

Public Housing Policies and the Mobility of Low Income
Households: Evidence from Pittsburgh*

Dennis Epple,
Carnegie Mellon University

Judy Geyer
Carnegie Mellon University

Holger Sieg
University of Pennsylvania

September 22, 2011

*We would like to thank Jackie Cohen, Michael Johnson, Matt Kahn, Ed Olson, and David Weber for comments and suggestions. We would like to thank the the Housing Authority of the City of Pittsburgh and Michael Peress for providing us with some of the data used in this study. Finally, we acknowledge financial support by the National Science Foundation grant SBR-0617844.

Abstract

The goal of this paper is to study the impact of public housing policies on the mobility of low income households in a large urban area. We focus on communities owned and managed by the Housing Authority of the City of Pittsburgh. Although participation guidelines and funding are controlled at the federal level, a local housing authority oversees many implementation issues that influence the program uniquely, including supply, community and neighborhood quality, waitlist implementation, and exit opportunities. The empirical analysis is based on a unique restricted use panel data set that allows us to follow low income households over a five year period. We find that heterogeneity in public housing communities is important in explaining households' decisions to enter and exit the housing assistance program. The paper also documents the importance of with-in program transfers. These transfers reflect a combination of desirability, events planned by the housing authority, and the turn-over rates of different communities. Tenant-initiated transfers and exits from public housing allow us to evaluate the relative desirability of different types of public housing communities. Understanding the link between community-specific amenities and mobility provides new insights for the design of better housing policies.

JEL classification: R12, R32, R53

1 Introduction

The U.S. Housing Act of 1937 formed the U.S. Public Housing Program that funds local governments in their ownership and management of buildings to house low-income residents at subsidized rents (Olsen, 2001). Currently, the U.S. Department of Housing and Urban Development (HUD) funds the efforts of hundreds of city and county Housing Authorities in the United States, Puerto Rico, the U.S. Virgin Islands, and Guam. In Pennsylvania alone, there are 92 distinct housing authorities. In 2006, the estimated HUD budget for public housing was \$24.604 billion (USDepartmentHousingAndUrbanDevelopment,).¹ Within the public housing program, this funding supports administration, building maintenance, and even law enforcement.

To provide new insights into the impact of public housing programs on residential choices of low income households, we use a micro level approach that focuses on one metropolitan area.² We focus on communities owned and managed by the Housing Authority of the City of Pittsburgh (HACP) which is primarily funded by HUD.³ In 2005 HUD provided the HACP with \$83.7 million in grants for public housing, housing vouchers, and other programs. In the same year, HACP received \$8.3 million from tenant payments.⁴ About 20,000 city residents are housed by HACP programs, about 6.3% of the total city population. The main programs offered by the HACP are public housing as well as the Housing Choice Voucher Program, also known as the Section 8 Housing Vouchers. Currently about half of the population served by the HACP lives in public housing.

By focusing on low income households within a single large urban area we can study

¹This figure does not include housing voucher programs, low income community development programs, or other none-state owned and managed housing programs.

²Most previous studies have tried to exploit variation in housing policies across metropolitan areas. Painter (2001) and (Currie and Yelowitz, 1998) have focused on the relationship of public housing to labor participation choices using data from a large number of US cities. Hungerford (1996) studies public housing dynamics includes some state-level explanatory variables but finds that they do not have a significant effect. Freeman (1998) includes several county-level explanatory variables.

³We use the term "community" to denote a public housing complex.

⁴See the 2005 HACP annual report for details.

the behavior of these households without the confounding effects of differences in local labor and housing markets.⁵ We also avoid pitfalls that are associated with heterogeneity in implementation of housing policies. Despite uniform regulation on rent and eligibility, program implementation varies greatly by locality due to differences in the quantity and quality of public housing supply. Since there is an excess demand for public housing in most local markets and a suitable apartment may not be immediately available, eligible households are typically placed on a waitlist. Local housing authorities differ in their selection of families of the waitlist, specifying priority ordering over veteran status, disability, age, income, and other factors. Controlling for these differences in policy implementation is exceedingly hard in empirical work.

By focusing our analysis on Pittsburgh, we can use new and, arguably, better data to analyze housing policies and mobility patterns of low income households.⁶ With the cooperation of the HACP, we have obtained access to a unique restricted use database which follows low income households that live in one of the public housing communities at any point during a five year period. We can thus follow households over time and also match them to a specific location within the City of Pittsburgh. As a consequence we have detailed information about their housing communities and the amenities of the relevant neighborhoods. This provides a unique opportunity to study the impact of heterogeneity in quality of housing communities on household behavior.

Our empirical approach allows us to study the impact of changes in the supply of public housing on household mobility. There have been recent trends towards demolishing government-managed buildings in favor of providing housing vouchers to be used in any privately-managed building.⁷ Several public housing communities were demolished dur-

⁵Since many features of local labor markets are likely to be difficult to measure for the econometrician, studies that exploit variation across metropolitan areas are likely to face some serious identification problems.

⁶Olsen, Davis, and Carrillo (2005) use restricted use data from HUD which is probably the best previously available data base to study the impact of variations in local housing policies on household behavior.

⁷Jacob (2004) describes some of the circumstances of this demolition; In 1996, Congress passed Section 202 of the Omnibus Consolidated Rescissions and Appropriations Act (Section 202) that required housing authorities to demolish a unit if its rehabilitation and maintenance costs exceeded the cost of providing the

ing the course of our survey. We can thus study the process of moving households from buildings that have been assigned for demolition and study the consequences of reallocating households to different communities. We find that 38.8% of transfers are due solely to the HACP's demolition plans.⁸

Some mobility is clearly driven by changes in family composition. As families grow, they often move to larger apartments. We find evidence of this in our data. Mobility within public housing communities is also driven by explicit choices of households. We document in this paper that there exists a fair amount of heterogeneity among public housing communities within Pittsburgh. Households have some limited opportunity to influence the decision making process of the local housing authority. Some households exercise a choice that alters their housing needs, rental payment, or simply enhances their well-being. As a consequence, these households can move from a less desirable community to a place that better fits their needs. These types of mobility patterns, and their effects on program participation, have received little attention in the previous literature. Our findings indicate that the variation in housing amenities is systematically linked to variation in the probability of transfers

household a 20-year rent subsidy in the private housing market. This Act and the redistribution of funds towards voucher programs led many cities to demolish public housing units.

⁸Our work is also closely related to recent studies of a federal Moving to Opportunity program that randomized public housing households' receipt of housing vouchers as a replacement of their public housing unit. Kling, Liebman, Katz, and Sanbonmatsu (2004) and Kling, Liebman, and Katz (2007) have recently addressed the economic and health outcomes of a housing voucher lottery implemented in several U.S. cities as part of MTO. They find that after five years of settlement in the new (or same) neighborhood, there were no significant differences in economic self-sufficiency (measured in income) or physical health outcomes. However, moving to a more desirable neighborhood was associated with improvements in mental health. Female youth were less likely to be arrested for violent or property crime, and male youth were less likely to be arrested for violent crime but more likely to be arrested for property crime. Jacob (2004) has recently studied the impact of housing demolitions and relocation on children's school performance in Chicago, concluding that children relocated using housing vouchers did not perform significantly different from their peers still in public housing. Jacob and Ludwig (2008) study the impact of housing demolitions and relocation on labor supply. With sufficient data on health and educational outcomes, these types of studies could also be executed by looking only at mobility within the public housing program.

within the public housing program and exits out of the public housing program.⁹

Finally, we also study exit from public housing. While entry into public housing is primarily need based and linked to strict eligibility criteria, exit is more complicated. Households are not forced to leave the program once they do not meet the eligibility criteria. Although the vacancy rate for all housing units in Pittsburgh was about 12% at the time of this study, it appears low income households can have difficulties finding acceptable alternative housing options in the private market. Therefore, they may prefer living in public housing communities even if they do not meet the eligibility criteria. Living in public housing provides households not only with quality housing, it also provides the means to explore economic opportunities. As these opportunities materialize for some of these households, they become fully or at least partially self-sufficient. As a consequence, they do not need public assistance and leave the public housing communities. We find some evidence for this behavior in our data.

The remainder of the paper is organized as follows. Section 2 discusses our main data sources. Mobility has three observable dimensions: entry into public housing is studied in Section 3. Transfers within public housing are analyzed in Section 4, and exit from public housing in Section 5. We discuss the main implications for research and public policy that can be drawn from our analysis in Section 6.

⁹Several studies find that public housing is related to undesirable neighborhood quality. For example, Newman and Schnare (1997) found that public housing provided worse neighborhood quality relative to those of households receiving welfare payments. Carter, Schill, and Wachter (1998) found that public housing construction is related to an increase in neighborhood poverty levels in succeeding decades. However, some studies suggest that public housing can promise better outcomes for some households. For example, Currie and Yelowitz (2000) find that controlling for endogeneity in program participation, households in public housing experience less overcrowding than similarly poor households outside of public housing and that children in public housing are less likely to be held back in schools.

2 Data

The public housing stock in the City of Pittsburgh is quite varied, including small houses converted into several apartment units, large high-rises, and large communities of low-rise housing spread continuously over several blocks. Several public housing communities were demolished during the course of our survey and we address this issue in a subsequent section of this paper. Still standing is a great variety of communities ranging in size from 4 units to over 600 units in various neighborhoods across the city. These communities are usually designated as either 'family' communities or 'senior' communities, where senior communities target households age 62 or older. There are 34 separate sites. Table 1 shows the number of communities by size and by family/senior designation.

Table 1: Public Housing Types In Pittsburgh

	Family	Senior	Mixed
Large (> 100 units)	9	4	3
Medium (40-100 units)	3	5	0
Small (< 40 units)	7	2	1

A significant fraction of the quality heterogeneity in public housing stems from differences in local amenities. One value in focusing on a local public housing market is the feasibility to examine this heterogeneity in depth.

The 34 public housing communities in the HACP are located across 19 of Pittsburgh's 32 wards and across 28 census tracts. At the city ward level, we examine the crime index and school quality index associated with each public housing community. The crime measure is the level of violent or property crime per year per 1,000 people.¹⁰

¹⁰The crime indices used here is taken from Epple, Peress, and Sieg (2005) who construct a crime index for every municipality in Allegheny County and for every ward in the City of Pittsburgh. The index is constructed based on crime data from the years 1999, 2000, and 2001; the index is adjusted to the 2001 - level and indicates crimes per year per 1,000 people. There is a violent crime index that includes murder,

The school quality measure is the average of public school test scores, weighted by enrollment in different school grades. There is a school quality measure for all schools serving each city ward and a school quality measure for high schools serving each city ward. The reason for this separation is that high schools serve larger areas. The correlation between overall school quality and high school quality is 0.75.¹¹ At the ward level, we also study the ratio of the average home sales price to the city-average home sales price.¹²

Clearly the public housing communities in Pittsburgh vary widely in terms of neighborhood amenities such as crime, school quality, property values and demographic characteristics as shown in the Table 2.

Table 2 also reports characteristics of census tracts in which the the housing communities are located. At the Census tract level, we examine median income, percent minority, building vacancy, percent of households that own their dwelling, and median age. While these measures also reflect the residency of public housing households in the selected census tracts, the percent of residents who are in public housing is sufficiently small to render these statistics still interesting.

We also computed the correlation between public housing community size and neighborhood attributes. A common perception of public housing is that large projects are generally associated with poorer neighborhoods. We find that this perception is not incorrect in the case of the City of Pittsburgh. We find that the number of units in a public housing community is negatively correlated with census tract median income (-0.48), school quality (-0.42), rape, robbery, and aggravated assault; there is a property crime index that includes burglary, larceny, theft, and motor-vehicle theft into Property Crimes.

¹¹The school quality data is also from taken Epple et al. (2005). The school quality index is based on the PSSA, a test of math and reading administered in all Pennsylvania public schools in grades 5, 8, and 11. They worked with data from the 1999-2000 school year. The school quality index is the average of the test scores, weighted by enrollment in the different grades, and divided by 1000. In the City of Pittsburgh, the school attendance zones do not correspond with any other available designation of geography. To assign a school quality index to each city ward, the index averages the scores of the participating school districts, weighted by the approximate fraction of households served by that school.

¹²The ratio of wards' median home prices are calculated using home sales prices recorded by the Allegheny County Office of Property Assessments.

Table 2: Neighborhood Amenities Across Public Housing Communities

	Mean (Std)	Min	P25	P50	P75	MAX
All Schools	1.20 (0.04)	1.15	1.19	1.20	1.22	1.29
High School	1.22 (0.06)	1.12	1.17	1.21	1.27	1.32
Violent Crime	969.02 (525.88)	248.71	551.17	920.00	1464.27	1953.69
Property Crime	4251.03 (1456.33)	2499.17	2635.05	4515.38	5386.50	6962.65
All Crime	1466.68 (613.27)	604.74	867.16	1297.98	2023.43	2539.56
Ratio of Sales Price	1.14 (0.49)	0.45	0.87	0.99	1.40	2.21
Median Income	19218.63 (9855.14)	7042.00	9315.00	17267.00	24923.00	38388.00
%White	0.41 (0.36)	0.01	0.04	0.24	0.76	0.97
Med age	35.23 (10.38)	14.10	27.70	37.60	40.65	51.90
%Own Home	0.34 (0.25)	0.00	0.09	0.34	0.52	0.79
%Homes Vacant	0.20 (0.17)	0.04	0.09	0.16	0.24	0.75

percent whites in the census tract (-0.59), median age in the census tract (-0.75), and home ownership in the census tract (-0.46). The number of units in a public housing community is positively correlated with violent crime (0.34), the overall crime index (0.23), and the percent of vacant buildings in a census tract (0.5). Also there is a negative correlation with property crime (-0.06) and the positive correlation between the number of public housing units and the ratio of the city ward's mean home sales price to the city's home sales price (0.12).¹³

The HACP data contains records of household entry, exits, and transfers from June 2001 to June 2006 within the 34 HACP public housing communities actively used during this time period. The data set also includes annual updates of each of these households as well as any non-periodic reports that update information about household composition or income that is reported to the HACP. These records contain most of the information fields requested of all U.S. housing authorities including age, race, disability, household composition including age and relationship of family members and housemates, earnings, assets, income from assets, and income adjustment exclusions including disability, medical, and childcare expenses. The only data on the household's unit is the monthly rent being charged to that particular household, the number of bedrooms, whether it's part of a community targeted to seniors, whether it's handicap-accessible, and the address and unit number. There are 7,070 households observed at least once during this time period; there are 2907 households that move in for the first time, 3155 households that move out, and 1244 that transfer from one public housing unit to another.

Table 3 summarizes key descriptive statistics. Although some families live in senior housing and some seniors live in non-senior housing, age and family composition distributions are fairly bimodal with respect to these two types of communities. In mixed communities, as expected demographic variables look similar to a weighted average of senior and family

¹³The negative correlation with property crime could be due to the lower rewards for theft and lower rates of reporting in impoverished wards. The positive correlation with sales price could be due to the fact that a few large communities are located close to well-off neighborhoods. The sales price ratios were determined at the level of the city ward; within each ward there is significant variation.

communities, however there are more co-habiting adults and a higher number of children in mixed housing than in family-only or senior-only housing. The mean age in senior housing is 31 years greater than the mean age in non-senior housing. The majority of households in both senior-only and family-only communities are female, but females are a much larger majority in family-only communities. Black households are a very high proportion of residents in family and mixed housing, while senior units have nearly equal proportions of black and white households. Marriage rates are low, 2.20% in family housing and 3.93% in senior housing; there are more cohabiting adults in family housing than in senior housing.¹⁴ There are fewer households in non-senior housing that have children than one might expect (about 53%).¹⁵

Table 3: Descriptive Statistics of Communities

	All	Family	Mixed	Senior
Age	48.86 (20.76)	40.42 (16.98)	49.06 (20.53)	71.15 (11.77)
% Female	80.59%	84.87%	83.85%	64.90%
% Married	2.66%	2.20%	2.65%	3.93%
# Adults	1.16 (.44)	1.17 (.45)	1.21 (.50)	1.06 (.23)
# Children	.95 (1.36)	1.00 (1.22)	1.59 (1.71)	0 (0)
% With Children	43.95%	53.46%	58.31%	0%
% Black	88.53%	96.67%	97.00%	55.59%
Annual Income	9082 (7776)	8516 (8957)	9714 (6968)	9784 (4602)
Disabled	20.12%	18.10%	16.06%	30.74%

¹⁴There is a strong incentive for families to not report the existence of a co-habiting adult or partner, as it would lead to an increase in rent if the co-habiting adult earns an income. As a result, the number of co-habiting adults as well as household income are surely larger than our estimates from the data.

¹⁵Our sample differs from other studies in that Pittsburgh public housing seems to house a higher percent of black households, female-headed households and households with children; but a much lower percent of married households. For example, Hungerford '96's sample from the 1986-1988 SIPP panel was 52% female, 23% black, 32% married and the mean number of children was 0.21(Hungerford, 1996).

Law, principle, and histories of lawsuits motivate housing authorities to avoid segregating households by race. Some sorting of households is inherent, however, by the restrictions on the type of units available in each community (number of bedrooms and family vs. senior designations). Large hi-rise non-senior communities mostly in the Center and North house a lot of non-senior adults without kids. Large and small low-rise non-senior communities house a lot of families with children. Most senior-dominated communities include a significant percentage of non-senior adults without kids (ranging from 13% - 37%); also most family-only communities include a significant percentage of senior households (ranging from 0 - 20%), about a third of which are caring for children. Tables 12 and 13 in the Appendix summarize the types of family by building. In communities that are designated for families, the percent of non-seniors with co-residing children ranges from 17% to 83%. In communities that are designated for seniors, the percent of non-seniors with no children ranges from 13% to 37% (many of these occupants are disabled).

Tables 4 and 5 offer more household demographic data.¹⁶ The mean age differs mostly between the family and the senior communities, and somewhat widely within each of those two categories (e.g., age 33-56 for families and age 66-76 for seniors). The percent of female-headed households varies greatly by community (min 50%, max 90%). There is variation in the racial composition of communities, ranging from 83% to 100% black in family communities and ranging from 3% to 84% black in senior communities. Across the public housing communities there is great variation in the average income per adult; the average average is \$9388 and the standard deviation across communities in average income per adult is \$3335 (in the fourth quarter of 2003). Higher average incomes per adult are generally seen in the senior housing communities and in the sites with a low number of household units.¹⁷

Finally, it is useful to compare Pittsburgh to other urban areas in the Northeast and

¹⁶In cooperation with the HACP, we were asked not to provide tabulations of, for example, mean neighborhood characteristics by demographic group.

¹⁷Rent follows this same pattern because rent is a function of income; however, the correlation is not 1.0 because rent is figured based on income adjusted for childcare credits, medical expenses and disability expenses.

Table 4: Demographics of Public Housing Communities, Fourth Quarter of 2003 (A)

Type	Size	Age	Female	Black	Married	Child	Inc/Adlt	Disabled
Fam	1-30	36.33	0.83	0.88	0.05	0.62	7428.52	0.14
Fam	1-30	47.92	1	0.85	0.08	1.54	13689.54	0.15
Fam	1-30	42	0.88	0.94	0	1	6389.12	0.24
Fam	1-30	48.25	1	1	0	1	23854.5	0
Fam	1-30	40.31	0.96	0.96	0	1.81	11447.06	0
Fam	1-30	41.7	1	0.83	0	1.39	6921.39	0
Fam	1-30	46.07	0.97	0.93	0.03	0.97	10496.55	0.14
Fam	1-30	56.33	0.5	0.83	0.33	0.33	8922	0.83
Fam	1-30	41.17	0.88	0.88	0.06	0.91	6135.75	0.13
Fam	30-100	45.85	0.88	0.94	0.14	1.54	11968.17	0.11
Fam	30-100	47.6	0.89	0.87	0.07	1.45	15191.82	0.15
Fam	100-200	39.36	0.76	0.94	0.01	0.48	5647.59	0.2
Fam	100-200	44.21	0.9	1	0.02	1.37	7856.23	0.17
Fam	100-200	37.38	0.96	0.99	0.02	2.09	7985.14	0.11
Fam	100-200	47.51	0.85	0.94	0.06	1.35	8948.55	0.1
Fam	200+	39.37	0.78	0.99	0.01	0.63	5548.91	0.25
Fam	200+	43.41	0.83	0.99	0.01	0.62	7066.31	0.21
Fam	200+	33.13	0.82	0.95	0.01	0.55	5491.66	0.21
Fam	200+	37.65	0.96	0.98	0.02	1.93	8060.86	0.08

Table 5: Demographics of Public Housing Communities, Fourth Quarter of 2003 (B)

Type	Size	Age	Female	Black	Married	Child	Inc/Adlt	Disabled
Mix	100-200	66.91	0.65	0.93	0.03	0.51	8553.57	0.22
Mix	100-200	62.09	0.66	0.97	0.04	0.93	8727.23	0.3
Mix	200+	42.36	0.9	0.98	0.03	1.89	8579.12	0.13
Mix	200+	46.08	0.89	0.98	0.02	1.86	8026.79	0.13
Sen	1-30	74.72	0.69	0.03	0	0	12355.83	0.1
Sen	1-30	74.07	0.67	0.1	0.07	0	10565.1	0.3
Sen	30-100	71.49	0.63	1	0	0	8628.35	0.25
Sen	30-100	75.75	0.53	0.24	0.12	0	8282.63	0.21
Sen	30-100	70.66	0.65	0.77	0.09	0	8937.48	0.31
Sen	30-100	71.98	0.8	0.43	0.04	0	10282.49	0.3
Sen	30-100	71.6	0.63	0.53	0.05	0	8934.49	0.24
Sen	30-100	69.79	0.7	0.3	0.04	0	9627.48	0.34
Sen	30-100	72.19	0.75	0.1	0	0	10819.42	0.34
Sen	100-200	66.66	0.62	0.84	0.02	0	9088.84	0.5
Sen	100-200	70.33	0.54	0.46	0.05	0	8858.01	0.3
Sen	100-200	73.54	0.73	0.98	0	0	9274.46	0.24

Midwest. We choose 13 metropolitan areas that have similar ratios of public housing units per household as Pittsburgh. Table 6 below provides some summary statistics of these 13 communities.

Table 6: Urban Areas in the Northeast and Midwest

City	PH/Elig	'99 Med Inc	'99 UnEm	Minority	'01 FMR
Pittsburgh	.0546	37467	4.4%	10%	476
Columbus	.0384	44782	2.7%	19%	471
Allentown	.0375	43098	4.2%	10%	511
Albany	.0373	43250	3.4%	10%	494
Dayton	.0372	41550	4.5%	18%	389
Buffalo	.0339	38488	5.3%	16%	453
Scranton	.0607	34161	5.6%	3%	408
St. Louis	.0169	44437	3.5%	22%	429
Madison	.0124	49223	1.7%	11%	559
Detroit	.0159	49160	3.9%	27%	598
Cleveland	.0291	42215	4.2%	21%	555
Cincinnati	.0109	44914	3.5%	15%	416
Philadelphia	.0266	47528	4.1%	27%	657
Milwaukee	.0193	46132	3.1%	22%	504

PH/Elig is the MSA's ratio of public housing units to households eligible for public housing. We also show the 1999 MSA median income, 1999 unemployment rate, and the HUD-determined 2001 fair market rent (FMR) for a one-bedroom unit.¹⁸ We conclude that Pittsburgh is representative for many other large urban areas in the Northeast and Midwest that face similar challenges in providing affordable housing for low income households.

¹⁸The number of public housing units is taken from the HUD 1998 Picture of Subsidized Housing. Percent minority and median incomes are from the 2000 Census. Unemployment is from The Real Estate Center at Texas A& M University. Fair Market Rents are published on the HUD website.

3 The Waitlist Policy and Entry into Public Housing

In this section we review the waitlist policy and explore the reasons for heterogeneity in wait times across public housing communities. Public housing programs define a set of criteria that a household has to satisfy to be considered eligible for housing aid. HUD sets eligibility and participation rules for public housing that are uniform across the United States' housing authorities. Eligibility is based on total household income. Income limits are set based on the local median household income. Generally, all low-income families are eligible for public housing, where "low income" for a family of four is defined as 80% of the local median income, usually rounded to the closest \$100.¹⁹ Rents are generally a fixed percent of household income; in Pittsburgh they were fixed at 30% throughout this paper's study period. Households are matched to available units based on their housing needs as defined by the number of bedrooms best suited for a family.²⁰

For the study period in our panel data, the waitlist policy was to offer a household at the top of the list their choice of all available apartments that are appropriately sized for that household. Essentially, this creates a separate waitlist for each apartment size (size is measured by the number of bedrooms needed).²¹ If a family does not respond to the solicitation, they are removed from the waiting list and may re-apply after 90 days. If a household rejects the location offered, it may remain on the waitlist but not after a total of three locations are rejected.²²

¹⁹Income limits for families of other sizes are generally based on the formula below (Olsen, 2001):

1	2	3	4	5	6	7	8
0.56	0.64	0.72	0.80	0.864	0.928	0.992	1.056

²⁰For example, a married couple with no children would be eligible for a 1, but usually not a 2, bedroom unit. Child gender plays a role in determining housing need; a couple with one boy and one girl is eligible for a 3 bedroom unit but a couple with two girls is usually only eligible for a 2 bedroom unit.

²¹Generally the longest waiting lists are for non-senior, non-disabled units; however, several large (5+ bedroom units) remain vacant because there are not many families eligible for such a large unit.

²²One month after the conclusion of our panel data, the waitlist policy changed. After July 2006, households either sign up a 'first-available' list or on a 'site preference' list. On the 'first-available' list, a household is offered the first unit available for which they are eligible (i.e. appropriate number of bedrooms). On the

Approximately 60% of the households living in Pittsburgh public housing during our sample have records that include the date at which they signed up on a waitlist.²³ This date can be compared to the date at which they first moved into public housing. We observe household characteristics only after a household moves into public housing, not the characteristics of the household when they applied for public housing.

Figure 1 shows a histogram of observed wait-times experienced by households in our sample. There are no observations with a wait time of zero months; this finding is consistent with our understanding of the HACP’s nontrivial amount of time spent to prepare a unit and settle paperwork. Over the whole sample, the mean wait time for households that accept an offer of HACP housing is 21.4 months (standard deviation 14.64).

The mean wait times also vary depending on the number of bedrooms the household is offered. The mean wait times vary from 19.45 months for a two bedroom apartment to 32.44 months for a five bedroom apartment.

Table 7 shows the results of three regressions of wait time on household characteristics.²⁴ In model 1 there are only household demographic variables. Model 2 includes community site-specific fixed effects, and model 3 includes neighborhood amenities. Some coefficients on community-specific variables are significant and improve the percent of variation in wait times explained by the independent variables. Accepting a community in a neighborhood with 10 percentage points more vacant housing structures reduces the expected wait time by 1.5 months. Accepting a community in a neighborhood with one standard deviation higher ‘site preference’ list, applicants select up to three communities are notified when an appropriately-sized apartment in those communities becomes available to them. For both list types, a household that rejects or does not respond to an offer is then removed from all of the waiting lists.

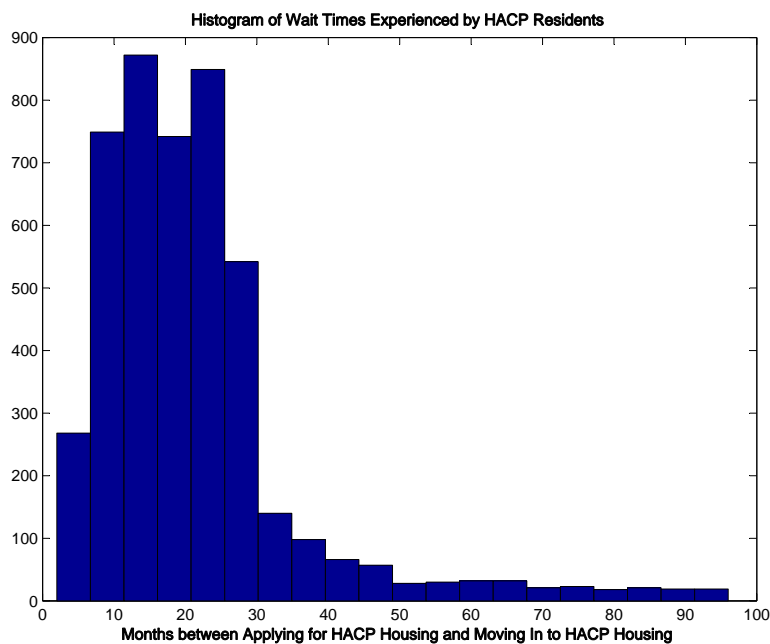
²³In contrast to households for whom we had wait list data, the households living in public housing we do not have waitlist data for were older (mean age 58 versus 41) and had fewer children (0.81 children versus 1.05 children). The list of households currently waiting for public housing from HACP is not available.

²⁴Only 60% of households have known sign-up dates on the waitlist. Households for which the sign-up date on the waitlist is not known tend to be older, have fewer children, and higher income than households for which the sign-up date is known. This observation is probably due to a somewhat recent policy of recording sign-up dates, therefore the policy missed the older residents who have been in the program a while. If the waitlist affects households’ mobility decisions, only the current perception of the waitlist should be relevant.

Table 7: Wait-Time Regressions

	Model 1		Model 2		Model 3	
	Coeff	Std. Error	Coeff	Std Error	Coeff	Std Err
Const	-28.74	(5.54)	-19.07*	-3.22	-38.62*	(-45.71)
# Adults	19.55*	(3.72)	12.15*	(3.61)	16.66*	(3.74)
Married	15.24*	(7.49)	15.08*	(7.26)	15.73*	(7.44)
Black	19.15*	(3.39)	2.72	(4)	10.17*	(3.98)
Log Income	.06	(0.2)	0.21	(0.19)	0.21	(0.2)
Female	11.62*	(2.73)	9.68*	(2.62)	10.00*	(2.76)
Age	.72*	(0.07)	0.92*	(0.08)	0.84*	(.07)
# Children	2.97*	(0.89)	-1.72	(0.98)	-0.46	(.99)
Disabled	2.02*	(2.75)	4.31	(2.66)	3.21	(2.76)
Violent Crime					-.01	(.00)
% White Neigh					-4.53	(7.83)
% Bldg Vacant					-14.60*	(6.99)
Sales Price					-18.24*	(3.91)
PH Size					0.00	(0.01)
% Owner-Occupied					-22.64*	(11.54)
Neigh Bldg Age					-1.38*	(0.17)
High School					79.76*	(38.91)
Fixed Effects			X			
Adj. R2	0.07		0.16		0.13	

Figure 1: Histogram of the Length of Time Between Applying and the Move-In Date



relative median home sale price reduces the expected wait time by 2 months. Accepting a community in a neighborhood with 10 percentage points more owner-occupied housing units reduces the expected wait time by 2.3 months. Accepting a community in a neighborhood where the average housing structure is 10 years older reduces the expected wait time by a year. Accepting a community in a neighborhood with one standard deviation higher high school test scores increases the expected wait time by 4.7 months.

We conclude that households exercise preferences for specific housing communities by waiting until a desired community becomes available. One limitation to this analysis is that we do not observe rejected offers to live in a housing community, and another is that we cannot control for supply restrictions. The best apartments may never become available, so that we might underestimate the desirability of certain amenities. We can, however, augment this analysis with an analysis of the probability of leaving a housing community.

4 Exit from Public Housing Communities

Public housing is an interesting example of a means-tested welfare program in part because it often tenures its participants. Households can continue to stay in public housing even if they do not satisfy the eligibility criteria. Tenants may face eviction for non-payment of rent or for other reasons. The HACP is constantly pursuing eviction proceedings for nonpayment of rent, but only a small percentage of cases result in eviction due to the reluctance of elected magistrates' hesitancy to make households subject to homelessness.²⁵

We would like to know what types of households decide to move out of public housing communities.²⁶ We observe a large number of households that experience composition changes as well as income changes. There are 1275 households that experience at least one change in the number of children, 93 households that experience a change in marital status at least once, 808 that experience a change in the number of adults at least once, and 3299 households whose annual income changes by \$1000 at least once. One question is whether or not a change in household composition would prompt a household to decide to move out of the public housing system.

Table 8 shows the difference in cumulative exit (and transfer) probabilities for households with no composition or income changes versus households with changes. We find that the departure of a child, adult, or spouse significantly reduces the probability of exit. The

²⁵The HACP prefers to have a 30-day notice that a tenant plans to vacate the apartment, after which a portion of the security deposit is returned. Often, tenants vacate without these formalities.

²⁶Previous studies of public housing participation generally focus on the likelihood of exit. Freeman (1998) uses data from the PSID to perform a logistic regression of the likelihood of moving out of public housing. He finds that education and work experience were more influential than family background and cultural factors. Demographic characteristics do play a role; older age and non-white heads of household were less likely to move out than younger and white heads of household. Olsen et al. (2005) use data from all U.S. participants in HUD's housing voucher program from 1995 to 2002 to estimate a proportional hazards model. Being elderly or disabled had the strongest effect on whether or not households move out. The larger the family size, the larger the income, being married, and being male increased the likelihood of moving out. In simulations, they find that large decreases in the maximum voucher amount and large increases in tenant rental payments would have small effects on program attrition.

Table 8: Cumulative Probability of Exit After Household Change

		# Quarters After Household Change				
		#	0	1	2	3
# Kids	Decrease	762	.0131	.021	.0236	.0328
	No Change	16948	.041	.0922	.1315	.1649
	Increase	219	.0183	.0776	.1324	.1781
# Adults	Decrease	708	0	0	.0017	.0017
	No Change	17076	.0409	.092	.1312	.1647
	Increase	145	0	0	0	.20
Spouse	Moves Out	580	.0028	.0099	.0198	.0268
	No Change	17339	.0411	.0925	.1319	.1656
	Moves In	10	.0345	.0621	.069	.0759
Income	Decrease	1631	.011	.03	.0533	.0705
	No Change	13752	.0461	.1023	.1425	.1766
	Increase	2546	.0224	.0546	.0903	.1233

addition of a child or spouse seems to initially decrease the probability of exit, but increase the probability of exit after three or four quarters. The addition of an adult who is not a spouse significantly decreases the probability of exit. While exit is more probable after an income increase than a decrease, it is not more probable after an income increase compared to a constant income; further dynamic analysis on the initial amount of wealth and income changes is warranted.

To gain some additional insights we estimate the conditional probability that a household will leave public housing given their demographic type, household composition, income, and the length of stay to date. This probability is modeled using a proportional hazards model.²⁷ Any households living in public housing during the last quarter of observation is considered to be right-censored. There are 3016 move-outs and 3611 right-censored households. A few households move out (in) more than once. The length of stay is the dependent variable and explanatory variables include age, black, female, disabled, log of average income in the last year, quarterly income changes, and public housing community dummy information. Table 9 reports the coefficient estimates and estimated standard errors.

We are particularly interested in studying whether housing and neighborhood quality play a role in program participation. Table 9 compares three specifications of the proportional hazards model. Model 1 includes household-specific demographic variables but no site-specific information, model 2 includes community fixed effects, and model 3 includes several neighborhood descriptors. All models control for the percent of units demolished in the public housing community where the household lived; interestingly, the coefficient for this variable is not significant in any of the specifications. The additional coefficients in models 2 and 3 are jointly significant and result in higher adjusted R^2 s compared to model 1. In all models, household demographic variables have significant coefficients. While age,

²⁷The probability (or hazard function) of staying in public housing $\lambda(t, X_i)$ is a separable function of how long a household has already been in public housing, t , and other explanatory variables X_i , namely $\lambda(t, X_i) = \lambda_0(t) \exp X_i \beta$. Integrating over the hazard function, we can get the probability of a length of stay t as $S(t|X_i) = [\exp(-\int_0^t \lambda_0(u) du)]^{\exp(X_i \beta)}$. We are interested in the β parameters, or the proportional survival probabilities.

Table 9: Proportional Hazards Model of Conditional Exit Probability

	Model (1)		Model 2		Model3	
	Coeff (Std)	Ratio	Coeff (Std)	Ratio	Coeff (Std)	Ratio
# Adults	-0.74* (0.06)	0.48	-0.58* (0.06)	0.56	-.71* (0.07)	0.49
Married	-0.57* (0.17)	0.57	-.30* (0.17)	0.74	-.48* (0.17)	0.62
Black	-0.39* (0.07)	0.68	-.19* (0.08)	0.82	-.47* (0.08)	0.62
Log Income	.004 (0.01)	1	.01 (0.01)	1	.00 (0.01)	1
Income Change	.07 (0.14)	1.07	.01 (0.14)	1.01	.03 (0.13)	1.03
Female	-0.35* (0.05)	0.71	-.22* (0.05)	0.8	-.30* (0.05)	0.74
Age	-.04* (0)	0.97	-.04* (0)	0.96	-.04* (0)	0.96
# Children	-.09 (0.02)	0.91	-.07* (0.02)	0.94	-.10* (0.02)	0.9
Disabled	-.11* (0.05)	0.9	-.15* (0.05)	0.86	-.13* (0.05)	0.88
% Demolished	0.15 (0.12)	1.16	.52 (0.29)	1.67	0.20 (0.13)	1.22
Violent Crime					.0005* (0)	1.001
% White Neigh					0.71* (0.16)	2.05
% Bldg Vacant					0.87* (0.14)	2.38
Sales Price					-0.28* (0.08)	0.76
PH Size					0 (0)	1
% Owner-Occupied					-1.47* (0.27)	0.23
Neigh Bldg Age					0.02* (0)	1.02
High School					-3.42* (0.77)	0.03
Fixed Effects			X			
Likelihood	-39768		-39228		-39551	
LL ratio test	$p < .0001$		$p < .0001$		$p < .0001$	

race, sex, household size, and disability are significant determinants of the probability of leaving public housing, interestingly income and observable income changes are not.²⁸

Models 2 and 3 clearly establish that neighborhood effects and/or community-specific effects are significant determinants of the decision to leave public housing. Summarizing model 3, an increase of one standard deviation in the number of crimes in a neighborhood would increase the probability a household would choose to exit by 30%. A 10 percentage point increase in the percent of whites in a neighborhood is associated with a 7.4% increase in leaving public housing. A 10 percentage point increase in the percent of housing units that are vacant in the neighborhood is associated with a 9.1% increase in leaving public housing. A one standard deviation increase in neighborhood relative median home prices is associated with a 13.4% decrease in leaving public housing. A 10 percentage point increase in the percent of neighborhood homes that are owner-occupied is associated with a 13.7% decrease in leaving public housing. In neighborhoods where the median age of housing units is 10 years older than others', public housing occupants are 22% more likely to leave public housing. Public housing occupants are 18.6% less likely to leave public housing if they live in a neighborhood with one standard deviation higher high school test scores compared to similar neighborhoods. Changes in likelihoods could be related to the neighborhood's desirability or to the neighborhood's influence on household's preparation to become self-sufficient.

5 The Relocation Policy and Mobility within Public Housing

One nice feature of our data set is that it allows us to study transfers within the communities managed by the HACP. We are interested in understanding events that may lead to

²⁸Proportional hazards models are also estimated by (Hungerford, 1996) who used data from the full 1986-1988 SIPP panel. Although the coefficients are not comparable because his study involved months as a unit of analysis rather than quarters, the coefficients are in the same direction. For example, age and female have significantly negative coefficients. Coefficients for black, disabled, income, number of children were not significant but exhibited the same sign as our findings.

households moving within or between communities. In particular, we look for evidence that transfers between communities may be influenced by households' choice and thus reveal the relative desirability of different communities. HACP 's stated policy is to offer little opportunity for families to move from one public housing unit to another based on personal preference alone. A fair number of relocations occur after a community's demolition gets approved; interestingly, more than half of all transfers do not seem to be due to demolitions. There are several categories of moves that are permitted and at times people will find a way to fit into a category so their personal preference can be achieved. There is some attempt to transfer families within the same community but sometimes units are not available so the family may move to a different community. The situations for which the housing authority will arrange transfers include:

1. If household composition changes by one person, a requested transfer will be approved.
2. If household composition changes by a lot (a difference in two or more bedrooms is necessary), HUD requires the family to move.
3. Emergency needs such as domestic violence or an unsafe physical condition.
4. Non-emergency maintenance needs that cannot be resolved quickly.
5. Change in disability status or a requirement to live more near to a specific doctor or treatment facility.
6. As a lower priority than all other reasons listed above, to move a family closer to work, school, or doctors.

Of the reasons listed above, we only observe changes in household composition and disability status; unobserved to the econometrician are maintenance changes, emergency reasons, and requests to live nearer to work, school, or doctors.

As there are limited data on the quality of each housing unit, the most interesting transfers to study are transfers from one community to another. However, we also look at within-community transfers. Within each of these types of transfers, one goal is to

distinguish between transfers related to changing housing needs (number of bedrooms) and transfers not related to changing house needs.

We observe 292 within-community transfers where households move to a unit with a different number of bedrooms. Given the HACP policy, this should only take place due to a household's change in housing needs. We find that only 167 (57%) of these transfers are preceded by a change in household size. Of the remaining transfers not preceded by a change in household size, only 44 cannot be explained by some sort of systematic maintenance.²⁹ The remaining transfers are likely due to a combination of several factors: measurement error in the number of household members or lax enforcement of HACP/HUD policy on housing size needs.³⁰ Lacking further information on the quality or maintenance needs of the units, it is difficult to explain these moves with our limited data set.

We also observe 267 within-community transfers where households do not move into a unit with a different number of bedrooms. 172 of these transfers take place in communities where maintenance activities are known to have taken place. Since we do not have further information on the quality or maintenance needs of the units, it is difficult to explain the remaining 95 moves.

In addition to transfers within communities, we observe 635 transfers between different communities; in the next few subsections we establish that a majority of these transfers are not due to community demolitions, and thus can be studied for information about household

²⁹For systematic maintenance, we find that 46 of these transfers are within the same community (Northview Heights). These 46 transfers are the total number of transfers into Northview Heights across the entire panel, so we may conclude that these transfers were a systematic upgrade for maintenance reasons. Also, an additional 35 of the within-community transfers to units with a different number of bedrooms that cannot be explained by an observed change in family size take place in three communities that experienced significant renovations or demolitions (14 in Addison Terrace, 8 in Bedford Dwellings, and 13 in Pressley Street High Rise).

³⁰The HACP is known to have a "one-up" policy where a household can sometimes move to a unit with a bedroom additional to their prescribed housing need; it is our perception that this policy is invoked only when there is sufficient supply of apartments and the "one-up" apartment is not demanded by an income household on the waiting list. It is also our perception that the HACP relies on tenants to inquire about the "one-up" opportunity instead of continuously advertising the opportunity to current residents.

preferences. Tables 14 and 15 in the Appendix present a summary of the transition matrix.³¹ There are several notable facts: communities that do not receive transferring households are of two types- either likely highly desirable or destined for demolition. Obviously the housing authority would not allow households to move into a community destined for demolition. We probably also do not observe transfers into highly desirable communities because there is very little turn-over in those buildings.

In the next subsection, we describe how transfers from communities slated for demolition work. Following that, we propose several motivations that households might have to transfer and we analyze how well these reasons could explain the transfers not due to demolition. These relocation reasons include poverty decentralization, relocation for personal reasons, relocation to fit over- or under- housed families, relocation due to family size or income changes, and aging-related transfers from family to senior housing.

Relocation to Accommodate Demolition Plans

Next we consider relocation due to demolition and renovations. In the years for which we have panel data, 12 public housing communities were affected by full or partial demolition or conversion to home-ownership. 40 units total were converted to owner-occupied homes. Although 6 communities were fully demolished, only 3 of the 34 communities represented in the panel were fully demolished (the other three were vacant at the beginning of the panel). 10 communities had partial demolitions, ranging from 14% to 77% of their original number of units. A full history of the demolitions is provided in the Appendix.

³¹The identities of the communities are somewhat protected; instead, communities are described by their type (Family, Senior, or Mixed), Size (number of units), and whether or not a full or partial demolition took place. The communities' local surroundings are also briefly described: the census tract median income (Inc), high school quality index, the ratio of the local home sales price to the city average, and the violent crime index. The low, average, and high categories correspond to the bottom, middle, and top third of the distribution of these indices across the 34 communities. Finally, the table shows the number of transfers, move ins, and move outs from each community during the span of the study period.

Of the 2378 units demolished in the communities studied here³², 35% were in the eastern region, 33% were in the central region, 17% the south, and 14% the north. Table 10 compares the neighborhood attributes of communities where some units were demolished, to communities where all units were maintained. The differences between means in Table 10 are not significant.

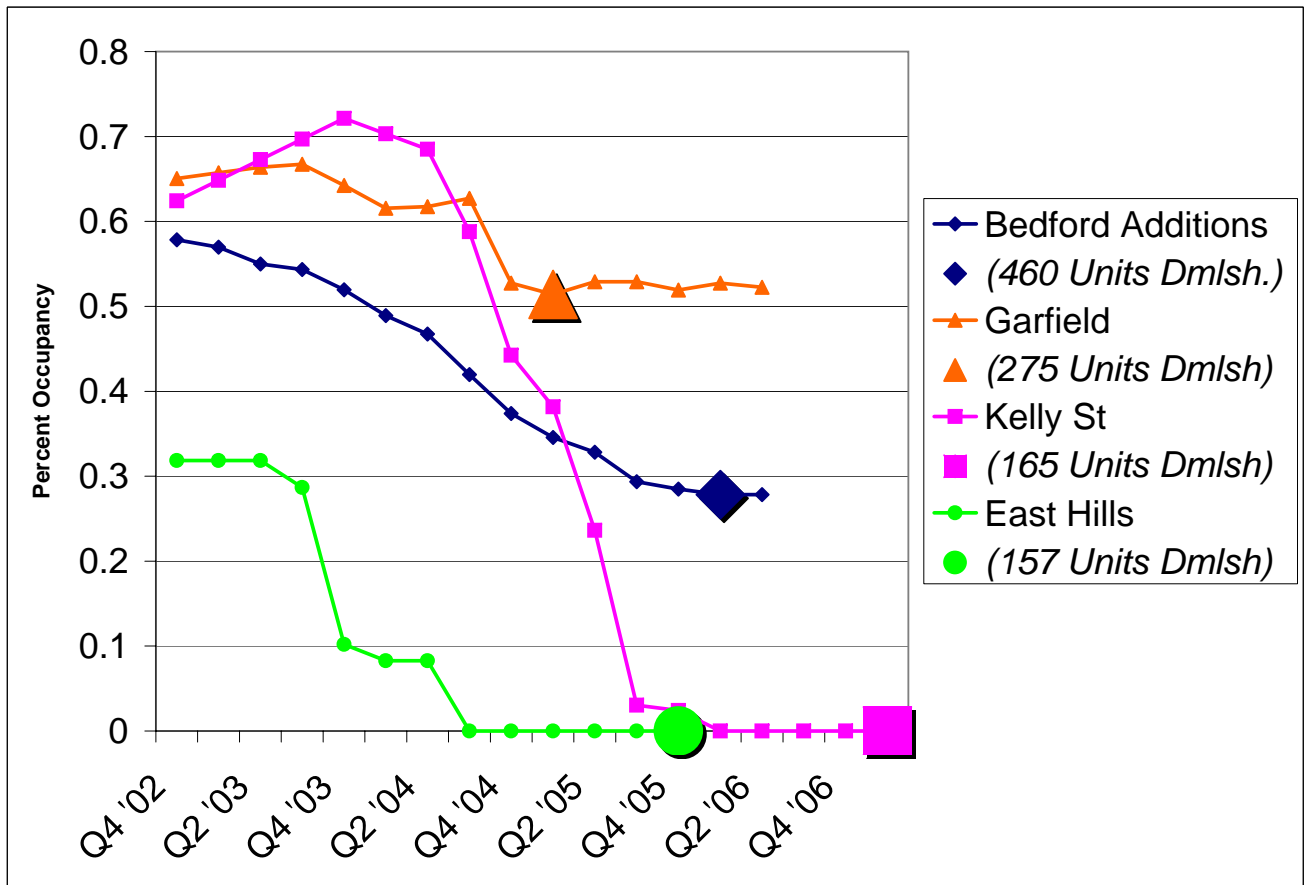
Table 10: Neighborhood Attributes of Communities With and Without Demolitions

	No Demolition	Some Demolition
Property Crime Index	4454 (1540)	3806 (1199)
Violent Crime Index	900 (507)	1118 (557)
Percent White	56%	8.9%
Percent Vacant Property	16.16%	29%
Sales Price Ratio	1.152 (.5)	1.11 (.5)
Percent Home Ownership	42.19%	16.36%
Median Income	22558 (10021)	11932 (3752)
Median Age	38.0 (7.5)	29.0 (13.2)
All School Quality Index	1.21 (.03)	1.19 (.04)
High School Quality Index	1.23 (.05)	1.21 (.06)

When a building demolition is approved, the housing authority begins an effort to transfer its occupants to units in other buildings. This process can take several years if turn-over in other buildings is low and there is no new construction. Typically, relocation efforts last years and the date between a demolition plan and its execution is over three years. Figure 2 shows the occupancy of East Hills High Rise and Kelly St. High Rise (both totally demolished) and Garfield High Rise and Bedford Additions (both partially demolished).

³²Allequippa is not included in this survey because it was vacant at the commencement of our panel.

Figure 2: Occupancy of Communities Being (Partially) Demolished



If we label the communities as fully, partially, or not demolished, we obtain the following matrix for transfers in and out of these communities during our 4 year history.

		to			
		Fully Demolished	Partially Demolished	Not Demolished	Total
from	Fully Demolished	14	27	157	198
	Partially Demolished	17	105	125	247
	Not Demolished	16	67	105	188
Total		47	199	387	633

Not surprisingly most transfers originate from buildings that are partially or fully demolished. We can safely conclude that the 198 transfers from fully demolished communities are due to the HACP's demolition plans. The net loss of transfers out of partially demolished communities, however, is only 48. As a lower bound, we thus conclude that 38.8% of transfers are due solely to the HACP's demolition plans $((48 + 198)/633)$.

Decentralizing Poverty

One political trend in public housing is an emphasis on the success of small communities so that the overall wealth distribution of a neighborhood is not homogeneous. If smaller communities are more desirable, of course the turnover rates would be lower than the turnover for housing in large communities.

		to			
		Small	Medium	Large	Total (%)
from	Small	5	39	6	50 (.08)
	Medium	8	33	150	191 (.30)
	Large	8	109	257	392 (.62)
Total		21	181	431	633

The table above shows transfers into small (< 40 units per community), medium (40 - 100 units per community) and large (> 100 units per community) communities. We find that there are more transfers out of small communities than into them. We thus do not find any evidence that relocation policies favor smaller housing communities. Also, the percent of transfers out of small, medium, and large communities (.08, .30, .62) does not precisely mirror the percent of units demolished in said communities (.02, .26, .73). Instead, fewer households transfer out of larger communities and more households transfer out of smaller and medium-sized communities than would be expected if demolitions were the sole cause of transfers.

Relocation for Personal Reasons

The HACP also states that it tries to transfer households within the same community, so we might not expect to see many transfers from one region of the city to another. We define four regions: North (north of the Allegheny River), Central (between the two rivers and accessible to downtown via ≤ 20 -minute bus route), East (east of Bloomfield, Shadyside and Squirrel Hill), and South (south of the Monongahela River).

		to				
		Central	South	North	East	Total (%)
from	Central	97	29	31	51	208 (.33)
	South	10	89	13	24	136 (.27)
	North	17	19	90	18	144 (.14)
	East	10	14	40	81	145 (.27)
Total		134	151	174	174	633

The table above shows that we see significant transfers in between regions. The greatest number of transfers were from the city center; the north and east regions received the greatest numbers of transfers. This mobility is consistent with the view that residents have

preferences over locations for job, health, school, or other reasons.³³ We also see significant movement away from the Center. The percent of transfers from the Center, South, North, and East (.33, .27, .14, and .27) are similar to the percent of demolished units in each of those areas (.33, .22, .23, and .23) except that fewer transfer out of the northern and eastern regions and more transfer out of the southern region. Therefore, demolitions do not explain all of these observed transfers.

We also looked at the transfers between areas with different levels of crime and quality of schools. The distribution of crime and school quality among the public housing community choices is divided into the thirds; the lowest labeled "Low", the middle labeled "Average", the highest labeled "High".³⁴ First consider mobility between communities that are associated with different levels of schooling.

		to			
		Low School	Avg School	Hi School	Total (%)
from	Low School	203	23	30	256 (.41)
	Avg School	52	41	16	109 (.17)
	Hi School	90	22	156	268 (.42)
Total		345	86	202	633

We find that the majority of transfers from low school quality districts are into other low school quality districts. Again, although demolitions account for a fraction of transfers, they do not explain the transfers between areas of different school qualities. Households transfer out of low, average, and high school quality areas at proportions .41, .17, and .42, while the percent of demolished units corresponding to low, average, and high school quality areas is .38, .27, and .35 respectfully. Thus, more households seem to transferring out of

³³Joassart-Marcelli (2007) asserts that households in public housing tend not to live in close proximity to lower-skill jobs and finds that income is negatively affected. Kleit (2001) suggests that public housing residents in less segregated areas have more diverse social networks, but are less likely to use these networks when looking for employment than public housing residents in highly segregated areas.

³⁴The violent crime index and the high school quality index are used because they predict the probability of exit better than other indices.

average and high performing school areas than the demolitions alone can explain.

Next we consider crime:

		to			
		Low Crime	Avg Crime	High Crime	Total (%)
from	Low Crime	42	21	29	92 (.15)
	Avg Crime	12	63	68	143 (.23)
	High Crime	14	119	265	398 (.63)
Total		68	203	362	633

We find that the majority of transfers from high crime areas are into other high crime areas; this could easily be a factor of low-crime area residents holding steadfastly to their low-crime housing opportunity. If transfers were driven only by demolitions, then percent of transfers out of low, average, and high crime areas (.15, .23, and .63) would mirror the percent of demolished units in these crime areas (.04, .48, .48); instead, we see that a much larger fraction of households transfer out of high-crime neighborhoods than would otherwise be generated by transfers driven only by demolitions.

Relocation due to Family Size or Income Changes

Each household is typically offered an apartment that meets its housing needs. A necessary change in the number of bedrooms can trigger a move from one community to another. Most communities offer only two or three sizes of units, so a change in household composition might necessitate a move to a different community in order to make sure that the household does not have too many or too few bedrooms. We find that 315 (about 50% of the transfers we are studying) are transfers between different communities as well as between units with different numbers of bedrooms. The HACP policy states that grossly over- or under-housed units must be transferred, where "grossly" means a difference between actual and desired unit size of two or more bedrooms; 52 transfers are transfers between communities that involve a change of ± 2 bedrooms.

We observe a large number of household composition changes as well as income changes. There are 1275 households that experience at least one change in the number of children, 93 households that experience a change in marital status at least once, 808 that experience a change in the number of adults at least once, and 3299 households whose annual income changes by \$1000 at least once.

According to HACP and HUD housing policy, a change in the composition of a household will trigger the possibility that its housing needs must be adjusted. However, the new housing needs might not be met until a reasonably sized apartment becomes available. We, therefore, look at the cumulative probabilities of transferring units within public housing after a change in the composition of a household. The main question is whether these cumulative probabilities differ from the the probabilities of transferring units if no change were to take place.

Table 11: Cumulative Probability of Transferring After Household Change

		# Quarters After Household Change				
		#	0	1	2	3
# Kids	Decrease	762	.0092	.0144	.0171	.021
	No Change	16948	.0172	.0339	.0474	.0598
	Increase	219	.0913	.1279	.1507	.2055
# Adults	Decrease	708	.0099	.0198	.0212	.0226
	No Change	17076	.0179	.0347	.0484	.0615
	Increase	145	.0483	.0552	.0552	.0621
Spouse	Moves Out	580	.0017	.0052	.0069	.0086
	No Change	17339	.0182	.0351	.0486	.0615
	Moves In	10	.20	.20	.30	.30
Income	Decrease	1631	.0153	.0325	.0435	.0521
	No Change	13752	.0132	.0298	.0431	.0568
	Increase	2546	.044	.0593	.0727	.0821

Table 11 shows the difference in cumulative transfer probabilities for households with no composition or income changes versus households with changes. The departure of a child, adult, or spouse slightly reduces the probability of a within-public housing transfer. The addition of a child, adult, or spouse significantly increases the probability of a within-public housing transfer. A loss in income does not seem to play a major role in transfer probabilities, although a gain in income corresponds with an increase in transfer probability.

In conclusion, the above within-program mobility analysis shows that public housing participation includes possibilities for housing-needs adjustment and the ability to move to a better-sized unit or more desirable community within the program. Any model of program participation should acknowledge this opportunity. As severe supply restrictions make correlations between transfer probabilities and community amenities spurious, a model incorporating the supply restrictions would be required to estimate the relative desirability of the public housing communities and their surrounding neighborhoods. Further research should consider possibilities of identifying the relative desirability of community types.

Separation of Family and Senior Housing

Most of the public housing communities are targeted either to seniors or to families. Individuals age 62 and older are eligible for senior housing. One event that might trigger a transfer is the onset of eligibility for senior housing. Below is a transition matrix for transfers between senior, family, and mixed/unknown-type communities.

		to			
		Senior	Family	Mixed	Total
from	Senior	78	9	51	138 (.22)
	Family	48	194	170	412 (.65)
	Mixed	24	41	18	83 (.13)
Total		244	150	239	633

We find that several households transfer from family to senior communities and only a few transfer from senior to family communities; our understanding is that sometimes these

transfers are temporary due to emergency maintenance or other issues. Generally, senior housing eligibility is strictly enforced. Also, the transfers out of senior, family, and mixed housing (.22, .65, and .13 percent respectfully) mirror the percent of senior, family, and mixed housing demolitions that were planned (.15, .62, .23).

6 Conclusions

Summarizing model 3, an increase of one standard deviation in the number of crimes in a neighborhood would increase the probability a household would choose to exit by 30%. A 10 percentage point increase in the percent of whites in a neighborhood is associated with a 7.4% increase in leaving public housing. A 10 percentage point increase in the percent of housing units that are vacant in the neighborhood is associated with a 9.1% increase in leaving public housing. A one standard deviation increase in neighborhood relative median home prices is associated with a 13.4% decrease in leaving public housing. A 10 percentage point increase in the percent of neighborhood homes that are owner-occupied is associated with a 13.7% decrease in leaving public housing. In neighborhoods where the median age of housing units is 10 years older than others', public housing occupants are 22% more likely to leave public housing. Public housing occupants are 18.6% less likely to leave public housing if they live in a neighborhood with one standard deviation higher high school test scores compared to similar neighborhoods. Changes in likelihoods could be related to the neighborhood's desirability or to the neighborhood's influence on household's preparation to become self-sufficient.

This paper contributes to the urban housing literature by documenting the importance of with-in program mobility and the relevance of heterogeneity in public housing communities. Both components play important roles in households' decisions to enter and exit public housing. We have shown that waitlists and queues for housing units are key aspects of public housing programs. Some factors affecting the length of time a household will wait for a public housing unit are the prevalence of vacant properties in the neighborhood, area home prices, the prevalence of owner-occupied housing units, the age of area housing

structures, and the mean student test scores at local schools. We have shown that exit out of the program is not just driven by changes in income and family status. Exit is also affected by the neighborhood's desirability or the neighborhood's influence on household's preparation to become self-sufficient, in particular prevalence of crime, vacant lots, area home prices, owner-occupied homes, the age of neighborhood housing structures, and mean student test scores at local schools. Finally, we have provided a comprehensive analysis of the relocation policies. These transfers reflect a combination of desirability, events planned by the housing authority, and the turn-over rates of different communities. The benefits of program participation and the link between community-specific amenities and mobility are vital insights to policy studies prescribing optimal housing legislation.

Our analysis provides ample scope for future research. More research into the dynamics of transfers within public housing communities is needed to help quantify the relative importance of each of these different factors. Future research is also needed to measure the benefits of the public housing program taking into account within program mobility. As shown by the Moving to Opportunity studies, non-economic outcomes such as physical and mental health can also be important benefits. In comparing housing voucher programs to public housing programs, it should not be assumed that public housing offers uniform quality, nor should it be assumed that there is no mobility within the public housing program. In fact, that there is so much variation in public housing quality within jurisdictions provides a rich basis for many housing studies in areas without extensive voucher programs. This research should incorporate variation in neighborhood quality in the analysis to address the correct balance of simultaneously meeting households' housing needs while motivating self-sufficiency. The interplay of the long queue for desirable units and the effect of the desirable units on moving towards self-sufficiency should be explored and quantified in future work incorporating dynamic participation models. These insights could help guide policy makers on the optimal supply and type of public housing.

References

- Carter, W. H., Schill, M. H., and Wachter, S. M. (1998). Polarisation, public housing and racial minorities in US cities. *Urban Studies*, 35(10), 1889–1911.
- Currie, J. and Yelowitz, A. (2000). Are public housing projects good for kids?. *Journal of Public Economics*, 75(1), 99–124.
- Currie, J. and Yelowitz, A. S. (1998). Public Housing and Labor Supply. JCPR Working Papers 52: Northwestern University/University of Chicago Joint Center for Poverty Research.
- Epple, D., Peress, M., and Sieg, H. (2005). Identification and Semiparametric Estimation of Equilibrium Models of Local Jurisdictions. Carnegie Mellon University.
- Freeman, L. (1998). Interpreting the Dynamics of Public Housing: Cultural and Rational Choice Explanations. *Housing Policy Debate*, 9(2), 323–353.
- Hungerford, T. L. (1996). The Dynamics of Housing Assistance Spells. *Journal of Urban Economics*, 39, 193–208.
- Jacob, B. A. (2004). Public Housing, Housing Vouchers, and Student Achievement: Evidence from Public Housing Demolitions in Chicago. *The American Economic Review*, 94, 233–258.
- Jacob, B. A. and Ludwig, J. (2008). The Effects of Housing Assistance on Labor Supply: Evidence from a Voucher Lottery. NBER Working Paper 14570.
- Joassart-Marcelli, P. (2007). Closing the gap between places of work and residence: The role of rental housing assistance in southern California. *Housing Policy Debate*, 18, 107–144.
- Kleit, R. G. (2001). The role of neighborhood social networks in scattered-site public housing residents' search for jobs. *Housing Policy Debate*, 12, 541–573.
- Kling, J. R., Liebman, J. B., and Katz, L. F. (2007). Experimental Analysis of Neighborhood Effects. *Econometrica*, 75(1), 83–119.
- Kling, J. R., Liebman, J. B., Katz, L. F., and Sanbonmatsu, L. (2004). Moving to Opportunity and Tranquility: Neighborhood Effects on Adult Economic Self-Sufficiency and Health from a Randomized Housing Voucher Experiment. Online at L. Katz webpage, Harvard.
- Newman, S. J. and Schnare, A. B. (1997). .. And a suitable living environment: The failure of housing programs to deliver on neighborhood quality. *Housing Policy Debate*, 8(4), 703–741.
- Olsen, E. O. (2001). Housing programs for low-income households. *NBER Working Paper*, 8208.
- Olsen, E. O., Davis, S. E., and Carrillo, P. E. (2005). Explaining Attrition in the Housing Voucher Program. *Cityscape: A Journal of Policy Development and Research*, 8(2), 95–113.
- Painter, G. (2001). Low-Income housing assistance: Its impact on labor force and housing program participation. *Journal of Housing Research*, 12(1), 1–26.

USDepartmentHousingAndUrbanDevelopment. Fiscal Year 2006 Budget Summary.
www.hud.gov/about/budget/fy06/fy06budget.pdf.

Appendix

Table 12: Probability of (Non) Senior Citizens With(out) Kids, by Project on June 2004

(A)

Type	Size	Inc	Educ	Price	Crime	Non-Senior		Senior	
						No Kids	Kids	No Kids	Kids
Fam	1-30	Lo	Hi	Av	Lo	0.43	0.48	0.07	0.04
Fam	1-30	Lo	Hi	Av	Lo	0.23	0.69	0	0.1
Fam	1-30	Hi	Hi	Av	Lo	0.24	0.59	0.12	0.08
Fam	1-30	Hi	Hi	Hi	Lo	0.25	0.75	0	0
Fam	1-30	Hi	Hi	Av	Lo	0.23	0.77	0	0
Fam	1-30	Hi	Av	Lo	Av	0.17	0.74	0.09	0
Fam	1-30	Hi	Av	Lo	Av	0.34	0.52	0.1	0.05
Fam	1-30	Lo	Hi	Av	Av	0.33	0.17	0.5	0
Fam	1-30	Lo	Av	Av	Lo	0.28	0.58	0.13	0.02
Fam	30-100	Hi	Av	Hi	Av	0.22	0.59	0.14	0.06
Fam	30-100	Hi	Lo	Av	Lo	0.18	0.64	0.15	0.04
Fam	100-200	Av	Av	Hi	Av	0.55	0.33	0.11	0.02
Fam	100-200	Lo	Hi	Hi	Hi	0.21	0.61	0.15	0.03
Fam	100-200	Av	Lo	Lo	Hi	0.14	0.8	0.04	0.03
Fam	100-200	Lo	Hi	Av	Lo	0.27	0.49	0.17	0.1
Fam	200+	Lo	Hi	Hi	Hi	0.48	0.4	0.11	0.01
Fam	200+	Lo	Hi	Hi	Hi	0.39	0.41	0.19	0.02
Fam	200+	Av	Lo	Lo	Hi	0.51	0.45	0.04	0
Fam	200+	Av	Av	Hi	Av	0.1	0.83	0.05	0.03

Table 13: Probability of (Non) Senior Citizens With(out) Kids, by Project on June 2004

(B)

Type	Size	Inc	Educ	Price	Crime	Non-Senior		Senior	
						No Kids	Kids	No Kids	Kids
Mix	100-200	Av	Lo	Lo	Hi	0.12	0.16	0.72	0.01
Mix	100-200	Lo	Hi	Hi	Hi	0.16	0.28	0.54	0.02
Mix	200+	Lo	Lo	Lo	Av	0.13	0.69	0.16	0.03
Mix	200+	Lo	Lo	Av	Av	0.09	0.64	0.24	0.04
Sen	1-30	Hi	Lo	Hi	Lo	0.17	0	0.83	0
Sen	1-30	Av	Av	Hi	Av	0.17	0	0.83	0
Sen	30-100	Av	Lo	Lo	Hi	0.23	0	0.77	0
Sen	30-100	Hi	Hi	Hi	Lo	0.13	0	0.87	0
Sen	30-100	Lo	Hi	Av	Lo	0.26	0	0.74	0
Sen	30-100	Hi	Av	Lo	Hi	0.24	0	0.76	0
Sen	30-100	Hi	Hi	Lo	Av	0.27	0	0.73	0
Sen	30-100	Hi	Av	Hi	Av	0.25	0	0.75	0
Sen	30-100	Hi	Av	Lo	Av	0.22	0	0.78	0
Sen	100-200	Hi	Lo	Av	Hi	0.37	0	0.63	0
Sen	100-200	Av	Lo	Lo	Hi	0.22	0	0.78	0
Sen	100-200	Av	Lo	Lo	Hi	0.22	0	0.78	0

Below is a history of the demolition of several communities' units. An 'F' denotes full demolition while a 'P' indicates partial demolition.³⁵

2001

Arlington Heights	South	(P) 366 units demolished
Northview	North	(P) 90 senior units demolished
Allequippa	Center	(F) 84 units demolished

2002

Addison Terrace	Center	(P) 45 units demolished
St. Clair Village	South	(P) 224 units demolished
Northview Heights	North	(P) 108 family units demolished
Northview Heights	North	(P) 5 senior units "to conversion"
Kelly St	East	(P) 33 units "to conversion"

2003 no demolitions

2004

Addison Terrace	Center	(P) 90 units demolished
Broadhead Manor	North	(P) 48 units damaged- hurricane

2005

Scattered Sites	North/South	(P) 2 to demolition or home ownership
Glen Hazel Homes	South	(P) 1 to home ownership
Garfield Senior	East	(P) 275 units demolished

³⁵We have no observations from Allequippa as it was vacant at time our panel data commenced.

2006

Northview Heights	North	(P) 78 units demolished
Bedford Additions	Center	(F) 460 units demolished
Glen Hazel -Cove Palace	South	(F) 39 units demolished
East Hills Hi-Rise	East	(F) 157 units demolished

2007

Addison Hi-Rise	Center	(F) 194 units to be demolished
Kelly St. Hi-Rise	East	(F) 165 units to be demolished

Table 14: Summary of Transition Matrix (A)

Type	Size	Event	Inc	Schools	Price	Crime	TransIn	TransOut	MoveIn	MoveOut
Fam	1-30	Y	Lo	Hi	Av	Lo	3	31	27	26
Fam	1-30		Lo	Hi	Av	Lo	0	8		1
Fam	1-30		Hi	Hi	Av	Lo	10	4	3	9
Fam	1-30		Hi	Hi	Av	Lo	0	1	4	9
Fam	1-30		Hi	Av	Lo	Av	3	0	8	10
Fam	1-30		Hi	Av	Lo	Av	1	0	5	9
Fam	1-30	Y	Lo	Av	Av	Lo	0	33	27	34
Fam	1-30		Hi	Hi	Hi	Lo	0	0		
Fam	1-30		Lo	Hi	Av	Av	4	5		1
Fam	30-100		Hi	Av	Hi	Av	10	8	13	27
Fam	30-100		Hi	Lo	Av	Lo	1	3	4	10
Fam	100-200	Y	Av	Av	Hi	Av	22	23	175	121
Fam	100-200	Y	Lo	Hi	Hi	Hi	0	78		79
Fam	100-200		Av	Lo	Lo	Hi	27	23	69	86
Fam	100-200		Lo	Hi	Av	Lo	40	6	29	60
Fam	200+		Lo	Hi	Hi	Hi	71	36	330	326
Fam	200+		Av	Lo	Lo	Hi	40	41	335	286
Fam	200+	Y	Av	Av	Hi	Av	34	40	175	144
Fam	200+	Y	Lo	Hi	Hi	Hi	29	88	667	531

Table 15: Summary of Transition Matrix (B)

Type	Size	Event	Inc	Schools	Price	Crime	TransIn	TransOut	MoveIn	MoveOut
Mix	100-200		Av	Lo	Lo	Hi	60	9	32	92
Mix	100-200		Lo	Hi	Hi	Hi	25	5	47	60
Mix	200+	Y	Lo	Lo	Lo	Av	46	33	293	331
Mix	200+	Y	Lo	Lo	Av	Av	69	30	198	270
Sen	1-30		Hi	Lo	Hi	Lo	1	0	20	16
Sen	1-30		Av	Av	Hi	Av	0	1	19	19
Sen	30-100		Lo	Hi	Av	Lo	12	5	33	47
Sen	30-100	Y	Av	Lo	Lo	Hi	19	74	28	59
Sen	30-100		Hi	Hi	Hi	Lo	2	1	25	32
Sen	30-100		Hi	Av	Lo	Hi	8	2	60	64
Sen	30-100		Hi	Hi	Lo	Av	7	1	32	37
Sen	30-100		Hi	Av	Hi	Av	4	1	25	23
Sen	30-100		Hi	Av	Lo	Av	4	1	42	36
Sen	100-200		Hi	Lo	Av	Hi	25	11	70	68
Sen	100-200	Y	Av	Lo	Lo	Hi	58	23	107	113
Sen	100-200	Y	Av	Lo	Lo	Hi	0	10	5	27