any type of housing assistance. Living in public housing only is not significantly different from not receiving housing assistance in terms of high school completion. In sum, children who rented with a voucher at some point during childhood are significantly more likely to complete high school than low-income children who never received housing assistance. Controlling for all covariates, children who lived in public housing during childhood are as likely to have completed high school as other low-income children who did not receive any housing assistance.

Across all models, several covariates are significantly associated with high school completion. Females with more highly educated, older mothers, higher income to poverty

ratios, and who lived in census tracts with a higher proportion of white residents at birth are more likely to complete high school. Children living in the Midwest or South at birth are less likely to complete high school than children living in the Northeast.

Duration of Assistance

Models 3 and 4, presented in Table 6, examine the association between the length of housing assistance receipt, first by years of any housing assistance (Model 3) and next by years of housing assistance for each housing assistance type with high school completion. The number of years housing assistance was received is not statistically significantly associated with high school completion, nor is the number of years each type of housing assistance (public housing and voucher) was received.

Across all models, being female, having a mother who at least completed high school (compared to did not complete high school), and having a higher income are significantly associated with being more likely to complete high school. While the relationships between completing high school and the mother's age and living in a census tract with a higher percentage of white residents are significant and positive, the coefficients are very small. Living in the Midwest or South is associated with a lower likelihood of completing high school compared to living in the Northeast.

It is important to consider these findings in conjunction with the findings from the main analyses. In the main analyses, receiving a voucher is significantly associated with a 9 percentage point increased likelihood of completing high school. Children who live in public housing are no more or less likely to complete housing assistance than other low-income children who do not receive housing assistance during childhood. While

receiving a voucher significantly predicts high school completion, the number of years housing assistance was received does not appear to be significant. The duration of voucher receipt is further explored in sensitivity analyses.

Table 6: OLS models of high school completion on housing assistance (n=1,069)

	Model 1: Any Housing Assistance)			Model 2: Type of Housing Assistance			Model 3: Years of Housing Assistance			Model 4: Years of Housing Assistance by Type		
Independent Variables												
Any Housing Assistance	0.03		(0.89)									
Housing Assistance Type (comparison group: no assistance)												
Public Housing Only				-0.01		(-0.34)						
Voucher Only				0.09	*	(2.25)						
Years of Any Housing Assistance							0.00		(0.55)			
Years of Housing Assistance by Type												
Public Housing										0.00		(0.55)
Voucher										0.00		(0.51)
Baseline Covariates												
Female	0.07	**	(2.83)	0.08	**	(2.81)	0.08	**	(2.84)	0.08	**	(2.84)
Low Birthweight	0.06		(0.76)	0.06		(0.740	0.06		(0.73)	0.06		(0.73)
Mom's Education (comparison group: <high school)												
High School or GED	0.13	***	(3.87)	0.13	***	(3.79)	0.13	***	(3.87)	0.13	***	(3.87)
Some College or Higher	0.14	***	(3.84)	0.14	***	(3.82)	0.14	***	(3.87)	0.14	***	(3.87)
Male Head of Household	-0.01		(-0.44)	-0.01		(-0.44)	-0.02		(-0.48)	-0.02		(-0.47)
Received Cash Assistance	0.00		(0.14)	0.00		(0.08)	0.01		(0.16)	0.01		(0.16)
Mom's Age	0.00	*	(2.43)	0.00	*	(2.50)	0.00	*	(2.36)	0.00	*	(2.36)
Mom was Head or Wife of Her Own Household	0.08		(1.78)	0.09		(1.93)	0.80		(1.71)	0.08		(1.70)
Income to Poverty Ratio	0.06	**	(2.87)	0.06	**	(2.86)	0.06	**	(2.86)	0.06	**	(2.86)
Race (comparison group: white)												
Black	0.02		(0.43)	0.02		(0.51)	0.02		(0.46)	0.02		(0.43)
Other	-0.06		(-0.81)	-0.07		(-0.89)	-0.06		(-0.81)	-0.06		(-0.80)

Region (Comparison group: Northeast)												
Midwest	-0.12	*	(-2.44)	-0.13	**	(-2.62)	-0.12	*	(-2.49)	-0.13	*	(-2.48)
South	-0.10	*	(-2.09)	-0.11	*	(-2.28)	-0.10	*	(-2.09)	-0.10	*	(-2.08)
West	-0.10		(-1.55)	-1.00		(-1.66)	-0.10		(-1.54)	-0.10		(-1.53)
Mean % in Poverty (Census Tract)	0.00		(0.74)	0.00		(0.89)	0.00		(0.74)	0.00		(0.72)
Mean % White (Census Tract)	0.00	**	(3.01)	0.00	**	(3.03)	0.00	**	(3.01)	0.00	**	(2.98)
Median Rent (Census Tract)	0.00		(-0.68)	0.00		(-0.85)	0.00		(-0.65)	0.00		(-0.67)

** p<0.05, **p<0.01, ***p<0.001*

Notes: Numbers presented are regression coefficients and t-statistics in parentheses. Models also control for year of birth (1970-1992) using dummy variables.

Timing of Assistance

The results from each of the timing models are presented in Table 7. Model 1 includes dummy variables of housing assistance receipt at each stage. In this model, receiving housing assistance is not a significant predictor of high school completion at any stage. However, the coefficients are positive in early and middle childhood and negative in late childhood. Model 2 presents housing assistance receipt at combinations of childhood stages. Again, in these models, none of the combinations of timing of housing assistance receipt are significant and, in all combinations other than early and late childhood, the coefficients are positive. Next, Model 3 presents results which include dummy variables for housing assistance receipt in childhood and adolescence. Again, these results are not significant. Interestingly, the coefficient for receiving housing assistance in childhood is positive while the coefficient for receiving assistance in adolescence is negative. Finally, in Model 4, the timing of housing assistance (childhood and adolescence) by housing assistance type is explored. As in Models 1 through 3, these results are not significant. The coefficient of receiving public housing in childhood is negative (receiving a voucher is positive) and then the signs of these coefficients change in adolescence: public housing has a positive coefficient and vouchers have a negative coefficient. In sum, there are no significant findings in these models about the timing of housing assistance receipt and high school completion. However, this may be a function of the low power in these analyses due to the small sample size.

Table 7: OLS models of timing of housing assistance & high school completion (n=1,069)

	Model 1: Housing Assistance at Each Stage		Model 2: Housing Assistance at Combinations of Childhood Stages		Model 3: Housing Assistance During Preadolescence and Adolescence		Model 4: Housing Assistance During Preadolescence and Adolescence by Type	
Independent Variables								
Housing Assistance (Specific Stages)								
HA at Early Childhood	0.01	(0.30)						
HA at Mid Childhood	0.03	(0.67)						
HA at Late Childhood	-0.02	(-0.42)						
Housing Assistance (Comparison Group: No Assistance)								
HA at Early Childhood			0.05	(0.94)				
HA at Mid Childhood			0.02	(0.17)				
HA at Late Childhood			0.02	(0.37)				
HA at All Three Waves			0.00	(0.01)				
HA at Early & Mid Childhood			0.09	(1.11)				
HA at Early & Late Childhood			-0.03	(-0.37)				
HA at Mid & Late Childhood			0.06	(0.84)				
Housing Assistance in Preadolescence					0.03	(0.97)		
Housing Assistance in Adolescence					-0.02	(-0.51)		
Housing Assistance in Childhood (by Type)								
Public Housing Only							-0.04	(-0.81)
Voucher Only							0.06	(1.36)
Other Assistance or Combination							0.14	(1.26)
Housing Assistance in Adolescence (by Type)								
Public Housing Only							0.05	(0.73)
Voucher Only							-0.03	(-0.56)

Other Assistance or Combination									-0.07		(-0.86)
Baseline Covariates												
Female	0.08	**	(2.83)	0.07	**	(2.76)	0.08	**	(2.84)	0.08	**	(2.87)
Low Birthweight	0.06		(0.72)	0.07		(0.84)	0.06		(0.71)	0.05		(0.68)
Mom's Education (comparison group: < high school)												
High School or GED	0.13	***	(3.90)	0.13	***	(3.77)	0.13	***	(3.89)	0.13	***	(3.93)
Some College or Higher	0.14	***	(3.87)	0.14	***	(3.75)	0.14	***	(3.84)	0.14	***	(3.94)
Male Head of Household	-0.02		(-0.46)	-0.01		(-0.41)	-0.01		(-0.41)	-0.01		(-0.42)
Received Cash Assistance	1.00		(0.18)	0.01		(0.17)	0.01		(0.20)	0.01		(0.23)
Mom's Age	0.00	*	(2.38)	0.00	*	(2.46)	0.00	*	(2.46)	0.00	*	(2.2)
Mom was Head or Wife of Her Own Household	0.08		(1.73)	0.09		(1.84)	0.08		(1.78)	0.07		(1.53)
Income to Poverty Ratio	0.06	**	(2.83)	0.06	**	(2.79)	0.06	**	(2.82)	0.06	**	(2.72)
Race (comparison group: white)												
Black	0.02		(0.45)	0.02		(0.42)	0.02		(0.43)	0.02		(0.41)
Other	-0.07		(-0.84)	-0.07		(-0.84)	-0.07		(-0.85)	-0.07		(-0.91)
Region (Comparison group: Northeast)												
Midwest	-0.13	*	(-2.48)	-0.13	*	(-2.46)	-0.13	*	(-2.49)	-0.13	*	(-2.55)
South	-0.10	*	(-2.06)	-0.10	*	(-2.11)	-0.10	*	(-2.08)	-0.10	*	(-2.07)
West	-0.09		(-1.50)	-0.09		(-1.50)	-0.10		(-1.54)	-0.10		(-1.54)
Mean % in Poverty (Census Tract)	0.00		(0.73)	0.00		(0.74)	0.00		(0.71)	0.00		(0.75)
Mean % White (Census Tract)	0.00	**	(2.98)	0.00	**	(2.97)	0.00		(2.95)	0.00	**	(2.93)
Median Rent (Census Tract)	0.00		(-0.62)	0.00		(-0.63)	0.00		(-0.62)	0.00		(-0.64)

** p<0.05, **p<0.01, ***p<0.001*

Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born
Abbreviations in table: HA – housing assistance

Addressing Selection Bias: AIPW Models

Augmented inverse probability weighted (AIPW) models, presented in Table 8, were estimated to address possible selection bias that could affect both housing assistance status and high school completion. These models are similar to the main models and find that receiving any housing assistance is associated with a greater likelihood of completing high school. This effect, however, seems to be driven by voucher receipt. Individuals who receive a voucher at some point during childhood have an 81% predicted probability of completing high school compared to 71% among children without a voucher. In this model, receiving public housing is associated with a significantly lower likelihood of completing high school compared to not receiving public housing (67% compared to 72%). This difference was not significant in the main models but this could be due to different comparison groups (no public housing in the AIPW models versus no housing assistance in the main models).

Table 8: Augmented inverse probability weighted models of high school completion on housing assistance (n=1,069)

	Predicted High School Completion		
No Housing Assistance	0.70		(39.59)
Any Housing Assistance	0.73	***	(28.06)
No Public Housing	0.72		(46.82)
Any Public Housing	0.67	***	(16.43)
No Voucher	0.71		(45.84)
Any Voucher	0.81	***	(28.22)

** p<0.05, **p<0.01, ***p<0.001*
Note: regression coefficients from fully controlled models with z-statistics in parentheses. Models control for all covariates included in main models.

Sensitivity Analyses

A series of sensitivity analyses were conducted in an effort to better understand the relationship between housing assistance receipt and high school completion. Tables for all analyses referenced in this section are included in Appendix 3.

Different subgroups of the sample are explored to ascertain whether the association between housing assistance and high school completion is more salient among certain subgroups. First, this association is explored for children who were persistently poor across childhood because these children may particularly benefit from housing assistance. In these models, receiving a voucher approaches significance (p=.10) in predicting high school completion. Second, housing assistance type is interacted with the mother's education in instances where the mother was the head of her own household at the child's birth. In these models, the main effect of each housing assistance type is not significant. Next, analyses were limited only to children whose mothers had established their own household at the time of the child's birth. Results from these analyses are similar to those in the main models: receiving any housing assistance is not associated with high school completion but receiving a voucher, compared to no assistance, is marginally associated (p=0.06) with an 8.7 percentage point increase in completing high school.

Building on Models 1 and 2 of Table 6 which show that only receiving a voucher is significantly associated with high school completion, and Model 4, which suggests that the duration of receiving a voucher is not important for its relationship with high school completion, this relationship is analyzed with a categorical measure of the duration of voucher receipt. Voucher receipt is coded into three categories, zero years (78.9%), one

to two years (12.4%), and three or more years (8.79%) with zero years as the reference category. Receiving a voucher for one to two years, compared to not receiving a voucher, is marginally associated with a 7.3 percentage point increase in completing high school (p=0.08). In addition to controlling for all covariates specified in prior models, these analyses also control for the number of years of public housing assistance because this variable may also affect the relationship between voucher receipt and high school completion.

Summary of Results

The results presented in this section indicate that housing assistance, overall, is not significantly associated with high school completion. However, analyses by housing assistance type show that children who receive a voucher at some point during childhood have a higher probability of completing high school than children who do not receive housing assistance. Children who live in public housing have the same likelihood of completing high school as other low-income children without assistance, after controlling for a rich set of baseline child, family, and census tract characteristics. The timing and duration of housing assistance receipt are not significantly associated with high school completion in this sample which may be due to sample size. Sensitivity analyses that probe the duration of voucher receipt suggest that receiving a voucher for a short period of time (one to two years), compared to not receiving a voucher, is a significant predictor of high school completion while receiving a voucher for a longer duration (three or more years) is not significant. Taken together, the results in this section suggest that receiving a

voucher for a short period of time may increase low-income children's likelihoods of completing high school.

Chapter 5: Housing Assistance and Neighborhood Disadvantage

Research Question

This section explores the association between housing assistance receipt and the neighborhoods to which children have access. First, these associations are examined looking at housing assistance overall and then they are explored by housing assistance type (vouchers and public housing).

Measures

The main independent and dependent variables are measured in each survey wave across childhood. In order to account for the PSID's switch from annual to biannual interviewing, time-varying variables (housing assistance receipt, neighborhood qualities, and covariates) are measured at each year from the child's birth to age six and biannually from ages seven to fifteen.

Housing Assistance

Housing assistance is measured annually, from birth to age six and biannually from ages seven to fifteen, using the PSID-AHD and is coded using two coding schemes. In the first set of analyses, housing assistance is coded in each wave of the data as a binary variable (received assistance or did not receive assistance). In the next set of analyses, housing assistance is coded as a categorical variable at each wave. The categories for this variable are: no housing assistance, received a housing voucher from a local or federal program, lived in public housing, and received other assistance. Due to heterogeneity in program receipt and small sample sizes, meaningful conclusions cannot be drawn about these other assistance programs (which include small local programs and

living in Low-Income Housing Tax Credit-financed buildings), however, these categories were included in the coding of the housing assistance variable to make the comparison group as pure as possible. Because housing assistance is measured annually, there are changes within children over time (e.g., going from not receiving housing assistance to living in public housing) which allow for the analysis of individual fixed effects models estimating changes within children over time.

Neighborhood Disadvantage

Neighborhood disadvantage is measured annually, from birth to age six and biannually from ages seven to fifteen, using census tract measures of poverty and minority concentration from the Longitudinal Tract Database. Three variables are coded: the census tract poverty rate, high poverty (a dichotomous variable where a poverty rate of at least 40% is coded as high poverty), and high poverty/high minority (a dichotomous variable representing census tracts with poverty rates of at least 40% and where at least 30% of residents are non-white). The 40% poverty threshold is established in the literature (e.g., Jargowsky, 2013) and the 30% threshold for minority residents is based on that from the Baltimore Housing Mobility Program (Engdahl, 2009).

These variables are coded using data from the decennial census. As such, the variables reflect snapshots of census tract characteristics every ten years. Thus, the values for the entire period between censuses are coded with values from the previous census (i.e., data from the 1970 census are applied to each year in the 1970s and so on).

Covariates

Analyses include both time invariant and time-varying variables that may confound the association between housing assistance receipt and moving.

Time invariant

Time invariant covariates are measured at the child's birth. Characteristics about the child's family include the mother's age and education, and the household head's race and ethnicity. Analyses also include child-level characteristics: the child's sex and if she had a low birthweight (<2500 grams). To account for variation in housing assistance availability and other economic, policy, and contextual changes in the U.S. over time, the year in which the child was born is also controlled for.

Time-Varying

A series of time-varying covariates, both at the family and census tract levels, are included. Family level characteristics include: cash public assistance receipt, whether the child's mother was the head or wife of her own household, whether the head of the household was male, household size, household income to poverty ratio, the region in which the family lived (Northeast, Midwest, South, or West), and whether the child's family moved since the prior wave. In multivariate analyses, all time-varying characteristics are lagged two years to ensure that these characteristics preceded the neighborhood characteristics experienced by the child.

Analytic Strategy

First, the sample is pooled across the first 15 years of the children's lives, representing 39 years of data. Next, descriptive statistics of all variables included in the analyses are presented for the full sample. Then, these descriptive statistics are presented for each coding scheme for the independent variable: no housing assistance, any housing assistance, public housing, and vouchers. Descriptive statistics for families with children who are receiving other housing assistance are not presented due to program heterogeneity and small sample sizes.

Next, ordinary least squares (OLS) regression models, known as linear probability models (LPM) when models have a dichotomous outcome, are used to estimate the association between housing assistance and neighborhood disadvantage (high poverty and combined high poverty and racially segregated) for the pooled sample. While the outcome variable in these analyses is dichotomous, linear probability models typically provide unbiased estimates of dichotomous outcomes when the probability is between 0.2 and 0.8 (Angrist and Pischke 2008, Hellevik 2009, Von Hippel 2015). Thus, the models are estimated using OLS equations for ease of interpretation, flexibility with interaction effects (Ai and Norton 2003), and to more easily compare coefficients across models (Karlson, Holm, and Breen 2012). OLS models are also utilized to consider as the dependent variable continuous measures of neighborhood poverty.

In these analyses, housing assistance is lagged by two years to establish temporal ordering. The length of the lag (two years) is utilized to address the switch to biannual data collection in the PSID beginning in 1997 (e.g., for children born later in the sample for the current study, the most recent measurement of neighborhood disadvantage is

reported two years prior). The first set of models examines the association between receiving any housing assistance and each dependent variable. The next set of models explores whether there are differences in the dependent variable by the type of housing assistance received. In each set of analyses, the following models are presented:

1. Random effects models that explicitly examine effects within and between children by allowing intercepts to vary across children.
2. Fixed effects models (more conservative estimates) that examine effects only within children over time and account for all static characteristics of children by permitting variation in both intercepts and slopes.

Results of each analysis are presented as regression coefficients and *t*-statistics. Regression coefficients can be interpreted as percentage point changes in the probability of living in a neighborhood with high poverty or high poverty and racial segregation.

Results

Descriptive Results

The sample for these analyses includes 14,489 observations of 1,783 children pooled over 11 time points from birth to age 15. Descriptive results are reported in Table 9. Of the sample, 8.5% lived in public housing and 5.4% rented using a voucher. Children in families receiving any type of housing assistance were more likely to live in neighborhoods with high poverty rates than children in families without housing assistance: about a quarter of children without housing assistance lived in a census tract with a poverty rate of at least 40% while more than half of children with housing assistance lived in such a neighborhood. Similarly, 24.6% of children without housing

assistance live in neighborhoods with both high poverty and high minority concentrations compared to 53.4% of children with housing assistance. Children receiving housing assistance also differed from children not receiving assistance on several demographic characteristics: they were more likely to have a mother with lower educational attainment who was slightly older and had established an independent household, and to live in a female-headed household, to receive cash assistance, be more impoverished, and live in the Northeast or South.

The neighborhoods in which children with different types of housing assistance live vary by assistance type. Over two-thirds (68.9%) of children living in public housing reside in neighborhoods with high poverty and high minority concentrations compared to 29.2% of children with vouchers. While the percentage of children with vouchers living in these neighborhoods is significantly higher than children without housing assistance, it is also much lower than among children living in public housing.

Children with a voucher are more likely to have low birthweights than children without housing assistance while children in public housing are less likely to have a low birthweight. Children receiving either type of housing assistance are more likely to be black, have lower income to poverty ratios, and live in female-headed households. Children in public housing have mothers who are less educated and slightly older than those of children who are not receiving housing assistance; they also live in slightly larger households and are more likely to receive cash assistance.

Table 9: Housing assistance and neighborhood disadvantage, descriptive statistics and significance tests by housing assistance receipt (n=14,489, with observations on 1,783 children)

	Col. 1		**Col. 2**		**Col. 3**		**Col. 4**	**Col. 5**		**Col. 6**	**Col. 7**		**Col. 8**
	Entire Sample (n=14,489)	**SD**	**No Housing Assistance (n=12,281)**	**SD**	**Any Housing Assistance (2,208)**	**SD**	**Sig. Test (Comp. Any Housing Assistance to None)**	**Public Housing (n=1,235)**	**SD**	**Sig. Test (Comp. Public Housing to None)**	**Voucher (n=788)**	**SD**	**Sig. Test (Comp. Voucher to No HA)**
Independent Variables	% or Mean		% or Mean		% or Mean			% or Mean			% or Mean		
No Housing Assistance	84.77		100.00		0.00			0.00			0.00		
Public Housing	8.52		0.00		55.93			100.00			0.00		
Voucher	5.43		0.00		35.69			0.00			100.00		
Other Housing Assistance^	1.28		0.00		8.38			0.00			0.00		
Dependent Variables													
Poverty (%)	23.64	14.42	22.01	13.08	32.74	17.75	***	39.08	17.81	***	23.80	14.43	**
Neighborhood-Level Poverty Categories							***			***			*
<=10%	19.10		20.96		8.74			3.72			17.51		
>10% & <=29%	27.06		27.93		22.24			16.03			30.33		
>29% & <40%	24.33		25.82		16.03			11.17			21.83		
>=40%	29.51		25.29		52.99			69.07			30.33		
High Poverty & High Minority	28.80		24.59		52.22		***	68.91		***	29.19		*
Baseline Covariates													
Female (%)	48.85		48.58		50.36			51.74			48.22		
Low Birth Weight (%)	2.82		2.76		3.13			1.05		**	5.71		***
Mom's Education at Birth (%)							***			***			
Less than High	49.86		48.45		57.70			68.66			47.59		

School													
High School	27.79		28.80		22.15			17.09			25.00		
Some College or Higher	22.35		22.75		20.15			14.25			27.41		
Race (%)							***			***			***
White	21.69		24.46		6.62			3.89			10.91		
Black	74.25		71.16		91.55			94.49			86.93		
Other	4.06		4.38		1.83			1.62			2.16		
Mom's Age at Birth	29.57	10.67	29.42	10.54	30.31	11.33	***	30.32	11.19	*	30.30	11.55	
Time-varying Covariates													
Household Characteristics													
Household Size	4.74	1.84	4.75	1.82	4.72	1.93		5.02	2.14	***	4.32	1.54	***
Received Cash Assistance (%)	28.04		26.42		37.05		***	42.63		***	28.24		
Mom is Head or Wife of Her Own Household (%)	88.96		88.72		90.26		*	90.53			89.47		
Head is Male (%)	44.42		47.12		29.39		***	30.63		***	30.28		***
Income to Poverty Ratio	1.13	0.81	1.18	0.82	0.87	0.66	***	0.77	0.57	***	1.01	0.74	***
Region							***						
Northeast	9.57		9.09		12.23			12.39			12.56		
Midwest	24.99		26.66		15.72			14.01			19.42		
South	55.22		53.71		63.63			66.15			58.63		
West	10.22		10.54		8.42			7.45			9.39		

** p<0.05, **p<0.01, ***p<0.001*

Notes: ^ Other HA are not included in significance tests due to small sample size. Abbreviations: standard deviations (SD)

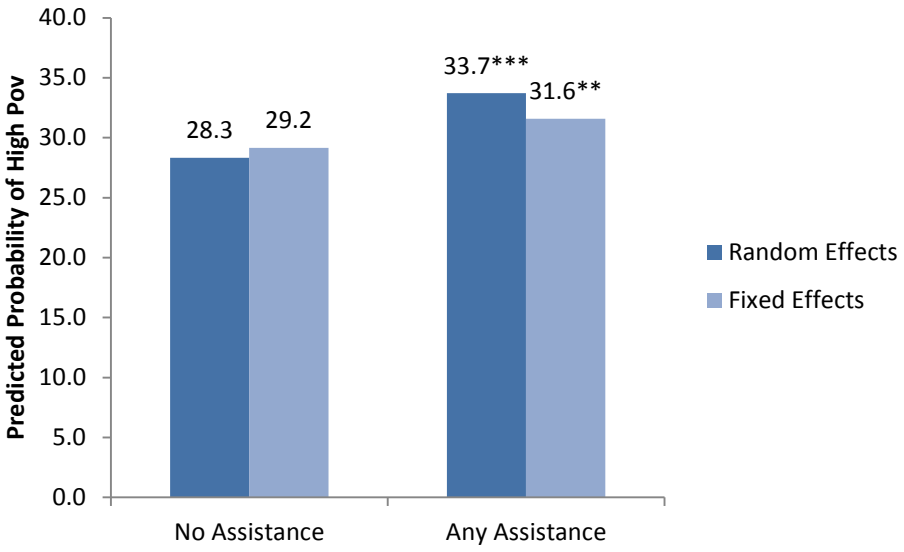
Multivariate Results

The first set of analyses examines the associations between housing assistance (any) and 1) the poverty rate for a child's neighborhood (measured continuously) and 2) child's likelihood of living in a) a high poverty neighborhood and b) a neighborhood that is both high poverty and high minority. Results from OLS models are presented in several tables. In models examining the census tract poverty rate as the dependent variable, presented in Table 10, housing assistance is associated with a 2.6 percentage point higher poverty rate compared to not receiving housing assistance. In the fixed effects model (Model 2), the effect size is slightly smaller: children receiving housing assistance live in neighborhoods with 1.8 percentage point higher poverty rates than when they did not receive housing assistance.

As seen in Table 11, in the random effects model, receiving any type of housing assistance is associated with a five percentage point increased likelihood of living in a high poverty neighborhood compared to not receiving any housing assistance. In the fixed effects model presented in Model 2, receiving any type of housing assistance is associated with a two percentage point increased likelihood of living in a high poverty neighborhood compared to when the child did not receive housing assistance. As shown in Figure 3, the predicted probability of living in a high poverty neighborhood is higher among those with any housing assistance in both the random and fixed effects models. In the random effects models, children with any assistance have a 33.7% chance of living in a high poverty neighborhood compared to 28.3% among children without housing assistance. In the fixed effects models, children have a 31.6% likelihood of living in a

high poverty neighborhood compared to a 29.2% probability when they did not have housing assistance.

Figure 3: Probability of living in a high poverty neighborhood by any housing assistance

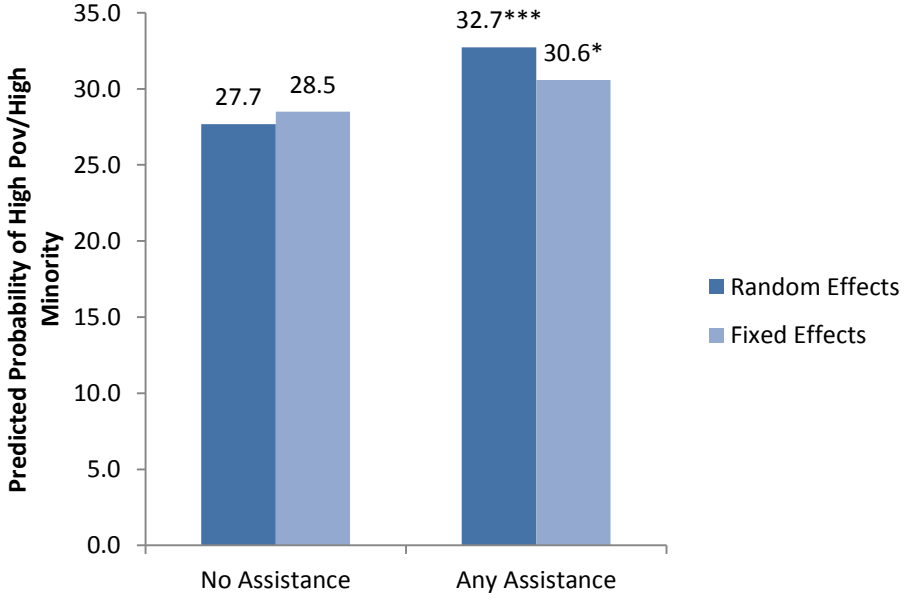


*Note: Results from fully-controlled OLS model, reference category is no assistance, *p<0.05, **p<0.01, ***p<0.001*

In Table 12, Models 1 and 2 explore the association between receiving any housing assistance and living in a high poverty/high minority neighborhood. In Model 1, the random effects model shows that receiving any housing assistance is associated with a five percentage point higher likelihood of living in a high poverty/high minority neighborhood, compared to not receiving housing assistance. These results hold, though the effect size is slightly attenuated, in the fixed effects model presented in Model 2. In this model, receiving any housing assistance is associated with a two percentage point increased likelihood of living in a high poverty/high minority census tract, compared to when the child was not receiving housing assistance.

As shown in Figure 4, the predicted probability of living in a high poverty and high minority neighborhood is higher among those with any housing assistance in both the random and fixed effects models. In the random effects models, children with any assistance have a 32.7% chance of living in a high poverty/high minority neighborhood compared to a 27.7% chance among children without housing assistance. In the fixed effects models, children have a 30.6% likelihood of living in a high poverty/high minority neighborhood compared to a 28.5% likelihood when they did not have housing assistance.

Figure 4: Probability of living in a high poverty/high minority neighborhood by any housing assistance



*Note: Results from fully-controlled linear models; reference category for significance tests is no assistance, *p<0.05, **p<0.01, ***p<0.001*

Table 10: Linear models of any housing assistance and census tract level poverty rates (n=14,489, with observations on 1,783 children)

	Model 1: Random Effects			Model 2: Fixed Effects		
Independent Variables						
Housing assistance (lagged 2 years, comparison group: no housing assistance)	2.63	***	(9.08)	1.77	***	(5.84)
Baseline Covariates						
Female	-0.09		(-0.20)			
Low birthweight	-0.66		(-0.44)			
Mom's education (comparison group: less than high school)						
High school or GED	-1.74	**	(-3.02)			
Some college or higher	-3.85	***	(-6.24)			
Race (comparison group: white, non-Hispanic)						
Black, non-Hispanic	13.28	***	(22.06)			
Other	9.49	***	(7.23)			
Mom's age	0.01		(0.81)			
Time-varying Characteristics (lagged 2 years)						
Household size	0		(-0.04)	-0.01		(-0.17)
Cash assistance	0.36		(1.59)	0.06		(0.25)
Mom was head or wife of her own household	-0.35		(-1.04)	-0.29		(-0.83)
Male household head	-0.03		(-0.11)	-0.03		(-0.12)
Income to poverty ratio	-0.64	***	(-5.49)	-0.47	***	(-4.04)
Region						
Midwest	1.8	*	(2.28)	1.28		(0.84)
South	0.39		(0.54)	0.54		(0.42)
West	2.22	*	(-2.41)	-3.28	*	(-2.02)
Moved since last wave	-0.70	***	(-4.08)	-0.67	***	(-3.86)

** p<0.05, **p<0.01, ***p<0.001*

Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born

Table 11: Linear models of any housing assistance and census tract level high poverty (n=14,489, with observations on 1,783 children)

	Model 1: Random Effects			Model 2: Fixed Effects		
Independent Variables						
Housing assistance (lagged 2 years, comparison group: no housing assistance)	0.05	***	(5.34)	0.02	*	(2.28)
Baseline Covariates						
Female	0.00		(0.20)			
Low birthweight	0.01		(0.22)			
Mom's education (comparison group: less than high school)						
High school or GED	-0.04	*	(-2.24)			
Some college or higher	-0.09	***	(-4.51)			
Race (comparison group: white, non-Hispanic)						
Black, non-Hispanic	0.32	***	(16.28)			
Other	0.22	***	(5.08)			
Mom's age						
Time-varying Characteristics (lagged 2 years)						
Household size	0.00		(-0.36)	0.00		(-0.94)
Cash assistance	0.00		(0.06)	-0.01		(-1.35)
Mom was head or wife of her own household	-0.01		(-0.62)	0.00		(-0.26)
Male household head	0.00		(0.15)	0.01		(0.72)
Income to poverty ratio	-0.02	***	(-4.69)	-0.01	***	(-3.50)
Region						
Midwest	0.03		(1.03)	0.01		(0.10)
South	-0.01		(-0.61)	0.03		(0.66)
West	-0.06	*	(-2.05)	-0.08		(-1.34)
Moved since last wave	-0.02	***	(-3.94)	-0.02	***	(-4.02)

** p<0.05, **p<0.01, ***p<0.001*

Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born

Table 12: Linear models of any housing assistance and census tract level high poverty & high minority (n=14,489, with observations on 1,783 children)

	Model 1: Random Effects			Model 2: Fixed Effects		
Independent Variables						
Housing assistance (lagged 2 years, comparison group: no housing assistance)	0.05	***	(5.09)	0.02	*	(1.98)
Baseline Covariates						
Female	0.01		(0.34)			
Low birthweight	0.02		(0.35)			
Mom's education (comparison group: less than high school)						
High school or GED	-0.03		(-1.85)			
Some college or higher	-0.09	***	(-4.38)			
Race (comparison group: white, non-Hispanic)						
Black, non-Hispanic	0.33	***	(16.82)			
Other	0.20	***	(4.80)			
Mom's age	0.00		(0.94)			
Time-varying Characteristics (lagged 2 years)						
Household size	0.00		(-0.52)	0.00		(-1.17)
Cash assistance	0.00		(0.30)	-0.01		(-1.12)
Mom was head or wife of her own household	-0.01		(-1.04)	-0.01		(-0.73)
Male household head	0.00		(-0.46)	0.00		(0.26)
Income to poverty ratio	-0.02	***	(-4.24)	-0.01	**	(-3.16)
Region						
Midwest	0.02		(0.72)	-0.01		(-0.11)
South	-0.02		(-0.97)	0.02		(0.51)
West	-0.06	*	(-2.13)	-0.07		(-1.29)
Moved since last wave	-0.02	***	(-4.07)	-0.02	***	(-4.11)

** p<0.05, **p<0.01, ***p<0.001*

Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born

Next, this relationship is explored in more detail, by housing assistance type. The first set of models, presented in Table 13, examines the effects of housing assistance (by type) on the percentage of people living in poverty in the census tract in which the child lives. Children living in public housing experience census tract poverty levels that are 5.5 percentage points higher than children not receiving housing assistance in Model 1. In the fixed effects model (Model 2), results indicate that children living in public housing experience poverty rates 4.1 percentage points higher than when they were not living in public housing. There are not significant differences in census tract poverty rates among children receiving a voucher compared to not receiving housing assistance.

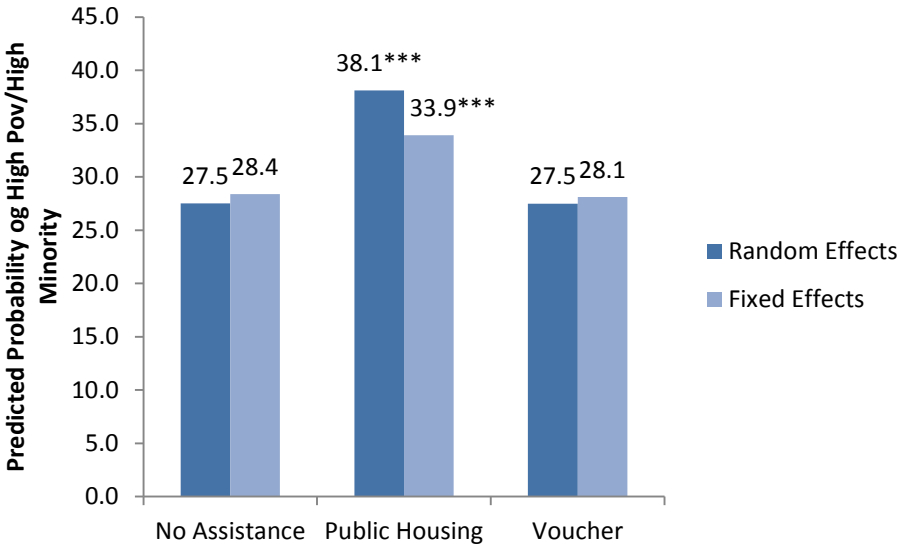
Table 14 includes models examining high poverty as the dependent variable. In the random effects model, children living in public housing are 11 percentage points more likely to live in high poverty census tracts compared to children not receiving housing assistance. In fixed effects models, the effect size is slightly attenuated but the significance remains the same: children living in public housing are six percentage points more likely to live in a high poverty neighborhood than when they did not receive housing assistance. Figure 5 presents the predicted probability of living in a high poverty neighborhood by housing assistance type. This figure shows that children living in public housing have a 39.4% chance of living in a high poverty neighborhood compared to 28.2% among children not receiving housing assistance in the random effects models. In the fixed effects models, living in public housing is associated with a 35.4% chance of living in a high poverty neighborhood compared to a 29.0% chance when the child was not receiving housing assistance. Children with a voucher are as likely as children not receiving housing assistance to live in a high poverty neighborhood.

Figure 5: Probability of living in a high poverty neighborhood by housing assistance type

*Note: Results from fully-controlled linear models; reference category for significance tests is no assistance, *p<0.05, **p<0.01, ***p<0.001*

Finally, Table 15 uses as the dependent variable a composite measure of high poverty and high minority concentration. The results from these models echo those of the previous set: children living in public housing are 11 percentage points more likely to live in a high minority/high poverty neighborhood than children without housing assistance and are six percentage points more likely to live in such a neighborhood than when they did not receive housing assistance. Figure 6 shows the predicted probability of living in a neighborhood with both high poverty and a high minority concentration. As shown in this figure, nearly 40% of children living in public housing live in such a neighborhood compared to less than 30% of children renting without housing assistance. The predicted probability from the fixed effects model show that children have a 33.9% likelihood of living in a neighborhood with concentrated economic and racial segregation when living in public housing compared to a 28.4% when they did not have housing assistance.

Figure 6: Probability of living in a high poverty/high minority neighborhood by housing assistance type



*Note: Results from fully-controlled linear models; reference category for significance tests is no assistance, *p<0.05, **p<0.01, ***p<0.001*

Several covariates are significant across these models. Having higher maternal education, a higher income to poverty ratio, and living in the South or West (compared to Northeast) are associated with living in a census tract with a lower poverty rate. Factors associated with a higher poverty rate at the census tract level are being black or "other" (compared to white) and living in the Midwest (compared to the Northeast).

Table 13: Linear models of type of housing assistance and census tract level poverty rates (n=14,489, with observations on 1,783 children)

	Model 1: Random Effects			Model 2: Fixed Effects		
Independent Variables						
Housing assistance (lagged 2 years, comparison group: no housing assistance)						
Public housing	5.50	***	(14.05)	4.10	***	(9.81)
Voucher	-0.02		(-0.05)	-0.11		(-0.24)
Other assistance	-0.82		(-0.94)	-1.50		(-1.69)
Baseline Covariates						
Female	-0.11		(-0.23)			
Low birthweight	-0.44		(-0.29)			
Mom's education (comparison group: less than high school)						
High school or GED	-1.57	**	(-2.78)			
Some college or higher	-3.70	***	(-6.07)			
Race (comparison group: white, non-Hispanic)						
Black, non-Hispanic	13.19	***	(22.19)			
Other	9.50	***	(7.34)			
Mom's age	0.01		(0.37)			
Time-varying Characteristics (lagged 2 years)						
Household size	-0.02		(-0.22)	-0.02		(-0.23)
Cash assistance	0.27		(1.21)	-0.01		(-0.06)
Mom was head or wife of her own household	-0.25		(-0.76)	-0.21		(-0.59)
Male household head	-0.04		(-0.17)	-0.04		(-0.17)
Income to poverty ratio	-0.59	***	(-5.14)	-0.44	***	(-3.77)
Region						
Midwest	1.88	*	(2.42)	1.26		(0.83)

South	0.42		(0.59)	0.46		(0.36)
West	-2.15	*	(-2.36)	-3.39	*	(-2.04)
Moved since last wave	-0.68	***	(-3.94)	-0.65	***	(-3.76)

** p<0.05, **p<0.01, ***p<0.001*

Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born.

Table 14: Linear models of type of housing assistance and census tract level high poverty (n=14,489, with observations on 1,783 children)

	Model 1: Random Effects			Model 2: Fixed Effects		
Independent Variables						
Housing assistance (lagged 2 years, comparison group: no housing assistance)						
Public housing	0.11	***	(8.26)	0.06	***	(4.32)
Voucher	0.00		(-0.05)	0.00		(-0.22)
Other assistance	-0.02		(-0.55)	-0.05		(-1.61)
Baseline Covariates						
Female	0.00		(0.18)			
Low birthweight	0.02		(0.32)			
Mom's education (comparison group: less than high school)						
High school or GED	-0.04	*	(-2.08)			
Some college or higher	-0.09	***	(-4.40)			
Race (comparison group: white, non-Hispanic)						
Black, non-Hispanic	0.32	***	(16.33)			
Other	0.22	***	(5.14)			
Mom's age	0.00		(0.82)			
Time-varying Characteristics (lagged 2 years)						
Household size	0.00		(0.47)	0.00		(-0.97)
Cash assistance	0.00		(-0.16)	-0.01		(-1.50)
Mom was head or wife of her own household	-0.01		(-0.47)	0.00		(-0.15)
Male household head	0.00		(0.11)	0.01		(0.68)
Income to poverty ratio	-0.02	***	(-4.48)	-0.01	**	(-3.37)
Region						
Midwest	0.03		(1.11)	0.01		(0.10)

South	-0.01		(-0.59)	0.03		(0.64)
West	-0.06	*	(-2.02)	-0.08		(-1.34)
Moved since last wave	-0.02	***	(-3.84)	-0.02	***	(-3.97)

** p<0.05, **p<0.01, ***p<0.001*

Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born

Table 15: Linear models of type of housing assistance and census tract level high poverty & high minority (n=14,489, with observations on 1,783 children)

	Model 1: Random Effects			Model 2: Fixed Effects		
Independent Variables						
Housing assistance (lagged 2 years, comparison group: no housing assistance)						
Public housing	0.11	***	(7.89)	0.06	***	(3.80)
Voucher	0.00		(-0.02)	0.00		(-0.19)
Other assistance	-0.02		(-0.60)	-0.05		(-1.53)
Baseline Covariates						
Female	0.00		(0.32)			
Low birthweight	0.02		(0.44)			
Mom's education (comparison group: less than high school)						
High school or GED	-0.03		(-1.69)			
Some college or higher	-0.08	***	(-4.27)			
Race (comparison group: white, non-Hispanic)						
Black, non-Hispanic	0.33	***	(16.88)			
Other	0.20	***	(4.85)			
Mom's age	0.00		(1.01)			
Time-varying Characteristics (lagged 2 years)						
Household size	0.00		(-0.61)	0.00		(-1.19)
Cash assistance	0.00		(0.09)	-0.01		(-1.26)
Mom was head or wife of her own household	-0.01		(-0.90)	-0.01		(-0.64)
Male household head	0.00		(-0.51)	0.00		(0.23)
Income to poverty ratio	-0.02	***	(-4.04)	-0.01	**	(-3.05)
Region						
Midwest	0.02		(0.79)	-0.01		(-0.11)
South	-0.02		(-0.95)	0.02		(0.49)

West	0.06	*	(-2.10)	-0.07		(-1.29)
Moved since last wave	-0.02	***	(-3.98)	-0.02	***	(-4.06)

** p<0.05, **p<0.01, ***p<0.001*
Note: Regression coefficients with t-statistics in parentheses;
models also include a control for the year the child was born

Sensitivity Analyses

A series of sensitivity analyses are conducted to explore whether the association between housing assistance receipt and neighborhood characteristics persists, strengthens, or weakens depending on several family-level characteristics. Building on the main analyses in this chapter, which show that neighborhoods to which families have access differ by housing assistance types, sensitivity analyses focus on the type of housing assistance received. This is especially important because families with vouchers have more choice in the neighborhoods they move to than families who receive public housing. Further, because of the significant overlap between racial and economic segregation, the outcome variable of interest in these analyses is the composite measure of high poverty and high minority concentration. There are several family-level characteristics that could affect the neighborhoods to which families have access with housing assistance. Tables for all analyses referenced in this section are included in Appendix 4.

Racial discrimination in the housing market means that black families may not have access to the same housing units or neighborhoods as white families (e.g., M. A. Turner et al., 2013). However, when race is included as a moderator in the current analyses, it is not significant.

Neighborhoods to which families have access may differ depending on the mother's education level. More educated mothers may have more tools to access neighborhoods without racial and economic segregation which could be of particular importance to families with vouchers. These analyses are limited to only include children whose mothers were at least 18 years old and had formed an independent household at

the time of the child's birth. These sample restrictions are utilized to increase the likelihood that the mother could have completed high school at the time of the child's birth and was not still in high school. Interestingly, in these analyses, children whose mothers completed high school and lived in public housing have the same likelihood of accessing a neighborhood with high minority and high poverty concentration as families without housing assistance, regardless of the mother's education level. While post-hoc analyses testing difference between types of housing assistance indicate that children whose mothers completed high school and lived in public housing have access to the same neighborhoods as families with a voucher and less than a high school diploma and to less racially and economically segregated neighborhoods than mothers with a high school diploma and a voucher, caution should be taken when making these comparisons because of small sample sizes (see Table 16).

Table 16: Mother's education by housing assistance type

	Mom's Education			
Housing Assistance	**<HS**	**HS or GED**	**At Least Some College**	**Total**
None	3,654	2,993	2,486	9,134
Public Housing	591	186	155	932
Voucher	210	156	184	550

Summary of Results

This section finds that receiving any housing assistance is associated with living in neighborhoods with higher poverty rates and rates that are above the high poverty threshold (40%). When exploring this association by housing assistance type, it appears that public housing receipt is driving these results: children who live in public housing

are likely to live in neighborhoods that are poorer, both when making comparisons between and within children. There are no significant effects for children whose families rent with vouchers meaning that, in this sample, children who receive a voucher do not access neighborhoods that are more advantaged than either children without housing assistance or compared to when they, themselves, did not have housing assistance.

Chapter 6: Housing Assistance and Residential Stability

Research Question

This section examines, first, whether receiving any housing assistance is associated with reduced likelihood of moving among children in low-income families, compared to children in similarly situated families not receiving assistance. Second, this chapter examines whether the likelihood of moving differs by type of housing assistance (public housing or vouchers) compared to receiving no assistance.

Measures

Residential Stability

Residential stability is calculated from an item asking whether the child moved since the previous wave (moved or did not move). A dichotomous variable is constructed for every available wave indicating whether the child moved since the prior wave (moved=1 (yes)). This variable is measured at 11 time points: annually from birth to age six and every other year from ages seven to fifteen. Because the independent variable is lagged, nine observations of whether the child moved are included in the pooled analyses. Since this variable asks only whether a child moved since the past wave, it does not capture all moves as some children may have moved multiple times in a given year which could lead to conservative estimates of the effects of housing assistance on residential stability.

Housing Assistance

Housing assistance is measured annually, from birth to age six and biannually from ages seven to fifteen, using the PSID-AHD and is coded using two coding schemes. In the first set of analyses, housing assistance is coded in each wave of the data as a binary variable (received assistance or did not receive assistance). In the next set of analyses, housing assistance is coded as a categorical variable at each wave. The categories for this variable are: no housing assistance, received a housing voucher from a local or federal program, lived in public housing, and received other assistance. Due to heterogeneity in program receipt and small sample sizes, meaningful conclusions cannot be drawn about these other assistance programs (which include small local programs and living in Low-Income Housing Tax Credit-financed buildings), however, these categories were included in the coding of the housing assistance variable to make the comparison group as pure as possible. Because housing assistance is measured annually, there are changes within children over time (e.g., going from not receiving housing assistance to living in public housing) which allow for the analysis of individual fixed effects models estimating changes within children over time.

Covariates

Analyses include both time invariant and time-varying variables that may confound the association between housing assistance receipt and moving.

Time invariant

Time invariant covariates are measured at the child's birth. Characteristics about the child's family include the mother's age and education, and the household head's race and ethnicity. Analyses also include child-level characteristics: the child's sex and if she had a low birthweight (<2500 grams). To account for variation in housing assistance availability and other economic, policy, and contextual changes in the US over time, the year in which the child was born is also controlled for.

Time-Varying

A series of time-varying covariates, both at the family and census tract levels, are included. Family level characteristics include: cash public assistance receipt, whether the child's mother was the head or wife of her own household, whether the head of the household was male, household size, household income to poverty ratio, and the region in which the family lived (Northeast, Midwest, South, or West). Census tract level characteristics include: the percentage of the population below the poverty line, the percentage of residents who are white, and the median rent. In multivariate analyses, all time-varying characteristics are lagged two years to ensure that these characteristics preceded the dependent variable (whether the child moved).

Analytic Strategy

First, the sample is pooled across the first 15 years of the children's lives, representing 39 years of data. Next, descriptive statistics of all variables included in the analysis are presented for the full sample. Then, these descriptive statistics are presented

for each coding scheme for the independent variable: no housing assistance, any housing assistance, public housing, and vouchers. Descriptive statistics for families with children who are receiving other housing assistance are not presented due to program heterogeneity and small sample sizes.

Next, OLS regression models, known as linear probability models (LPM) when models have a dichotomous outcome, are used to estimate the association between housing assistance and whether the child moved for the pooled sample. While the outcome variable in these analyses is dichotomous, linear probability models typically provide unbiased estimates of dichotomous outcomes when the probability is between 0.2 and 0.8 (Angrist and Pischke 2008, Hellevik 2009, Von Hippel 2015). Thus, the models are estimated using OLS equations for ease of interpretation, flexibility with interaction effects (Ai and Norton 2003), and to more easily compare coefficients across models (Karlson, Holm, and Breen 2012). In these analyses, housing assistance is lagged by two years to establish temporal ordering. The two year lag is utilized to address the switch to biannual data collection in the PSID beginning in 1997 (e.g., for children born later in the sample for the current study, the most recent measurement of a residential move is reported two years prior). The first set of models examines the association between receiving any housing assistance and whether the child moved. The next set of models explores whether there are differences in moving by the type of housing assistance received. In each set of analyses, the following models are presented:

1. Random effects models that explicitly examine effects within and between children by allowing intercepts to vary across children.

2. Fixed effects models (more conservative estimates) that examine effects only within children over time and account for all static characteristics of children by permitting variation in both intercepts and slopes.

Results of each analysis are presented as regression coefficients and *t*-statistics. Regression coefficients can be interpreted as percentage point changes in the probability of having moved.

Results

Descriptive Statistics

The sample for these analyses includes 14,121 observations pooled across 1,890 children. Table 17 presents descriptive statistics of the pooled sample for all variables included in the analyses. Column 1, which represents the entire sample of low-income (<200% of FPL) children, shows that a little under a third (29.4%) of the sample reported moving in a given wave. Among children whose families did not receive housing assistance, a slightly higher percentage (31.5%) moved while only about a quarter of children whose families had housing assistance moved. There are differences by housing assistance type: children living in public housing had about a 20% chance of moving compared to a 31.2% chance for children whose families rented with a voucher. Not shown in Table 1 is that about 20% of children whose families received any public housing between birth and age 15 also received a voucher at some point during that period and that about 20% of children whose families who received any voucher during that period also reported having lived in public housing for at least one wave. This variation in housing assistance receipt over time within children is a key piece of these

analyses because it allows for the analyses of individual fixed effects models which estimate changes within children over time.

Column 3 presents descriptive statistics for children in families receiving any type of housing assistance at that given wave. At the household level, during periods in which children's families are receiving housing assistance, children tend to be more disadvantaged than children in families not receiving assistance: their families are more likely to have a lower income to poverty ratio, lower maternal educational attainment, and are more likely to receive cash assistance. They also differ demographically; when children's families are receiving housing assistance, mothers also tend to be older, household sizes larger, families less likely to have a male household head, and more likely to be black. When children's families are receiving housing assistance, they are more likely to live in neighborhoods with higher poverty rates and a higher percentage of residents who are not white.

Children living in public housing, compared to similarly situated children in families not receiving housing assistance at that wave, are less likely to have a low birthweight, a mother with high educational attainment, or a male household head. Children living in public housing are more likely to be black than children without housing assistance, have slightly older mothers and are significantly poorer, more likely to receive cash assistance and to have a larger household size. The neighborhoods in which children live when residing in public housing have higher poverty rates and minority concentration and lower median rents compared to children without housing assistance. Compared to children in families without housing assistance at a given wave, children whose families receive a voucher are more likely to have low birthweights, be

black, have a lower income, and to have a smaller household size. They are also less likely to have a male household head. Children in families with vouchers have smaller household sizes than do children in families without assistance. At the census tract level, children in families receiving a voucher are more likely to live in neighborhoods with higher poverty and minority rates and higher median rents than families without housing assistance.

Table 17: Housing assistance and residential stability, descriptive statistics and statistical tests by housing assistance receipt (n=14,121, with observations on 1,890 children)

	Col. 1		**Col. 2**		**Col. 3**		**Col. 4**	**Col. 5**		**Col. 6**	**Col. 7**		**Col. 8**
	Entire Sample (n=14,121)	**SD**	**No Housing Assistance (n=11,963)**	**SD**	**Any Housing Assistance (n=1,983)**	**SD**	**Sig. Test (Comp. Any Housing Assistance to None)**	**Public Housing (n=1,206)**	**SD**	**Sig. Test (Comp. Public Housing to None)**	**Voucher (n=777)**	**SD**	**Sig. Test (Comp. Voucher to None)**
Independent Variables	% or Mean		% or Mean		% or Mean			% or Mean			% or Mean		
No housing assistance	84.72							0			0		
Public housing	8.54							100			20.87		
Voucher	5.5							21.12			100		
Other housing assistance^	1.24							^			^		
Stability													
Moved	29.44		31.5		25.39		***	20.65		***	31.66		
Baseline Covariates													
Female (%)	48.78		48.61		49.72			51.16			47.49		
Low birthweight (%)	2.82		2.75		3.2			1.08		**	5.79		***
Mom's education at birth (%)							***			***			
Less than HS	49.88		48.47		57.65			68.74			47.23		
HS	27.67		28.71		21.92			16.75			25.35		
Some college or higher	2.82		22.82		20.44			14.51			27.41		
Race (%)							***			***			***
White	21.36		24.12		6.07			3.98			10.04		
Black	74.54		71.46		91.61			94.36			87.77		
Other	4.1		4.42		2.32			1.66			2.19		
Mom's age at birth (years)	29.6	10.66	29.44	10.52	30.5	11.32	***	30.37	11.19	*	30.32	11.51	
Time-varying Covariates													
Household Characteristics													
Household size	4.75	1.85	4.75	1.83	4.73	1.94	***	5.04	2.15	***	4.32	1.53	***

Received cash assistance	28.22		26.7		33.61		***	42.29		***	27.93		
Mom was head or wife of her own household	88.94		88.7		90.27		*	90.46			89.58		
Male household head	44.04		46.71		29.24		***	30.43		***	30.12		***
Income to poverty ratio	1.14	0.81	1.19	0.82	0.87	0.66	***	0.79	0.57	***	1.00	0.75	***
Region							***						
Northeast	9.66		9.21		12.19			12.52			12.1		
Midwest	24.95		26.66		15.48			13.35			19.56		
South	55.12		53.56		63.76			66.5			58.82		
West	10.27		10.57		8.57			7.63			9.52		
Census Tract Characteristics													
Below the poverty line (%)	23.82		22.13		33.03		***	39.51		***	24.06		**
White (%)	42.47		44.65		30.51		***	25.67		***	37.19		***
Median rent ($)	209.86	126.72	212.54	126.46	195.19	127.2		144.06	93.25	***	260.69	140.38	***

**p<0.05, **p<0.01, ***p<0.001*

Notes: ^ Other HA are not included in significance tests due to small sample size.

Abbreviations: standard deviations (SD), column (Col.).

Multivariate Analyses

Table 18 presents multivariate analyses of the association between any type of housing assistance and whether the child moved. In all models, housing assistance is lagged two years to ensure temporal precedence. Results in Model 1, which analyzes this relationship using random effects, show that receiving housing assistance is a statistically significant predictor of moving and is associated with a 2.1 percentage point reduction in moving. Model 2, a fixed effects model, is the more conservative of these models because it examines differences only within individuals over time as their housing assistance status changes (i.e., to or from receiving housing assistance). While the directionality and size of the coefficient persist in this model, receiving housing assistance is not statistically significantly associated with moving.

In Model 1, covariates associated with a lower likelihood of moving are higher maternal education, if the mother is the head or wife of her own household, a larger household size, and if the household head was male. Receiving cash assistance and being born in certain years are associated with an increased likelihood of moving. While the main effect of housing assistance on moving is not significant in Model 2, children are less likely to move if their mother was the head or wife of her own household, as household size increases, and if the child lives in the South.

Table 18: Linear models of housing assistance and residential moves, multivariate analyses (n=14,121, with observations on 1,890 children)

	Model 1: Random Effects			Model 2: Fixed Effects		
Independent Variables						
Housing assistance (lagged 2 years, comparison group: no housing assistance)	-0.02	*	(-1.97)	-0.02		(-1.27)
Baseline Covariates						
Female	-0.01		(-1.28)			
Low birthweight	0.01		(-0.24)			
Mom's education (comparison group: less than HS)						
High school or GED	-0.06	***	(-4.28)			
Some college or higher	-0.04	*	(-2.56)			
Race (comparison group: white, non-Hispanic)						
Black, non-Hispanic	0.00		(-0.05)			
Other	0.02		(-0.78)			
Mom's age (years)	0.00	***	(-5.39)			
Time-varying Characteristics (lagged 2 years)						
Household size	-0.01	***	(-4.12)	-0.01	*	(-2.58)
Cash assistance	0.03	*	-2.48	0.00		(-0.29)
Mom was head or wife of household	-0.04	**	(-2.93)	-0.05	**	(-2.66)
Male household head	-0.04	***	(-3.75)	-0.03		(-1.92)
Income to poverty ratio	0.01		(1.28)	0.01		(0.91)
Region (comparison group: Northeast)						

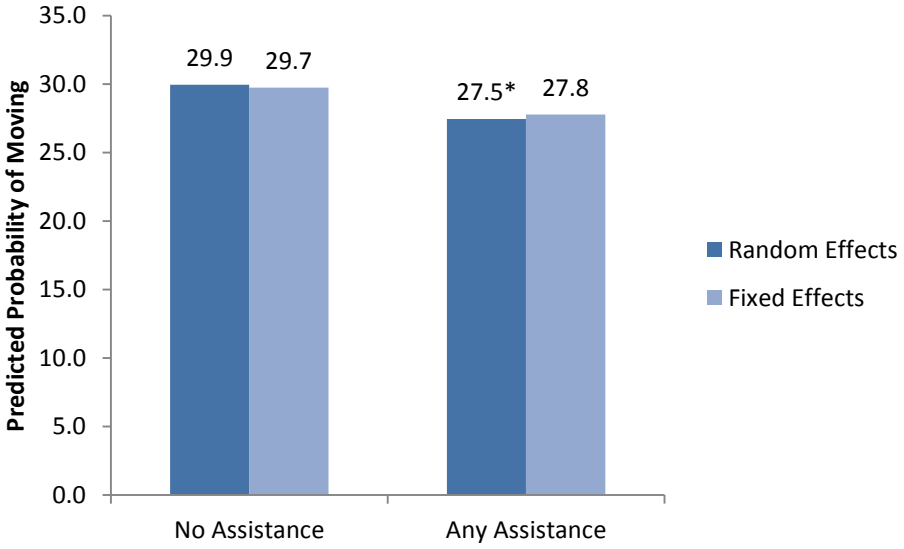
Midwest	-0.03	(-1.68)	-0.15		(-1.88)
South	-0.03	(-1.81)	-0.15	*	(-2.23)
West	0.03	(1.40)	-0.12		(-1.52)
Poverty rate (census tract)	0.00	(-0.82)	0.00		(-0.16)
Percent white (census tract)	0.00	(0.34)	0.00		(0.54)
Median rent (census tract)	0.00	(-1.17)	0.00	**	(-2.92)

** p<0.05, **p<0.01, ***p<0.001*

Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born

Figure 7 presents the predicted probability of moving by housing assistance receipt. The random effects results show that children who receive any type of housing assistance have a 27.5% chance of moving compared to a 29.9% chance among children without housing assistance. This difference is statistically significant. In the fixed effects models, the predicted probability of moving when children have housing assistance is lower than the predicted probability when they do not have assistance but this difference is not statistically significant.

Figure 7: Probability of moving by any housing assistance



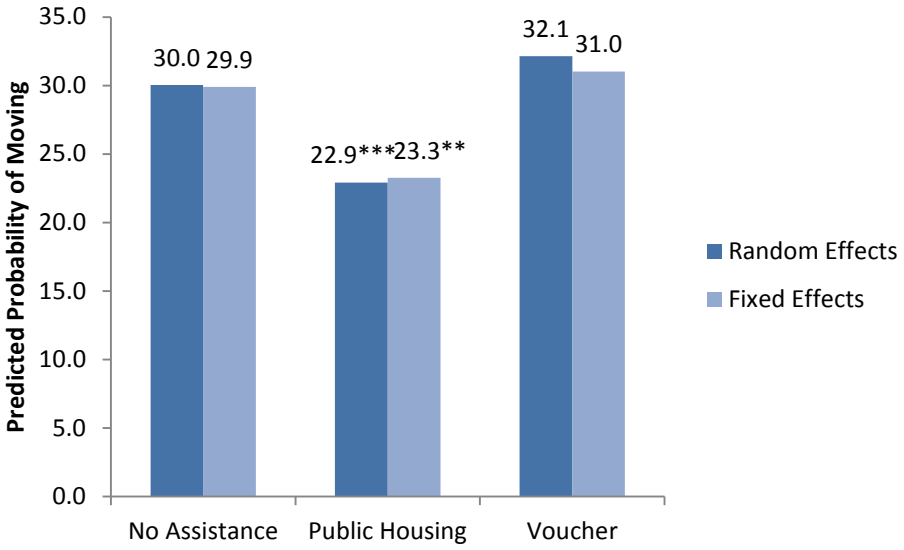
*Note: Results from fully-controlled linear models; reference category for significance tests is no assistance, *p<0.05, **p<0.01, ***p<0.001*

Table 19 presents three multivariate regression analyses of the association between types of housing assistance (public housing and vouchers) and moving with not receiving housing assistance as the reference group. As in the models presented in Table 18, housing assistance is lagged two years to establish proper temporal ordering. In Model 1, which presents results from a random effects model, children living in public

housing are 7.1 percentage points less likely to move than children in families without assistance. Model 2 presents results from a fixed effects model, comparing differences within children over time and testing the association between housing assistance and moving when housing assistance status changes (e.g., from receiving no housing assistance to receiving public housing). These fixed effects results are conservative as they reflect changes within individuals over time, rather than across individuals. Thus, these results say that when children are living in public housing, they are 6.7 percentage points less likely to move than they were when their families rented without housing assistance. Across both models, there are no statistically significant differences in moving when comparing children in families renting with a voucher to children in families without housing assistance. In Table 3, the covariates that are statistically significantly associated with moving are the same as those which were significant in the models presented in Table 18.

Figure 8 shows the predicted probability of moving by housing assistance type. Children who live in public housing have a significantly lower likelihood of moving than children who do not receive assistance. In the random effects models, children living in public housing have a 22.9% chance of moving compared to 30.0% among children without housing assistance. In fixed effects models, children have a 23.3% chance of moving when living in public housing compared to 29.9% when they did not receive housing assistance. Children with a voucher have just over a 30% chance of moving which is not significantly different from children whose families are not receiving housing assistance.

Figure 8: Probability of moving by housing assistance type



*Note: Results from fully-controlled linear models; reference category for significance tests is no assistance, *p<0.05, **p<0.01, ***p<0.001*

Taken together, the models in Table 18 and Table 19 suggest that the association between any housing assistance, compared to none, and moving is driven by public housing, not voucher, receipt. As illustrated in Table 19, not only is receiving a voucher not significantly associated with moving but the directions of the coefficients for public housing and vouchers differ. Public housing is associated with a reduced likelihood of moving while the coefficient for receiving a voucher is positive.

Table 19: Linear models of type of housing assistance and residential moves, multivariate regression analyses (n=14,121, with observations on 1,890 children)

	Model 1: Random Effects			Model 2: Fixed Effects		
Independent Variables						
Housing assistance (lagged 2 years, comparison group: no housing assistance)						
Public housing	-0.07	***	(-4.27)	-0.07	**	(-3.04)
Voucher	0.02		(1.11)	0.01		(0.51)
Other assistance	0.05		(1.30)	0.06		(1.42)
Baseline Covariates						
Female	-0.01		(-1.25)			
Low birthweight	0.01		(0.15)			
Mom's education (comparison group: less than high school)						
High school or GED	-0.06	***	(-4.47)			
Some college or higher	-0.04	**	(-2.69)			
Race (comparison group: white, non-Hispanic)						
Black, non-Hispanic	0.00		(0.06)			
Other	0.02		(0.72)			
Mom's age	0.00	***	(-5.50)			
Time-varying Characteristics (lagged 2 years)						
Household size	-0.01	***	(-3.96)	-0.01	*	(-2.54)
Cash assistance	0.03	**	(2.60)	0.00		(-0.19)
Mom was head or wife of her own household	-0.04	**	(-2.99)	-0.05	**	(-2.72)
Male household head	-0.04	***	(-3.77)	-0.03		(-1.92)
Income to poverty ratio	0.01		(1.19)	0.00		(0.83)

Region					
Midwest	-0.04	(-1.79)	-0.15		(-1.88)
South	-0.04	(-1.89)	-0.15	*	(-2.21)
West	0.03	(1.40)	-0.12		(-1.51)
Poverty rate (census tract)	0.00	(-0.27)	0.00		(0.13)
Percent white (census tract)	0.00	(0.54)	0.00		(0.62)
Median rent (census tract)	0.00	(-1.31)	0.00	**	(-3.12)

** p<0.05, **p<0.01, ***p<0.001*

Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born

Sensitivity Analyses

A number of robustness checks are performed to further explore the association between housing assistance and whether the child moved. All results reported in this section are from fixed effects models because these models allow us to examine this relationship within children as their housing status changes (removing concerns about unobserved time-invariant characteristics). First, heterogeneity in the association between housing assistance and moving is explored through interaction models and stratifying the sample. There are certain groups for whom receiving housing assistance might be more or less likely to predict whether a child has moved. If a child's family is more disadvantaged (lower educational or income levels) or has a family structure that may be associated with increased instability (e.g., single female-headed household or young mother), receiving public housing or a voucher may be particularly important for residential stability. Household-level changes such as changes in income, household size, and partnership status could also impact the relationship between housing assistance and moving. Lastly, I explore whether the association between housing assistance and moving differs based on the timing of the lagged measure of housing assistance receipt. Tables for all analyses referenced in this section are included in Appendix 5.

Overall, the association between public housing and whether a child moves is stronger among more disadvantaged groups than in the full sample. The effect of living in public housing is particularly salient among children whose mothers have not completed high school. For these children, living in public housing is associated with a 13.5 percentage point lower chance of moving, compared to 7.0 in the main models. Similarly, among children with young mothers (aged 19-21 at the time of the child's birth) who had

not completed high school, receiving public housing is associated with a 12.8 percentage point lower chance of moving. Children who grow up in persistently poor families may particularly benefit from receiving housing assistance as it may provide a form of economic security. In analyses examining only these children, receiving public housing is associated with reduced likelihood of moving and the effect size is slightly larger than that for the full sample. Because racial minorities and families living in certain geographic areas of the country may face increased instability, moderated models examining race and region are also performed, neither of which have statistically significant results. Lastly, it is possible that changes in household circumstances (income, size, and partners) may affect the relationship between housing assistance type and moving. However, when tested as moderators, these factors have no effect on the relationship.

To further explore how the association between housing assistance and residential stability may differ by another marker of disadvantage and to analyze this relationship with a sample similar to prior literature (Berger et al. 2008, Heintze et al. 2006), analyses are run on a sample limited to children in single female-headed households. In these models, the effects for public housing are slightly attenuated and only approach statistical significance. These findings are inconsistent with the prior literature which finds that living in either public housing or receiving a voucher is associated with an increase in tenancy length for that specific sample (female-headed households) (Heintze et al., 2006) and that vouchers, but not public housing, are associated with a small increase tenancy length (Berger et al.). These discrepancies may be due to several methodological differences between these studies including the timing of the measures (both other papers

use cross-sectional data while the current study uses longitudinal data), measurement of housing assistance receipt, and the use of instrumental variables in the earlier papers./s

Lastly, in order to address the concern that housing assistance should be lagged one year rather than two (to determine whether housing assistance protects against acute financial shocks) and the possibility that families' housing assistance status could change during the two year lag period, models are estimated with a one year lag for children for whom observations are available at all years between birth and age 15 (those born between 1970 and 1982). In these models, public housing is associated with a 12.0 percentage point lower chance of moving, compared to receiving no assistance (versus 7.0 percentage points in the original model) which suggests that the results in the main analyses of the present study are conservative. In these models, there is still no significant association between receiving a voucher and moving.

These robustness checks highlight the importance of housing assistance particularly for children living in more disadvantaged households, with lower educated and younger mothers, and in persistent poverty.

Summary of Results

The results in this section suggest that receiving any housing assistance is associated with increased residential stability. However, when exploring this association by type of housing assistance (vouchers or public housing), only living in public housing is associated with increased residential stability across random and fixed effects models, controlling for a rich set of individual, family, household, and census tract level characteristics. There are no statistically significant differences in residential stability

between receiving a voucher and being eligible for housing assistance but not receiving it. Though initial models presented in this paper show that receiving any housing assistance is associated with increased residential stability, subsequent results suggest that public housing, rather than receiving any type of assistance, is associated with residential stability which highlights the protective role public housing can play in promoting residential stability.

Chapter 7: Housing Assistance and Residential Crowding

Research Question

This section explores the association between housing assistance receipt and residential crowding. First, these effects are examined looking at housing assistance overall and then they are explored by housing assistance type (vouchers and public housing).

Measures

Crowding

Crowding is measured as a dichotomous variable based on the ratio of people to rooms in the household at each year. The crowding variable is computed based on two items: the first asks about the actual number of rooms in the household and the second asks the number of people in the family unit (Newman, 2008). There are several ways in which to measure crowding: a person-per-room ratio (measured continuously), person-per-bedroom ratio, and person-per-room ratio (measured dichotomously with differing cut-offs) (Blake, Kellerson, & Simic, 2007). There are two commonly used cut-offs for the number of people per room that counts as crowding: a more conservative measure of greater than one person per room and a more severe measure of more than 1.5 people per room (Blake et al., 2007). Both of these measures of crowding are utilized in the current study.

Housing Assistance

Housing assistance is measured using the PSID-AHD at each year, from birth to age six and biannually from ages seven to fifteen. This variable is coded using two schemes. In the first set of analyses, in which the receipt of any housing assistance is examined, housing assistance is coded in each wave as a binary variable (received assistance or did not receive assistance). In the second set of analyses, housing assistance is coded at each wave as a categorical variable. The categories for this variable are: no housing assistance, received a housing voucher from a local or federal program, lived in public housing, and received other assistance. While the category "other assistance" (which includes small local programs and living in Low-Income Housing Tax Credit-financed buildings) is included in the coding of this variable, because there is a great deal of program heterogeneity and small sample sizes, meaningful conclusions cannot be drawn about these other assistance programs. Still, in order to make the comparison group as clean as possible, these categories were included in the coding of the housing assistance variable. Since housing assistance is measured annually, changes in children over time are (e.g., going from not receiving housing assistance to receiving a voucher) allowing for individual fixed effects models to be estimated, examining changes within children over time.

Covariates

Analyses include both time invariant and time-varying variables that may confound the association between housing assistance receipt and moving.

Time invariant

Time invariant covariates are measured at the child's birth. Characteristics about the child's family include the mother's age and education, and the household head's race and ethnicity. Analyses also include child-level characteristics: the child's sex and if she had a low birthweight (<2500 grams). To account for variation in housing assistance availability and other economic, policy, and contextual changes in the US over time, the year in which the child was born is also controlled for.

Time-Varying

A series of time-varying covariates, both at the family and census tract levels, are included. Family level characteristics include: cash public assistance receipt, whether the child's mother was the head or wife of her own household, whether the head of the household was male, household income to poverty ratio, and the region in which the family lived (Northeast, Midwest, South, or West). Census tract level characteristics include: the percentage of the population below the poverty line, the percentage of residents who are white, and the median rent. In multivariate analyses, all time-varying characteristics are lagged two years to ensure that these characteristics preceded whether the child experienced crowding.

Analytic Strategy

First, the sample is pooled across the first 15 years of the children's lives, representing 39 years of data. Next, descriptive statistics of all variables included in the analysis are presented for the full sample. Then, these descriptive statistics are presented

for each coding scheme for the independent variable: no housing assistance, any housing assistance, public housing, and vouchers. Descriptive statistics for families with children who are receiving other housing assistance are not presented due to program heterogeneity and small sample sizes.

Next, OLS regression models, known as linear probability models (LPM) when models have a dichotomous outcome, are used to estimate the association between housing assistance and whether the child experienced crowding (first, the traditional measure and, second, a more severe measure) for the pooled sample. While the outcome variable in these analyses is dichotomous, linear probability models typically provide unbiased estimates of dichotomous outcomes when the probability is between 0.2 and 0.8 (Angrist and Pischke 2008, Hellevik 2009, Von Hippel 2015). Thus, the models are estimated using OLS equations for ease of interpretation, flexibility with interaction effects (Ai and Norton 2003), and to more easily compare coefficients across models (Karlson, Holm, and Breen 2012). In these analyses, housing assistance is lagged by two years to establish temporal ordering. The two year lag is utilized to address the switch to biannual data collection in the PSID beginning in 1997 (e.g., for children born later in the sample for the current study, the most recent measurement of residential crowding is reported two years prior). The first set of models examines the association between receiving any housing assistance and whether the child experienced crowding (again, using both measures). The next set of models explores whether there are differences in experiencing crowding by the type of housing assistance received. In each set of analyses, the following models are presented:

1. Random effects models that explicitly examine effects within and between children by allowing intercepts to vary across children.
2. Fixed effects models (more conservative estimates) that examine effects only within children over time and account for all static characteristics of children by permitting variation in both intercepts and slopes.

Results of each analysis are presented as regression coefficients and *t*-statistics. Regression coefficients can be interpreted as percentage point changes in the probability of experiencing crowding.

Results

Descriptive Results

The sample for these analyses includes 13,858 observations of 1,768 children pooled over 11 time points from birth to age 15. Descriptive results are presented in Table 20. Over 8% of children lived in public housing and more than 6% received a voucher. Crowding was fairly common among the full sample with over a quarter (27.4%) living in housing with more than one person per room. Families receiving any type of housing assistance were no more or less likely to experience crowding (measured either more traditionally or severely) than families not receiving assistance. However, when examining differences by housing assistance type, children living in public housing were significantly more likely to experience crowding than children without assistance (35.9% compared to 27.2%). Children renting with a voucher were significantly less likely to experience crowding than children without assistance (19.0% compared to 27.2%). Additionally, children renting with a voucher were significantly less likely to experience severe crowding than children without housing assistance. Children with

public housing were as likely to experience severe crowding as children without assistance. On average, children without housing assistance had a person to room ratio of 0.97 compared to a person to room ratio of 1.02 in public housing and 0.88 with a voucher.

Children receiving housing assistance are more likely to have mothers with lower educational attainment, be black, receive cash assistance, be poorer, live in neighborhoods with higher concentrations of poverty and racial minorities, and lower rents and are less likely to have a male household head. Children receiving different types of housing assistance differ in dissimilar ways with children without housing assistance. Children with public housing are more likely to have mothers with lower education levels and receive cash assistance. They are also more likely to live in neighborhoods with poverty and minority concentrations and lower rents. Compared to children not receiving housing assistance, children with a voucher are less likely to live in poor neighborhoods with high minority concentration and are more likely to have a higher median census tract level rent.

Table 20: Housing assistance and residential crowding, descriptive statistics and statistical tests by housing assistance receipt (n=13,858, with observations on 1,768 children)

	Col. 1		**Col. 2**		**Col. 3**		**Col. 4 Sig. Test (Comp. Any Housing Assistance to None)**	**Col. 5**		**Col. 6 Sig. Test (Comp. Public Housing to None)**	**Col. 7**		**Col. 8 Sig. Test (Comp. Voucher to None)**
	Entire Sample (n=13,858)	**SD**	**No Housing Assistance (n=11,723)**	**SD**	**Any Housing Assistance (n=2,135)**	**SD**		**Public Housing (n=1,206)**	**SD**		**Voucher (n=777)**	**SD**	
Independent Variables	% or Mean		% or Mean		% or Mean			% or Mean			% or Mean		
No housing assistance	84.59												
Public housing	8.59												
Voucher	5.59												
Other housing assistance^	1.23												
Crowding													
Crowded (>1 person per room)	27.37		27.20		28.29			35.94		***	18.99		***
Crowded (>=1.5 people per room)	6.89		7.28		4.73			6.38			2.84		***
Person to room ratio	0.97	0.43	0.97	0.45	0.96	0.37		1.02	0.37	**	0.88	0.36	***
Baseline Covariates													
Female (%)	48.69		48.47		49.88			51.30			47.93		
Low birthweight (%)	2.69		2.60		3.19			1.09		**	5.68		***
Mom's education at birth (%)							***			***			
Less than high school	49.85		48.43		57.61			68.60			47.42		
High school	27.45		28.48		21.78			16.79			25.06		
Some college or higher	22.70		23.08		20.61			14.61			27.52		
Race (%)							***			***			***
White	21.39		24.17		6.09			4.03			9.95		

Black	74.55		71.43		91.66			94.29			88.11		
Other	4.06		4.39		2.25			1.68			1.94		
Mom's age at birth (years)	29.55	10.60	29.40	10.47	30.40	11.26	***	30.30		*	30.21		
Time-varying Covariates													
Household Characteristics													
Received cash assistance	28.25		26.73		36.59		***	42.18		***	27.85		
Mom was head or wife of her own household	88.93		88.68		90.30		*	90.60			89.28		
Male household head	44.42		47.18		29.32		***	30.50		***	30.05		***
Income to poverty ratio	1.15	0.81	1.20	0.83	0.87	0.66	***	0.79	0.58	***	1.00	0.74	***
Region							***						
Northeast	9.65		9.21		12.04			12.43			12.14		
Midwest	24.95		26.66		15.55			13.35			19.64		
South	55.01		53.39		63.89			66.58			58.91		
West	10.40		10.74		8.52			7.64			9.30		
Census Tract Characteristics													
Below the poverty line (%)	23.81		22.12		32.95		***	39.48		***	23.99		**
White (%)	42.58		44.79		30.60		***	25.67		***	37.21		***
Median rent ($)	209.55	126.73	212.13	126.46	195.61	127.29	***	144.62	93.52	***	260.50	140.28	***

**p<0.05, **p<0.01, ***p<0.001*
^ Other housing assistance types are not included in significance tests due to small sample size.
Abbreviations: standard deviations (SD), column (Col.).

Multivariate Results

Table 21 and

Table 22 present multivariate results for two sets of regression models examining the association between receiving any housing assistance and crowding. In Table 21, Models 1 and 2 regress a traditional measure of crowding (where crowded is indicated as having more than one person per room) on any housing assistance receipt. Housing assistance assistance receipt. Housing assistance receipt is not a significant predictor of crowding in any of these models. In

any of these models. In

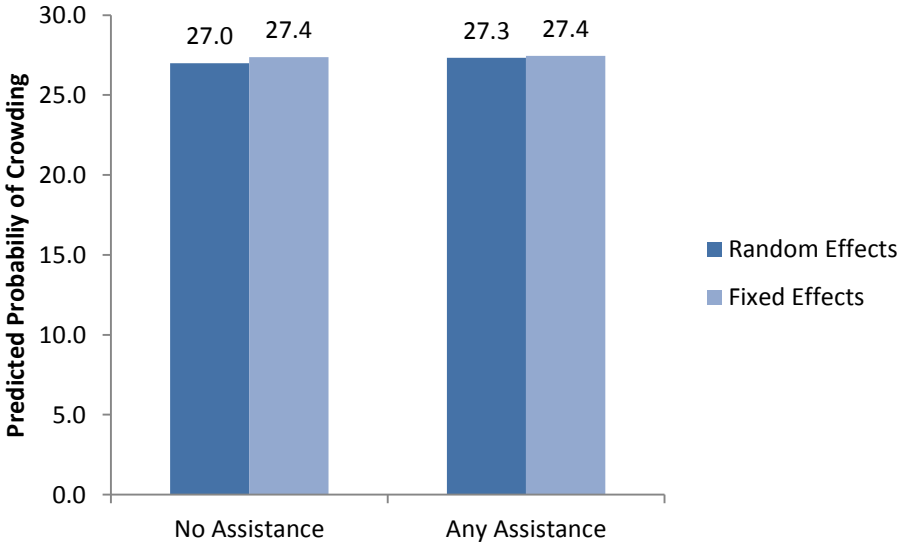
Table 22, Models 1 and 2 examine an indicator of more severe crowding (where having at least 1.5 people per room is coded as experiencing crowding). In these models, receiving housing assistance is associated with a four percentage point decrease in the likelihood of experiencing severe crowding. These results are consistent across both models (random effects and fixed effects) which suggest that receiving housing assistance is associated with a reduced likelihood of severe crowding both when comparing between and within children. Thus, when children receive housing assistance, they are less likely to experience severe crowding when compared both to other children not receiving assistance and to when the child herself was not receiving housing assistance.

Other significant predictors of reduced severe crowding in the pooled cross-sectional and random effects include mother's education, if cash assistance was received, if the mom was head or wife of her own household, and a higher income to poverty ratio. Significant predictors associated with increased severe crowding were race (black or other compared to white) and having a male household head. In the fixed effects model, receiving cash assistance and having a male household head were associated with an increased likelihood of experiencing severe crowding.

Figure 9 presents the predicted probability of experiencing crowding by housing assistance receipt. Just over a quarter of children, regardless of whether they received housing assistance, experienced crowding. Figure 10 presents the predicted probability of severe crowding by any housing assistance receipt. The random effects model shows that children who receive any housing assistance have a 3.7% chance of experiencing severe crowding compared to 7.5% among children without housing assistance. The predicted

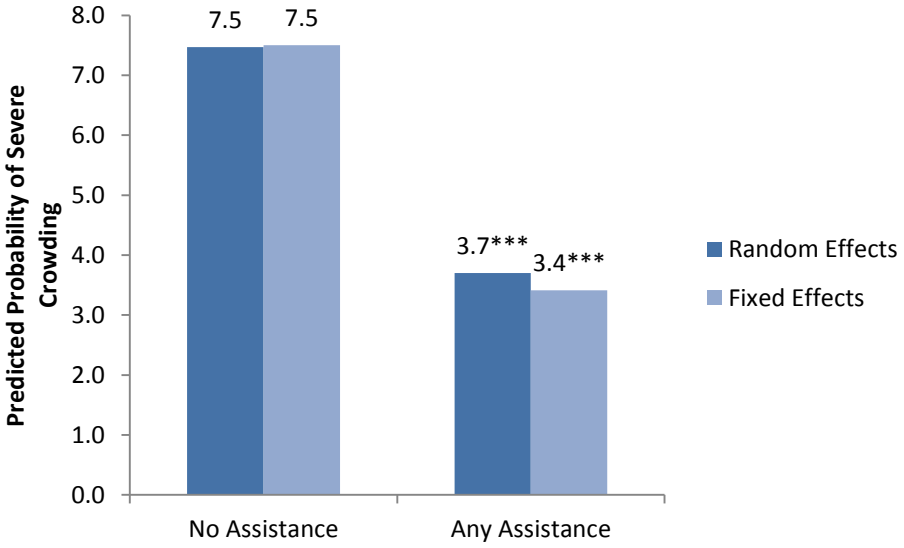
probabilities in the fixed effects models are similar with children who have housing assistance about half as likely to experience severe crowding as when the same children did not receive housing assistance.

Figure 9: Probability of crowding by any housing assistance



*Note: Results from fully-controlled linear models; reference category for significance tests is no assistance, *p<0.05, **p<0.01, ***p<0.001*

Fi



*Note: Results from fully-controlled linear models; reference category for significance tests is no assistance, *p<0.05, **p<0.01, ***p<0.001*

Table 21: Linear models of any housing assistance and crowding (n=13,858, with observations on 1,768 children)

	Model 1: Random Effects			Model 2: Fixed Effects		
Independent Variables						
Housing assistance (lagged 2 years, comparison group: no housing assistance)	0.00		(0.04)	0.00		(0.06)
Baseline Covariates						
Female	-0.01		(-1.11)			
Low birthweight	0.07		(1.52)			
Mom's education (comparison group: less than high school)						
High school or GED	-0.08	***	(-4.89)			
Some college or higher	-0.05	**	(-2.68)			
Race (comparison group: white, non-Hispanic)						
Black, non-Hispanic	0.11	***	(5.51)			
Other	0.10	**	(2.69)			
Mom's age (years)	0.00		(1.17)			
Time-varying Characteristics (lagged 2 yrs)						
Cash assistance	0.04	***	(4.45)			
Mom was head or wife of her own household	-0.04	**	(-3.34)	-0.03	*	(-2.26)
Male household head	0.11	***	(11.40)	0.07	***	(6.93)
Income to poverty ratio	-0.03	***	(-6.57)	-0.02	***	(-3.78)
Region (comparison group: Northeast)						
Midwest	0.02		(0.78)	-0.12		(-1.78)
South	0.03		(1.22)	-0.13	*	(-2.35)
West	0.04		(1.56)	-0.18	**	(-2.76)
Poverty rate (census tract)	0.00		(-0.62)	0.00		(-0.52)
Percent white (census tract)	0.00		(1.04)	0.00	**	(2.60)
Median rent (census tract)	0.00	***	(-6.48)	0.00	***	(-7.23)

** p<0.05, **p<0.01, ***p<0.001*
Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born

Table 22: Linear models of any housing assistance and severe crowding (n=13,858, with observations on 1,768 children)

	Model 1: Random Effects			Model 2: Fixed Effects		
Independent Variables						
Housing assistance (lagged 2 years, comparison group: no housing assistance)	-0.04	***	(-5.37)	-0.04	***	(-4.97)
Baseline Covariates						
Female	0.00		(-0.14)			
Low birthweight	0.01		(0.35)			
Mom's education (comparison group: less than high school)						
High school or GED	-0.04	***	(-5.54)			
Some college or higher	-0.03	***	(-3.73)			
Race (comparison group: white, non-Hispanic)						
Black, non-Hispanic	0.05	***	(4.73)			
Other	0.04	*	(2.16)			
Mom's age (years)	0.00		(1.11)			
Time-varying Characteristics (lagged 2 years)						
Cash assistance	-0.01	***	(-3.72)	0.02	*	(2.55)
Mom was head or wife of her own household	-0.02	**	(-3.21)	-0.04		(-1.28)
Male household head	0.03	***	(5.82)	0.02	**	(3.13)
Income to poverty ratio	-0.01	***	(-3.72)	0.00		(-1.23)
Region (comparison group: Northeast)						
Midwest	0.00		(-0.14)	0.01		(0.23)
South	-0.01		(-0.47)	-0.03		(-0.87)
West	0.02		(1.30)	-0.01		(-0.21)
Poverty rate (census tract)	0.00		(0.64)	0.00		(1.29)

Percent white (census tract)	0.00		(-1.37)	0.00		(-0.14)
Median rent (census tract)	0.00	*	(-2.10)	0.00	*	(-2.01)

** p<0.05, **p<0.01, ***p<0.001*

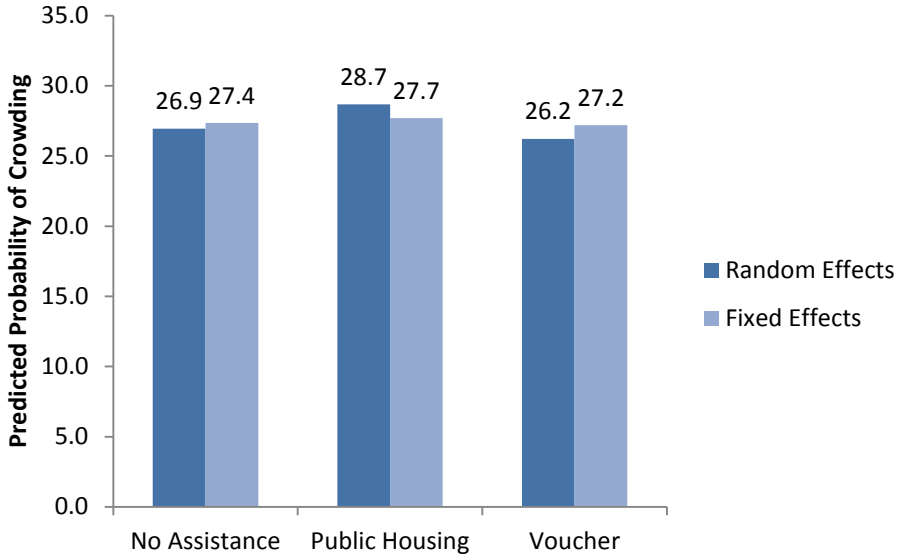
Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born

Table 24 presents results from analyses of crowding regressed on housing assistance type. Models 1 and 2 reflect the traditional measure of crowding (where crowding is indicated by having more than one person per room). Housing assistance is not significantly associated with crowding in either of these models. Table 24 also presents models using the more severe measure of crowding. In these models, both vouchers and public housing are associated with a reduced likelihood of experiencing severe crowding. Children who live in public housing are 3 percentage points less likely to experience severe crowding than children without housing assistance and compared to when they, themselves, did not receive housing assistance. Similarly, children receiving a voucher are 4 percentage points less likely to experience severe crowding than children without housing assistance or when the child herself was not receiving assistance. The same covariates that were significant predictors of severe crowding in the models presented in

Table 22 are also significant in the models presented in Table 24.

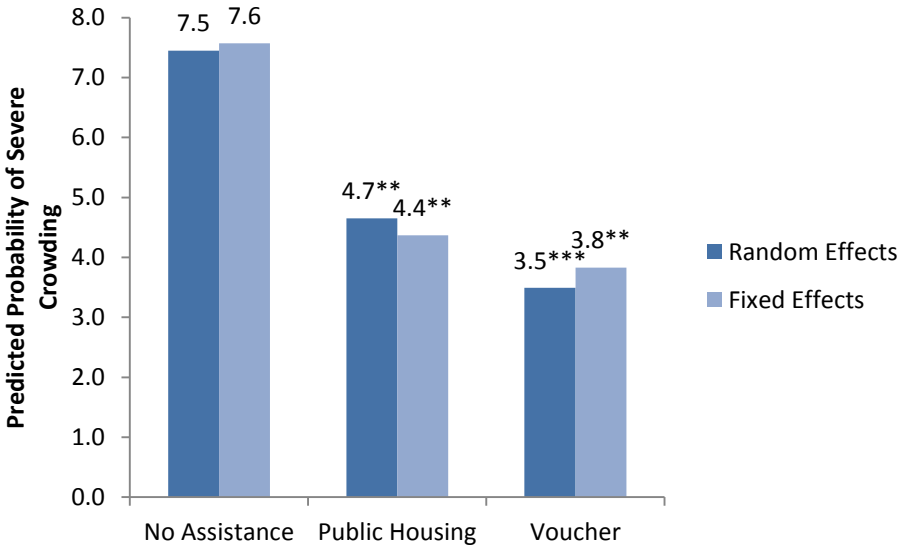
Figure 11 presents the predicted probabilities of experiencing crowding by housing assistance types. Children who do not receive assistance, live in public housing, or rent with a voucher have a similar probability of experiencing crowding; just over a quarter of children experience this condition. Figure 12 illustrates the predicted probabilities of experiencing severe crowding by housing assistance type. The probabilities of experiencing severe crowding for children either receiving a voucher or living in public housing are significantly lower than among children not receiving housing assistance. In the random effects models, children in public housing have a 4.7% chance of severe crowding and children with a voucher have a 3.5% chance, compared to 7.5% among children without housing assistance. The fixed effects model has similar results: children receiving public housing have a 4.4% likelihood of experiencing severe crowding and children with a voucher have a 3.8% likelihood compared to 7.6% when they were not receiving housing assistance.

Figure 11: Probability of crowding by housing assistance type



*Note: Results from fully-controlled linear models; reference category for significance tests is no assistance, *p<0.05, **p<0.01, ***p<0.001*

Figure 12: Probability of severe crowding by housing assistance type



*Note: Results from fully-controlled linear models; reference category for significance tests is no assistance, *p<0.05, **p<0.01, ***p<0.001*

Table 23: Linear models of housing assistance types and crowding (n=13,858, with observations on 1,768 children)

	Model 1: Random Effects			Model 2: Fixed Effects		
Independent Variables						
Housing assistance (lagged 2 years, comparison group: no housing assistance)						
Public housing	0.02		(1.11)	0.00		(0.20)
Voucher	-0.01		(-0.43)	0.00		(0.21)
Baseline Covariates						
Female	-0.02		(-1.12)			
Low birthweight	0.07		(1.54)			
Mom's education (comparison group: less than high school)						
High school or GED	-0.08	***	(-4.84)			
Some college or higher	-0.05	**	(-2.65)			
Race (comparison group: white, non-Hispanic)						
Black, non-Hispanic	0.11	***	(5.50)			
Other	0.10	**	(2.71)			
Mom's age	0.00		(1.19)			
Time-varying Characteristics (lagged 2 years)						
Cash assistance	0.04	***	(4.42)	0.02	*	(2.27)
Mom was head or wife of her own household	-0.04	**	(-3.30)	-0.03	*	(-2.26)
Male household head	0.11	***	(11.39)	0.07	***	(6.91)
Income to poverty ratio	-0.03	***	(-6.54)	-0.02	***	(-3.78)
Region						
Midwest	0.02		(0.81)	-0.12		(-1.78)
South	0.03		(1.24)	-0.13	*	(-2.35)

West	0.04		(1.56)	-0.18	**	(-2.76)
Poverty rate (census tract)	0.00		(-0.76)	0.00		(-0.52)
Percent white (census tract)	0.00		(0.98)	0.00	**	(2.62)
Median rent (census tract)	0.00	***	(-6.41)	0.00	***	(-7.19)

**p<0.05, **p<0.01, ***p<0.001*

Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born

Table 24: Linear models of housing assistance types and severe crowding (n=13,858, with observations on 1,768 children)

	Model 1: Random Effects			Model 2: Fixed Effects		
Independent Variables						
Housing assistance (lagged 2 years, comparison group: no housing assistance)						
Public housing	-0.03	**	(-2.99)	-0.03	**	(-2.69)
Voucher	-0.04	***	(-3.82)	-0.04	**	(-3.14)
Baseline Covariates						
Female	0.00		(-0.15)			
Low birthweight	0.01					
Mom's education (comparison group: less than high school)						
High school or GED	-0.04	***	(-5.41)			
Some college or higher	-0.03	***	(-3.66)			
Race (comparison group: white, non-Hispanic)						
Black, non-Hispanic	0.05	***	(4.73)			
Other	0.04	*	(2.21)			
Mom's age	0.00		(1.15)			
Time-varying Characteristics (lagged 2 years)						
Cash assistance	0.02	***	(4.16)	0.02	*	(2.48)
Mom was head or wife of her own household	-0.02	**	(-3.18)	-0.01		(-1.28)
Male household head	0.03	***	(5.76)	0.02	**	(3.06)
Income to poverty ratio	-0.01	***	(-3.69)	0.00		(-1.21)
Region						
Midwest	-0.01		(-0.10)	0.01		(0.25)
South	0.00		(-0.42)	-0.03		(-0.86)
West	0.02		(1.32)	-0.01		(-0.20)
Poverty rate (census tract)	0.00		(0.48)	0.00		(1.25)
Percent white (census tract)	0.00		(-1.38)	0.00		(-0.05)

Median rent (census tract)	0.00	*	(-2.05)	0.00	(-1.91)

** p<0.05, **p<0.01, ***p<0.001*

Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born

Sensitivity Analyses

A series of sensitivity analyses were conducted to further test the association between housing assistance and crowding. To align with the most commonly used measure of crowding in the literature and because more extreme crowding, measured as at least 1.5 people per room, is relatively rare in the sample (6.9%), these sensitivity tests examine crowding measured as more than one person per room. Tables for all analyses referenced in this section are included in Appendix 6.

First, several family composition characteristics that affect the size of units families with assistance live in are explored. Families with children of different sexes need to have more bedrooms as children get older. Additionally, it can be challenging for large families to find housing with several bedrooms. While it seems that these characteristics would theoretically moderate the relationship between housing assistance (or type of housing assistance) and crowding, neither having children of both sexes nor having a large family (more than 6 people in the household, 15.3% of the sample) are found to be significant moderators. Next, whether the mother has formed an independent household, separate from her parents (either with or without a partner), is explored as a moderator. Children living in public housing with a mother who has formed such a household are less likely to experience crowding than children living in public housing where the mother has not established her own household. Lastly, changes in family size may be associated with changes in crowding: families that experience changes in size may move into or out of crowding. Neither changes in family size nor changes in the mother's partnership status moderate the relationship between housing assistance (or type of assistance) and crowding.

Families may experience crowding because they are trying to access better neighborhoods. To explore this, the association between housing assistance (and type of assistance, since families with vouchers can move with their assistance while families living in public housing cannot) and crowding is examined using several characteristics as moderators: region (because cost of living may vary by region), living in a high poverty neighborhood (with a poverty rate above 40%), and living in a neighborhood that is both racially and economically segregated. None of these variables moderate this relationship.

Summary of Results

In the analyses presented, housing assistance is not associated with the traditional measure of crowding where a housing unit is crowded if the person to room ratio is above 1. However, receiving any housing assistance is associated with reduced severe crowding (where a unit is crowded if the person to room ratio is above 1.5). When further exploring this relationship by housing assistance type, both living in public housing and receiving a voucher are associated with reduced severe crowding.

While housing assistance is a significant predictor of this more conservative measure of crowding, sensitivity analyses were conducted to better understand situations in which housing assistance might effectively reduce crowding, measured traditionally. The only characteristic that seems to be of particular importance is whether the mother had formed her own independent household (with or without a partner). Among children living with mothers in independent households, housing assistance is associated with reduced crowding.

Chapter 8: Housing Assistance and Housing Cost Burden

Research Question

This section examines, first, whether receiving housing assistance is associated with housing cost burden and, second, whether this association differs by housing assistance type (vouchers and public housing, compared to no housing assistance).

Measures

Housing Cost Burden

Housing cost burden is calculated using two variables from the PSID core survey: housing cost (rental or mortgage payment) and household income. The housing expense to household income ratio is calculated by dividing amount spent on housing by household income. A household is coded as having a housing cost burden if their housing costs exceed 30% of household income. This method of calculating housing cost burden is conventional and follows HUD's determination of housing cost burden (Belsky, Goodman, & Drew, 2005).

Housing Assistance

Housing assistance is measured annually, from birth to age six and biannually from ages seven to fifteen, using the PSID-AHD and is coded using two coding schemes. In the first set of analyses, housing assistance is coded in each wave of the data as a binary variable (received assistance or did not receive assistance). In the next set of analyses, housing assistance is coded as a categorical variable at each wave. The categories for this variable are: no housing assistance, received a housing voucher from a

local or federal program, lived in public housing, and received other assistance. Due to heterogeneity in program receipt and small sample sizes, meaningful conclusions cannot be drawn about these other assistance programs (which include small local programs and living in Low-Income Housing Tax Credit-financed buildings), however, these categories were included in the coding of the housing assistance variable to make the comparison group as pure as possible. Because housing assistance is measured annually, there are changes within children over time (e.g., going from not receiving housing assistance to living in public housing) which allow for the analysis of individual fixed effects models estimating changes within children over time.

Covariates

Analyses include both time invariant and time-varying variables that may confound the association between housing assistance receipt and moving.

Time invariant

Time invariant covariates are measured at the child's birth. Characteristics about the child's family include the mother's age and education, and the household head's race and ethnicity. Analyses also include child-level characteristics: the child's sex and if she had a low birthweight (<2500 grams). To account for variation in housing assistance availability and other economic, policy, and contextual changes in the US over time, the year in which the child was born is also controlled for.

Time-Varying

A series of time-varying covariates, both at the family and census tract levels, are included in all analyses. Family level characteristics include: cash public assistance receipt, whether the child's mother was the head or wife of her own household, whether the head of the household was male, household size, household income to poverty ratio, and the region in which the family lived (Northeast, Midwest, South, or West). Census tract level characteristics include: the percentage of the population below the poverty line, the percentage of residents who are white, and the median rent. In multivariate analyses, all time-varying characteristics are lagged two years to ensure that these characteristics preceded whether the child experienced housing cost burden.

Analytic Strategy

First, the sample is pooled across the first 15 years of the children's lives, representing 39 years of data. Next, descriptive statistics of all variables included in the analysis are presented for the full sample. Then, these descriptive statistics are presented for each coding scheme for the independent variable: no housing assistance, any housing assistance, public housing, and vouchers. Descriptive statistics for families with children who are receiving other housing assistance are not presented due to program heterogeneity and small sample sizes.

Next, ordinary least squares (OLS) regression models, known as linear probability models (LPM) when models have a dichotomous outcome, are used to estimate the association between housing assistance and whether the child moved for the pooled sample. While the outcome variable in these analyses is dichotomous, linear probability

models typically provide unbiased estimates of dichotomous outcomes when the probability is between 0.2 and 0.8 (Angrist and Pischke 2008, Hellevik 2009, Von Hippel 2015). Thus, the models are estimated using OLS equations for ease of interpretation, flexibility with interaction effects (Ai and Norton 2003), and to more easily compare coefficients across models (Karlson, Holm, and Breen 2012). In these analyses, housing assistance is lagged by two years to establish temporal ordering. The two year lag is utilized to address the switch to biannual data collection in the PSID beginning in 1997 (e.g., for children born later in the sample for the current study, the most recent measurement of housing cost burden is reported two years prior). The first set of models examines the association between receiving any housing assistance and housing cost burden. The next set of models explores whether there are differences in the dependent variable by the type of housing assistance received. In each set of analyses, the following models are presented:

1. Random effects models that explicitly examine effects within and between children by allowing intercepts to vary across children.
2. Fixed effects models (the most conservative estimates) that examine effects only within children over time and account for all static characteristics of children by permitting variation in both intercepts and slopes.

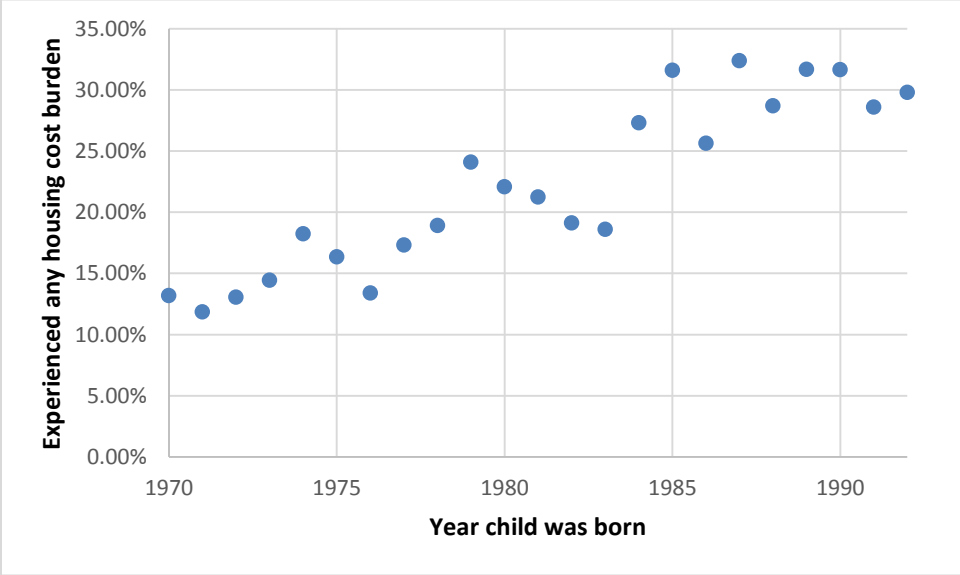
Results of each analysis are presented as regression coefficients and *t*-statistics. Regression coefficients can be interpreted as percentage point changes in the probability of having moved.

Results

Descriptive Results

The sample includes 12,975 observations of 1,767 individuals. Descriptive statistics are presented in Table 25. Overall, 8.4% of the sample lived in public housing and 5.5% received a voucher. Of the full sample, 21.6% experienced a housing cost burden where housing costs were more than 30% of total household income. While average housing cost burden over the entire period is relatively low, it has increased over the study period. This trend is evidenced in Figure 13 which shows housing cost burden based on the year the child was born. Less than 1% of the sample experienced a high housing cost burden (with housing costs of at least 40% of total household income).

Figure 13: Housing cost burden by year born



Families receiving any housing assistance were significantly less likely to experience a housing cost burden than low-income families without assistance (20.9%

compared to 25.13%, respectively). Examining differences by assistance type, families receiving public housing were the least likely (16.7%) to experience housing cost burdens. Children whose families rented with vouchers were as likely to experience a housing cost burden as children in families without housing assistance.

Children receiving any housing assistance differed significantly from children not receiving housing assistance in several ways. These children were more likely to have less educated mothers, be black, have a slightly older mother who had formed an independent household, receive cash assistance, live in a single-female headed household, have a lower income to poverty ratio, live in the South or Northeast, and live in census tracts with higher poverty rates, more minority concentration, and lower median rents. Compared to children not receiving housing assistance, children living in public housing were less likely to have a low birth weight, more likely to have a less educated mother, be black, have a larger household size, receive cash assistance, have a single female-headed household with a mother who has formed her own household, be more impoverished, and live in a census tract with a higher poverty rate, greater minority concentration, and lower median rents. Also compared to children not receiving housing assistance, children whose families were renting with a voucher were more likely to be poorer, have a low birth weight, be black, have a slightly older mother and a smaller household size, and to live in census tracts with higher poverty rates, more racial segregation, and higher median rents. These households were less likely to have a male headed household.

Table 25. Housing assistance and housing cost burden, descriptive statistics and statistical tests by housing assistance receipt (n=12,975, with observations on 1,767 children)

	Col. 1		**Col. 2**		**Col. 3**		**Col. 4**	**Col. 5**		**Col. 6**	**Col. 7**		**Col. 8**
	Entire Sample (n=12,975)	**SD**	**No Housing Assistance (n=10.996)**	**SD**	**Any Housing Assistance (n=1,979)**	**SD**	**Sig. Test (Comp. Any Housing Assistance to None)**	**Public Housing (n=1,089)**	**SD**	**Sig. Test (Comp. Public Housing to None)**	**Voucher (n=718)**	**SD**	**Sig. Test (Comp. Voucher to None)**
Independent Variables	% or Mean		% or Mean		% or Mean			% or Mean			% or Mean		
No housing assistance	84.75												
Public housing	8.39												
Voucher	5.53												
Other housing assistance^	1.33												
Housing Cost Burden													
Housing costs greater than 30% of income	24.48		25.13		20.87		***	16.71		***	25.63		
Median rent to income ratio	0.15		0.15		0.17			0.17			0.17		
Baseline Covariates													
Female (%)	48.60		48.36		49.92			51.06			48.33		
Low birthweight (%)	3.02		2.96		3.39			1.19		**	5.99		***
Mom's education at birth (%)							***			***			
Less than HS	50.27		48.85		58.11			69.79			47.63		
HS	27.64		28.66		21.93			16.44			25.63		
Some college or higher	22.10		22.48		19.96			13.77			26.74		
Race (%)							***			***			***
White	21.34		24.03		6.42			4.13			10.86		
Black	74.45		71.54		91.16			94.21			86.77		
Other	4.12		4.43		2.43			1.65			2.37		
Mom's age at birth (years)	29.62		29.44		30.57		***	30.31			30.55		*

Time-varying Covariates													
Household Characteristics													
Household size	4.75	1.86	4.76	1.8	4.73	1.97		5.05	2.2	***	4.33	1.6	***
Received cash assistance	28.26		26.77		36.49		***	41.83		***	28.63		
Mom was head or wife of her own household	88.94		88.65		90.55		*	91.09		*	89.42		
Male household head	43.68		46.31		29.05		***	30.70		***	29.47		***
Income to poverty ratio	1.14	0.81	1.19	0.8	0.88	0.69	***	0.78		***	1.02		***
Region							***						
Northeast	9.70		9.22		12.33			12.76			12.12		
Midwest	24.84		26.62		14.96			12.86			18.80		
South	55.16		53.63		63.67			66.39			58.91		
West	10.30		10.53		9.04			7.99			10.17		
Census Tract Characteristics													
Below the poverty line (%)	23.86		22.24		32.76		***	39.29		***	23.94		**
White (%)	42.55		44.69		30.83		***	25.94		***	37.35		***
Median rent ($)	214.14		216.48		201.30		***	147.22		***	269.26		***

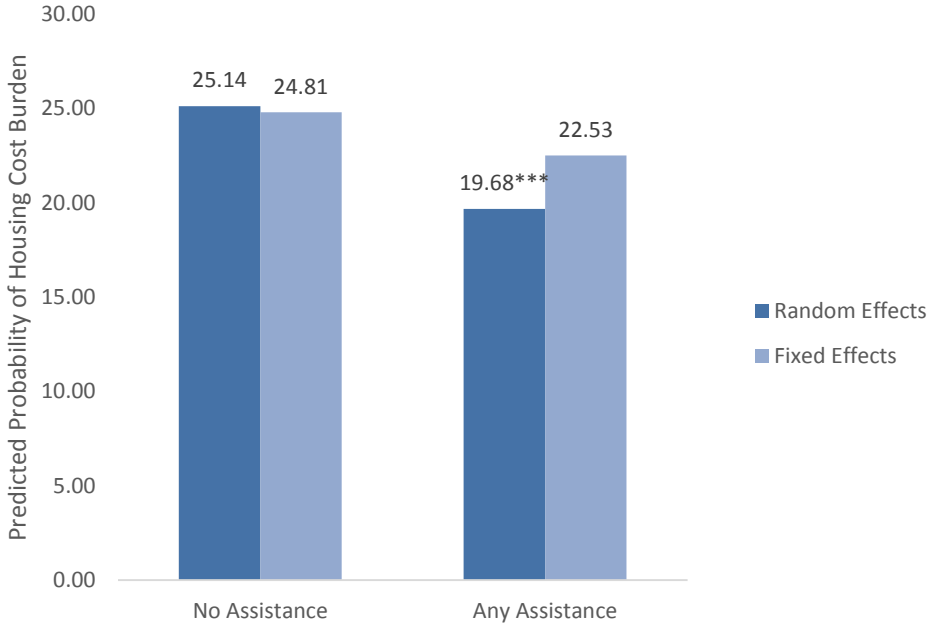
**p<0.05, **p<0.01, ***p<0.001*

Notes: ^ Other HA are not included in significance tests due to small sample size. Abbreviations: standard deviations (SD), column (Col.)

Multivariate Results

Table 26 displays the results from multivariate analyses of housing cost burden regressed on any housing assistance receipt. Model 1 examines this relationship using random effects. In this model, receiving any housing assistance is associated with a five percentage point decrease in experiencing housing cost burden. Model 2 presents results from fixed effects models examining the association between housing assistance and housing cost burden within individuals, reflecting changes in housing cost burden as individuals move in and out of housing assistance receipt. The findings in this model are not statistically significant suggesting that the significance of association between housing assistance receipt and housing cost burden in Model 1 may be driven by unobserved time-varying characteristics. As shown in Figure 14: Probability of housing cost burden by any housing assistance Figure 14, in random effects models, about 20% of children receiving any housing assistance experienced a housing cost burden compared to 25% among children not receiving assistance. There are not significant differences in housing cost burden between children receiving and not receiving assistance in the fixed effects model.

Figure 14: Probability of housing cost burden by any housing assistance



*Note: Results from fully-controlled linear models; reference category for significance tests is no assistance, *p<0.05, **p<0.01, ***p<0.001*

Table 27 shows the results of analyses examining the effects of different types of housing assistance on housing cost burden. As presented in Table 26, Model 1, displaying random effects results, shows that both living in public housing and receiving a voucher are associated with a seven percentage point decrease in experiencing housing cost burden.

The fixed effects model (Model 2) in

Table 27 shows that, compared to when a child did not receive housing assistance, neither receiving public housing nor a voucher are associated with housing cost burden. As seen in Figure 15, in random effects models, children who live in public housing have less than a 20% chance of experiencing a housing cost burden while children with a voucher have just over a 20% chance compared to a 25% chance among children without housing assistance.

Figure 15: Probability of housing cost burden by housing assistance type

*Note: Results from fully-controlled linear models; reference category for significance tests is no assistance, *p<0.05, **p<0.01, ***p<0.001*

In the random effects models presented in Table 26 and

Table 27, certain covariates are also significantly associated with housing cost burden. Having a mother who is more highly educated (compared to one who did not complete high school), a larger household size, a male household head, a higher income to poverty ratio, and living in either the South or Midwest (compared to the Northeast) are associated with a lower likelihood of experiencing housing cost burden. Meanwhile, being black and receiving cash assistance are associated with an increased likelihood of experiencing housing cost burden. At the census tract level, having a greater proportion of people in poverty and greater proportion of the population that is white is associated with reduced housing cost burden while higher median rent is associated with increased housing cost burden. In the fixed effects models, receiving cash assistance is associated with an increased likelihood of experiencing a housing cost burden while having a male as household head, higher income to poverty ratio, a greater proportion of families in poverty at the census tract level, and a higher median rent at the census tract level are associated with a decreased chance of having a housing cost burden.

Table 26. Linear models of any housing assistance and housing cost burden (n=12,975, with observations on 1,767 children)

	Model 1: Random Effects			**Model 2: Fixed Effects**		
Independent Variables						
Any housing assistance	-0.05	***	(-4.69)	-0.02		(-1.61)
Baseline Covariates						
Female (%)	0.01		(0.83)			
Low birthweight (%)	0.06		(1.88)			
Mom's education at birth (%)						
High school	-0.05	***	(-4.24)			
Some college or higher	-0.05	***	(-3.73)			
Race (%)						
Black	0.03	*	(2.00)			
Other	-0.01		(-0.24)			
Mom's age at birth (years)	0.00		(-0.47)			
Time-varying Covariates						
Household size	-0.02	***	(-6.36)	-0.01		(-1.62)
Received cash assistance	0.07	***	(7.44)	0.04	***	(3.57)
Mom was head or wife of her own household	-0.02		(-1.78)	0.02		(1.26)
Male household head	-0.09	***	(-8.85)	-0.06	***	(-4.56)
Income to poverty ratio	-0.03	***	(-6.22)	-0.01		(-1.59)
Region						
Midwest	-0.06	**	(-3.09)	0.06		(0.76)
South	-0.11	***	(-6.21)	0.03		(0.46)
West	-0.02		(-1.07)	-0.08		(-1.10)
Below the poverty line (%)	0.00	*	(-2.20)	0.00	*	(-2.31)
White (%)	0.00	***	(-5.77)	0.00		(-1.05)
Median rent ($)	0.00	*	(2.41)	0.00	***	(-4.21)

** p<0.05, **p<0.01, ***p<0.001*

Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born

Table 27. Linear models of housing assistance (by type) and housing cost burden (n=12,975, with observations on 1,767 children)

	Model 1: Random Effects			Model 2: Fixed Effects		
Independent Variables						
Public housing	-0.07	***	(-4.83)	-0.03		(-1.27)
Voucher	-0.04	*	(-2.35)	-0.04		(-1.76)
Baseline Covariates						
Female (%)	0.01		(0.85)			
Low birthweight (%)	0.06		(1.85)			
Mom's education at birth (%)						
High school	-0.05	***	(-4.35)			
Some college or higher	-0.05	***	(-3.81)			
Race (%)						
Black	0.03	*	(2.00)			
Other	-0.01		(-0.28)			
Mom's age at birth (years)	0.00		(-0.52)			
Time-varying Covariates						
Household size	-0.02	***	(-6.30)	-0.01		(-1.63)
Received cash assistance	0.07	***	(7.48)	0.04	***	(3.58)
Mom was head or wife of her own household	-0.02		(-1.80)	0.02		(1.27)
Male household head	-0.09	***	(-8.84)	-0.06	***	(-4.52)
Income to poverty ratio	-0.03	***	(-6.27)	-0.01		(-1.58)
Region						
Midwest	-0.06	**	(-3.14)	0.05		(0.74)
South	-0.11	***	(-6.26)	0.03		(0.44)
West	-0.02		(-1.08)	-0.08		(-1.11)
Below the poverty line (%)	0.00		(-1.95)	0.00	*	(-2.34)
White (%)	0.00	***	(-5.69)	0.00		(-1.13)

Median rent ($)	0.00	*	(2.37)	0.00	***	(-4.20)

** p<0.05, **p<0.01, ***p<0.001*

Note: Regression coefficients with t-statistics in parentheses; models also include a control for the year the child was born

Sensitivity Analyses

A series of sensitivity analyses were estimated to explore whether the association between housing assistance between housing assistance and housing cost burden is more salient for certain groups than others and under certain than others and under certain family and household circumstances. Tables for all analyses referenced in this section referenced in this section are included in

Appendix 7.

First, the association between housing assistance and housing cost burden is explored among families with permanent incomes at or below 150% of the federal poverty line. The effect of housing assistance on housing cost burden is slightly stronger for this group than for the full sample with a 6.6 percentage point lower likelihood of experiencing housing cost burden among those who received housing assistance, compared to a five percentage point lower likelihood in the main models. As with the main models, there are not significant results in the fixed effects model. When examining the effects of different types of housing assistance on housing cost burden among this group, public housing and vouchers are both associated with a decreased likelihood of experiencing housing cost burden (by 8.0 and 6.4 percentage points, respectively). In the fixed effects model, receiving a voucher is statistically significant: children are 5.5 percentage points less likely to experience housing cost burden when receiving a voucher than when they did not receive housing assistance. This finding differs from the finding in the main model which was not significant for either voucher-holders or children living in public housing; this suggests that vouchers may be particularly effective in reducing housing cost burden among more disadvantaged families.

The next set of robustness checks controls for a set of family and household changes over the prior two years. Marital status change is coded categorically (1 = no

change; 2 = went from a single female-headed household to a male-headed household; 3 = went from a male-headed household to a single female-headed household); no change is the comparison group. Household size change is measured dichotomously (change/no change). Income to poverty ratio is coded categorically [1 = no change (reference category); 2 = became less poor; 3 = became more poor]. In these analyses, receiving any housing assistance is associated with reduced housing cost burden. In analyses examining type of housing assistance, receiving a voucher is associated with reduced housing cost burden across all models, included fixed effects models, while living in public housing is significant only in random effects models. Across all models, going from a single female-headed household to a male-headed household, having a change in household size, and having a higher income to poverty ratio are associated with reduced housing cost burden. A decrease in a family's income to poverty ratio (meaning they got poorer over the two year period) has a very large effect on housing cost burden: in the fixed effects model examining the effects of housing assistance (by type) on housing cost burden, there is a 20.3 percentage point increase in housing cost burden if a family has become poorer.

While it would be interesting to examine the effects of housing assistance on severe housing cost burden (when families spend at least 40% of their household income on rent), experiencing severe housing cost burdens is very rare in the current sample (less than 1%). This may be due, in part, to the time period of the sample. Housing cost burdens have increased steadily over time, as illustrated in Figure 13: Housing , which suggests that severe housing cost burden may be more of a concern among children born in the end of the 20th century or later.

Summary of Results

The findings from the random effects models presented in the main analyses show that receiving any housing assistance is associated with reduced housing cost burden. This effect holds regardless of housing assistance type though public housing has a larger effect size than vouchers. Fixed effects models both for any housing assistance and by housing assistance type do not have significant main effects suggesting that unobserved characteristics may be driving this association. Robustness checks to further explore this relationship controlling for family change variables find that, even in fixed effects models, receiving a voucher is associated with reduced housing cost burden. This suggests that family change (whether the partnership status of the head, poverty dynamics, or household size) are significant in predicting housing cost burden.

Chapter 9: Discussion

Summary of Results

A discussion of the results from the current study and their place in the existing literature follows. The discussion first addresses the overarching research question (is housing assistance associated with high school completion?) and then moves into the various pathways explored in this study.

Housing Assistance and High School Completion

Existing literature on the effects of housing assistance receipt on high school completion is scarce. Prior research suggests that public housing may improve children's educational outcomes (Currie & Yelowitz, 2000; Newman & Harkness, 2000). One paper finds that children living in public housing are less likely to be held back a grade (Currie & Yelowitz, 2000). Other research finds a positive, though not statistically significant, association between receiving public housing and educational outcomes including high school completion (Newman & Harkness, 2000). One prior paper finds that vouchers are not associated with educational achievement or school completion (Jacob et al., 2015). Research from the Moving to Opportunity experiment, in which experimental vouchers were restricted to use in low-poverty neighborhoods, suggests that there were no long-term effects of vouchers on educational attainment (Sanbonmatsu et al., 2011). In sum, these studies do not portray a clear picture of the effects of public housing on high school completion and suggest that vouchers may not have an effect on this outcome.

The current study adds to the existing literature by examining the associations between both public housing and voucher receipt over childhood and high school

completion. The findings about the association between public housing and high school completion in this study align with the findings in the one other paper examining this association: public housing does not have a significant effect on high school completion (Newman & Harkness, 2000). The coefficient in the current study is negative, in contrast to findings from Newman and Harkness (2000).

Additionally, this study is the first to the author's knowledge to examine the association between all vouchers (not solely those associated with specific demonstration programs) nationwide and high school completion. The findings from the current study show that receiving a voucher is associated with a significantly higher likelihood of completing high school, compared to not receiving assistance. The effect size of this association is large (nine percentage points) off a mean value in the sample of 72%, indicating a 13% increase in likelihood of completion. The nine percentage point increase in the likelihood of completing high school is similar to the effect size of other interventions to increase high school completion; for example, the percentage point increases in high school completion for supplemental academic services, alternative schools, and vocational training are 9.6, 9.0, and 11.9, respectively (S. J. Wilson et al., 2011). Relatively, vouchers seem to be more effective in increasing high school completion rates than academic monitoring (which is associated with a 5.6 percentage point increase) and less effective than community service (associated with a 14.1 percentage point increase) (S. J. Wilson et al., 2011). However, the findings from the current study contract with those in the Jacob et al. (2015) paper which finds no effects of housing vouchers on educational achievement. It is possible the that this discrepancy is due to significant differences in the sample (nearly two-thirds of the sample in the Jacob

et al. (2015) paper received TANF compared to about a third in the current study and the samples reflect different geographies and time periods; additionally, the current study examines receipt across childhood, not only after random voucher receipt) or methodological differences (the former paper uses a randomized voucher program with instrumented models and a more robust set of controls than available in the PSID data).

Overall, the findings for this question suggest that housing vouchers may be an important tool in increasing children's likelihood of completing high school, in league with more conventional school- and community-based interventions. While the current study does not find that the timing of voucher receipt significantly predicts high school completion, receiving a voucher for one to two years approaches statistical significance, suggesting that shorter time periods of voucher receipt may be particularly effective.

Because of concerns about selection bias and endogeneity, augmented inverse probability weighted (AIPW) models were estimated. In these models, both receiving a voucher (compared to not receiving a voucher) and living in public housing (compared to not living in public housing) are significantly associated with high school completion. As with the main models, children who receive a voucher are more likely to complete high school than low-income children who did not receive a voucher. In these models, children who have lived in public housing are less likely to complete high school than children who have not lived in public housing. It is important to highlight the reference categories in the AIPW models. The public housing model's comparison group is those who did not receive public housing (but the child's family could have received a voucher or another type of housing assistance). The voucher model's comparison group is those

who did not receive a voucher but the child could have received some other type of housing assistance.

These AIPW results differ from the results in Newman and Harkness (2000), perhaps because of methodological differences. Newman and Harkness (2000) utilize an instrumental variables approach and find that effects of public housing were not significant but were positive. While an instrumental variables approach was not used in the current study (due to concerns about selecting an instrument and data availability), AIPW models aim to address the same concerns as instrumental variable approaches though this strategy only addresses observable characteristics. In addition to the methods explaining differences in the results of this study, it is also possible that these discrepancies are due to differences in sample sizes. The sample in the current study is significantly larger than that in the comparison paper (Newman & Harkness, 2000).

Pathways between Housing Assistance and High School Completion

The prior discussion highlights the overall associations between housing assistance (any and by type) and high school completion. In order to better understand these relationships, several pathways were explored. Because the two housing assistance programs studied in this dissertation differ in the directions in which they are associated with high school completion, the pathways are discussed by housing assistance type, rather than by receipt of any housing assistance.

Neighborhood Disadvantage

Disadvantaged neighborhoods are often marked by community-level resource deprivation, unemployment, and social isolation, all of which can affect children's educational outcomes (W. J. Wilson, 1987). Schools typically represent neighborhoods' attributes and the socioeconomic characteristics of children's neighborhoods can impact educational performance (Benson & Borman, 2010). Existing research shows that public housing is commonly located in more distressed neighborhoods than units in which other poor households live and that voucher holders are able to access slightly better neighborhoods than other poor households, but often not middle- and upper-income areas (McClure & Johnson, 2014; Newman & Schnare, 1997).

The current study finds that living in public housing is associated with living in neighborhoods with higher poverty and minority concentrations compared to children not receiving assistance. Children in the current study who live in public housing are likely to live in neighborhoods that are more disadvantaged than children without housing assistance, both when making comparisons between and within children. There are not statistically significant effects of vouchers on neighborhood characteristics meaning that children receiving vouchers are not accessing neighborhoods that are more advantaged than either children without housing assistance or compared to when they, themselves, did not have housing assistance. These results are consistent with existing literature (e.g., McClure & Johnson, 2014).

The existing literature suggests that schools, as reflections of the characteristics of the neighborhoods in which they are located, shape children's educational performance (Benson & Borman, 2010). In the current study, children with vouchers do not access

neighborhoods that differ from those accessed by children without housing assistance. Thus, it appears that the effects of vouchers on high school completion may be operating through a pathway other than neighborhood disadvantage. Similarly though, in this study, living in public housing is associated with living in more disadvantaged neighborhoods, children who receive public housing are no more or less likely to complete high school than children who did not receive it. Because neighborhoods are important determinants of children's educational performance, this finding suggests that other pathways between housing assistance and high school completion may be protecting children against the effects of living in disadvantaged neighborhoods.

Residential Stability

The school instability experienced with residential instability is associated with poor educational outcomes including grade repetition (Rumberger, 2002) and dropping out of high school (Haveman, Wolfe, & Spaulding; Haveman et al., 1991). Because housing assistance can provide low-income families with a cushion against financial shocks, potentially promoting residential stability, this study tested whether housing assistance is associated with residential stability. Existing research finds that receiving housing assistance, whether through a voucher or public housing, is associated with increased residential stability (Berger et al., 2008; Heintze et al., 2006).

Findings from the current study show that living in public housing is associated with increased residential stability. There are no statistically significant differences in residential stability between receiving a voucher and not receiving assistance. Children in families with public housing are more likely to experience residential stability than

children without housing assistance *but* they do not experience a higher chance of completing high school. On the other hand, children in families receiving a voucher are no more stable than children in families without housing assistance *and* have a higher likelihood of completing high school. Because these relationships differ in direction from the anticipated effects of stability on high school completion, it appears that residential stability is likely not the driving pathway between housing assistance and high school completion.

Residential Crowding

Residential crowding is associated with poor academic performance among children (Goux & Maurin, 2005; Solari & Mare, 2012). Existing literature suggests that housing assistance, whether provided through vouchers (Abt Associates Inc. et al., 2006; Mancuso et al., 2003) or public housing (Berger et al., 2008; Heintze et al., 2006), is associated with reduced crowding. In the current study, receiving either a voucher or public housing is not associated with the traditional measure of crowding (having more than one person per room) but both types of housing assistance are associated with a lower likelihood of experiencing severe crowding (where a housing unit is crowded if the person to room ratio is above 1.5). These findings suggest that receiving housing assistance can reduce the likelihood of children living in some of the most overcrowded housing conditions.

Housing Cost Burden

Severe housing cost burdens are experienced by the majority of low-income families in the United States (Holupka & Newman, 2011). Housing assistance can reduce these burdens, allowing families to allocate more of their resources towards activities that can improve their children's educational outcomes. Existing literature on housing cost burden among families with housing assistance finds that housing cost burden is common among families with vouchers (Mast, 2012; McClure, 2005) and that families with vouchers may not experience reduced housing cost burdens compared to when they did not receive assistance (Comey et al., 2012). A contributing factor to housing cost burden among voucher-holders is that they are permitted by program guidelines to spend up to 40% of their income on housing. Existing research shows that families receiving public housing are unlikely to experience housing cost burdens though, in this research, rent burden is not defined for families with no income who live in public housing (Mast, 2012).

Descriptive findings in the current study align with the literature on vouchers. In these findings, about a third of families with a voucher experience housing cost burden. Prevalence of housing cost burden among children living in public housing is higher than in the literature but this may be due to the methodological choice to exclude families with zero reported income in the one prior paper that presents this information (Mast, 2012). Findings from multivariate analyses show that receiving either a voucher or public housing is associated with reduced housing cost burden. The effect size in these analyses is larger for public housing than a voucher which was expected given program guidelines allowing families with a voucher to spend up to 40% of their income on housing. Fixed

effects models both for any housing assistance and by housing assistance type do not have significant main effects suggesting that unobserved characteristics may be driving this association. For example, it is possible that families with vouchers were already spending a large portion of their income on housing before receiving a voucher and the subsidy provided by the voucher simply covered part of these costs. Descriptive statistics from the current study indicate that families receiving public housing are more disadvantaged than families not receiving housing assistance. Prior to moving into public housing, these families may have utilized other strategies (e.g., doubling up with family or friends) to reduce their housing cost burden.

Tying Together the Overarching Research Question and Pathways

Results from the analyses for Question 1, examining the association between housing assistance receipt and high school completion, show that children whose families receive a voucher at some point during childhood are more likely to complete high school than children who do not receive assistance. There is no significant effect of public housing on high school completion. However, when examining the pathways through which housing assistance is theorized to operate in its association with high school completion, there are some interesting findings that suggest that children living in public housing may experience conditions that are associated with improved educational attainment (e.g., reduced crowding and housing cost burden and increased residential stability). Thus, it is critical to think through the combinations of the various pathways in understanding how and why vouchers, but not public housing, are associated with high school completion.

Children with vouchers live in neighborhoods with similar characteristics (i.e., poverty rates and minority concentration) as those in which children without housing assistance live. They are just as likely to move as children without housing assistance but are less likely to experience crowding or housing cost burdens. In contrast, compared to children without housing assistance, children who live in public housing live in neighborhoods that are more economically and racially segregated and are less likely to move or experience crowding and housing cost burdens. Taken together, it is possible that families who live in public housing may be experiencing some improvements in housing quality and economic security (e.g., reduced crowding and housing cost burden) but are stuck in housing or neighborhoods that they might rather leave. Vouchers, on the other hand, may provide families with the flexibility they need to access housing situations, and neighborhoods with desired amenities (perhaps schools and access to employment opportunities), that better meet their needs.

These findings help illuminate the possible reasons why receiving a voucher, but not public housing, is associated with high school completion. They also highlight some of the ways in which some of the positive characteristics of public housing may protect children against its more negative characteristics (particularly its typical location in more disadvantaged neighborhoods). Examining the pathways through which housing assistance receipt may impact high school completion allows for a deeper understanding of program adjustments that can be made to improve outcomes for children and families with housing assistance.

Limitations

There are several limitations of the current study due to policy changes, data constraints, and methodological challenges.

The first limitation is inherent in examining policy over an extended period of time. As illustrated in Chapter 1 with the discussion of the history of the public housing and voucher programs, the structures of these programs have changed over time. For example, in public housing, families' rental payment caps were increased from 20% to 30% in 1981. While this increase is significant for family finances, it should not impact the current study's findings: when housing cost burden is examined as an outcome, it is measured as having housing costs greater than 30% of household income. Thus, the concern would be only that the estimates in the present paper are conservative, if we consider housing cost burden prior to 1981 to be housing costs greater than 20% of household income. Additionally, the Housing Choice Voucher program was created in 1998 through a consolidation and standardization of other housing voucher programs. While this represented a shift in policy, the HCV program shares with its predecessors its fundamental design: the use of vouchers in privately owned buildings, portability, and limiting rental payments to about 30% of household income. Therefore, these program changes are unlikely to have greatly impacted the analyses in the current study.

There are several data constraints in the current study that affect how various constructs are measured and included (or not) in analyses. When examining the residential stability pathway, moves are measured as having moved since the prior wave. This does not account for multiple moves over the reference period. Additionally, due to data limitations in the PSID, we cannot understand the context of moves families

experienced. While the PSID asks why families moved, it does not clearly specify whether a move was an eviction or a voluntary move. The response choice that contains evictions never includes only evictions; it also includes reasons such as job transfer, divorce, armed services, and health reasons. Because evictions are associated with increased residential instability (Desmond et al., 2015), it would be interesting to explore whether the association between housing assistance and residential stability is moderated by prior evictions.

Additionally, it is possible that the occurrence and extent of housing cost burden is underestimated. In this study, housing cost burden is measured as the percentage of a family's income that is going towards rent or a mortgage. While these costs comprise the bulk of housing costs for most families, measures of housing cost burden typically also include utility costs (Belsky et al., 2005). Unfortunately, the PSID does not consistently measure utility expenditures (e.g., annual electric payments were collected in only two years, 1980 and 1982, in the study period) so these expenses are not included in the calculation of housing cost burden.

Another concern is the measurement of census tract characteristics. All tract characteristics are applied based on the decennial census. For example, the poverty rate in 1970 is assigned to a census tract for the entire decade (through 1979), even though the poverty rate may have changed over this period. While this is a concern, annual changes cannot be measured due to limited data collection at the federal level. Future research using more contemporary data can address this issue by drawing on data from the more frequently collected American Community Survey which has 1-, 3-, and 5-years estimates at the census tract level.

An additional concern is that criminal convictions are not included as covariates in the present study though a family member's conviction can result in a family losing either housing assistance or their access to it. Children with an incarcerated parent are also more likely to drop out of school, even when controlling for other socioeconomic characteristics (Morsy & Rothstein, 2016). However, the PSID core survey only asked at one time point (in 1995) whether an individual had ever spent time in a corrections institute (including jail, prison, or a reform school). In addition to only being asked at one point, this item is only asked about individuals who were living in the household at the time of the survey, eliminating from the sample individuals who were currently incarcerated.

Analyses of the pathways between housing assistance and educational attainment (e.g., residential stability, crowding, housing cost burden, and neighborhood disadvantage) control for time-varying characteristics that could affect both families' likelihoods of accessing housing assistance and children's chances of completing high school. However, models examining whether housing assistance is associated with high school completion do not control for these time-varying characteristics. All covariates in those analyses occur at the child's birth to order them prior to the treatment (housing assistance). Family changes, from events such as incarceration, income changes, geographic moves, and evictions, can alter both eligibility for assistance and children's probabilities of graduating from high school. Several steps are taken to address this concern: first, for all analyses, the sample is limited to children in families with low permanent income (averaged across birth to age 15); second, robustness checks are conducted limiting the sample to families that are permanently poor. Lastly, models are

estimated using augmented inverse probability weighting which allows for comparisons to similar families who did not receive the treatment.

Implications

The results from the current study indicate that receiving a housing voucher at any point during the childhoods of low-income children greatly increases their likelihood of completing high school. While the current study does not find that the timing of assistance matters for this outcome, it does suggest that receiving such assistance for even a short time period (one to two years), compared to not receiving a voucher at all, may be particularly salient for high school completion. Based on these findings, it seems that families may be using their vouchers to position themselves for long-term success, be it economic (which can allow families to allocate spending in ways that benefit child well-being) or academic.

Increasing access to short-term housing vouchers during childhood could provide families with an important tool to support children's academic achievement. Building on existing literature which finds that moving to a low poverty neighborhood during childhood, before age 13, is associated with better academic outcomes (Chetty et al., 2016) and knowledge that living in disadvantaged neighborhoods is associated with worse academic outcomes (e.g., Burdick-Will, 2016; Jencks & Mayer, 1990; Sampson, Raudenbush, & Earls, 1997), these vouchers could be used to help families access neighborhoods with low poverty and crime rates and well-performing schools. An important Obama-era shift in HCV policy could help families access better neighborhoods: the HUD Small Area Fair Market Rent Rule would calculate fair market

rents based on smaller geographic areas to more accurately reflect the actual rent in a neighborhood (U.S. Department of Housing and Urban Development, 2016). This would allow families to use their vouchers in higher rent areas. Providing families with vouchers accompanied with housing counseling and enforcing the HUD Small Area Fair Market Rent Rule could increase the benefits of investing additional resources in the HCV program.

The various pathways examined in this dissertation also provide areas for policy reforms. Based on the findings from this study, children living in public housing are less likely to experience severe crowding or housing cost burden compared both to other children and to when they were not living in public housing. These children are also more likely to experience residential stability. However, children living in public housing live in neighborhoods with racial and economic segregation which, as discussed, has a host of negative outcomes for children. While the benefits of receiving public housing reflected in the pathways other than neighborhood disadvantage may counterbalance the effects of living in a poor, segregated neighborhood, the program could do more to have positive effects on educational attainment. Because public housing is inherently place-based and these buildings already exist, investing in the neighborhoods in which public housing is located would allow policymakers to capitalize on the strengths of this housing program (increased stability and reduced housing cost burden and severe crowding) to promote positive outcomes for residents both of public housing and the surrounding neighborhoods. These investments could involve job creation and training, transportation, and public safety initiatives.

As shown in this study, housing vouchers are associated with educational achievement. Children in families with vouchers are able to access the same neighborhoods as their low-income peers who do not receive assistance but spend a lower percentage of their household income on housing than their peers and are less likely to experience severe crowding. However, these families do not experience reduced housing cost burdens compared to when they were not receiving a voucher. The voucher program provides families with the flexibility to spend up to 40% of their income on housing so they can access more desirable neighborhoods. However, spending a higher percentage of income on housing can create economic hardship. Again, adjusting Fair Market Rents through the HUD Small Area Fair Market Rent Rule could provide families access to better neighborhoods without increasing their housing cost burdens (U.S. Department of Housing and Urban Development, 2016).

Future Research

The current study provides important contributions to knowledge about the effects of housing assistance on academic achievement and the pathways through which the association operates. It also raises additional questions to be addressed in future research.

First, a better understanding of the importance (or lack thereof) of timing and duration of voucher receipt is critical for understanding why receiving a voucher at any point in childhood is associated with increased educational attainment. Results from the duration of housing assistance analyses suggests that receiving a voucher for only a short time may be effective for increasing educational attainment. However, the present study does not explore what happens to families after receiving a voucher for this period of

time. This understanding is critical for knowing why vouchers operate the way they do. Thus, there may be several other pathways between short-term receipt of vouchers and high school completion, such as using vouchers to access employment opportunities, transportation, or schools, which could be examined. Future research can explore what happens to families after they receive vouchers for a short period of time: why do they leave assisted housing? What changes in their personal circumstances happen from the time they initially receive housing assistance to when they leave the voucher program?

Additional attention should be paid to the contexts of residential moves/stability in each of the housing assistance programs. This study does not discern whether the residential stability experienced by families living in public housing is desired. It is possible that families living in public housing would prefer to move if they could retain their housing assistance; in these situations, it is unclear whether residential stability would be wholly beneficial. Additionally, while certain moves among families with vouchers or without housing assistance may be wanted and mean families are accessing less-disadvantaged neighborhoods (Feins and Patterson, 2005), the models in this study do not take into account these contexts. Future research could explore these issues, particularly how families receiving housing assistance make decisions around moving.

This study shows that children whose families are renting with a voucher are more advantaged than children whose families live in public housing (i.e., they are less poor and more educated). While the program guidelines dictate that a higher percentage program recipients be extremely low-income in the HCV program than in public housing, families who receive, and are able to use vouchers, may be more advantaged than those who receive a voucher and are unable to lease up with their vouchers. The current study

addresses this selection bias through augmented inverse probability weighting and fixed effects models but it is important to better understand the barriers to leasing an apartment through the voucher program. Future research in this area could inform policy change to better implement the HCV program.

References

Abt Associates Inc., Mills, G., Gubits, D., Orr, L., Long, D., Feins, J. D., . . . The QED Group. (2006). *Effects of housing vouchers on welfare families*. Retrieved from

Atlas, J., & Dreier, P. (1994). Public housing: What went wrong. *Shelterforce, 74*.

Austin, P. C. (2011). An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies. *Multivariate Behavioral Research, 46*(3), 399-424.

Austin, P. C., & Stuart, E. A. (2015). Moving towards best practice when using inverse probability of treatment weighting (IPTW) using the propensity score to estimate causal treatment effects in observational studies. *Statistics in Medicine, 34*(28), 3661-3679. doi:10.1002/sim.6607

Basolo, V. (2013). Examining Mobility Outcomes in the Housing Choice Voucher Program: Neighborhood Poverty, Employment, and Public School Quality, 135.

Belsky, E. S., Goodman, J., & Drew, R. (2005). *Measuring the nation's rental housing affordability problem*. Retrieved from

Benson, J., & Borman, G. (2010). Family, neighborhood, and school settings across seasons: When do socioeconomic context and racial composition matter for the reading achievement growth of young children? *Teachers College Record, 112*(5), 1338-1390.

Berger, L. M., Heintze, T., Naidich, W. B., & Meyers, M. K. (2008). Subsidized Housing and Household Hardship among Low-Income Single-Mother Households. *Journal of Marriage and Family, 70*(4), 934. doi:10.1111/j.1741-3737.2008.00537.x

Blake, K. S., Kellerson, R. L., & Simic, A. (2007). *Measuring Overcrowding in Housing*. Retrieved from Bethesda, MD:

Brooks-Gunn, J., Duncan, G. J., & Maritato, N. (1997). Poor families, poor outcomes: The well-being of children and youth. In G. J. Duncan & J. Brooks-Gunn (Eds.), *Consequences of Growing Up Poor*. New York: Sage.

Burdick-Will, J. (2016). Neighborhood Violent Crime and Academic Growth in Chicago: Lasting Effects of Early Exposure. *Social Forces*. doi:10.1093/sf/sow041

Cameron, S. V., & Heckman, J. J. (1993). The Nonequivalence of High School Equivalents, 1.

Center on Budget and Policy Priorities. (2015). *The Housing Choice Voucher Program*. Retrieved from http://www.cbpp.org/sites/default/files/atoms/files/PolicyBasics-housing-1-25-13vouch.pdf

Chetty, R., Hendren, N., & Katz, L. F. (2016). The effects of exposure to better neighborhoods on children: New evidence from the Moving to Opportunity Experiment. *American Economic Review, 106*(4), 855-902. doi:10.1257/aer.20150572

Climaco, C. G., Rodger, C. N., Feins, J. D., & Lam, K. (2008). Portability Moves in the Housing Choice Voucher Program, 1998—2005, 5.

Comey, J., Popkin, S. J., & Franks, K. (2012). MTO: A Successful Housing Intervention, 87.

Congressional Budget Office. (2015). *Federal Housing Assistance for Low Income Households*. Retrieved from https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/50782-LowIncomeHousing-OneColumn.pdf

Corman, H. (2003). The effects of state policies, individual characteristics, family characteristics, and neighbourhood characteristics on grade repetition in the United States. *Economics of Education Review, 22*(4), 409-420. doi:http://dx.doi.org/10.1016/S0272-7757(02)00070-5

Crowder, K., & South, S. J. (2003). Neighborhood distress and school dropout: The variable significance of community context. *Social Science Research, 32*, 659-698. doi:doi:10.1016/S0049-089X(03)00035-8

Currie, J., & Yelowitz, A. (2000). Are public housing projects good for kids? *Journal of Public Economics, 75*(1), 99-124. doi:http://dx.doi.org/10.1016/S0047-2727(99)00065-1

Dastrup, S., McDonnell, S., & Reina, V. (2011). *Household energy bills and subsidized housing*. Paper presented at the American Housing Survey User Conference, Washington, D.C. https://www.huduser.gov/portal/pdf/Dastrub_McDonnell_Reina.pdf

Dawkins, C., & Jeon, J. S. (2017). *Rent Burden in the Housing Choice Voucher Program*. Retrieved from https://www.huduser.gov/portal/sites/default/files/pdf/Rent-Burden-HCV.pdf

Department of Housing and Urban Development. (2002). *FACT SHEET: "How Your Rent Is Determined" For Public Housing and Housing Choice Voucher Programs*. Washington, D.C. Retrieved from https://portal.hud.gov/hudportal/documents/huddoc?id=DOC_11689.pdf.

Desmond, M. (2016). *Evicted: Poverty and Profit in the American City*. New York, NY: Crown.

Desmond, M., An, W., Winkler, R., & Ferriss, T. (2013). Evicting Children. *Social Forces, 92*(1), 303-327.

Desmond, M., Gershenson, C., & Kiviat, B. (2015). Forced Relocation and Residential Instability among Urban Renters. *Social Service Review, 89*(2), 227-262. doi:http://www.jstor.org/action/showPublication?journalCode=sociservrevi

Ellen, I. G., & Horn, K. M. (2012). *Do federally assisted households have access to high performing public schools?* Retrieved from Washington, D.C.:

Ellen, I. G., Horn, K. M., & Schwartz, A. F. (2016). Why Don't Housing Choice Voucher Recipients Live Near Better Schools? Insights from Big Data. *Journal of Policy Analysis and Management, 35*(4), 884.

Elwert, F. (2016). *Instrumental Variables*. Philadelphia, PA.

Engdahl, L. (2009). *New homes, new neighborhoods, new schools: A progress report on the Baltimore Housing Mobility pRogram*. Retrieved from http://www.prrac.org/pdf/BaltimoreMobilityReport.pdf

Falk, G. (2014). *Low-Income Assistance Programs: Trends in Federal Spending*. Retrieved from Washington, D.C.: http://greenbook.waysandmeans.house.gov/sites/greenbook.waysandmeans.house.gov/files/R41823_gb.pdf

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

Fletcher, J. M., Andreyeva, T., & Busch, S. H. (2009). Assessing the effect of changes in housing costs on food insecurity. *Journal of Children & Poverty, 15*(2), 79.

Fogel, S. J., Smith, M. T., & Williamson, A. R. (2008). A decent home for every family? Housing policy initiatives since the 1980s. *Journal of Sociology & Social Welfare, 35*(1), 175-196.

Forget, E. L. (2011). The Town with No Poverty: The Health Effects of a Canadian Guaranteed Annual Income Field Experiment. *Canadian Public Policy, 37*(3), 283-305.

Freedman, D. A., & Berk, R. A. (2008). Weighting regressions by propensity scores. *Evaluation Review, 32*(4), 392-409. doi:10.1177/0193841X08317586

Goux, D., & Maurin, E. (2005). The effect of overcrowded housing on children's performance at school. *Journal of Public Economics, 89*(5–6), 797-819. doi:http://dx.doi.org/10.1016/j.jpubeco.2004.06.005

Haveman, R., Wolfe, B., & Spaulding, J. Childhood events and circumstances influencing high school completion. *Demography, 28*(1), 133-157. doi:10.2307/2061340

Haveman, R., Wolfe, B., & Spaulding, J. (1991). Childhood Events and Circumstances Influencing High School Completion, 133.

Heintze, Theresa C., Berger, Lawrence M., Naidich, Wendy B., & Meyers, Marcia K. (2006). Housing Assistance and Employment: How Far-Reaching Are the Effects of Rental Subsidies?, 635.

Hernán, M. A., & Robins, J. M. (2006). Estimating causal effects from epidemiological data. *Journal of Epidemiology and Community Health, 60*(7), 578.

Holupka, C. S., & Newman, S. J. (2011). The housing and neighborhood conditions of America's children: Patterns and trends over four decades. *Housing Policy Debate, 21*(2), 218-245. doi:10.1080/10511482.2011.567289

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.

Jacob, B. A. (2003). *Public housing, housing vouchers and student achievement: Evidence from public housing demolitions in Chicago*. Retrieved from Cambridge, MA:

Jacob, B. A., Kapustin, M., & Ludwig, J. (2015). The Impact of Housing Assistance on Child Outcomes: Evidence from a Randomized Housing Lottery. *Quarterly Journal of Economics, 130*(1), 465-506.

Jargowsky, P. A. (2013). *Concentration of poverty in the new millennium: Changes in prevalence, composition, and location of high poverty neighborhoods*. Retrieved from https://tcf.org/assets/downloads/Concentration_of_Poverty_in_the_New_Millennium.pdf

Jencks, C., & Mayer, S. E. (1990). The Social Consequences of Growing Up in a Poor Neighborhood. In L. E. Lynn, Jr & M. G. H. McGeary (Eds.), *Inner-City Poverty in the United States* (pp. 111-185). Washington, DC: National Academies Press.

Kane, T. J., Riegg, S. K., & Staiger, D. O. (2006). School Quality, Neighborhoods, and Housing Prices. *American Law and Economics Review, 8*(2), 183-212. doi:10.1093/aler/ahl007

King, G., & Nielson, R. (2016). *Why Propensity Scores Should Not Be Used for Matching*. Retrieved from http://j.mp/2ovYGsW

Leventhal, T., & Newman, S. (2010). Housing and child development. *Children and Youth Services Review, 32*, 1165-1174. doi:http://dx.doi.org/10.1016/j.childyouth.2010.03.008

Logan, J., Xu, Z., & Stults, B. (2017). *A Longitudinal Tract Database*. Retrieved from: https://s4.ad.brown.edu/Projects/Diversity/Researcher/Bridging.htm

Mancuso, D. C., Lieberman, C. J., Lindler, V. L., & Moses, A. (2003). TANF Leavers: Examining the Relationship Between the Receipt of Housing Assistance and Post-TANF Well-Being. *Cityscape, 63*(2), 123-138.

Massey, D. S., & Denton, N. A. (1993). *American Apartheid: Segregation and the Making of the Underclass*. Cambridge, MA: Harvard University Press.

Massey, D. S., & Kanaiaupuni, S. (1993). Public Housing and the Concentration of Poverty. *Social Science Quarterly, 74*(1), 109-122.

Mast, B. D. (2012). Comparing Public Housing and Housing Voucher Tenants With Bayesian Propensity Scores. *Cityscape*(1), 55.

Mast, B. D. (2014). Markov Chain Model of Rent Burden in the Housing Choice Voucher Program. *Journal of Housing Research, 23*(2), 177-202.

McClure, K. (2005). Rent Burden in the Housing Choice Voucher Program. *Cityscape*(2), 5.

McClure, K., & Johnson, B. (2014). Housing Programs Fail to Deliver on Neighborhood Quality, Reexamined. *Housing Policy Debate*. doi:10.1080/10511482.2014.944201

Miller, R. B., & Hollist, C. S. (2007). Attrition Bias. In N. Salkind (Ed.), *Encyclopedia of Measurement and Statistics* (Vol. 1, pp. 57-60). Thousand Oaks: Sage Reference.

Morsy, L., & Rothstein, R. (2016). *Mass incarceration and children's outcomes: Criminal justice policy is education policy*. Retrieved from http://www.epi.org/publication/mass-incarceration-and-childrens-outcomes/

Murnane, R. J. (2013). U.S. High School Graduation Rates: Patterns and Explanations. *Journal of Economic Literature, 51*(2), 370-422. doi:10.1257/jel.51.2.370

National Center for Education Statistics. (2015). Public high school 4-year adjusted cohort graduation rate (ACGR). In.

Newman, S. (2008). Does housing matter for poor families? A critical summary of research and issues still to be resolved. *Journal of Policy Analysis and Management, 27*(4), 895-925. doi:10.1002/pam.20381

Newman, S., & Harkness, J. (2000). Assisted housing and the educational attainment of children. *Journal of Housing Economics, 9*(1), 40-63.

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

Olsen, E. O. (2003). Housing Programs for Low-Income Households. In R. A. Moffitt (Ed.), *Means-Tested Transfer Programs in the United States*. Chicago: University of Chicago Press.

Olsen, E. O., & Zabel, J. E. (2014). *United States Housing Policy*.

Orfield, G., Kucsera, J., & Siefel-Hawley, G. (2012). *E-pluribus... separation: Deepening double segregation for more students*. Retrieved from http://civilrightsproject.ucla.edu/research/k-12-education/integration-and-

diversity/mlk-national/e-pluribus...separation-deepening-double-segregation-for-more-students/orfield_epluribus_revised_omplete_2012.pdf

Owens, A. (2017). How Do People-Based Housing Policies Affect People (and Place)? *Housing Policy Debate, 27*(2), 266-281. doi:10.1080/10511482.2016.1169208

Panel Study of Income Dynamics. (2014). *Assisted Housing Database Codebook*. Retrieved from https://simba.isr.umich.edu/restricted/docs/AssistedHousing/ahd_codebook.pdf

Panel Study of Income Dynamics. (2015). *PSID Main Interview User Manual*. Retrieved from University of Michigan:

Pilkauskas, N. V., Garfinkel, I., & McLanahan, S. S. (2014). The Prevalence and Economic Value of Doubling Up. *Demography, 51*(5), 1667-1676. doi:10.1007/s13524-014-0327-4

Public and Affordable Housing Research Corporation. (2016). *Housing Agency Waiting Lists and the Demand for Housing Assistance*. Retrieved from https://www.housingcenter.com/wp-content/uploads/2017/11/5k1S1v-waiting-list-spotlight.pdf

Rice, D., & Sard, B. (2009). *Decade of neglect has weakened federal low-income housing programs: New resources required to meet growing needs*. Retrieved from http://www.cbpp.org/research/decade-of-neglect-has-weakened-federal-low-income-housing-programs

Rumberger, R. W. (2002). *Student mobility and academic achievement*. Retrieved from Washington, D.C.:

Rumberger, R. W. (2011). *Dropping out: Why students drop out of high school and what can be done about it*. Cambridge, MA: Harvard University Press.

Rumberger, R. W., & Lim, S. A. (2009). *Why Students Drop Out of School: A Review of 25 Years of Research*. Retrieved from http://www.cdrp.ucsb.edu/dropouts/researchreport15.pdf

Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997). Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science, 277*(5328). doi:10.1126/science.277.5328.918

Sanbonmatsu, L., Ludwig, J., Katz, L. F., Gennetian, L. A., Duncan, G. J., Kessler, R. C., & Lindau, S. T. (2011). *Moving to Opportunity for Fair Housing Demonstration Program: Final Impacts Evaluation*. Retrieved from

Seltzer, J. A., Lau, C. Q., & Bianchi, S. M. (2012). Doubling up when times are tough: A study of obligations to share a home in response to economic hardship. *Social Science Research, 41*(5), 1307-1319. doi:http://dx.doi.org/10.1016/j.ssresearch.2012.05.008

Sharkey, P. (2013). *Stuck in place: Urban neighborhoods and the end of progress toward racial equality*. Chicago, IL: The University of Chicago Press.

Shroder, M. (2002). Does housing assistance perversely affect self-sufficiency? A review essay. *Journal of Housing Economics, 11*, 381-417. doi:10.1016/S1051-1377(02)00128-6

Solari, C. D., & Mare, R. D. (2012). Housing crowding effects on children's wellbeing. *Social Science Research, 41*, 464-476. doi:10.1016/j.ssresearch.2011.09.012

StataCorp. (2013). *Stata 13 Base Reference Manual*. Retrieved from College Station, TX.:

Stoloff, J. A. (2004). *A Brief History of Public Housing*. Retrieved from http://citation.allacademic.com/meta/p_mla_apa_research_citation/1/0/8/8/5/pages108852/p108852-1.php

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. doi:doi:10.1177/0885412216670603

Turner, M. A., Levy, D. K., Wissoker, D., Aranda, C. L., Pitingolo, R., & Santos, R. (2013). *Housing Discrimination against Racial and Ethnic Minorities, 2012*. Retrieved from https://www.huduser.gov/portal/publications/fairhsg/hsg_discrimination_2012.html

Turner, M. A., Popkin, S. J., & Rawlings, L. (2009). *Public Housing and the Legacy of Segregation*. Washington, D.C.: The Urban Institute.

U.S. Department of Housing and Urban Development. (2001). *Housing Voucher Program Guidebook*. Washington, D.C. Retrieved from https://portal.hud.gov/hudportal/HUD?src=/program_offices/administration/hudclips/guidebooks/7420.10G.

U.S. Department of Housing and Urban Development. (2003). *Public Housing Occupancy Guidebook*. Retrieved from https://portal.hud.gov/hudportal/documents/huddoc?id=DOC_10760.pdf.

U.S. Department of Housing and Urban Development. (2015). *Picture of Subsidized Housing*. Retrieved from: https://www.huduser.gov/portal/datasets/picture/yearlydata.html

Establishing a More Effective Fair Market Rent System; Using Small Area Fair Market Rents in the Housing Choice Voucher Program Instead of the Current 50th Percentile FMRs, (2016).

U.S. Department of Housing and Urban Development. (n.d.). *Housing Choice Voucher Program Guidebook*. Washington, D.C. Retrieved from https://portal.hud.gov/hudportal/documents/huddoc?id=DOC_35611.pdf.

The Housing Act of 1937, 75-412 C.F.R. (1937).

The Housing Act of 1949, 81-171 C.F.R. (1949).

Individuals with Disabilities Education Act, 20 U.S. Code § 1412 C.F.R. (2004).

Vale, L. J. (2000). *From the Puritans to the Projects*. Cambridge, M.A.: Harvard University Press.

Von Hoffman, A. (2000). A study in contradictions: The origins and legacy of the Housing Act of 1949. *Housing Policy Debate, 11*(2).

Wilson, S. J., Tanner-Smith, E. E., Lipsey, M. W., Steinka-Fry, K., Morrison, J., & Campbell, C. (2011). *Dropout Prevention and Intervention Programs: Effects on School Completion and Dropout among School-Aged Children and Youth. Campbell Systematic Reviews. 2011:8*. Retrieved from https://login.proxy.libraries.rutgers.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED535219&site=eds-live

Wilson, W. J. (1987). *The truly disadvantaged*. Chicago, IL: The University of Chicago Press.

Wood, M., Turnham, J., & Mills, G. (2008). Housing Affordability and Family Well-Being: Results from the Housing Voucher Evaluation. *Housing Policy Debate, 19*(2), 367-412. doi:http://www.tandfonline.com/loi/rhpd20

Appendices

Appendix 1: PSID Number of Families and Individuals by Sample Type, 1970-2009 (Data drawn from PSID Main Interview User Manual, 2015

	Core SRC		CORE SEO		Total	
Year	**Families**	**Indiv.**	**Families**	**Indiv.**	**Families**	**Indiv.**
1970	2754	8752	1891	8597	4645	17349
1971	2834	8827	2006	8763	4840	17590
1972	2947	9109	2113	8942	5060	18051
1973	3057	9191	2228	9045	5285	18236
1974	3165	9286	2352	9110	5517	18396
1975	3252	9437	2473	9186	5725	18623
1976	3318	9556	2544	9212	5862	18768
1977	3382	9670	2625	9328	6007	18998
1978	3416	9697	2738	9443	6154	19140
1979	3497	9856	2876	9587	6373	19443
1980	3589	10034	2944	9713	6533	19747
1981	3617	10080	3003	9716	6620	19796
1982	3673	10232	3069	9880	6742	20112
1983	3715	10322	3137	10005	6852	20327
1984	3729	10349	3189	10044	6918	20393
1985	3753	10474	3279	10206	7032	20680
1986	3750	10400	3268	10037	7018	20437
1987	3778	10508	3283	9978	7061	20486
1988	3809	10555	3305	9951	7114	20506
1989	3809	10524	3305	9927	7114	20451
1990	3935	10677	3393	10068	9371	28197
1991	3957	10707	3418	10063	9363	27845
1992	4051	10934	3510	10211	9829	29275
1993	4231	11560	3642	10751	9977	29726
1994	4624	12576	4034	11939	10764	31545

1995	4565	12314	4002	11615	10401	29884
1996	4547	12294	3964	11516	8511	23810
1997	4592	12363	1714	5703	6747	19761
1999	4740	12787	1787	5937	6997	20515
2001	4970	13340	1945	6232	7406	21400
2003	5159	13684	2126	6661	7822	22290
2005	5175	13873	2260	6998	8002	22918
2007	5295	14150	2412	7263	8289	23501
2009	5446	14606	2607	7593	8690	24385

Appendix 2: Coding of Primary Assisted Housing Variable

Code in this Study	**1968-1994**	**1995-2009**
Eligible for but did not receive housing assistance (1)	No match for that year using this coding scheme (0); LIHTC (1); Other federal subsidies (3); State subsidies (4); Farmers Home Administration Subsidies (5); unknown (5)	No match for that year using this coding scheme (0); Other Project-based housing, including LIHTC (2); Farmers Home, State-assisted Housing (1995 only) (4)
Public housing (2)	Public housing (2)	Public housing (1)
Voucher (3)		Tenant-based housing, primarily vouchers (3)
Received a combination of vouchers and public housing (4)		Combination of 1 and 3 from birth through age 15

Appendix 3: Robustness checks, housing assistance and high school completion

	Sample limited to persistently poor (n=522)		Sample limited to children with moms who had established their own households (n=813)	
	High School Completion		High School Completion	
Any Housing Assistance (ref=none)	0.02	(0.44)	0.02	(0.65)
Years of Housing Assistance (continuous)	0.00	(0.38)	0.00	(0.37)
Type of Housing Assistance (ref=none)				
Public Housing	-0.05	(-0.79)	0.01	(0.12)
Voucher	0.10	(1.63)	0.09	(1.87)

Notes: Models include all covariates in main models - except covariates used to limit the sample (in relevant models); numbers presented included regression coefficients and t-statistics

**p<0.05, **p<0.01, ***p<0.001*

	Interacted w/ mother's education if mother had established own household (n=813)		
	High School Completion		
Housing Assistance Type			
Public Housing Only	-0.07		(-1.03)
Voucher Only	0.14		(1.87)
Mother's Education at Birth			
HS or GED	0.11	*	-2.24
Some College or Higher	0.14	**	(2.74)
Housing Assistance Type x Education			
Public Housing x HS or GED	0.24	*	(2.05)
Public Housing x Some College or Higher	0.08		(0.73)
Voucher Only x HS or GED	-0.06		(-0.57)
Voucher Only x Some College or Higher	-0.10		(-0.90)

Notes: Models include all covariates in main models - except covariates used to limit the sample (in relevant models); numbers presented included regression coefficients and t-statistics
**p<0.05, **p<0.01, ***p<0.001*

Appendix 4: Robustness checks, housing assistance and neighborhood disadvantage

	Sample limited to children with mothers who were 18+, had independent HH (n=10,746)		
	High Poverty & High Minority		
Any Housing Assistance (ref=none)	0.03	*	(2.32)
Type of Housing Assistance (ref=none)			
Public Housing	0.06	***	(3.69)
Voucher	.01		(0.45)

Notes: Models include all covariates in main models - except covariates used to limit the sample (in relevant models); numbers presented included regression coefficients from fixed effects models and t-statistics

**p<0.05, **p<0.01, ***p<0.001*

	Housing Assistance Interacted with Race (n=14,559)		
	High Poverty & High Minority		
Type of Housing Assistance (ref=none)			
Public Housing	-0.02		(-0.41)
Voucher	-0.05		(-1.08)
Race			
Black, non-Hispanic	0.32	***	(16.65)
Other	0.20	***	(4.63)
Type of Housing Assistance x Race			
Public Housing x Black	0.13	*	(2.18)
Public Housing x Other	0.31	**	(2.71)
Voucher x Black	0.05	**	(1.13)
Voucher x Other	0.03		(0.38)

*Notes: Models include all covariates in main models - except covariates used to limit the sample (in relevant models); numbers presented included regression coefficients and t-statistics. *p<0.05, **p<0.01, ***p<0.001*

	Interaction with Education, Mom Had Formed Independent Household & Was at Least 18 at Child's Birth (n=10,746)		
	High Poverty & High Minority		
Type of Housing Assistance (ref=none)			
Public Housing	0.15	***	(7.46)
Voucher	-0.02		(-0.73)
Mother's Education at Birth			
HS or GED	-0.03	*	(-1.34)
Some College or Higher	-0.07	**	(-3.06)
Type of Housing Assistance x Education			
Public Housing x HS or GED	-0.16	***	(-4.19)
Public Housing x Some College or Higher	0.00		(0.02)
Voucher x HS or GED	0.18	***	(4.44)
Voucher x Some College or Higher	-0.03		(-0.79)

*Notes: Models include all covariates in main models - except covariates used to limit the sample (in relevant models); numbers presented included regression coefficients and t-statistics. *p<0.05, **p<0.01, ***p<0.001*

Appendix 5: Robustness checks, housing assistance and residential stability

	Sample limited to mothers w/ <HS education (n=7,043)			Sample limited to young mothers (ages 19-21) who did not complete H.S. (n=2,005)			Sample Limited to persistently poor (n=5,618)		
	Moved			Moved			Moved		
Any Housing Assistance (ref=none)							-0.04		(-1.74)
Type of Housing Assistance (ref=none)									
Public Housing	-0.10	**	(-3.46)	-0.13	*	(-2.30)	-0.09	**	(-2.97)
Voucher	0.02		(0.83)	0.03		(0.44)	-0.01		(-0.36)

Notes: Models include all covariates in main models - except covariates used to limit the sample (in relevant models); numbers presented included regression coefficients and t-statistics from fixed effects models

**p<0.05, **p<0.01, ***p<0.001*

	Sample limited to single female-headed HH			One Year Lag of HA (n=11,070)		
	Moved			Moved		
Any Housing Assistance (ref=none)				-0.1	***	(-5.38)
Type of Housing Assistance (ref=none)						
Public Housing	-0.05		(-1.80)	-0.06	*	(-2.56)
Voucher	-0.02		(-0.74)	-0.04		(-1.31)

Notes: Models include all covariates in main models - except covariates used to limit the sample (in relevant models); numbers presented included regression coefficients and t-statistics from fixed effects models

**p<0.05, **p<0.01, ***p<0.001*

	Interaction with region		
	Moved		
Housing Assistance			
Public Housing	-0.13	**	(-2.31)
Voucher	0.00		(0.00)
Region			
Midwest	-1.70	*	(-2.07)
South	-0.15	*	(-2.25)
West	-0.12		(-1.50)
Housing Assistance x Region			
PH x Midwest	0.07		(0.88)
PH x South	0.08		(1.20)
PH x West	0.10		(1.14)
Voucher x Midwest	0.12		(1.40)
Voucher x South	0.03		(0.36)
Voucher x West	-0.21	*	(-2.37)

Notes: Models include all covariates in main models - except covariates used to limit the sample (in relevant models); numbers presented included regression coefficients and t-statistics from fixed effects models

**p<0.05, **p<0.01, ***p<0.001*

	Interaction with race: Moved		
Type of Housing Assistance (ref=none)			
Public Housing	-0.09		(-1.09)
Voucher	0.12	*	(2.24)
Race			
Black, non-Hispanic	0.00		(0.18)
Other	0.03		(0.92)
Type of Housing Assistance x Race			
Public Housing x Black	0.01		(0.16)
Public Housing x Other	0.12		(0.88)
Voucher x Black	-0.11		(-1.88)
Voucher x Other	-0.26	*	(-2.19)

Notes: Models include all covariates in main models - except covariates used to limit the sample (in relevant models); numbers presented included regression coefficients and t-statistics from random effects models

**p<0.05, **p<0.01, ***p<0.001*

	Interaction w/ income to poverty ratio change			Interaction with HH size change			Interaction with partnership change		
	Moved			Moved			Moved		
Type of Housing Assistance (ref=none)									
Public Housing	-0.08	**	(-3.10)	-0.07	**	(-2.82)	-0.10	***	(-4.02)
Voucher	0.05		(1.60)	0.01		(-0.27)	0.01		(0.41)
IPR Change									
IPR Increased	0.02		(1.95)						
IPR Decreased	0.02		(1.79)						
Type of HA x IPR Change									
Public Housing x IPR Increased	0.05		(1.44)						
Public Housing x IPR Decreased	0.00		(0.01)						
Voucher x IPR Increased	-0.07		(-1.55)						
Voucher x IPR Decreased	-0.07		(-1.57)						
Household Size Change				0.01		(1.36)			
Housing Assistance x HH Size Change									
Public Housing x HH Size Change				0.01		(0.34)			
Voucher x HH Size Change				0.01		(0.31)			
Partnership Change									
Added Partner							0.02		(0.74)
Lost Partner							0.10	***	(4.60)
Housing Assistance x Partner Change									
PH x Added Partner							0.13		(1.63)
PH x Lost Partner							-0.03		(-0.31)
Voucher x Added Partner							0.12		(1.32)
Voucher x Lost Partner							-0.02		(-0.18)

*Notes: Models include all covariates in main models - except covariates used to limit the sample (in relevant models); numbers presented included regression coefficients and t-statistics, *p<0.05, **p<0.01, ***p<0.001*

Appendix 6: Robustness checks, housing assistance and crowding

	Interaction with Having a Large Family			Interaction with change in family size			Interaction with having both male and female children		
	Crowded			Crowded			Crowded		
Any Housing Assistance (ref=none)	0.00		(0.05)						
Large Family	0.13	***	(8.73)						
Any Housing Assistance x Large Family	0.04		(1.38)						
Any Housing Assistance (ref=none)				0.02		(1.29)			
Change in HH Size				0.01		(0.68)			
Any Housing Assistance x Change in HH Size				-0.01		(-0.40)			
Any Housing Assistance (ref=none)							-0.01		(-0.36)
Kids of Both Sexes							0.05	**	(3.03)
Any Housing Assistance x Kids of Both Sexes							0.05		(1.71)

Notes: Models include all covariates in main models - except covariates used to limit the sample (in relevant models); numbers presented included regression coefficients and t-statistics from fixed effects models

**p<0.05, **p<0.01, ***p<0.001*

	Interaction with high poverty neighborhood			Interaction with racial & economically segregated neighborhood			Interaction with region	
	Crowded			Crowded			Crowded	
Any Housing Assistance (ref=none)	-0.03	**	(-3.22)					
High Pov Neighborhood	0.02	*	(2.06)					
Any Housing Assistance x High Pov	-0.01		(-0.83)					
Any Housing Assistance (ref=none)				-0.04	**	(-3.34)		
High Pov/High Minority Neighborhood				0.02	*	(2.40)		
Any HA x High Pov/High Min				-0.01		(-0.76)		
Any Housing Assistance (ref=none)							-0.01	(-0.60)
Region								
Midwest							0.01	(0.88)
South							0.01	(0.43)
West							0.02	(1.47)
Any Housing Assistance x Region								
Any HA x Midwest							-0.01	(-0.54)
Any HA x South							-0.03	(-1.53)
Any HA x West							-0.01	(-0.49)

Notes: Models include all covariates in main models - except covariates used to limit the sample (in relevant models); numbers presented included regression coefficients and t-statistics from fixed effects models

**p<0.05, **p<0.01, ***p<0.001*

	Sample limited to permanent income <150% FPL		Controlling for HH changes^		Not Including Measure of IPR as a Control	
	Housing Cost Burden		Housing Cost Burden		Housing Cost Burden	
Any Housing Assistance (ref=none)	-0.03	`	not estimable		not estimable	
Type of Housing Assistance (ref=none)						
Public Housing	-0.02	(-0.76)	-0.03	(-1.44)	-0.02	(-1.20)
Voucher	-0.05 *	(-2.32)	-0.05 *	(-2.31)	-0.04	(-1.76)

Notes: Models include all covariates in main models - except covariates used to limit the sample (in relevant models); numbers presented included regression coefficients and t-statistics from fixed effects models

**p<0.05, **p<0.01, ***p<0.001*

^ *HH changes include changes in partnership status, household size, and income*