Cityscape

A Journal of Policy Development and Research

American Housing Survey
Volume 14, Number 1 • 2012

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Guest Editor's Introduction

Shawn Bucholtz
U.S. Department of Housing and Urban Development

The American Housing Survey (AHS) is the largest regular national housing sample survey in the United States. The AHS began in 1973 and has used the same longitudinal sample of housing units since 1985. The AHS instrument asks numerous questions concerning housing-related topics, including housing unit size and condition, household characteristics, neighborhood amenities, housing costs, rents and mortgages, and reasons for moving. Information from the AHS is important for monitoring the overall housing market, the housing stock, and the performance of U.S. Department of Housing and Urban Development (HUD) housing programs. Most AHS users create single-survey, cross-section estimates. A smaller number of users make use of the longitudinal structure of the AHS.

HUD hosted an AHS User Conference on March 8, 2011, to highlight the many uses of the AHS in research and to present results from newly released 2009 AHS data sets, which included new disability-related questions and a supplemental survey of post-Hurricane Katrina recovery in New Orleans. Of the 15 papers presented, we selected 8 for the symposium in this issue of *Cityscape*. The symposium features an article on housing for the disabled, two articles on housing subsidy recipients' housing and neighborhood satisfaction, two articles on the physical adequacy of housing, one article on energy use, and one article on housing units with negative equity. Two articles make use of the longitudinal data and six use the 2009 AHS as a cross-section. Two Australian authors familiar with housing data provide an international perspective.

For the 2009 AHS, HUD adopted a standardized set of six disability questions that a Census Bureau advisory committee recommended for all federal surveys, and one symposium article uses these new questions to better understand the disabled population's housing conditions. In the article, "The House Next Door: A Comparison of Residences by Disability Status Using New Measures in the American Housing Survey," Denise W. Hoffman and Gina A. Livermore explore how disability status is associated with a range of housing and neighborhood quality characteristics. Using the 2009 AHS and multivariate cross-sectional analysis to control for income and other characteristics, they conclude that individuals with disabilities report living in lower quality housing and lower quality neighborhoods than households with no people with disabilities. Their findings are consistent with previous research that cited higher health and other living costs and reduced household efficiency as reasons why people with disabilities experience lower quality housing and neighborhoods. Hoffman and Livermore also conclude that housing programs help alleviate some hardships for the disabled, but additional assistance may be needed.

Two articles focus on self-reported housing and neighborhood satisfaction for housing program participants. In the first article, "You Can't Always Get What You Want: The Role of Public Housing and Vouchers in Achieving Residential Satisfaction," Lauren M. Ross, Anne B. Shlay, and Mario G. Picon explore housing and neighborhood satisfaction levels among Housing Choice Voucher Program (HCVP) and public housing participants and among unassisted renters. Using an ordered logit regression analysis to control for individual, household, and neighborhood characteristics, the authors find that HUD program participants report higher levels of housing satisfaction (on a scale of 1 to 10) than unassisted renters. HUD program participants, especially HCVP participants, however, reported lower levels of neighborhood satisfaction.

In the second article to explore HUD program participants' self-reported housing and neighborhood satisfaction, "Comparing Public Housing and Housing Voucher Tenants With Bayesian Propensity Scores," Brent D. Mast notes that HUD currently has no administrative data to compare the quality of public housing units with HCVP units and that the AHS could serve this purpose. Building on previous work with additional analysis, Mast concludes that AHS identification of HUD program participants is problematic because the AHS overrepresents public housing participants and underrepresents HCVP participants. As a result, apparent differences in housing or neighborhood satisfaction between the two housing programs based on AHS data may be biased. Mast introduces a Bayesian model that uses income and rent variables common to HUD administrative data and 2009 AHS data to improve the reliability of quality comparisons. Mast finds little statistical difference in household and neighborhood satisfaction ratings between public housing participants and HCVP participants.

A housing unit's physical adequacy is an important component of housing quality and an important determinant for overall housing assistance needs. HUD researchers currently create housing inadequacy indicators for the AHS. Two articles in this symposium focus on housing's physical adequacy, as defined in the AHS. In the first article, "Exploring Housing Challenges of Low-Income Minority Populations in the Southern United States," Sung-jin Lee, Kathleen R. Parrott, and Mira Ahn examine housing conditions of low-income minority householders in the South using data from the 2009 AHS. They conduct a bivariate analysis to determine which factors influence housing adequacy. They find that income, housing structure and type, geography, neighborhood quality, and housing assistance receipt all influence the housing adequacy measure.

In the second article on housing adequacy, "Housing Value, Costs, and Measures of Physical Adequacy," Paul Emrath and Heather Taylor reexamine the AHS housing adequacy indicators and find that, in contrast to what economic theory would predict, they had little correlation with housing values and rents. Motivated by this finding, they propose a new methodology for determining physical inadequacy by indentifying adequacy-related variables that they show to have strong correlation with housing values and rents. The new methodology identifies more units as physically inadequate, relative to the existing indicators. Emrath and Taylor reach the important conclusion that the inventory of existing homes on the market may be overstated, because some of the units are not physically adequate to serve as housing.

In "Household Energy Bills and Subsidized Housing," Samuel Dastrup, Simon McDonnell, and Vincent Reina investigate energy use for housing program participants, including differences in billing arrangements between housing program participants and unassisted renters, and energy use

for tenants paying utilities separately from rent. They build on a previous theoretical model of tenants' energy use when landlords pay utilities by extending the model to show utility-maximizing decisionmaking for housing program participants. To complement their theoretical analysis, Dastrup, McDonnell, and Reina use data from the 2003, 2005, 2007, and 2009 AHS to show that tenants receiving housing assistance, especially public housing tenants, are more likely to live in units where the landlord pays the utilities. Their analysis reveals no statistically significant differences in energy use between unassisted low-income renters who pay their utilities separately from rent and housing program participants who pay their utilities separately from rent.

The rapid decline of housing values since 2007 has caused many homeowners to have mortgage balances that are now larger than the value of their housing unit. These homeowners are said to have negative equity and to have mortgages that are "under water." In "Housing Units With Negative Equity, 1997 to 2009," George R. Carter III uses AHS longitudinal data from 1997 through 2009 to calculate trends in negative equity nationally and for individual housing units, including the persistence of negative equity over time and the extent to which home sales could be considered distressed. Carter's negative equity estimates, derived from the AHS, are substantially lower (11.6 percent) than estimates produced by other data sources (First American CoreLogic's 23 percent). Carter also finds that negative equity persistence increased between 2007 and 2009, as did the number of distressed sales.

In "The American Housing Survey From a Cross-National Perspective," Andrew Beer and Debbie Faulkner provide an Australian perspective on housing issues and housing data. Australia faces housing supply and housing adequacy issues, and Beer and Faulkner note that the AHS's emphasis on housing quality is an important and desirable feature of housing surveys. Much like the United States, Australia is grappling with how best to provide adequate housing for the disabled. The authors note that Australia does not have a survey of similar quality and scope as the AHS to help understand how housing programs for the disabled will affect the housing market. Finally, the authors mention that budget issues and privacy concerns are two of Australia's major limitations to conducting a survey similar to the AHS.

The articles chosen for this symposium represent cross-sections of housing policy topics and AHS data uses, reflecting their origins in the 2011 AHS User Conference. Researchers from housing-related disciplines will benefit from reading these articles from both policy and technical perspectives. Beginner and intermediate AHS data users may learn new ways that they can use the AHS to answer important questions, including questions requiring longitudinal analysis. Advanced users may find indepth discussions of AHS's limits useful for their analyses.

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The House Next Door: A Comparison of Residences by Disability Status Using New Measures in the American Housing Survey

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Abstract

Using new measures in the American Housing Survey, we document housing differences by disability status. We compare housing and neighborhood characteristics for people with and without disabilities using multivariate analyses to control for individual-level characteristics. Our impact estimates suggest that people with disabilities live in housing units and neighborhoods with significantly less desirable characteristics. Low-cost mortgages and housing voucher receipt, however, have positive effects on the housing and neighborhood characteristics of people with disabilities. Other forms of housing assistance, particularly subsidized housing and rent control, are associated with less desirable residences.

Introduction

Researchers have documented the struggles of working-age people (18 to 64 years old) with disabilities in terms of their employment, health insurance coverage, access to health care, and poverty status. No one has yet researched the state of housing for this group, however, perhaps in part because of data limitations. Now, because of the inclusion of disability-related questions in the 2009 American Housing Survey (AHS), this issue can be analyzed in detail for the first time. Understanding the housing needs of working-age people with disabilities is crucial to developing housing policies for this population, such as the Section 811 program. By analyzing the differences in housing between adults with and without disabilities, we can identify areas in which housing for people with disabilities is lacking and assess the effect of housing policies on the likelihood that people with disabilities will have poor or unstable housing.

Most of the existing literature on housing and disabilities focuses on elderly people or children with disabilities. This article is intended to fill the knowledge gap on the housing status of working-age people with disabilities. We also focus on this population because it represents a large and growing segment that relies heavily on state and federal government programs. In 2008, approximately 19 million working-age people had disabilities (U.S. Census Bureau, 2008). In that same year, the federal government spent nearly $360 billion, or approximately $19,000 per person, on programs and services that working-age people with disabilities used (Livermore, O'Toole, and Stapleton, 2010). Although federal spending on housing-related programs represented only about 1 percent ($3.8 billion) of these expenditures, people with disabilities represent a disproportionate share of those who need housing assistance. For example, the U.S. Department of Housing and Urban Development (HUD) estimates that 40 percent of homeless individuals in shelters have a disability (HUD, 2010). We also focus on working-age people with disabilities because they are the target of recent efforts to promote employment, reduce poverty, and reduce reliance on income assistance, primarily from the Social Security Disability Insurance (SSDI) and Supplemental Security Income (SSI) programs. Such efforts, however, are unlikely to be effective if many of these individuals are in poor or unstable housing situations. Recent research has suggested that 1.1 million (HUD PD&R, 2008) to 1.4 million (Nelson, 2008) households with a working-age person with a disability had "worst-case" housing needs in 2005. This worst-case status is defined as low-income household members paying more than one-half of their incomes in rent, living in severely substandard housing, or both.

Before the release of the 2009 AHS, researchers made use of supplements to the AHS, the American Community Survey (ACS), and other large national data sets to find basic housing information on people with disabilities. Studies have identified differences in housing quality for households with and without members with disabilities, including the number of people per room, unit size, the number of families in the home, whether the unit is a mobile home, and neighborhood amenities (National Council on Disability, 2010; White, Peaslee, and LaQuatra, 1994). Other researchers have compared household surroundings such as urbanicity, local crime, density, access to transportation, racial and age composition of neighborhood residents, and mobility barriers for working-age people with disabilities (National Council on Disability, 2010) and for elderly people (Beard et al., 2009; Freedman et al., 2008; Gilderbloom and Markham, 1996; Keysor et al., 2010).

The new disability-related questions in the 2009 AHS included questions on health-related functional impairments and on disability-income receipt. Specifically, the survey asked if a household member has a physical or mental condition that causes difficulties with hearing, vision, cognitive functions, walking or climbing stairs, self-care, or performing errands. Other questions focused on SSI receipt and disability payments (defined as SSDI, workers' compensation, veterans' disability compensation or pension, or other disability payments). These questions enable us to examine housing differences by self-reported disability status (problems with one of the six specific activities or disability-income receipt).

Disability status may be associated with a range of housing characteristics. This analysis focused on some characteristics that have been addressed in previous research and others that have not. We examine two housing areas:

- **Housing quality**. Overall rating, size, rooms per person, square feet per person, manufactured/mobile home, amenities (for example, appliances, cooling, safety devices, and garage), and deficiencies (for example, problems with the physical structure, equipment breakdowns, plumbing problems, and rodents).
- **Neighborhood quality**. Overall rating, Area Median Income (AMI), average fair-market rent, community services available, benefits (proximity to public transportation, stores, and police protection), and problems (for example, crime, noise, odors, and surrounding building and road conditions).

To help explain our findings, we also examined responses to questions about the reasons for choosing a particular residence.

For this study, we conducted multivariate analyses of the likelihood of particular housing and neighborhood features while controlling for sociodemographic characteristics. In particular, we assessed the extent to which aspects of housing and neighborhood quality differ between working-age people with and without disabilities, holding income and other household characteristics constant. We also compared the AHS estimates of the number of working-age people with disabilities with estimates from the Current Population Survey (CPS) and the ACS. All three surveys contain identical disability questions, which enabled us to assess the extent to which the AHS fully captures the noninstitutional population with disabilities. One concern is that the AHS does not survey those living in noninstitutional group quarters; the percentage of residents with disabilities in some types of noninstitutional group quarters is very high (HUD, 2008).

Our findings indicate that, with other characteristics (including income) held constant, working-age individuals with disabilities live in lower quality housing and lower quality neighborhoods than their nondisabled counterparts. These results are consistent with other research showing that, holding income constant, working-age people with disabilities are more likely to face a range of material hardships, which may be in part because of the higher costs and reduced household efficiency associated with activity limitations and disability (She and Livermore, 2007). Further, previous studies on elderly people with disabilities found similar results; these studies focused on a subset of the housing characteristics analyzed here, although they often used different data sources and methods (as discussed in the following section).

We also assessed the extent to which housing assistance influenced housing and neighborhood outcomes. Our results suggest that, in general, housing assistance programs are relatively more beneficial for people with disabilities than for people without disabilities. Of the five housing assistance types considered, low-cost mortgages and housing vouchers were the most beneficial for people with disabilities.

The remainder of this article is organized as follows: In the next section, we describe previous research related to disability and housing. In Data and Methods, we discuss the 2009 AHS and its new disability measures. In Findings From the Multivariate Analyses, we present our findings on the association between disability and housing and neighborhood characteristics, controlling for important covariates such as income and household size. In Housing Assistance, we examine the role that housing assistance plays in the housing characteristics of people with disabilities. In the final section, we conclude and discuss the policy implications of our findings.

Disability and Housing Characteristics

Disability is likely to affect housing and neighborhood characteristics in a number of ways. First, disability may limit a person's income and assets, which in turn limits his or her housing options. Working-age people with disabilities are much more likely to have low incomes and to experience long-term poverty than those without disabilities (She and Livermore, 2009). Poverty occurs primarily because of the disability's effect on earnings, the primary source of income for most working-age individuals.[1] Limited income and assets can restrict people with disabilities to low-cost, low-quality housing options. It can also inhibit their ability to save and purchase their own homes, thereby reducing the control and incentives they might have to make home improvements. Second, disability can affect perceived housing and neighborhood quality through its effect on the individual's needs. For example, individuals with disabilities might require specific modifications to make their housing safe and accessible. They might also require community services such as accessible public transportation. If the available affordable housing cannot meet such needs, people with disabilities will be more likely to perceive their housing and neighborhoods to be of lower quality. Third, people with disabilities may find it difficult to address housing deficiencies (such as maintenance issues) that arise, which may lower their housing quality. Mobility, sensory, and cognitive limitations might affect an individual's ability to identify and address housing problems, and low income may limit a person's ability to purchase maintenance services.

A number of researchers have analyzed the relationship between disability and housing characteristics. Periodic HUD reports estimate worst-case housing needs, the most recent of which estimated that approximately 1 million nonelderly households with disabled members have worst-case needs, making disabled households, at a 36-percent rate, the most likely of any family type to fall into this category (HUD, 2011).[2] Disability advocacy groups have also examined the housing status of people with disabilities; one group found that housing affordability is the greatest need facing disabled households and that 41 percent of such households have trouble affording their housing costs (National Council on Disability, 2010). An older study, which revealed that households with disabilities have higher housing-to-income ratios, reached the same conclusion (White, Peaslee, and LaQuantra, 1994).

Other studies on the relationship between housing and disability have shown that, among elderly people, disability is associated with poor economic conditions (Beard et al., 2009; Freedman et al., 2008), neighborhood mobility barriers (Freedman et al., 2008; Keysor et al., 2010), a lack of transportation facilitators (Keysor et al., 2010), and higher levels of crime or perceived crime (Beard et al., 2009; Clark et al., 2009). These studies involved diverse populations, but all focused exclusively on individuals who are age 55 and older. A study conducted by Newman (2003) estimated the effect of disability on the number of unmet housing needs and dwelling modifications for

[1] Disability can negatively affect earnings through its effect on one's productivity and ability to work and through its effect on human capital development (for example, limiting education because onset occurred during childhood).

[2] The study also notes that the data on which the numbers are based (the 2009 AHS) likely underestimate the number of households with members with disabilities compared with other surveys, such as the ACS, implying that the number of disabled households with worst case needs may be even higher.

elderly people. Newman's study was based on data from a one-time supplement to the 1995 AHS that contained information on disability and housing modifications. In the supplement, disability was defined as (1) difficulty entering and exiting the home; (2) difficulty getting around inside the home; (3) difficulty with personal activities; (4) difficulty seeing; (5) difficulty hearing; or (6) use or need of special modifications, equipment, or assistance. Using counts of difficulties as a proxy for disability, Newman estimated that each difficulty is associated with a 10-percent increase in the number of unmet needs and a 7-percent increase in the number of dwelling modifications.

Data and Methods

In this section, we first describe the disability measures in the AHS and compare disability prevalence rates in the AHS to rates in two large, nationally representative surveys. We then measure demographic characteristics, housing characteristics, and neighborhood characteristics by disability status. Finally, we outline our estimation strategy for subsequent regression analyses.

Disability Measurement in the AHS

The AHS is the largest regular national housing survey in the United States (U.S. Census Bureau, 2004).[3] Conducted every 2 years by the U.S. Census Bureau on behalf of HUD, the AHS is designed to provide data on housing units between the decennial censuses, which also produce housing data. The 2009 AHS surveyed more than 53,000 housing units, representing a cross-section of all U.S. housing, excluding group quarters such as barracks, dormitories, prison wards, group homes, and assisted-living facilities (HUD, 2011). The AHS focuses on the housing unit itself, the surrounding area, and the household's inhabitants, if applicable.

Because the AHS represents all U.S. housing units, it includes vacant housing units in the sample, with information about each vacant unit gathered from neighbors, landlords, and rental agents. In our study, however, we exclude all vacant units. In addition, although the AHS is representative at the household level, information is gathered for every occupant of each housing unit, making it possible to conduct individual-level analyses. For our study, we analyzed data at both the individual and household levels, although we present only the individual-level estimates in what follows.[4] The sample of individuals used in this analysis includes only those of working age (18 to 64 years old). In the household-level analysis, we included only households with at least one member between ages 18 and 64.

The standard core of the AHS first included disability questions in 2009.[5] The survey asked respondents the following six questions regarding the existence of disabling limitations among all adult household members older than age 16:

[3] The AHS has two components: National Data and Metropolitan Data. For this article, we use the National Data; all references to the AHS are to the National Data.

[4] Household-level estimates are available from the authors upon request.

[5] Before the 2009 AHS, supplements containing disability-related questions were added to the 1978 and 1995 surveys.

1. Is anyone in this household deaf, or do they have serious difficulty hearing?
2. Is anyone in this household blind, or do they have serious difficulty seeing, even when wearing glasses?
3. Because of a physical, mental, or emotional condition, does anyone in this household have serious difficulty concentrating, remembering, or making decisions?
4. Does anyone in this household have serious difficulty walking or climbing stairs?
5. Does anyone in this household have serious difficulty dressing or bathing?
6. Because of a physical, mental, or emotional condition, does anyone in this household have difficulty doing errands alone, such as visiting a doctor's office or shopping?

To attribute the limitation to specific household members, an affirmative answer to any of these questions was followed by the question, "Who is that?" Hereafter, we refer to the limitations mentioned in these six questions as (1) hearing, (2) visual, (3) cognitive, (4) ambulatory, (5) self-care, and (6) independent-living disabilities, respectively. The AHS also asked respondents two questions regarding disability-income receipt: (1) "Did _____ receive any disability payments, such as SSDI, workers' compensation, veterans' disability, or other disability payments?" and (2) "Did _____ receive any SSI payments?" Any household member who had income from either source, for purposes of this analysis, is a person who received a disability payment.

Exhibit 1 shows disability prevalence rates at the individual and household levels, based on AHS data. To make these rates nationally representative, we used sample weights to calculate estimates. The unweighted sample sizes for these statistics are also included in exhibit 1. Disability prevalence rates are uniformly higher at the household level because a household needs only one working-age member with one of the six limitations to be considered a household with a disability. Of the individual sample and household sample, 6.0 and 10.1 percent, respectively, reported having at least one of the six limitations. Ambulatory disability was the most common, with 3.3 percent of individuals and 5.9 percent of households reporting this limitation. The least common limitations

Exhibit 1

Disability Prevalence Among Individuals Age 18 to 64 and Households With Members Age 18 to 64

Disability Measure	Individuals		Households	
	(N)	(%)	(N)	(%)
Hearing disability	69,305	1.2	36,705	2.2
Visual disability	69,308	0.8	36,706	1.4
Cognitive disability	69,255	1.9	36,673	3.4
Ambulatory disability	69,285	3.3	36,688	5.9
Self-care disability	69,285	0.7	36,689	1.4
Independent-living disability	69,283	1.7	36,690	3.0
Any of the six limitations	69,225	6.0	36,656	10.1
Disability-payment receipt	65,519	4.7	36,817	7.8
Any of the six limitations or disability-payment receipt	65,040	8.7	36,540	13.9

Source: 2009 American Housing Survey

were vision and self-care. Independent of limitations, approximately 4.7 percent of individuals and 7.8 percent of households reported receiving disability payments. Aggregating responses across all limitations and disability-payment receipt, 8.7 percent of individuals and 13.9 percent of households had a disability or a household member with a disability.

The six functional limitation questions in the 2009 AHS are similar to those in the CPS and ACS in 2009. A federal interagency workgroup for the 2000 Decennial Census developed these questions, which are becoming the new survey standard for identifying disability (Adler et al., 1999). Although the limitation questions in all three surveys are almost identical, the sampling methodologies differ substantially. As noted previously, the AHS does not sample those living in group quarters, but the ACS does sample this group (Weathers, 2009). The CPS sample is limited to the noninstitutionalized population, but it includes members of the armed forces living in civilian housing units. Consistency in the questions across the three surveys enables us to compare their disability prevalence rates if we limit the ACS and CPS samples to include only the noninstitutionalized, nongroup-quarters population to make them comparable to the AHS.

Exhibit 2 shows the individual-level disability prevalence rates based on the AHS, CPS, and ACS for the noninstitutionalized, nongroup-quarters population. The rates based on the AHS are lower than those from the CPS, and both of these rates are lower than those based on the ACS.[6, 7] Differences in survey context and data collection methodology likely contribute to the differences in prevalence estimates across surveys (Brault, 2010). For example, the ACS uses three data collection

Exhibit 2

Rates of Disability Prevalence for Individuals Age 18 to 64, by Data Source

Disability Measure	AHS (N = 135,442,153)	CPS (N = 189,087,636)		ACS (N = 186,851,396)	
	Weighted Percent	Weighted Percent	Percentage-Point Difference From AHS	Weighted Prevalence	Percentage-Point Difference From AHS
Hearing disability	1.20	1.47	0.27***	2.06	0.86***
Visual disability	0.80	1.08	0.28***	1.70	0.90***
Cognitive disability	1.92	2.90	0.98***	3.99	2.07***
Ambulatory disability	3.29	4.24	0.95***	5.17	1.88***
Self-care disability	0.75	1.24	0.49***	1.72	0.97***
Independent-living disability	1.68	2.49	0.81***	3.35	1.67***
Any of the six limitations	5.96	7.84	1.88***	9.91	3.95***

ACS = American Community Survey. AHS = American Housing Survey. CPS = Current Population Survey.

**Indicates significance at the 10-percent level, two-sample t-test. **Indicates significance at the 5-percent level, two-sample t-test. ***Indicates significance at the 1-percent level, two-sample t-test.*

Sources: 2009 American Housing Survey; 2009 Current Population Survey; 2009 American Community Survey

[6] We also calculated individual-level disability prevalence rates based on the AHS without sample weights and with an alternate sample weight; all weighting mechanisms produced similar statistics.

[7] Similarly, Pelletiere and Nelson (2011) found that among nonelderly adults between the ages of 18 and 61, household disability prevalence rates based on the AHS were lower (10.0 percent) than those based on the ACS (16.1 percent).

modes sequentially to elicit high response rates; respondents are contacted first by mail, then by telephone, and finally in person (U.S. Census Bureau, 2010b). Using multiple survey modes may be particularly valuable in facilitating the participation of people with disabilities. The AHS and CPS use only two collection modes each; neither uses mailed surveys. Further, the presence or absence of a field representative may affect responses. Field representatives may clarify questions and obtain more accurate responses, or respondents may understate disabilities while in a field representative's presence because of social stigmas (Brault, 2009).

To assess the extent to which the populations with disabilities in the three surveys are similar, we developed descriptive statistics for the sample with disabilities in the AHS, CPS, and ACS (exhibit 3). The ACS statistics are based on published estimates (U.S. Census Bureau, 2010a); the samples over which the ACS statistics were calculated varied by age. To make the statistics comparable across surveys, we used these same age groups to compute the AHS and CPS statistics (as noted in parentheses for each variable). Exhibit 3 indicates that people who reported limitations in the CPS and ACS have similar, although generally statistically different, characteristics compared with those who reported limitations in the AHS. Given the size of the CPS and ACS, which provide estimates for more than 300 million people overall and more than 30 million people with disabilities, statistics across the surveys would have to be nearly identical to avoid being statistically different. Therefore, the small percentage differences suggest that the populations with disabilities are similar across the three surveys.

Exhibit 3

Individual-Level Characteristics of People With Disabilities Identified via the Six Questions on Functional Limitations, by Data Source

Individual Characteristic	AHS	CPS		ACS	
	Disabled (%)	Disabled (%)	Percentage-Point Difference From AHS	Disabled (%)	Percentage-Point Difference From AHS
Male (age 18–64)	48.6	49.5	– 0.9***	49.7	– 1.1***
Less than high school diploma (age 25+)	24.8	26.1	– 1.3***	27.6	– 2.8***
High school diploma or GED (age 25+)	34.0	36.0	– 2.0***	34.2	– 0.2
Some college or associate's degree (age 25+)	25.3	24.2	1.1***	25.1	0.2
Bachelor's degree or higher (age 25+)	15.9	13.6	2.3***	13.1	2.8***
Employed (age 16+)	22.1	19.4	2.7***	23.0	– 0.9***
Below 100 percent of the federal poverty level (age 16+)	21.2	20.2	1.0***	21.0	0.2

ACS = American Community Survey. AHS = American Housing Survey. CPS = Current Population Survey. GED = General Educational Development degree.

**Indicates significance at the 10-percent level, two-sample t-test. **Indicates significance at the 5-percent level, two-sample t-test. ***Indicates significance at the 1-percent level, two-sample t-test.*

Sources: 2009 American Housing Survey; 2009 Current Population Survey; 2009 American Community Survey (American FactFinder, Table B18101)

Descriptive Statistics

Our analysis focuses on comparing the housing-related characteristics of working-age people with and without disabilities. We defined a person with a disability as someone of working age who reported having any of the six limitations or receiving disability income. Accordingly, we limited our analytic sample to working-age individuals who responded to all six limitation questions and the disability-income questions.[8] This restriction led us to exclude 479 people who were missing information for one or more of the six limitation questions, 4,185 who were missing information on disability-income receipt, and 26 who were missing information on both sets of questions.[9] Of the remaining 65,040 people, 8.7 percent (5,564 people) had a disability, according to our definition.

The demographic characteristics of people with and without disabilities differ significantly (exhibit 4). Compared with people without disabilities, those with disabilities are significantly older, reflecting

Exhibit 4

Demographic Characteristics, by Disability Status

Demographic Characteristic	People With Disabilities (N = 5,564)	People Without Disabilities (N = 59,476)	Difference
Age (years)	47.8	40.7	7.1***
Less than high school diploma (%)	18.4	9.5	8.9***
High school diploma (%)	67.2	60.5	6.7***
College degree or higher (%)	14.4	30.0	– 15.6***
Married (%)	45.4	60.6	– 15.2***
Male (%)	47.7	48.3	– 0.5
Non-U.S. citizen (%)	3.6	10.2	– 6.6***
White (%)	78.0	81.9	– 3.9***
African American (%)	16.5	10.8	5.7***
Other race[a] (%)	5.5	7.3	– 1.8***
Hispanic (%)	12.6	16.0	– 3.4***
Household income ($)	47,273	82,592	– 35,319***
Interest-income receipt (%)	14.4	20.9	6.5***
City (%)	28.7	27.9	0.8
Northeast (%)	18.0	18.2	– 0.2
Midwest (%)	22.2	22.4	– 0.2
South (%)	39.0	36.2	2.8***
West (%)	20.9	23.2	– 2.3***

[a] *Other race represents all races other than White and African American.*

**Indicates significance at the 10-percent level, two-sample t-test. **Indicates significance at the 5-percent level, two-sample t-test. ***Indicates significance at the 1-percent level, two-sample t-test.*

Note: Estimates are based on individual-level data.

Source: 2009 American Housing Survey

[8] Of the 53,350 households interviewed for the AHS, 45,057 are occupied (HUD, 2011). Multiple people may reside in a housing unit, resulting in a sample of more than 113,000 individuals. From this sample, we included only those between the ages of 18 and 64 (69,730 people) and with nonmissing information on key variables (65,040 people).

[9] We excluded 6.7 percent of AHS respondents because of missing information on key disability variables. Based on the information available, rates of disability prevalence among excluded respondents were similar to or lower than the rates among included respondents: for those missing information on receipt of disability income, 5.4 percent reported any of the six limitations (compared with 6.0 percent in the sample), and for those missing information on limitations, 5.0 percent received disability income (compared with 4.7 percent in the sample).

the higher prevalence of functional limitations with age. People with disabilities also have lower education levels, are less likely to be married, are more likely to be U.S. citizens, and are more likely to be non-Hispanic or non-White compared with their nondisabled counterparts. People with disabilities have household incomes of less than 60 percent of those without disabilities. People with disabilities also were less likely to reside in households receiving interest income from savings, money market funds, or other interest-bearing accounts. Differences in household income and savings are likely related to the lower average education level of people with disabilities, coupled with a lower marriage incidence (and thus, no spousal earnings or assets). Working-age people with disabilities also are significantly less likely to be employed compared with those without disabilities,[10] and the lack of earnings is likely the primary reason for the observed differences in income and savings. Location, relative to both the city and the region of the country, is similar for both groups.

Exhibit 5 shows housing characteristics by disability status. People with disabilities reported lower satisfaction ratings with their housing unit than did their nondisabled counterparts. Ratings are subjective, ranked on a scale between 0 and 10, with higher ratings indicating higher satisfaction levels. Satisfaction might vary by disability status; a person with disabilities might have different housing needs and preferences than a person without a disability, which could affect their subjective ratings. Examining specific housing aspects more closely, however, suggests that these lower ratings are justified: people with disabilities have smaller housing units and are more likely to live in a manufactured or mobile home than people without disabilities. The former group, on average, also has fewer amenities, such as a dishwasher, washing machine, clothes dryer, central

Exhibit 5

Average Housing Characteristics, by Disability Status

Housing Characteristic	People With Disabilities	People Without Disabilities	Difference
Unit rating (10-point scale)	7.93	8.25	– 0.32***
Square footage	1,704	2,067	– 363***
Rooms per person	2.56	2.35	0.21***
Square feet per person	768	781	– 13
Manufactured or mobile home (%)	9.3	4.7	4.6***
Number of amenities	6.17	6.99	– 0.82***
Any of the 10 deficiencies (%)	47.7	38.1	9.6***
Number of deficiencies	0.81	0.55	0.26***

**Indicates significance at the 10-percent level, two-sample t-test. **Indicates significance at the 5-percent level, two-sample t-test. ***Indicates significance at the 1-percent level, two-sample t-test.*

Notes: Estimates are based on individual-level data. Sample sizes vary based on the count of nonmissing responses for the housing characteristic variables. Unit ratings are between 0 and 10, with higher ratings indicating higher satisfaction levels. Amenities include a dishwasher, washing machine, clothes dryer, central air conditioning, garbage disposal, stove or oven, fire extinguisher, carbon monoxide detector, smoke detector, and garage. The 10 deficiencies include holes in the floor, large areas of peeling paint, evidence of rodents, inside leaks, outside leaks, recent toilet breakdowns, incomplete plumbing, unsafe drinking water, open cracks in the foundation, and rooms missing electrical outlets. See exhibit A–1 for a complete list of summary statistics for all amenities and deficiencies, by disability status.

Source: 2009 American Housing Survey

[10] In 2009, the employment rate of people between the ages of 16 and 64 with disabilities was 35 percent compared with a rate of 77 percent among those without disabilities (Rehabilitation Research and Training Center on Disability Statistics and Demographics, 2010).

air conditioning, garbage disposal, stove or oven, fire extinguisher, carbon monoxide detector, and garage.[11] People without disabilities have greater numbers of all such amenities, although the gaps between the two groups in the shares with a dishwasher, garbage disposal, and garage are the largest. People with disabilities are also more likely, on average, to live in units with at least one deficiency and with more deficiencies, such as these 10: holes in the floor, large areas of peeling paint, evidence of rodents, inside leaks, outside leaks, recent toilet breakdowns, incomplete plumbing, unsafe drinking water, open cracks in the foundation, and rooms missing electrical outlets.[12] The largest differences exist for evidence of rodents, open cracks, indoor leaks, and outdoor leaks. People with and without disabilities have similar amounts of square footage per person in their housing units; the fact that people without disabilities have larger residences may reflect a higher number of occupants in nondisabled households.

Similar to housing characteristics, neighborhood characteristics tend to be more favorable for nondisabled individuals than for those with disabilities (exhibit 6). Individuals with disabilities reported lower overall neighborhood ratings (ratings are a subjective measure, ranked on a scale between 0 and 10, with higher ratings indicating higher satisfaction levels) and live in areas with lower AMIs and lower fair-market rent values, on average. Individuals and households with disabilities reported fewer neighborhood benefits, including access to public transportation, proximity to stores, and satisfactory police protection, than did those without disabilities.[13] People with disabilities also reported more frequent neighborhood problems, including crime, odors, noise, vandalism, trash, proximity to roads in need of repair, and proximity to high-traffic areas (such

Exhibit 6

Average Neighborhood Characteristics, by Disability Status

Neighborhood Characteristic	People With Disabilities	People Without Disabilities	Difference
Neighborhood rating (10-point scale)	7.70	8.09	– 0.39***
Area Median Income ($)	63,668	65,842	– 2,174***
Average fair-market rent ($)	1,014	1,135	– 121***
Community services provided (%)	20.9	17.3	3.6***
Number of benefits	2.39	2.45	– 0.06***
Any of the seven problems (%)	75.5	65.5	10.0***
Number of problems	1.60	1.14	0.46***

**Indicates significance at the 10-percent level, two-sample t-test. **Indicates significance at the 5-percent level, two-sample t-test. ***Indicates significance at the 1-percent level, two-sample t-test.*

Notes: Estimates are based on individual-level data. Sample sizes vary based on the count of nonmissing responses for the neighborhood characteristic variables. Neighborhood ratings are between 0 and 10, with higher ratings indicating higher satisfaction levels. Benefits include access to public transportation, proximity to stores, and satisfactory police protection. The seven problems include crime, odors, noise, vandalism, trash, proximity to roads in need of repair, and proximity to high-traffic areas.

Source: 2009 American Housing Survey

[11] Means for each housing amenity and deficiency, along with the total number of observations for all variables, are in appendix exhibit A–1.

[12] See footnote 8.

[13] Means for each neighborhood benefit and problem, along with the total number of observations for all variables, are in appendix exhibit A–2.

as four-lane highways and airports) than did nondisabled individuals.[14] People with disabilities, however, were more likely to report living in neighborhoods where community services (daycare and shuttle buses) are provided.

Multivariate Methods

The differences in housing and neighborhood characteristics by disability status, as described previously, represent correlations between each characteristic and disability status. Other variables correlated with disability might similarly affect housing and neighborhood characteristics. For example, people with disabilities in general have lower education levels than people without disabilities; it is therefore possible that low education (rather than disability status) is driving the relationship between disability and negative housing and neighborhood characteristics. Likewise, people with disabilities are less likely to be married, and the lack of spousal income (rather than disability status) might be lowering their housing quality. Unmarried individuals also may have sole responsibility for housing maintenance. The same may be true of many other characteristics, particularly income. To control for other individual and household characteristics, we produced regression-adjusted estimates of the likelihood of experiencing selected housing and neighborhood characteristics, taking into account age, education, marital status, gender, race, ethnicity, U.S. citizenship, household income, interest-income receipt (proxy for savings), region, urbanicity, and the number of people in the household. To account for correlation within households, we calculated regressions using standard errors clustered at the household level.[15]

We estimated an ordinary least squares (OLS) regression model for each housing and neighborhood characteristic. These characteristics include those shown in exhibits 5 and 6: (1) housing unit rating, (2) square footage, (3) rooms per person, (4) square feet per person, (5) whether unit is a manufactured or mobile home, (6) number of housing amenities, (7) presence of any housing deficiencies, (8) number of housing deficiencies, (9) neighborhood rating, (10) AMI, (11) average fair-market rent in neighborhood, (12) community services provided, (13) number of neighborhood benefits, (14) presence of any neighborhood problems, and (15) number of neighborhood problems. The basic model is

$$Y_j = a + B_1 \text{ Disability Status} + B_2 \text{ Age} + B_3 \text{ Education} + B_4 \text{ Marital Status} + B_5 \text{ Gender} + B_6 \text{ Race} + B_7 \text{ Ethnicity} + B_8 \text{ Citizenship} + B_9 \text{ Household Income} + B_{10} \text{ Interest Income} + B_{11} \text{ Region} + B_{12} \text{ Urbanicity} + B_{13} \text{ Number in Household} \quad (1)$$

where $j = 1, \ldots, 15$ represents the 15 outcomes of interest.

We estimated each model separately, resulting in 15 initial regression models. For ease of interpretation and comparison, we estimated all regressions as OLS models. In the case of binary variables (mobile home, any housing deficiencies, any community services, any neighborhood problems), we also estimated logistic regression models. The odds ratios produced from logistic regression

[14] Means for each neighborhood benefit and problem, along with the total number of observations for all variables, are in appendix exhibit A–2.

[15] For more information on clustering, refer to Cameron and Trivedi (2005).

models (available upon request) are similar in direction and magnitude to OLS estimates. We also estimated additional models to explore differences based on the severity level of the disability. All estimates were weighted to account for the AHS sample design.

We used the available data in the AHS to control for many confounding variables in our analysis, but we were unable to observe or control for many other factors. We included controls for household income in our analysis and a proxy for savings (interest-income receipt). Our analyses, however, do not account for expenditures and needs. If two otherwise similar households have the same income, but one has higher medical needs and costs related to disability, that household might have less money to pay for housing. People with disabilities may also have limited housing options if they must live near family members or friends who assist them, or if they face discrimination in the housing market; however, we did not control for either family proximity or discrimination in this analysis. Finally, our analysis does not permit us to attribute causality. We have estimated relationships between disability and housing and neighborhood conditions, but these relationships are not necessarily causal.

Findings From the Multivariate Analyses

The descriptive statistics presented in the previous section suggest that disability is associated with poorer housing and neighborhood characteristics. Other variables that are correlated with disability, however, might be driving those relationships. To explore this issue, we estimated a set of regression models that control for individual and household characteristics that might also be correlated with housing and neighborhood characteristics.

The first column of exhibit 7 presents coefficient estimates on the disability variable in a series of regression models that estimate the likelihood of reporting particular housing and neighborhood characteristics. The second column shows the simple (unadjusted) differences between people with and without disabilities. Controlling for other characteristics produces largely the same findings on housing characteristics as did the unadjusted statistics. If other characteristics are held constant, living with a disability is associated with a lower housing-unit rating (-0.26 points on a 10-point scale), a greater likelihood of living in a mobile home (+2.5 percentage points), 0.39 fewer amenities, and 0.25 more deficiencies compared with those living without a disability. Living with a disability is also associated with having a unit that is 161 square feet smaller, has 109 fewer square feet per person, and has 0.16 fewer rooms per person compared with living without a disability.

With all else held constant, people with disabilities live in less desirable neighborhoods compared with people without disabilities. Having a disability is associated with a lower overall rating of one's neighborhood (-0.32 points on a 10-point scale), lower AMI, and average fair-market rent, which suggests that people with disabilities live in poorer neighborhoods. People with disabilities are also significantly more likely to reside in neighborhoods with fewer benefits and are almost 8 percentage points more likely to live in neighborhoods with at least one of the seven problems queried. People with disabilities, however, are also 3.4 percentage points more likely to live in neighborhoods where community services are offered, possibly because of a greater demand for such services among those with disabilities.

Exhibit 7

Relationship Between Disability and Housing and Neighborhood Characteristics

	Regression-Adjusted Difference	Unadjusted Difference
Housing characteristic		
Unit rating (10-point scale)	– 0.26***	– 0.32***
Square footage	– 161***	– 363***
Rooms per person	– 0.16***	0.21***
Square feet per person	– 109***	– 12
Manufactured or mobile home (%)	2.5***	4.6***
Number of amenities	– 0.39***	– 0.82***
Any of the 10 deficiencies (%)	9.4***	9.6***
Number of deficiencies	0.25***	0.27***
Neighborhood characteristic		
Neighborhood rating (10-point scale)	– 0.32***	– 0.39***
Area Median Income ($)	– 730***	– 2,174***
Average fair-market rent ($)	– 53***	– 121***
Community services (%)	3.4***	3.6***
Number of benefits	– 0.03***	– 0.06***
Any of the seven problems (%)	7.8***	11.0***
Number of problems	0.37***	0.47***

**Indicates significance at the 10-percent level, two-sample t-test. **Indicates significance at the 5-percent level, two-sample t-test. ***Indicates significance at the 1-percent level, two-sample t-test.*

Notes: Estimates are based on individual-level data. Sample sizes vary based on the count of nonmissing responses for the housing and neighborhood characteristic variables. The statistics represent coefficients on the disability variables in a series of separate ordinary least squares regressions. Full regression estimates are available from the authors on request. Amenities include a dishwasher, washing machine, clothes dryer, central air conditioning, garbage disposal, stove or oven, fire extinguisher, carbon monoxide detector, smoke detector, and garage. The 10 deficiencies include holes in the floor, large areas of peeling paint, evidence of rodents, inside leaks, outside leaks, recent toilet breakdowns, incomplete plumbing, unsafe drinking water, open cracks in the foundation, and rooms missing electrical outlets. Benefits include access to public transportation, proximity to stores, and satisfactory police protection. The seven problems include crime, odors, noise, vandalism, trash, proximity to roads in need of repair, and proximity to high-traffic areas.

Source: 2009 American Housing Survey

We used total household income to measure income in our regression models. Regional variables and location relative to the city were also included, which might help adjust for differences in income across regions. These variables, however, still might not capture income relative to a person's location. We estimated regression models using an alternative specification where total household income was replaced by household income relative to AMI. The effects of disability on the outcomes of interest in these regressions (not shown) were similar to or slightly larger than the estimates from the regression models controlling for total income.

The measure of disability used up to this point encompasses many types of disabilities and levels of severity. To explore the differential effects by type of disability, we estimated a regression model that included three new measures of disability in addition to the basic measure ("any disability") used in our previous analyses. The first new measure represents those with multiple disabilities (that is, those who responded affirmatively to two or more of the limitation questions), the second measure represents those who received SSI, and the final measure represents those who received other disability income. The model, a variation of equation (1), is

$$Y_j = a + B_1 \text{ Disability Status} + B_2 \text{ Multiple Limitations} + B_3 \text{ Receipt of SSI} + B_4 \text{ Receipt of SSDI} + B_5 \text{ Age} + B_6 \text{ Education} + B_7 \text{ Marital Status} + B_8 \text{ Gender} + B_9 \text{ Race} + B_{10} \text{ Ethnicity} + B_{11} \text{ Citizenship} + B_{12} \text{ Household Income} + B_{13} \text{ Interest Income} + B_{14} \text{ Region} + B_{15} \text{ Urbanicity} + B_{16} \text{ Number in Household} \quad (2)$$

where j = 1,…,15 represents the 15 outcomes of interest.

Out of the 5,564 individuals who have any type of disability, 1,454 have multiple disabilities, 1,352 received SSI, and 1,791 received disability income such as SSDI or workers' compensation.[16]

Estimates including our four disability measures indicate that those with multiple disabilities experience worse housing and neighborhood characteristics compared with those with our baseline disability measure, a person with one or fewer limitations who does not receive disability income (exhibit 8). Having multiple disabilities is associated with a lower overall housing unit rating, more deficiencies, a lower neighborhood rating, and more neighborhood problems. Similarly, receiving SSI is associated with negative housing and neighborhood outcomes. People who receive SSI live in smaller housing units with fewer amenities, are more likely to live in mobile homes, live in neighborhoods with significantly lower AMIs and fair-market rent values, and are more likely to experience neighborhood problems compared with our baseline disability measure. One exception is that people who receive SSI have a lower probability of any housing deficiencies but no difference in the total number of deficiencies reported compared with those with our baseline disability measure. Overall, the findings suggest that having multiple limitations and/or receiving SSI is associated with a large, negative effect on many housing and neighborhood characteristics, both overall and relative to those with one limitation who do not receive disability income. These two disability measures may be acting as a proxy for disability severity, implying that those with more severe disabilities experience worse housing outcomes.

Those who receive disability income other than SSI report better housing and neighborhood characteristics compared with individuals with disabilities who do not receive this assistance. Because SSDI beneficiaries in general have very severe disabilities, the finding that receipt of non-SSI disability payments has a smaller negative effect on housing and neighborhood characteristics than nonreceipt of disability income was unexpected. Because SSDI, workers' compensation, and veterans' disability compensation are usually awarded to former workers,[17] these individuals may have had greater housing assets before the onset of disability, which allowed them to make better living arrangements compared with those with limitations (no work history is necessary to claim a limitation). Indeed, 65.3 percent of people who receive non-SSI disability income own their home compared with only 43.9 percent of people who receive SSI.

[16] These categories of disability are not mutually exclusive. Of the 5,564 sample members who had a disability, 1,757 had no limitations (666 received SSI, 1,040 received other disability payments, and 51 received SSI and other disability payments), 2,353 had exactly one limitation (1,763 did not receive any disability payments, 240 received SSI, 324 received other disability payments, and 26 received SSI and other disability payments), and 1,454 had multiple limitations (778 did not receive any disability payments, 346 received SSI, 307 received other disability payments, and 33 received SSI and other disability payments).

[17] In general, a person must have worked for a certain amount of time to become an SSDI beneficiary, must be injured on the job to receive workers' compensation, and must have served in the military to receive veterans' disability compensation.

Exhibit 8

Effects of Disability on Housing and Neighborhood Characteristics, by Severity of Disability

Dependent Variable/Parameter	Coefficient on Any Disability	Coefficient on Multiple Limitations	Coefficient on SSI Receipt	Coefficient on Disability-Income Receipt
Housing characteristic				
Unit rating (10-point scale)	– 0.31***	– 0.12*	0.04	0.16***
Square footage	– 142***	0	– 138**	6
Rooms per person	– 0.10***	– 0.05	– 0.21***	0.00
Square feet per person	– 81***	– 38	– 123***	1
Manufactured or mobile home (%)	1.9**	0.9	2.6**	– 0.1
Number of amenities	– 0.33***	– 0.08	– 0.58***	0.24***
Any of the 10 deficiencies (%)	11.0***	6.3***	– 3.3**	– 4.9***
Number of deficiencies	0.25***	0.21***	0.01	– 0.11***
Neighborhood characteristic				
Neighborhood rating (10-point scale)	– 0.34***	– 0.14*	– 0.08	0.20***
Area Median Income ($)	– 642***	201	– 1,135***	471
Average fair-market rent ($)	– 47***	– 7	– 54***	16*
Community services (%)	3.3***	1.4	1.2	– 2.3*
Number of benefits	– 0.03***	– 0.04	0.00	0.03
Any of the seven problems (%)	6.9***	4.5***	3.8***	– 1.9
Number of problems	0.34***	0.22***	0.18***	– 0.14***

SSI = Supplemental Security Income.

**Indicates significance at the 10-percent level, two-sample t-test. **Indicates significance at the 5-percent level, two-sample t-test. ***Indicates significance at the 1-percent level, two-sample t-test.*

Notes: Estimates are based on individual-level data. Sample sizes vary based on the count of nonmissing responses for the housing and neighborhood characteristic variables. The statistics represent coefficients on the disability variables in a series of separate ordinary least squares regressions. Full regression estimates are available from the authors upon request. Amenities include a dishwasher, washing machine, clothes dryer, central air conditioning, garbage disposal, stove or oven, fire extinguisher, carbon monoxide detector, smoke detector, and garage. The 10 deficiencies include holes in the floor, large areas of peeling paint, evidence of rodents, inside leaks, outside leaks, recent toilet breakdowns, incomplete plumbing, unsafe drinking water, open cracks in the foundation, and rooms missing electrical outlets. Benefits include access to public transportation, proximity to stores, and satisfactory police protection. The seven problems include crime, odors, noise, vandalism, trash, proximity to roads in need of repair, and proximity to high-traffic areas.

Source: 2009 American Housing Survey

To better understand why people with disabilities live in less desirable homes and neighborhoods compared with people without disabilities, we examined self-reported reasons for moving, choosing a unit, and choosing a neighborhood. The survey asked respondents who had moved within the 2 years before the interview about their main reason for moving, choosing their current unit, and choosing their current neighborhood. The questions had 16 possible responses for moving and 9 possible responses each for unit choice and neighborhood choice. Many of the responses did not differ by disability status. Similar shares of people with and without disabilities reported moving because of a change in marital status, selecting a housing unit for its yard or construction quality, and selecting a neighborhood for its proximity to leisure activities or the design of the neighborhood.

Exhibit 9 shows the responses that differed significantly. People without disabilities reported moving or selecting a neighborhood based on a job or school more frequently than people with

Exhibit 9

Reasons for Moving, Choosing a Unit, and Choosing a Neighborhood, by Disability Status

	People With Disabilities	People Without Disabilities	Difference
Main reason for moving	(N = 1,310)	(N = 13,124)	
New job or job transfer (%)	6.0	11.2	– 5.2***
To be closer to work or school (%)	5.0	9.1	– 4.1***
To establish own household (%)	8.3	10.3	– 2.0***
Needed a larger home (%)	7.1	11.9	– 4.8***
Family or personal related (%)	11.2	7.2	4.0***
Main reason for choosing unit	(N = 1,357)	(N = 13,257)	
Financial reasons (%)	31.0	26.6	4.4***
Room layout or design (%)	13.1	16.8	– 3.7***
Main reason for choosing neighborhood	(N = 1,354)	(N = 13,314)	
Convenient to job (%)	9.2	21.9	– 12.7***
Convenient to family (%)	19.8	13.3	6.5***
Good schools (%)	5.1	7.5	– 2.4***

**Indicates significance at the 10-percent level, two-sample t-test. **Indicates significance at the 5-percent level, two-sample t-test. ***Indicates significance at the 1-percent level, two-sample t-test.*

Note: Estimates are based on individual-level data.

Source: 2009 American Housing Survey

disabilities did. Those with disabilities reported moving or selecting a neighborhood to be closer to relatives and friends more often, suggesting that proximity to family may trump other household and neighborhood benefits for this group. We found similar results when we calculated the percentage of people with disabilities by their reason for moving. These differences highlight the unique preferences and needs of those with disabilities, which may contribute to the link between disability and negative housing and neighborhood characteristics. For example, if people with disabilities select units based on financial reasons, it is not surprising that they have few amenities in their homes.

Housing Assistance

People with disabilities often struggle to find accessible and affordable housing that fits their unique needs (Perl, 2008). To assist this population, policymakers have implemented several federal and local housing policies that aim to help people with disabilities find suitable, affordable housing.

The first housing program to specifically aid people with disabilities was established by the Housing Act of 1961. This legislation expanded the eligibility criteria for public housing, previously limited to low-income and elderly people, to include households with an adult member with a disability. In 1990, the federal government allocated funding to create housing exclusively for people with disabilities, known as Section 811 housing. Under Section 811, households in public housing units pay no more for rent than a certain percentage of their income, typically 30 percent, making housing more affordable for qualifying households. The legislation that established Section 811 also established project rental assistance contracts, under which contractors receive subsidies

from the federal government to make up the difference between operating costs and rent received from tenants (capped at approximately 30 percent of a tenant's income). Introduced in 1983 and updated in 1997, further legislation makes people with disabilities eligible to receive housing vouchers to rent units in the private market. Privately owned, subsidized housing also is available to people with disabilities. Subsidized rental differs from housing vouchers in that vouchers are given directly to eligible individuals, whereas in subsidized rental agreements, HUD assists apartment owners in offering reduced rent to qualifying tenants. Public housing, housing vouchers, and subsidized rentals are generally available to people with disabilities whose incomes are below certain limits. The definition of disability varies slightly across programs, but income limits are typically set to earnings below 50 percent of AMI.[18]

People with disabilities may also take advantage of many other housing programs not specifically targeted to this group. One such program is rent control, which exists in certain cities (such as New York, San Francisco, and Los Angeles) and acts as a price ceiling for rent. Another program, operated at the state and local levels, provides low-cost mortgages.

We examined the use of these programs by working-age AHS respondents with and without disabilities. The findings appear in the first three columns of exhibit 10. People with disabilities are significantly more likely to live in public housing units, receive rent subsidies, and use a housing voucher compared with people without disabilities.[19] Participation rates for the two programs (rent

Exhibit 10

Receipt of Housing Assistance, by Disability Status

Housing Assistance Type	Participation Rates (%)			Disability Prevalence (%)		
	People With Disabilities	People Without Disabilities	Difference	Among Those Receiving Assistance	All Individuals Age 18–64	Difference
Public housing	3.3	0.8	2.5***	26.9	8.7	18.2***
Subsidized rent	10.8	2.0	8.8***	33.7	8.7	25.0***
Housing vouchers	4.9	0.8	4.1***	37.0	8.7	28.3***
Rent control	0.8	0.6	0.2	11.2	8.7	2.5
Low-cost mortgage	3.1	2.8	0.3	9.3	8.7	0.5
Any housing assistance	14.6	5.5	9.1***	20.2	8.7	11.5***

**Indicates significance at the 10-percent level, two-sample t-test. **Indicates significance at the 5-percent level, two-sample t-test. ***Indicates significance at the 1-percent level, two-sample t-test.*

Notes: Estimates are based on individual-level data. Sample sizes vary based on the count of nonmissing responses for housing assistance variables.

Source: 2009 American Housing Survey

[18] Section 811 defines a person with a disability as "an individual having a physical, mental, or emotional impairment (1) that is expected to be of long-continued and indefinite duration, (2) that substantially impedes his or her ability to live independently, and (3) is of such a nature that the ability to live independently could be improved by more suitable housing conditions." Section 8 expands this definition to include those unable to participate in substantial gainful activity. Eligibility for people with HIV/AIDS also varies across programs; see Perl (2008).

[19] Although all three programs have provisions targeted toward people with disabilities, the programs also more generally target low-income individuals.

control and low-cost mortgages) that are not specifically targeted to people with disabilities were similar for both groups. Any housing assistance use, defined as participation in at least one of the five programs listed in exhibit 10, is twice as high among those with disabilities (15 percent) as among those without disabilities (6 percent).[20]

Exhibit 10 also shows disability prevalence among those receiving each assistance type. Compared with the general working-age population, disability prevalence rates were very high among those receiving each assistance type, except for rent control and low-cost mortgages. Disability prevalence was about 20 percent among those receiving any housing assistance, compared with about 9 percent among the general population.

As a formal test of the effect of disability on housing assistance, we estimated a linear probability model to examine the relationship between disability and housing assistance use. The independent control variables used in the model include the same variables used in the regression models estimating the likelihood of specific housing and neighborhood characteristics:

$$\text{Receipt of any Housing Assistance} = a + B_1 \text{ Disability Status} + B_2 \text{ Age} + B_3 \text{ Education} + B_4 \text{ Marital Status} + B_5 \text{ Gender} + B_6 \text{ Race} + B_7 \text{ Ethnicity} + B_8 \text{ Citizenship} + B_9 \text{ Household Income} + B_{10} \text{ Interest Income} + B_{11} \text{ Region} + B_{12} \text{ Urbanicity} + B_{13} \text{ Number in Household.} \quad (3)$$

Results presented in exhibit 11 show that having a disability is associated with an 8-percentage-point increase in housing assistance use. Of all variables included in the regression, disability is the most statistically significant (highest t-value) and has the largest coefficient estimate, indicating its importance as a determinant of housing assistance receipt.

Housing assistance may affect housing and neighborhood characteristics. Receipt of housing assistance, or any in-kind transfer, increases income and enables the recipient to invest in other goods, including housing improvements. Conversely, housing assistance may come with restrictions, such as being required to reside in a certain building or location that may be undesirable. Because a nontrivial share of working-age people with disabilities (15 percent) receives housing assistance, we explored the extent to which housing assistance affects the likelihood that this group will report adverse housing and neighborhood characteristics. In exhibit 12, we present the coefficient estimates for the disability variable from two separate regression models. The first model includes control variables for each of the five assistance programs:

$$Y_j = a + B_1 \text{ Disability Status} + B_2 \text{ Age} + B_3 \text{ Education} + B_4 \text{ Marital Status} + B_5 \text{ Gender} + B_6 \text{ Race} + B_7 \text{ Ethnicity} + B_8 \text{ Citizenship} + B_9 \text{ Household Income} + B_{10} \text{ Interest Income} + B_{11} \text{ Region} + B_{12} \text{ Urbanicity} + B_{13} \text{ Number in Household} + B_{14} \text{ Public Housing} + B_{14} \text{ Subsidized Rent} + B_{15} \text{ Housing Vouchers} + B_{16} \text{ Rent Control} + B_{17} \text{ Low-Cost Mortgage} \quad (4)$$

where j = 1,…,15 represents the 15 outcomes of interest.

The second model does not control for housing assistance and was previously presented as equation (1); the regression-adjusted estimates from this model are in exhibit 7.

[20] HUD considers public housing units, Section 8 housing, and households using housing vouchers all as public housing (National Center for Health in Public Housing, 2010). The statistics in exhibit 10 are based on self-reports and, as such, may be inconsistent with official statistics for public housing and other related programs.

Exhibit 11

The Effect of Individual Characteristics on the Likelihood of Receiving Housing Assistance

Independent Variable	Estimate (N = 65,040)
Disability (%)	8.0***
Age (years)	0.0***
Less than high school diploma (%)	2.7***
College degree or higher (%)	– 0.5**
Married (%)	– 1.5***
Male (%)	– 1.8***
Non-U.S. citizen (%)	– 2.5***
African American (%)	7.7***
Other race[a] (%)	2.0***
Hispanic (%)	1.9***
Household income	– 0.0***
Interest-income receipt (%)	– 1.3***
Northeast (%)	2.6***
Midwest (%)	0.7**
West (%)	1.4***
City (%)	3.5***
Number in household	0.0

[a] *Other race represents all races other than White and African American. *Indicates significance at the 10-percent level, two-sample t-test. **Indicates significance at the 5-percent level, two-sample t-test. ***Indicates significance at the 1-percent level, two-sample t-test.*

Note: Estimates are based on individual-level data.

Source: 2009 American Housing Survey

The effect of disability on the likelihood of reporting negative housing characteristics is generally dampened when we control for housing assistance (exhibit 12). For example, disability is associated with 0.39 fewer amenities if we do not account for housing assistance, compared with 0.33 fewer amenities if we do account for housing assistance. Similarly, disability is associated with a 0.32-point decline (on a 10-point scale) in the overall neighborhood rating if we do not account for housing assistance, but only a 0.29-point decline if we do account for housing assistance. These findings suggest that housing assistance provides a modest benefit to people with disabilities in terms of their housing and neighborhood. Note, however, that controlling for housing assistance leads to a stronger association between living with a disability and residing in a mobile or manufactured unit.

To assess the effect of particular housing programs on people with and without disabilities, we estimated OLS models including controls for each of the five housing assistance types and interacted the housing assistance variables with the disability indicator,

$$Y_j = a + B_1 \text{ Disability Status} + B_2 \text{ Age} + B_3 \text{ Education} + B_4 \text{ Marital Status} + B_5 \text{ Gender} + B_6 \text{ Race} + B_7 \text{ Ethnicity} + B_8 \text{ Citizenship} + B_9 \text{ Household Income} + B_{10} \text{ Interest Income} + B_{11} \text{ Region} + B_{12} \text{ Urbanicity} + B_{13} \text{ Number in Household} + B_{14} \text{ Public Housing} + B_{15} \text{ Public Housing*Disability} + B_{16} \text{ Subsidized Rent} + B_{17} \text{ Subsidized Rent*Disability} + B_{18} \text{ Housing Vouchers} + B_{19} \text{ Housing Vouchers*Disability} + B_{20} \text{ Rent Control} + B_{21} \text{ Rent Control*Disability} + B_{22} \text{ Low-Cost Mortgage} + B_{23} \text{ Low-Cost Mortgage*Disability}. \quad (5)$$

where j = 1,…,15 represents the 15 outcomes of interest.

Exhibit 12

Differential Effects of Disability on Housing and Neighborhood Characteristics, by Housing Assistance Receipt

Dependent Variable/Parameter	Adjusted, With Controls for Housing Assistance	Adjusted, Without Controls for Housing Assistance
Housing characteristic		
Unit rating (10-point scale)	– 0.25***	– 0.26***
Square footage	– 150***	– 161**
Rooms per person	– 0.14***	– 0.16***
Square feet per person	– 101***	– 109***
Manufactured or mobile home (%)	3.0***	2.5***
Number of amenities	– 0.33***	– 0.39***
Any of the 10 deficiencies (%)	9.5***	9.4***
Number of deficiencies	0.25***	0.25***
Neighborhood characteristic		
Neighborhood rating (10-point scale)	– 0.29***	– 0.32***
Area Median Income ($)	– 740***	– 730***
Average fair-market rent ($)	– 49***	– 53***
Community services (%)	2.8***	3.4***
Number of benefits	– 0.04***	– 0.03***
Any of the seven problems (%)	7.5***	7.8***
Number of problems	0.35***	0.37***

**Indicates significance at the 10-percent level, two-sample t-test. **Indicates significance at the 5-percent level, two-sample t-test. ***Indicates significance at the 1-percent level, two-sample t-test.*

Notes: Estimates are based on individual-level data. Sample sizes vary based on the count of nonmissing responses for the housing and neighborhood characteristic variables. The statistics represent coefficients on the disability variables in a series of separate ordinary least squares regressions. Full regression estimates are available from the authors on request. Amenities include a dishwasher, washing machine, clothes dryer, central air conditioning, garbage disposal, stove or oven, fire extinguisher, carbon monoxide detector, smoke detector, and garage. The 10 deficiencies include holes in the floor, large areas of peeling paint, evidence of rodents, inside leaks, outside leaks, recent toilet breakdowns, incomplete plumbing, unsafe drinking water, open cracks in the foundation, and rooms missing electrical outlets. Benefits include access to public transportation, proximity to stores, and satisfactory police protection. The seven problems include crime, odors, noise, vandalism, trash, proximity to roads in need of repair, and proximity to high-traffic areas.

Source: 2009 American Housing Survey

For people without disabilities, low-cost mortgages were the most beneficial in improving housing characteristics (exhibit 13). For example, receiving a low-cost mortgage is associated with a 0.17-point (on a 10-point scale) increase in housing rating, 0.11 more rooms per person, a 2.0-percentage-point decrease in the probability of living in a manufactured or mobile home, and 0.35 more amenities. Housing vouchers were also associated with significant increases in the number of rooms per person and number of amenities for people without disabilities. Subsidized housing and rent control were associated with negative effects for nearly every housing and neighborhood characteristic considered. Many negative effects were also associated with living in public housing.

For people with disabilities, housing vouchers and low-cost mortgages are the most beneficial housing programs. Receiving a housing voucher is associated with a 0.37-point (on a 10-point scale) increase in housing unit satisfaction rating, 0.56 more amenities, an increase of almost $2,500 in average AMI, an 8-percentage-point increase in the likelihood of having any neighborhood benefits, and a 5-percentage-point decline in the probability of having any neighborhood problems. For people

Exhibit 13

Effects of Housing Assistance Programs on Housing and Neighborhood Characteristics, by Disability Status

Dependent Variable/Parameter	Public Housing	Public Housing x Disability	Subsidized Rent	Subsidized Rent x Disability	Voucher	Voucher x Disability	Rent Control	Rent Control x Disability	Low-Cost Mortgage	Low-Cost Mortgage x Disability
Housing characteristic										
Unit rating (10-point scale)	– 0.09	0.00	– 0.28**	0.24	– 0.05	0.42	– 0.37***	– 0.12	0.17***	0.01
Square footage	– 101	153	– 184	– 54	164	– 188	– 691***	600***	55	98
Rooms per person	– 0.09*	– 0.11	– 0.33***	– 0.06	0.21**	– 0.08	– 0.44***	0.05	0.11***	0.07
Square feet per person	– 11	25	– 129***	– 102	79	– 51	– 270***	164	11	57
Mobile home (%)	– 1.9***	– 2.4*	– 4.5***	– 2.0	– 0.6	– 2.4	0.9***	– 2.3**	– 2.0**	– 3.7
Number of amenities	– 0.75***	0.38*	– 0.73***	– 0.59***	0.45***	0.11	– 1.71***	1.12***	0.35***	0.52
Any of the 10 deficiencies (%)	2.4	– 0.3	– 0.2	– 3.1	0.6	– 7.0	18.1***	1.9	3.8**	– 8.4
Number of deficiencies	0.02	0.10	0.04	– 0.09	0.05	– 0.12	0.48***	– 0.11	0.04	– 0.16
Neighborhood characteristic										
Neighborhood rating (10-point scale)	– 0.44***	– 0.12	– 0.35**	0.33	– 0.10	0.14	0.11	– 0.50	– 0.10	– 0.05
Average AMI ($)	– 2,942***	5,851***	– 272	267	774	1,723	555	2,159	– 372	– 912
Average fair-market rent ($)	2	– 4	– 57***	– 47*	4	19	87***	38	10	– 3
Community services	0.10***	– 0.04	0.06**	– 0.04	– 0.04	0.12**	0.05	0.09	0.01	– 0.02
Number of benefits	– 0.09*	0.07	0.07*	0.04	0.01	0.07	– 0.01	– 0.15	0.02	– 0.06
Any of the seven problems (%)	3.9	– 7.2	6.1**	– 4.1	– 2.2	– 2.8	5.1	4.9	2.2	– 0.2
Number of problems	0.17	0.38*	0.20**	– 0.26*	0.05	0.03	0.24**	0.34	0.05	– 0.05

AMI = Area Median Income.

**Indicates significance at the 10-percent level, two-sample t-test. **Indicates significance at the 5-percent level, two-sample t-test. ***Indicates significance at the 1-percent level, two-sample t-test.*

Notes: Estimates are based on individual-level data. Sample sizes vary based on the count of nonmissing responses for the housing and neighborhood characteristic variables. The statistics represent coefficients on the disability variables in a series of separate ordinary least squares regressions. Full regression estimates are available from the authors upon request. Amenities include a dishwasher, washing machine, clothes dryer, central air conditioning, garbage disposal, stove or oven, fire extinguisher, carbon monoxide detector, smoke detector, and garage. The 10 deficiencies include holes in the floor, large areas of peeling paint, evidence of rodents, inside leaks, outside leaks, recent toilet breakdowns, incomplete plumbing, unsafe drinking water, open cracks in the foundation, and rooms missing electrical outlets. Benefits include access to public transportation, proximity to stores, and satisfactory police protection. The seven problems include crime, odors, noise, vandalism, trash, proximity to roads in need of repair, and proximity to high-traffic areas.

Source: 2009 American Housing Survey

with disabilities, benefits associated with low-cost mortgages include an average 154-square-foot increase in housing unit size, a 6-percentage-point lower probability of living in a mobile home, and 0.87 more amenities.

For many of the outcomes considered, housing assistance program benefits differ between people with and without disabilities. For example, among those without disabilities, low-cost mortgages are associated with 0.35 more amenities, but for people with disabilities they are associated with 0.87 more amenities, an effect that is more than twice as large. In general, the only significant differences in outcomes between people with and without disabilities were more favorable effects of housing assistance for people with disabilities. Previous research has shown that people with disabilities spend a larger share of their income on housing compared with people without disabilities. If people with disabilities use the remainder of their income to purchase other basic necessities (such as food, clothing, medical needs, and transportation), they may be unable to spend higher proportions of their income on housing. Therefore, targeted housing assistance may grant this population the ability to obtain better housing that was not previously possible. Further, people with disabilities are in worse housing and neighborhoods on average, so more room for improvement in housing likely exists for this population.

Conclusions

Using data from the 2009 AHS, we quantified the differences in housing and neighborhood characteristics for people with and without disabilities. We found that, compared with their nondisabled counterparts, working-age people with disabilities are more likely to reside in smaller, lower rated housing units, manufactured or mobile homes, and homes with fewer amenities (such as a dishwasher, central air conditioning, or a garage) and more deficiencies (such as evidence of rodents, leaks, and open cracks). People with disabilities were also more likely to live in lower rated neighborhoods with lower AMIs, lower fair-market rent values, fewer benefits (such as access to public transportation, stores, and satisfactory police protection), and more problems (such as neighborhood crime, roads in need of repair, and heavy street noise). These differences persisted when we measured disability at the household level. Further, housing and neighborhood characteristics generally became less desirable as the severity of a person's disability—or number of limitations—increased.

It is perhaps not surprising that people with disabilities are more likely to report living in poorer quality housing and neighborhoods than those without disabilities, even after controlling for income and other characteristics. As noted previously, other research has shown that this population experiences other types of material hardships at significantly higher rates than people without disabilities. Those with disabilities also are more likely than others to experience long-term poverty and homelessness. High rates of poverty, especially long-term poverty, likely reduce housing quality for these individuals, but other consequences of disability may also lead to poor-quality housing. For example, people with disabilities may have more costs related to health and personal care than their nondisabled counterparts, and therefore might have to make a choice between purchasing disability-related necessities or having better housing. Disabilities might also make it difficult for a person to identify and fix housing deficiencies, such as structural problems and rodent infestations.

For all of these reasons, housing support for people with disabilities is warranted. Indeed, some policies are already in place to help people with disabilities secure affordable housing that meets their needs. Our findings suggest that such assistance improves the living conditions of those with disabilities. Housing vouchers and low-cost mortgages, for example, appear to be associated with improved housing characteristics for people with disabilities.

We did not, however, examine the costs, or quantify the full benefits, of such housing assistance in this study, partly because it is difficult to do so accurately.[21] Many HUD services and programs are for use by people with disabilities and other groups, such as elderly people, making it difficult to isolate the costs for people with disabilities only. Housing assistance benefits are also hard to quantify because the value of these benefits is not available in the AHS, which only asks whether respondents receive various housing assistance types. The AHS also lacks information on the length of time a person has received housing assistance. Further, housing assistance may provide many indirect benefits beyond the dollar value of the assistance. For example, having a secure residence and a place to store belongings may make it easier for a person to obtain stable employment, higher wages, and other employment benefits. But despite the limits of this study, our findings suggest that housing assistance improves the housing and neighborhood conditions of those people with disabilities.

[21] A variety of methods may be used to estimate the value of housing costs, but these methods all produce a wide range of estimates. According to Johnson, Renwick, and Short (2010), the median values of housing assistance received (regardless of disability status) range from $1,920 to $6,564 per year.

Appendix

Exhibit A-1

Detailed Housing Characteristics

	People With Disabilities		People Without Disabilities	
	(N)	(Average)	(N)	(Average)
Unit rating (10-point scale)	5,444	7.93	57,601	8.25
Square footage	4,948	1,704	54,165	2,067
Rooms per person	5,564	2.56	59,476	2.35
Square feet per person	4,948	768	54,165	781
Manufactured or mobile home	5,564	0.09	59,476	0.05
Amenities in housing unit				
Working dishwasher	5,564	0.53	59,476	0.71
Working washer	5,564	0.80	59,476	0.87
Working dryer	5,564	0.77	59,476	0.85
Central air conditioning	5,564	0.58	59,476	0.67
Garbage disposal	5,534	0.40	59,364	0.54
Stove/oven	5,564	0.99	59,476	1.00
Fire extinguisher	5,501	0.44	58,506	0.48
Smoke detector	5,539	0.92	59,144	0.95
Carbon monoxide detector	5,483	0.33	58,576	0.39
Garage	5,563	0.57	59,465	0.71
Number of amenities	5,564	6.17	59,476	6.99
Deficiencies in housing unit				
Holes in floor	5,564	0.02	59,476	0.01
Large area of peeling paint	5,564	0.05	59,476	0.02
Evidence of rodents	5,564	0.22	59,476	0.17
Inside water leaks (past year)	5,544	0.12	59,141	0.08
Outside water leaks (past year)	5,543	0.14	59,139	0.10
Toilet breakdowns (last 3 months)	5,536	0.04	59,154	0.02
Incomplete plumbing facilities	5,564	0.01	59,476	0.01
Water unsafe for drinking	5,514	0.11	59,146	0.08
Open cracks	5,564	0.09	59,476	0.05
Rooms missing electrical outlets	5,564	0.02	59,402	0.01
Any of the 10 deficiencies	5,485	0.48	58,764	0.38
Number of deficiencies	5,485	0.81	58,764	0.55

Notes: Estimates based on individual-level data. Several of the questions on amenities and deficiencies have missing values, and many values are missing across different individuals. The total number of amenities and deficiencies includes only respondents who do not have missing values for any of these variables. Amenities include a dishwasher, washing machine, clothes dryer, central air conditioning, garbage disposal, stove or oven, fire extinguisher, carbon monoxide detector, smoke detector, and garage. The 10 deficiencies include holes in the floor, large areas of peeling paint, evidence of rodents, inside leaks, outside leaks, recent toilet breakdowns, incomplete plumbing, unsafe drinking water, open cracks in the foundation, and rooms missing electrical outlets.

Source: 2009 American Housing Survey

Exhibit A-2

Detailed Neighborhood Characteristics

	People With Disabilities		People Without Disabilities	
	(N)	(Average)	(N)	(Average)
Neighborhood rating (10-point scale)	5,442	7.70	57,569	8.09
Area Median Income ($)	5,564	63,668	59,476	65,842
Average fair-market rent ($)	5,564	1,014	59,476	1,135
Community service provided	5,564	0.21	59,476	0.17
Neighborhood benefits				
Public transportation in the area	5,469	0.55	58,088	0.55
Neighborhood stores within 1 mile	5,522	0.96	58,852	0.97
Satisfactory police protection	5,452	0.88	58,307	0.93
Number neighborhood benefits	5,367	2.39	57,243	2.45
Neighborhood problems				
Serious neighborhood crime in last year	5,499	0.24	58,616	0.18
Bad odors	5,542	0.10	59,011	0.05
Abandoned/vandalized buildings within 1/2 block	5,443	0.12	57,908	0.06
Trash in street within 1/2 block	5,471	0.15	58,046	0.08
Roads within 1/2 block need repairs	5,459	0.46	57,951	0.39
Heavy street noise	5,543	0.33	59,013	0.22
Heavy transportation within 1/2 block	5,480	0.22	58,098	0.17
Any of the seven neighborhood problems	5,378	0.75	57,345	0.64
Number neighborhood problems	5,378	1.60	57,345	1.14

Notes: Estimates based on individual-level data. Several of the questions on benefits and problems have missing values, and many values are missing across different individuals. The total number of benefits and problems includes only respondents who do not have missing values for any of these variables. Benefits include access to public transportation, proximity to stores, and satisfactory police protection. The seven problems include crime, odors, noise, vandalism, trash, proximity to roads in need of repair, and proximity to high-traffic areas.

Source: 2009 American Housing Survey

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You Can't Always Get What You Want: The Role of Public Housing and Vouchers in Achieving Residential Satisfaction

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Abstract

Using data from the 2009 American Housing Survey, this research examines neighborhood and housing satisfaction among assisted and unassisted renters. Studying the effect of housing assistance on neighborhood satisfaction allows for an assessment of the role that housing vouchers play in promoting household mobility to higher quality housing and neighborhoods compared with public housing developments or unsubsidized housing units. A major goal of this study is to shed light on the effectiveness of a predominant form of U.S. government-sponsored housing assistance at providing expanded housing choices for low-income families. Our findings show that housing voucher holders and public housing residents achieve higher levels of housing satisfaction and choose more desirable dwellings than do unassisted low-income renters. Housing assistance, however, does not enable recipients to locate to better neighborhoods.

Introduction

Policies and programs that federal, state, and city governments support for the provision of subsidized housing have changed dramatically since their emergence in the post-Great Depression era. Initially, policy to provide housing to extremely low-income families supported large-scale, project-based subsidized housing developments, often isolated from the surrounding community.

Project-based public housing developments created physically and socially isolated neighborhoods of concentrated poverty and decay that were lambasted from all sides of the political spectrum. In recent years, subsidized housing development and housing subsidies for the low-income have focused more on integrating new housing and families into the physical and social fabric of local neighborhoods. The goals are to decrease poverty and racial concentration, to improve neighborhood conditions, and to enable assisted renters to move to better neighborhoods.

In 1974, the U.S. Department of Housing and Urban Development (HUD) began providing eligible households with Section 8 rental certificates (vouchers) that cover a set percentage of their rent payments for private-market housing. These subsidies enabled low-income households to move to private-sector housing rather than live in public housing. HUD requires the housing rented under this program to meet standards for quality. To participate, landlords must be willing to accept government rental subsidy payments. The premise of this market-based approach is that these vouchers (demand-side subsidies) will provide better living environments than place-based housing assistance (supply-side subsidies) by offering recipients choices about where they live. Today, the program, now known as the Housing Choice Voucher Program (HCVP), is the largest housing subsidy program for low-income individuals in the United States. HCVP households comprise 42 percent of all HUD-assisted households, an increase from 34 percent in 1993 (Schwartz, 2010).

By encouraging housing mobility, vouchers intend to provide low-income renters better quality housing and neighborhood choice and to promote racial and economic desegregation (Schwartz, 2010). Yet, a growing body of research shows that voucher holders, particularly minority households, often live in neighborhoods with higher levels of poverty and racial concentration and that they are more likely to live in inadequate housing compared with unassisted renters (Comey, 2007; Devine et al., 2003; Koebel, 1997; Pendall, 2000; Popkin, 2010; Popkin, Levy, and Buron, 2009). To understand these disparate outcomes, researchers are examining the constraints that voucher households face when they search for housing in the private rental market. Race- and class-based discrimination are two possible constraints.

Whether the HCVP increases the housing and neighborhood satisfaction of voucher recipients is an unanswered question. Increasing the amount of housing and neighborhood choices available to low-income renters and ultimately improving accessibility to more satisfactory housing and neighborhood situations are major goals of the HCVP. Although researchers find improvements in the physical housing structure of those relocating from public housing projects, they also find that voucher holders remain spatially concentrated in lower income neighborhoods compared with other renters (Devine et al., 2003; Galvez, forthcoming; Popkin and Cunningham, 2000).

Do housing vouchers improve the residential satisfaction of their recipients? This article continues the examination of the spatial outcomes of assisted renters by looking at a major dimension of the housing experience: residents' satisfaction with their neighborhoods. Neighborhood satisfaction is a key component of overall residential satisfaction, which includes satisfaction with the housing structure in addition to its location. Using data from the 2009 American Housing Survey (AHS), this research examines whether housing assistance influences neighborhood and housing satisfaction among assisted renters compared with unassisted renters.

Without direct measures of neighborhood quality, neighborhood satisfaction is a good proxy for assessing the quality of neighborhood experiences by assisted households. Controlling for household, individual, and neighborhood characteristics, we ask if housing assistance (housing vouchers or public housing) significantly affects neighborhood satisfaction among low-income renters. Studying housing assistance effects on neighborhood satisfaction enables us to assess the role that housing vouchers play in promoting the mobility of low-income households to higher quality neighborhoods compared with households living in either public housing developments or unassisted housing units (that is, those who reported not receiving government housing assistance).

Questions about the success of housing policies inevitably lead to discussion of location. The spatial dimension of housing is inextricably linked with access to schools, employment, and other vital neighborhood entities (Shlay, 1995). These entities are some of the many ways in which opportunity is structured within place, specifically the privilege of place (Squires, 2002). A major goal of this study is to shed light on how effective a predominant form of government-sponsored housing assistance, in its attempts to provide expanded housing choices for low-income families, is in overcoming America's legacy of a discriminatory and segregated housing market.

Why Neighborhood Satisfaction?

According to HUD's mission statement, one of its primary goals is for housing to improve families' quality of life (HUD, 2011). The HCVP's goals—to help very low-income families, elderly people, and people with disabilities afford decent, safe, and sanitary housing in the private market—embody these principles. This program, unlike development-based housing, offers individuals and families the opportunity to choose residential options, including single-family homes, townhouses, and apartments.

Because housing is a commodity that is fixed in a particular location, neighborhood choices accompany housing choices; neighborhood satisfaction is a key ingredient of residential satisfaction. Moreover, neighborhood satisfaction itself is recognized as a significant component of people's overall quality of life (Adams, 1984; Lu, 1999; Rossi, 1980). Vouchers, by facilitating housing choices, are intended to enable families to choose their desired neighborhoods. People's evaluations of their neighborhoods indicate the extent to which they are satisfied with their neighborhoods' quality, an element assumed to improve with receiving a voucher. Understanding neighborhood satisfaction is therefore central to judging the success of any housing mobility program.

Determinants of residential satisfaction, consisting of one's satisfaction with both one's neighborhood and one's housing unit, are varied (Bruin and Cook, 1997; Glaster, 1987; Lu, 1999). A household's needs, aspirations, and factors likely to hinder residential mobility often influence these determinants. Researchers have examined the effects on neighborhood satisfaction of a number of housing and neighborhood conditions, household characteristics, and community and neighborhood perceptions. These conditions include indicators of crime, poverty, and social disorder (Ahlbrandt, 1984; Marans and Rodgers, 1975) and also individual and housing characteristics, such as housing assistance, income, tenure, life cycle stage, housing quality, and so on (Ahlbrandt, 1984; Jargun et al., 1990; Lu, 1999). Attitudinal or perceptual variables of individuals' residential satisfaction receive much attention. Community and neighborhood perceptions appear to play a major role in addition to the

actual configuration of residential and household characteristics, particularly perceptions of crime, social order, and social ties (Adams, 1992; Greenberg, 1999; Hipp, 2010; Marans and Rodgers, 1975; Markowitz et al., 2001).

Research has demonstrated a strong correlation between residents' housing satisfaction and neighborhood satisfaction, suggesting that the two phenomena are intertwined (Basolo and Strong, 2002; Glaster, 1987; James, 2008; Lu, 1999). Moreover, both objective and self-reported measures have been found useful in explaining neighborhood satisfaction.

Neighborhood Outcomes Among Voucher Holders

Recent research on voucher households' housing and neighborhood outcomes has examined participants of the Moving to Opportunity (MTO) mobility program and public housing residents who moved from their housing demolished as a result of the HOPE VI Program.[1] Both groups moved to the private rental market via housing vouchers. Most studies have found that voucher households relocated to areas of better quality housing and to lower poverty, safer neighborhoods (Buron, Levy, and Gallagher, 2007; Popkin, 2010; Popkin and Cove, 2007). Research has shown that those who engaged in residential shifts across political jurisdictions (portability moves) also experienced improved neighborhood conditions. From 1998 through 2005, only 9 percent of all HCVP recipients engaged in portability moves (Climaco et al., 2008). In particular, those who relocated from severely distressed public housing experienced improvements in neighborhood satisfaction, especially in terms of safety (Comey, 2007; Gubits, Khadduri, and Turnham, 2009; Kingsley and Petit, 2008; Popkin, 2010; Popkin, Levy, and Buron, 2009).

Other research on the experiences of housing voucher recipients suggests that families reported additional social and economic burdens when they chose to relocate to the private rental market (Buron, Levy, and Gallagher, 2007; Popkin, 2010; Popkin, Levy, and Buron, 2009; Rasinski, Lee, and Haggerty, 2010; Rosenbaum, DeLuca, and Tuck, 2005; Wood, Turnham, and Mills, 2008). Major hardships remained that made their living situations extremely precarious. Many reported facing difficulty keeping up with additional expenses of private rental housing and dealing with pre-existing hardships, such as health and unemployment (Buron, Levy, and Gallagher, 2007; Popkin, 2010; Popkin, Levy, and Buron, 2009; Rasinski, Lee, and Haggerty, 2010; Rosenbaum, DeLuca, and Tuck, 2005; Wood, Turnham, and Mills, 2008).

Additional research has compared the spatial and neighborhood outcomes of voucher holders and unassisted renters. When compared with unsubsidized renters within the same metropolitan area, voucher holders fared worse in terms of neighborhood poverty level, safety, and racial concentration (Comey, 2007; Cunningham and Droesch, 2005; Devine et al., 2003). Race is a major issue. Research finds that voucher holders moved into areas with a high concentration of

[1] MTO is a HUD-sponsored randomized housing mobility experiment. MTO provided 4,600 low-income families with children living in public housing within some of the nation's most disadvantaged urban neighborhoods the chance to move to private-market housing in much less distressed communities. The HOPE VI Program replaces severely distressed public housing projects, occupied exclusively by low-income families, with redesigned mixed-income housing and provides housing vouchers to enable some of the original residents to rent apartments in the private market.

African-American residents (Comey, 2007; Popkin, 2010; Popkin, Levy, and Buron, 2009) and that African-American voucher holders were more likely to live in impoverished neighborhoods than were voucher holders of other racial groups (Basolo and Nguyen, 2005; Cunningham and Sawyer, 2005).

A Closer Look at Housing Choice Among Voucher Holders

Research has identified several constraints that prevent voucher holders from moving to better neighborhoods (Basolo and Nguyen, 2005; Cunningham and Sawyer, 2005; GNOFHAC, 2009; Stone, 1993; Turner, Popkin, and Cunningham, 1999). Two major barriers to entering areas of lower poverty concentration are landlord behavior—in particular landlord discrimination—and private rental housing market characteristics, primarily affordable housing availability.

Researchers have identified landlord discrimination against voucher holders, African Americans in particular, as a major barrier in voucher holders' search for available rental housing (Basolo and Nguyen, 2005; Cunningham and Sawyer, 2005; GNOFHAC, 2009). Stone (1993) showed that lower income groups, particularly those receiving housing assistance and other forms of public assistance, are more vulnerable to discrimination by landlords. Turner, Popkin, and Cunningham (1999) suggested that requiring prospective tenants to identify their income sources may serve as a proxy for racial or voucher discrimination. Others have noted that the lack of affordable rental housing available to those with housing vouchers served as a major barrier to relocating to newer, better quality neighborhoods (Basolo and Nguyen, 2005; Comey, 2007; Ma, 2009).

Households with members who have developmental problems or other special needs face even more constrained choices when using housing vouchers. Snell and Duncan (2006) found children's health, behavioral, and educational problems to have a significant effect on voucher households' decisions to move. Those with children who have learning disabilities and require special assistance were less likely to relocate via housing vouchers than were families without these considerations. Popkin, Cunningham, and Burt (2005) studied the transition from distressed public housing and identified a population that was "hard to house." These public housing residents typically have personal or family circumstances—for example, substance abuse, physical or mental health problems, and poor education and work history—that make it difficult for standard relocation options to serve them adequately. These households' special needs make it difficult to make a successful transition to mixed-income or private-market housing. Most housing voucher programs, in their current form, do not address the additional needs of these extremely vulnerable populations (Popkin, Cunningham, and Burt, 2005).

Research has found that voucher recipients are often discouraged and overwhelmed by the housing search process and have difficulty finding housing in tight, affordable housing markets (Basolo and Nguyen, 2005; Finkel and Buron, 2001; Galvez, 2010; Kennedy and Finkel, 1994). The intersection of these challenges, in addition to individual-level hardships, complicates the search and moving processes for voucher holders and ultimately undermines the major policy goals behind the HCVP.

Data and Methods

The data for this study are from the American Housing Survey, a nationally representative sample of housing units and householders. The AHS, sponsored by HUD, is a longitudinal sample of housing units. The Census Bureau has conducted the survey biannually since 1973.[2] It includes samples both nationally and of selected metropolitan areas. The AHS includes data on individual, household, and neighborhood characteristics and on households' assessment of their neighborhoods and housing quality.

The analysis in this article uses data from the 2009 national sample, which consists of 73,222 households. The sample is restricted to those households that rent and responded to the AHS question, "Does the Federal, State, or local government pay some of the cost of the unit?" Those who responded "No" were coded as unassisted renters. From those who answered "Yes" to this question, those who reported receiving housing vouchers that could be used to move or reported living in a building owned by a public housing authority (PHA) were included in the sample. Including only those who reported having a housing voucher that could be used to move to another location ensures that the voucher holders in the sample had knowledge that their vouchers allowed for mobility. Unassisted renters were further restricted to include only those with a household income below or equal to the HUD very low-income limit, based on 50 percent of the Area Median Income. This restriction allows for comparing assisted low-income renters with unassisted low-income renters. The resulting sample size is 6,117 households consisting of voucher holders, public housing residents, and unassisted low-income renters.

Research has found that survey responses regarding the fact and type of housing assistance received are widely misreported (Casey, 1992; Shroder, 2002), a recognized limitation of this study. Casey (1992) conducted a study that matched HUD-assisted addresses with those reporting assistance in their AHS responses. She found housing assistance misidentification among voucher holders (33 percent), those residing in project-based assisted housing (42 percent), and eligible but unassisted renters (10 percent). In addition to these well-documented "false positives," reporting errors also exist in cases in which those who are assisted report that they are not, and vice versa (Shroder, 2002). Because of these reporting errors associated with self-reported housing assistance, differences between assisted and unassisted households may be understated. Since these findings were reported, however, the wording of housing assistance questions in the AHS has improved substantially to reduce reporting errors.

The two major variables used in this study are housing satisfaction and neighborhood satisfaction. Housing satisfaction is measured by a respondent's answer to the question, "On a scale of 1 to 10, how would you rate your unit as a place to live?" Neighborhood satisfaction is measured by a respondent's answer to the question, "On a scale of 1 to 10, how would you rate the neighborhood as a place to live?" For both questions, 10 indicates the best rating and 1 indicates the worst. For these questions, the AHS leaves the concepts of *housing* and *neighborhood* undefined; respondents define their own concepts of housing and neighborhood.

[2] Formerly the Annual Housing Survey, the survey became biannual in 1981.

The distributions for the dependent variables of interest, housing and neighborhood satisfaction, are positively skewed, with most of the sample rating their housing and neighborhood at 6 or above. Because of the small number of observations in the lower satisfaction levels, 1 through 4, the satisfaction measures were recoded into five ordered categories: least satisfied (1 to 2), somewhat satisfied (3 to 4), moderately satisfied (5 to 6), very satisfied (7 to 8), and most satisfied (9 to 10). Exhibit 1 shows the respective distributions of housing and neighborhood satisfaction rankings in the sample.

Explanatory variables used in this analysis can be grouped in three distinct ways: (1) neighborhood attributes (exposure to crime, the presence of anything bothersome in the neighborhood, and availability of community services), (2) socioeconomic attributes (form of housing assistance, race, age,[3] education, duration of residence, the presence of children, welfare receipt, disabled householders, and housing adequacy), and (3) geographic controls (city/suburb/rural indication, fixed effects for metropolitan statistical area codes, and the availability of affordable rental housing, referred to as the tightness of the housing market[4]).

The selection of these variables is largely guided by past research that has found them to be significant predictors of neighborhood satisfaction.[5] The geographic variables control for local variations in urban and rural settings and for metropolitan-level factors in housing subsidy program administration. Subsidized housing allocation and distribution are often products of local arrangements via the state or property owners. For example, dramatic differences exist among state and local programs and in HUD's allocation of resources to particular regions, states, and cities, which make for variation in approaches to subsidized rental housing. In addition, we cluster observations by metropolitan area. This technique assumes shared unobservable characteristics among people from the same metropolitan areas and attempts to capture variation within groups of renters.

Exhibit 1

Neighborhood and Housing Satisfaction of Renters

	Neighborhood Satisfaction	Housing Satisfaction
Least satisfied	3%	2%
Somewhat satisfied	5%	4%
Moderately satisfied	18%	17%
Very satisfied	38%	43%
Most satisfied	36%	34%
Total	6,000	6,022

Source: 2009 American Housing Survey

[3] Because age is analyzed as a vector of age and age-squared to account for the nonlinear relationship between age and neighborhood and housing satisfaction, we include both age and age-squared as independent variables.

[4] The ratio of Fair Market Rent (FMR) to Area Median Income (AMI) is used as a summary indicator of market tightness and shortages of affordable housing. This indicator reflects the percentage of the AMI at which a two-bedroom FMR equals 30 percent of the income of a three-person household. For more information on this measure, see Nelson (2002).

[5] Other potential explanatory variables, including gender (female), marital status (single), and income, were highly correlated with whether households received public assistance.

The model that predicts housing satisfaction includes neighborhood satisfaction as an independent variable and the model that predicts neighborhood satisfaction does the same with housing satisfaction. These variables are included as independent variables because housing and neighborhood satisfaction are closely related (Lu, 1999). The specification for each model is different. The housing satisfaction model includes an index measure of housing adequacy that is based on a number of structural conditions for the housing unit. The neighborhood satisfaction model includes three perceptual variables that assess neighborhood conditions.

Housing and neighborhood satisfaction are ordered dependent variables; therefore, the analysis employs an ordered logit model. Although researchers typically use multinomial logit or probit models for discrete-outcome categorical variables, an ordered logit model is most appropriate in this case because it takes into account the ordinal nature of the outcomes (Greene, 1997; Lu, 1999). Under this ordered logit model, the cumulative probability of an individual (i) being in a particular neighborhood satisfaction category (j) or higher is

$$F_{ij} = \sum_{m=j}^{J} P_{im} \tag{1}$$

where P_{im} is the probability that individual i falls into category m and J is equal to the highest neighborhood satisfaction category (in this case, a rating of 9 or 10). Each F_{ij} is the probability that the ith individual is in the jth or lower neighborhood satisfaction category. The model is

$$\log\left(\frac{F_{ij}}{1-F_{ij}}\right) = \alpha_j + Bx_i, j = 1, \ldots, J-1 \tag{2}$$

where $Bx_i = \beta_i x_{i1} + \ldots + B_k x_{ik}$ with k being equal to the number of independent variables in the model. These formulas create a single set of coefficients, but a different intercept/break for each equation that represents the probability of being in any higher satisfaction category (Allison, 1999).

Results

The following section presents the relationships between forms of housing assistance and socioeconomic, neighborhood, and housing characteristics. These results demonstrate the unique ways in which groups of low-income renters differ. We then present a multivariate analysis to see if housing assistance, when controlling for this host of individual, neighborhood, and housing characteristics, impacts housing and neighborhood satisfaction among low-income renters. We place special emphasis on comparing voucher holders and PHA residents with unassisted low-income renters.

Assisted and Unassisted Low-Income Renters: Comparative Analysis

Although all respondents are low-income renters, some notable differences exist between those receiving assistance and unassisted renters. Exhibit 2 compares the housing and household characteristics of voucher holders, public housing residents, and unassisted low-income renters. Voucher holders and public housing residents were more likely than unassisted renters to be female, African American, without a spouse, and receive welfare assistance such as Aid to Families with Dependent Children or food stamps. Voucher holders and public housing residents reported lower contract

rents (without utilities) compared with unassisted renters, average differences of $68 and $331 per month for voucher holders and public housing residents, respectively. Voucher holders (42 percent) and public housing residents (39 percent) were also more likely to have a disabled household member compared with unassisted renters (22 percent). About one-third to one-half of all renters had at least one child present in the household.

Voucher holders and public housing residents were economically worse off than unassisted renters. This condition is the direct result of eligibility requirements for housing subsidy program participants. Although only voucher holders were more likely to have children, both voucher holders and public housing residents had lower incomes, were more likely to receive other welfare assistance, and were more likely to have a disabled householder than unassisted renters—in part, conditions mandated by the design of subsidy eligibility standards.

Assisted renters tended to be slightly less likely to be satisfied with their neighborhood compared with their unassisted counterparts, although all groups were about equally satisfied with their housing units. The vast majority of these three groups also lived in adequate housing as indicated by structural conditions of their housing unit. The differences among neighborhood characteristics are slight to negligible. The comparability of neighborhood conditions among these groups suggests that these low-income renters largely reside in similar types of neighborhoods.

Exhibit 2

Household and Neighborhood Characteristics by Housing Assistance (1 of 2)

Socioeconomic Characteristics		Unassisted Renters	Voucher Holders	PHA Residents
Sex	Female	58%	80%	75%
		(4,993)	(544)	(580)
Race	African American	24%	49%	42%
	Hispanic	23%	15%	16%
		(4,613)	(513)	(521)
Marital status	Single	78%	90%	90%
		(4,993)	(544)	(580)
Welfare/food stamps	Yes	23%	58%	45%
		(4,993)	(544)	(580)
Children present	Yes	39%	47%	36%
		(4,993)	(544)	(580)
Education	Less than high school diploma	26%	31%	33%
	High school diploma or more	74%	69%	67%
		(4,993)	(544)	(580)
Mobility	Moved into unit in past 2 years	44%	35%	22%
		(4,993)	(544)	(580)
Contract rent	Mean	734	666	403
	Standard deviation	399	402	368
		(4,935)	(540)	(576)
Disabled householder	Yes	22%	42%	39%
		(4,975)	(543)	(576)

Exhibit 2

Household and Neighborhood Characteristics by Housing Assistance (2 of 2)

Neighborhood/Housing Characteristics		Unassisted Renters	Voucher Holders	PHA Residents
Neighborhood satisfaction	Least satisfied	3%	5%	5%
	Somewhat satisfied	4%	6%	5%
	Moderately satisfied	18%	21%	20%
	Very satisfied	40%	30%	33%
	Most satisfied	35%	38%	37%
		(4,889)	(541)	(570)
Housing satisfaction	Least satisfied	2%	2%	2%
	Somewhat satisfied	4%	4%	4%
	Moderately satisfied	17%	16%	14%
	Very satisfied	44%	39%	37%
	Most satisfied	33%	40%	43%
		(4,908)	(540)	(574)
Presence of serious crime	Yes	23%	31%	26%
		(4,913)	(539)	(571)
Community services	Available	25%	29%	36%
		(4,993)	(544)	(580)
Bothersome neighborhood aspects	Yes	17%	20%	19%
		(4,982)	(543)	(580)
Housing unit adequacy	Inadequate	11%	13%	8%
	Adequate	89%	87%	92%
		(4,993)	(544)	(580)
Urbanicity	Central city of MSA	47%	52%	50%
	Suburban	42%	38%	38%
	Rural	11%	10%	12%
		(4,993)	(544)	(580)

MSA = metropolitan statistical area. PHA = public housing authority.

Effect of Government Housing Assistance on Neighborhood and Housing Satisfaction

Exhibits 3 and 4 present ordered logit modeling of the effects of socioeconomic, neighborhood, and geographic variables on two different satisfaction measures for low-income renters. The first model examines these effects on housing satisfaction. The second model looks at these effects on neighborhood satisfaction. The model for housing satisfaction examines the influence of neighborhood satisfaction and different housing assistance types (voucher holders, public housing residents, and unassisted renters) on whether people are more or less satisfied with their particular housing unit, net of other factors. The model for neighborhood satisfaction shows the influence of housing satisfaction, different housing assistance types, and other factors on the variation in neighborhood satisfaction.

Neighborhood satisfaction is included as an independent variable in the housing satisfaction model, and vice versa. The high correlation between housing satisfaction and neighborhood satisfaction (0.57) indicates that approximately 30 percent of the variance in neighborhood satisfaction is explained by housing satisfaction for low-income renters. The estimates of the effects of different

types of housing assistance on housing and neighborhood satisfaction, therefore, are net of the influence of satisfaction with their housing unit or neighborhood.[6]

Exhibit 3 presents the results of the equation for housing satisfaction among renters. Housing assistance had a significant positive effect on housing satisfaction. Compared with unassisted low-income renters, both voucher holders and public housing residents were more satisfied with their housing, independent of their satisfaction with their neighborhood. In particular, the odds of observing a higher degree of housing satisfaction for voucher holders are 58 percent higher than the odds for unassisted renters.

Exhibit 3

Housing Satisfaction by Household and Neighborhood Characteristics

	Log Odds	Robust SE
Housing assistance[a]		
Housing vouchers	0.455***	(0.100)
PHA housing	0.500***	(0.092)
Neighborhood satisfaction	1.462***	(0.045)
Housing adequacy (1 = adequate)	0.528***	(0.069)
Socioeconomic attributes[b]		
Hispanic	0.018	(0.081)
African American	– 0.046	(0.057)
Age	– 0.014*	(0.006)
Age^2	0.000***	(0.000)
Welfare receipt (1 = welfare recipient)	0.022	(0.054)
Education[c] (1 = high school diploma or more)	– 0.074	(0.041)
Children (1 = has children)	– 0.046	(0.051)
Special needs (1 = disabled householder)	– 0.223***	(0.049)
Contract rent (in thousands)	0.025	(0.075)
Moved into unit in past 2 years (1 = yes)	0.135***	(0.040)
Geographic variables[d]		
Suburban areas of MSA	– 0.100*	(0.045)
Rural	– 0.152***	(0.041)
Tightness of housing market	0.644	(0.524)
Number of observations	5,469	
Wald Chi^2 (17)	2,653.44	
Pseudo R^2	0.191	

MSA = metropolitan statistical area. PHA = public housing authority.

[a] Omitted group = unassisted renters. [b] Omitted group = White. [c] Omitted group = less than high school diploma. [d] Omitted group = central city of MSA.

** p < 0.05. ** p < 0.01. *** p < 0.001.*

Source: 2009 American Housing Survey, National Sample

[6] The high correlation between housing satisfaction and neighborhood satisfaction most likely reflects that housing and neighborhood are intimately connected. People's sense of satisfaction with their housing may include their perspectives on their neighborhood, and vice versa. At the same time, housing and neighborhood conditions covary. Nicer, higher quality housing tends to be in nicer neighborhoods, and vice versa. To be sure, housing satisfaction and neighborhood satisfaction are not perfectly correlated, indicating that, for these low-income renters, a significant proportion of the variance in each variable remains unexplained by variance in the other.

Estimates also show, as expected, that locational and household characteristics are significant predictors of housing satisfaction, net of neighborhood satisfaction, among low-income renters. All else being equal, young renters, those with children or a disabled householder, and those renting in suburban and rural areas were less satisfied with their housing compared with older renters, those without children or a disabled householder, and those renting in central cities, respectively. Residing in a housing unit with adequate structural conditions (such as readily available hot water and proper electrical wiring) and having moved into the unit in the past 2 years have significant positive effects on housing satisfaction among low-income renters. Actual rent (in thousands) and market tightness (a proxy for the availability of affordable rental housing) do not have significant effects on housing satisfaction for these groups.

Exhibit 4 presents the results of the model predicting neighborhood satisfaction for low-income renters. In this case, housing assistance has an opposite effect on neighborhood satisfaction than

Exhibit 4

Neighborhood Satisfaction by Household and Neighborhood Characteristics

	Log Odds	Robust SE
Housing assistance[a]		
Housing vouchers	– 0.184*	(0.083)
PHA housing	– 0.337**	(0.114)
Housing satisfaction	1.525***	(0.060)
Neighborhood attributes		
Crime (1 = experienced crime)	– 0.823***	(0.056)
Community services (1 = services are available)	0.140**	(0.057)
Anything bothersome in neighborhood (1 = yes)	– 1.094***	(0.080)
Socioeconomic attributes[b]		
Hispanic	0.063	(0.132)
African American	– 0.081	(0.089)
Age	0.009	(0.007)
Age^2	– 0.000	(0.000)
Welfare receipt (1 = welfare recipient)	– 0.022	(0.062)
Education[c] (1 = high school diploma or more)	0.017	(0.049)
Children (1 = has children)	0.044	(0.047)
Special needs (1 = disabled householder)	0.107	(0.089)
Contract rent (in thousands)	0.224**	(0.072)
Moved into unit in past 2 years (1 = yes)	– 0.076	(0.052)
Geographic variables[d]		
Suburban areas of MSA	0.232***	(.044)
Rural	0.438***	(0.043)
Tightness of housing market	– .899*	(0.431)
Number of observations	5,397	
Wald Chi^2 (19)	3,279.87	
Pseudo R^2	0.218	

MSA = metropolitan statistical area. PHA = public housing authority.

[a] Omitted group = unassisted renters. [b] Omitted group = White. [c] Omitted group = less than high school diploma. [d] Omitted group = central city of MSA.

** p < 0.05. ** p < 0.01. *** p < 0.001.*

Source: 2009 American Housing Survey, National Sample

that demonstrated above. Although both voucher holders and public housing residents were more satisfied with their housing units compared with unassisted low-income renters, both were less satisfied with their neighborhoods. The odds of observing a higher level of neighborhood satisfaction are 17 percent lower for voucher holders compared with unassisted renters.

Neighborhood attributes also had an effect on neighborhood satisfaction, net of socioeconomic and geographic controls. The presence of crime (negative), community services (positive), and bothersome neighborhood aspects (negative) all had significant effects on neighborhood satisfaction. Although suburban and rural renters were less happy with their housing compared with urbanites, they were happier with their neighborhoods. Paying more rent brought more satisfaction with their neighborhood as well. Residing in a tighter housing market, where presumably affordable rental housing is scarcer, however, had a significant negative effect on neighborhood satisfaction, everything else being equal.

Discussion and Policy Implications

The positive influences on housing satisfaction when receiving a housing voucher or living in public housing indicate that housing assistance is providing lower income households with higher quality housing compared with unassisted low-income renters. Both public housing residents and voucher holders, all else being equal, had higher levels of satisfaction with their housing units. Greater housing assistance among those receiving vouchers or residing in public housing suggests that, as a policy, housing assistance is working to improve the housing situations of the lowest income sector of the population. By increasing households' expenditures on rent, housing vouchers improve housing quality for low-income renters, although housing vouchers did not have this effect on neighborhood quality.

HUD intends for vouchers to enable families to locate in more desirable neighborhoods by increasing household expenditures toward rent and by facilitating housing choices. For voucher holders, however, the assumption that better housing leads to better neighborhoods did not hold true. Although housing assistance appears important for voucher holders and public housing residents in choosing a suitable or even desired dwelling, it does not appear to be sufficient in supporting their relocation to better neighborhoods. These results suggest that voucher holders may be restricted to housing in less desirable neighborhoods than the neighborhoods available to unassisted renters. These findings are consistent with previous research that suggests voucher holders may face barriers to relocation in the private rental market and, as a result, may be limited to particular neighborhoods (Devine et al., 2003; Popkin and Cunningham, 2000).

How do these results inform the elements, goals, and implementation of the HCVP? Over the years, the program has adopted measures to encourage and facilitate mobility across neighborhoods and PHA jurisdictions. In addition to allowing for portability, the voucher program raised the ceiling on the rent amount that recipients can pay. These modifications to the program were a response to the continued concentration of poverty and lack of mobility among voucher households. Despite these changes, the main goal of the HCVP is still to provide greater housing choice to low-income voucher holders who undeniably face a host of social problems and disadvantages and who often lack the resources to escape these problems. As a mobility program, the HCVP

encourages low-income households to improve their housing, but it does not directly alter the neighborhood conditions in which these housing units are available.

This research suggests that housing assistance, by providing either public housing or vouchers, enables people to live in better (more satisfactory) housing. This research does not, however, support the assumption that housing choice enables families to optimize neighborhood conditions, as indicated by neighborhood satisfaction. More generally, a need exists for greater attention to neighborhood conditions of all rental housing, particularly of housing available to voucher holders and other low-income households. This need may reflect problems in the neighborhoods of rental housing for low-income renters as a whole.

Basing our analysis on this research, we cannot argue that housing vouchers are more successful than many of the project-based approaches to public housing. Many of those projects were located in low-income neighborhoods and consisted of inadequate housing. In those cases, low-income renters could accept the subsidy and deal with the location, or reject the subsidy and try to make it in the private rental market, where a better location was not necessarily guaranteed. The HCVP's tenant-based approach certainly grants greater freedom of choice, but choice is still constrained and renters do not have access to the entire rental marketplace. The premise behind choice is to find adequate housing in a good neighborhood, but these findings suggest that voucher holders may still be confined to particular neighborhoods when they search for better housing.

The absence of neighborhood effects also concerns the implementation of housing policy interventions within the context of a segmented housing market. Providing vouchers that theoretically allow choice cannot change the location of low-income affordable housing, which is largely defined by the institutional mechanisms that underlie the housing market. A policy that supports choice cannot realistically free up these choices when these choices are already constrained to particular neighborhoods. Rental markets remain highly segmented by income, independent of location and other factors. Although this research is based on residential outcome data, the findings call for greater attention to the conditions and processes that voucher holders, and low-income renters more generally, face in their search for housing. Although numerous efforts on behalf of the federal government have been aimed at improving living conditions for all groups and localities, the concentration of low-income housing cannot be ignored in efforts for greater mobility choices.

Conclusion

Studying the effect of housing assistance on neighborhood satisfaction allows for an assessment of the role that housing vouchers play in promoting the mobility of low-income households to higher quality neighborhoods compared with those living in either public housing developments or unassisted housing units. These findings indicate the persistence of a limited housing choice for assisted households—particularly one that remains unchallenged with the introduction of housing vouchers. Access to neighborhoods of opportunity, in which voucher households are more or equally satisfied with their neighborhood compared with unassisted households, remains elusive. Families residing in undesirable areas likely face inadequate education systems, inadequate employment opportunities, and safety and health concerns. Without programs that drastically alter the institutions underlying this geography, these same outcomes are likely to pass on to future generations.

More than 35 years ago, Chester Hartman, a national advocate for low-income housing, stated in his seminal book, *Housing and Social Policy*, that housing vouchers ...

> … foster the principle of individual choice in the housing market, which is a critical component of housing satisfaction but it takes no steps to ensure that market conditions will be such that the low-income consumer can truly have free choice or satisfaction. With the present realities of housing conditions and the housing market, freedom of choice can only be enhanced by more government intervention, not less (Hartman, 1975: 159).

This study indicates that barriers to choice remain a critical concern. Geographic obstacles to opportunity appear to persist. Market-based mechanisms such as housing vouchers do not correct for market failure—in this case, concentration of affordable rental housing, discrimination, and transportation costs that limit choices in the residential search process. Housing voucher policy is not meeting some of its broader policy goals, such as equality in neighborhood choice and quality.

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Comparing Public Housing and Housing Voucher Tenants With Bayesian Propensity Scores

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The contents of this article are the views of the author and do not necessarily reflect the views or policies of the U.S. Department of Housing and Urban Development or the U.S. government.

Abstract

The U.S. Department of Housing and Urban Development (HUD) currently has no administrative data to compare housing quality of public housing units with that of Housing Choice Voucher Program (HCVP) units. The American Housing Survey (AHS) provides the only data available to compare subjective housing and neighborhood quality assessments in HUD's largest rental assistance programs.

Quality comparisons based on AHS data are problematic because the AHS overrepresents public housing and underrepresents the HCVP.

HUD administrative data, however, are an excellent source of prior information for the expected proportion of households in public housing. In this study, I explore Bayesian methods using prior information on variables such as income and rents to estimate propensity scores for program participation. I then use the Bayesian propensity scores to improve the reliability of AHS-based quality comparisons. Results indicate that, after adjusting for program participation propensities, little difference exists in AHS household and neighborhood quality ratings between public housing and voucher households.

Introduction

Today, the U.S. Department of Housing and Urban Development (HUD) provides rental assistance to about 1 million households in public housing (PH) projects and about 2.1 million households through the Housing Choice Voucher Program (HCVP).[1, 2] PH units are owned and operated by public housing agencies (PHAs). In sharp contrast, the HCVP provides subsidizes to low-income households to seek safe and sanitary privately owned rental units.

Numerous arguments are made for providing rental assistance in privately owned buildings instead of providing PH. The primary motivation for increasing private-sector housing choices has been expanding social and economic opportunities for low-income households receiving rental assistance. Another argument is that private owners might have better incentives for operational efficiency, thus lowering program costs.

An argument against private-sector choices is that private landlords may have more incentive to control costs by reducing housing quality. To ensure all HCVP units meet a minimum-quality threshold, HUD requires compliance with Housing Quality Standards regulations. PHAs must preinspect units before tenants occupy a unit and PHAs enter into assistance contracts. Annual reinspections are also required for all units. Samples of units must be selected for quality control inspections, and PHAs and landlords must ensure that housing-quality problems are promptly rectified.

Measuring living conditions of assisted households is integral to evaluating the performance of HUD rental assistance programs. Currently, HUD has no administrative data to compare the housing quality of PH units with that of HCVP units.

In addition to providing quality housing, HUD rental assistance programs are also intended to promote access to good neighborhoods. Geocoding of HUD administrative records allows for comparison of census measures of neighborhood quality such as median income, poverty rates, and minority concentration. Buron and Pantrabansh (2007), however, report that census measures do not correlate well with HCVP households' subjective opinions of their neighborhoods.

The American Housing Survey (AHS) data are the only data available for comparing both subjective housing quality assessments and subjective neighborhood quality assessments in HUD's largest rental assistance programs. Quality comparisons based on AHS data are problematic because the AHS overrepresents PH and underrepresents the HCVP. The 2009 sum of weights was about 1.65 million households for either program. Apparently, many AHS HCVP tenants respond that they are PH tenants (Casey, 1992; HUD, 2008; Rucinski and Athey, 1995; Shroder, 2002).

[1] Throughout this paper, the public housing program will be referred to as PH, and participants in the program will be referred to as PH tenants. The Housing Choice Voucher Program will be referred to as HCVP, and participants in HCVP will be referred to as HCVP tenants.

[2] HUD provides rental assistance to another 1.4 million households in the project-based Section 8 program, and the Internal Revenue Service subsidizes approximately 1.8 million low-income tenants via the Low-Income Household Tax Credit (LIHTC) Program. Because the American Housing Survey identifies only PH and HCVP tenants, this study is limited to these two programs.

In 2011, the Census Bureau began using HUD administrative data to sample renters known to receive rental assistance through various HUD programs. This new information could substantially improve the analysis of assisted housing tenants, assuming the data are made available on the public use file.

One method for dealing with the AHS overrepresentation of PH is to use HUD administrative data to establish prior distributions. Specifically, in this study, I explore Bayesian methods for using prior information from variables such as income and rents to estimate propensity scores for program participation. I then use the Bayesian propensity scores to improve the reliability of AHS-based quality comparisons. Results indicate that, after adjusting for program participation propensities, no statistical difference exists in AHS household and neighborhood quality ratings between PH and HCVP households.

The remainder of the article is organized into six additional sections. The next section reviews relevant literature. The section Data Sources discusses and summarizes the data employed. The section AHS Reporting of Rental Assistance Programs addresses AHS response error and is followed by a section that compares characteristics of tenants in both programs The next section, which discusses Bayesian propensity scores, is followed by a comparison of home and neighborhood quality. The final section summarizes results.

Review of Past Studies

This section reviews relevant literature on two topics: comparing PH tenants with HCVP tenants and measurement error in the reporting of assistance and assistance type.

Comparing Public Housing and Vouchers

Because rent burdens tend to be lower in PH compared with the HCVP, one might question whether PH tenants are better off than HCVP tenants with similar incomes. The voucher program is designed to foster choices outside areas with high concentrations of poverty. Therefore, HCVP tenants with higher burdens might be compensated with higher housing quality or better neighborhoods.

Numerous studies have compared outcomes between PH and HCVP tenants. Some programs, such as the Gautreaux program in Chicago, have compared outcomes for HCVP families that move out of PH. The Moving to Opportunity (MTO) program compares outcomes for PH residents in five cities randomly assigned to three groups. The first group, referred to as the MTO treatment group, is made up of households that received a voucher that could be used only to move to low-poverty neighborhoods. Along with the voucher, families in this group received special counseling and assistance in locating rental units. The second group, referred to as the Section 8 comparison group, received regular vouchers with no geographic restrictions and no special counseling beyond assistance PHAs normally provide in locating housing. The final group, referred to as the in-place control group, received no voucher but continued to receive PH assistance.

MTO is considered an improvement from previous programs, such as Gautreaux, in which families that used vouchers to move out of PH were self-selected. The most appropriate MTO groups for general comparison of PH and HCVP are the in-place and Section 8 groups. Interim results

indicate that both the MTO treatment group and Section 8 group had significant increases in neighborhood quality and satisfaction, but the effects were about twice as large for the MTO treatment group (HUD, 2003). Because of dangerous conditions in PH developments, both the MTO and Section 8 group "mentioned safety as the most valuable aspect of their current neighborhoods" (HUD, 2003: 67).

Other studies more relevant to this study have made cross-sectional comparisons. Newman and Schnare (1997) compared neighborhood quality using census tract measures such as the poverty rate and minority concentration from the 1990 Census. They found that, compared with PH residents, HCVP households are less likely to be located in extremely high-poverty neighborhoods. They found little evidence, however, that vouchers "encourage moves into middle- and upper-income areas to any significant degree" (Newman and Schnare, 1997: 728).

To expand on Newman and Schnare's analysis, exhibit 1 compares tract measures for PH and HCVP tenants using more recent data from the 2000 Census. Household means are reported for tract measures of minority concentration, median income, the poverty rate, and a binary indicator for tracts with poverty rates of at least 40 percent.

Compared with PH tenants, HCVP tenants tend to live in census tracts with lower percentages of minorities. The average tract minority percentage is 57.5 percent for PH tenants, versus 47.8 percent for HCVP tenants. HCVP tenants also tend to live in higher median income tracts with lower poverty rates. The average tract poverty rate is 30.3 percent for PH tenants versus 19.0 percent for HCVP tenants. More than 22 percent of PH tenants live in tracts with poverty rates at or above 40 percent. The corresponding percentage for HCVP tenants is 6.7 percent.

The results in exhibit 1 are consistent with Newman and Schnare's (1997) findings that, compared with other rental assistance programs, the HCVP tends to lower "the probability that families live in the most economically and socially distressed areas" (Newman and Schnare, 1997: 728).

HUD's *Picture of Subsidized Households* reports census measures of tract poverty rates, minority concentration, and percentage of households that are owner occupied for HUD-assisted tenants.[3] Although HUD administrative data on rental assistance programs are available annually, tract data

Exhibit 1

Census Measures of Neighborhood Quality

Variable	Public Housing (PH)		Housing Choice Voucher Program (HCVP)	
	Mean	Standard Deviation	Mean	Standard Deviation
Percent minority	57.5	35.5	47.8	33.4
Median income	$25,135	$12,412	$35,160	$13,708
Poverty rate	30.3	16.6	19.0	12.3
Poverty rate ≥ 40 percent	0.226	0.418	0.067	0.250

N = 1,031,855 for PH and 1,961,593 for HCVP.

Sources: Public and Indian Housing Information Center (PIC), 2009; U.S. Census Bureau, 2000 Census

[3] http://www.huduser.org/portal/datasets/assthsg.html.

are available only from the decennial census or the American Community Survey averaged over 5 years. Thus census data are limited in their ability to measure current neighborhood conditions.

Furthermore, Buron and Pantrabansh (2007) report that census measures do not correlate well with HCVP households' subjective opinions of their neighborhoods. Mast (2010), however, reports that Buron and Pantrabansh's findings may be driven by use of household data. When household opinions are aggregated at the tract level, Mast (2010) reports fairly strong correlation with census variables.

AHS data are the only data available for comparing subjective housing and neighborhood quality assessments in HUD's largest rental assistance programs. The survey asks respondents if they live in PHA-owned housing or if they use a voucher to subsidize their rent. Numerous studies have measured housing and neighborhood quality with AHS data (Chapman and Lombard, 2006; Dilulio, 1994; Goodman, 2005; Hipp, 2007; Mast, 2010; Thibodeau, 1995). Yet, before this symposium (see Ross, Shlay, and Picon, 2012), no studies have used AHS data to compare housing or neighborhood quality in HUD rental assistance programs, which is perhaps due to reporting error regarding assistance status.

Reporting Assistance

Numerous studies have examined the reporting of housing assistance and type of assistance (Casey, 1992; HUD, 2008; Rucinski and Athey, 1995; Shroder, 2002). According to Shroder (2002),

> …researchers should expect difficulties in using and interpreting survey data when they are interested in identifying households receiving housing assistance and the type of assistance received. The fact and type of housing assistance are widely misreported (Shroder, 2002: 411–412).

In general, PH tenants tend to report assistance much more accurately than HCVP tenants. Casey (1992) compared known HUD-assisted addresses with addresses of AHS respondents. More than 90 percent of PH tenants correctly identified their type of assistance. One-third of HCVP tenants incorrectly identified themselves as PH tenants.

This study attempts to extend this literature by using Bayesian methods to more accurately predict type of assistance for AHS households reporting rental assistance. Although the method is not as accurate as address matching (Casey, 1992; HUD, 2008; Rucinski and Athey, 1995), the propensity score method I employ is a useful alternative for researchers using public use AHS data.

I do not calculate propensity scores for receipt of assistance. The method I employ could be adopted to predict both receipt of assistance and type of assistance, however.

Data Sources

I analyze data from two main sources: HUD's Public and Indian Housing Information Center (PIC) data system and the AHS.

PIC Data

The PIC system has quarterly entries for each family receiving HUD rental assistance starting in 1995.[4] Data are available on income, rent, and a large number of other household and PHA characteristics. I use PIC data for HUD's two largest rental assistance programs: the HCVP (including project-based vouchers and excluding homeownership vouchers subsidizing mortgages), and PH.

The PIC data system is transaction based. The most common transactions are (1) admissions, (2) annual reexams, (3) interim reexams due to changes in eligibility factors such as income or family size, (4) moves, and (5) exits from the program. The system captures the most recent transaction at the end of each quarter. If multiple transactions for a household occur during a quarter, only the most recent is available. If no transaction occurs during a quarter, the family's entry is a duplicate of the entry for the previous quarter.

Rent contracts are effective for 1 year and most households have only one transaction per year. Therefore, most changes are made annually, not quarterly. For this study, I employ a longitudinal file that captures the most recent PIC transaction at the end of 2009. The data provide a consistent end-of-year snapshot for each family. In total, I analyze PIC data on 1,967,865 HCVP households and 1,032,239 PH households.

Eligibility for HUD rental assistance programs is based on adjusted household income. Adjusted income is calculated by subtracting off certain expenses from total household income.[5] Accounting for known eligibility restrictions, I drop some outlier observations with suspect data.

I exclude HCVP households if their (1) adjusted annual income is negative or more than $42,000; (2) total household income is negative, more than $44,000, or less than adjusted income; or (3) household rent burden [(household rent + utility allowance)/adjusted monthly income] is less than 28 percent or more than 100 percent of adjusted monthly income.

I exclude PH tenants if their (1) adjusted annual income is negative or more than $62,000; (2) total household income is negative, more than $64,000, or less than adjusted income; or (3) rent burden is less than 10 percent or more than 100 percent of adjusted monthly income. The upper income cutoffs for both programs are approximately the 99th percentiles; lower rent burden cutoffs are less than the 1st percentiles. Households with missing incomes are dropped. Rent burden is not defined for households with $0 adjusted income; these cases are not dropped.

AHS Data

Although PIC data provide a large amount of information, it is not possible to measure housing quality or subjective neighborhood quality with PIC data. To compare HCVP and PH housing and neighborhood quality, I use AHS data. The AHS includes both national and metro surveys; I employ national AHS data, primarily for 2009.

[4] http://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/systems/pic.

[5] Details of adjusted income calculation are reported on HUD form 50058: http://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/systems/pic/50058.

I limit my AHS sample to households that self-report receiving voucher or PH rental assistance. The AHS voucher question asks, "Did a public housing authority, or some similar agency, give you a CERTIFICATE or VOUCHER to help pay the rent for this housing unit?" (HUD, 2006: 529). The PH question asks, "Is the building owned by a public housing authority?" (HUD, 2006: 404). Neither question asks if the subsidy program is HUD funded, so it is possible that a respondent could have participated in a local- or state-funded program.

In addition, the sum of weights for 2009 AHS voucher respondents is about 1.64 million, while the count of occupied HCVP units is around 2.1 million. The 2009 AHS sum of weights for PH is greater than the actual number of households in HUD PH. One possible explanation for the discrepancy is that some HCVP tenants respond that they are PH tenants. I study these discrepancies in more detail in the next section.

AHS Reporting of Rental Assistance Programs

To measure housing and neighborhood quality, I use data from the national AHS, which is weighted to be nationally representative. As noted in the previous section on data sources, the AHS overrepresents PH households and underrepresents HCVP households. Exhibit 2 reports responses, weighted household frequencies, and proportion of households in PH from the 2005, 2007, and 2009 national AHS. Of course, AHS overrepresentation of PH in any given year could be due to random sampling variance. Yet the overrepresentation occurs each year.

For comparison with AHS estimates, exhibit 3 reports HUD counts and ratios for the same years, along with 95-percent confidence intervals. Uneven PIC reporting in the HCVP Moving to Work

Exhibit 2

AHS Counts of Voucher and Public Housing Households

Year	Number of Responses	Number of Weighted HCVP Households	Number of Weighted PH Households	Weighted Proportion in PH
2005	1,125	898,895	1,850,512	0.673
2007	1,119	1,266,161	1,900,533	0.600
2009	1,422	1,642,867	1,656,488	0.502

AHS = American Housing Survey. HCVP = Housing Choice Voucher Program. PH = public housing.

Sources: AHS data for 2005, 2007, and 2009

Exhibit 3

HUD Counts of Voucher and Public Housing Households

Year	Number of HCVP Households	Number of PH Households	PH As a Proportion of Total Households	Lower 95% CI	Upper 95% CI
2005	1,994,827	1,072,730	0.350	0.325	0.379
2007	1,993,524	1,090,901	0.354	0.330	0.384
2009	2,105,004	1,053,481	0.334	0.312	0.359

CI = confidence interval. HCVP = Housing Choice Voucher Program. HUD = U.S. Department of Housing and Urban Development. PH = public housing.

Notes: Confidence intervals are bootstrap estimates with 1,000 samples. Bootstrap sample size is 1,125 for 2005, 1,119 for 2007, and 1,422 for 2009.

Sources: HUD Voucher Management System data; Public and Indian Housing Information Center (PIC) data

demonstration program could result in undercounting of vouchers. To more accurately estimate the proportion of households in PH, HCVP data in exhibit 3 are based on HUD financial data on counts of occupied units by PHA.[6]

The confidence intervals in exhibit 3 are nonparametric estimates based on a simulation with 1,000 random samples with replacement. I simulate data for each year, with total households and proportions in PH according to HUD official counts reported in exhibit 3. I then take 1,000 repeated random samples with replacement, generating a new estimate of the PH proportion for each sample. The sample size for the repeated samples in a given year is the number of AHS respondents who reported receiving rental assistance that year. This process, referred to as bootstrapping, provides a method for computing confidence intervals directly from the distribution of sample means or, in this case, sample proportions (Lohr, 2007). I compute 95-percent confidence intervals based on the 2.5th and 97.5th percentiles.

The confidence intervals measure the probability that a random sample of assisted households of the same sample size as the AHS will have a PH proportion equal to the AHS estimate. None of the confidence intervals contain the AHS estimate. Not reported, the same is true for wider 99-percent confidence intervals. It is highly unlikely that the AHS systematic overcounting of PH is the result of random sampling variability.

Numerous studies (see Shroder, 2002, for a review) find that tenants receiving rental assistance often misreport their type of assistance. For example, Casey (1992) compared known HUD-assisted addresses with addresses of AHS respondents. More than 90 percent of PH tenants correctly identified their type of assistance. One-third of HCVP tenants incorrectly identified themselves as PH tenants.

The overrepresentation of PH raises serious questions regarding our ability to compare PH and HCVP tenants with AHS data. HUD administrative data, however, are an excellent source of prior information for the expected proportion of households in PH. I will now explore Bayesian methods for using this prior information to improve the reliability of AHS-based comparisons.

Comparing Tenant Characteristics

The Bayesian technique employed in this study depends on differences in characteristics between PH and HCVP tenants. In this section, I explore differences in incomes and rents of HCVP and PH tenants, using 2009 PIC data. I use these differences in the next section to estimate program participation probabilities.

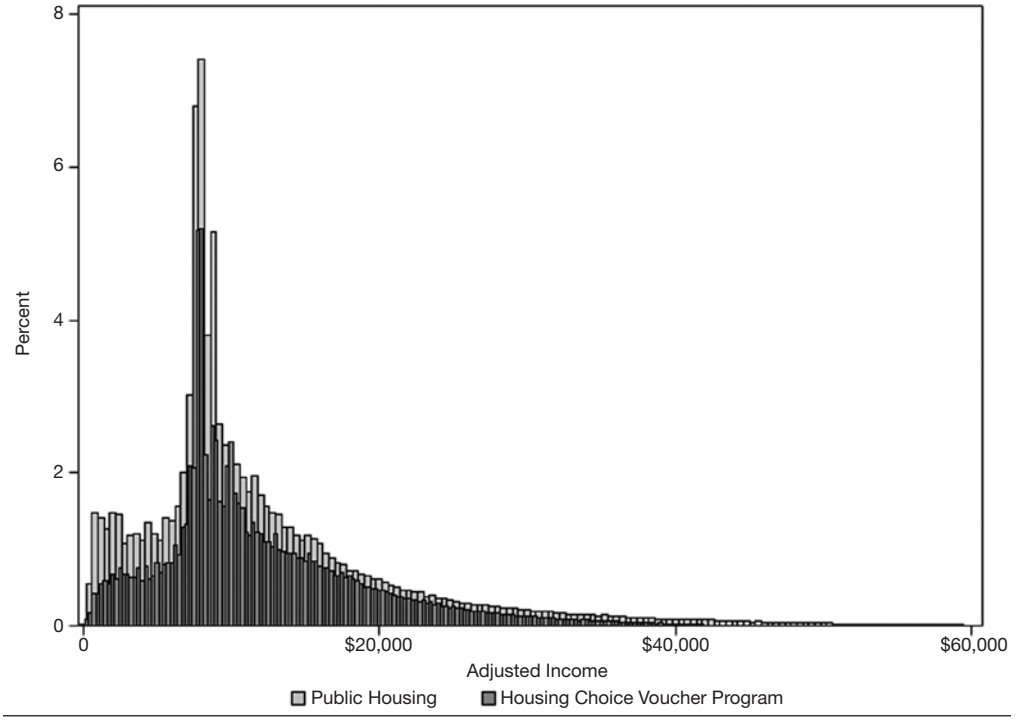
Because income limits are higher for PH, incomes can be larger for PH tenants compared with HCVP tenants. Exhibit 4 depicts distributions for adjusted annual income in both programs. Although the distributions are similar, the PH distribution has a much longer upper tail. Exhibit 5

[6] Exhibit 3 data on HCVP occupied units are from HUD's Voucher Management System. The system does not report separately on homeownership vouchers. For exhibit 3, I subtracted PIC homeownership voucher counts from VMS counts of total vouchers. Homeownership vouchers are a tiny fraction of total vouchers, totaling 8,496 vouchers in 2009 according to PIC.

reports means and percentiles (10th, 25th, median, 75th, 90th) for adjusted and total annual household income. For both programs, adjusted income is about 92 percent of total income at the mean.

Exhibit 4

Histogram for Adjusted Annual Household Income



N = 1,032,239 for public housing and 1,967,865 for the Housing Choice Voucher Program.

Source: 2009 Public and Indian Housing Information Center (PIC) data

Exhibit 5

Summary Statistics for Household Adjusted and Total Annual Income

Program	10th Percentile ($)	25th Percentile ($)	Median ($)	Mean ($)	75th Percentile ($)	90th Percentile ($)
Household adjusted annual income						
HCVP	4,524	7,688	10,040	12,058	15,506	22,068
PH	3,420	7,332	9,233	12,192	15,060	23,870
Household total annual income						
HCVP	5,424	8,256	10,901	13,132	16,812	23,669
PH	4,225	8,088	10,192	13,213	16,456	25,341

HCVP = Housing Choice Voucher Program. PH = public housing.

N = 1,032,239 for PH and 1,967,865 for the HCVP.

Source: 2009 Public and Indian Housing Information Center (PIC) data

Median income is slightly higher in the HCVP. Adjusted (total) median income is $10,040 ($10,901) in the HCVP, compared with $9,233 ($10,192) in PH. Mean income, however, is slightly higher in PH. Adjusted (total) mean income is $12,058 ($13,132) in the HCVP, compared with $12,192 ($13,213) in PH. One-tenth of voucher households have adjusted incomes below $4,524, and only 10 percent have adjusted incomes above $22,068. For PH, the 10th percentile adjusted income is $3,420 and the 90th percentile is $23,870.

Compared with income differences, rent burden differences between programs are much greater. PH tenants have an option to pay a flat rent that does not vary with income. Although gross rent, as a percentage of adjusted income, is not supposed to fall below 30 percent in the HCVP, the flat rent option makes rent burdens well below 30 percent possible in PH.

Exhibit 6 reports percentages of households by program in six rent burden categories: (1) missing, (2) 10 to 19 percent, (3) 20 to 27 percent, (4) 28 to 31 percent, (5) 32 to 40 percent, and (6) 41 percent or more. The missing category is for households with $0 adjusted income for which rent burden is undefined. Of HCVP tenants, 10.8 percent have undefined rent burden, as do 11.6 percent of PH tenants.

About 6 percent of PH tenants have rent burdens of less than 20 percent, and 6.1 percent have rent burdens between 20 and 27 percent. Because of the 30-percent minimum, no HCVP tenants fall in these categories. Of PH tenants, 58.2 percent have rent burdens between 28 and 31 percent, as do 72.7 percent of HCVP tenants. More than 20 percent of HCVP tenants have rent burdens between 32 and 40 percent, and 10.5 percent have rent burdens greater than 40 percent. In sharp contrast, less than 4 percent of PH tenants have rent burdens above 31 percent.

Exhibit 6

Rent Burden Frequency Distributions

Rent Burden Category	Percent of HCVP Households	Percent of PH Households
Missing	10.8	11.6
10 to 19 percent	0.0	6.3
20 to 27 percent	0.0	6.1
28 to 31 percent	58.2	72.7
32 to 40 percent	20.5	0.9
41 percent and above	10.5	2.3

HCVP = Housing Choice Voucher Program. PH = public housing.

Notes: N = 1,032,239 for PH and 1,967,865 for the HCVP. Rent burden = (rent + utility allowance)/adjusted income.

Source: 2009 Public and Indian Housing Information Center (PIC) data

Bayesian Propensity Scores

In this section, I compute prior distributions for the propensity of an AHS-assisted household residing in public housing based on HUD admininisrative data and compute Bayesian posterior distributions based on HUD and AHS data.

Prior Distributions

As discussed in the previous section comparing tenant characteristics, incomes and rent burdens vary across programs; I use this information to help predict whether a given AHS rental-assisted household participates in PH or the HCVP. I start by constructing 21 categories based on income and rent burden reported in exhibit 7. The first category is for households with $0 income for which rent burden cannot be computed. The remaining categories are based on four rent burden ranges and five income ranges. The upper limits for the rent burden categories are roughly the 25th, 50th, 75th, and 100th percentiles for the 2009 PIC combined programs. The upper income limits are approximately the 20th, 40th, 60th, 80th, and 100th percentiles.

Although HUD program regulations are based on adjusted income, it is not possible to construct a comparable income measure with AHS data. As such, the income and rent burden categories in exhibit 7 are based on total income.

Also reported in exhibit 7 is the number of PIC HCVP and PH households in each category, the number of PH households, and the proportion of households in each category living in PH (μ). For example, in 2009 112,024 PIC households (category 8) had incomes ranging from $7,033

Exhibit 7

PIC Income and Rent Burden Categories

Category	Household Annual Income ($)	Rent Burden (%)	Total Number of HCVP and PH Households	Number of PH Households	Proportion of Total Households in PH (μ)
1	0	Missing	308,030	114,132	0.371
2	1–7,032	0.0–26.6	175,484	61,001	0.348
3	1–7,032	26.7–28.5	61,027	26,803	0.439
4	1–7,032	28.6–30.0	39,045	15,244	0.390
5	1–7,032	30.1–100.0	120,104	29,208	0.243
6	7,033–9,012	0.0–26.6	97,219	40,964	0.421
7	7,033–9,012	26.7–28.5	247,419	118,144	0.478
8	7,033–9,012	28.6–30.0	112,024	50,605	0.452
9	7,033–9,012	30.1–100.0	115,176	3,182	0.028
10	9,013–12,168	0.0–26.6	103,352	45,700	0.442
11	9,013–12,168	26.7–28.5	81,902	31,381	0.383
12	9,013–12,168	28.6–30.0	275,946	108,090	0.392
13	9,013–12,168	30.1–100.0	112,499	2,874	0.026
14	12,169–18,108	0.0–26.6	125,960	66,252	0.526
15	12,169–18,108	26.7–28.5	170,175	61,040	0.359
16	12,169–18,108	28.6–30.0	158,164	55,490	0.351
17	12,169–18,108	30.1–100.0	118,947	1,592	0.013
18	18,109 and above	0.0–26.6	170,607	126,591	0.742
19	18,109 and above	26.7–28.5	116,009	34,545	0.298
20	18,109 and above	28.6–30.0	167,034	38,043	0.228
21	18,109 and above	30.1–100.0	117,325	974	0.008
Total			2,993,448	1,031,855	0.345

HCVP = Housing Choice Voucher Program. PH = public housing. PIC = Public and Indian Housing Information Center.

Note: Rent burden = (rent + utility allowance)/total household monthly income.

Source: 2009 PIC data

to $9,012 and burdens ranging from 28.6 to 30.0 percent. Of these households, 50,605, or 45.2 percent, resided in PH. The final row presents data for all households. In total, 34.5 percent of total tenants resided in PH.

I use the proportion μ for each of the 21 categories as the prior probability that an AHS household in the same category resides in PH. Although PIC underreporting of voucher households in Moving to Work PHAs may slightly bias the percentages, they are almost certainly closer to actual values than AHS estimates.

AHS Distributions

Exhibit 8 reports 2009 AHS responses in each of the 21 categories, total weighted households, weighted households in PH, and the weighted proportion in PH (p). The standard error of the proportion (s) is also reported. In total, 50.4 percent of AHS-weighted HCVP and PH households report living in PH; this estimate is much larger than the PIC estimate of 34.5 percent. I assume that the AHS proportion in each category follows a Normal distribution with mean p and standard deviation estimated by s.

Exhibit 8

AHS Income and Rent Burden Categories

Category	Total Household Annual Income ($)	Rent Burden (%)	(N)	Weighted Households	Weighted PH Households	Weighted Proportion in PH (p)	Standard Error of the Proportion (s)
1	0	Missing	269	637,350	320,595	0.503	0.033
2	1–7,032	0.0–26.6	18	49,468	23,496	0.475	0.123
3	1–7,032	26.7–28.5	5	15,714	5,003	0.318	0.201
4	1–7,032	28.6–30.0	3	5,885	4,599	0.782	0.214
5	1–7,032	30.1–100.0	65	151,804	84,971	0.560	0.065
6	7,033–9,012	0.0–26.6	26	58,475	33,161	0.567	0.105
7	7,033–9,012	26.7–28.5	20	48,049	31,625	0.658	0.115
8	7,033–9,012	28.6–30.0	14	35,084	23,754	0.677	0.124
9	7,033–9,012	30.1–100.0	114	263,543	122,978	0.467	0.050
10	9,013–12,168	0.0–26.6	57	122,603	74,871	0.611	0.069
11	9,013–12,168	26.7–28.5	28	62,535	29,336	0.469	0.101
12	9,013–12,168	28.6–30.0	16	40,257	27,122	0.674	0.121
13	9,013–12,168	30.1–100.0	81	191,740	72,522	0.378	0.057
14	12,169–18,108	0.0–26.6	67	153,256	67,949	0.443	0.064
15	12,169–18,108	26.7–28.5	17	30,007	14,742	0.491	0.131
16	12,169–18,108	28.6–30.0	17	42,215	23,839	0.565	0.128
17	12,169–18,108	30.1–100.0	103	231,933	102,997	0.444	0.053
18	18,109 and above	0.0–26.6	157	377,579	228,974	0.606	0.042
19	18,109 and above	26.7–28.5	14	34,938	21,184	0.606	0.143
20	18,109 and above	28.6–30.0	16	36,930	13,053	0.353	0.121
21	18,109 and above	30.1–100.0	89	206,298	82,736	0.401	0.055
Total			1,196	2,795,662	1,409,507	0.504	

AHS = American Housing Survey. N = total number in a category. PH = public housing.

Note: Rent burden = (rent + utility allowance)/total household monthly income.

Source: 2009 AHS data

I drop 226 AHS responses: 202 responses with burdens above 100 percent and 24 responses with household incomes above $64,000. My remaining sample consists of 1,196 responses, of which 269 cases have missing burdens due to missing rent data or $0 income; these cases are relegated to the first category for missing data.

Bayesian Posterior Distributions

The Bayesian Posterior distribution for each category is Normal with mean p* and standard deviation s*; exhibit 9 reports p* and s*. s* equals the square root of $1/[\frac{1}{\sigma^2}+\frac{n}{s^2}]$, where n is the AHS number of responses and σ is the prior standard deviation. I set σ equal to $1/\sqrt{4n/s^2}$. p* equals $[\frac{\mu}{\sigma^2}+\frac{np}{s^2}]s^{*2}$, where μ is the PIC mean proportion reported in exhibit 7. For comparison, n, μ, p, σ, and s are also reported in exhibit 9.

We can define an alternative equation for p* as a weighted average of the prior mean and AHS sample mean (Laskey, 2009). Let r be the precision (inverse variance) of the AHS data; and λ be the prior precision: $r = 1/s^2$, and $\lambda = 1/\sigma^2 = 4n/s^2 = 4nr$. λ^* is the posterior precision: $\lambda^* = \lambda + nr = 5nr$. The posterior mean $p^* = (\lambda\mu + nrp)/\lambda^*$. The prior mean μ receives weight $\lambda/\lambda^* = 4/5$, and the AHS mean p receives weight $nr/\lambda^* = 1/5$.

Exhibit 9

Bayesian Posterior Statistics

Category	AHS Responses (N)	Prior Proportion (μ)	AHS Proportion (p)	Bayesian Posterior Proportion (p*)	Prior Standard Deviation (σ)	AHS Standard Deviation (s)	Bayesian Posterior Standard Deviation (s*)
1	269	0.371	0.503	0.397	0.001	0.033	0.001
2	18	0.348	0.475	0.373	0.014	0.123	0.013
3	5	0.439	0.318	0.415	0.045	0.201	0.040
4	3	0.390	0.782	0.469	0.062	0.214	0.055
5	65	0.243	0.560	0.307	0.004	0.065	0.004
6	26	0.421	0.567	0.451	0.010	0.105	0.009
7	20	0.478	0.658	0.514	0.013	0.115	0.012
8	14	0.452	0.677	0.497	0.017	0.124	0.015
9	114	0.028	0.467	0.115	0.002	0.050	0.002
10	57	0.442	0.611	0.476	0.005	0.069	0.004
11	28	0.383	0.469	0.400	0.010	0.101	0.009
12	16	0.392	0.674	0.448	0.015	0.121	0.013
13	81	0.026	0.378	0.096	0.003	0.057	0.003
14	67	0.526	0.443	0.509	0.004	0.064	0.004
15	17	0.359	0.491	0.385	0.016	0.131	0.014
16	17	0.351	0.565	0.394	0.016	0.128	0.014
17	103	0.013	0.444	0.100	0.003	0.053	0.002
18	157	0.742	0.606	0.715	0.002	0.042	0.001
19	14	0.298	0.606	0.359	0.019	0.143	0.017
20	16	0.228	0.353	0.253	0.015	0.121	0.014
21	89	0.008	0.401	0.087	0.003	0.055	0.003

AHS = American Housing Survey.

Sources: 2009 Public and Indian Housing Information Center (PIC) data; 2009 AHS data

I chose 4nr for the prior precision so that the prior mean would have 4 times the influence as the AHS mean on the posterior mean. I gave the PIC-based prior much greater weight because I believe it to be a much more reliable data source than the AHS.

For example, consider category 6; this category has the median number of AHS responses equal to 26. The prior mean $\mu = 0.0421$, and the AHS mean $p = 0.567$. The posterior mean $p^* = 0.451$ is a weighted average of 0.421 and 0.567, with 0.421 receiving weight 4/5 and 0.567 receiving weight 1/5.

I use the Bayesian Posterior proportion p^* as a propensity score for an AHS assisted household residing in PH, conditional on their income and rent burden. Using propensity score weighting, the probability of an AHS assisted household residing in PH is 0.352, which is much closer to the PIC estimate of 0.345 than the unadjusted AHS estimate of 0.504.

Note that the normal-normal conjugate model I employ adjusts only the propensity of residing in PH for households reporting receipt of rental assistance; it does not adjust the propensity of receiving rental assistance, incomes, or rent burdens. Additional variables could be adjusted with a Dirichlet-multinomial conjugate model.

Housing and Neighborhood Quality Comparisons

In this section, I compare AHS housing and neighborhood quality responses of HCVP tenants with PH respondents. I measure housing quality with responses to a question asking households to rate their home on a scale of 1 to 10. I measure neighborhood quality with a neighborhood rating on a scale of 1 to 10 and with a question asking if any serious neighborhood crimes occurred in the past year. I compare both unadjusted estimates and estimates adjusted by the propensity scores computed in the previous section.

Exhibits 10 and 11 report weighted 2009 AHS home and neighborhood ratings, respectively, along with ratings adjusted by propensity scores. I compute the adjusted PH ratings by multiplying the survey weight by the propensity score for residing in PH. I compute the adjusted HCVP ratings by multiplying the survey weight by 1 minus the propensity score.

Exhibit 12 reports sample means for binary home, neighborhood, and crime indicators. For home and neighborhood ratings, three binary indicators are constructed for ratings of at least 7, 8, and 9. H7 through H9 are the binary home indicators, and N7 through N9 are the binary neighborhood indicators. The crime indicator equals 1 for households that responded "yes" when asked if serious neighborhood crimes occurred in the past year; "no" and "don't know" responses are set to 0. Nonresponses for all indicators are set to missing.

Little difference in home ratings exists across programs, either for the adjusted or unadjusted ratings. Neighborhood ratings indicate more pronounced differences. For the proportions adjusted by propensity scores, 55.1 percent of HCVP tenants rated their neighborhoods 8 or greater on a scale of 1 to 10; the corresponding percentage for PH tenants is 51.8 percent. About 36 percent of adjusted HCVP tenants rated their neighborhoods 9 or greater, compared with 32.8 percent of adjusted PH households.

Exhibit 10

Home Ratings

Home Rating	Unadjusted AHS Estimates		Adjusted Estimates	
	Percent of PH Tenants	Percent of HCVP Tenants	Percent of PH Tenants	Percent of HCVP Tenants
1	1.5	1.8	1.6	1.7
2	1.1	0.8	1.5	0.7
3	1.2	1.9	1.9	1.4
4	1.7	1.7	1.7	1.7
5	9.0	8.6	8.6	8.9
6	7.1	6.9	6.8	7.1
7	17.0	16.1	15.5	17.2
8	23.9	23.4	24.7	23.1
9	8.9	10.5	10.9	9.0
10	28.5	28.2	26.7	29.2

AHS = American Housing Survey. HCVP = Housing Choice Voucher Program. PH = public housing.

Notes: N = 1,196. Adjusted data are adjusted by propensity scores for program participation.

Sources: 2009 AHS data; Public and Indian Housing Information Center (PIC) data

Exhibit 11

Neighborhood Ratings

Neighborhood Rating	Unadjusted AHS Estimates		Adjusted Estimates	
	Percent of PH Tenants	Percent of HCVP Tenants	Percent of PH Tenants	Percent of HCVP Tenants
1	2.5	4.1	3.8	3.1
2	2.4	2.6	2.9	2.3
3	2.2	2.3	2.4	2.2
4	3.4	2.6	2.8	3.1
5	13.2	13.2	12.6	13.5
6	9.1	8.3	9.7	8.2
7	10.7	14.0	13.2	11.8
8	19.3	20.3	19.8	19.8
9	11.2	8.1	9.3	9.8
10	25.9	24.5	23.5	26.1

AHS = American Housing Survey. HCVP = Housing Choice Voucher Program. PH = public housing.

Notes: N = 1,196. Adjusted data are adjusted by propensity scores for program participation.

Sources: 2009 AHS data; Public and Indian Housing Information Center (PIC) data

The unadjusted crime indicator is considerably lower for PH tenants (0.257) compared with HCVP tenants (0.293). Adjusted crime indicators indicate little difference between programs; 27.1 percent of HCVP tenants report major crime problems in the past year, as did 28.2 percent of PH tenants.

Exhibit 13 reports Rao-Scott Chi-square test statistics and probability values for each binary indicator. The null hypothesis is that the sample proportions are equal for both the HCVP and PH samples. Only one unadjusted test statistic is significant at the 0.05 level—the unadjusted crime indicator is significantly lower for PH tenants compared with HCVP tenants. None of the test statistics are statistically significant for data adjusted by propensity scores.

On the whole, little statistical evidence indicates that any of the indicators vary significantly across programs. This lack of statistical evidence raises equity concerns, because rent burdens tend to be much higher in the HCVP compared with PH.

Exhibit 12

Binary Indicators of Home and Neighborhood Quality

Variable	Unadjusted AHS Estimates				Adjusted Estimates			
	PH		HCVP		PH		HCVP	
	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
H7	0.782	0.019	0.784	0.019	0.779	0.016	0.785	0.014
H8	0.615	0.021	0.608	0.022	0.617	0.018	0.608	0.016
H9	0.387	0.021	0.374	0.021	0.377	0.017	0.383	0.016
N7	0.668	0.021	0.671	0.021	0.659	0.018	0.676	0.015
N8	0.520	0.022	0.559	0.022	0.518	0.018	0.551	0.016
N9	0.325	0.020	0.372	0.022	0.328	0.017	0.359	0.016
Crime	0.257	0.019	0.293	0.020	0.282	0.016	0.271	0.014

AHS = American Housing Survey. HCVP = Housing Choice Voucher Program. PH = public housing.

Notes: N = 1,196. H7 = home rating ≥ 7. H8 = home rating ≥ 8. H9 = home rating ≥ 9. N7 = neighborhood rating ≥ 7. N8 = neighborhood rating ≥ 8. N9 = neighborhood rating ≥ 9. Crime is a binary indicator for serious crime in the past year. Adjusted data are adjusted by propensity scores for program participation.

Source: 2009 AHS data

Exhibit 13

Rao-Scott Chi-Square Test Statistics

Variable	Unadjusted AHS Estimates		Adjusted Estimates	
	Chi-Square Test Statistic	Probability Value	Chi-Square Test Statistic	Probability Value
H7	0.004	0.952	0.108	0.742
H8	0.054	0.817	0.159	0.690
H9	0.184	0.668	0.064	0.801
N7	0.007	0.931	0.542	0.462
N8	1.638	0.201	1.863	0.172
N9	2.477	0.116	1.850	0.174
Crime	6.563	0.038	0.235	0.628

AHS = American Housing Survey.

Notes: N = 1,196. H7 = home rating ≥ 7. H8 = home rating ≥ 8. H9 = home rating ≥ 9. N7 = neighborhood rating ≥ 7. N8 = neighborhood rating ≥ 8. N9 = neighborhood rating ≥ 9. Crime is a binary indicator for serious crime in the past year. Adjusted data are adjusted by propensity scores for program participation.

Sources: 2009 AHS data; 2009 Public and Indian Housing Information Center (PIC) data

Conclusion

Unfortunately, HUD has no administrative data to compare participants' perception of housing quality or objective measures specific to the dwelling they occupy. AHS data are the only data available to compare subjective housing quality and subjective neighborhood quality assessments in HUD's largest rental assistance programs.

Quality comparisons based on AHS data are problematic because the AHS overrepresents PH households and underrepresents HCVP households. Apparently, many AHS households in the HCVP respond that they live in PH.

HUD administrative data, however, are an excellent source of prior information for the expected proportion of households in PH. In this study, I explore Bayesian methods for using prior information on variables such as income and rents to estimate propensity scores for program participation. I then use the Bayesian propensity scores to improve the reliability of AHS-based quality comparisons.

Results indicate that, after adjusting for program participation propensities, neighborhood quality indicators are higher on average for HCVP tenants compared with those for PH tenants. The differences are not statistically significant, however. Thus, the AHS provides little evidence that HCVP tenants are living in better neighborhoods compared with PH tenants. My estimates raise equity concerns, because rent burdens tend to be much higher in the HCVP compared with PH.

The AHS sample of assisted households is very small relative to the population receiving HUD rental assistance, however. The small sample size limits the usefulness of the AHS for comparing HUD programs.

In 2011, the Census Bureau will begin using HUD administrative data to sample renters known to receive rental assistance through various HUD programs. This new information could substantially improve analysis of assisted housing tenants, assuming the data are made available on the public use file.

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Exploring Housing Challenges of Low-Income Minority Populations in the Southern United States

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Abstract

This study examined the housing challenges of low-income minority populations living in the Southern United States (the South), focusing on demographic and housing characteristics, and using data from the 2009 American Housing Survey. When investigating housing challenges, housing adequacy was considered to be a representative term and was used as the dependent variable. This article presents a detailed profile of the demographic and housing characteristics of the sample of 2,304 householders. Bivariate analysis, with the housing adequacy variable, showed that people who were older, had less family income, were native born, had less than a high school education, lived in rural and suburban areas, and were less satisfied with their neighborhood were more likely to live in inadequate housing. Living in inadequate housing was more likely to be associated with single-family housing and less likely to be associated with renting for cash. A model was developed that hypothesized a relationship between demographic and housing characteristics and the respondents' housing adequacy levels. The model was supported by the rejection of the null hypothesis, and family income, geographic location, housing subsidies, neighborhood rating, structure size, and structure type were found to be significant variables. This article highlights both affordability and quality issues regarding housing for low-income minority populations in the South and topics that are of interest to both researchers and policymakers.

Introduction

Those who have tracked housing and demographic trends in the United States in recent years are likely to be aware of two key trends: (1) the distressed economy has led to plummeting real estate values and has increased the number of foreclosures, and (2) the population's diversity is growing and is especially influenced by immigration. These trends are especially evident in the Southern United States (the South) and interact to influence housing in the South. It is important to move beyond general trends to understand the specific influences on a region's housing challenges, however. Within a region, particular demographic groups, such as low-income or minority households, may be affected in unique ways.

The purpose of this study was to examine housing challenges of low-income minority populations in the South, focusing on demographic and housing characteristics, and to recommend future housing studies and policies related to U.S. minority populations. A premise of the study was that housing environments of the low-income minority populations in the South were likely to be influenced by the ongoing distressed economy because they may have limited demographic and housing resources.

The study defined the South to include Delaware, Maryland, the District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas (Econometrica, Inc., 2011). Minority populations were defined as non-White. The study was based on the 2009 American Housing Survey (2009 AHS) national data.

Background

Minority populations in the South face at least three major demographic and housing issues: (1) the increasing number of minority residents, (2) relatively lower income levels, and (3) lower homeownership rates and higher worst case needs for renters.

Increasing Number of Minority Residents

The United States is currently experiencing a rapid increase in minority (non-White) populations. The combined Hispanic and Asian population represented about 21.1 percent of the U.S. population in 2010. Between 2000 and 2010, the Hispanic population increased 43.0 percent and the Asian population increased 43.3 percent (U.S. Census Bureau, 2011). From the 2010 U.S. Census, minority populations consisted of 36.3 percent (111.9 million) of the total U.S. population (308.7 million). The Hispanic population was the largest and fastest growing minority group, with 50.5 million (16.3 percent), and the Black population was the second largest minority group, with 38.9 million (12.6 percent). In terms of geographical distribution, the largest minority population, at 45.8 million, lived in the South, followed by 33.9 million in the West (Humes, Jones, and Ramirez, 2011).

Relatively Lower Income Levels

According to the *State of the Nation's Housing 2010*, median incomes of minority households are lower than those of White households. For example, the median income for 35-to-44-year-old minority-headed households was $45,000 in 2008, whereas the median income for the same age group for White-headed households was $72,900 (JCHS, 2010).

According to the 2008 and 2009 American Community Surveys (ACSs) of the Census Bureau, household incomes in 13 out of 17 states in the South were below the U.S. median income (2009 U.S. median household income = $50,221). In the South, only Delaware, Maryland, the District of Columbia, and Virginia showed more than the median U.S. household income (Noss, 2010).

The 2009 ACS data also indicate an estimated 14.3 percent of the U.S. population had incomes below the poverty threshold[1] in the past 12 months. The survey shows that 16 states and the District of Columbia had 16 percent or more of the population living below the poverty level. Among that group, 13 states[2] and the District of Columbia are located in the South, as defined for this study (Bishaw and Macartney, 2010).

Lower Homeownership Rates and Higher Worst Case Needs for Renters

Homeownership rates for the minority populations are considerably lower than those for the White population. The U.S. Census Bureau *Housing Vacancy Survey* indicates that the homeownership rate for the minority population was 49.7 percent in 2009 compared with 74.8 percent for the White population. The Black population had the lowest homeownership rate, 46.6 percent, followed by the Hispanic population, 48.4 percent, and Asian/Other, 59 percent. According to the annual study in 2010 by the Joint Center for Housing Studies of Harvard University, 40.3 million households spent more than 30 percent of their incomes on housing in 2008, while 18.6 million of these households spent more than one-half of their income—up from 13.8 million in 2001. This study also indicated that the rate of unemployment was 9.9 percent in April 2010 and the overall vacancy rate of housing for rent, for sale, or held off the market hit a record high in 2009 (JCHS, 2010). It is easily assumed that an increasing number of families in low-income groups are housing-cost burdened.

Low-income American renters are suffering housing-cost burdens. The U.S. Department of Housing and Urban Development (HUD) (HUD, 2011) reports worst case housing needs by using AHS data, providing information on critical problems facing low-income American renters. "Worst case needs" is defined as "very low-income renters with incomes below 50 percent of the area median income who do not receive government housing assistance and who either paid more than one-half of their income for rent or lived in severely inadequate conditions, or who faced both of these challenges" (HUD, 2011: vii). The report emphasizes that the number of renters experiencing worst

[1] Poverty state is determined by comparing annual income with a set of dollar values called thresholds, which vary by family size, number of children, and age of householder. If a family's before-tax income is less than the dollar value of its threshold, then that family and every individual in it are considered to be in poverty. For people not living in families, poverty status is determined by comparing an individual's income with his or her threshold (Bishaw and Macartney, 2010).

[2] These states are Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and West Virginia.

case needs increased more than 20 percent, from 5.91 million in 2007 to 7.10 million in 2009. The Hispanic population experienced the largest increase in worst case needs in that 45 percent of all very low-income Hispanic renters faced worst case needs in 2009, an increase of 8 percent from the 2007 rate. Among all renters with worst case needs, non-Hispanic Black and Hispanic renters each comprised about 23 percent of the total. Regarding the geography of worst case needs, the South had the highest number of income-burdened renters by a significant margin, although the incidence of worst case needs in the South was similar to the average. Three causes were pivotal in the increase in worst case needs: renters' income losses, lack of rental assistance, and competition for affordable rental units (HUD, 2011).

Theoretical Background

This research was based on the theory of housing adjustment (Morris and Winter, 1998, 1978, 1975) and was adapted from Lee's study (2010). The theory of housing adjustment has been used extensively in housing research to investigate housing preferences and housing decisions (Steggell et al., 2003) and to reveal the relationships among individual characteristics, housing, and neighborhoods (Morris and Winter, 1978). The theory describes the complex processes that American families use to make decisions about their housing and explains the relationships of individuals, housing, and neighborhoods within the social context (Morris and Winter, 1978). The central themes of housing adjustment theory are (1) housing adjustment represents a causal chain from housing conditions to dissatisfaction and adjustment behavior to adaptive behavior, (2) progress through the chain depends on the household members' ability to complete housing adjustment processes, and (3) the ability to adjust depends on the strengths of the various constraints (Morris and Winter, 1998).

According to the theory, housing norms and constraints are important influential forces when members of a household need to evaluate housing conditions. Morris and Winter (1975) suggest five types of American housing norms: housing space, tenure, structure type, quality, and neighborhood (location). Typical housing norms in the United States prescribe homeownership (an example of tenure norm); single-family dwellings (an example of structure type norm); an adequate number of rooms, especially sleeping spaces, for the number of household members of each age and sex category; and private outdoor space (Morris and Winter, 1998). Quality norms are more likely to be subjective and are most likely to be congruent with income. Neighborhood norms are related to the location of the unit and the nature of the area, which are important determinants of the family's satisfaction with the dwelling and of its ability to complete nonhousing goals; for example, the quality of the children's education is greatly determined by the location of the dwelling (Morris and Winter, 1975). Constraints may interfere with people's ability to live in normative housing conditions. The five categories of constraints are (1) *resources* (income, wealth, information, skills, and time), (2) *family organization* (the household's ability to effectively make and implement decisions about its housing), (3) the *housing market* (prices, supplies of housing, building materials, and mortgage money), (4) *predispositions* (psychological characteristics of household members—apathy, ambition, and so on), and (5) *discrimination* (because of race, ethnicity, sex, age, disability, or

social class) (Morris and Winter, 1998). These forces lead households to either housing adjustment, adaptation to reduce housing deficits and problems, or continued dissatisfaction with their housing. One assumption of this study is that the low-income minority populations in the South are likely to face housing challenges from the current distressed economy because they may have limited demographic and housing resources, which can be interpreted as constraints to housing adjustment.

In summary, low-income minority populations in the South are growing in number and proportion of the population. They tend to have relatively lower income levels than the population as a whole and are less likely to be homeowners. These facts suggest that a growing proportion of the regional population could be facing housing challenges because of limited resources and a lack of access to homeownership. Data from the 2009 AHS were used in this study to investigate the housing challenges of low-income minority populations in the South to profile and examine demographic and housing characteristics.

Methodology

The methodology section includes (1) research questions and hypothesis, (2) research framework, (3) sample selection, (4) data coding, and (5) data analysis procedures.

Research Questions and Hypothesis

The following research questions directed this study:

1. What is the demographic profile of low-income minority populations in the South?
2. What is the housing profile of low-income minority populations in the South?
3. What are the relationships between demographic and housing characteristics and housing adequacy of low-income minority populations in the South?

The following hypothesis was developed to address research question 3:

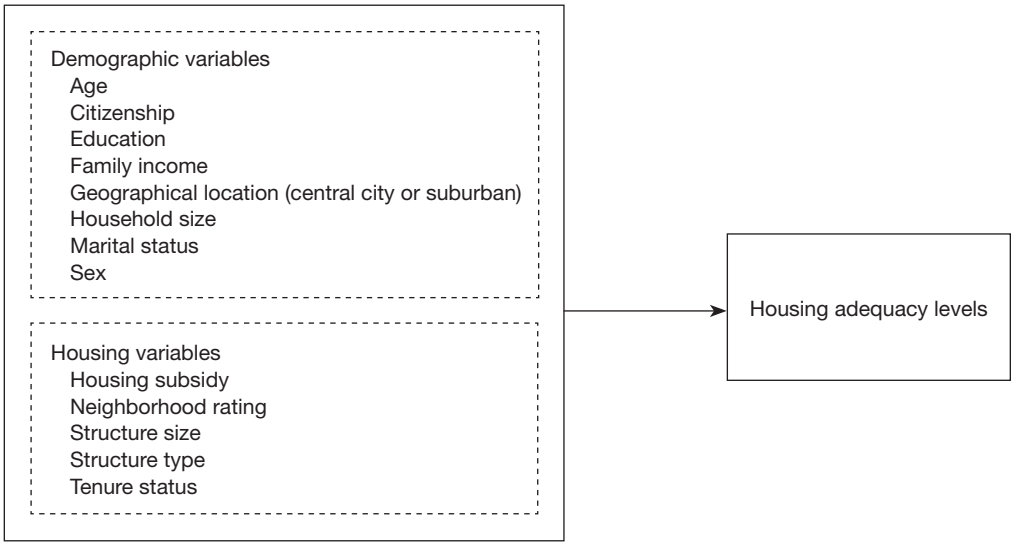
H_0 = Demographic and housing characteristics as a whole are not related to housing adequacy of low-income minority populations in the South.

Research Framework

To implement the study purpose, a research framework was developed based on the housing adjustment theory (Morris and Winter, 1978) and related previous research (exhibit 1). Housing adequacy was considered as a representative term when investigating each householder's housing challenges in the United States. To measure housing challenges, a housing adequacy level was used as a dependent variable in this study. The framework focused on revealing the overall relationships between demographic and housing variables (independent variables [IVs]) and housing adequacy levels (dependent variable [DV]) of low-income minority populations in the South (exhibit 1).

Exhibit 1

A Research Model



Sample Selection

This study focused on low-income minority populations in the South in the 2009 AHS national sample. To select a subsample of the group and determine eligibility for the study, the following procedures were used (exhibits 2 and 3):

1. A category, *South,* from the variable *REGION* was selected from the 2009 AHS.
2. A variable, *race1,* was used when determining a minority group in the South. The variable related to race was categorized into 21 groups. *Minority* included all race categories (2-21) excluding *White Only* (1).
3. A low-income group was developed from the minority group in the South by using the variable related to family income (*zinc*). If a householder earned a family income of less than $50,221 (2009 U.S. median household income), the householder was considered part of a low-income group.

The useable sample was 2,304 low-income minority householders in the South, which was 70.5 percent of the total minority householders in the South (exhibit 2). Among the sample of householders, most identified themselves as *Black Only* (86.5 percent), followed by *Asian Only* (5.4 percent), and *White/American Indian, Alaska Native* (2.9 percent) (exhibit 3).

Exhibit 2

Summary of Useable Sample Numbers in This Study

Total Number of Observations	Response Number in the South	Percent of Total Observations	Minority[a] House-holders in the South	Percent of Total House-holders in the South[b]	Low-Income[c] Minority House-holders in the South	Percent of Total Minority House-holders in the South
2009 AHS 73,222	25,913	35.39	3,265	22.45	2,304	70.50

AHS = American Housing Survey.

[a] *From a variable,* race1, minority *means all race categories (2-21), excluding* White Only *(1).*

[b] *Total householders in the South = 14,543.*

[c] Low-income *means those having family incomes of less than $50,221, which was the 2009 median household income in the United States.*

Data Coding

Data analysis employed in this study included *direct logistic regression* where the DV used a categorical measurement scale that revealed how well the set of predictor variables explained the categorical DV. Exhibit 4 shows how data were coded in the 2009 AHS national data and also shows the value labels and measurement scales for the study. In this study, *housing adequacy level* was the DV, measured with a single-item variable showing adequacy of housing (*zadeq*). In the 2009 AHS, the variable was a roughly continuous variable, which employed a three-rating scale, including *adequate* (1), *moderately inadequate* (2), and *severely inadequate* (3). For this study, the variable was converted to a categorical variable having *adequate* (1) and *inadequate* (0). *Moderately inadequate* (2) and *severely inadequate* (3) were recoded as *inadequate* (0) in this study.

Housing Adequacy Variable in the AHS

In the AHS data, the housing adequacy variable was constructed from AHS disrepair-related variables based on plumbing, heating, electricity, upkeep problems, and kitchen equipment (only applied when measuring moderately inadequate). *Severely inadequate* was assigned if the housing unit met one of the following four conditions: (1) unit had fewer than two full bathrooms and at least one of the following—no hot and cold running water, no bathtub or shower, no flush toilet, and shared plumbing facilities; (2) unit was cold for 24 hours or more and had more than two breakdowns of the heating equipment lasting longer than 6 hours; (3) electricity was not used; or (4) unit had exposed wiring, not every room had working electrical plugs, and the fuses had blown more than twice in past year. Also, *severely inadequate* was assigned if the unit met five or six of the following six upkeep problems: (1) outside water leaks in the past 12 months, (2) inside water leaks in the past 12 months, (3) holes in the floor, (4) open cracks wider than a dime, (5) an area of peeling paint larger than 8 by 11 inches, or (6) rats in past 3 months. *Moderately inadequate* was assigned if the unit met three or four of the upkeep problems of the housing unit. Also, *moderately inadequate* was assigned if the housing unit met one of the following three conditions: (1) unit had more than two breakdowns of the toilet that lasted longer than 6 hours; (2) main heating equipment was unvented room heaters burning kerosene, gas, or oil; or (3) unit was lacking complete kitchen facilities. *Adequate* was assigned if a unit was neither severely nor moderately inadequate (Econometrica, Inc., 2011; Vandenbroucke, 2011).

Exhibit 3

Racial Distribution of White and Minority Householders in the South by Income Levels

	Race as Reported in the 2009 AHS	High Income Level[b]	Percent of Total	Low Income Level[c]	Percent of Total	Percent Among Low-Income Minority Householders	Total	Percent of Total
White householders	1 White Only	4,905	33.7	6,373	43.8		11,278	77.5
Minority[a] householders	2 Black Only	699	4.8	1,992	13.7	**86.5**	2,691	18.5
	3 American Indian, Alaskan Native Only	21	0.1	58	0.4	**2.5**	79	0.5
	4 Asian Only	176	1.2	125	0.9	**5.4**	301	2.1
	5 Hawaiian, Pacific Islander Only	7	0.0	13	0.1	**0.6**	20	0.1
	6 White/Black	7	0.0	24	0.2	**1.0**	31	0.2
	7 White/American Indian, Alaska Native	32	0.2	67	0.5	**2.9**	99	0.7
	8 White/Asian	4	0.0	3	0.0	**0.1**	7	0.0
	9 White/Hawaiian, Pacific Islander	2	0.0	1	0.0	**0.0**	3	0.0
	10 Black/American Indian, Alaska Native	7	0.0	17	0.1	**0.7**	24	0.2
	11 Black/Asian	0	0.0	0	0.0		0	0.0
	12 Black/Hawaiian, Pacific Islander	1	0.0	0	0.0		1	0.0
	13 American Indian, Alaska Native/Asian	0	0.0	0	0.0		0	0.0
	14 Asian/Hawaiian, Pacific Islander	1	0.0	0	0.0		1	0.0
	15 White/Black/American Indian, Alaska Native	3	0.0	3	0.0	**0.1**	6	0.0
	16 White/Black/Asian	0	0.0	0	0.0		0	0.0
	17 White/American Indian, Alaska Native/Asian	0	0.0	0	0.0		0	0.0
	18 White/Asian/Hawaiian, Pacific Islander	0	0.0	0	0.0		0	0.0
	19 White/Black/American Indian, Alaska Native/Asian	1	0.0	0	0.0		1	0.0
	20 Other combinations of two or three races	0	0.0	0	0.0		0	0.0
	21 Other combinations of four or five races	0	0.0	1	0.0	**0.0**	1	0.0
	Total	5,866	40.3	8,677	59.7	**100.0**[d]	14,543	100.0

AHS = American Housing Survey.

Note: Numbers may not sum to column totals because of rounding.

[a] *From a variable,* race1, minority *means all race categories (2-21) excluding* White Only *(1).*

[b] High income *refers to those having family incomes of $50,221 or more; $50,221 was the 2009 median household income in the United States.*

[c] Low income *refers to those having family incomes of less than $50,221, which was the 2009 median household income in the United States.*

[d] *Total number of low-income minority householders in the South = 2,304.*

Exhibit 4

Value Labels and Measurement Scale in This Study (1 of 4)

	Construct	Variable Name (Label)	Coding Value	Value Label in the 2009 AHS	Coding Value	Value Label and Measurement Scale in This Study
Dependent variable						
Housing adequacy levels	Housing adequacy	zadeq (Adequacy of housing)	1	Adequate (1)	1	Adequate
			2	Moderately inadequate (0)	0	Inadequate
			3	Severely inadequate (0)		
			B	Not applicable		**Categorical**
Independent variables						
Demographic variables	Age	age1/HHAGE (Age of householder)	0–120	0–120 years old	0–120	0–120 years old **Continuous**
	Citizenship	citshp1/HHCITSHP (U.S. citizenship of householder)	1	Native, born in the United States	1	Native, born in the United States
			2	Native, born in Puerto Rico or U.S. outlying area	2	Native, born in Puerto Rico or U.S. outlying area
			3	Native, born abroad of U.S. parent(s)	3	Native, born abroad of U.S. parent(s)
			4	Foreign born, U.S. citizen by naturalization	4	Foreign born, U.S. citizen by naturalization
			5	Foreign born, not a U.S. citizen	5	Foreign born, not a U.S. citizen
			Blank	Not reported		**Categorical**
	Education	grad1/HHGRAD (Educational level of householder)	31	Less than 1st grade (1)	1	Less than high school
			32	1st, 2nd, 3rd, or 4th grade (1)		
			33	5th or 6th grade (1)		
			34	7th or 8th grade (1)		
			35	9th grade (1)		
			36	10th grade (1)		
			37	11th grade (1)		

Exhibit 4

Value Labels and Measurement Scale in This Study (2 of 4)

Construct	Variable Name (Label)	Coding Value	Value Label in the 2009 AHS	Coding Value	Value Label and Measurement Scale in This Study
		38	12th grade, no diploma (1)		
		39	HIGH SCHOOL GRADUATE—high school DIPLOMA or equivalent (for example, GED) (2)	2	High school graduate
		40	Some college but no degree (3)	3	Some college or associate's degree
		41	Diploma or certificate from a vocational, technical, trade, or business school beyond high school (3)		
		42	Associate's degree in college—occupational/vocational program (3)		
		43	Associate's degree in college—academic program (3)		
		44	Bachelor's degree (e.g., BA, AB, BS) (4)	4	Bachelor's degree or more
		45	Master's degree (e.g., MA, MS, MEng, MEd, MSW, MBA) (4)		
		46	Professional school degree (e.g., MD, DDS, DVM, LLB, JD) (4)		
		47	Doctorate degree (e.g., PhD, EdD) (4)		
					Categorical
Family income	zinc (Family income)	– 10,000	Loss of $10,000 or more	0	No income
		– 9,999 to – 1	Loss of $1 to $9,999		
		0	No income		
		1 to 9,999,995	Income of $1 to $9,999,995	1 to 50,220	$1 to $50,220
		9,999,996	Income of $9,999,996 or more		
		B	Not applicable		**Continuous**

Exhibit 4

Value Labels and Measurement Scale in This Study (3 of 4)

Construct	Variable Name (Label)	Coding Value	Value Label in the 2009 AHS	Coding Value	Value Label and Measurement Scale in This Study
					Log_{10} transformation for data analysis **Continuous**
				1	Less than $25,000
				2	$25,000 to $34,999
				3	$35,000 to $49,999
				4	$50,000 to $50,220 **Categorical**
Geographical location	metro3 (Central city or suburban)	1	Central city of MSA (1)	1	Urban
		2	Inside MSA, but not in central city—urban (1)		
		3	Inside MSA, but not in central city—rural (2)	2	Suburban
		4	Outside MSA, urban (2)		
		5	Outside MSA, rural (3)	3	Rural **Categorical**
Household size	per (Number of persons in household)	1–30	1–30 persons	1–30	1–30 persons **Continuous**
Marital status	mar1/ HHMAR (Marital status of householder)	1	Married, SPOUSE PRESENT (0)	0	Married
		2	Married, SPOUSE ABSENT (0)		
		3	Widowed (1)	1	Not married
		4	Divorced (1)		
		5	Separated (1)		
		6	Never married (1)		
		Blank	Not reported		**Categorical**
Sex	sex1/HHSEX (Sex of householder)	1	Male (0)	0	Male
		2	Female (1)	1	Female
		Blank	Not reported		**Categorical**

Exhibit 4

Value Labels and Measurement Scale in This Study (4 of 4)

	Construct	Variable Name (Label)	Coding Value	Value Label in the 2009 AHS	Coding Value	Value Label and Measurement Scale in This Study
Housing variables	Housing subsidy	subrnt[a] (Government housing subsidy)	1	Yes (1)	0	No
			2	No (0)	1	Yes
			B	Not applicable (2)	2	Not applicable
			D	Don't know (missing)		**Categorical**
			R	Refused (missing)		
			Blank	Not reported (missing)		
	Neighborhood rating	HOWN (Rating of neighborhood as place to live)	0	No neighborhood		
			1–10	Rating (10 is best, 1 is worst)	1–10	Rating (10 is best, 1 is worst) **Continuous**
	Structure size (Space)	BEDRMS (Number of bedrooms in unit)	0–10	0 to 10 full bedrooms	0–10	0–10 full bedrooms **Continuous**
	Structure type	nunit2 (Structure type)	1	One-unit building, detached from any other building	1	One-unit building, detached from any other building
			2	One-unit building, attached to one or more buildings	2	One-unit building, attached to one or more buildings
			3	Building with two or more apartments	3	Building with two or more apartments
			4	Manufactured (mobile) home	4	Manufactured (mobile) home
			B	Not applicable		**Categorical**
	Tenure	TENURE (Owner or renter status of unit)	1	Owned or being bought by someone in your household	1	Own or buying
			2	Rented for cash rent	2	Rent for cash
			3	Occupied without payment of cash rent	3	No cash rent
			B	Not applicable		**Categorical**

AHS = American Housing Survey.

[a] *Long description in the AHS: Does the Federal, State, or local government pay some of the cost of the unit?*

Source: Econometrica, Inc. (2011)

Data Analysis Procedures

The Statistical Package for the Social Sciences (SPSS) version 18 was used to analyze data for this study. Descriptive statistics (frequencies, percentages, and means) were employed for the demographic and housing characteristics of low-income householders in the South. Further, to assess bivariate associations, one-way analysis of variance was used to detect the association between the continuous IVs and the categorical DV; crosstabs were used to investigate the association between the categorical IVs and the DV. To test the hypothesis, a direct logistic regression was used. A significance level of $\alpha = 0.05$ was chosen as the criterion for decision on rejecting the null hypotheses. The null hypothesis in this study was as follows:

H_0: Demographic and housing characteristics as a whole are not related to housing adequacy of low-income minority populations in the South.

Analysis: Direct logistic regression

Statistical hypothesis test: $H_0 : \beta_j = 0$ vs. $H_1 : \beta_j \neq 0$ *for* $j = 1\sim13$

A model for hypothesis:

$$ln\left[\frac{p}{1-p}\right] = \beta_0 + \beta_1 \text{Age}_i + \beta_2 \text{Citizenship}_i + \beta_3 \text{Education}_i + \beta_4 \textit{Family Income}_i + \beta_5 \text{Geographical Location}_i + \beta_6 \text{Household Size}_i + \beta_7 \text{Marital Satus}_i + \beta_8 \text{Sex}_i + \beta_9 \text{Housing Subsidy}_i + \beta_{10} \text{Neighborhood Rating}_i + \beta_{11} \text{Structure Size}_i + \beta_{12} \text{Structure Type}_i + \beta_{13} \text{Tenure}_i + \varepsilon_i$$

Where "$ln\left[\frac{p}{1-p}\right]$" is the log odds (logit) of the dependent variable

Where β_0 is the constant

$_i$ = individual householder

β is the logistic regression coefficinet.

Results

This section provides a demographic and housing profile of low-income minority householders in the South and discusses bivariate relationships between the housing adequacy levels and demographic and housing characteristics of those householders, and a result of the hypothesis test.

Demographic and Housing Profile of the Sample of Low-Income Minority Householders in the South

Descriptive statistics of categorical variables related to the demographic and housing profile are provided in exhibit 5 and those of continuous variables are in exhibit 6. Nearly 90 percent of low-income householders in the South (N = 2,304, the total number of minority householders in the South having family incomes of less than $50,221) had adequate housing units. Of the householders, 12 percent were foreign born. The average age of the householders was nearly 49 years.

Education and family income levels were relatively low; 59 percent of the householders reported education levels as a high school graduate or less and 58 percent earned less than $25,000. Most of the respondents lived in urban areas (66 percent). Their household sizes were relatively small with *M* = 2.35 persons. Most were not married (76 percent) and were female (62 percent). Only 13 percent of the householders received a housing subsidy. The average structure size was 2.56 bedrooms. Nearly one-half of the householders lived in a one-unit building, detached from any other building. Less than one-half (45 percent) of the householders were homeowners. The householders' neighborhood rating was relatively high, *M* = 7.75 (1 to 10 range).

Exhibit 5

Demographic and Housing Profile: Categorical Variables (N = 2,304)

		n	%
Housing adequacy level	Adequate	2,052	89.1
	Inadequate	252	10.9
Citizenship	Native, born in United States	2,002	86.9
	Native, born in Puerto Rico or U.S. outlying area	19	0.8
	Native, born abroad of U.S. parent(s)	19	0.8
	Foreign born, U.S. citizen by naturalization	129	5.6
	Foreign born, not a U.S. citizen	135	5.9
Education	Less than high school	564	24.5
	High school graduate	785	34.1
	Some college or associate degree	663	28.8
	Bachelor's degree or more	292	12.7
Family income	Less than $25,000	1,326	57.6
	$25,000 to $34,999	479	20.8
	$35,000 to $49,999	451	19.6
	$50,000 to $50,220	48	2.1
Geographical location (Central city or suburban)	Urban	1,511	65.6
	Suburban	488	21.2
	Rural	305	13.2
Marital status	Married	548	23.8
	Not married	1,756	76.2
Sex	Male	869	37.7
	Female	1,435	62.3
Housing subsidy[a]	No	925	40.1
	Yes	302	13.1
	Not applicable (for housing subsidy)	1,027	44.6
Structure type	One-unit building, detached from any other building	1,159	50.3
	One-unit building, attached to one or more buildings	133	5.8
	Building with two or more apartments	849	36.8
	Manufactured (mobile) home	163	7.1
Tenure status	Own or buying—regular	1,027	44.6
	Rent for cash	1,216	52.8
	No cash rent	61	2.6

N = total number in a sample. n = number in a subsample.

[a] n = *2,254 for the housing subsidy. Fifty values were missing from the sample (*n = *2,304).*

Exhibit 6

Demographic and Housing Profile: Continuous Variables (N = 2,304)

	N	Min.	Max.	*M*	*SD*	Skewness Statistic	Kurtosis Statistic
Age	2,304	17	93	48.74	17.684	0.293	– 0.747
Family income	2,304	0	50,200	21,564.13	14,257.454	0.246	– 0.963
Family income[a]	2,197	0	5	4.21	0.470	– 2.250	8.081
Household size	2,304	1	14	2.35	1.520	1.482	3.268
Neighborhood rating[b]	2,193	1	10	7.75	2.078	– 1.086	1.117
Structure size	2,304	0	7	2.56	0.960	0.248	0.709

M = mean. N = total number in a sample. SD = standard deviation.

[a] *Log transformation was used for* family income.

[b] *Scale: 1 = worst to 10 = best.*

Association of Demographic Variables and Housing Adequacy Levels

One-way analysis of variance (ANOVA) was employed to assess the association between continuous demographic variables (age, family income, and household size) and housing adequacy levels. When conducting ANOVA, three assumptions were also examined, including normality of errors, homogeneity of variance of errors, and independent observations. Also, crosstabs were employed to assess whether the association between the categorical demographic variables (citizenship, education, family income, geographical location, marital status, and sex) and the housing adequacy levels were statistically significant. The ANOVA tables showing significant mean differences among groups of each variable are provided in exhibit 7. Means plots showing significant mean differences among groups of each variable are provided in exhibit 8. Exhibit 9 provides the significance level among the variables from the Chi-square tests. The results revealed statistically significant associations between demographic factors and housing adequacy levels.

- **Age** [$F(1, 2{,}302) = 10.569$, $p < 0.05$]: The average age of householders who lived in *inadequate* housing ($M = 52.15$, $SD = 17.033$) was higher than the average age of those who lived in *adequate* housing quality ($M = 48.32$, $SD = 17.033$).
- **Family income** [$F(1, 2{,}195) = 5.683$, $p < 0.05$; $\chi^2(3, N = 2{,}304) = 15.367$, $p < 0.05$]): Those who lived in inadequate housing ($M = 4.14$, $SD = 0.434$) had less family income than those who lived in adequate housing ($M = 4.22$, $SD = 0.474$). From the Chi-square test regarding family income, the most influential cell was that those who had incomes of *less than $25,000* lived in inadequate housing. The cell had more observed frequencies than expected, indicating that those who had incomes of *less than $25,000* were more likely to live in inadequate housing.
- **Citizenship** [$\chi^2(4, N = 2{,}304) = 16.543$, $p < 0.05$]: From the Chi-square test, the most influential cell was that those who were *native, born in the United States* lived in inadequate housing. The cell had more observed frequencies than expected, indicating that those who were *native, born in the United States* were more likely to live in inadequate housing.

- **Education** [$\chi^2(3, N = 2{,}304) = 13.869, p < 0.05$]: From the Chi-square test, the most influential cell was that those who had *less than a high school education* lived in inadequate housing. The cell had more observed frequencies than expected, indicating that those who had *less than a high school education* were more likely to live in inadequate housing.
- **Geographical location** [$\chi^2(2, N = 2{,}304) = 28.073, p < 0.05$]: From the Chi-square test, the most influential cell was that those in *urban areas* lived in inadequate housing. The cell had fewer observed frequencies than expected, indicating that those in *urban areas* were less likely to live in inadequate housing (that is, those in *urban areas* were more likely to live in adequate housing).

Briefly, those respondents who lived in inadequate housing were older, had less family income (were more likely to have incomes of less than $25,000), were more likely to be native born, had less than a high school education, and were less likely to live in urban areas (exhibits 7, 8, and 9).

Exhibit 7

Result of One-Way ANOVA for Continuous Demographic Variables by Housing Adequacy Levels

	SS	*df*	*MS*	*F*	*p*
(a) Age of householder by housing adequacy levels					
Between groups	3,291.638	1	3,291.638	10.569	0.001*
Within groups	716,929.632	2,302	311.438		
Total	720,221.270	2,303			
(b) Family income by housing adequacy levels					
Between groups	1.254	1	1.254	5.683	0.017*
Within groups	484.390	2,195	0.221		
Total	485.645	2,196			

ANOVA = analysis of variance. df = degree of freedom. F = Fisher's F ratio. MS = mean square. p = probability. SS = sum of squares.

* p < *0.05.*

Exhibit 8

Means Plots of Continuous and Demographic Variables by Housing Adequacy Levels

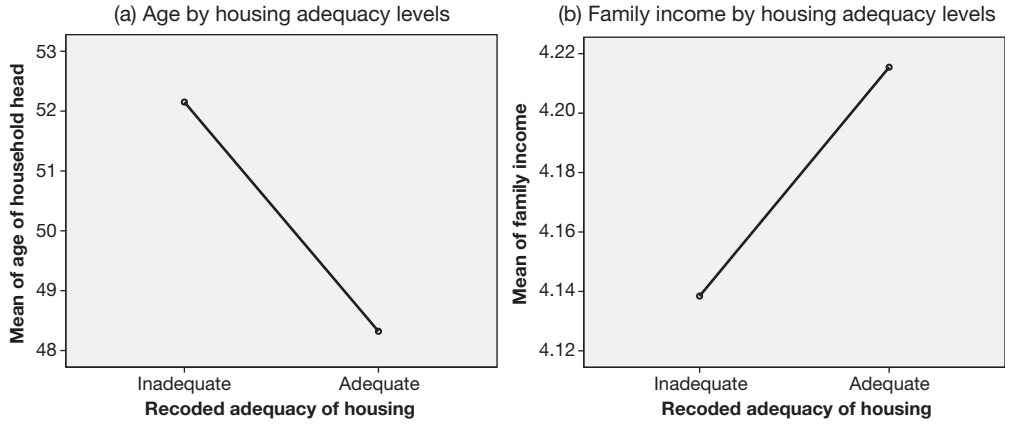


Exhibit 9

A Compound Matrix of Chi-Square Analyses Results (Association Between Categorical Demographic Variables and Housing Adequacy Levels)

	Citizenship	Education	Family Income	Geographical Location	Marital Status	Sex
Housing adequacy levels	0.002*	0.003*	0.002*	0.000*	0.439	0.273

Note: Each value in a cell was p-value from Pearson's Chi-square test results.

* $p < 0.05$.

Association of Housing Variables and Housing Adequacy Levels

One-way ANOVA was employed to investigate the association between continuous housing variables (neighborhood rating and structure size) and housing adequacy levels. Crosstabs were employed to assess whether the association between the categorical housing variables (housing subsidy, structure type, and tenure status) and the housing adequacy levels were statistically significant. Exhibits 10 and 11 provide the ANOVA result and a means plot, respectively, only showing significant mean differences. Exhibit 12 provides the significance level among the variables from the Chi-square tests. The results revealed statistically significant associations between housing characteristics and housing adequacy levels.

- **Neighborhood** [$F(1, 2{,}191) = 6.994$, $p < 0.05$]: For neighborhood rating, the mean of those who lived in adequate housing ($M = 7.79$, $SD = 2.026$) was significantly different from those who lived in inadequate housing ($M = 7.42$, $SD = 2.432$), indicating that those who lived in adequate housing were more satisfied with their neighborhood than those living in inadequate housing.
- **Structure type** [$\chi^2(3, N = 2{,}304) = 13.265$, $p < 0.05$]: From the Chi-square test, the most influential cell was that those living in a *one-unit building, detached from any other building* lived in inadequate housing. The cell had more observed frequencies than expected, indicating that those living in a *one-unit building, detached from any other building* were more likely to live in inadequate housing.
- **Tenure status** [$\chi^2(2, N = 2{,}304) = 6.121$, $p < 0.05$]: From the Chi-square test, the most influential cell was that those renting for cash lived in adequate housing. The cell had more observed frequencies than expected, indicating that those renting for cash were more likely to live in adequate housing.

Exhibit 10

Result of One-Way ANOVA for Neighborhood Rating by Housing Adequacy Levels

	SS	*df*	*MS*	*F*	*p*
Between groups	30.111	1	30.111	6.994	0.008
Within groups	9,433.427	2,191	4.306		
Total	9,463.539	2,192			

ANOVA = analysis of variance. df = degree of freedom. F = Fisher's F *ratio. MS = mean square. p = probability. SS = sum of squares.*

* $p < 0.05$.

Exhibit 11

A Means Plot of Neighborhood Rating by Housing Adequacy Levels

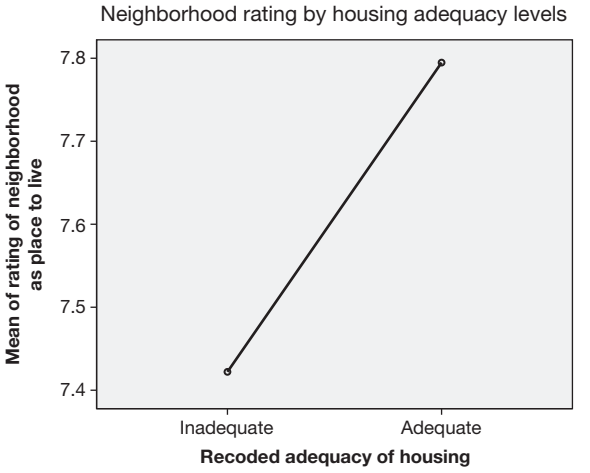


Exhibit 12

A Compound Matrix of Chi-Square Analyses Results (Association Between Categorical Housing Variables and Housing Adequacy Levels)

	Housing Subsidy	Structure Type	Tenure Status
Housing quality levels	0.246	0.004*	0.047*

Note: Each value in a cell was p-value from Pearson's Chi-square test results.

* $p < 0.05$.

Those respondents who lived in inadequate housing were less satisfied with their neighborhoods and were more likely to live in a one-unit building detached from any other building. Conversely, those renting for cash were more likely to live in adequate housing (exhibits 10, 11, and 12).

Tests of Hypothesis

This study employed a categorical DV. Therefore, logistic regression was employed because it is appropriate for testing hypotheses about relationships between a categorical outcome variable and one or more categorical or continuous predictor variables (Peng, Lee, and Ingersoll, 2002).

Null hypothesis: *Demographic and housing characteristics as a whole are not related to housing adequacy of low-income minority populations in the South.* A direct logistic regression was employed to assess the relationships of housing adequacy levels of low-income minority populations in the South and their demographic and housing characteristics. The DV was coded as *1* if the householder lived in *adequate* housing and *0* otherwise. Demographic predictors were age, citizenship, education, family income, geographical location (census region), household size, marital status, and sex. Housing variables were housing subsidy, neighborhood rating, structure size, structure type, and tenure status. For categorical IVs, each category was compared with the reference group (see footnotes in exhibit 13).

Exhibit 13

Logistic Regression Results for Hypothesis 1 (n = 2,180) (1 of 2)

Predictor	β	SE β	Wald's χ^2	*df*	*p*	Odds Ratio	95% CI for Odds Ratio	
							Lower	Upper
Constant	– 0.030	0.634	0.002	1	0.962	0.970		
Age	– 0.009	0.005	3.075	1	0.080	0.991	0.982	1.001
Citizenship (1)[a]	18.939	9,149.761	0.000	1	0.998	1.679E8	0.000	—
Citizenship (2)[b]	18.841	9,059.087	0.000	1	0.998	1.523E8	0.000	—
Citizenship (3)[c]	0.852	0.435	3.842	1	0.050	2.345	1.000	5.499
Citizenship (4)[d]	0.829	0.441	3.527	1	0.060	2.290	0.964	5.437
Education (1)[e]	0.076	0.182	0.174	1	0.677	1.079	0.755	1.541
Education (2)[f]	0.313	0.205	2.338	1	0.126	1.368	0.916	2.043
Education (3)[g]	0.234	0.283	0.680	1	0.409	1.263	0.725	2.201
Family income (1)[h]	0.420	0.200	4.409	1	0.036*	1.522	1.028	2.253
Family income (2)[i]	0.512	0.222	5.313	1	0.021*	1.669	1.080	2.581
Family income (3)[j]	– 0.311	0.469	0.438	1	0.508	0.733	0.292	1.840
Census region (1)[k]	– 0.392	0.176	4.967	1	0.026*	0.676	0.479	0.954
Census region (2)[l]	– 0.778	0.209	13.896	1	0.000*	0.459	0.305	0.691
Household size	– 0.046	0.060	0.591	1	0.442	0.955	0.849	1.074
Marital status[m]	0.010	0.195	0.003	1	0.960	1.010	0.689	1.480
Sex[n]	0.121	0.152	0.630	1	0.427	1.128	0.838	1.520
Housing subsidy (1)[o]	0.525	0.252	4.332	1	0.037*	1.690	1.031	2.772
Housing subsidy (2)[p]	0.561	0.357	2.468	1	0.116	1.752	0.870	3.526
Neighborhood rating	0.109	0.032	11.387	1	0.001*	1.115	1.047	1.189
Structure size	0.329	0.106	9.710	1	0.002*	1.390	1.130	1.710
Structure type (1)[q]	0.756	0.417	3.293	1	0.070	2.131	0.941	4.822
Structure type (2)[r]	0.597	0.233	6.548	1	0.011*	1.817	1.150	2.870
Structure type (3)[s]	0.468	0.277	2.861	1	0.091	1.596	0.928	2.745
Tenure (1)[t]	0.326	0.370	0.777	1	0.378	1.386	0.671	2.862

Test		χ^2	*df*	*p*
Overall model evaluation		99.070	24	0.000*
Goodness-of-fit test	Hosmer and Lemeshow	9.685	8	0.288

β = *regression coefficient. CI = confidence interval.* df = *degree of freedom.* p = *probability.* SE = *standard error.*

Note: Dependent variable: housing adequacy level (1 = adequate and 0 = inadequate); Nagelkerke R2 = 0.088; Model Prediction = 88.9 percent.

[a] *A value label,* Native, born in Puerto Rico or U.S. outlying area*, was coded 1, and other value labels were coded 0.* Native, born in the United States *was a reference group.*

[b] *A value label,* Native, born abroad of U.S. parent(s)*, was coded 1, and other value labels were coded 0.* Native, born in the United States *was a reference group.*

[c] *A value label,* Foreign born, U.S. citizen by naturalization*, was coded 1, and other value labels were coded 0.* Native, born in the United States *was a reference group.*

[d] *A value label,* Foreign born, not a U.S. citizen*, was coded 1, and other value labels were coded 0.* Native, born in the United States *was a reference group.*

[e] *A value label,* High school graduate*, was coded 1, and other value labels were coded 0.* Less than high school *was a reference group.*

[f] *A value label,* Some college or associate degree*, was coded 1, and other value labels were coded 0.* Less than high school *was a reference group.*

[g] *A value label,* Bachelor's degree or more*, was coded 1, and other value labels were coded 0.* Less than high school *was a reference group.*

[h] *A value label,* $25,000–$34,999*, was coded 1, and other value labels were coded 0.* Less than $25,000 *was a reference group.*

Exhibit 13

Logistic Regression Results for Hypothesis 1 (n = 2,180) (2 of 2)

[i] *A value label,* $35,000–$49,999*, was coded 1, and other value labels were coded 0.* Less than $25,000 *was a reference group.*

[j] *A value label,* $50,000–$50,220*, was coded 1, and other value labels were coded 0.* Less than $25,000 *was a reference group.*

[k] *A value label,* Suburban*, was coded 1, and other value labels were coded 0.* Urban *was a reference group.*

[l] *A value label,* Rural*, was coded 1, and other value labels were coded 0.* Urban *was a reference group.*

[m] *A value label,* Not married*, was coded 1, and* Married *was coded 0.* Married *was a reference group.*

[n] *A value label,* Female*, was coded 1, and* Male *was coded 0.* Male *was a reference group.*

[o] *A value label,* Yes*, was coded 1, and other value labels were coded 0.* No *was a reference group.*

[p] *A value label,* Not applicable*, was coded 1, and other value labels were coded 0.* No *was a reference group.*

[q] *A value label,* one-unit building*,* detached from any other building*, was coded 1, and other value labels were coded 0.* One-unit building*,* detached from any other building *was a reference group.*

[r] *A value label,* building with two or more apartments*, was coded 1, and other value labels were coded 0.* One-unit building*,* detached from any other building *was a reference group.*

[s] *A value label,* manufactured (mobile) homes*, was coded 1, and other value labels were coded 0.* One-unit building*,* detached from any other building *was a reference group.*

[t] *A value label,* rent for cash*, was coded 1, and other value labels were coded 0.* Own or buying *was a reference group.*

* p < *0.05.*

The full model was statistically significant with $\chi^2(24, n = 2{,}180) = 99.070$, $p < 0.05$, indicating that the model was able to distinguish between the respondents who lived in adequate housing and those who lived in inadequate housing. Based on the value of Nagelkerke R^2, which provides an indication of the variation amount in the dependent variable explained by the model from a minimum value of 0 to a maximum of approximately 1 (Pallant, 2007), the model as a whole explained 8.8 percent (Nagelkerke $R^2 = 0.088$) of the variance in housing adequacy levels. The value of Nagelkerke R^2 was low in this study, but it is the norm in logistic regression (Hosmer and Lemeshow, 2000; Walker, Bukenya, and Thomas, 2010). Overall, 88.9 percent of respondents (1,937 out of 2,180) were correctly classified as those who lived in adequate housing. The Chi-square value for the Hosmer-Lemeshow Goodness of Fit Test was 9.685 with a significant level of 0.288 ($p > 0.05$), indicating support for the model. For the Hosmer-Lemeshow Test, poor fit is indicated by a significant value of less than 0.05 and, therefore, to support the model, the value should be greater than 0.05 (Pallant, 2007).

As shown in exhibit 13, the hypothesis that housing adequacy was significantly affected by demographic and housing characteristics was supported by findings that related *family income* levels [Family income (1) and (2) ($\chi^2 = 4.409$, $p < 0.05$ and $\chi^2 = 5.313$, $p < 0.05$ respectively)], *geographical location* [Census region (1) and (2) ($\chi^2 = 4.967$, $p < 0.05$ and $\chi^2 = 13.896$, $p < 0.05$ respectively)], *housing subsidy* [housing subsidy (1) ($\chi^2 = 4.332$, $p < 0.05$)], *neighborhood rating* ($\chi^2 = 11.387$, $p < 0.05$), *structure size* ($\chi^2 = 9.710$, $p < 0.05$), and *structure type* [structure type (2) ($\chi^2 = 6.548$, $p < 0.05$)].

Those respondents with incomes ranging from *$25,000 to $34,999* were 1.5 times more likely to live in adequate housing than those with incomes of *less than $25,000,* when controlling for all other variables in the model (Odds Ratio = 1.522). Those with incomes ranging from *$35,000 to $49,999* were 1.7 times more likely to live in adequate housing than those with incomes of *less than $25,000*, when controlling for other variables in the model (Odds Ratio = 1.669). Those living in

suburban and *rural* areas were 0.68 times and 0.50 times, respectively, less likely to live in adequate housing than those living in *urban* areas, when controlling for all other variables in the model (Odds Ratio = 0.676 and 0.459, respectively).

For a 1-point increase in the level of *neighborhood rating* and *structure size*, the likely increases in a householder's housing adequacy were 12 percent (Odds Ratio = 1.115) and 39 percent (Odds Ratio = 1.390), respectively, when controlling for other variables in the model. That means, the higher the neighborhood rating and structure size, the more likely it was that the householder had adequate housing. Those with (federal, state, and local) *government housing subsidies* were 1.69 times more likely to live in adequate housing than *those who did not receive government housing subsidies* (Odds Ratio = 1.690), when controlling for other variables in the model. Those living in a *building with two or more apartments* were 1.82 times more likely to live in adequate housing than *those living in one-unit building, detached from any other building* (Odds Ratio = 1.817), when controlling for other variables in the model. The regression coefficients of age, citizenship, education, household size, marital status, sex, and tenure were insignificant, implying that those variables had no effect on the housing adequacy levels when controlling for other variables.

Briefly, H_0 was rejected and it was concluded that a relationship existed between demographic and housing characteristics and housing adequacy of low-income minority populations in the South. The variables of *family income*, *geographical location*, *housing subsidies*, *neighborhood rating*, *structure size*, and *structure type* were statistically significantly related with housing adequacy levels, when controlling for other variables. Those individuals with slightly higher incomes ranging from *$25,000 to $34,999 and $35,000 to $49,999* were more likely to live in adequate housing than those having the lowest income (*less than $25,000)*. Those individuals living in *suburban* and *rural* areas were less likely to live in adequate housing than those living in urban areas. The greater the neighborhood rating and the larger the structure size, the more likely it was that the household had adequate housing. Those individuals who receive government housing subsidies were more likely to live in adequate housing than those who did not receive subsidies. Those individuals living in apartments were more likely to have adequate housing than those living in single-family detached homes.

Discussion and Conclusion

This study examined housing challenges of low-income minority populations in the South, focusing on demographic and housing characteristics. In this study, housing adequacy was considered as a representative term when investigating each householder's housing challenges.

Discussion

An important finding of this study was that those living in urban areas, living in apartment housing, and having housing subsidies were more likely to live in adequate housing than their counterparts. In this study, more than one-half of the sample of householders were renters (55.4 percent) and lived in urban areas (65.6 percent). Renters and households living in apartments in urban areas may have more options for housing that meets their needs and be adequate than those living in rural areas. Low-income minority households that are homeowners are likely to have purchased homes with below median prices, which are more likely to be inadequate, and they would be more

likely to be challenged to maintain those homes. From the JCHS (2010), the median home price in 2009 was $172,100. Assuming a 30-year mortgage with a 10-percent downpayment and a 5-percent mortgage rate, a homeowner would pay approximately $835 per month as an after-tax mortgage payment (that is, the actual mortgage payment less the mortgage interest and property taxes deducted in a federal income tax return). This median house price raises an affordability challenge to low-income households, even before maintenance and repair costs are added.

Realistically, however, even renters in this study have housing affordability issues. In general, poor housing quality is closely related to affordability issues. Nearly 50 percent of low-income households living in inadequate housing pay more than 50 percent of their incomes for housing (JCHS, 2009). In this study, 58 percent had incomes of less than $25,000. A useful evaluation of the effect of low income on housing can be determined by considering the idea of Fair Market Rents (FMRs). An FMR is HUD's best estimate of what a household seeking a modest rental unit can expect to pay for *rent and utilities* in the current market, using approximately 30 percent of their income (Wardrip, Pelletiere, and Crowley, 2009). A household earning adequate income to afford FMR is considered to receive a *housing wage*. In 2009, the national FMR for a two-bedroom housing unit was $928 a month (Wardrip, Pelletiere, and Crowley, 2009). To spend 30 percent of income for housing would require a household to earn $37,105. More than 78 percent of the sample of householders reported incomes below this level (exhibit 5), indicating that a big gap exists between their incomes and a housing wage. Households that received housing subsidies were less likely to be constrained by income and more likely to achieve adequate housing.

In this study, housing adequacy levels were used as the dependent variable to represent housing challenges of low-income minority populations in the South. In the AHS data, a variable, *adequacy of housing (zadeq)* is a *summary measure of housing quality* and objectively developed by considering several variables, including plumbing, heating, electricity, upkeep problems, and kitchen equipment quality (Econometrica, Inc., 2011; Vandenbroucke, 2011). The emphases of the AHS variable are physical adequacy and defining substandard housing. One interesting finding from this study is that nearly 90 percent of the sample of householders lived in the *adequate* housing, a variable defined in the American Housing Survey. This finding raises the question of whether the AHS variable appropriately constructs or defines the housing adequacy levels of low-income family households in the United States.

Implications

The results of this study have the following implications for researchers, educators, nonprofit organizations, and policymakers:

1. Policymakers can refer to the research results in developing future housing or income-related policies. From the study results, nearly 60 percent of the sample of householders had incomes of less than $25,000 and 53 percent rented their homes. From this aspect, policymakers may consider how they will administer public income-oriented or housing programs.

2. This study was based on housing adjustment theory and showed how the theory was applied to this research by making connections between housing adequacy levels and the housing constraints of low-income minority populations in the South. Therefore, the research framework in this study can be helpful when developing similar research.

3. The results of this study provided housing and demographic profiles of low-income minority populations in the South. Therefore, the findings of this study could be used as information for students in housing and social classes.

4. Statistical methods of this study can be useful to show how data are treated and how secondary data can be analyzed based on this research.

Further Studies When Employing American Housing Survey Data

1. In this study, we used a single variable regarding neighborhood condition instead of exploring several neighborhood-related AHS variables, such as crime, traffic, school, and noise. In the future, another approach using each neighborhood-related variable could also be considered when investigating relationships between each neighborhood characteristic (for example, crime, traffic, and schools) and housing adequacy levels.

2. Within the AHS data coding, the variable related to race of householder has been named as *RACE1, HHRACE, or RACE*. Since 2003, the variable was categorized into 21 groups (exhibit 3). In this study, we used a single file version, *race1* (*hhrace*) to develop a minority group from 21 race categories (exhibit 3); most low-income minority householders in the South were *Black Only* (87 percent). From Econometrica, Inc. (2011), nearly 92 percent of Hispanic people are categorized as *White Alone* in AHS. It was a limitation of our study that the race variable did not allow us to include Hispanic householders as a minority population. Therefore, if a researcher wants to explore a sample of minority householders including Hispanic people, one more variable from the AHS could be considered. The variable is named as *SPAN, SPAN1, or HHSPAN* (long description: *Is this person Hispanic or Spanish-American?*).

3. When exploring housing challenges, housing satisfaction can also be considered as a representative term, based on the housing adjustment theory. Housing satisfaction provides *contentment levels with current housing conditions* (Morris and Winter, 1978). From this aspect, an AHS variable of *housing satisfaction score* [a 10-point rating scale, from 1 (worst) to 10 (best)] could be employed to measure housing challenges. The variable was not employed in this study, however, because of its subjective measurement characteristic. A single measure of housing satisfaction as a dependent variable has long been a challenge for researchers given the high positive response level. When using the AHS housing satisfaction variable, the respondents tend to be very satisfied with their housing and few people expressed dissatisfaction. For example, Lee and Parrott (2010), James (2008), and Liu (2005) all employed the AHS variable, housing satisfaction score, for their research and obtained a relatively high satisfaction average score, nearly 8 out of 10. Despite this limitation, the variable can be useful if a researcher wants to explore perception of housing conditions or subjective housing satisfaction levels of household members.

Conclusion

Low-income minority households, by definition, can be expected to experience constraints in achieving adequate housing. Our study revealed a number of factors that were associated with both a greater and lesser likelihood to live in adequate housing. Some factors, such as income and education, were anticipated. Other factors, such as native birth, urban residence, and apartment living, are less easily explained. Challenging and interesting research questions result from our findings and await further study.

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Housing Value, Costs, and Measures of Physical Adequacy

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Abstract

Part of the U.S. Department of Housing and Urban Development's (HUD's) mission is to create quality affordable homes for all. To accomplish this mission, HUD must define quality and must develop a method for detecting physically inadequate housing units. In the past, researchers have relied on summary indicators of inadequacy provided on the American Housing Survey (AHS) public use data file. These measures are designed by HUD and are used by HUD for HUD purposes. This article reexamines these standard indicators in a hedonic regression framework, using AHS data to develop models that estimate house values and rent. The hedonic models are then used to define a new indicator of physical inadequacy that has a statistically significant negative effect on house values and rents, in contrast to the traditional indicators that are not statistically significant and often have the wrong sign. The new indicator indentifies a substantially larger number of housing units in the United States as being physically inadequate, especially single-family units, suggesting that the need for housing assistance is more widespread than is generally recognized. Housing units identified as inadequate under this new criterion are concentrated in the older stock and are disproportionately occupied by households with children. The new criterion also identifies a substantial number of nonseasonal, vacant single-family housing units as being physically inadequate, implying that the inventory of existing homes on the market may be effectively overstated. The statistical models used to derive these results also illustrate the practical utility of a large number of variables in different sections of the AHS. Many neighborhood characteristics are shown to have a significant effect on home values, for example, which is information of potentially great value to homeowners and local governments.

Introduction

An important aspect of the U.S. Department of Housing and Urban Development's (HUD's) mission is its goal of creating quality affordable homes for all. To accomplish this goal effectively, it is necessary to consider affordability and quality in tandem. Affordability may be achieved by neglecting routine maintenance and allowing properties to deteriorate, or by failing to replace or renovate very old housing units to bring them more in line with modern building codes. Few people would consider these to be desirable outcomes.

Historically, to judge the quality of the U.S. housing stock, researchers have typically relied on standard criteria for classifying housing units as physically adequate or inadequate, using characteristics of the housing units collected in the American Housing Survey (AHS). The AHS, which is funded by HUD and conducted by the U.S. Census Bureau in odd-numbered years, collects information on a large number of housing characteristics. A number of these characteristics are combined to produce a variable that classifies housing units as adequate, moderately inadequate, or severely inadequate. This variable is included on the AHS public use file. These measures are designed by HUD and are used by HUD for HUD purposes. It is much more common to accept this traditional classification scheme uncritically than to consider an alternative specification, despite the richness of the AHS data set that would permit extensive experimentation with alternatives.

Relying on the standard AHS adequacy classification scheme produces a view of the U.S. housing market in which problems of high housing costs relative to income are considerably more widespread than problems of poor-quality housing. For example, HUD's latest report to Congress on "Worst Case Housing Needs" (HUD, 2011) states, "Of the two types of priority problems that qualify as worst case needs, severe rent burden appears far more frequently than severely inadequate housing." An implication is that the problem of physically inadequate housing in the United States and its interaction with affordability, although of interest from a theoretic perspective, can often be comfortably neglected in favor of a concentration on affordability problems.

This article investigates the issue of housing quality in a hedonic regression framework that estimates the effect of various housing characteristics and different definitions of inadequacy on the value of owner-occupied and cost (rent) of renter-occupied housing units. The underlying hypothesis is that inadequate housing units should have lower values (if they are owner occupied) or rents (if they are renter occupied), controlling for other characteristics.

The Baseline Regressions section presents baseline hedonic regression results for owner-occupied single-family housing units and renter-occupied multifamily units. The Physical Inadequacy section proposes new definitions of inadequacy and shows how the new definitions compare with the standard ones that have been used historically when added to the pertinent baseline regression. The next section, Characteristics of Inadequate Housing Units, addresses the number of housing units flagged as inadequate and the characteristics of the inadequate units and their occupants under the proposed new classification scheme. The final section summarizes the results and offers conclusions.

Baseline Regressions

The primary statistical technique used in this study is called hedonic regression. In practice, hedonic regression refers to a technique that estimates the price of a good based on its characteristics. Hedonic price estimation dates back at least to Waugh (1928), although Griliches (1961) and Rosen (1974) are usually credited for establishing it as a widely used technique. One general use of hedonic regression is to estimate a constant quality price index for a heterogeneous set of commodities. It is often used this way in housing markets, for example to derive constant quality price indices for new construction (U.S. Census Bureau, 2005). It is also used to estimate the marginal effect of a particular characteristic on the price of a commodity.

Hedonic Regression Specification

One central problem in estimating a hedonic regression is model specification. This problem can be particularly challenging in the case of housing because a housing unit is a complex commodity with an effectively infinite number of characteristics that can affect its market price. For this reason, any hedonic housing model will fail to capture some relevant characteristics and, therefore, must be misspecified to a certain extent. Moreover, some characteristics are likely to be collinear, tending to obscure the marginal effect of a particular attribute. The collinearity problem, in general, is less of an issue when the primary objective of the hedonic model is to drive an index that predicts the value of a housing unit.

Even if prediction is the primary intent, however, most hedonic regression estimates eventually end up being used to assess the marginal effects of particular features. Indeed, a substantial body of hedonic housing market research targets the marginal effect of a particular attribute as the principal objective. Targeting the marginal effect of a particular attribute typically occurs when hedonic models are used for policy analysis, as when estimating the value of environmental improvements. A recent example of using hedonic methods to analyze the marginal effect of environmental improvements is Carruthers, Clark, and Renner (2010).

Marginal effects from hedonic models also have applications for private business decisions. McDonald and McMillen (2007), for example, have argued that hedonic models are useful tools for real estate appraisers because the models provide information on the value of particular attributes. For cases in which marginal effects of particular characteristics are important, as is typically the case, omitted variable bias and collinearity are particularly important and should be taken into account when developing an empirical strategy.

The empirical strategy employed by the National Association of Home Builders (NAHB) in applying the hedonic regression method to AHS data has been developed over a period of several years. The first example, for single-family house prices, appeared in Emrath (1993) with a subsequent extension to multifamily housing in Emrath (1996). Results from the regressions have been made available to the public on the Internet in a form that can be used interactively to estimate house prices, as described in Emrath (2004). The key elements of the NAHB strategy include a substantial effort to clean the data; experimentation with a large number of independent variables, including neighborhood characteristics and interaction terms; and care taken to avoid deleting variables that materially alter estimated coefficients on any of the variables retained.

This strategy is designed to exploit several strengths of the publicly available AHS data set. Although the AHS allocates item nonresponses and truncates many variables to preserve respondent confidentiality, these procedures are well documented so that researchers are able to adjust for them. The longitudinal nature of the AHS—revisiting the same housing units year after year—allows researchers to investigate the way key variables change over time, providing an additional useful aid for screening suspect values. Perhaps most significantly, from the perspective of a researcher trying to estimate a single regression equation, the AHS includes a very large number of housing attributes as well as a large number of observations. The flattened version of the 2009 public use AHS file, for example, contains 2,776 variables and 73,222 observations. Although the public use file includes vacant housing units and noninterviews, the number of observations with usable data is nevertheless large enough to accommodate virtually any conceivable single-equation specification while reducing effects of collinearity.

The complete list of independent variables used in all the hedonic regression models presented in this article are displayed in exhibit 1.

Exhibit 1

List of Independent Variables Used in the Regression Models (1 of 2)

Location indicator	
CENT_NE	Central city in the Northeast census region
CENT_MW	Central city in the Midwest census region
CENT_SO	Central city in the South census region
CENT_CA	Central city in large California metropolitan areas
CENT_WE	Central city in the remainder of the West census region
BURB_NE	Suburban area in the Northeast census region
BURB_MW	Suburban area in the Midwest census region
BURB_SO	Suburban area in the South census region
BURB_CA	Suburban area in large California metropolitan areas
BURB_WE	Suburban area in the remainder of the West census region
NMET_NE	Nonmetropolitan area in the Northeast census region
NMET_MW	Nonmetropolitan area in the Midwest census region
NMET_WE	Nonmetropolitan area in the West census region
The base location omitted from this list is nonmetropolitan area in the South census region.	
Housing unit characteristic	
SIZE1900	Size of the unit in 1,000 sq ft if built before 1950; 0 otherwise
SIZE1950	Size of the unit in 1,000 sq ft if built from 1950 through 1979; 0 otherwise
SIZE1980	Size of the unit in 1,000 sq ft if built from 1980 through 1994; 0 otherwise
SIZE1995	Size of the unit in 1,000 sq ft if built from 1995 through 2006; 0 otherwise
SIZE2007	Size of the unit in 1,000 sq ft if built after 2006; 0 otherwise
SIZEBF85	Size of the unit in 1,000 sq ft if built before 1985; 0 otherwise
SIZE1985	Size of the unit in 1,000 sq ft if built from 1985 through 1989; 0 otherwise
SIZEPOST	Size of the unit in 1,000 sq ft if built after 1990; 0 otherwise
LOTSIZE	Size of the lot in acres for single-family units
BATHS	Number of full bathrooms in the unit
HALFB	Number of half bathrooms in the unit
BEDRMS	Number of bedrooms in the unit
DINING	Number of dining rooms in the unit
FAMRM	Number of family rooms in the unit

Exhibit 1

List of Independent Variables Used in the Regression Models (2 of 2)

Housing unit characteristic (continued)	
OTHROOMS	Number of rooms other than baths and bedrooms for multifamily units; other than baths, bedrooms, dining rooms, and family rooms for single-family units
BA_MW	Indicator for full or partial basement in the Midwest census region
BA_SO	Indicator for full or partial basement in the South census region
BA_CA	Indicator for full or partial basement in large California metropolitan areas
GARAGEX	Indicator for garage or carport included with unit
FIREPLAC	Indicator for presence of a fireplace
AC_MWSO	Indicator for central air conditioning in the Midwest and South census regions
UDISH	Indicator for presence of a working dishwasher in the unit
UDRY	Indicator for presence of a working clothes dryer in the unit
Neighborhood and multifamily building characteristic	
GREEN	Indicator for open spaces within one-half of a block
COMRECR	Indicator for presence of community recreational facilities
COMGATE	Indicator for a unit lying within a gated community
XWATER	Indicator for property not on the waterfront, but with a body of water within one-half of a block
XWFPROP	Indicator for waterfront property
WFP_NE	Indicator for waterfront property in the Northeast census region
WFP_MW	Indicator for waterfront property in the Midwest census region
WFP_SO	Indicator for waterfront property in the South census region
WFP_CA	Indicator for waterfront property in large California metropolitan areas
WFP_WE	Indicator for waterfront property in the remainder of the West census region
XTRAN	Indicator for neighborhood with satisfactory public transportation
XTR_MET	Indicator for satisfactory neighborhood public transportation within metropolitan areas
XSHOP	Indicator for neighborhood with satisfactory shopping
SHP_MET	Indicator for satisfactory neighborhood shopping within metropolitan areas
UELEV	Indicator for unit within a multifamily building, on a floor with access to an elevator
UACCESSB	Indicator for entry system that restricts access to the building
FLOOR_3	Indicator for unit in a building with 3 floors
FLOOR_49	Indicator for unit in a building with 4 to 9 floors
FLOOR_10	Indicator for unit in a building with 10 or more floors
FIFTY_1	Indicator for unit in a building with 1 floor and 50 or more housing units
BARCL	Indicator for buildings within one-half of a block of the unit with metal bars on their windows
ABAN	Indicator for abandoned or vandalized buildings within one-half of a block of the unit
BADROADS	Indicator for roads in need of repair within one-half of a block of the unit
COMCRIME	Indicator for serious crime in the neighborhood within the past year
COMODOR	Indicator for unit in a neighborhood with smoke, gas, or bad smells
XSTNOISE	Indicator for unit in a neighborhood with heavy street noise or traffic
JNK_MET	Indicator for trash/litter/junk within one-half of a block of the unit in metropolitan areas
JNK_NM	Indicator for trash/litter/junk within one-half of a block of the unit outside of metropolitan areas
COM1	Indicator for businesses or institutions within one-half of a block of the unit
COM2	Indicator for factories/industrial structures within one-half of a block of the unit
MB_MET	Indicator for mobile homes within one-half of a block of the unit in metropolitan areas
MB_NM	Indicator for mobile homes within one-half of a block of the unit outside of metropolitan areas
Indicator of physical inadequacy	
NEW_INAD	Unit inadequate according to proposed new criteria described in the text
AHS_MOD	Unit either moderately or severely inadequate according to the traditional AHS criteria
AHS_SEV	Unit severely inadequate according to the traditional AHS criteria

A potential disadvantage of the AHS, which is sometimes cited in an application like the models in exhibit 1, is its national nature and somewhat limited level of geographic detail. The information collected on neighborhood characteristics compensates for the limited geographic detail, to some extent. For some purposes, information on characteristics of the neighborhood, rather than very precise information on the location of the neighborhood, may be a strength rather than a weakness. Although location indicators identifying housing units to within a fine level of geography, such as a specific census tract or block group, could likely be used to improve the fit of a hedonic regression, this approach would not provide information on what aspect of a neighborhood is responsible for improving the fit. Yet, information about the effect of being located on the waterfront or in a neighborhood with abandoned buildings on a property's value would typically be of interest to homeowners and local policymakers. The NAHB strategy of trying a relatively large number of neighborhood characteristics in the hedonic specification seeks to take as much advantage as possible of this section of the AHS.

The location indicators used in this article intersect the four principal census regions (Northeast, Midwest, South, and West) with a metropolitan status measure that identifies if an area is in a central city, suburb, or nonmetropolitan area.[1] This combination of region and metropolitan status, in general, is the most precise level of geographic detail available in the AHS. The AHS does identify certain metropolitan areas (based on the definitions and boundaries of metropolitan areas that prevailed in 1980), but there are, in general, too few observations in a metropolitan area to treat each of them separately in the model. For this article, a number of the large California metropolitan areas were carved out as a separate "region" distinct from the rest of the West, however, a procedure first employed in Emrath (1995). The metropolitan areas included in the California region are Bakersfield, Fresno, Los Angeles-Long Beach, Modesto, Oakland, Orange County, Riverside-San Bernardino, Sacramento, San Diego, San Francisco, San Jose, Santa Barbara-Santa Maria, Santa Rosa, Stockton-Lodi, Vallejo-Fairfield-Napa, and Ventura. It is well known that home values tend to be high in many of these areas, and being in a central city or suburban location within one of the California metropolitan areas has the strongest effect on house values of any of the location indicators. In theory, intersecting 5 regions (Northwest, Midwest, South, West, and California) with 3 metropolitan status categories (central city, suburb, and nonmetropolitan) produces a total of 15 geographically unique areas. Because the California region does not include nonmetropolitan counties, however, in practice the intersection results in only 14 unique areas. To avoid perfect multicollinearity in models with a constant term, the geographically unique area of the nonmetropolitan South is omitted.

An additional specification issue in hedonic regression is the choice of functional form. Although the term hedonic is often used simply to indicate a regression that estimates price of a good as a function of its characteristics, economic theory underlies the technique. Because production costs and utility of a particular good typically both change with changes in its characteristics, a question arises as to whether the hedonic regression captures a demand or supply relationship. The answer

[1] The term *suburb* is used as a convenient way to describe territory inside metropolitan areas but outside the central city. The AHS variable METRO3 is used to define the three metropolitan status categories as follows: central city if METRO3 = 1, suburb if METRO3 = 2 or 3, and nonmetropolitan if METRO3 = 4 or 5. This classification scheme is consistent with the one used in the AHS printed reports.

is essentially both, as equilibrium in a hedonic model represents a point of tangency between the offer curves of a buyer and seller. The relationship between price and a particular characteristic traces an envelope of these tangency points, a point emphasized by Rosen (1974). Although the first derivative of a desirable characteristic is, in general, positive, as increasing a desirable characteristic in a commodity usually coincides with a higher production cost, economic theory otherwise provides little guidance on choice of functional form. Although use of the semilogarithmic specification in exhibit 2 has been commonplace dating back as far as a paper by Court (1939), in the absence of a theoretic justification, some testing of alternative forms is desirable. To allow for some flexibility in functional form and provide a way to test alternatives, all models considered in this article were initially estimated by employing a Box-Cox functional form that transforms the dependent variable (house value or rent) according to the following formula:

$$f(\lambda) = (y^{\lambda} - 1) / \lambda$$

where λ is a free parameter to be estimated. This specification includes linear ($\lambda = 1$) and semilogarithmic ($\lambda = 0$) models as special cases. This functional form was first employed by NAHB to analyze AHS data in Emrath (2002) for single-family housing and in Emrath (2001) for multifamily housing.

Exhibit 2

House Value: Ordinary Least Squares (OLS) Regression Estimates (1 of 2)

Dependent variable: natural logarithm of value of owner-occupied, single-family detached housing units

	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	10.644* (0.421)	10.725* (0.423)	10.738* (0.424)	10.727* (0.424)	10.724* (0.423)
Location indicator					
CENT_NE	0.777* (0.076)	0.637* (0.066)	0.627* (0.065)	0.635* (0.066)	0.636* (0.066)
CENT_MW	0.016 (0.024)	– 0.083* (0.030)	– 0.078* (0.030)	– 0.084* (0.030)	– 0.083* (0.030)
CENT_SO	0.123* (0.021)	0.035 (0.024)	0.036 (0.024)	0.035 (0.024)	0.035 (0.024)
CENT_CA	1.156* (0.109)	1.039* (0.099)	1.034* (0.099)	1.037* (0.099)	1.039* (0.099)
CENT_WE	0.693* (0.067)	0.567* (0.059)	0.562* (0.058)	0.565* (0.059)	0.567* (0.059)
BURB_NE	0.866* (0.080)	0.731* (0.070)	0.724* (0.069)	0.730* (0.070)	0.731* (0.070)
BURB_MW	0.144* (0.024)	0.045* (0.026)	0.046* (0.026)	0.044* (0.026)	0.045* (0.026)
BURB_SO	0.194* (0.022)	0.119* (0.024)	0.120* (0.024)	0.118* (0.024)	0.119* (0.024)
BURB_CA	1.293* (0.122)	1.163* (0.110)	1.156* (0.110)	1.161* (0.110)	1.163* (0.110)
BURB_WE	0.753* (0.071)	0.625* (0.062)	0.619* (0.061)	0.623* (0.062)	0.625* (0.062)
NMET_NE	0.435* (0.047)	0.389* (0.043)	0.385* (0.043)	0.387* (0.043)	0.389* (0.043)
NMET_MW	– 0.088* (0.023)	– 0.111* (0.024)	– 0.112* (0.024)	– 0.112* (0.024)	– 0.111* (0.024)
NMET_WE	0.596* (0.059)	0.580* (0.057)	0.573* (0.056)	0.578* (0.057)	0.580* (0.057)
Housing unit characteristic					
SIZE1900	0.055* (0.008)	0.056* (0.008)	0.058* (0.008)	0.056* (0.008)	0.056* (0.008)
SIZE1950	0.072* (0.008)	0.067* (0.008)	0.067* (0.008)	0.067* (0.008)	0.067* (0.008)
SIZE1980	0.100* (0.011)	0.094* (0.010)	0.094* (0.010)	0.094* (0.010)	0.094* (0.010)
SIZE1995	0.111* (0.012)	0.107* (0.011)	0.106* (0.011)	0.107* (0.011)	0.107* (0.011)
SIZE2007	0.129* (0.018)	0.124* (0.017)	0.123* (0.017)	0.124* (0.017)	0.124* (0.017)
LOTSIZE	0.009* (0.002)	0.012* (0.002)	0.012* (0.002)	0.012* (0.002)	0.012* (0.002)
BATHS	0.213* (0.021)	0.193* (0.019)	0.191* (0.019)	0.193* (0.019)	0.193* (0.019)
HALFB	0.122* (0.013)	0.115* (0.013)	0.113* (0.012)	0.115* (0.013)	0.115* (0.013)
BEDRMS	0.040* (0.006)	0.044* (0.006)	0.045* (0.006)	0.044* (0.006)	0.044* (0.006)
DINING	0.068* (0.010)	0.067* (0.009)	0.067* (0.009)	0.067* (0.009)	0.066* (0.009)

Exhibit 2

House Value: Ordinary Least Squares (OLS) Regression Estimates (2 of 2)

Dependent variable: natural logarithm of value of owner-occupied, single-family detached housing units

	Model 1	Model 2	Model 3	Model 4	Model 5
Housing unit characteristic (continued)					
FAMRM	0.083* (0.011)	0.074* (0.010)	0.074* (0.010)	0.074* (0.010)	0.074* (0.010)
OTHROOMS	0.039* (0.006)	0.038* (0.006)	0.040* (0.006)	0.038* (0.006)	0.038* (0.006)
BA_MW	0.088* (0.018)	0.085* (0.018)	0.085* (0.018)	0.085* (0.018)	0.085* (0.018)
BA_SO	0.193* (0.023)	0.182* (0.022)	0.180* (0.022)	0.182* (0.022)	0.182* (0.022)
BA_CA	0.442* (0.077)	0.452* (0.076)	0.449* (0.075)	0.452* (0.076)	0.452* (0.076)
GARAGEX	0.052* (0.012)	0.039* (0.011)	0.036* (0.011)	0.039* (0.011)	0.039* (0.011)
FIREPLAC	0.141* (0.015)	0.126* (0.014)	0.126* (0.013)	0.126* (0.014)	0.126* (0.014)
AC_MWSO	0.148* (0.018)	0.125* (0.016)	0.118* (0.016)	0.124* (0.017)	0.125* (0.016)
Neighborhood characteristic					
GREEN		0.028* (0.008)	0.029* (0.008)	0.029* (0.008)	0.028* (0.008)
COMRECR		0.025* (0.008)	0.026* (0.008)	0.025* (0.008)	0.025* (0.008)
COMGATE		0.105* (0.019)	0.104* (0.019)	0.105* (0.019)	0.105* (0.019)
XWATER		0.066* (0.012)	0.067* (0.012)	0.066* (0.012)	0.066* (0.012)
WFP_NE		0.170* (0.051)	0.166* (0.051)	0.170* (0.051)	0.170* (0.051)
WFP_MW		0.304* (0.046)	0.301* (0.046)	0.304* (0.046)	0.304* (0.046)
WFP_SO		0.365* (0.046)	0.363* (0.045)	0.365* (0.046)	0.365* (0.046)
WFP_CA		0.324* (0.187)	0.316* (0.187)	0.324* (0.187)	0.325* (0.187)
WFP_WE		0.436* (0.084)	0.429* (0.083)	0.436* (0.084)	0.436* (0.084)
XTR_MET		0.121* (0.014)	0.120* (0.014)	0.121* (0.014)	0.121* (0.014)
SHP_MET		0.046* (0.018)	0.044* (0.018)	0.046* (0.018)	0.046* (0.018)
BARCL		– 0.096* (0.018)	– 0.095* (0.018)	– 0.096* (0.018)	– 0.096* (0.018)
ABAN		– 0.154* (0.022)	– 0.149* (0.021)	– 0.154* (0.022)	– 0.154* (0.022)
BADROADS		– 0.031* (0.008)	– 0.030* (0.008)	– 0.031* (0.008)	– 0.031* (0.008)
COMCRIME		– 0.029* (0.010)	– 0.026* (0.010)	– 0.029* (0.010)	– 0.029* (0.010)
COMODOR		– 0.046* (0.018)	– 0.043* (0.018)	– 0.046* (0.018)	– 0.046* (0.018)
XSTNOISE		– 0.037* (0.010)	– 0.034* (0.010)	– 0.037* (0.010)	– 0.037* (0.010)
JNK_MET		– 0.100* (0.020)	– 0.094* (0.020)	– 0.100* (0.020)	– 0.100* (0.020)
JNK_NM		– 0.018* (0.031)	– 0.010 (0.031)	– 0.017 (0.031)	– 0.018 (0.031)
COM1		– 0.038* (0.010)	– 0.037* (0.010)	– 0.038* (0.010)	– 0.038* (0.010)
COM2		– 0.030 (0.021)	– 0.029 (0.021)	– 0.030 (0.021)	– 0.030 (0.021)
MB_MET		– 0.165* (0.024)	– 0.162* (0.024)	– 0.165* (0.024)	– 0.165* (0.024)
MB_NM		– 0.092* (0.020)	– 0.091* (0.020)	– 0.092* (0.020)	– 0.093* (0.020)
Alternative indicators of physical inadequacy					
NEW_INAD			– 0.112* (0.017)		
AHS_MOD				– 0.014 (0.022)	
AHS_SEV					0.036 (0.036)
Adj. R^2	**0.5044**	**0.5320**	**0.5335**	**0.5320**	**0.5320**

*Standard errors in parentheses. * Indicates a coefficient significant at the 0.1 level.*

Single-Family Regressions

Exhibit 2 shows the results of estimating several specifications of a hedonic model using the 2009 national AHS, where the dependent variable is the natural logarithm of the value of a single-family detached, owner-occupied home. The five models were estimated using NLOGIT 3.0 (the software previously named LIMDEP). Manipulation of the AHS public use file and preparation of a data set for input into NLOGIT was accomplished with SAS.

One feature of the AHS that may be considered a disadvantage in a hedonic model like this is that the dependent variable, the logarithm of the current market value of an owner-occupied housing unit, is based on the owner's estimate of the home's value, rather than an independent appraisal or transaction price reported on real estate records. Researchers have raised questions about the accuracy of owner's self-reported valuations, which were systematically investigated by Kiel and Zabel (1999). They found that recent buyers on average reported home values 8.4 percent above the stated sales price, while owners who had been in their homes for a longer period of time tended to overvalue their homes by 3.3 percent. The average across all owners was a tendency to overvalue their homes by 5.1 percent. However, they also found that, with the exception of length of tenure in the current residence, owners' valuations were not systematically related to characteristics of the owner, housing unit, or neighborhood. If this finding holds, it suggests that coefficients in a correctly specified hedonic model could accurately identify independent variables that have a significant effect on the value of the home, although the coefficients on the independent variables may be inflated slightly.

Before the models were estimated, efforts were undertaken to clean the data, which consisted primarily of removing observations for which the dependent or key independent variables have been allocated, top coded, or appear unreasonable. Deleted were observations for manufactured housing units; cases in which value or size of the unit is allocated or top coded, in which the number of bathrooms or year built is allocated, or in which the house value is $29,000 or less; and, taking advantage of the longitudinal nature of the AHS, in which the housing unit's value has fallen to less than one-third of the value reported for the same unit in 2007. After these deletions, a total of 20,340 observations from the 2009 AHS were used to generate the ordinary least squares (OLS) estimates shown in exhibit 2.

Exhibit 3 shows likelihood ratio tests for each semilogarithmic model shown in exhibit 2 against an alternative of the more general Box-Cox specification. In each case, the estimated value of λ is relatively close to zero—0.009 or smaller in absolute value—and not statistically significant even at, for example, a 0.1 significance level. In other words, the likelihood ratio tests fail to reject any of the semilogarithmic specifications in exhibit 2 in favor of the more general form. Moreover, even if the Box-Cox version of the model were to be used, with an estimated value of λ so close to zero, it would make little practical difference. Hence, the semilogarithmic specification was chosen for the models shown in exhibit 2. Because of the logarithmic transformation, coefficients in exhibit 2 have the interpretation of percentage change in home value that is attributable to a particular independent variable.

Exhibit 3

Likelihood Ratio Tests of Alternatives to House Value Models in Exhibit 2
Dependent variable: natural logarithm of value of owner-occupied, single-family detached housing units

	Model 1	Model 2	Model 3	Model 4	Model 5
	Location indicator	Location indicator	Location indicator	Location indicator	Location indicator
	Housing unit characteristic	Housing unit characteristic	Housing unit characteristic	Housing unit characteristic	Housing unit characteristic
		Neighborhood characteristic	Neighborhood characteristic	Neighborhood characteristic	Neighborhood characteristic
			NEW_INAD	AHS_MOD	AHS_SEV
Test against alternative of a Box-Cox form with parameter λ					
estimate of λ	0.0089	0.0089	0.0078	0.0088	0.0090
χ^2 statistic	1.386	1.437	1.096	1.403	1.456
d.f.	1	1	1	1	1
p-value	0.2391	0.2306	0.2952	0.2362	0.2275
Test against a model with fewer independent variables					
null hypothesis	constant only	Model 1	Model 2	Model 2	Model 2
χ^2 statistic	14,307.826	1,188.738	68.215	0.401	1.032
d.f.	31	23	1	1	1
p-value	< 0.0001	< 0.0001	< 0.0001	0.5265	0.3097

d.f. = degrees of freedom.

Model 1 in exhibit 2 shows the result of regressing the logarithm of home value on locational indicators and housing unit characteristics. Because the geographically unique area of the nonmetropolitan South is omitted to avoid collinearity, the coefficients on the location indicators in exhibit 2 are estimated percentage changes in value relative to a location in the nonmetropolitan South.

Model 1 excludes an important set of characteristics—those that describe neighborhood conditions. Researchers broadly agree that neighborhood conditions can affect property values, so model 1 is included not as a likely candidate for the final model, but to illustrate the sensitivity of coefficients on certain variables, particularly the location indicators, to a significant change in the model's specification.[2] Model 2 includes all the variables in model 1 plus 23 neighborhood characteristics, most of which are statistically significant. The adjusted R^2 statistic, a conventional measure of the fit of the model, is higher for model 2 than for model 1.

Exhibit 3 also shows likelihood ratio tests of model 1 against a model with a constant term as the only regressor, and of model 2 against model 1. The likelihood ratio test is applicable under relatively general conditions that can be used to evaluate all models considered in this article, including those that are nonlinear and estimated with a technique other than OLS. The likelihood ratio tests in exhibit 3 reject a constant-only model in favor of model 1, and model 1 in favor of model 2.

[2] Also, HUD is currently considering deleting many of the neighborhood characteristics the next time the AHS is redesigned. In the future, researchers may have to work with models that do not include these variables.

Coefficients on the independent variable common to models 1 and 2 are relatively stable across specifications, especially the housing unit characteristics. Among the location indicators, the smallest coefficient in model 1 (for CENT_MW) changes sign in model 2 and the second smallest (for CENT_SO) becomes insignificant at the 0.1 level.

Housing characteristics employed in the models include size of the home crossed with the year it was built, because of a systematic tendency for a square foot of living space to be worth more for homes that were built more recently. This tendency may reflect lower maintenance or operating costs that are capitalized into the value of the home, or more stringent building codes that increase perceived safety of the homes and their construction costs. The age of the home may also be acting in part as a proxy for floor plans that change over time in response to consumer preferences or for other features not captured in the data set.

Interactions between location and many of the housing unit characteristics and all of the neighborhood characteristics were tried in preliminary versions of the models and retained in the specifications shown in exhibit 2, where they made a noticeable difference. Among the housing unit characteristics, the strongest effects on home values are associated with the presence of a basement if the presence of a basement occurs in the California metropolitan region, followed by the addition of a full bathroom. The difference in the cost of excavating and constructing a basement relative to the alternatives can vary substantially with location, depending on soil conditions and code requirements for a foundation in the absence of a basement.

All of the housing unit characteristics included in exhibit 2 have a positive effect on home values that is significant at the 0.1 level or better. The 23 neighborhood characteristics in model 2 include those with both positive and negative effects on value. The strongest positive estimated effects on value among the neighborhood characteristics are associated with a location directly on the waterfront. The strongest negative estimated effects come from the presence of abandoned buildings in the neighborhood. Coefficients on two of the neighborhood variables, JNK_NM and COM2, are not significant at the 0.1 level, but the sign of the coefficients and their magnitude relative to other coefficients estimated in the models in exhibit 2 are plausible.

Multifamily Regressions

Exhibit 4 shows estimated results for several specifications of a model in which the dependent variable is a Box-Cox transformed version of monthly rent for multifamily units, defined as units in structures with five or more units. Manufactured housing is excluded. The measure of rent is based on gross rent for units in which no fuel (electricity, gas, or oil) is included in the rental payment. Gross rent includes rent paid to the property owner and the cost of nontelecommunication utilities, regardless of who pays for them. To remove ambiguity and achieve a consistent measure across observations, it is necessary to use gross rent rather than simply the payment made to the property owner, due to the substantial variation that exists in practices for including utility costs in the rental payment. Some ambiguity remains due to differential treatment of items such as water and sewer payments, but these payments are typically small relative to the payment for energy.

Efforts to clean the multifamily rental data from the 2009 national AHS included deleting cases in which the tenant is occupying the unit without paying cash rent; the occupant reports that the unit

Exhibit 4

Multifamily Rent: Box-Cox Regression Estimates

Dependent variable: rent paid by tenants in structures with five or more units, transformed by Box-Cox parameter λ

	Model 1	Model 2	Model 3	Model 4	Model 5
λ	– 0.4291* (0.0344)	– 0.3887* (0.0334)	– 0.3872* (0.0334)	– 0.3887* (0.0334)	– 0.3885* (0.0334)
Constant	2.1586* (0.1368)	2.3230* (0.1491)	2.3297* (0.1497)	2.3230* (0.1491)	2.3238* (0.1491)
Location indicator					
CENT_NE	0.0328* (0.0079)	0.0308* (0.0076)	0.0312* (0.0076)	0.0308* (0.0076)	0.0308* (0.0075)
CENT_MW	0.0134* (0.0037)	0.0091* (0.0034)	0.0092* (0.0034)	0.0091* (0.0034)	0.0091* (0.0034)
CENT_SO	0.0127* (0.0035)	0.0116* (0.0036)	0.0118* (0.0036)	0.0116* (0.0036)	0.0116* (0.0036)
CENT_CA	0.0314* (0.0076)	0.0365* (0.0087)	0.0369* (0.0088)	0.0365* (0.0087)	0.0364* (0.0087)
CENT_WE	0.0160* (0.0042)	0.0157* (0.0045)	0.0158* (0.0045)	0.0157* (0.0045)	0.0157* (0.0045)
BURB_NE	0.0309* (0.0075)	0.0342* (0.0082)	0.0346* (0.0083)	0.0342* (0.0082)	0.0342* (0.0082)
BURB_MW	0.0134* (0.0037)	0.0106* (0.0035)	0.0107* (0.0036)	0.0106* (0.0035)	0.0106* (0.0035)
BURB_SO	0.0163* (0.0042)	0.0164* (0.0044)	0.0166* (0.0044)	0.0164* (0.0044)	0.0164* (0.0044)
BURB_CA	0.0329* (0.0079)	0.0409* (0.0097)	0.0413* (0.0098)	0.0409* (0.0097)	0.0409* (0.0097)
BURB_WE	0.0159* (0.0042)	0.0168* (0.0047)	0.0170* (0.0047)	0.0168* (0.0047)	0.0169* (0.0047)
NMET_NE	0.0210* (0.0065)	0.0208* (0.0072)	0.0214* (0.0073)	0.0208* (0.0072)	0.0209* (0.0072)
NMET_MW	– 0.0016 (0.0027)	– 0.0045 (0.0035)	– 0.0046 (0.0035)	– 0.0045 (0.0035)	– 0.0047 (0.0035)
NMET_WE	0.0044 (0.0035)	0.0049 (0.0044)	0.0047 (0.0044)	0.0049 (0.0044)	0.0047 (0.0044)
Housing unit characteristic					
SIZEBF85	0.0003 (0.0005)	0.0009 (0.0007)	0.0008 (0.0007)	0.0009 (0.0007)	0.0008 (0.0007)
SIZE1985	0.0010 (0.0009)	0.0013 (0.0011)	0.0013 (0.0011)	0.0013 (0.0011)	0.0014 (0.0011)
SIZEPOST	0.0034* (0.0011)	0.0036* (0.0012)	0.0036* (0.0012)	0.0036* (0.0012)	0.0036* (0.0012)
BATHS	0.0069* (0.0019)	0.0076* (0.0021)	0.0077* (0.0021)	0.0076* (0.0021)	0.0078* (0.0021)
HALFB	0.0015 (0.0008)	0.0023* (0.0011)	0.0023* (0.0011)	0.0023* (0.0011)	0.0023* (0.0011)
BEDRMS	0.0042* (0.0011)	0.0071* (0.0017)	0.0072* (0.0017)	0.0071* (0.0017)	0.0071* (0.0017)
OTHROOMS	0.0003 (0.0006)	0.0006 (0.0007)	0.0006 (0.0008)	0.0006 (0.0007)	0.0006 (0.0007)
GARAGEX	0.0050* (0.0014)	0.0043* (0.0014)	0.0043* (0.0014)	0.0043* (0.0014)	0.0042* (0.0014)
FIREPLAC	0.0018 (0.0010)	0.0038* (0.0015)	0.0039* (0.0015)	0.0038* (0.0015)	0.0038* (0.0015)
UDISH	0.0057* (0.0015)	0.0056* (0.0016)	0.0056* (0.0016)	0.0056* (0.0016)	0.0057* (0.0016)
UDRY	0.0049* (0.0014)	0.0059* (0.0016)	0.0059* (0.0016)	0.0059* (0.0016)	0.0058* (0.0016)
Building/neighborhood characteristic					
UELEV		0.0043* (0.0019)	0.0044* (0.0019)	0.0043* (0.0019)	0.0044* (0.0019)
UACCESSB		0.0026* (0.0011)	0.0026* (0.0011)	0.0026* (0.0011)	0.0026* (0.0011)
FLOOR_3		0.0038* (0.0012)	0.0039* (0.0012)	0.0038* (0.0012)	0.0038* (0.0012)
FLOOR_49		0.0104* (0.0029)	0.0106* (0.0029)	0.0104* (0.0029)	0.0104* (0.0029)
FLOOR_10		0.0247* (0.0063)	0.0250* (0.0064)	0.0247* (0.0063)	0.0248* (0.0063)
FIFTY_1		0.0395* (0.0120)	0.0397* (0.0121)	0.0395* (0.0120)	0.0397* (0.0120)
COMRECR		0.0024* (0.0010)	0.0024* (0.0010)	0.0024* (0.0010)	0.0024* (0.0010)
XWATER		0.0032* (0.0013)	0.0032* (0.0013)	0.0032* (0.0013)	0.0032* (0.0013)
XWFPROP		0.0048* (0.0027)	0.0048* (0.0028)	0.0048* (0.0027)	0.0048* (0.0027)
XTRAN		0.0028* (0.0012)	0.0028* (0.0012)	0.0028* (0.0012)	0.0027* (0.0012)
XSHOP		0.0050* (0.0023)	0.0050* (0.0023)	0.0050* (0.0023)	0.0050* (0.0023)
JNK_MET		– 0.0013 (0.0012)	– 0.0011 (0.0012)	– 0.0013 (0.0012)	– 0.0014 (0.0012)
JNK_NM		– 0.0110* (0.0049)	– 0.0107* (0.0049)	– 0.0110* (0.0049)	– 0.0109* (0.0049)
Indicator of physical inadequacy					
NEW_INAD			– 0.0030* (0.0017)		
AHS_MOD				0.0002 (0.0014)	
AHS_SEV					0.0044 (0.0029)
Amemiya's prediction criteria	**0.6179**	**0.5531**	**0.5527**	**0.5535**	**0.5530**

*Standard errors in parentheses. * Indicates a coefficient significant at the 0.1 level.*

is public housing, that the government subsidizes the rent or limits the rent through rent control or stabilization, or that the rent is adjusted because the tenant is related to the owner; the size of the unit is allocated or top coded; the rent or the number of bathrooms is allocated; or the rent has either tripled or fallen to less than one-third of value reported for the same unit in 2007. After these deletions, a total of 2,645 observations from the 2009 AHS were used to generate the regression estimates shown in exhibit 4.

The regressions in exhibit 4 are a Box-Cox functional form with λ, an additional parameter that is estimated with the rest through a maximum-likelihood procedure. Because of the use of this functional form, the adjusted R^2 statistic is not available. As a substitute, the Prediction Criterion (PC) introduced in Amemiya (1980) is provided as an alternate goodness-of-fit measure, where a smaller PC indicates a better fit.

Model 1 in exhibit 4 shows the result of regressing the transformed version of rent on locational indicators and housing unit characteristics. Model 2 includes all the variables in model 1 plus a number of characteristics that pertain to the overall building or community surrounding it. According to PC, model 2 is preferred to model 1. Exhibit 5 shows likelihood ratio tests for the models in exhibit 4. These tests reject a constant-only model in favor of model 1, and model 1 in favor of model 2 against a model with a constant term as the only regressor, and of model 2 against model 1. Both the PC and likelihood ratio tests indicate that a model that includes building and neighborhood characteristics is appropriate.

Exhibit 5

Likelihood Ratio Tests of Alternatives to the Multifamily Rent Models in Exhibit 4
Dependent variable: rent paid by tenants in structures with five or more units, transformed by Box-Cox parameter λ

	Model 1	Model 2	Model 3	Model 4	Model 5
	Location indicator	Location indicator	Location indicator	Location indicator	Location indicator
	Housing unit characteristic	Housing unit characteristic	Housing unit characteristic	Housing unit characteristic	Housing unit characteristic
		Neighborhood characteristic	Neighborhood characteristic	Neighborhood characteristic	Neighborhood characteristic
			NEW_INAD	AHS_MOD	AHS_SEV
Test against null of a linear model ($\lambda = 1$)					
χ^2 statistic	2,210.051	2,228.667	2,226.896	2,228.496	2,230.078
d.f.	1	1	1	1	1
p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Test against null of a semilogarithmic model ($\lambda = 0$)					
χ^2 statistic	167.435	145.452	144.488	145.448	145.470
d.f.	1	1	1	1	1
p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Test against a model with fewer independent variables					
null hypothesis	constant only	Model 1	Model 2	Model 2	Model 2
χ^2 statistic	1,323.449	317.750	373.347	0.0002	2.553
d.f.	24	13	1	1	1
p-value	< 0.0001	< 0.0001	< 0.0001	0.9902	0.1101

d.f. = degrees of freedom.

For each of the models considered in exhibit 4, exhibit 5 also includes likelihood ratio tests for linear and semilogarithmic models against the alternative of the Box-Cox specification. In each case, both the linear and semilogarithmic forms are rejected in favor of the more general alternative of the Box-Cox regression that appears in exhibit 4.

The estimated value of λ varies somewhat across the exhibit, but remains in the neighborhood of -0.4. Analogous to the results shown for the single-family regressions, coefficients on the independent variable common to models 1 and 2 are relatively stable across specifications in exhibit 4, although coefficients on two of the housing unit characteristics (HALFB and FIREPLAC) become significant with the addition of building and neighborhood characteristics to the model.

Because of the Box-Cox functional form, coefficients associated with independent variables no longer have the interpretation of a percentage change in the dependent variable. As an aid to interpretation, a few examples of marginal effects are included in the exposition. If a housing unit with characteristics that produced an estimated monthly rent of $1,000 in the nonmetropolitan South were located instead in a southern central city, the coefficient in model 2 in exhibit 4 implies that its monthly rent would increase by $190. If the original unit were located in a suburb in the "California metropolitan" region rather than the nonmetropolitan South, its rent would increase by $962.

Housing characteristics considered in the rent models include size of the unit crossed with the year in which the structure was built. Although exhibit 4 shows a systematic tendency for a square foot of living space to be worth more in structures that were built more recently, this tendency is shown in considerably less detail than in the single-family model, with vintage differences becoming undetectable among units built before 1985. This lack of detail may be a symptom of the smaller number of observations used to generate exhibit 4, but renters may also be less knowledgeable than owners about the vintage of the building they are living in. Neither the coefficient on SIZEBF85 or SIZE1985 is significant at the 0.1 level, but both are retained in the models under the argument that the hypothesis that rents increase along with square footage of the unit remains reasonable, and the relative magnitude of the coefficients is consistent with the hypothesis that the value of a square foot of living space is higher in newer units.

The coefficient on OTHROOMS is also relatively small and not significant at the 0.1 level. This coefficient is estimated in a model that controls for a number of other characteristics, including square footage of the unit, bathrooms, and bedrooms. It is reasonable to suppose that an extra wall partition in an apartment that does not result in a larger unit, or an extra bed or bathroom, would add relatively little to the rent that can be charged. For a hypothetical unit that rents for $1,000 per month, the coefficient in model 2 in exhibit 4 implies that an extra room without a corresponding increase in square footage would increase the estimated monthly rent by $8.

A number of building characteristics have a significant effect on rents in model 2, particularly those related to the number of floors and units in the building. Tall buildings and buildings containing a large number of units tend to be more common in places where land is expensive, and the indicators for these characteristics are acting as a proxy for this tendency in the model. Some neighborhood characteristics have a significant effect, but there are fewer significant neighborhood effects in the multifamily models than in the single-family models shown in exhibit 2. Again, this difference between single-family and multifamily models may partly reflect the smaller number of

observations used to estimate the multifamily models, but it may also be that renters in multifamily structures feel more isolated from conditions in the surrounding neighborhood and therefore do not attach the same value to these conditions as do single-family homeowners. For a hypothetic unit that rents for $1,000, the coefficient in model 2 in exhibit 4 implies that a waterfront location increases rent for the unit by $73.

Physical Inadequacy

Because an important part of HUD's mission is to create quality housing for all, it is not surprising that a survey such as the AHS, which is funded by HUD to track the condition of housing in the United States, collects considerable information on housing unit quality. Combining this information into a single indicator is far from a trivial exercise, however. The multidimensional nature of housing means that a meaningful analysis of housing quality cannot be reduced to one or two simple characteristics, a point emphasized by Weicher (1979). One implication of this inability to measure quality by using one or two simple characteristics is that data sets that contain information on only a limited number of housing characteristics, such as the American Community Survey, are not useful for detecting physical inadequacy. In fact, it is difficult to imagine a data set other than the AHS that could be effectively used for this purpose.

The AHS had traditionally provided two standards for housing inadequacy—moderately inadequate and severely inadequate. A housing unit is classified as severely inadequate in the AHS if it has any one of the following conditions:

- Fewer than two full bathrooms without hot and cold running water, or without bathtub or shower, or without a flush toilet, or with shared plumbing.
- Respondent who reports being cold for 24 hours or more and at least two breakdowns of heating equipment lasting longer than 6 hours.
- Respondent reporting that the household does not use electricity.
- Exposed wiring, plus a lack of electrical outlets in every room, plus fuses that have blown more than twice.
- At least five of the following conditions:
  - Outside water leaks.
  - Inside water leaks.
  - Holes in the floor.
  - Open cracks in the inside walls or ceilings.
  - An area of peeling paint larger than 8 by 11 inches.
  - Respondent who reports seeing rats recently.

A housing unit that is not severely inadequate is moderately inadequate in the AHS if it has any one of the following conditions:

- At least three of the conditions listed in the previous list.
- More than two toilet breakdowns lasting 6 hours or more.
- Main heating equipment consisting of unvented room heaters.
- Lack of complete kitchen facilities.

Although these criteria are relatively complex, they exploit only a fraction of the data collected in the AHS that could be used as a basis to classify housing units as adequate or inadequate.

The basic structure of the AHS summary inadequacy definitions has been in place for decades, and it appears to have undergone relatively little scrutiny during that time. The changes that have taken place seem to be the result of attempts to streamline the AHS data set rather than to refine or improve the adequacy classification scheme. For example, the definitions of severe and moderate inadequacy were simplified slightly in 2007, removing additional criteria based on problems in common areas of multifamily structures (such as lack of lighting, broken stairways, and loose or no rails on stairs), when questions on some of these characteristics were deleted from the AHS questionnaire.

Moreover, when the concepts of moderate and severe inadequacy were originally defined, although considerable thought went into the process, it was nevertheless done in a relatively ad hoc fashion, without trying alternate specifications in an economic model, according to Crowe (2011), who was involved in the development of the AHS in the 1970s.

This section of the article proposes new summary criteria for determining the physical adequacy of housing units that use somewhat different AHS variables. The new definition of inadequacy presented in this article, identified in the exhibits as NEW_INAD, flags a single-family structure as physically inadequate if it has any one of the following conditions:

- Missing siding.
- Broken windows.
- Holes, cracks, or crumbling in the foundation.
- Sagging roof.
- Holes in the floor.

These characteristics were chosen by running a number of regressions with each possible indicator of inadequacy entered one at a time to identify those that individually tended to lower single-family home values, controlling for other factors. Building conditions, such as the ones used to construct NEW_INAD, would generally cost a significant amount of money, time, and effort to repair, so it is theoretically plausible that they would have a depressing effect on the reported value of single-family housing units.

To illustrate the effect of NEW_INAD on the reported value of the home, model 3 in exhibit 2 adds NEW_INAD to model 2. The coefficient is significant and indicates that, controlling for the other variables in the model, NEW_INAD reduces the value of the single-family unit by roughly 11 percent.

Models 4 and 5 introduce the standard AHS measures of inadequacy, AHS_MOD and AHS_SEV, into the hedonic specification. Although it would be unfair to expect these traditional inadequacy indicators to perform as well as NEW_INAD, which was constructed to work well in the model, the weakness of the traditional indicators in the hedonic specification is perhaps surprising. The estimated coefficients indicate that AHS_MOD reduces house value by 1.4 percent, while AHS_SEV increases house value by 3.6 percent. Neither effect is significant at the 0.1 level. Among the three alternative indicators of inadequacy in exhibit 2, only NEW_INAD improves the fit of the model as indicated by the adjusted R^2.

The hypothesis tests in exhibit 3 also reject model 2 in favor of model 3, but they fail to reject model 2 in favor of either model 4 or model 5.

An advantage of the conditions used to define NEW_INAD for single-family housing units is that they are based on questions asked in all AHS interviews, including interviews conducted for vacant units, allowing investigation into the condition of vacant as well as occupied housing units.

A drawback to the conditions used in the single-family definition of NEW_INAD is that they do not allow for a consistent definition across structure type—for example, the conditions, in general, are not applicable to multifamily structures. Most of the conditions used in single-family NEW_INAD were cited by very few to zero occupants of multifamily rental units in the 2009 AHS. This finding is probably not surprising, given the nature of the characteristics, which refer to the condition of the building rather than a particular unit in a building. Depending partly on the location of their unit within the building, occupants of multifamily structures may be unaware of the condition of, for example, the foundation or roof. Indeed, the occupant may not consider deficiencies in these parts of the building to be problems if the deteriorated condition is located in a part of the structure that is remote from his or her own unit.

Hence, the proposed definition for NEW_INAD for multifamily units is based on a different set of characteristics. NEW_INAD indicates that a multifamily housing unit is inadequate if it has any of the following conditions:

- Lack of a kitchen sink.
- Lack of a bathroom sink.
- Open cracks in the inside walls or ceilings.
- A breakdown of the sewage system since the previous interview.
- Lack of built-in equipment designed to distribute heat throughout the unit in climates with 4,000 or more heating degree days (HDDs).

The individual characteristics used to define the multifamily version of NEW_INAD were also chosen by running a number of regressions with each possible indicator of inadequacy entered one at a time to identify those that individually tended to have a depressing effect on the dependent variable in question—in this case, monthly rent. The characteristics in the multifamily version of NEW_INAD, in general, are observable by occupants of the multifamily unit. Except for a breakdown of the sewage system, the characteristics are also based on information that the AHS collects for both vacant and occupied housing units.

A housing unit is identified as having a lack of built-in heating equipment designed to distribute heat throughout the unit if it has no main heating equipment, or if the main heating equipment is one of the following:

- Vented room heaters burning kerosene gas or oil.
- Unvented room heaters burning kerosene gas or oil.
- Portable electric heaters.
- A cooking stove.

In the AHS, the only one of these heating deficiencies that is used in the definition of inadequate housing is unvented room heaters. Yet, all types of room heaters, portable electric heaters, and gas or electric cooking stoves are often cited as safety hazards by organizations such as the U.S. Consumer Product Safety Commission (2009, 2011).

The multifamily version of NEW_INAD assumes that reliance on any heating equipment that requires so much care on the part of tenants to operate safely is a reasonable indicator of the physical inadequacy of the unit, as is a total lack of heating equipment in an area where heating equipment is needed. The cutoff used to identify areas where heating is needed is a climate with, on average, at least 4,000 HDDs.

The information on climate available in the AHS public use file is somewhat restricted. Climate data are collapsed into six zones, based on both heating and cooling degree days, and sometimes are suppressed for confidentiality reasons. The first three zones (coldest, cold, and cool) are characterized by at least 4,000 HDDs. The standard reference for a picture of the area captured by this degree day requirement is the set of maps produced by the National Oceanic and Atmospheric Administration (2009). In the central part of the country, 4,000-plus HDDs roughly coincide with the area north of Missouri's southern border. Toward the east coast, the line of demarcation drifts upward and the northern part of Virginia is the only part of that state that has 4,000-plus HDDs. On the west coast, the 4,000-plus HDD zone starts well north of San Francisco. In mountainous areas, the cutoff is determined by elevation as much as by latitude. Around the Sierra Nevada and Rocky Mountain ranges, the 4,000-plus HDD zone extends well to the south, but much of this area is sparsely populated.

When considering the depressing effect that a lack of built-in heating in colder climates has on rent, it is useful to recall that the sample used to estimate the models in exhibit 4 excludes cases in which utility payments are included in rents, so the estimated effects on rents are effects on rents exclusive of utility costs.

Analogous to the treatment of inadequacy in single-family regressions, competing definitions of inadequacy are added to model 2 one at a time in exhibit 4. Model 3 adds the proposed new definition of physical inadequacy. The coefficient on this variable is statistically significant and implies that, for a hypothetical housing unit that would otherwise rent for $1,000, inadequacy under this new definition reduces rent by $42.

In contrast, in models 4 and 5, coefficients on the standard AHS measures of inadequacy, AHS_MOD and AHS_SEV, are insignificant and have the wrong signs. For the hypothetical

$1,000-per-month rental apartment, the coefficients in these models imply that AHS_MOD would increase rent by 25 cents and AHS_SEV would increase rent by $67. The PC statistics favor model 3 over any of the alternatives in exhibit 4. The hypothesis tests in exhibit 5 also reject model 2 in favor of model 3, but they fail to reject model 2 in favor of either model 4 or model 5.

Of the three indicators of physical inadequacy considered, the statistics presented in exhibits 2 through 5 consistently favor the new definition proposed in this article over the traditional summary measures provided on the AHS data file in the hedonic models that explain house value and rent levels.

Characteristics of Inadequate Housing Units

The first question that arises in evaluating a proposed definition of inadequacy is the number of housing units that it classifies as inadequate. Exhibit 6 shows the number of housing units classified as inadequate under both of the standard summary criteria in the AHS and under the new criterion proposed in this article.

The standard criteria in the AHS tend to classify a small share of single-family units as inadequate relative to multifamily units. According to these criteria, 1.3 percent of occupied single-family units and 2.9 percent of occupied multifamily units are severely inadequate and 3.5 percent of occupied single-family units are at least moderately inadequate compared with 10.1 percent of the occupied multifamily units. Because a large proportion of the U.S. housing stock consists of single-family housing, however, the standard AHS measures fairly equal numbers of occupied inadequate single-family and multifamily units—2.7 and 2.6 million, respectively, in the case of the moderately or severely inadequate category.

In contrast, the new inadequacy criterion proposed in this article, although based on somewhat different characteristics depending on structure type, captures near-equal shares of occupied single-family and multifamily units, classifying 8.5 percent of single-family units and 8.3 percent of multifamily units as inadequate. These percentages translate into a larger number of inadequate occupied housing units—8.8 million (6.7 million single-family and 2.1 million multifamily units) compared with only 5.3 million for the most inclusive of the traditional AHS inadequacy measures.

Exhibit 6

Number of Housing Units Classified as Inadequate Under Alternative Definitions

	Occupied		Nonseasonal Vacant		Total
	Single-Family	Multifamily	Single-Family	Multifamily	
AHS severely inadequate	991,358	744,606	0	0	1,735,965
	1.3%	2.9%	0.0%	0.0%	1.5%
AHS moderately or severely inadequate	2,727,494	2,607,392	0	0	5,334,886
	3.5%	10.1%	0.0%	0.0%	4.6%
Inadequate under new definition	6,733,007	2,153,890	1,104,633	397,619	10,389,149
	8.5%	8.3%	19.4%	8.9%	9.0%
Total housing units	79,133,307	25,920,344	5,707,567	4,449,398	115,210,615

AHS = American Housing Survey.

The tables published on the Census Bureau's website, based on the 2009 national AHS, show 5.7 million moderately or severely inadequate occupied units rather than 5.3 million, because the Census-published tables include 0.4 million inadequate manufactured housing units, and the tabulations in this article exclude manufactured housing.

Because the proposed inadequacy criterion relies primarily on data that are collected during AHS interviews conducted for both vacant and occupied housing units, it can be applied to vacant housing units. Exhibit 6 also shows estimates of the number of inadequate nonseasonal vacant units.[3] The share of nonseasonal vacant multifamily units that are inadequate is only slightly higher than the share for occupied units, but the inadequate share of nonseasonal single-family units is more than 19 percent. The total number of nonseasonal vacant homes that are now defined as inadequate is 1.5 million. Knowledge of this statistic could significantly alter the way industry observers evaluate the inventory of existing single-family units on the market that are for sale or rent.

Exhibit 7 shows housing units by the year they were built, both for all units and for those that are inadequate under the definition of inadequacy proposed in this article. The inadequate units tend to be relatively old. Roughly one-third of inadequate units were built before 1940 compared with 16 percent of all occupied and nonseasonal vacant units. These results are not surprising because older units have had more time to undergo wear and tear and more time for problems of neglected maintenance to accumulate.

Exhibit 8 partitions the housing stock by geography rather than by vintage. Compared with housing units in general, the inadequate units are found less often in suburbs and more often in central cities and nonmetropolitan areas. A partial exception to this general rule is that, for nonseasonal vacant multifamily housing, the inadequate units are more concentrated in central cities but not in nonmetropolitan areas. Because the housing stock tends to be older in central cities and outside metropolitan areas, the results in exhibit 8, in general, are consistent with those shown in exhibit 7.

Exhibit 9 details the housing cost burden for households in units classified as inadequate under the new inadequacy criterion proposed in this article. Of the more than 8.8 million households living in inadequate housing units in the United States as of 2009, nearly 5.2 million are owners and 3.7 million are renters (exhibit 9). Fewer than 0.5 million owners and renters living in inadequate units are spending 30 percent or more of their incomes on housing. This relatively small overlap means that most occupants of inadequate units are not counted among the cost-burdened (using the traditional HUD definition of an occupant spending at least 30 percent of his or her income on housing) and represent a net addition to the number of American households with housing problems. All households that are both cost-burdened and living in inadequate units earn less than 50 percent of Area Median Income (AMI).

Renters living in inadequate housing units are particularly concentrated at the lower end of the income distribution. Nearly 40 percent of those renters earn less than 30 percent of AMI. Homeowners living in inadequate housing are more evenly spread across the income distribution.

[3] Nonseasonal vacant housing units exclude vacant units that are coded as seasonal, migratory, or held for occasional use. These units are excluded from the tabulations because adequacy standards may be different for housing units not intended for year-round occupation.

Exhibit 7

Housing Units by Year Built

	Occupied		Nonseasonal Vacant		Total
	Single-Family	Multifamily	Single-Family	Multifamily	
Units inadequate under new definition					
Built before 1940	2,073,311	711,765	477,613	185,514	3,448,204
	30.8%	33.1%	43.2%	46.7%	33.2%
Built 1940 to 1949	688,909	150,805	127,836	28,666	996,217
	10.2%	7.0%	11.6%	7.2%	9.6%
Built 1950 to 1959	935,887	157,986	165,810	49,159	1,308,842
	13.9%	7.3%	15.0%	12.4%	12.6%
Built 1960 to 1969	803,426	270,471	99,785	27,372	1,201,054
	11.9%	12.6%	9.0%	6.9%	11.6%
Built 1970 to 1979	1,069,371	521,169	142,209	63,983	1,796,733
	15.9%	24.2%	12.9%	16.1%	17.3%
Built 1980 to 1989	516,269	178,954	39,629	19,637	754,489
	7.7%	8.3%	3.6%	4.9%	7.3%
Built 1990 to 1999	380,763	90,624	15,802	10,095	497,284
	5.7%	4.2%	1.4%	2.5%	4.8%
Built 2000 to 2004	178,932	47,066	15,290	2,771	244,059
	2.7%	2.2%	1.4%	0.7%	2.3%
Built 2005 or later	86,137	25,050	20,659	10,422	142,268
	1.3%	1.2%	1.9%	2.6%	1.4%
Total	6,733,007	2,153,890	1,104,633	397,619	10,389,149
All units					
Built before 1940	12,078,056	4,756,872	1,295,838	957,960	19,088,726
	15.3%	18.4%	22.7%	21.5%	16.6%
Built 1940 to 1949	5,410,738	1,284,757	521,825	221,246	7,438,567
	6.8%	5.0%	9.1%	5.0%	6.5%
Built 1950 to 1959	10,045,797	1,678,732	686,503	206,774	12,617,806
	12.7%	6.5%	12.0%	4.7%	11.0%
Built 1960 to 1969	9,705,514	3,231,039	572,304	456,795	13,965,651
	12.3%	12.5%	10.0%	10.3%	12.1%
Built 1970 to 1979	13,150,016	6,619,579	742,667	1,052,086	21,564,348
	16.6%	25.5%	13.0%	23.7%	18.7%
Built 1980 to 1989	8,642,609	4,034,224	405,514	674,840	13,757,187
	10.9%	15.6%	7.1%	15.2%	11.9%
Built 1990 to 1999	9,449,565	2,112,683	478,721	346,680	12,387,649
	11.9%	8.2%	8.4%	7.8%	10.8%
Built 2000 to 2004	6,044,946	1,296,530	350,801	182,769	7,875,046
	7.6%	5.0%	6.2%	4.1%	6.8%
Built 2005 or later	4,606,067	905,928	653,394	350,246	6,515,635
	5.8%	3.5%	11.5%	7.9%	5.7%
Total	79,133,307	25,920,344	5,707,567	4,449,398	115,210,615

Exhibit 8

Housing Units by Geography

	Occupied		Nonseasonal Vacant		Total
	Single-Family	Multifamily	Single-Family	Multifamily	
Units inadequate under new definition					
Central city	1,930,735	1,315,266	376,062	267,035	3,889,098
	28.7%	61.1%	34.0%	67.2%	37.4%
Urban suburb	1,860,964	526,729	205,822	78,455	2,671,969
	27.6%	24.5%	18.6%	19.7%	25.7%
Rural suburb	932,336	55,413	143,889	9,666	1,141,304
	13.9%	2.6%	13.0%	2.4%	11.0%
Urban nonmetropolitan	673,566	187,674	126,685	30,723	1,018,647
	10.0%	8.7%	11.5%	7.7%	9.8%
Rural nonmetropolitan	1,335,406	68,809	252,176	11,740	1,668,131
	19.8%	3.2%	22.8%	3.0%	16.1%
Total	6,733,007	2,153,890	1,104,633	397,619	10,389,149
All units					
Central city	18,976,616	13,079,571	1,521,548	2,436,767	36,014,503
	24.0%	50.5%	26.7%	54.8%	31.3%
Urban suburb	28,624,659	8,933,583	1,686,688	1,290,695	40,535,626
	36.2%	34.5%	29.6%	29.0%	35.2%
Rural suburb	12,914,932	1,118,746	822,732	211,028	15,067,438
	16.3%	4.3%	14.4%	4.7%	13.1%
Urban nonmetropolitan	6,041,805	2,015,375	554,617	364,156	8,975,953
	7.6%	7.8%	9.7%	8.2%	7.8%
Rural nonmetropolitan	12,575,294	773,070	1,121,982	146,750	14,617,096
	15.9%	3.0%	19.7%	3.3%	12.7%
Total	79,133,307	25,920,344	5,707,567	4,449,398	115,210,615

Exhibit 9

Housing Cost Burden for Households in Units Classified as Inadequate Under the New Definition

Household Income	Owner Occupied			Renter Occupied			Total
	Under 30% of Income	30–50% of Income	50% of Income or More	Under 30% of Income	30–50% of Income	50% of Income or More	
Under 30% AMI	769,197	38,605	106,118	1,165,377	55,057	231,845	2,366,200
30 to 50% AMI	762,509	2,508	0	805,814	0	0	1,570,831
50 to 80% AMI	976,511	0	0	752,663	0	0	1,729,174
80 to 120% AMI	1,100,113	0	0	428,960	0	0	1,529,074
120% AMI or more	1,421,420	0	0	270,198	0	0	1,691,618
Total	5,029,751	41,113	106,118	3,423,013	55,057	231,845	8,886,897

AMI = Area Median Income.

More than one-fourth of those homeowners earn at least 120 percent of AMI. It seems reasonable to suppose that many owners of inadequate units in this income range have resources to upgrade their existing units or move to new ones if they so choose. These homeowners may therefore not be appropriate targets for housing assistance in the conventional sense, but an educational effort that provides information about property repair and maintenance could be worthwhile.

Exhibit 10 shows the number of housing units captured under the new inadequacy criterion proposed in this article by race and ethnicity of the household head. The problems of physically inadequate housing persist across major racial and ethnic categories. More than 76 percent of homeowners living in inadequate units are non-Hispanic White, and this statistic is only about 2 percent less than the incidence of 78 percent of non-Hispanic Whites among all homeowners. In fact, among the groups shown in exhibit 10, only non-Hispanic Black households are overrepresented among the homeowners who live in inadequate units. The racial and ethnic breakdown of renters living in inadequate units is very similar to the breakdown for all renters. In exhibit 10, Hispanic renters are the only group that is overrepresented in the inadequate column compared with its share among all renters, but the difference is less than 1 percentage point.

In contrast to the relatively egalitarian distribution of physically inadequate housing across racial and the ethnic lines, exhibit 11 shows that particular categories of households are disproportionately affected by problems of inadequate housing, and these are families with children. The effect is strongest for single-parent households and other households that are not headed by a married couple but nevertheless contain children under age 18. Although these nonmarried households with children account for 6.7 percent of all homeowners, they account for 11.6 percent of owners living in inadequate housing. Nonmarried households with children, which account for 19.7 percent of renters, represent 26.1 percent of renters in inadequate housing units.

Exhibit 10

Race/Ethnicity of Household Head in Units Classified as Inadequate Under the New Definition

	Owners		Renters	
	In Inadequate Units	All Owners	In Inadequate Units	All Renters
Non-Hispanic White	3,958,482	55,669,648	2,040,241	18,456,583
	76.5%	78.3%	55.0%	54.3%
Non-Hispanic Black	582,333	5,941,607	768,626	7,067,630
	11.3%	8.4%	20.7%	20.8%
Hispanic	424,317	5,952,846	692,640	6,067,802
	8.2%	8.4%	18.7%	17.9%
Other	211,850	3,514,626	208,407	2,382,910
	4.1%	4.9%	5.6%	7.0%
Total	5,176,982	71,078,727	3,709,915	33,974,924

Exhibit 11

Type of Household in Units Classified as Inadequate Under the New Definition

	Owners		Renters	
	In Inadequate Units	All Owners	In Inadequate Units	All Renters
Married couple with children	1,433,851 27.7%	19,536,247 27.5%	592,948 16.0%	4,827,748 14.2%
Other with children	600,449 11.6%	4,746,176 6.7%	967,907 26.1%	6,701,880 19.7%
65 + householder with no children	851,531 16.5%	16,514,343 23.2%	273,081 7.4%	4,336,733 12.8%
Other without children	2,291,152 44.3%	30,281,960 42.6%	1,875,980 50.6%	18,108,562 53.3%
Total	5,176,982	71,078,727	3,709,915	33,974,924

Summary and Conclusion

This article presents baseline hedonic regression models that estimate house values for owner-occupied housing units and rents for rental apartments, building on models developed by NAHB during the past two decades and based on data from the 2009 national AHS. Distinguishing features of these models include extensive use of the allocation flags and other features of the AHS public use file to clean the data before estimation (which includes exploiting the longitudinal nature of the survey and comparing the same unit across years to detect outliers), interaction terms that combine information on the size of the units with the year they were built, and explanatory variables drawn from many sections of the survey, including the section that collects information on neighborhood characteristics.

A relatively large number of neighborhood characteristics have economically and statistically significant effects on the dependent variables, particularly on the value of owner-occupied single-family housing,

This subset of the results, by itself, has a number of potential uses, especially at the local level. For example, homeowners associations or local governments could use the results to estimate how certain public policies (such as providing public transportation, or finding a use for abandoned buildings) are likely to affect home values in particular neighborhoods. Moreover, it is not obvious that these effects could be estimated from any alternative data source that currently exists.

This article combines the regression models with information from the housing quality section and other related sections of the AHS to develop a new summary indicator of physically inadequate housing. This is another line of research that would be difficult or impossible to pursue without the information contained in the AHS. The new inadequacy indicator proposed in this article is based primarily on conditions on the outside of the building (such as missing siding, holes in the roof, and broken windows) for single-family units and conditions that are more readily observed from inside the unit (such as lack of a bathroom or kitchen sink and a household's reliance on heating equipment that poses a risk, or a home with no heating equipment inside the unit) for multifamily

units. This new indictor of inadequacy has a statistically significant and negative effect on house values and rents—in contrast to the traditional summary indicators of inadequacy that are provided in the public use AHS file, which are not significant and often have the wrong (positive) sign.

The new indicator also indentifies a substantially larger number of housing units in the United States as physically inadequate, especially single-family units. The inadequate units are strongly concentrated in the older housing stock and in geographic areas where the housing stock tends to be older, including both central cities and outlying nonmetropolitan areas.

Physical adequacy and affordability are two sides of the same coin, in that affordability may be achieved by neglecting maintenance and repairs, which leads to conditions such broken windows or holes in the roof—or failure to replace or upgrade older units that lack sinks or safe central heating equipment in colder climates—but achieving pure affordability through these means is not in general a desirable outcome.

Very few households identified by the new indicator as living in physically inadequate housing are also suffering from housing costs that are high relative to their incomes. Therefore, the larger number of households living in inadequate units represents primarily a net addition to the estimated number of U.S. households experiencing housing problems that need to be addressed in some fashion. Some households living in inadequate units are owners who appear to be relatively well off, with incomes of at least 120 percent of AMI and housing costs that are less than 30 percent of this income.

From a public policy perspective, the remedy for these cases may primarily be educational. Government organizations could provide homeowners with information about recommended repair and maintenance schedules, or how to cost-effectively upgrade older structures to more current standards. Even net of these relatively well-off cases, however, the estimates of inadequate housing presented in this article indicate that the need for housing assistance in the conventional sense is more widespread than is generally recognized. A disproportionate share of households suffering from inadequate housing are households with children.

The new indicator proposed in this article can also be applied to estimate the number of inadequate vacant housing units. The resulting estimate is more than 1 million inadequate nonseasonal vacant housing units in the United States, with a particularly high rate of inadequacy found among nonseasonal vacant single-family units. An implication of this relatively large number of inadequate vacant units is that the effective inventory of existing single-family units available on the market may be overstated, if it is assumed these units are ready to be sold to prospective full-time occupants without substantial repairs or upgrades.

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Household Energy Bills and Subsidized Housing

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Abstract

Household energy consumption is crucial to national energy policy. This article analyzes how the rules covering utility costs in the four major federal housing assistance programs alter landlord and tenant incentives for energy efficiency investment and conservation. We conclude that, relative to market-rate housing, assistance programs provide less incentive to landlords and tenants for energy efficiency investment and conservation, and utilities are more likely to be included in the rent. Using data from the American Housing Survey, we examine the differences in utility billing arrangements between assisted and unassisted low-income renters and find that—even when controlling for observable building and tenant differences—the rent that assisted tenants pay is more likely to include utilities. Among all tenants who pay utility bills separately from rent, observable differences in energy expenses for assisted and unassisted tenants are driven by unit, building, and household characteristics rather than the receipt of government assistance.

Introduction

Federal housing policy emphasizes both sustainability and affordability (EPA, 2009; HUD, 2010); household energy use is central to both of these priorities. The federal government provides some form of subsidy for more than 6 million affordable housing units, largely through the four major housing programs: public housing, project-based Section 8, the Low-Income Housing Tax Credit (LIHTC) Program, and tenant-based Section 8 (vouchers). This article analyzes how the treatment of utility costs in these programs shapes incentives for energy efficiency investments and conservation. We focus particularly on how program design influences whether utilities are included in the

rent or paid for separately by assisted tenants.[1] We then use the American Housing Survey (AHS) to compare tenant expenditures and utility billing arrangements for gas and electricity among low-income households that do and do not report receiving government housing assistance.

We argue that the reimbursement of utility costs in the major federal housing programs leaves landlords with less incentive to contain costs or improve energy efficiency and more incentive to include utilities in the rent than their private market counterparts. When utilities are included in the rent, assisted tenants have no financial incentives to conserve energy. In contrast, when assisted tenants pay for energy usage separately from the rent, they face the marginal costs of their consumption, much like unassisted tenants in the private market whose utilities are not included in the rent.

Using data from the AHS, we show that respondents who are assisted tenants (who, by program design, have low incomes) report that their utilities are included in the rent more often than unassisted renters who fall into similar income categories. This difference is robust to controlling for observable differences in the characteristics of the buildings of residence and of the respondents. For example, we find that for households that report living in a building owned by a public housing authority (PHA), the share of households for which utilities are included in the rent is 21 percentage points higher for electricity and 10 percentage points higher for gas compared with unassisted tenants, after controlling for observable building and tenant characteristics. Tenants who report receiving assistance in the form of vouchers also report having utilities included in the rent more often than those reporting no subsidy, although the difference is less dramatic than for other forms of household assistance. Although we do not observe consumption or energy efficiency investments in our data directly, we are able to examine reported utility expenditures for households paying utility bills separately from the rent. For this group, we find that observable differences between assisted and unassisted households in mean spending on utilities are attributable to differences in characteristics of the units, buildings, and households rather than receipt of government housing assistance.

This work is motivated by the broader questions of how household energy use responds to price incentives and how the treatment of utility costs in affordable housing programs supports policy goals. The U.S. Department of Housing and Urban Development (HUD) administers federal affordable housing programs as part of its mission to promote "quality affordable homes for all."[2] HUD's housing policy also includes minimizing the environmental impacts of residential energy consumption, as exemplified by the agency's $50 million energy innovation fund, a key component of HUD's sustainability strategy. Household spending on utilities interacts with housing affordability; utility costs may represent a large share of low-income household budgets (HUD, 2000). In addition, HUD's annual spending on public and subsidized housing includes $5 billion for energy (HUD, 2009b). Energy efficiency and conservation gains may present a significant opportunity for savings or resource redirection in a time when the agency is facing significant cuts (HUD, 2011a).

[1] Throughout this article, we use the term "assisted tenants" to explicitly distinguish tenants receiving (or, in the empirical section, reporting receipt of) assistance in one of the four housing programs from "unassisted tenants" who rent in the private market with no (reported) assistance. When applicable, we identify the program from which assisted tenants receive assistance.

[2] HUD's mission statement on http://hud.gov.

Landlords and developers influence energy consumption through energy efficiency investments, maintenance, the appliances they include in units, and whether they offer rent with utilities included (Davis, 2010; Levinson and Niemann, 2004). Renters consider billing arrangements and expected utility costs, among other factors, when choosing an apartment. In addition to these choices that landlords, developers, and tenants make, realized energy consumption also depends on residential utility rates and the characteristics of the residence and the household. The treatment of utility costs in affordable housing programs may alter the incentives framing these choices for both landlords and assisted tenants. This article introduces this potential differential in incentives between assisted and market-rate housing as an opportunity to examine renter and landlord choices that determine energy use and analyze the outcomes of housing policy in this regard. It also contributes to research that informs housing policies that promote affordability while encouraging energy efficiency and conservation.

Utility Costs and Affordable Housing Programs

Federal, state, and city governments have created programs that provide or promote affordable rental options for low- and moderate-income Americans. These programs range from rental units owned and managed by government agencies to voucher programs that subsidize the rent of low-income tenants in privately owned properties. The wider literature has explored many effects of housing assistance. For example, Shroder (2002) reviews the literature on whether housing assistance hinders the self-sufficiency of assisted families, and Khadduri, Burnett, and Rodda (2003) review the literature regarding the most effective use of government subsidies in producing rental housing. Our analysis adds to this literature by examining the interaction between assisted housing programs and utility billing arrangements and expenditures. We begin by describing how the four major federal housing assistance programs treat utility expenses. Public housing, project-based Section 8, LIHTC, and voucher programs together provide the bulk of government housing assistance in the United States. Exhibit 1 compares the size and basic administration of these programs.

The federal government began to fund public housing development with the 1937 Housing Act (Stoloff, 2004). In the late 1960s, federal policy shifted away from public housing in favor of voucher programs and subsidies to privately owned, income-restricted developments. Recent decades have seen the demolition of some public housing and few additions to the overall supply. As of 2009, approximately 1.13 million public housing units existed in the United States (HUD, 2009a).

Exhibit 1

Federal Rental Housing Assistance Programs

Program	Units (millions)	Administering Agency	Funding Agency
Public housing	1.13	Local public housing authority	HUD
Project-based Section 8	1.28	Contract administrator or HUD regional office	HUD
LIHTC	1.70	State and/or local allocating agency	Tax expenditure
Tenant-based Section 8 (voucher)	2.09	Contract administrator or HUD regional office	HUD

HUD = U.S. Department of Housing and Urban Development. LIHTC = Low-Income Housing Tax Credit Program.

Note: Unit counts taken from HUD (2009a) "HUD Assisted Housing Units by Program" table.

Local PHAs own and manage public housing developments. The rent paid by assisted tenants living in public housing is based on tenant income. The development's funding agency, which is usually HUD, covers additional operating costs. In some developments, PHAs pay utility costs not included in the rent from their own operating budgets. When all utilities are included in the rent, assisted tenants in public housing pay 30 percent of their income in rent. At the end of every year, the housing authority submits its utility costs to HUD as part of the subsequent year's funding request. HUD compares the year's utility costs with the average utility costs for the previous 3 years. If costs decreased, HUD adjusts the subsequent year's utility cost funding downward by 25 percent of the decrease; if the utility costs are higher, HUD increases subsequent funding by 25 percent of the increase.[3] Variability in utility costs that may result from energy price fluctuation or a PHA's efficiency and conservation initiatives is absorbed elsewhere in PHA budgets. The extent to which changes in energy expenses affect a PHA's operating budget, and subsequently a PHA's energy efficiency investments and conservation efforts, is a research question that would require analysis of HUD or PHA administrative data. Within the scope of this article, we note that these partial budget adjustments represent a potential cost or benefit to PHAs of including utilities in assisted tenants' rents, depending on energy price variability and opportunities for efficiency or conservation improvements.

In other public housing developments, assisted tenants pay some or all of their utility bills separately from rent. Every year, the local PHA develops a utility allowance schedule based on typical household utility bills in the area. The allowance is a flat amount, based on the number of bedrooms in a unit. For example, in 2010, the New York City Housing Authority set the monthly utility allowance for gas and electricity at $71 for a one-bedroom apartment in an elevator building.[4] When an assisted tenant in public housing pays utilities, the rent—originally 30 percent of income—is decreased by the unit's applicable utility allowance. The assisted tenant keeps or pays the difference, depending on whether the incurred bill is more or less than the utility allowance. If utility costs rise by more than 10 percent during the year, the PHA may adjust the allowance before the annual budget review.

The project-based Section 8 program was developed under the Housing and Community Development Act of 1974. In this program, private owners and developers contract with HUD to reserve a fraction of a building's units for low-income tenants. HUD sets local income limits that determine what constitutes "low-income"—typically 80 percent of Area Median Income (AMI). In these units, assisted tenants pay 30 percent of their income in rent, and HUD pays the landlord the difference between the assisted tenant's payment and HUD's approved rent, which is based on a local Fair Market Rent (FMR).[5] Approximately 1.28 million project-based Section 8 housing units existed across the country as of 2009 (HUD, 2009a).

[3] 24 Code of Federal Regulation (CFR) § 990.110.

[4] New York City Housing Authority Section 8 Assistance General Information: Voucher Payment Standards. Available at http://www.nyc.gov/html/nycha/html/section8/voucher_payment.shtml.

[5] HUD calculates FMR for each metropolitan area using the Office of Management and Budget's definition of a metropolitan area. HUD uses various inputs to calculate each metropolitan area's FMR, including the census, American Community Survey data, and the Consumer Price Index (*HUD Register* Vol. 75, No. 191, 2010). Nonprofits own many project-based Section 8 properties. In these cases, HUD bases rents on operating costs, capped at FMR, except for high market areas, which can go above FMR.

Similar to those in public housing, some assisted tenants in the project-based Section 8 program have utilities included in the rent and others pay utilities separately. However, some key differences exist in implementation between the two programs. When utilities are included in the rent, project-based Section 8-assisted tenants pay 30 percent of their incomes in rent, and the additional HUD subsidy to the landlord includes the difference between the assisted tenant's payment and HUD's approved rent plus utility costs. An owner initially establishes utility costs based on similar buildings but is able to adjust that amount based on actual costs in subsequent years. If utility costs are higher than in the previous year, an owner can submit a rent adjustment request based on the higher costs. Because project-based Section 8-assisted tenants' rents are capped at 30 percent of their incomes, the adjustment results in a larger subsidy from HUD. HUD expects owners to submit cost reimbursement adjustments every year, including years in which costs decline. In practice, most owners ask for adjustments less frequently than once a year (Goodman and Wolsky, 2011). Profit motives suggest that owners are more likely to request adjustments in years with relatively high utility costs, when reimbursements would be increased.

When the assisted tenant pays utilities and rent separately in a project-based Section 8 property, the assisted tenant's rent payment is discounted by a utility allowance. Each month, an assisted tenant pays the owner 30 percent of his or her income, minus the utility allowance, and HUD subsidizes the remaining approved rent. The assisted tenant's utility allowance is based on an analysis of recent utility costs in the area, adjusted for the number of bedrooms in the unit, and may be further adjusted to reflect individual building costs.[6] These building-specific utility allowance adjustments often require assisted tenants to provide landlords with utility bills and landlords to then submit the bills to HUD for verification of the building-specific average utility cost per unit. As in public housing, project-based Section 8 assisted tenants face the marginal cost of their consumption in this scenario. Again, cost motives suggest that assisted tenants in the project-based Section 8 program are more likely to submit their bills only in years with high utility costs, when allowances would be increased. In addition, landlords might view collecting bills as an unreimbursed administrative cost that provides them no financial benefit.

The LIHTC Program, created in 1986, gives tradable tax credits to developers who build or rehabilitate affordable housing. More than 1.7 million LIHTC units exist nationally (HUD, 2011b). For a project to qualify for LIHTCs, for the first 30 years of the building's operation, households with incomes of 50 percent or less of the AMI must occupy at least 20 percent of the project's units, or households with incomes of 60 percent or less of the AMI must occupy 40 percent of the units. Either the assisted tenant or the landlord can pay the utilities in a LIHTC property. Most LIHTC properties, however, have billing arrangements in which the assisted tenant pays at least some of the utilities (Montesinos, 2011).

Rent and utility allowance rules for LIHTC properties differ from those of the other programs. The state or local agency administering the credit caps rents at no higher than 30 percent of the monthly household income each property is targeting. A tenant's individual income determines eligibility for a unit but not the amount of the monthly rental payment. Because the local administering agency

[6] 24 CFR § 880.610.

establishes rents annually, the utility allowance is the only local variation in maximum rents for the low-income units in two properties targeting the same income band. An owner can use a utility allowance that is set by the local PHA, by the administering agency, or by a professional who analyzes costs for the previous year.[7] If the LIHTC-assisted tenant pays utility bills separately from rent, the owner must reduce the rent by this utility allowance and the assisted tenant must pay the actual billed costs of utility consumption from this allowance. Accordingly, the assisted tenant benefits if actual costs are less than the allowance but must pay out of pocket for any utility costs that exceed the allowance. When utilities are included in the rent, the owner receives the normal LIHTC rent from the assisted tenant and utility costs are part of landlord operating expenses. In this scenario, fluctuations in utility costs directly affect the landlord's bottom line.

HUD's Section 8 voucher program provides a subsidy that low-income voucher recipients can use toward any privately owned rental unit with a rent at or below the "voucher rent," usually 110 percent of FMR, set by the local PHA. More than 2 million U.S. households were receiving vouchers as of 2009 (HUD, 2009a).

For the voucher program, the local PHA establishes a utility allowance based on citywide averages and projected utility rate changes, again adjusted by the number of bedrooms in a unit. If utilities are not included in the rent, the voucher-assisted tenant pays the landlord 30 percent of his or her income, minus the utility allowance, and HUD pays the remaining rent each month. If the owner pays for utilities, HUD's payment includes the utility allowance, and the assisted tenant pays 30 percent of his or her income in rent. In principle, the amount HUD pays the landlord is the same in either scenario, with the assisted-tenant payment decreased by the utility allowance amount when utilities are paid separately. The local PHA will adjust rents and utility allowances annually based on the previous year's market trends and costs, but it will adjust the utility allowance more frequently if utility costs increase more than 10 percent during the year (HUD, 2001).

Incentives for Billing Arrangement and Utility Consumption

Our review of the treatment of utility expenses in housing assistance programs suggests that program design may alter landlord and assisted-tenant incentives that shape decisions that affect energy consumption, including how to bill utilities. A program's structure may induce landlords to offer rental contracts that include or exclude utilities. Program incentives, billing arrangements, landlord investments, and assisted tenant preferences together determine consumption levels and future investment decisions. In this section, we first highlight key issues in determining billing arrangements in the unassisted rental market, then contrast this standard setting with the incentives for utility billing arrangements in assisted rental housing. We then look at consumption incentives when utilities are and are not included in rent under assisted housing programs.

Levinson and Niemann (2004) develop a model of energy use by unassisted tenants in the private rental market when landlords pay for utilities. Their model, outlined and extended in the following section, highlights the paradox of rental contracts that include utilities, which, in the basic model,

[7] 26 CFR § 1.42-10(b).

results in economic loss relative to contracts in which unassisted tenants pay utility bills separately. The model demonstrates that "landlord-side explanations" of metering costs, economies of scale, and asymmetric information about a building's energy efficiency can resolve this paradox. Using Residential Energy Consumption Survey (RECS) data and AHS data, the authors find evidence that these landlord-side explanations, rather than tenant preferences, drive billing arrangements.

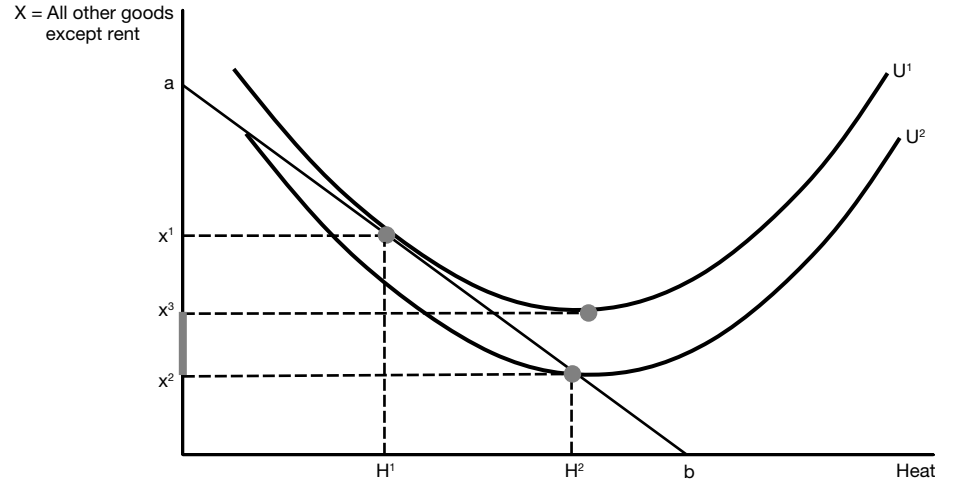
Research in the energy efficiency sphere has focused on principal-agent and split-incentive problems in landlord-tenant relationships (Davis, 2010; Gillingham, Newell, and Palmer, 2009). If unassisted tenants renting in the private market pay utility bills, landlord (agent) investments determine the level of energy efficiency in the unit, and the tenant (the principal) pays the associated costs. The unassisted tenant, in general, has incomplete information about the energy efficiency of the building; this lack of information makes it difficult for the landlord to pass on the full costs of economic welfare-improving energy efficiency investments. Accordingly, landlords are likely to underinvest in energy efficiency (Jaffe and Stavins, 1994; Maruejols and Young, 2010). In contrast, when owners pay the bill, unassisted tenants do not face the marginal cost of consumption and will consume more than the efficient amount of utilities. Levinson and Niemann's empirical analysis confirms that rents are higher in apartments with utilities included, but the increase does not cover the cost of the induced consumption. Munley, Taylor, and Formby (1990) also find evidence of additional usage.

We now adapt Levinson and Niemann's model to the case of affordable housing programs. Tenants have a dollars, which unassisted tenants divide between *Heat* and X (all other goods) after paying rent. X is a numeraire and the price of *Heat* is a/b. Tenant utility, U, has a satiation point—the ideal temperature when the price of consumption is zero. Exhibit 2, reproduced from Levinson and Niemann (which does not consider housing assistance), depicts optimal consumption in this model for unassisted tenants. When heat is not included in the rent, the unassisted tenant faces the marginal cost of consumption, utility is maximized at (H^1, X^1) with marginal tradeoffs equalized, and unassisted tenants spend $(a - X^1)$ on heat. When unassisted tenants do not face marginal costs, they consume to their satiation point. The model requires that landlords break even, so monthly rent increases to cover the increased consumption. This condition implies that the new consumption is on the old budget line, so when the landlord pays the bill, consumption is (X^2, H^2) with rent (now including heat) increasing by $(a - X^2)$. Using this model, the fact that we observe rental contracts in which landlords pay the utility bill is puzzling, because it results in lower unassisted tenant utility. As indicated previously, Levinson and Niemann and others explore resolutions to this question, including metering costs, economies of scale, and energy efficiency signaling.

As reviewed previously, public housing, the project-based Section 8 program, and voucher program target assisted tenants' housing and utility costs (simplified to heating for this discussion) as no more than 30 percent of income, whereas LIHTC properties fix assisted tenants' rents based on area incomes. Exhibit 3 depicts consumption decisions when the model is adapted to reflect the program design. First, consider the case in which the assisted tenant pays the heating bill. The assistance programs require the assisted tenant to pay the landlord rent—30 percent of income—less a "utility allowance" which, to avoid confusion with economic utility and to reflect Levinson and Niemann's exposition, we refer to as a "heating allowance," HA. In this scenario, the assisted tenant divides $0.7I + HA$ dollars (where I is income) between *Heat* and all other goods and maximizes utility by choosing (H^1, X^1). The assisted tenant spends $0.7I + HA - X^1$ on heat. If the housing authority has

Exhibit 2

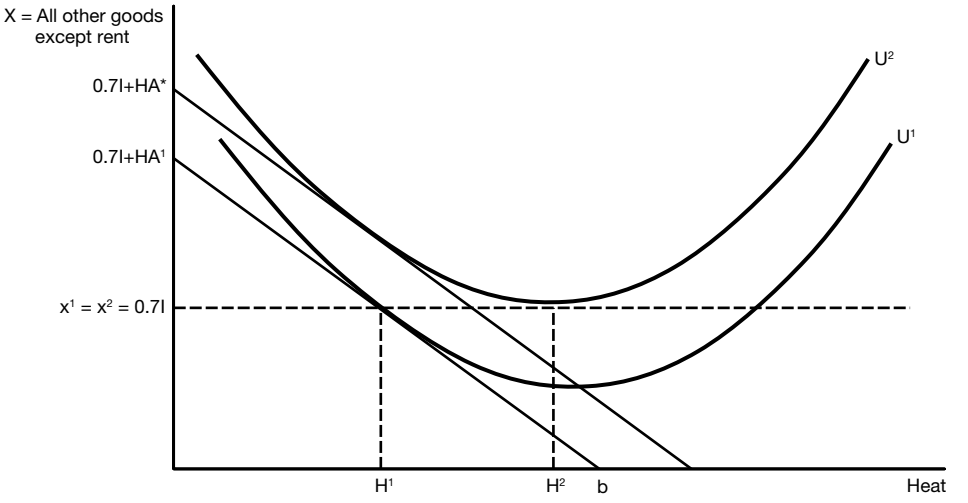
Optimal Consumption in Levinson and Niemann's Model for Unassisted Tenants



a = tenant after-rent income in dollars. b = tenant after-rent income in heat. U = tenant utility.
Source: Levinson and Niemann (2004)

Exhibit 3

Assisted Household Heat Consumption Decision



b = tenant after-rent income in heat. HA = heating allowance. U = tenant utility.

set the heating allowance to equal this amount of actual spending, then the assisted tenant indeed spends 30 percent of income on rent and heating costs, and $X^1 = 0.7I$. For any income range in which both *Heat* and *X* are normal goods, if the heating allowance is less than this amount, the assisted tenant will spend more than the heating allowance on heat. If the allowance is more than

this amount, the assisted tenant will spend less than the heating allowance. Notice that the difference in consumption between assisted tenants who pay for utilities separately and receive assistance and tenants who pay for utilities separately and do not receive assistance is driven entirely by the increase of after-rent disposable income provided by the housing assistance. To the extent that heat is a normal good, we expect this income effect to be positive, although the magnitude may be small.

When the landlord pays the heating bill, the assisted tenant pays the landlord 30 percent of income in rent, and the administering agency reimburses the landlord based on historical (or geographical) utility costs. As in Levinson and Niemann's market setting, assisted tenant heat consumption increases to the satiation point. Unlike in the market context, rents (and government reimbursements) are not sensitive to the amount of heat consumed. The assisted tenant consumes $X^2 = 0.7I$ of X and H^2 of *Heat*, which is preferable to consumption when assisted tenants face heating bills and a calibrated heating allowance. Of course, the assisted tenant would prefer to receive the cost that the housing authority is incurring to heat the apartment to H^2, but would spend only a fraction of that amount on heating. A heating allowance, *HA**, exists which would make the assisted tenant indifferent between the optimal consumption when paying the heating bill and satiated heating with a total rent of 0.3I. If the housing authority's heating allowance is less than *HA**, the assisted tenant is made worse off by paying the heating bill and $0.3I - HA$ in rent compared with having the landlord pay the heating bill and the tenant paying $0.3I$ in rent. If the heating allowance is greater than *HA** in this case, then the tenant is made better off. To the extent that allowances to assisted tenants paying utilities separately are calibrated to actual spending, our model predicts that assisted tenants would prefer that the landlord pay the utilities.

To summarize, because rents in housing assistance programs are set proportionally to tenants' income, when those rents include utilities, an assisted tenant's after-rent budget does not adjust with average utility costs, as would be expected in unassisted housing. This decoupling leaves assisted tenants better off when utilities are included in the rent set at 30 percent of income than with an allowance targeted so that observed rent plus utility spending equals 30 percent of income.

We now turn to landlord incentives based on our description of the assistance programs. Let *FMR* be the rental rate agreed between the landlord and the administering agency for a given subsidized apartment. When the landlord pays the heating bill, the housing authority pays the landlord the difference between the *FMR* and 30 percent of the assisted tenant's income, plus a heating allowance. The assisted tenant pays 30 percent of his or her income to the landlord, but we assume there is a risk that the assisted tenant will not make the payment. The landlord incurs known administration and maintenance costs (which could be allowed to depend on the billing arrangement) plus a heating bill. The amount of the heating bill is uncertain, because it depends on use and on the potentially changing price of heat. When the landlord pays the heating bill, the landlord's per-assisted-tenant profits are

$$Profit_{\text{llpays}} = (FMR - 0.3I) + E(0.3I) - Admin - E(HeatingBill_{\text{ll}}) + HA_{\text{ll}}. \quad (1)$$

Anecdotal evidence suggests that, although HUD often adjusts landlord utility allowances upward after years when utility costs are high, the allowances are not adjusted downward when costs are low. Under this scenario, HA_{ll} will be above the expected heating bill, and, when it is not, landlords are likely to recoup losses in future years. The difference is potentially profitable. In addition,

landlord administration costs may be lower when paying the bills because, when assisted tenants pay, landlords may have to collect bills from assisted tenants for the administering agency's use in determining tenant *HA*.

When assisted tenants pay the heating bill, the amount they pay the landlord decreases by the assisted tenant heating allowance HA_{ten}, and the amount the housing authority pays the landlord increases by this amount. The overall administrative and maintenance costs are still *Admin*. The landlord's per-assisted-tenant profits when the assisted tenant pays the heating bill are

$$Profit_{tenpays} = (FMR - (0.3I - HA_{ten})) + E(0.3I - HA_{ten}) - Admin. \quad (2)$$

When the assisted tenant pays the utilities separately, the landlord receives a greater proportion of the *FMR* from the housing authority, which is assumed to pay with certainty, whereas the assisted tenant may miss rent payments. This factor would lead the landlord to prefer that assisted tenants pay the bills.

If assisted tenants never miss rental payments and administration costs are the same under both regimes, the housing authority sets $HA_{landlord} = E(HeatingBill_{landlord})$, and the landlord's profit is the same under both scenarios. Thus, the landlord is indifferent between the two utility billing arrangements. Our understanding of program implementation suggests that, in the place-based programs (public housing, project-based Section 8, and LIHTC), administration costs are lower when landlords pay the bills, and heating allowances for a particular building are more likely to increase than to decrease. We would expect landlords in these programs to prefer to include utilities in the rent more often than their private market counterparts. In contrast, landlords of voucher holders may be less familiar with housing assistance reimbursement rules or face different cost structures because, at any given point, they may or may not have tenants receiving assistance. As such, these landlords are less likely to benefit from economies of scale in interacting with program rules and may be less likely to deviate from market practices in determining utility billing arrangements. We also note that neither scenario encourages landlords to make energy efficiency investments.

HUD has several policy goals for low-income housing programs. The primary goal is to provide low-income households with quality affordable housing, including adequate consumption of energy and other housing utilities. Adequate heat and electricity consumption is more likely when utilities are included in rent, rather than as a separate component of low-income household budgeting. HUD also gives priority to the continued participation of private owners in affordability programs, often referred to as the "preservation of affordable housing." Exposure to energy cost uncertainty without the possibility of recouping costs from assisted tenants may discourage participation, a concern that is mitigated if HUD reliably reimburses utility expenses. The agency's budget, which encourages program cost minimization, constrains these goals. Passing utility costs in affordable housing programs on to assisted tenants may lower HUD's costs, but it may also interfere with the primary goal of quality housing and utility provision. Increasing landlords' exposure to utility costs may also reduce HUD's budget, but, if landlords' profitability declines, HUD's preservation priorities may suffer. Although HUD does have an incentive to promote energy efficiency initiatives in new properties and in rehabilitating existing properties, to the extent that such initiatives lower HUD's costs, HUD must confront the tension between its policy goals and the potentially adverse effects that encouraging efficiency gains may have on landlords' and assisted tenants' financial incentives.

In summary, market forces require private market rents to respond to the increased average costs associated with including utility payments in rental contracts. At the same time, these contracts lead tenants to consume beyond the point at which the marginal benefit equals the marginal costs. Together, these conditions make the existence of these contracts an economic puzzle. In contrast, federal housing policy is not constrained by the market, but rather is focused on limiting housing and utility costs for as many assisted tenants as program budgets allow. Under our simplified exposition of current policy, assisted tenants will prefer rental contracts in which landlords pay utility costs, unless the utility allowance provided to assisted tenants is sufficiently greater than the amount they would spend on utilities when facing marginal costs. In practice, landlords are more likely to prefer paying utility bills because reimbursements are more often adjusted upward than downward, and because assisted-tenant pay regimes may result in higher administration costs. Finally, housing policy goals face a tension between providing sufficient utility consumption and containing costs. A system in which HUD reimburses landlords' utility costs achieves the goals of sufficient utility consumption and encourages program participation, but it does not provide direct financial incentives for energy efficiency or conservation.

Empirical Analysis

Our empirical analysis first compares the proportion of low-income renters who pay utility bills separately for assisted and unassisted tenants.[8] In making the comparison, we control for other factors that might influence landlords to offer, and tenants to prefer, rental contracts including or excluding utility costs. Most of these factors relate to both landlords' costs and tenants' preferences. They include the fuel source for heat, hot water, cooking, and other appliances; the existence of relevant major appliances, such as a dishwasher and clothes washer and dryer; the unit's physical characteristics that correlate to its energy efficiency or indicate quality, such as unit size, number of rooms, presence of a garbage disposal and trash compactor; if the unit is subject to rent control; the building's characteristics, such as age, number of units and floors, and whether the owner lives on site; and household demographics, including size, income, race and ethnicity, and educational attainment. Most of the unit and building characteristics represent significant capital investment decisions by landlords. Household location decisions involve myriad inseparable goods; we intend our large set of controls to control directly and indirectly for household preferences. Housing policy targets housing quality and adequacy, along with broader social objectives that are also related to our controls. In this article we do not explicitly model how either investment decisions or housing choices respond to the design of subsidized housing programs or how program design is determined or responds to the market. Rather, our regression estimates provide a reduced-form description of the observed outcomes that result from these varied and interconnected processes. We present the mean difference in the proportion of households that pay utility bills separately from the rent by government housing assistance status and estimate the regression-adjusted difference in this proportion, controlling for unit, building, and household observables.

[8] We now use "assisted tenants" and "unassisted tenants" to refer to AHS respondents who report receiving and not receiving housing assistance, respectively, as described subsequently.

We also compare utility expenditures for those low-income renters who pay utility bills separately from rent for both assisted and unassisted tenants. Because our data do not include consumption amounts, we focus on reported utility expenditure as a proxy for utility use. As with the determination of the inclusion of utilities with rent, a variety of landlord, household, and policy factors contribute to the amount of a utility used by a household, which, in turn, determines expenditure.[9] We again examine the regression-adjusted differences, controlling for observable differences in units, buildings, and households.

Our data source is the combined AHS national files from 2003, 2005, 2007, and 2009. The primary unit of observation in the survey is the housing unit, which is followed over time. The detailed housing unit information includes the building and occupant characteristics described previously. The survey also reports if households receive government rental assistance and the local income limits that housing authorities use to determine eligibility for assistance. These reports enable us to compare renters who receive low-income housing assistance to similarly low-income households that do not receive assistance.[10] Households report whether they pay utilities separately from, or included in, the monthly rent and, when paid separately, the monthly household expenditures on each utility type. The AHS is unique in providing housing assistance and eligibility information together with utility billing arrangement and expenditure. This information is the basis of our analysis for a significant sample of households drawn from across the country every 2 years.[11] We focus on the two primary energy utilities commonly observed for nearly all households in the AHS: electricity and gas. To construct our sample, we group the 2003, 2005, 2007, and 2009 AHS national sample microdata—the years for which area income limits are available. Our analysis is uniformly robust to narrowing the data set to any given year.

The AHS asks respondents if "the Federal, State, or local government pay(s) some of the cost of the unit," if "the building (is) owned by a public housing authority," and whether a government agency gave them "a certificate or voucher to help pay the rent for this housing unit." We code our government housing assistance variable, *GovAssist*, as a 1 for an affirmative response to any of these three questions and as 0 for a negative response to all. We also examine differences among these assisted tenants by creating three mutually exclusive categories. Our variable *Public* indicates an affirmative response to whether the building is owned by a housing authority, *Voucher* indicates an affirmative response to whether a certificate or voucher was received, and *Other Assist* indicates a positive response to government assistance receipt but a negative response to the other assistance questions. Error in the response to these questions is well documented. The appendix of Shroder (2002) is particularly helpful in assessing the nature of the error. Citing Casey (1992), Shroder reports that, although 91 percent of respondents who actually live in public housing correctly report living in a building owned by a PHA, 33 percent of voucher recipients, 42 percent of project-based

[9] We note that consumer utility pricing schedules are typically nonlinear, motivated in part as an additional policy assistance to low-income consumers. See Ito (2010) for a careful examination of how nonlinear pricing influences consumption.

[10] Because housing assistance is not considered an entitlement, most qualifying households do not receive benefits.

[11] Although the RECS provides higher fidelity reports of household energy consumption and the associated built environment, the small number of housing assistance recipients in the sample preclude using the survey for this overview. We hope to use the AHS and RECS surveys together in extensions of this article.

residents, and 10 percent of eligible unassisted residents incorrectly report living in public housing. Respondents do a somewhat better job identifying whether they receive any assistance; 81 percent of eligible nonrecipients correctly answered that they received no assistance and 3 percent, 17 percent, and 13 percent of public housing, voucher, and project-based recipients, respectively, incorrectly reported no assistance. Because of these reporting errors, our comparisons based on self-reported housing assistance status will likely understate actual differences between households that do and do not receive assistance. In our comparisons among different assistance recipient subgroups, our public housing group will also include households that actuality live in project-based assisted units and voucher recipients, our voucher group will also include households that actually live in project-based units, and our other assistance group will contain both voucher and project-based recipients. We rely on the AHS area average of the HUD very low-income limit, based on 50 percent of AMI, to create a comparison group of low-income unassisted tenants (which we define as households reporting income at less than 80 percent of local median income [LMI]). We designate households with reported incomes at or below the AHS very low-income limit variable, but who report no housing assistance, as our final group, *Qualify*.

Because our research questions deal with renters, we exclude owner-occupants in the AHS from our analysis. For each utility, the survey reports whether the household pays for the use separately or if it is included in the rent. We denote these variables as *PayElectric* and *PayGas*, each equal to 1 if the household pays the utility bill separately and 0 otherwise. Exhibit 4 reports means of these variables, along with a number of control variables for all renters, very low-income unassisted tenants, and assisted tenants, the latter both together and separated by public housing, voucher, and other assistance types. In spite of the documented misreporting of assistance type, large differences exist between group means for all our variables. Whereas 92 and 48 percent, respectively, of all unassisted tenants pay electricity and gas bills separately from rent, only 77 and 37 percent, respectively, of assisted tenants pay these bills separately. Means for voucher-assisted tenants are similar to the very low-income comparison group averages, except that voucher holders have larger households, slightly more income, and larger apartments. This result differs from that for tenants reporting other housing assistance types, whose average characteristics for all variables differ from those of both all unassisted tenants and the very low-income comparison group. Because households

Exhibit 4

Means of Selected Variables

	All Unassisted Renters	Qualify	GovAssist	Public	Voucher	OtherAssist
PayElectric	0.917	0.892*	0.771*‡	0.654*‡†	0.897*†	0.802*‡†
PayGas	0.483	0.473*	0.372*‡	0.324*‡†	0.487†	0.320*‡†
UnitSqFt	1,191	1,097*	1,045*‡	1,019*‡	1,114*†	1,010*‡
Rooms	4.48	4.27*	4.18*‡	4.03*‡†	4.53‡†	4.03*‡†
Persons	2.38	2.40	2.33*‡	2.21*‡†	2.64*‡†	2.16*‡†
Income (1k)	43.13	14.99*	16.52*‡	15.43*‡†	16.81*‡†	17.69*‡
BldgUnits	17.03	16.60	32.18*‡	39.4*‡†	17.58†	37.25*‡†
Dishwasher	0.511	0.392*	0.257*‡	0.118*‡†	0.378*†	0.323*‡†
N	32,601	12,565	4,118	1,654	1,242	1,222

*Note: Based on a two-sample t-test, this group mean is statistically different from the mean of *all other renters not receiving assistance, ‡all other very low-income renters, and †all other assisted households.*

receiving assistance differ from other low-income households and other renters in their number of people, unit size and age, and most other observable characteristics, the observed differences in incidence of utility billing arrangements or expenditures is not informative regarding the potential effect housing assistance has on these outcomes. The detail on these characteristics in the AHS enables us to control for these factors and present means of billing arrangement and expenditure as conditional on available household, unit, and building characteristics.

We turn to a multivariate regression to assess the extent to which the lower incidence of direct payment by assisted tenants derives from the policy design rather than from differences in observable building and household characteristics. We regress the binary variables *PayElectric* and *PayGas* in turn on housing assistance and low-income group indicators while controlling for four types of variables. The first type are the source-of-fuel and appliance variables, which indicate whether the utility is used for heat, hot water, cooking, air conditioning, and drying and whether the unit includes a clothes washer and dishwasher. The second variable type is characteristics of the unit and building: the log of the square footage, indicator variables for the number of rooms and bathrooms, indicator variables for the decade (a pre-1920 group and decade groups from the 1920s through 1960s) or 5-year span (from 1970–1974 to 2005–2009) in which the building was built, the number of units, number of units squared, an indicator for being taller than three floors, whether the unit is a condominium, whether the unit is rent controlled, whether the owner lives on site, and whether the unit has a garbage disposal and trash compactor. The third type includes occupant characteristics: the number of people in the household, the log of household income, race and ethnicity, and educational attainment. Finally, the fourth type includes whether the unit is in a rural or urban area, fixed effects for metropolitan areas when identifiable in the AHS, and census region by urban status groupings when the metropolitan area is not available. This set of geographic controls should capture the combined contributions of weather, local utility infrastructure and policy, and other local factors.

Our regression results, presented in exhibit 5, indicate that, although some of the difference between assisted and unassisted households in the frequency of utility billing separate from rent is explained by other factors, an economically and statistically significant correlation between assistance and utility billing structure remains. Whereas the differences in unconditional means between assisted tenants who report living in public housing and unassisted tenants are 26.3 and 11.1 percentage points for *PayElectric* and *PayGas* respectively, the conditional difference is estimated to be 20.6 and 9.7 percentage points, respectively.[12] The measured gap for households in the *OtherAssist* category also decreases but remains substantive, at 7.4 and 5.4 percentage points, respectively, for *PayElectric* and *PayGas*. In contrast, differences in the rate at which voucher-assisted tenants pay for electricity separately remain indistinguishable from very low-income unassisted tenants, with a marginally significant lower rate for voucher-assisted tenants compared with unassisted renters not in the low-income comparison group. For *PayGas*, households receiving vouchers are again slightly less likely to pay separately from rent, with a 3.4-percentage-point conditional difference compared with unassisted households. In all cases, coefficients do not change materially when the sample is limited to renters with incomes below 80 percent of LMI.

[12] In each case, an F-test rejects that the coefficient is equal to the difference in the unconditional means.

Exhibit 5

Key Coefficients for Pay Utilities Separately Regressions

	PayElectric			PayGas		
	All Renters	All Renters	< 80% LMI Renters	All Renters	All Renters	< 80% LMI Renters
GovAssist	– 0.107***			– 0.064***		
	(0.018)			(0.014)		
Public		– 0.206***	– 0.198***		– 0.097***	– 0.101***
		(0.030)	(0.029)		(0.027)	(0.027)
Voucher		– 0.020*	– 0.014		– 0.034**	– 0.041**
		(0.012)	(0.013)		(0.015)	(0.016)
OtherAssist		– 0.074***	– 0.054***		– 0.054***	– 0.051***
		(0.018)	(0.016)		(0.014)	(0.016)
Qualify	– 0.014**	– 0.015**	– 0.010*	– 0.009	– 0.009	– 0.010
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)
N	35,724	35,724	23,192	35,724	35,724	23,192
R^2	0.103	0.111	0.125	0.454	0.454	0.447

LMI = local median income.

** Coefficients are statistically significantly different from zero at the 10% level. ** Coefficients are statistically significantly different from zero at the 5% level. *** Coefficients are statistically significantly different from zero at the 1% level.*
Notes: All regressions also include fuel and appliance, unit and building characteristics, household characteristics, and geographic control variables. All coefficient estimates are available from the authors. Robust standard errors reported in parentheses. "All Renters" indicates the sample used to estimate the two different models in the first two columns.

The smaller coefficients for the *Voucher* group, which are statistically different from the coefficients for the *OtherAssist* group, are consistent with the observed differences, because they are a landlord response to housing policy design. Voucher holders' landlords are less likely to have made investments that reflect the incentives embedded in the policy design compared with both PHA property managers and landlords who develop a property with the intention of serving assisted tenants.

Our first empirical results demonstrate that the lower frequency with which assisted tenants pay utility bills separately from rent is robust to including controls for observable building and household characteristics and for unobservable city characteristics. Because we control for differences in building and household characteristics and, in addition, limit our sample to a low-income, unassisted tenant comparison group, these regressions suggest that less frequent separate utility payment by assisted tenants is an outcome of housing assistance policy.

Although differences in the frequency of separate payment are robust to a full set of controls, differences in the amount paid in monthly utility bills are not. As reported in exhibit 6, among those billed for utilities, assisted tenants' average monthly bills are not statistically different from the $77 and $61 a month mean for electricity and gas, respectively, that unassisted tenants pay. Assisted tenants reporting residence in public housing, however, pay statistically significantly lower monthly bills for electricity ($69 a month) and voucher recipients pay a higher amount ($87 a month). Similar discrepancies exist for gas, with billed public housing and voucher expenses of $58 and $70, respectively.

These differences are not robust to the inclusion of unit, building, and household controls. We use the same variables as controls as in our previous regressions, except that we now fit geographic

Exhibit 6

Means of Selected Variables by Electricity and Gas Paid Separately

	All Renters		Qualify		GovAssist		Public		Voucher	
	PayElectric = 0	PayElectric = 1	PayElectric = 0	PayElectric =1	PayElectric = 0	PayElectric = 1	PayElectric = 0	PayElectric = 1	PayElectric = 0	PayElectric = 1
MonthlyBill		77.7		74.5*		76.1		68.8*†‡		86.9*†‡
UnitSqFt	1,076	1,202$^{\Delta}$	1,104	1,042	926	1,080$^{\Delta}$	973	1,043	831	1,146$^{\Delta}$
Rooms	3.84	4.54$^{\Delta}$	3.69	4.34$^{\Delta}$	3.65	4.33$^{\Delta}$	3.65	4.22$^{\Delta}$	3.77	4.61$^{\Delta}$
Persons	1.97	2.41$^{\Delta}$	1.95	2.44$^{\Delta}$	1.89	2.45$^{\Delta}$	1.89	2.38$^{\Delta}$	2.04	2.71$^{\Delta}$
Income (1k)	3.57	4.37$^{\Delta}$	1.31	1.52$^{\Delta}$	1.64	1.65	1.47	1.58	2.10	1.63
BldgUnits	37.31	15.18$^{\Delta}$	34.84	14.39$^{\Delta}$	67.84	21.59$^{\Delta}$	69.61	23.39$^{\Delta}$	39.21	15.08$^{\Delta}$
Dishwasher	0.36	0.53	0.28	0.41	0.14	0.29	0.08	0.14	0.21	0.40
N	2,715	29,886	1,355	11,210	943	3,175	573	1,081	128	1,114

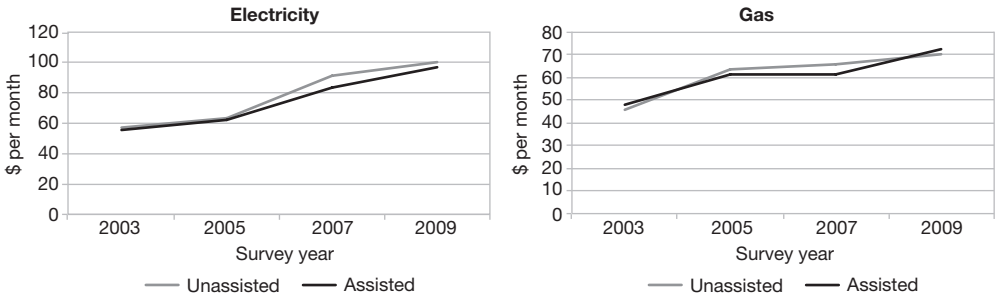
	All Renters		Qualify		GovAssist		Public		Voucher	
	PayGas = 0	PayGas = 1	PayGas = 0	PayGas =1	PayGas = 0	PayGas = 1	PayGas = 0	PayGas = 1	PayGas = 0	PayGas = 1
MonthlyBill		61.07	61.77	61.39	57.51	69.63				
UnitSqFt	1,076	1,202$^{\Delta}$	1,012	1,193$^{\Delta}$	944	1,215$^{\Delta}$	942	1,180$^{\Delta}$	1,001	1,232$^{\Delta}$
Rooms	3.85	4.54$^{\Delta}$	3.99	4.57$^{\Delta}$	3.92	4.62$^{\Delta}$	3.80	4.52$^{\Delta}$	4.20	4.87$^{\Delta}$
Persons	1.97	2.42$^{\Delta}$	2.14	2.68$^{\Delta}$	2.06	2.78$^{\Delta}$	1.97	2.72$^{\Delta}$	2.35	2.95$^{\Delta}$
Income (1k)	3.57	4.38$^{\Delta}$	1.42	1.59$^{\Delta}$	1.57	1.79$^{\Delta}$	1.50	1.63	1.58	1.79
BldgUnits	37.31	15.18$^{\Delta}$	23.15	9.29$^{\Delta}$	42.97	13.96$^{\Delta}$	52.78	11.50$^{\Delta}$	25.10	9.64$^{\Delta}$
Dishwasher	0.36	0.53$^{\Delta}$	0.46	0.31$^{\Delta}$	0.26	0.26	0.11	0.13	0.41	0.34$^{\Delta}$
N	29,886	2,715	6,622	5,943	2,586	1,532	1,118	536	637	605

*Note: Based on a two-sample t-test, this group mean is statistically different from the mean of * all other renters not receiving assistance, ‡ all other very low-income renters, † all other assisted households, and $^{\Delta}$ households in the same group with either PayElectric=0 or PayGas=0.*

time trends in rates. The relatively dramatic increase in utility bills over the survey years, shown in exhibit 7, motivated this decision. We present coefficients from the regressions of reported monthly electricity and gas bills on housing assistance group indicators and on our control variables in exhibit 8. With the possible exception of a slight increase in electricity expenditure among voucher recipients, differences in monthly gas and electricity bills for assisted and unassisted tenants are

Exhibit 7

Average Monthly Utility Bills of Renters by Government Assistance



Source: Based on author's tabulations of American Housing Survey data

Exhibit 8

Key Coefficients for Amount Paid in Utilities Regressions

	Electric				Gas			
	All Renters	All Renters	Renters and Owners	< 80% LMI Renters	All Renters	All Renters	Renters and Owners	< 80% LMI Renters
GovAssist	– 0.005 (0.013)				– 0.018 (0.022)			
Public		– 0.031 (0.021)	0.006 (0.021)	– 0.030 (0.023)		– 0.045 (0.035)	– 0.044 (0.036)	– 0.070 (0.037)
Voucher		0.028 (0.017)	0.068*** (0.017)	0.033* (0.018)		0.003 (0.027)	0.027 (0.026)	0.009 (0.029)
OtherAssist		– 0.014 (0.020)	0.030 (0.020)	– 0.006 (0.020)		– 0.015 (0.033)	0.004 (0.038)	– 0.011 (0.040)
Qualify	– 0.010 (0.008)	– 0.010 (0.009)	0.011** (0.005)	– 0.006 (0.008)	– 0.004 (0.014)	0.004 (0.014)	0.003 (0.008)	– 0.001 (0.014)
Renter			– 0.010** (0.005)				– 0.034*** (0.010)	
N	32,227	32,227	130,893	20,510	16,480	16,480	32,222	23,192
R^2	0.318	0.318	0.301	0.323	0.242	0.242	0.211	0.447

LMI = local median income.

** Coefficients are statistically significantly different from zero at the 10% level. ** Coefficients are statistically significantly different from zero at the 5% level. *** Coefficients are statistically significantly different from zero at the 1% level.*

Notes: All regressions also include fuel and appliance, unit and building characteristics, household characteristics, and geographic time trend control variables. All coefficient estimates are available from the authors. Robust standard errors reported in parenthesis. "All Renters" indicates the sample used to estimate the two different models in the first two columns.

captured by the other characteristics determining expenditure. We conclude that the small increase in disposable income relative to other low-income households in similar housing increases utility expenditures.

Our empirical approach captures the reduced-form confluence of landlord business decisions, tenant housing and energy demand, and government policy. Although we do not estimate parameters governing these processes, we have identified a few stylized facts of utilities and subsidized housing in the AHS. First, observed lower instances of gas and electricity being billed directly to assisted tenants are robust to controlling for factors governing landlords' and tenants' decisions. This observation is consistent with incentives for landlords and assisted tenants embedded in housing policy design and the possible policy implication of increased utility costs. Among households paying separate utility bills, however, spending differentials between those in public housing, voucher recipients, and unassisted tenants are not attributable to government programs.

Conclusion

Government subsidy program regulations can affect utility billing arrangements and expenditures. In this article, we argue that the programs' treatment of utility expenditures creates incentives for both landlords and assisted tenants to prefer including utilities in rent and does not motivate conservation or energy efficiency investments. This condition exists because, among the four primary federal assisted housing programs, utility allowances are generally lagged, partial, or one-way responses to changes in year-to-year costs. As a result, contract rents do not rise with average utility costs when utilities are included in the rent as they would in nonsubsidized competitive markets. Assisted tenants will prefer that landlords pay utility bills unless the utility allowance sufficiently exceeds actual spending, and landlords may increase profits if allowances adjust upward more easily than downward. We note that these incentives may be more muted in the LIHTC and voucher programs and suggest that future research using administrative data from all the programs could determine the extent to which they indeed differ.

Using self-reported AHS data, we confirm that tenants receiving some form of government subsidy are more likely to live in a property where the owner pays the utilities. Specifically, assisted tenants who live in public housing are 21 percentage points less likely to pay for their own electricity and 10 percentage points less likely to pay for gas than are low-income renters receiving no assistance. The differences are much less pronounced, however, for assisted tenants who report receiving vouchers, suggesting that landlords with voucher tenants act differently than landlords of the other assisted groups; differences in cost structures or familiarity with assistance program rules may contribute to these differences.

We also look at the differences in energy costs between assisted and unassisted low-income tenants who pay their utilities. Our results indicate no significant difference in utility costs between these groups. Observable differences exist in mean spending between assisted and unassisted households, but these differences are attributable to differences in characteristics of the units, buildings, and households rather than in government assistance.

Our theoretical and empirical analysis indicates that both landlords and assisted tenants may be influenced by program structures. We also find evidence that some program rules provide

little incentive for landlords or assisted tenants to contain costs. These issues are important to tackle because these program structures may undermine current and future energy efficiency initiatives. Our results suggest that the incentives for billing arrangements and subsequent energy expenditure embedded in assisted housing programs are relevant to HUD's increased emphasis on sustainability. Our analysis indicates that administration costs of both billing and utility allowance adjustments may play a role in determining billing arrangement, suggesting that administrative and technology improvements may promote more economically and environmentally efficient arrangements.

These results are a foundation for further analysis. Detailed building-level utility costs for properties in each of these portfolios would provide a clearer and likely more nuanced picture of the differences in energy use and costs across the assisted housing programs and across local program guideline implementations. Such an analysis will provide guidance into ways programs can incentivize landlords and assisted tenants to reduce utility costs, which will prove beneficial for cost containment in existing programs and the development of future initiatives.

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Housing Units With Negative Equity, 1997 to 2009

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This article is intended to inform interested parties of ongoing research and to encourage discussion of work in progress. The views expressed on methodological, technical, and operational issues are those of the author and not necessarily those of the U.S. Census Bureau.

Abstract

Homeownership rates in the United States[1] increased between 1997 and 2004 and by 2007 had declined from 2004 levels. Home prices peaked in 2006 and have since fallen at the national level.[2] According to First American CoreLogic, an increasing number of homeowners are "under water." Underwater homeowners have negative equity, meaning that they owe more on their mortgages than their homes are worth.[3] The American Housing Survey (AHS) collects longitudinal data on self-reported home values and outstanding principal on mortgages, making it possible to calculate estimates of home equity, underwater status, and loan-to-value ratios at the national level and for individual housing units over time. Using data from the 1997–2009 AHS, this study explores national and regional trends in negative equity, housing and mortgage characteristics associated with negative equity, and demographic characteristics of householders with negative equity. In addition, this study examines the persistence of negative equity over time and the relative contributions of home value and mortgage debt to making homes under water. The percentage of underwater mortgages increased in the AHS from 2007 to 2009, but the 2009 percentage was lower than CoreLogic estimates. Negative equity impedes wealth accumulation and decreases spending power, and it can lead to several different outcomes for homeowners. Some homeowners may have limited mobility while they wait for the market to improve. Other homeowners may choose to strategically default on their mortgage because their home will not appreciate enough to make the unit profitable.

[1] U.S. Census Bureau, Current Population Survey. For more information, refer to http://www.census.gov/hhes/www/housing/hvs/qtr108/q108tab5.html.

[2] Standard & Poor's Case-Shiller® Home Price Index. For more information, refer to http://www2.standardandpoors.com.

[3] The end of data collection for the 2009 American Housing Survey fell in the third quarter of 2009. At the end of the third quarter of 2009, First American CoreLogic estimated that 23 percent of mortgages were under water.

Abstract (continued)

Still others may default on their mortgage if their income declines or if they experience significant life events that make it difficult for them to make mortgage payments, such as unemployment, divorce, or a death in the family. The AHS does not collect data on mortgage default, but it does capture information on the purchase prices when homes are sold to new owners. Analysts using internal AHS data can use this information to determine if the sale was distressed. Examining individual housing units longitudinally, this study uses the previous owner's outstanding principal and the new owner's purchase price to develop an estimate of the prevalence of distressed sales.

Introduction

Homeownership rates in the United States[4] increased between 1997 and 2004 and by 2007 had declined from 2004 levels. Home prices peaked in 2006 and have since fallen at the national level. Since 2006, home prices have fallen at the national level.[5] As home prices have fallen, an increasing number of homeowners are now "under water." Homeowners who are "under water" have negative equity, meaning that they owe more on their mortgages than their home is worth. First American CoreLogic estimated that 23 percent of homeowners were under water at the end of the third quarter of 2009.[6]

The American Housing Survey (AHS), which the U.S. Census Bureau conducts for the U.S. Department of Housing and Urban Development (HUD), collects data on home values and mortgage debt, making it possible to estimate underwater status. The AHS has followed the same housing unit sample since 1985 and collects information on housing characteristics and housing quality in the United States and information on household characteristics.

In this article, internal data from the 1997–2009 AHS national files are used to explore national and regional trends in negative equity, housing and mortgage characteristics associated with negative equity, and the demographic characteristics of householders with negative equity. The AHS does not collect data on mortgage default, foreclosures, or short sales. To measure distressed sales, units sold since the last survey are identified with purchase prices equal to or less than the previous owner's outstanding principal. Prevalence of distressed sales is estimated between 1999 and 2009.

[4] U.S. Census Bureau, Current Population Survey. For more information, refer to http://www.census.gov/hhes/www/housing/hvs/qtr108/q108tab5.html.

[5] Standard & Poor's Case-Shiller® Home Price Index. For more information refer to http://www2.standardandpoors.com/.

[6] *First American CoreLogic Negative Equity Report.* For more information refer to https://www.corelogic.com/About-Us/ResearchTrends/Negative-Equity-Report.aspx. CoreLogic includes both occupied and vacant single-family residential properties with a mortgage, but the American Housing Survey analyses presented in this article are restricted to owner-occupied housing units.

The next section of this article provides a brief overview of the AHS. Following that, the discussion turns to what it means to be under water, how underwater mortgages are measured, and how underwater mortgages affect the housing market. Existing research on self-reported home values, home equity, mobility, and distressed sales is then discussed. This section is followed by a discussion of research methodology and results, before turning to concluding remarks in the last section.

Overview of the AHS

The AHS started in 1973 and has sampled the same housing units since 1985, drawing additional sample to account for new construction. From 1973 to 1981, the Census Bureau conducted the AHS, formerly called the Annual Housing Survey, annually. The AHS consists of two surveys: a national survey and a metropolitan area survey. Since 1983, the national survey has collected data on a nationally representative sample of approximately 55,000 housing units every 2 years, in odd-numbered years. The national and metropolitan surveys are longitudinal, following the same housing units over time until a new sample is collected.

The 1973 AHS through the 1983 AHS followed a sample of housing units drawn from the 1970 Census. Since 1985, the AHS has followed a sample of housing units drawn from the 1980 Census. The AHS sample is updated with building permit data for permit-issuing areas and through listing procedures for areas that do not issue permits. The AHS has drawn additional sample for housing units missed in the 1980 Census, for units added to existing sample units, for manufactured/mobile homes from Census 2000, and from a sample of assisted-living units to improve coverage of elderly people.[7] Dependent interviewing techniques on some items confirm housing characteristics of returning cases recorded in previous interviews.[8] Since 1997, the AHS has been collected via in-person and telephone interviews using an electronic questionnaire.

Data analyzed in this article come from the internal versions of the 1997–2009 AHS national files. From 2005 to 2009, the data collection period for the AHS national survey was between late April and mid-September. In 2003, the data collection period was between June and September. From 1997 to 2001, the data collection period was between July and November.

Underwater Mortgages

Home equity is calculated by subtracting the outstanding principal on all mortgages or loans on a property from the home's value. Home equity calculated from the AHS uses self-reported home values and outstanding principal calculated from self-reported mortgage characteristics. Underwater properties have negative equity, meaning that the home's value is less than the outstanding principal on all mortgages and loans on the property. First American CoreLogic began reporting on negative

[7] The sample frame of assisted-living units was developed by matching independent lists of assisted-living units to addresses of housing units from Census 2000. Although improving coverage of elderly people, this methodology may have missed assisted-living housing units that were erroneously enumerated as group quarters in Census 2000.

[8] Further detailed information concerning the AHS sample is available at http://www.census.gov/hhes/www/housing/ahs/ahs01/appendixb.pdf.

equity in 2008. CoreLogic calculates negative equity using public record data on mortgage debt outstanding and estimates of home values using Automated Valuation Models (AVMs). Using this methodology, the percentage of homes with negative equity was 18 percent in the fourth quarter of 2008, 23 percent in the third quarter of 2009, and 24 percent in the first quarter of 2010.[9]

Being under water can lead to several different housing outcomes. Underwater mortgages impede housing wealth accumulation and decrease spending power. For some homeowners, being under water may limit residential mobility as they wait for the market to improve. Some homeowners decide to take a loss or negotiate with their bank to conduct a short sale. Other homeowners choose to strategically default on their mortgage when they decide that their home will not appreciate enough to make the unit profitable. Still others default on their mortgages if their incomes decline or if they experience significant life events that make mortgage payments difficult, such as job loss, divorce, or death in the household. At the community level, increasing defaults may contribute to continuing price declines and lead to even more underwater homes (Leonard and Murdoch, 2009; Rogers and Winter, 2009; Schuetza, Been, and Ellen, 2008; Wassmer, 2011).

Literature Review

Home equity estimates are affected by the accuracy of home value estimates. In this section, research on the validity and reliability of self-reported home values is discussed first. Second, previous research on home equity is reviewed. Lastly, research on relationship between negative equity, mobility, and distressed sales is explored.

Home Values

Unlike CoreLogic's home equity estimates, the AHS uses self-reported home value measures in its estimates. The AHS asks respondents, "How much do you think the house and lot would sell for on today's market?" The AHS asks respondents to exclude rental properties attached to the residence from their calculation of home value.

The earliest research on owners' home value estimates, using appraisal data and national data from the Survey of Consumer Finance, found that owners overstate their home values by about 4 percent (Kish and Lansing, 1954). Kain and Quigley (1972) replicated Kish and Lansing's study on a single city and found that home value estimate errors were systematically related to the owners' socio-economic characteristics. Kiel and Zabel (1999) compared AHS home value data with sales prices of houses sold in the 12 months before the interview. They found that owners reported their home values 5.1 percent higher than stated sales prices, and a subset of owners who bought their unit recently reported home values 8.4 percent higher than stated sales prices. They found AHS estimates to be reliable, but that the survey consistently overestimated home values. Unlike Kain and Quigley (1972), they did not find differences between sales prices and owners' estimates to be

[9] *First American CoreLogic Negative Equity Report*. For more information, refer to https://www.corelogic.com/About-Us/ResearchTrends/Negative-Equity-Report.aspx.

related to owner characteristics other than length of tenure. Recent research by Benitez-Silva et al. (2008) suggests that respondents who purchase their homes during soft housing markets, in which sellers outnumber buyers, are more accurate in assessing their home's value.

Home Equity

The AHS does not provide a home equity variable on its public use file. Some researchers have approximated a value for home equity for the AHS by subtracting the total remaining principal on all mortgages and loans from the housing unit's current value (Bourassa and Yin, 2008; Krivo and Kaufman, 2004). HUD states that home equity can be calculated in this way, using AHS national publication table specifications code but advises against doing so, because both the home value and the loan amounts used to calculate outstanding principal are top-coded on the AHS public use file (Vandenbroucke, 2008). In this article, the internal use version of the AHS is used to calculate home equity, which is then used to produce an indicator of negative equity. The AHS internal use file contains variable values before they have been top-coded and geographic information not found on the public use file. Using the internal use file removes errors in calculating the home equity measure due to top-coding.

Negative Equity, Mobility, and Distressed Sales

Previous research has found that households with negative equity are less likely to move and are more likely to default on their mortgages than households with positive equity. Recent research by Ferreira, Gyourko, and Tracy (2010, 2011), using data from the AHS from 1985 to 2007, found that owners with negative equity are one-third less mobile than owners with positive equity, but other research has found that homeowner's with high levels of negative equity are more likely to move (Schulhofer-Wohl 2011). Examining listing data from the Listing Information Network, Inc., on the Boston condominium market in the early 1990s, Genesove and Mayer (2001, 1997) found that owners with high loan-to-value ratios were more likely to set higher asking prices and have higher expected time on the market.

Some studies have found a link between high loan-to-value ratios and mortgage default. Van Order and Zorn (2000) found negative equity to be positively correlated with default across different income groups and neighborhoods. Examining FHA single-family mortgage foreclosures in the 1980s, Hendershott and Schultz (1993) found that unemployment and the book value of equity, or what a seller would receive without defaulting, are significant predictors of default.

Research Methodology

This study has three goals: (1) to analyze trends in negative equity since 1997, (2) to analyze the persistence of negative equity within individual housing units between 1997 and 2009, and (3) to estimate the prevalence of distressed sales since 1999. Analyses are restricted to owner-occupied housing units with at least one mortgage. First, negative equity trends between 1997 and 2009 are presented at national and regional levels and by householder and housing characteristics. Second, longitudinal analyses of the persistence of negative equity and the prevalence of distressed sales are examined.

Results

The results[10] of the research fall into three categories: (1) trends in home values, outstanding principal, and loan-to-value ratios; (2) trends in underwater mortgages between 1997 and 2009; and (3) longitudinal analyses of the persistence of underwater status over time and the prevalence of distressed sales, using linked AHS data from 1997 and 1999, 1999 and 2001, 2001 and 2003, 2003 and 2005, 2005 and 2007, and 2007 and 2009.

Trends in Home Values, Outstanding Principal, and Loan-to-Value Ratios

Standard & Poor's Case-Shiller® 10-City Composite House Price Index is a weighted repeat sales home price index of 10 major metropolitan statistical areas (MSAs) in the United States. Exhibit 1 presents average seasonally adjusted yearly house price index values from 1997 to 2009. The Case-Shiller® 10-City Index increased between 1997 and 2006 and declined from 2006 to 2009.[11] Data on self-reported home values from the AHS in exhibit 1 follow a similar pattern to the Case-Shiller® 10-City Index, showing a steady increase in home values from 1997 to 2007 and the decline in home values from 2007 to 2009. During this time period, median outstanding principal in the AHS increased sharply in 2003. Exhibit 1 shows that the percentage of units with two mortgages or loans increased in 2005.

Using data from a large loan database from a major secondary mortgage market participant, LaCour-Little, Rosenblatt, and Yao (2010) examined homeowners' home equity extraction decisions from 2000 to 2006 and found that, although 43 percent of households decided to take out equity when they refinanced, their home price appreciation was sufficient to decrease loan-to-value ratios on average during the time period. They found that home price appreciation was the main factor in explaining the amount borrowed during this time period.

However, while outstanding principal continued to increase through 2009, home values declined between 2007 and 2009, resulting in increases in median loan-to-value ratios between 2007 and 2009 (exhibit 1). Increases in percentages of units with loan-to-value ratios at or above 80 percent during this time period fueled these increases in median loan-to-value ratios (exhibit 2). Mortgages with loan-to-value ratios at or above 80 percent are a greater default risk, and owners with such mortgages are often required to purchase private mortgage insurance to insure the mortgage lender against default. Underwater units, or those with negative equity, have loan-to-value ratios above 100 percent.

[10] All differences reported in the text have been tested at the 5-percent significance level. Differences were tested with z tests for differences in proportions and differences in medians.

[11] The 10 MSAs in the Case-Shiller® 10-City Composite House Price Index are Boston-Cambridge-Quincy, MA; Chicago-Napierville-Joliet, IL-IN-WI; Denver-Aurora, CO; Las Vegas, NV-AZ; Los Angeles-Long Beach-Santa Ana, CA; Miami-Fort Lauderdale-Pompano Beach, FL; New York-Northern New Jersey-Long Island, NY-NJ-PA; San Diego-Carlsbad-San Marcos, CA; San Francisco-Oakland-Fremont, CA; and Washington-Arlington-Alexandria, DC-VA-MD-WV. The index is a quality-adjusted, 3-month moving average that is normalized to have a value of 100 in January 2000. The index is published monthly by Standard & Poor's. Annual index values in exhibit 1 were calculated by taking the average of seasonally adjusted monthly values for each year.

Exhibit 1

Home Value, Total Outstanding Principal, and Number of Mortgages and Loans, 1997–2009

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Case-Shiller® 10-City HPI average	80.22	86.93	95.13	107.38	120.02	133.28	151.24	178.84	209.08	224.52	214.61	178.76	155.56
AHS: Home value (median)[a]	$108,000		$120,000		$130,000		$150,000		$180,000		$200,000		$185,000
AHS: Total outstanding principal (median)[a]	$52,867		$64,923		$69,208		$82,060		$92,915		$100,971		$106,917
AHS: Loan-to-value ratio (median)[a]	0.55		0.60		0.56		0.58		0.55		0.54		0.63
AHS: Number of mortgages, lump sum home equity loans, and home equity lines of credit (weighted percentages)[a]													
1	79.88		79.87		76.78		78.03		72.14		70.99		73.92
2	18.81		18.99		20.77		19.91		25.19		27.05		24.31
3	1.19		1.02		2.21		1.92		2.48		1.85		1.58
4 or more	0.12		0.13		0.24		0.15		0.18		0.11		0.18

AHS = American Housing Survey. HPI = Housing Price Index.

[a] Of owner-occupied housing units with at least one regular mortgage or lump-sum home equity loan.

Source: U.S. Census Bureau, 1997–2009 American Housing Survey, National Sample

Exhibit 2

Loan-to-Value Ratios, 1997–2009 (weighted percentages)

	1997	1999	2001	2003	2005	2007	2009
Loan-to-value ratio[a]							
Less than 50 percent	44.67	38.42	43.02	40.62	44.90	45.85	37.68
50 to 69 percent	22.33	25.15	24.13	24.21	22.85	21.80	19.16
70 to 79 percent	12.04	13.63	12.96	12.93	11.94	11.04	10.76
80 to 89 percent	9.99	10.33	9.54	9.85	8.83	9.63	10.73
90 to 99 percent	6.80	7.53	6.78	7.27	6.49	6.85	10.08
100 to 109 percent	0.96	1.17	0.78	1.01	0.94	1.34	3.17
110 to 124 percent	0.78	0.79	0.73	0.85	0.83	0.77	2.70
125 to 174 percent	1.01	1.15	0.84	1.25	1.17	0.88	3.02
175 to 299 percent	0.59	0.84	0.55	1.02	0.97	0.69	1.56
300 percent or more	0.83	0.99	0.69	0.99	1.07	1.15	1.16

[a] *Of owner-occupied housing units with at least one regular mortgage or lump-sum home equity loan.*

Source: U.S. Census Bureau, 1997–2009 American Housing Survey, National Sample

Trends in Underwater Mortgages

Trends in underwater mortgages are presented in exhibit 3. Overall, the percentage of housing units under water increased from 4.17 to 4.94 percent from 1997 to 1999; dipped to 3.58 percent in 2001; increased to 5.12 percent in 2003; remained steady during 2003, 2005, and 2007; and shot up to 11.59 percent in 2009. As previous research by Kiel and Zabel (1999) found, self-reported home values are, on average, 5.1 percent higher than actual home values. Adjusting home values by 5.1 percent increases the percentage of underwater units in 2009 from 11.59 to 16.40 percent. Even after adjusting home values downward, estimates of the percentage of underwater mortgages in 2009 in the AHS are lower than CoreLogic's estimates of 23 percent. Remaining differences may be because of differences in how AHS and CoreLogic measure negative equity and the types of units for which they estimate negative equity. Whereas the AHS estimates negative equity from self-reported home values and outstanding principal from self-reported mortgage characteristics,[12] CoreLogic estimates negative equity from AVM-calculated home values and outstanding principal from public record data on mortgage debt outstanding. Whereas the AHS calculates negative equity for occupied housing units with at least one mortgage or loan, CoreLogic includes both single-family occupied and vacant residential properties with mortgages in its estimates. Although AHS estimates are lower than CoreLogic's estimates, both the AHS and CoreLogic detect increases in underwater units in 2009.

Examining regional differences in underwater housing units between 1997 and 2009, we find a decline in the percentage of underwater units in the Northeast in 2007 and an increase in 2009.

[12] The American Housing Survey collects detailed mortgage information on the first two mortgages on the housing unit and less detailed information on other mortgages on the unit. It asks for initial loan amount, origination date, mortgage term, and interest rate of the first two mortgages, and only initial loan amount of other mortgages. In the formula for outstanding principal, origination date, loan amounts, mortgage term, and interest rate are used to calculate the remaining principal on the first two mortgages. For housing units with more than two mortgages, the assumption is made that homeowners have paid off 25 percent of the principal of mortgages past the first two. For more recently purchased homes, this assumption may underestimate the amount of outstanding principal.

Exhibit 3

Underwater Housing Units, 1997–2009 (weighted percentages) (1 of 2)

	1997	1999	2001	2003	2005	2007	2009
Total units[a]	4.17	4.94	3.58	5.12	4.98	4.83	11.59
Total with adjusted home value	7.08	7.96	6.61	8.36	8.01	8.00	16.40
Race[b]							
White only	3.89	4.73	3.54	5.12	4.99	4.76	11.12
Black only	5.33	6.09	3.52	5.60	4.27	4.59	14.74
Asian only	7.63	7.44	3.24	3.51	6.27	5.97	13.62
Other	7.43	5.20	5.43	5.28	5.79	7.08	13.90
Hispanic origin							
Hispanic	7.96	5.50	3.22	4.83	4.55	6.12	20.51
Non-Hispanic	3.92	4.90	3.61	5.14	5.03	4.70	10.69
Marital status							
Married	3.93	4.70	3.38	5.25	4.95	4.51	11.07
Not married	4.76	5.54	4.04	4.82	5.06	5.52	12.71
Educational attainment							
Less than high school	6.08	8.10	4.69	8.31	6.16	7.63	14.28
High school	4.34	6.13	4.22	6.21	6.21	5.65	12.09
Some college	4.30	4.78	3.78	5.33	4.81	4.93	12.96
College	3.65	3.52	2.86	3.36	4.08	4.02	10.51
Advanced degree	2.81	2.64	2.09	3.20	3.95	2.97	8.37
Region							
Northeast	5.12	5.22	4.15	4.70	5.53	3.66	7.46
Midwest	2.94	3.74	3.44	5.23	4.62	4.74	11.36
South	3.65	5.52	3.29	5.97	5.65	4.97	11.04
West	5.57	5.17	3.73	4.03	3.93	5.60	15.87
Age							
Less than 35	6.98	7.99	4.43	6.28	6.99	7.23	18.92
35 to 44	4.20	4.66	3.99	5.65	5.66	5.29	13.97
45 to 54	3.26	4.32	3.11	4.55	4.23	3.99	8.81
55 to 64	3.22	3.30	3.20	4.13	4.31	3.55	8.03
65 or older	1.59	3.29	2.49	4.40	2.43	3.80	6.54
Interest rate type							
Adjustable rate mortgage	5.50	4.78	4.73	3.55	7.05	8.31	21.54
Fixed	4.35	5.33	3.75	5.61	5.04	4.67	11.59
Interest rate (%)[c]							
Less than 5.00	4.66	4.93	9.18	3.71	3.45	3.56	7.09
5.00 to 5.875	3.08	5.73	3.87	4.07	4.05	3.63	8.77
6.00 to 6.875	2.39	3.64	2.39	4.29	5.06	4.38	13.92
7.00 to 7.875	3.49	3.95	2.83	5.07	5.61	6.17	15.88
8.00 or more	4.95	6.99	5.24	9.14	9.61	9.40	17.89
Monthly income quintile							
First	4.65	6.53	4.40	6.61	5.84	6.54	11.92
Second	5.67	7.24	4.62	6.31	5.92	6.43	13.20
Third	5.72	7.54	4.46	6.81	6.62	6.74	13.30
Fourth	4.02	4.28	3.67	5.53	5.05	4.95	12.59
Fifth	2.74	2.96	2.54	3.19	3.45	2.74	9.21

Exhibit 3

Underwater Housing Units, 1997–2009 (weighted percentages) (2 of 2)

	1997	1999	2001	2003	2005	2007	2009
Building Type							
One-unit detached	2.25	2.38	2.19	3.26	3.58	3.34	9.99
One-unit attached	3.96	4.41	2.98	2.98	2.95	3.50	13.48
Two or more apartments	16.10	16.40	11.25	9.83	10.27	9.31	18.99
Manufactured (mobile) home	20.97	31.88	18.06	33.30	25.97	30.43	32.71
First-time homeowner	3.54	5.32	3.58	5.66	5.53	5.24	13.95
Owned home before	5.07	5.98	3.71	4.83	4.68	4.58	10.15

[a] *Units in table are restricted to owner-occupied housing units with at least one regular mortgage or lump-sum home equity loan.*

[b] *Before 2003, the race categories in the American Housing Survey (AHS) were White; Black; American Indian, Aleut, or Eskimo; Asian or Pacific Islander; and Other Race. The category American Indian, Aleut, or Eskimo was combined with Other Race in the analyses for 1997 through 2001.*

[c] *In the 1997 AHS, interest rates were collected in increments of one-fourth of a percent. In the 1999 through 2009 AHS, interest rates were collected in increments of one-eighth of a percent.*

Source: U.S. Census Bureau, 1997–2009 American Housing Survey, National Sample

The Midwest saw increases in the percentage of underwater units in 2003 and 2009. The South saw increases in the percentage of underwater units in 1999, 2003, and 2009, and a decrease in 2001. The West had a lower percentage of underwater mortgages in 2003 than it did in 1997, but, like all other regions, showed an increase in 2009. In 2003, the West had a smaller percentage of underwater homes than the South and Midwest, but was not statistically different than the Northeast. In 2005, the West had a smaller percentage of underwater homes compared with all other regions except the Midwest. In 2007, the South and the West had higher percentages of underwater homes than the Northeast. Rates began to rise in the West in 2007. In 2009, the highest rates were in the West and the lowest rates were in the Northeast.

Prevalence of underwater status was examined by demographic characteristics of householders. Using the public use version of the 2001 AHS, Krivo and Kaufman (2004) found Black and Hispanic householders had lower levels of home equity than White householders. They found age, education, income, length of residence, being a previous owner, and having lower interest rates to be positively related to higher home equity levels. As shown in exhibit 3, percentages of underwater units increased among White householders between 2007 and 2009. For Black householders, the percentage of underwater units decreased from 1999 to 2001; increased in 2003; remained steady in 2003, 2005, and 2007; and increased in 2009. For Asian householders, the percentage of underwater units declined in 2001 and increased in 2005 and 2009. In 2009, housing units with White householders had lower underwater mortgage percentages than Black householders. Percentages for Black, Asian, and other householders were about the same in 2009.

For Hispanic householders, the percentage of underwater units declined between 1997 and 2001, remained steady from 2003 to 2007, and increased in 2009. For Non-Hispanic householders, the percentage of underwater units increased from 1997 to 1999, declined from 1999 to 2001, increased from 2001 to 2003, remained steady from 2003 to 2007, and increased in 2009. In 2003 and 2005, no statistically significant differences existed between Hispanic and non-Hispanic householders. In 2007, the percentage of Hispanic households with underwater mortgages rose to 6.12 percent,

while non-Hispanic percentages remained steady at 4.70 percent. In 2009, 20.51 percent of Hispanic householders and 10.69 percent of non-Hispanic householders were under water.

The percentage of underwater units for householders under age 35 declined in 2001 and increased in 2003 and 2009, age 35 to 44 and 45 to 54 increased in 2003 and 2009, age 55 to 64 increased in 2009, and age 65 and older declined in 2005 and increased in 2007 and 2009. In 2003, householders less than 35 years old and those between 35 and 44 were more likely to be under water than householders age 45 and older. In 2005, householders who were 65 or older were less likely than other age groups to be under water. In 2007 and 2009, householders who were less than 35 were more likely than other age groups to be under water. The percentage of underwater housing units increased for all groups in 2009.

The percentage of underwater units among married and nonmarried householders declined in 2001 and increased in 2009. In 2009, married householders were slightly less likely to be under water than nonmarried householders.

Socioeconomic status was examined through an analysis of householder education level and household income. The results revealed that householders with advanced degrees were less likely than those with less than a high school education to be under water in all years. The percentages of homes that were under water increased in all education categories in 2009. Householders with a high school education or less saw a decline in 2001 and an increase in 2009. Householders with some college education saw increases in 2003 and 2009. Householders with a college degree had similar underwater percentages between 1997 and 2007 and increases in 2009. Householders with advanced degrees saw increases in 2003 and 2009. In 2003, 2005, and 2007, householders with some college education or more had lower rates of underwater mortgages compared with householders with lower education levels.

Housing units in the fifth income quintile were less likely to be under water than all other income quintiles between 1997 and 2009. Percentages of underwater homes increased across the board in all income quintiles in 2009.

Underwater status was examined by characteristics of the first mortgage on the property. Higher percentages of units with interest rates below 5 percent, from 5 to 5.875 percent, and from 6 to 6.875 percent were under water in 2009 than in 2007. Units with interest rates between 7 and 7.875 percent experienced a decline in the percent that were under water in 2001 and increases in the percent in 2003 and 2009. Units with interest rates at 8 percent or more experienced a decline in the percent under water in 2001 and increases in 1999, 2003, and 2009. In 2007, housing units with first mortgage interest rates at 7 percent or more were more likely to be under water compared with units with interest rates below 7 percent. In 2009, all categories experienced an increase.

For units in which the first mortgage is an adjustable rate mortgage (ARM), we find increases in the percent under water in 2005 and 2009. In 2003, ARMs were less likely to be under water compared with fixed-rate mortgages. In 2005, 2007, and 2009, the percentage of ARMs that were under water was greater than that of fixed mortgages.

The effect of the housing bust on first-time homeowners was examined. The percentage of first-time homeowners whose mortgages were under water increased in 1999, 2003, and 2009 and

decreased in 2001. No statistically significant differences emerged between the percentages for first-time homeowners and repeat homeowners in 2007. In 2009, first-time homeowners were more likely to be under water.

Manufactured and mobile homes do not appreciate in the same way as detached and attached single units and condominiums (Jewell, 2003). Manufactured and mobile home financing is different from that of single-family homes and condominiums, because the homeowner does not always own the land on which the home sits. Across all years, except 1997, manufactured and mobile homes were more likely to be under water than other building types. The percentage of underwater units increased for all building types, except for manufactured and mobile homes, in 2009. For one-unit detached buildings, the percent under water also increased in 2003. For one-unit attached buildings, the percent under water declined in 2001 and remained steady in 2003, 2005, and 2007. Manufactured and mobile homes saw increases in the percent under water in 1999 and 2003 and declines in 2001 and 2005.

Was the increase in underwater units concentrated in newly constructed units and among owners who bought units at the top of the market? Exhibit 4 presents the percentages of units under water by the year the unit was built and the year the unit was bought, obtained, or received for each AHS survey year. Units built in all time periods were more likely to be under water in 2009 than

Exhibit 4

Percent of Units Under Water by Year Unit Built and Year Unit Bought, Obtained, or Received, 1997–2009 (weighted percentages)

	1997	1999	2001	2003	2005	2007	2009
Year Built[a]							
1919–69	3.59	3.93	3.53	3.95	4.09	3.72	9.57
1970–89	3.58	3.92	2.84	4.45	4.15	4.64	9.93
1990–94	6.73	5.71	3.68	6.22	4.55	5.51	10.26
1995–99	7.18	11.01	5.60	9.12	7.92	6.66	13.77
2000–04	—	—	4.64	7.29	7.57	6.06	14.29
2005	—	—	—	—	12.95	5.50	21.10
2006	—	—	—	—	—	10.19	25.35
2007	—	—	—	—	—	5.20	25.68
2008	—	—	—	—	—	—	14.19
2009	—	—	—	—	—	—	15.65
Year Unit Bought, Obtained, or Received[a]							
1919–69	0.34	1.09	1.27	1.85	2.16	3.89	4.93
1970–89	1.94	2.51	2.03	2.40	2.54	2.13	3.29
1990–94	5.61	4.35	2.86	4.07	2.89	3.11	3.53
1995–99	6.06	7.34	4.62	6.27	5.35	4.29	6.85
2000–04	—	—	5.21	6.69	6.07	4.77	11.64
2005	—	—	—	—	10.21	6.78	20.49
2006	—	—	—	—	—	9.38	23.81
2007	—	—	—	—	—	8.91	23.20
2008	—	—	—	—	—	—	15.75
2009	—	—	—	—	—	—	7.42

[a] *Restricted to owner-occupied housing units with at least one regular mortgage or lump-sum home equity loan.*

Source: U.S. Census Bureau, 1997–2009 American Housing Survey, National Sample

in previous AHS survey years. In the 2009 AHS, units built between 2005 and 2007, at the height of the market, were more likely to be under water than units built before 2005 or after 2007. In all survey years before 2009, recently purchased units were more likely to be under water than units purchased between 1919 and 1969. In 2009, units were more likely to be under water if they were purchased between 2000 and 2008 than if they were purchased before 2000 or in 2009.

Longitudinal Analyses

Data for individual housing units linked across 2 survey-year periods (1997 and 1999, 1999 and 2001, 2001 and 2003, 2003 and 2005, 2005 and 2007, and 2007 and 2009) are presented in exhibits 5 and 6. In exhibit 5, units are linked that are the same dwelling unit[13] in both years and had at least one continuing household member 2 years later. Exhibit 6 is restricted to units with a new owner 2 years later.[14] Exhibit 5 shows that, in 2007, 21.78 percent of units that were under water in the previous survey year remained under water 2 years later. This percentage rose to 38.85 percent in 2009. In exhibit 6, sales as distressed if the unit's purchase price was less than or equal to the outstanding principal on the unit in the previous survey year. Distressed sales rates were relatively steady between 11.21 and 13.77 percent before 2009. Exhibit 6 shows that, in 2007, 11.64 percent of sales were distressed. In 2009, the percentage of distressed sales rose to 20.97 percent.

Exhibit 5

Negative Equity Persistence (weighted percentages)

Years	Percent of Units Under Water at First Survey Year That Are Under Water 2 Years Later[a]
2007 and 2009	38.85
2005 and 2007	21.78
2003 and 2005	26.80
2001 and 2003	23.44
1999 and 2001	20.21
1997 and 1999	28.21

[a] *Underwater status calculated for owner-occupied housing units with at least one regular mortgage or lump-sum home equity loan.*

Source: U.S. Census Bureau, 1997–2009 American Housing Survey, National Sample

[13] A unit is considered not the same dwelling if any of the following conditions are met: "the unit is the result of a conversion or merger since the previous survey, the interviewer went to the wrong place last survey, the current unit is a replacement mobile home (or, much less frequently, a replacement structure), the unit is a vacant mobile home site that was occupied in the previous survey, or the address identifies a location that is now a type C noninterview" (ICF International, 2009: 1274).

[14] Both the pure weight (PWT) and Components of Inventory Change (CINCH) weights were used in the analyses. HUD and the Census Bureau recommend that PWT, or the inverse of the probability of selection, be used as a longitudinal weight, but the PWT may vary from year to year because of adjustment to the sample size to account for new construction, supplemental samples, and sample reductions. For 2001 to 2007, the CINCH analyses used an adjusted PWT value that accounts for differences in the PWT and sample over a 2-year period. CINCH weights were used to analyze the linked data for 2001 and 2003, 2003 and 2005, and 2005 and 2007. For other years, the PWT for the first survey year was used in the analysis. See Watson (2007) for more information on AHS weighting methodology and Eggers (2009) for more information on the CINCH weighting methodology. New households were identified with the SAMEHH variable. HUD has warned of potential problems with the SAMEHH variable but notes that the variable is reliable for units that remain occupied in both years. Ferreira, Gyourko, and Tracy (2010), in their research on household mobility using the AHS, use demographic data on the household to edit their data longitudinally and identify false moves.

Exhibit 6

Distressed Sales

Years	Percent of Sales Distressed 2 Years Later[a]
2007 and 2009	20.97
2005 and 2007	11.64
2003 and 2005	11.21
2001 and 2003	13.77
1999 and 2001	13.12
1997 and 1999	12.83

[a] *Restricted to owner-occupied housing units with at least one mortgage or lump-sum home equity loan in both years. Vacant units, usual residence elsewhere (URE) units, and units owned free and clear 2 years later are not included.*

Source: U.S. Census Bureau, 1997–2009 American Housing Survey, National Sample

Summary and Conclusions

The study presented in this article documented increases in underwater mortgage percentages across all types of owners and units, except manufactured and mobile homes, in 2009. Estimates of the percentage of units with negative equity in 2009 in the AHS (11.59 percent) were found to be lower than CoreLogic's estimates (23 percent). These differences were attributed to differences in how the methodologies AHS and CoreLogic use to measure negative equity and the housing populations they cover in their estimates. The persistence of negative equity was examined for units that remained the same dwelling unit in both years and had at least one continuing household member 2 years later. Analyses of the prevalence of distressed sales were conducted on units that remained the same dwelling unit in both years and had a new household 2 years later. Negative equity persistence increased between 2007 and 2009, as did the prevalence of distressed sales. The question remains: What effects have increases in negative equity had on distressed sales in the wake of the housing bust? Future research plans include analyzing the AHS to explore the effects of negative equity and housing burden on distressed sales.

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The American Housing Survey From a Cross-National Perspective

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In all developed economies, housing is an important part of the economy, a major determinant of individual and community well-being, and a dominant part of the urban landscape. Across time periods and international boundaries, real and pressing questions on housing are open for public policy, research, and community debate. The links between the ongoing economic downturn in most developed nations and the subprime mortgage market underline the significance of housing in the contemporary era. The articles in this *Cityscape* symposium highlight both the strength of U.S.-based research and the richness of data available to those investigating a range of housing-related issues. The wealth of articles in this symposium—ranging from disability and housing through to energy costs, the quality of the dwelling stock, housing vouchers, and affordability—serves as testimony to the value of good-quality research infrastructure such as the American Housing Survey (AHS).

The AHS, from an Australian perspective, is a remarkable research asset. It provides a depth and range of data that informs both the fundamental understanding of housing markets and the development of better policy. The AHS is a substantial data collection exercise, both with respect to the range of questions asked and the sample size. The data enable researchers to perform a detailed analysis of issues that would remain unexamined in the data's absence and also provide confidence in the statistical significance of the outcomes of the analysis.

Governments around the globe have embraced evidence-based policymaking efforts and increasingly look to economic modeling and other analyses to identify solutions to many of the intractable problems that confront their direct societies and society at large. In Australia, issues of housing affordability and support for people with disabilities have attracted recent investment from the Australian government. Housing affordability has become a pressing issue in Australia since 2000, because housing demand has far outstripped supply, and this state of market imbalance is expected to continue for decades (Commonwealth of Australia, 2010). In response, the Australian government has invested substantially in social housing and introduced a range of measures to reduce homelessness. At the same time, the government has recently signaled its intention to consider a National Disability Insurance Scheme (NDIS) that would cover all Australians who acquire, or are born

with, a significant disability (Productivity Commission, 2011). The available evidence indicates important relationships among disability, housing costs, and homelessness (Beer and Faulkner, 2011)—but, in the absence of a data set of the quality and scope of the AHS, it is impossible to estimate precisely how NDIS will interact with existing programs and policies and in what ways such an initiative will affect the housing market. To date, Australia's understanding of the relationships and connections between all dimensions of housing and people with disabilities has been partial, and the modeling of policy outcomes has been patchy and incomplete. The quality of public debate and policy development has consequently been lessened.

From our perspective, one key feature of the articles in this symposium and of the data collected within the AHS is the inclusion of information on the quality of housing. Australia lacks a substantial national collection of data pertaining to dwelling quality and, although specific-purpose surveys allow for the analysis of the relationship between housing and health for Indigenous Australians, the effect of Australia's housing stock on the wider population remains largely unknown (Baker, 2007). A far stronger contemporary evidence base exists in the United States and is reflected in this collection of articles. As Emrath and Taylor (2012) note, problems of high housing costs relative to income are more widespread than the challenges of poor-quality housing, but, as with Australia, these challenges can have significant effects on the well-being of a person or community.

The capacity for longitudinal analysis is, from the perspective of Australian researchers, a second key feature of the AHS. Some dimensions of the housing market can be understood only through a longitudinal analysis and, unfortunately, no substantial longitudinal data sets exist for the Australian housing market. Microsimulation techniques have been used in a number of instances (Nepal et al., 2008), but they do not provide the depth and surety of insight available through longitudinal analysis. Unfortunately, the prospect of establishing a similar survey to the AHS in Australia seems slim in the foreseeable future because of the costs involved and the strong concerns about privacy that exist in Australia.

Finally, it is worth reflecting on the fact that the AHS is conducted every 2 years and has been a feature of the housing research landscape in the United States since the early 1970s. The ability to have access to such a detailed, high-quality data set on an ongoing basis must be of great benefit to U.S.-based researchers and policymakers. The data allow for both ongoing studies of topics of enduring interest and investigation of emerging issues. There are strong grounds, therefore, for U.S.-based researchers to value the AHS, while those of us who work outside the United States can only look on with envy.

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Point of Contention: Shadow Inventory

With this issue, we introduce a new section of Cityscape, *"Point of Contention," in which we present viewpoints on narrow issues on which expert opinions nonetheless may be remarkably different. The first point of contention is the shadow inventory. For our purposes, we define the shadow inventory as housing units being held off the market by lenders, either in the form of Real Estate Owned (REO) properties not offered for sale or in the form of mortgages delinquent for more than X months on which the lenders have not foreclosed. The unknown X is at least 3, but lenders seem to differ on how many months of delinquency they allow and what other conditions must be met before foreclosure occurs. Some commentators argue that home prices cannot stabilize as long as a large potential supply of inventory overhangs the market and that falling home prices are a major drag on the economy. For this issue, we asked three experts to explain why the shadow inventory exists, why it has increased, how large they think it is, how large it would be in a normal market, and whether the shadow inventory requires government action to accomplish economic recovery.*

Chasing Shadow Inventory: Sloppy Foreclosures and Unintended Consequences

Daren Blomquist
RealtyTrac® Inc.

The specter of shadow inventory continues to loom over the housing market, despite an undeniable decrease in the actual shadow inventory numbers.

The inventory of properties in some stage of foreclosure or Real Estate Owned (REO) shrank from a record high of more than 2.2 million properties in December 2010 to slightly fewer than 1.5 million properties in September 2011—a 32-percent drop in just 9 months—according to RealtyTrac® Inc. proprietary data.

During a similar time period, the unsold REO inventory fell 30 percent, from more than 1 million properties in January 2011 to about 710,000 properties in September 2011. The inventory of properties in the foreclosure process fell 37 percent during the same period.

The decreases in foreclosure inventory in 2011 should not be too surprising given the decreases in delinquency rates in 2010. After peaking at 10.06 percent of mortgage loans in the first quarter of 2010, delinquency rates fell for three straight quarters through the end of 2010, according to the

Mortgage Bankers Association National Delinquency Survey. The national delinquency rate then increased in the first and second quarters of 2011 before decreasing again in the third quarter to the lowest level since the fourth quarter of 2008.

Nonetheless, shadow inventory continues to strike fear and uncertainty into many hearts, because no one quite trusts all of the numbers floating around. This dark corner of the housing market might be hiding the true enormity of the problem. Or, perhaps a cleverly concealed lighting effect is causing a relatively small inventory to cast a disproportionately long shadow that is simply feeding irrational fear.

The fear and uncertainty saturating the market, whether rational or not, is prolonging the shadow inventory problem, making it a sort of self-fulfilling prophecy. This fear and uncertainty about the actual magnitude of the shadow inventory problem is helping to drive down consumer confidence and demand from most real estate buyers. The lower confidence and demand mean that the market takes longer to absorb the distressed properties that make up the bulk of the shadow inventory.

RealtyTrac® proprietary data show that REO properties sold in the third quarter of 2011 sold an average of 193 days after they were foreclosed upon—the highest average since the first quarter of 2007, when RealtyTrac began tracking this metric. Properties in the foreclosure process that sold during the third quarter of 2011 sold an average of 318 days after they entered the foreclosure process, also the highest average since the first quarter of 2007.

Weak consumer demand is not entirely responsible for those record-long times to sell foreclosures, however. In fact, in-foreclosure and REO property sales increased in the first two quarters of 2011 after decreasing in the two quarters immediately after the first-time homebuyer tax credit expired in the second quarter of 2010.

In select markets hard hit by the foreclosure crisis, we have even been hearing for several months now about an inventory shortage and bidding wars on foreclosure properties. This shortage is happening in places like Stockton, California, and Detroit, Michigan, where a member of the RealtyTrac® Agent Network recently said he thinks that a "backlog of buyers" in his market is just waiting for more properties to become available (Whitelaw, 2011).

What else could be holding up the efficient sale of distressed inventory in today's market? The two answers are sloppy foreclosure practices on the part of lenders and the unintended consequences of government intervention.

Government intervention began in earnest at the federal level with the introduction of the Home Affordable Modification Program (HAMP) in March 2009. HAMP's beginning coincided with a key turning point in the distressed property sales trends tracked by RealtyTrac®.

Starting in the first quarter of 2006, sales of REOs and properties in the foreclosure process had steadily increased for 12 straight quarters, or 3 years. Those sales peaked at 348,629 in the first quarter of 2009 and began trending downward for the next four quarters, a trend interrupted by a sizable jump in the second quarter of 2010, most likely the result of the expiring first-time homebuyer tax credit. Although distressed sales have taken a recent uptick, the second quarter 2011 total of 265,087 distressed sales was still much less than the first quarter 2009 peak.

Although the intended purpose of HAMP and the other foreclosure intervention programs that followed was to help homeowners avoid foreclosure, the programs also had the unintended consequence of slowing the absorption rate of distressed properties, which in turn allowed for a shadow inventory of in-foreclosure and REO properties to begin building to a peak of more than 2.2 million early this year.

Whereas foreclosure sales slowed with the introduction of HAMP, actual foreclosure activity picked up. March 2009 began 20 consecutive months in which more than 300,000 U.S. properties had a foreclosure notice of some kind, according to RealtyTrac® data. That dubious trend came to an abrupt halt in November 2010, after the "robo-signing" controversy brought to light the questionable foreclosure processing and paperwork that many lenders used to push foreclosures through quickly.

The fallout from the robo-signing controversy continues to slow the pace at which lenders foreclose. Properties foreclosed in the third quarter of 2011 spent an average of 336 days in the foreclosure process, from start to completion, a record high in RealtyTrac® data and up from the 140-day average to foreclose recorded in the third quarter of 2007.

These extended timelines clearly demonstrate that lenders are not able to process foreclosures as quickly as they did in the past. This fact has reduced the shadow inventory of REOs and properties in the foreclosure process, but it may be pushing the shadow inventory of delinquencies higher—hence the uptick in delinquency rates in the first half of 2011, after three straight quarters of declines.

Although the so-called shadow inventory certainly exists, attempts to somehow contain it are a bit like trying to catch one's shadow—mostly ending in frustration and exhaustion with nothing to show for it. Instead, we should continue trying to shed light on the true nature of the shadow inventory in an attempt to remove the paralyzing fear and uncertainty it has brought to this market.

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Shadow Inventory: Influence of Mortgage Modifications and State Laws

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As the housing market seeks stabilization and eventual recovery, one of the most significant deterrents is the magnitude of the shadow inventory. Unlike the visible inventory of homes for sale—those listed for sale on multiple listing services (MLSs) or directly by homeowners—the shadow inventory is the stock of homes that are likely to be for sale in the future but are not yet listed or "visible." CoreLogic® (2011a) estimated the shadow inventory to be 1.6 million single-family residential homes in October 2011, compared with 1.9 million a year ago. The shadow inventory is smaller than its peak of slightly more than 2 million housing units in January 2010, but it remains significantly elevated relative to the level that would occur under healthy market conditions. The elevated shadow inventory level is a significant drag on the health of the housing market, because it represents the future stock of distressed-asset sales that, when sold at a discount to market value, place downward pressure on price levels. The shadow inventory and its effect on housing markets will vary dramatically based on foreclosure laws and disposition timelines.

Shadow inventory, as we define it, is the current stock of distressed properties not currently listed on MLSs that are seriously delinquent (90 or more days), in foreclosure, or Real Estate Owned (REO). We use transition rates of delinquency to foreclosure and of foreclosure to REO to identify the currently distressed, unlisted properties most likely to become REO properties. Properties that are not yet delinquent but may become delinquent in the future are not included in current shadow inventory estimates. The cumulative estimates that measure the shadow inventory over a window of future years are significantly larger than the existing shadow inventory because they include estimates of the current shadow inventory, of future serious delinquencies, and of future redefaulting loan modifications. Shadow inventory is typically not included in the official metrics of unsold inventory.

A typically unmeasured component of shadow inventory is the incidence of owners holding their homes off the market because of market conditions or because they are in a negative equity position. CoreLogic® (2011b) estimates that more than 10 million borrowers are under water on their homes, their outstanding mortgage debt being more than the value of their home. Of course, not all underwater borrowers want to sell, but being under water makes it more difficult to move for a new or better job, or respond to changed circumstances, such as increased household size. Reduced mobility creates pent-up housing inventory and can exacerbate unemployment by keeping

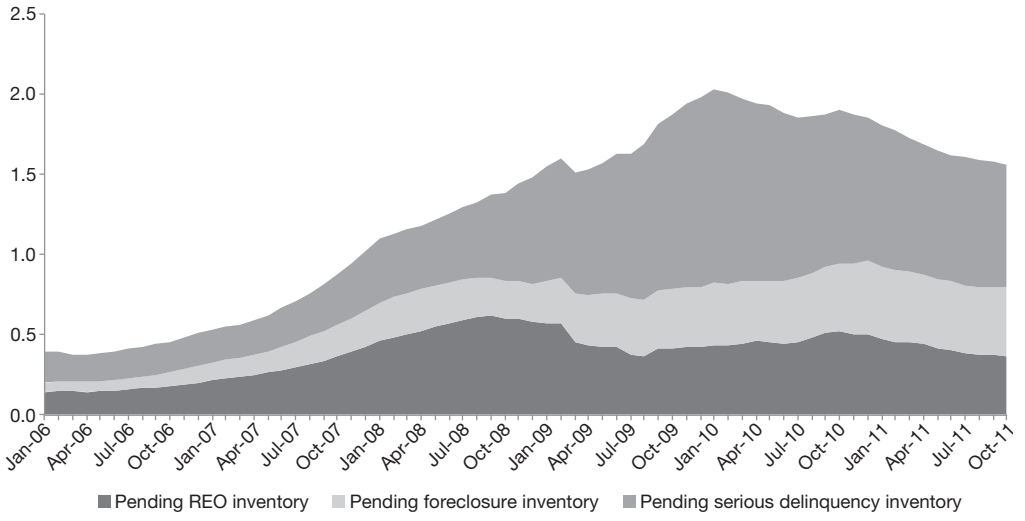
households from moving for employment. We recognize that this reduced mobility increases the size of the shadow inventory but, because estimating inaction on the part of households is challenging, we do not attempt to estimate this component of shadow inventory.

Exhibit 1 shows the shadow inventory over time from January 2006 through October 2011, the most recent data available at the time of this writing. The inventory grew from less than 400,000 housing units 3 years ago to slightly more than 1.6 million in October 2011. Foreclosure and REO levels stabilized at below 500,000 each in 2011. The most recent trend shows REO shadow inventory declining faster than foreclosed shadow inventory. We estimate that fewer than 400,000 REO properties are unlisted at this time, but that 430,000 foreclosed properties are likely to become visibly listed REO properties over the next year (CoreLogic®, 2011a). The unlisted REO count in the shadow inventory peaked in late 2010 but, because of the "robo-signing" debate and consent orders to review foreclosure practices, the transition of properties from foreclosure to REO slowed in 2011.

The declining number of seriously delinquent loans in the shadow inventory accounts for most of the 2011 decline in shadow inventory levels. The current inventory of seriously delinquent shadow properties is 770,000, down 36 percent from the peak of 1.2 million in January 2010. A reduction in the flow of new seriously delinquent loans has accounted most for the decrease of the seriously delinquent shadow inventory (CoreLogic®, 2011a). Throughout 2010 and 2011, the overall delinquency level slowly improved, along with a slow improvement in economic conditions. Alternatives to foreclosure, such as the Home Affordable Modification Program (HAMP), Home Affordable Refinance Program (HARP), short sales, and so on, have become more operationally successful. To date, HAMP and HARP have combined to prevent more than 1.7 million likely foreclosures (Treasury Department, 2011). Short sales are also an increasingly popular alternative

Exhibit 1

Shadow Inventory Detail



REO = Real Estate Owned.
Note: Count in millions.
Source: CoreLogic® (2011a)

to foreclosure. As of August 2011, short sales represented 8 percent of all home sales transactions and 30 percent of all distressed home sales (CoreLogic®, 2011c).

The effect of the shadow inventory on the housing market itself is largely dependent on the time it takes for a loan to go through the foreclosure process, enter REO, and go through the REO disposition process. The differences in the time it takes to foreclose in different states—which depends on whether they are judicial or nonjudicial foreclosure states and on the strength of demand in the different markets—can make a big difference in the effect of the shadow inventory on home sales prices. For example, California, a nonjudicial foreclosure state, and Florida, a judicial foreclosure state, have had very similar home price paths over the past 10 years. California's foreclosure inventory is currently 2.5 percent of all active loans, down 18 percent from the August 2010 inventory. This number represents a 12-month supply of foreclosures, given the prevailing pace of REO sales in California. By contrast, Florida's foreclosure inventory is currently 12 percent of all active loans, unchanged from the August 2010 rate. Given the prevailing pace of REO sales in Florida, this supply will last 61 months. California's faster disposition of distressed assets is evident in the states' respective shares of all sales that are distressed: 48 percent in California and 34 percent in Florida. The effect on price levels is also directly apparent. In California, home prices were down 6.2 percent in August 2011, whereas in Florida, prices were down moderately less: 4.7 percent. California is resolving its shadow inventory more quickly, taking the pain in the short term, but it is likely to reap the benefits of a faster resolution in the long run, whereas in Florida, the length of the process will drag out the deleterious effects of shadow inventory on the housing market and price levels.

Shadow inventory sellers face competing risks after a property becomes part of the REO stock. On one hand, they can sell properties quickly and reduce the stock by significantly underpricing the distressed properties; on the other hand, they can set a higher initial price, but doing so reduces demand and lengthens the time to sale. One incentive to underprice distressed properties is offsetting the additional loss from the sale with the net present value savings of reducing the holding cost for the property. Unfortunately, distressed property sales have spillover effects. As properties sell, they become value benchmarks for properties yet to be sold. Underpricing a distressed asset makes any other distressed assets in the local market less valuable. Servicers often manage many properties in the same market or neighborhood, so the risk of reducing the values of other distressed assets, which those servicers must subsequently sell in the same neighborhood, offsets the incentive to underprice a distressed property to facilitate a quick sale.

In addition, if a servicer were to bring too many distressed assets to market too quickly, those assets would increase the supply relative to demand. Buyers would have many properties from which to choose, and sellers would have to further underprice properties to attract contract bids. Servicers would effectively compete against themselves, and potentially against other servicers attempting to sell distressed properties in the same neighborhood. Therefore, those responsible for the disposition of REO assets have to balance the number of assets they supply and how they price those assets to facilitate timely sales without creating unnecessary downward price pressure. The faster the shadow inventory converts into visible inventory, the greater the risk of increasing losses if the market cannot support the distressed asset supply. Even if geographically diverse legal requirements did not impede the flow of the shadow inventory into the visible spectrum, servicers' attempts to mitigate losses on behalf of the investors would prevent them from "dumping" distressed assets on the market and causing large home price declines.

Conclusions

Although the shadow inventory level is currently below its early 2010 peak, it is well above the precrisis levels of only a few hundred thousand properties. It is clear that disposition of the shadow inventory impedes future home price growth and can also increase the magnitude of home price declines. But the effect may not be as calamitous as some have suggested. A slowly improving economy and a collection of government programs have intervened to provide alternatives to foreclosure, slow the pace of new delinquencies, and reduce the shadow inventory. Geographically differentiated legal requirements for the foreclosure process and disincentives for servicers to dump distressed assets indicate that the shadow inventory will not enter the visible inventory all at once, but instead will enter more slowly, as the courts and housing markets can reasonably absorb it. Even so, reducing the shadow inventory more quickly has benefits. Reducing the shadow inventory to precrisis levels will further accelerate the stabilization and growth of home prices going forward, as will longer term positive trends in economic growth and household formation.

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Shadow Inventory: Holding Down Home Values in Multiple Ways

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The views expressed in this article are those of the authors alone and do not reflect the views of their employer, Fannie Mae.

National real home prices have dropped back to levels last seen in 1999. Nominally, they have fallen 31 percent from their peak in April 2006 if we include distressed sales and 22 percent if we exclude them (CoreLogic®, 2011). At the same time, mortgage interest rates are at generational lows. The combination of cheap houses and cheap money makes homes more affordable now than they have been in decades. So why do home sales prices continue to fall? One could suggest reasons such as unemployment and tight credit, but the shadow supply of available properties is one key factor. American consumers know the basic law of supply and demand and can see that, although the number of months of listed inventory is near historic averages right now, vast numbers of homes wait on the sidelines. These coming sales include unlisted repossessed homes, homes associated with the 8.1 percent of mortgages delinquent as of March 31, 2011, according to Mortgage Banks Association survey, and some growing fraction of the 10.9 million homes with underwater owners (CoreLogic®, 2011) who would have sold by now if they could have paid off their mortgages. In her testimony to the U.S. Senate Subcommittee on Housing, Transportation, and Community Development on September 20, 2011, Laurie Goodman of Amherst® Securities Group, LP, predicted that upwards of 1.4 million units of distressed housing will hit the market annually for the next 6 years (Goodman, 2011). These "sales on the way" are additive to the normal economic rates of offerings and are therefore likely to exceed even normal demand rates. Actual demand, however, will probably fall short of normal in response to the tightest underwriting practices since at least 1995.[1]

The expected supply and demand imbalance, however, is only the first weight on pricing from shadow inventory. After all, shadow inventory is a substantial share of the whole market, perhaps one-fifth, according to Goodman (2011). What happens to the values of homes on their way to ultimate foreclosure? Just as potential buyers are wary of investing in a losing asset, underwater owners, and delinquent owners in particular, are reluctant to invest in their homes because they will not realize a return upon sale. The longer a home is delinquent, the longer the disinvestment period. Without proper maintenance, the condition of the home worsens and it becomes harder to

[1] That was the year when credit scores were first collected regularly, enabling such a comparison.

sell. Gerardi et al. (2011a) estimated that the ultimate value of a foreclosed property falls by about 0.5 percent for each month of delinquency before foreclosure. By sheer numbers, the lower values of the shadow inventory bring down average prices for the housing stock as a whole.

This erosion of value through underinvestment may well be the bulk of the explanation for the so-called foreclosure stigma price effect, a mysterious price discount long presumed due to the desperation of foreclosed property owners and the hesitation of buyers to live in foreclosure-haunted homes. The data that drive stigma theories are the same data that drive the different House Price Index estimates above—a battered index for the market as a whole, but a somewhat less beaten-down index for nondistressed sales, as if two separate housing markets can exist side by side. By controlling for the home condition recorded in realtor listings, Clauretie and Daneshvary (2009) estimated that the stigma discount is far smaller than the simple average price differences would indicate. And if we assume that realtors likely downplay the full adverse condition of their listed properties, then the stigma effect would shrink further. Indeed, Harding, Rosenblatt, and Yao (2012) do not find any significant foreclosure discount, as measured by a failure of most buyers of foreclosed homes to realize abnormal profits upon reselling their homes. If resellers cannot make excess profits, then the homes must have been sold at prices reasonably near their market values.

Beyond these effects lies an additional and less obvious devaluating force from shadow inventory, what Gerardi et al. (2011b) call "the broken window effect." The poorer maintenance and condition of the shadow inventory are either eyesores or harbingers of a neighborhood in decline, harming the salability of nearby homes. Several papers have appeared recently that document this so-called *contagion effect*. Using a sample ending in 2007, Harding, Rosenblatt, and Yao (2009) found that foreclosed homes in bank portfolios cause about a 1-percent loss in value to nondistressed homes selling within 300 feet, but the value loss begins at least 1 year before foreclosure and builds steadily until the bank takes over the home and resumes maintenance. Gerardi et al. (2011b) found a 3.2-percent negative contagion effect in a 2007–2009 sample. The contagion effect is greater if the bank appraiser considers the neighboring foreclosure home to be in poor condition. Again, the contagion effect does not spring suddenly into life with default. Gerardi et al. (2011b) also find the effect before foreclosure, with each seriously delinquent (SDQ) loan (SDQ = 3 or more months delinquent) lowering neighboring property values by 2.8 percent.

The longer a home is delinquent, the longer maintenance is deferred. Extended delinquency lowers the value of the delinquent home and that of its neighbors. Because of administrative and political logjams, but also because of humanitarian efforts to help delinquent borrowers, time in delinquency has risen rapidly in the last several years, astonishingly so in some states. Nationally, the share of Fannie Mae loans that are SDQ rose about 7 times from December 2006 to December 2010, and the share of loans 12 or more months late rose twentyfold. In California and Florida, the SDQ rates rose about twenty-fivefold, but the rate of loans at least 12 months delinquent rose hundredfold. Of course, in 2006, it was easy to sell homes in these states—almost anybody could sell a delinquent home in less than 1 year and pay off their mortgage—so comparing 2010 to 2006 might be misleading. But from December 2008 to December 2010, the rate of home loans delinquent for more than 1 year rose by a factor of six in Florida, and now more than one-half of the SDQs in that state have been delinquent for at least 1 year. The delinquency contagion effect might have been ignorable in the past in Florida, but now it is a rare sale that is not near a delinquent property.

In summary, we have identified three ways in which shadow inventory hurts home prices and retards economic recovery. Shadow inventory creates gloom about future supply/demand imbalance, it destroys value directly through maintenance failure, and it harms neighboring home values through the broken window effect. Other avenues of adverse effect likely exist, however, such as economic uncertainty and complexity in urban planning. Endogeneity effects, such as falling prices from contagion causing an increase in foreclosures, surely exist. Shadow inventory plays a pernicious role in the housing and economic recessions, and delays in resolution do not mitigate its effects.

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Public Housing Transformation and Resident Relocation: Comparing Destinations and Household Characteristics in Chicago

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Abstract

Nearly a decade after the start of the Chicago Housing Authority's (CHA's) Plan for Transformation, more than 16,000 households have been relocated into a variety of housing contexts, including new mixed-income developments, private rental housing subsidized with vouchers, scattered-site public housing units, and rehabilitated 100-percent public housing developments. Using administrative data from the CHA and a number of state agencies, we compare the characteristics of residents who ended up in the different housing contexts and examine differences in their current well-being. Counter to expectations, our analysis reveals no evidence of any sorting of higher functioning households into new mixed-income developments or into the private market with housing choice vouchers, or of more challenged households being left behind in traditional public housing developments. On the contrary, we find that the households that ended up taking vouchers were relatively more challenged (as suggested, for example, by patterns of employment, income, and welfare receipt) in 1999 than other subgroups and even have relatively more troubling indicators of well-being in 2008. Furthermore, although the households living in scattered-site housing in 2008 seem to be faring quite well, those in mixed-income developments are surprisingly indistinguishable across most indicators from the households living in traditional public housing developments.

Introduction

During the past two decades, scholarly interest in and policy responses to urban poverty have largely focused on concentration effects in very high-poverty neighborhoods. In these neighborhoods, the social problems linked to poverty have a cumulative negative effect on residents above and beyond their direct effects on individuals or households (Jargowsky, 1997; Massey and Denton, 1993; Wilson, 1996, 1987). Public housing, which has been relegated generally to very low-income, African-American neighborhoods, has increased substantially the concentration of poverty and the racial segregation in many urban areas (Massey and Kanaiaupuni, 1993).

Given these concentration effects, housing policies aimed at deconcentrating poverty in urban centers have taken one of two approaches. The first approach, dispersal policies, encourage public housing residents to move out of large public housing projects and, ideally, into higher income and less segregated neighborhoods. Residents may receive vouchers to use in the private market or move to public housing units scattered throughout the city (Goetz, 2003, 2000; Varady and Walker, 2003). In addition, federal housing policy has included efforts to allow for greater mobility of public housing residents; for example, by shifting from project-based to tenant-based subsidies, and by enabling residents to use vouchers across municipal boundaries (Goetz, 2000). By contrast, the second approach, place-based redevelopment policies, focus on demolishing large public housing projects and replacing them with mixed-income developments on the same site. The federal HOPE VI Program is an example of this approach (Cisneros and Engdahl, 2009; Popkin et al., 2004; Smith, 2006).

Policymakers intend both strategies to counteract the effects of concentrated poverty by providing public housing residents with access to more resources and opportunities, including better schools, more responsive services, better access to the workforce, and opportunities to forge new social relationships with more affluent neighbors (Arthurson, 2002; Joseph, Chaskin, and Webber, 2007; Kearns and Mason, 2007; Kleit, 2001). Redevelopment policies have the additional goal of improving conditions in the surrounding neighborhood (Goetz, 2010, 2003; Popkin et al., 2004).

The Chicago Housing Authority's (CHA's) Plan for Transformation (the Transformation), which has affected almost 25,000 public housing households directly, represents the most ambitious effort in the United States to address the problems of concentrated urban poverty through both dispersal and redevelopment strategies.[1] At its completion, the Transformation will have demolished about 22,000 public housing units, rehabilitated more than 17,000 units, and constructed approximately 7,700 public housing replacement units in new, mixed-income developments that will also include more than 8,300 units of affordable and market-rate housing (CHA, 2008).

[1] Chicago's Plan for Transformation includes two additional strategies that do not attempt to deconcentrate poverty. The first is renovating (primarily) low-rise family developments located away from the city center. These developments will comprise 20 percent, or 4,978, of the planned 25,000 replacement units. As of January 2011, the city had renovated 76 percent of these planned units. The second strategy involves renovating senior housing, and the CHA has made a concerted effort to provide seniors with the option of living in seniors-only developments with associated support services. Of the planned 25,000 replacement units, 38 percent, or 9,382, will be in senior housing developments. As of January 2011, CHA had renovated 99 percent of the senior units (CHA, 2011a).

The demolition and involuntary relocation at the heart of the Transformation have not been without controversy. As in other cities implementing similar changes, Chicago's low-income residents and their advocates have met the Transformation with resistance (for example, Goetz, 2000; Pattillo, 2007). Studies have raised questions about the expected benefits of relocation, including the assumption that cross-class interaction will foster social capital development or positive behavior change (Joseph, Chaskin, and Webber, 2007; Kleit, 2001; Lees, 2008). Moreover, some have claimed that such schemes are essentially revanchist efforts to appropriate low-income neighborhoods for the benefit of the affluent rather than to address the needs of low-income residents through system reform and neighborhood revitalization (Fraser and Kick, 2007; Lees, 2008; Smith, 1996; Smith and Stovall, 2008).

In any case, the Transformation has led to a massive relocation of more than 56,000 Chicago residents who were living in public housing as of October 1999, the month in which the Transformation was announced (CHA, 2000).[2] Most of these residents have since relocated to private rental housing subsidized with vouchers, newly rehabilitated traditional and scattered-site public housing units, and new mixed-income developments. In the process, many experienced multiple moves, relocating temporarily into vacant public housing units or accepting temporary housing vouchers before landing in their permanent housing choices.[3] Other residents secured unsubsidized housing in the private market, moved in with family or friends, or simply failed to fulfill the requirements to retain their subsidy.

In many cases, the relocation process has been quite lengthy and disruptive for residents. For example, residents living in highrise buildings slated for demolition relocated early on in the Transformation. Those choosing to return to the new mixed-income developments had to wait several years for developers to build the first units, and many of the planned units are still not complete. In other cases, most notably for residents of scattered-site public housing, the process has been shorter and possibly more stable. Although these residents had the same housing relocation options as other residents, rehabilitation has generally taken less time than the wait for new mixed-income and renovated traditional public housing units; some residents have been able to relocate within or near their building until a completed unit becomes available; and, as we shall see, the vast majority of these residents elected to remain in scattered-site housing.

Although a number of studies have examined the relocation process, the characteristics of the neighborhoods to which public housing residents relocate, and the effects of relocation on a range

[2] This population, referred to in Transformation documents as the 10/1/99 population, includes leaseholders in CHA housing as of October 1, 1999, and other household members enumerated on the lease. Under the Relocation Rights Contract, a legal agreement established between the CHA and its residents at the Transformation's start, all lease-compliant households in the 10/1/99 population are guaranteed a right to return to a new or rehabilitated unit.

[3] The Relocation Rights Contract guarantees residents one of four permanent housing choices: a newly built unit in a mixed-income development, a permanent housing choice voucher, a rehabilitated scattered-site unit, or a rehabilitated unit in a traditional CHA development. After residents have signed a lease for one of these units, they receive a notice indicating that their right to return has been satisfied. The Relocation Rights Contract does not guarantee assistance with subsequent moves except in cases of changes to household composition (CHA, 2001).

of outcome measures, those studies generally did not compare residents based on the type of housing to which they relocate.[4] Comparing these groups is important for at least two reasons.

First, although the October 1999 CHA population consisted of predominantly extremely low-income, African-American, female-headed households with long public housing histories, they were diverse in numerous other ways, including household size, the age of household members, their involvement with other public systems, and their attachment to the labor market. Comparing residents based on the housing type to which they relocate can provide insight into the ways in which these differences may either constrain housing choices or shape preferences.

One might posit, for example, that residents who were faring better when the Transformation began would have been more likely to move to the new mixed-income developments, which have the most rigorous eligibility criteria (including work requirements, criminal background checks, and drug testing), or to the private market with housing choice vouchers (HCVs), which require the often difficult task of finding both a unit and a landlord willing to accept a voucher. Conversely, one might expect that the residents who stay in (or return to) traditional public housing would be those with the greatest challenges to becoming independent—such as chronic unemployment, disabilities, mental or physical health problems, or other systems involvement—or those with larger families, given the smaller unit sizes available in the mixed-income developments.[5]

Second, a better understanding of these differences will also shed light on some fundamental practice and policy questions: To what extent do housing options and their eligibility criteria match the preferences and characteristics of the relocating population? To what extent do differences in household characteristics reflect differences in the pathways to opportunity generated by the public housing transformation? And to what extent will households that have relocated to different types of housing require different types of ongoing supports and services?

Furthermore, although other studies have examined how residents are faring post-relocation, they have not compared those in different types of housing on indicators of well-being. Nor have they determined whether well-being improves the longer residents have been in the housing to which they relocated, or if these improvements vary by housing type. Given the massive investment of time and money—more than $2 billion during the first 10 years—that has gone into creating Chicago's 10 major new mixed-income developments, and given the attention given to the selection criteria used to identify the residents most likely to succeed in these environments, it seems important to ask whether and to what extent the residents who have relocated to these developments are faring better than those in other subsidized housing options. For example, are the residents of mixed-income developments more likely to be employed or earning higher wages and less likely to be receiving public assistance? Similarly, are they less likely to be involved with the juvenile justice or child welfare systems?

[4] A recent exception is Buron and Popkin (2010), who found differences among relocated residents of one Chicago public housing development, Madden Park/Wells. Specifically, residents who moved into the private market (using housing choice vouchers or without assistance) tended to be younger, less likely to have been long-term public housing residents, and more likely to have had household incomes above $20,000 than those who were living in either traditional public housing or mixed-income developments. In addition, those in mixed-income developments were more likely to have children than those in traditional public housing.

[5] For more information about this "hard-to-house" population, see Popkin et al. (2010a) and Theodos et al. (2010).

This article begins with a brief review of the literature on relocation. Specifically, we explore the extent to which relocation seems to be achieving the broader goal of deconcentrating poverty and discuss some of the evidence related to the effect of relocation on family well-being. Next, we outline some of the factors that condition resident mobility and housing choice under the Transformation. We then turn to an analysis of administrative data from public housing and several other state and local agencies to address three questions. First, to what extent did CHA households across different housing types differ from one another at the beginning of the Transformation with respect to demographic characteristics and indicators of well-being? Second, to what extent do they differ from one another nearly a decade after the Transformation began? And third, is there any evidence that family well-being improves the longer residents have been living in mixed-income developments? Finally, we offer some conclusions and suggest some implications of these findings for practice and policy.

Resident Relocation and Concentrated Poverty

The results of recent research on the relocation of public housing residents have been mixed. In the case of Chicago families relocated from public housing to suburban communities under the original Gautreaux desegregation case ruling, the policy largely achieved its goals of desegregation and deconcentration. Most residents moved to (and continued to live in) significantly higher income and less racially segregated suburban neighborhoods with access to better infrastructure, services, and amenities (DeLuca, 2005; DeLuca and Rosenbaum, 2003; DeLuca et al., 2010; Keels, 2008; Keels et al., 2005). Similarly, recent research on public housing residents who received vouchers as part of the HOPE VI Program and the Transformation suggests that most moved to neighborhoods that were less poor and safer than the neighborhoods from which they came (Buron et al., 2002; CHA, 2011b; Kingsley, Johnson, and Pettit, 2003; Kleit and Galvez, 2011; Popkin, 2010; Popkin, Levy, and Buron, 2009).

In other cases, relocation has been less effective. For example, many residents who relocated to higher income neighborhoods with lower crime rates, better infrastructure, and more responsive services as part of the Moving to Opportunity (MTO) program eventually returned, often after several moves, to socially isolated, overwhelmingly African-American neighborhoods with high levels of poverty, high unemployment rates, and underperforming schools (Briggs, Popkin, and Goering, 2010; Orr et al., 2003). Similarly, families who relocated during the second round of Gautreaux often experienced subsequent moves to largely low-income, racially segregated neighborhoods (Boyd, 2008; Boyd et al., 2010).[6]

Evidence is also mixed regarding the effect of relocation on individual-level outcomes. Studies of the families affected by the original Gautreaux ruling found improvements in employment and educational attainment (Rubinowitz and Rosenbaum, 2000), but the economic benefits of moving to the suburbs were more tenuous than the initial research had suggested (DeLuca et al., 2010).

[6] The overriding emphasis in the original Gautreaux ruling was racial desegregation. By contrast, Gautreaux Two sought to move residents to "opportunity areas" characterized by lower levels of both poverty and racial segregation, and the MTO program focused on moving families to low-poverty neighborhoods without explicit reference to race.

Similarly, residents who relocated as part of the MTO program reported better physical and mental health but no gains in employment or educational attainment and, despite a reduction in risky behavior among young women, delinquent behavior among young men increased (Briggs, Popkin, and Goering, 2010; Orr et al., 2003). Research has found improved mental health among HOPE VI voucher holders, but also significant economic hardship (Popkin, 2010) and no positive effects on employment or income (Clampet-Lundquist, 2004a; Curley, 2010; Goetz, 2003). A recent report by the CHA (2011b) found that residents relocated as part of the Transformation increased their rate of employment and average annual income over time, but the report did not look separately at outcomes for residents relocated to different housing types.

In addition, no evidence indicates that relocation under these programs improved social interaction or increased social capital (Clampet-Lundquist, 2010, 2004b; Cove et al., 2008; Greenbaum et al., 2008). Indeed, some scholars argue that any observed relocation benefits may have more to do with the institutional resources to which residents have access in their new neighborhoods than with exposure to higher income families (Curley, 2010; Fauth, Leventhal, and Brooks-Gunn, 2008; Jacob, 2004; Jacob and Ludwig, 2008).

Factors Conditioning Relocation Destinations in Chicago

A primary stated goal of the Transformation was to end the social isolation of public housing residents and create opportunities for them to choose where to live. These opportunities, however, were substantially constrained by several factors. Some of these factors were of a structural nature. For example, although more than 16,000 households will ultimately be relocated, only about 7,000 of the units in the new mixed-income developments will be set aside for public housing residents. Furthermore, these units are less accommodating of larger families and families with older children because they tend to have smaller and fewer bedrooms than units in traditional public housing. Similarly, although there may have been an adequate HCV supply for relocating residents who wanted to move into private-market housing, the number of landlords willing to accept vouchers and the location of their rental units were limited (MPC, 1999). Changes in the housing market over time have also likely affected residents' ability to move with vouchers.

Another factor that conditioned residents' housing choices was the fact that different housing choices were subject to different eligibility criteria. The eligibility criteria for the mixed-income developments were the most stringent and included working 30 hours a week and having no unpaid rent or utilities and no recent criminal convictions. Each mixed-income development was also free to create additional site-specific criteria, such as having to pass a drug test. Although exemptions were available for those physically unable to work and those engaged with service providers to become eligible, residents may have been deterred by the vigilance with which private managers were monitoring compliance. By contrast, not only did the other housing options have fewer eligibility criteria, but the assessment and screening processes were, in general, more lenient.[7] Residents taking vouchers and those moving to scattered-site and traditional public housing

[7] It is worth noting, however, that the CHA instituted a 20-hour-per-week work requirement in 2010 for all traditional public housing development residents, and plans exist to implement a work requirement for voucher holders, as well.

units were subject to criminal background checks by the CHA, which left any additional screening of scattered-site residents and voucher holders to individual property managers.

Yet a third set of factors that conditioned residents' options were the administrative realities and complexity of the relocation process. These factors included the scale of the Transformation, the fast pace of demolition, protracted delays in construction and rehabilitation, lawsuits brought against the CHA by resident advocates, changing policies and procedures, turnover in CHA staff (including the CEO), and the involvement of numerous actors with overlapping roles.[8] Depending on where residents were in the relocation process, they may have been working with relocation counselors on staff with the CHA; social service providers contracted to provide outreach, assessment, and preoccupancy services; private property managers who screened and selected residents for the new mixed-income developments and scattered-site and voucher housing; and CHA property management staff at the rehabbed traditional developments. The complexity of this process created a great deal of uncertainty and made getting up-to-date, accurate information particularly challenging. As a result, many residents who were already skeptical of commitments made by the CHA after decades of mismanagement were forced to make high-stakes decisions about where to live based on incomplete information and under time pressure (Joseph and Chaskin, in press).

One implication of these conditioning factors is that the relocation decisions residents made were not likely to be a pure reflection of their preferences. Although some residents had multiple options, were well informed about those options, and made a choice based mainly on their preferences, that was not often the case.

Data and Methods

This article uses data from three sources. First, the CHA provided data files containing information about all leaseholders who had a right to return because they were living in CHA developments when the Transformation was launched in October 1999. In addition to providing CHA residential histories, these data included information about the demographic characteristics of all individual child and adult household members (for example, birthdate, gender, relationship to household head) as of November 2008, and about the current address and subsidized housing type of each household.

Second, we linked the individual-level CHA household member records through probabilistic matching to the integrated database (IDB) at Chapin Hall at the University of Chicago. The IDB contains administrative records from a variety of state and local agencies in Illinois, including the Illinois Department of Children and Family Services, the Illinois Department of Human Services, the Illinois Department of Employment Security (IDES), and the Cook County Juvenile Court. These data were used to measure labor force participation, Temporary Assistance for Needy Families (TANF) and food stamp receipt, child welfare services involvement (that is, child abuse or neglect investigation, foster care placement), and juvenile justice system involvement.

[8] For more information about the resident relocation process in Chicago, see Joseph (2010); Levy and Gallagher (2006); Polikoff et al. (2009); Popkin (2010); and Williams, Fischer, and Russ (2003).

Third, we obtained additional household composition data from the U.S. Department of Housing and Urban Development's (HUD's) Multifamily Tenant Characteristics System (MTCS). HUD matched the 9,980 November 2008 CHA leaseholder records to 1999 CHA leaseholder records in the MTCS. HUD found matches for 8,484 (or 85 percent) of the 2008 leaseholder records. HUD then created and provided for analysis an extract containing individual-level records for all child and adult household members living with the leaseholder in 1999.

Our primary analysis focuses on those CHA residents who were living in one of four types of subsidized housing in November 2008: new mixed-income developments, private-market housing subsidized with an HCV, scattered-site public housing units, or traditional public housing developments. We used several analytical methods to compare households living in each of these subsidized housing types. First, we plotted their current addresses on a map of Chicago to show household dispersal patterns for different housing types, and examined some characteristics of the areas to which they relocated using the most recent 5-year estimates from the American Community Survey. Second, we compared their demographic characteristics (for example, household composition) and years in CHA housing. Third, we ran bivariate analyses to compare how they were faring on various indicators of well-being, including labor force attachment, TANF and food stamp receipt, and child welfare and juvenile court involvement, in both 1999 and 2008. Fourth, we ran multivariate models to test whether household composition (for example, older children) can explain any differences in the 2008 indicators by housing type.[9]

Finally, we reran those multivariate models, limiting the analysis to residents of mixed-income developments and controlling for the number of months since they had relocated. The rationale for this analysis was twofold. First, by the end of 2008, only 36 percent of CHA units in mixed-income developments and 52 percent of units in traditional public housing developments were complete, meaning that some proportion of the residents in voucher, scattered-site, and traditional public housing were only living in these environments temporarily while awaiting their right to return to new or rehabilitated units. Given limitations in data availability, residents of the mixed-income developments were the only residents for whom we could be certain had been permanently relocated to new units. Second, as noted above, what happens to those residents is of great interest to policymakers because of the large investment made in the mixed-income developments.

Findings

The following sections describe the location, household composition, and well-being of families in CHA housing at the start of the Transformation and nearly 10 years later. Our primary analysis excludes approximately 6,600 households that were no longer living in CHA-subsidized housing at the end of 2008. Household composition data are not available for this group and we know little

[9] Because state and local agencies use administrative data for accountability and monitoring purposes, the agencies routinely collect only information relevant to those functions. This fact limits the range of individual and family characteristics that researchers can measure and control for in their analyses. As a result, the multivariate models that we estimated contained only a few of the many individual and family-level factors that could potentially affect labor market outcomes, program participation, and systems involvement.

about why they left or where they were living at the time. Since 2008, CHA has gathered more information on this population, which we explore separately in the sections that follow.

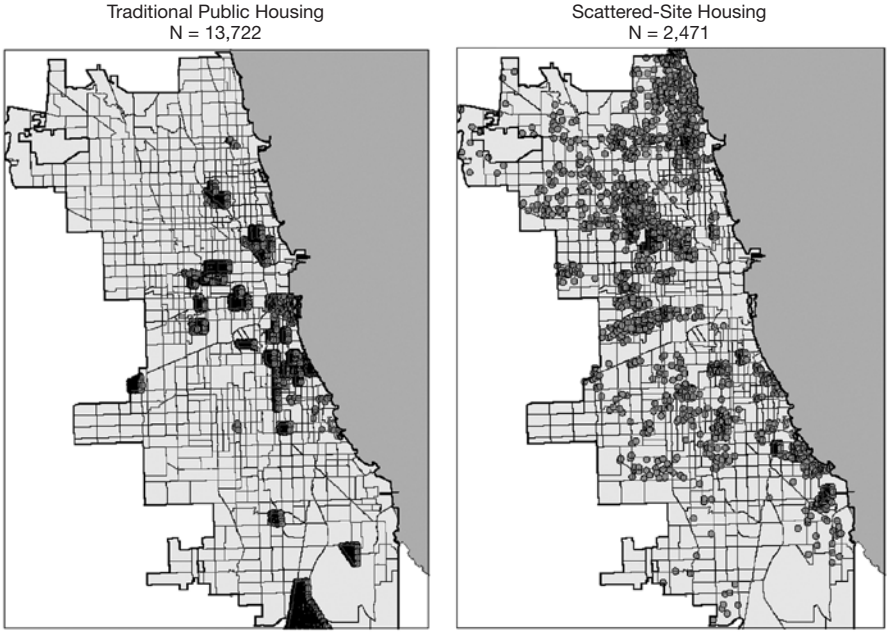
Residential Location in 2008

By the end of 2008, 9,980 nonsenior households were living in one of the four CHA-subsidized housing types: 13 percent (1,278) were living in one of the new mixed-income developments; 40 percent (3,978) were using a voucher in the private market; 16 percent (1,571) were in scattered-site public housing; and 32 percent (3,153) were living in one of the remaining traditional public housing developments.

Exhibits 1 and 2 provide a visual depiction of the dispersal of households across the city of Chicago since the Transformation launched in 1999. Although families have dispersed throughout the city, a clear predominance of moves to the traditionally African-American neighborhoods on the city's south and west sides is evident; other areas, including the northwest, near north, and far southeast, did not receive many relocatees. Looking separately at the dispersion by housing type, it appears that voucher holders are primarily on the south side, and to some extent on the west side, of the city.[10] As a result of the Gautreaux ruling, scattered-site units have been located intentionally

Exhibit 1

Geographic Dispersal Across Chicago in 1999 by Subsidized Housing Type*



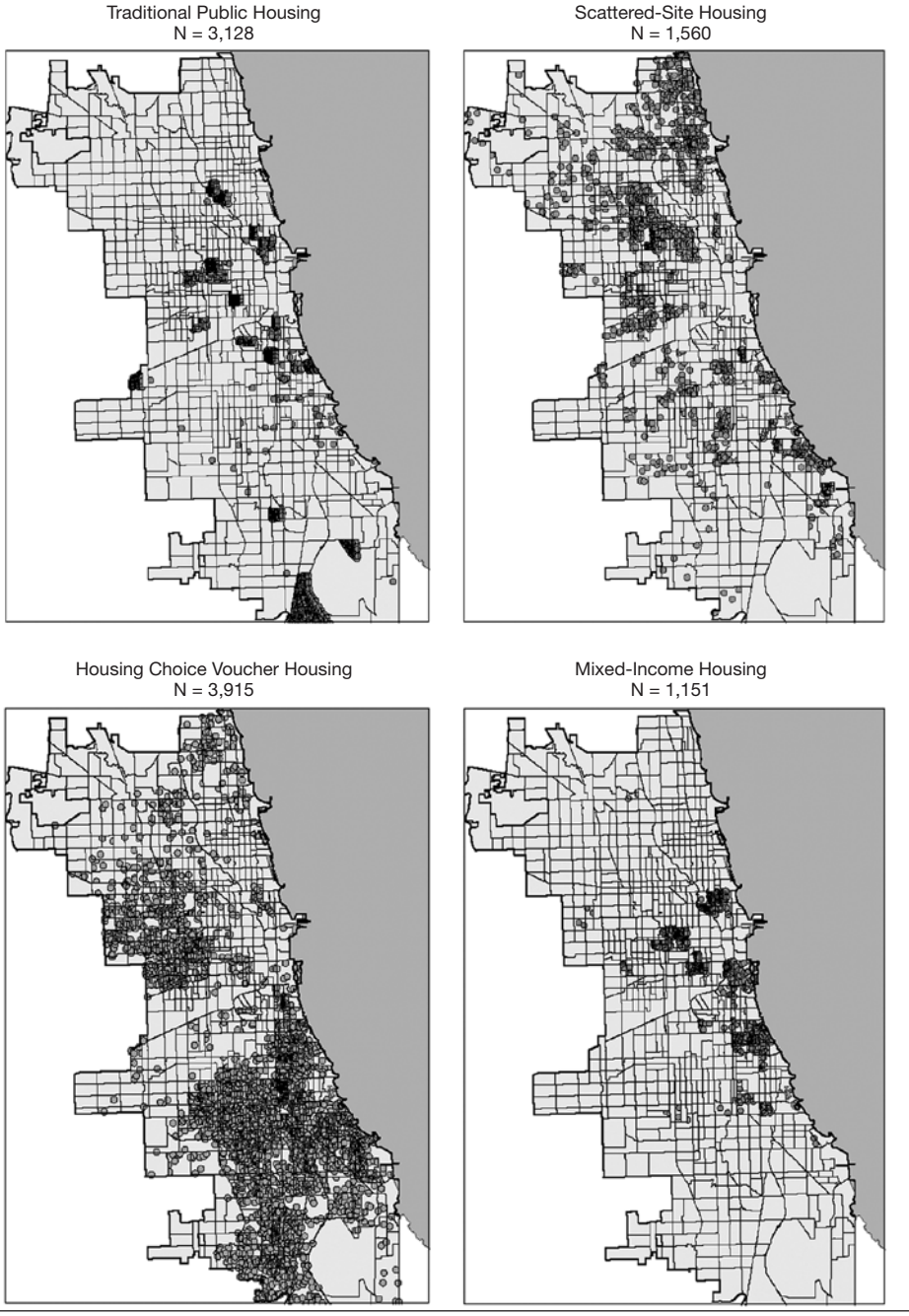
** One dot = one household.*

Source: Chicago Housing Authority

[10] Only 43 of the nearly 4,000 households using vouchers in 2008 were living outside the city limits. Of these households, 12 were living out of state and the rest were located primarily in the counties surrounding the Chicago metropolitan area.

Exhibit 2

Geographic Dispersal Across Chicago in 2008 by Subsidized Housing Type*



** One dot = one household.*

Source: Chicago Housing Authority

in opportunity areas, including many throughout the more affluent north side. Smaller numbers of residents are now living in the mixed-income developments that have replaced the large highrise buildings that housed most CHA residents in 1999, many surrounding the downtown business district, while a substantial number of residents remain in traditional public housing developments located throughout the city.

Exhibit 3 indicates that high rates of racial segregation and poverty characterized many of the neighborhoods in which these households were living in 2008, although some differences by subsidized housing type existed. The average proportion of African Americans in scattered-site housing census tracts was only 37 percent, compared with 71 percent for mixed-income household tracts and 79 percent for traditional public housing development tracts. With an average tract population that was 85 percent African American, HCV holders were actually now more racially segregated than those in traditional public housing developments. Voucher holders and residents of mixed-income developments had moved to census tracts with considerably lower poverty rates, both 29 percent on average, than traditional public housing development tracts, which averaged 40 percent, although not as low as scattered-site tracts, which averaged 24 percent. Tracts with traditional public housing developments and voucher holders also had higher unemployment rates, 23 and 19 percent, respectively, and lower average household incomes, $25,528 and $31,407 annually, respectively, compared with tracts with mixed-income and scattered-site housing.

Exhibit 3

Geographic Dispersal Across Chicago in 2008: Census Tract Characteristics by 2008 Subsidized Housing Type

	Total (N = 9,754+)	Mixed-Income Housing (N = 1,151)	HCV Housing (N = 3,915)	Scattered-Site Housing (N = 1,560)	Traditional Public Housing (N = 3,128)
Percent African American	73.65	71.02	84.93	37.23	78.73
Percent households with children in poverty	31.81	29.16	29.11	23.68	40.44
Percent labor force unemployed	18.85	17.14	19.42	11.87	22.33
Median annual household income	$32,332	$42,297	$31,407	$40,740	$25,528

HCV = housing choice voucher.

Note: Because of incomplete address information, we were not able to link all 9,980 households to their appropriate census tracts.

Sources: American Community Survey 2005–2009 5-year estimates; Chicago Housing Authority

Household Composition

Exhibit 4 shows that the families who remained in subsidized housing in November 2008 were predominantly female-headed households. The average family size was three people and the household head was, on average, 48 years old in 2008. More than 56 percent of the households had children at that time. Very few of these families had very young children (under 5 years old), whereas almost two-thirds had at least one child between the ages of 11 and 17. On average, these families had lived in CHA housing for nearly 7 years when the Transformation began.

Exhibit 4

2008 Household Characteristics by 2008 Subsidized Housing Type, Chicago

	Total (N = 9,980)	Mixed-Income Housing (N = 1,278)	HCV Housing (N = 3,978)	Scattered-Site Housing (N = 1,571)	Traditional Public Housing (PH) (N = 3,153)
Household head is female	88.9	89.3	93.9	87.4	83.3
Age of household head					
Less than 40 years old	32.6	29.7	46.9	20.1	22.1
40–59 years old	49.2	49.6	43.9	57.7	51.7
60 years old or older	18.1	20.7	9.2	22.3	26.3
Mean age of household head in years[a]	48.1	49.6	43.8	50.6	51.8
Number of household members					
One	24.8	26.0	15.2	22.9	37.4
Two or three	40.4	50.2	36.4	49.0	37.4
Four or more	34.8	23.9	48.5	28.2	25.3
Mean number of household members[b]	3.0	2.7	3.6	2.8	2.6
Number of children					
Zero	43.5	47.7	31.8	47.9	54.2
One or two	37.1	40.2	40.6	38.3	31.0
Three or more	19.4	12.1	27.6	13.8	14.8
Mean number of children[c]	1.3	1.0	1.7	1.1	1.0
Any child 0 to 4 years old[d]	8.8	8.0	4.7	13.4	12.0
Any child 5 to 10 years old[e]	25.1	19.6	32.2	21.3	20.2
Any child 11 to 14 years old[f]	31.7	28.7	43.7	21.9	22.6
Any child 15 to 17 years old[g]	30.6	26.2	40.1	26.4	22.6
Mean number of years in CHA housing before the Plan for Transformation[h]	6.9	7.3	6.2	7.3	7.4

CHA = Chicago Housing Authority. HCV = housing choice voucher.

Note: Significant differences when adjusted for multiple comparisons using Bonferroni correction (see notes a through h).

[a] HCV significantly different from traditional PH, scattered site, and mixed income; traditional PH significantly different from scattered site and mixed income.

[b] HCV significantly different from scattered site, mixed income, and traditional PH; scattered site significantly different from mixed income and traditional PH.

[c] HCV significantly different from scattered site, mixed income, and traditional PH.

[d] Scattered site significantly different from mixed income and HCV; traditional PH significant different from mixed income and HCV; mixed income significantly different from HCV.

[e] HCV significantly different from scattered site, traditional PH, and mixed income.

[f] HCV significantly different from mixed income, traditional PH, and scattered site; mixed income significantly different from traditional PH and scattered site.

[g] HCV significantly different from scattered site, mixed income, and traditional PH.

[h] HCV significantly different from traditional PH, mixed income, and scattered site.

Where significant differences by subsidized housing type are apparent, they are generally between those who were living with HCVs in 2008 and those who were living in one or more of the other three subsidized housing groups. On average, HCV households were the largest, their household heads were the youngest, and they had lived in public housing for the shortest period of time before the Transformation. These households were also the least likely to include very young children in 2008.

Very few statistically significant differences in household composition emerged between households in mixed-income developments and those in traditional public housing developments in 2008. This finding is surprising given that the mixed-income developments tend to be smaller and possibly less child-friendly (because of the thinness of the walls and the stringent monitoring of noise and behavior) than the traditional public housing developments.

Exhibit 5 shows the household composition of these families at the start of the Transformation in 1999. As in 2008, the households that would use vouchers included more children and had younger household heads when compared with the other groups. In addition, nearly all of the future HCV households (more than 99 percent) included at least one child under the age of 11 in 1999.

Exhibit 5

1999 Household Characteristics by 2008 Subsidized Housing Type, Chicago

	Total (N = 8,484)	Mixed-Income Housing (N = 1,117)	HCV Housing (N = 3,468)	Scattered-Site Housing (N = 1,280)	Traditional Public Housing (PH) (N = 2,619)
Household head is female	89.8	89.5	98.4	88.7	85.6
Age of household head					
Less than 40 years old	56.9	51.5	71.9	46.9	44.5
40–59 years old	22.8	25.0	17.9	43.0	41.2
60 years old or older	20.3	23.4	10.3	10.1	14.3
Mean age of household head in years[a]	39.6	41.0	34.9	42.6	43.6
Number of household members					
One	18.3	22.1	14.0	9.2	26.9
Two or three	42.8	49.7	39.3	46.6	42.7
Four or more	38.9	28.2	46.7	44.2	30.4
Mean number of household members[b]	3.2	2.8	3.5	3.4	2.8
Number of children					
Zero	27.8	32.7	19.1	22.2	40.0
One or two	40.5	46.4	39.2	45.9	37.2
Three or more	31.7	21.0	41.7	31.9	22.9
Mean number of children[c]	1.8	1.5	2.3	1.9	1.4
Any child 0 to 4 years old[d]	31.9	27.7	42.7	24.9	23.0
Any child 5 to 10 years old[e]	46.1	38.4	56.8	45.9	35.2
Any child 11 to 14 years old[f]	27.9	24.4	27.9	37.3	25.0
Any child 15 to 17 years old[g]	19.4	17.8	17.4	29.1	17.5

HCV = housing choice voucher.

Note: Significant results when adjusted for multiple comparisons using Bonferroni correction (see notes a through g).

[a] HCV significantly different from traditional PH, scattered site, and mixed income; mixed income significantly different from traditional PH and scattered site.

[b] HCV significantly different from mixed income and traditional PH; scattered site significantly different from mixed-income and traditional PH.

[c] HCV significantly different from scattered site, mixed income, and traditional PH; scattered site significantly different from mixed income and traditional PH.

[d] HCV significantly different from mixed income, scattered site, and traditional PH.

[e] HCV significantly different from scattered site, mixed income, and traditional PH; scattered site significantly different from mixed income and traditional PH.

[f] Scattered site significantly different from HCV, traditional PH, and mixed income.

[g] Scattered site significantly different from mixed income, traditional PH, and HCV.

After analyzing household composition data from 1999 and 2008, it appears that household size, age of children, and number of years in public housing may have influenced the relocation outcomes of HCV households. Perhaps larger families or families with relatively younger children at the time were able to find more adequately sized units in the private market, or perhaps they wanted to avoid the stricter rules and monitoring associated with some of the other housing options. Families with older children, on the other hand, may have had difficulty finding a private property owner willing to rent to them. In addition, given that households that took vouchers had lived, on average, for fewer years in public housing, they may have been more open to moving into the private market and less attracted to a development setting.

Employment and Earnings

We looked at three measures of labor force attachment in both 1999 and 2008. First, we counted a household as employed in a given year if at least one household member reported wages in any quarter of that year. Second, we calculated total household earnings from employment by summing all the wages that household members reported across the four quarters.[11] Third, number of quarters worked was simply the total number of quarters in which any household member reported wages.[12]

Exhibit 6 shows that, although employment rates and earnings were exceedingly low for all households in 1999, considerable variation existed among families who would ultimately end up in different subsidized housing types. Almost 45 percent of households that would have an HCV in 2008 had some earnings from employment in 1999 compared with only 23 percent of households that would be in traditional public housing developments, 24 percent of households that would be in scattered-site units, and 33 percent of households that would move into mixed-income developments.

Future HCV and mixed-income households had higher earnings in 1999 compared with those households that would be living in scattered-site and traditional public housing, when averaged across all households. Among just those households with any earnings in 1999, however, the future HCV households earned significantly less than households that would be in all other subsidized housing types in 2008. Workers who would be in HCV households earned an average of $8,906 in 1999, whereas workers who would be in other subsidized housing types earned between $10,894 and $12,395. Workers who would be in HCV households also had earnings in significantly fewer quarters than workers who would be in scattered-site housing or mixed-income developments. This finding suggests that although residents of households that would have vouchers in 2008 were more likely to work at all in 1999, these earners worked with less regularity and for lower total earnings.

[11] Approximately 170 records showed quarterly wages greater than $25,000, including 15 records with quarterly wages in excess of $50,000. When we consulted with the CHA about these outliers, the CHA told us that income limits exist to qualify for public housing, but that no income limit exists for current residents. The CHA also confirmed that a handful of households had current annual incomes of approximately $100,000. Because removing outliers would have required us to select some arbitrary value, we opted to retain all of the records in our analysis.

[12] Employment and earnings records from the IDES are limited to those businesses that register for unemployment insurance. To the extent that residents are working for small firms not registered with IDES or in the informal economy, we could be underestimating employment and earnings.

Exhibit 6

Household Employment and Earnings in 1999 and 2008 by 2008 Subsidized Housing Type, Chicago

	Total	Mixed-Income Housing	HCV Housing	Scattered-Site Housing	Traditional Public Housing (PH)
Percent of households with any earnings	N = 9,980	N = 1,278	N = 3,978	N = 1,571	N = 3,153
1999[a]	33.3	33.4	44.6	24.8	23.3
2008[b]	47.5	44.6	45.0	58.9	46.1
Mean earnings (all households)					
1999[c]	$3,381	$3,982	$3,964	$3,077	$2,542
2008[d]	$9,286	$8,746	$8,489	$12,543	$8,889
Mean earnings (earners only)					
1999[e]	N = 3,327	N = 427	N = 1,774	N = 390	N = 736
	$10,141	$11,914	$8,906	$12,395	$10,894
2008[f]	N = 4,739	N = 570	N = 1,790	N = 925	N = 1,454
	$19,559	$19,624	$18,903	$21,303	$19,231
Mean quarters with earnings (earners only)					
1999[g]	3.0	3.1	2.9	3.2	3.0
2008[h]	3.4	3.5	3.4	3.5	3.3

HCV = housing choice voucher.

Note: Significant results when adjusted for multiple comparisons using Bonferroni correction (see notes a through h).

[a] HCV significantly different from mixed income, scattered site, and traditional PH; mixed income significantly different from scattered site and traditional PH.

[b] Scattered site significantly different from traditional PH, HCV, and mixed income.

[c] Mixed income significantly different from scattered site and traditional PH; HCV significantly different from scattered site and traditional PH.

[d] Scattered site significantly different from traditional PH, mixed income, and HCV.

[e] HCV significantly different from scattered site, mixed income, and traditional PH.

[f] HCV significantly different from scattered site.

[g] HCV significantly different from scattered site and mixed income.

[h] Scattered site significantly different from HCV and traditional PH; mixed income significantly different from traditional PH.

By 2008, the employment picture looked very different. Scattered-site households were now significantly more likely to have earnings from employment (59 percent) than households in any other type of subsidized housing (45 to 46 percent). In addition, HCV households were the only households in which the percentage with any earnings had not increased since 1999. It is also noteworthy that, despite the 30-hour work requirement imposed on residents of mixed-income developments, the proportion of mixed-income households with earners was similar to the proportion of households with earners in traditional public housing developments.[13] Scattered-site households earned significantly more than all other housing types in 2008, when earnings are

[13] Read changes in employment and earnings between 1999 and 2008 with caution. Chapin Hall's IDB includes quarterly wage records for the years 1995 through 2006 that the IDES provided to Chapin Hall and linked to the CHA data using probabilistic matching. We used those data to measure employment and earnings among the CHA residents in 1999. By contrast, we measured employment and earnings in 2008 using quarterly wage records that the CHA had obtained directly from the IDES.

averaged across all households. Among working households, however, average earnings and number of quarters worked were not significantly different among households in scattered-site, mixed-income, and traditional public housing, although HCV households had lower earnings and earnings in fewer quarters.

In the following section, we explore whether household characteristics drive these findings by controlling for these characteristics in multivariate models. At this point, however, two storylines begin to emerge from these labor market data. The first is about the relative vulnerability of HCV households. Households that were using vouchers in 2008 stood out from the other households in 1999, with the highest employment rates but with low and irregular earnings among earners. By 2008, their employment rates had stagnated while those of other households had climbed. One interpretation of this finding is that it reflects some kind of selection process. That is, households with poorer prospects for employment are opting for (or ending up in) HCV housing. Alternatively, living in HCV housing may, for some reason, have a negative effect on employment.

The second emerging storyline is about the lack of strong evidence that households that ended up in mixed-income developments were somehow advantaged. Although they were more likely to have earnings from employment in 1999 than households that ended up in traditional public housing or scattered-site developments, those who worked did not earn significantly more or have earnings in significantly more quarters in 1999. Also striking is that, by 2008, a majority of these mixed-income households had no earnings from employment, and those that did have earnings did not earn more or work with more regularity than their counterparts in other subsidized housing types, despite screening policies and lease requirements regarding work in mixed-income developments.

TANF and Food Stamp Receipt

We measured welfare receipt in 1999 and 2008 using four indicators.[14] Limiting our analysis to TANF-eligible households (that is, those containing at least one minor child in the relevant year), we counted households as TANF recipients in a given year if they received a TANF cash grant in at least one month that year.[15] For TANF recipient households, we computed the number of months in which they received a cash grant. Similarly, we counted households as food stamp recipients in a given year if they received food stamp benefits in at least one month that year, and we computed the number of months in which food stamp recipient households received food stamp benefits.

Exhibit 7 shows that, consistent with national trends, TANF receipt dropped drastically among households in all types of subsidized housing. In 1999, 68 percent of CHA households received TANF; in 2008, that percentage dropped to only 17 percent. By contrast, during a period when the United States Department of Agriculture was involved in a national outreach campaign to increase

[14] Although one could view receiving public assistance benefits as indicating a lack of self-sufficiency, one could also see it as evidence of a household's ability to access needed resources.

[15] Because we did not have complete 1999 household composition data, we had to use 2008 data to determine the presence of minor children in the household in 1999. This method misses any children who moved out of the household before 2008 and might incorrectly count children present in 2008 who moved into the household after 1999.

Exhibit 7

TANF and Food Stamp Receipt in 1999 and 2008 by 2008 Subsidized Housing Type, Chicago

	Total	Mixed-Income Housing	HCV Housing	Scattered-Site Housing	Traditional Public Housing (PH)
Percent of households receiving TANF*					
1999[a]	N = 7,621	N = 913	N = 3,321	N = 1,287	N = 2,100
	67.5	63.9	79.8	55.6	57.1
2008	N = 5,643	N = 668	N = 2,719	N = 819	N = 1,437
	16.7	15.7	16.7	17.1	16.8
Mean months of TANF receipt (if any TANF)					
1999[b]	10.2	9.6	10.4	9.9	10.2
2008[c]	8.8	8.9	8.4	9.0	9.4
Mean earnings (earners only)					
1999[d]	N = 9,980	N = 1,278	N = 3,978	N = 1,571	N = 3,153
	75.1	72.2	85.1	67.9	67.3
2008[e]	74.0	68.8	83.5	65.4	68.3
Mean months of food stamp receipt (if any food stamps)					
1999[f]	10.1	9.7	10.3	10.1	10.0
2008[g]	10.7	10.5	10.9	10.4	10.6

HCV = housing choice voucher. TANF = Temporary Assistance for Needy Families.

** Households with at least one child less than 18 years old.*

Note: Significant results when adjusted for multiple comparisons using Bonferroni correction (see notes a through g).

[a] HCV significantly different from mixed income, traditional PH, and scattered site; mixed income significantly different from traditional PH and scattered site.

[b] HCV significantly different from scattered site and mixed income; traditional PH significantly different from mixed income.

[c] HCV significantly different from traditional PH.

[d] HCV significantly different from mixed income, scattered site, and traditional PH.

[e] HCV significantly different from mixed income, traditional PH, and scattered site.

[f] Mixed income significantly different from HCV, scattered site, and traditional PH; traditional PH significantly different from HCV.

[g] HCV significantly different from traditional PH, scattered site, and mixed income.

food stamp receipt among eligible households, receipt of food stamps remained stable. In 1999, 75 percent of CHA households received food stamps and, in 2008, 74 percent received food stamps.

Exhibit 7 also shows the variation in TANF and food stamp receipt by subsidized housing type. Of households that were using HCVs in 2008, 80 percent received TANF in 1999 compared with 57 percent of households that would be living in traditional public housing developments, 64 percent of those that would relocate to mixed-income developments, and 56 percent of those that would be in scattered-site units. Somewhat surprisingly, the proportion of households receiving TANF in 1999 was significantly higher among those that would move into mixed-income developments as compared with those that would be living in scattered-site or traditional public housing developments.

By 2008, the rates of TANF receipt were not significantly different among housing types. Again, the lack of difference between households in mixed-income developments and those in other types of subsidized housing is somewhat unexpected. Although statistically significant differences

appeared in months of TANF receipt among housing types in both 1999 and 2008, the magnitude of those differences is relatively small.

Food stamp receipt was also significantly higher in both years among households that would be using vouchers than among those that would be in other subsidized housing types in 2008. Of the future HCV households, 85 percent received food stamps in 1999 compared with only 67 percent of the households that would be in traditional public housing developments, 68 percent of the households that would be in scattered-site housing, and 72 percent of the households that would move into mixed-income developments. These differences were still evident in 2008, and the non-HCV households were not statistically distinguishable from one another in terms of food stamp receipt. As with months of TANF receipt, the statistically significant differences in months of food stamp receipt among housing types were relatively small.

To summarize, this analysis of benefit receipt is consistent with the picture that emerged from our analysis of labor market participation. Households that were using HCVs in 2008 were relatively more likely to have received food stamps and TANF benefits than other households, both at the outset of the Transformation and nearly 10 years later. In addition—and again contrary to what we might have expected—households in mixed-income developments did not have significantly lower rates of TANF or food stamp receipt in 2008 than households in other subsidized housing types, with the exception of HCV households.

Child Welfare and Juvenile Justice System Involvement

Exhibit 8 shows the percentage of CHA households that had any involvement with the child welfare system (that is, child maltreatment investigation or foster care placement) or juvenile justice system in 1999 or 2008. Because families would only be involved in those systems if they had at least one minor, we limited our analysis of child welfare system involvement to households with at least one child under age 18 and our analysis of juvenile justice system involvement to families with a child between the ages of 11 and 17 in the relevant year.

Of these households, 4 percent had any involvement with the child welfare system in 1999. Even fewer had any juvenile justice system involvement that year. Although both percentages remained relatively low in 2008, there had been little change in child welfare system involvement and an increase in involvement with the juvenile justice system.[16] This increase likely reflects the fact that many of the children in these households had entered adolescence and hence were of the age when delinquency is more likely to occur.

Households that would have vouchers in 2008 were more likely to be involved with the child welfare system in 1999 than households that would be in traditional public housing or mixed-income developments. No statistically significant differences in child welfare system involvement were apparent across subsidized housing types in 2008. Similarly, households that would have vouchers

[16] To put the CHA figures in context, the FY 2006 Cook County child abuse and neglect report rate was 23.6 per 1,000 children, and the indicated report rate (cases in which evidence of abuse or neglect was found) was 5.3 per 1,000 children (Illinois Department of Children and Family Services, 2006). In 2000, the Cook County delinquency petition rate for youth ages 10 to 16 was 2,041 per 100,000 (Illinois Criminal Justice Information Authority, 2003).

Exhibit 8

Child Welfare and Juvenile Justice System Involvement in 1999 and 2008 by 2008 Subsidized Housing Type, Chicago

	Total	Mixed-Income Housing	HCV Housing	Scattered-Site Housing	Traditional Public Housing (PH)
Percent of households with any child welfare system involvement*					
1999[a]	N = 7,627	N = 913	N = 3,321	N = 1,287	N = 2,106
	4.4	2.9	5.7	3.7	3.5
2008	N = 5,649	N = 668	N = 2,719	N = 819	N = 1,443
	4.9	3.1	5.6	5.6	4.0
Percent of households with any juvenile justice system involvement+					
1999[b]	N = 4,713	N = 545	N = 1,750	N = 974	N = 1,444
	2.5	2.2	4.6	0.6	1.3
2008	N = 4,672	N = 566	N = 2,390	N = 616	N = 1,100
	7.0	5.5	8.5	4.9	6.0

HCV = housing choice voucher.

** Households with at least one child less than 18 years old; includes being investigated for child abuse or neglect or having a child in foster care.*

+ Households with at least one child between 11 and 17 years old.

Note: Significant results when adjusted for multiple comparisons using Bonferroni correction (see notes a and b).

[a] HCV significantly different from traditional PH and mixed income.

[b] HCV significantly different from traditional PH and scattered site.

in 2008 were also more likely to be involved with the juvenile justice system in 1999 than households that would be in traditional public housing or scattered-site developments, but no differences were evident in 2008.

These results suggest that households in different subsidized housing types have fairly similar levels of child welfare and juvenile justice involvement, with the exception of the HCV households, which were more likely to be involved with the child welfare and juvenile justice systems in 1999. Once again, households that would move to mixed-income developments were statistically indistinguishable from others.

The Relevance of Family Composition and Residential History

An important question to consider is whether any of the differences that we observe among families in different subsidized housing types may be present simply because of differences in household composition, rather than other factors. To explore this possibility, we estimated a series of multivariate models predicting the various indicators examined in 2008. Specifically, the dependent variables were: any earnings in 2008; total earnings in 2008; any TANF receipt in 2008; any food stamp receipt in 2008; any child welfare services involvement in 2008; and any juvenile justice

system involvement in 2008.[17] Each model included three dummy variables to control for the four types of subsidized housing. Because HCV households emerged from our bivariate analyses as the most consistently different group, we chose this group to be the excluded category and thus the group to which the others are compared. The covariates in our models controlled for household characteristics in 2008, including the number of children in the household, the number of adults in the household, the presence of very young children, the age of the household head, whether the household was female-headed, and the number of years the family had lived in CHA housing before the Transformation began. Because our primary concern is whether the differences we observed among families in different types of subsidized housing might be explained by differences in household composition, we focus on the parameter estimates for the three dummy variables.

Exhibit 9 shows that, controlling for family composition and length of time in CHA housing, HCV households were less likely to have earnings from employment and earned significantly less in 2008 than households in other types of subsidized housing. HCV households were more likely to

Exhibit 9

Results From Multivariate Models Predicting Well-Being Indicators in 2008, HCV Households as Excluded Category,[a] Chicago

	Employment (N = 9,971)	Earnings (N = 9,971)	TANF Receipt (N = 5,630)	Food Stamp Receipt (N = 9,971)	Child Welfare Involvement (N = 5,636)	Juvenile Justice Involvement (N = 4,669)
Mixed-income housing	1.494*	6,594.215*	0.916	0.617*	0.691	0.856
Scattered-site housing	2.707*	13,859.030*	0.910	0.489*	1.217	0.740
Traditional public housing	1.797*	8,214.926*	0.863	0.652*	0.754	0.812
Age of household head	0.959*	– 546.077*	1.023*	0.986*	1.001	0.993
Household head is female	1.330*	2,008.829*	1.776*	1.215*	1.234	2.471*
Number of household children	0.955*	– 708.664*	1.090*	1.517*	1.487*	1.325*
Any child 0 to 4 years old	1.508*	1,766.696	1.669*	1.737*	0.936	0.715
Number of household adults	1.935*	9,508.845*	1.200*	1.399*	0.902	1.260*
Mean number of years in CHA housing before the Plan for Transformation	1.057*	495.812*	1.043	0.996	1.041	1.160*

CHA = Chicago Housing Authority. HCV = housing choice voucher. TANF = Temporary Assistance for Needy Families.

** $p < 0.05$.*

[a] Estimated odds ratios from logistic regression models are reported for employment, TANF receipt, food stamp receipt, child welfare system involvement, and juvenile justice system involvement; estimates from the Tobit regression model are reported for earnings.

[17] We used logistic regression models to determine estimates for employment, TANF and food stamp receipt, and child welfare and juvenile justice system involvement. Because of the large number of households with zero earnings, we used Tobit models to estimate earnings for exhibits 9 and 10. Results from Tobit models cannot be interpreted in the same way as regression coefficients, so we focus only on the significance and direction of these results in discussing our findings.

have received food stamps in 2008 than each of the other household types, but, after controlling for all of the covariates in our model, no statistically significant differences existed in TANF receipt or child welfare and juvenile justice system involvement. These findings are largely consonant with those suggested by our previous analyses.

Thus, even after controlling for differences in household composition, it appears that (based on the well-being indicators we were able to measure) households using vouchers in 2008 faced greater challenges than those who ended up in other types of subsidized housing. In 2008, these HCV households were less likely to be employed, earned less on average, and were more likely to receive public assistance in the form of food stamps.

The Relevance of Time Spent in Mixed-Income Development After Relocation

One of the storylines emerging thus far from our analysis is that, despite the Transformation's significant investment of resources in mixed-income development and the strict screening guidelines and ongoing monitoring of CHA residents now living in them, these households do not appear to be faring significantly better than CHA residents who end up in other subsidized housing, at least along the lines that these administrative data analyses enable us to explore. This parity among housing types is true even on measures of labor force attachment, which is an element of the screening criteria.

These findings are likely to disappoint mixed-income development proponents, given that mixed-income developments are intended to promote benefits such as enhanced social capital, greater access to information and opportunity (including for employment), and the encouragement of particular kinds of mainstream behavior (such as working, going to school, and obeying the law) through the influence of higher levels of social control and the presence of middle-class role models.[18] One possible explanation for our findings running counter to expectations is that any positive effects on these indicators will take time to emerge. Residents must settle into the new environments, be exposed to their higher income neighbors, and have access to the opportunities and resources those neighbors—and the new investments in the broader neighborhood environment—provide. Without controlling for length of time in the development, our results might obscure these effects. To test this possibility, we examined the association between our indicators of well-being and length of residence in a mixed-income development by estimating a set of regression models similar to the ones described above but limited to households that had relocated to mixed-income developments as of January 1, 2008.

Exhibit 10 shows no significant association between length of residence in a mixed-income development and TANF receipt, food stamp receipt, or juvenile justice involvement. Length of time in a mixed-income development was actually negatively related to employment and earnings. This finding needs to be read with caution, however, particularly given the broader context of the major national recession, beginning in 2007, in which these data were collected. With this caveat in mind, at this stage of the Transformation, our analyses do not support the claim that residence

[18] These assumptions are, of course, not without problems. See, for example, Joseph, Chaskin, and Webber (2007) for a more detailed review.

Exhibit 10

Results From Multivariate Models Predicting Well-Being Indicators in 2008 for Mixed-Income Households,[a] Chicago

	Employment (N = 925)	Earnings (N = 925)	TANF Receipt (N = 481)	Food Stamp Receipt (N = 925)	Juvenile Justice Involvement (N = 397)
Months in mixed-income development	0.991*	– 88.875*	0.994	0.999	0.988
Age of household head	0.947*	– 680.016*	1.036*	1.003	0.996
Household head is female	1.244	4,968.169	1.186	1.181	0.612
Number of household children	0.905	– 1,119.710	0.951	1.372*	1.339
Any child 0 to 4 years old	1.218	– 1,479.370	2.084*	1.751	0.285
Number of household adults	1.775*	9,970.203*	0.847	1.437*	1.221
Mean number of years in CHA before the Plan for Transformation	1.042	– 131.215	1.001	0.896*	1.123

CHA = Chicago Housing Authority. TANF = Temporary Assistance for Needy Families.

** $p < 0.05$*

[a] Estimated odds ratios from logistic regression models are reported for employment, TANF receipt, food stamp receipt, and juvenile justice system involvement; estimates from Tobit regression model are reported for earnings.

in a mixed-income development benefits relocated households on the indicators that we have been able to measure here. We reached this conclusion, notwithstanding current research on mixed-income developments that suggests some benefits, such as safer and healthier environments, less stress related to concerns about safety, greater satisfaction with homes and built environment, and (for some) changes in aspirations (for example, Joseph and Chaskin, 2010; Kearns and Mason, 2007; Tach, 2009).

Households Missing in 2008

Our analysis has focused on the relocated households that remained in CHA-subsidized housing in November 2008. A significant number of households that had a right to return (6,623 households, or 40 percent), however, were unaccounted for at this time. Recent information that CHA provided sheds some light on what has happened to these missing households: 1,050 are deceased, 1,231 have been evicted from CHA housing, 581 have chosen to leave on their own after moving to a new or rehabilitated unit, 14 have moved into senior housing, and 712 indicated that they were living in unsubsidized private market housing while awaiting their right to return to CHA housing.[19] The remaining 3,035 households were still unaccounted for as of July 2010 and had not responded to contact attempts or public notices from CHA indicating that they could lose their right to return.[20]

Two groups of particular interest are those that were evicted from CHA housing and those that chose to leave voluntarily after having their right to return satisfied by placement in a new or

[19] As of July 2010, 273 of the households living unsubsidized in the private market awaiting their right to return in 2008 had returned to some type of CHA-subsidized housing.

[20] Nationally, the average length of stay in public housing is 4.7 years (Turner and Kingsley, 2008), making some turnover unremarkable. Given the emphasis on residents' legal right to return and expectations for high demand, particularly for the mixed-income units, however, the large number of residents who have not returned is surprising.

rehabilitated unit. One might expect that evicted households are among the most disadvantaged of the relocated families, whereas those who exited voluntarily could have experienced gains that led them to move up and out of subsidized housing.

Analysis of available data shows that, in some important ways, the evicted households look similar to the HCV households—the group that appeared most vulnerable of those who remained in subsidized housing. As with the HCV households, evicted households were significantly larger than those who ended up in mixed-income, scattered-site, and traditional public housing developments.[21] They had also spent fewer years in public housing at the time the Transformation began. In 1999, only about one-fourth of these households were employed. Much like the households that would be using vouchers in 2008, those who did work earned less and had earnings in fewer quarters in 1999 than households that would be in mixed-income, scattered-site, or traditional public housing developments. Their rates of child welfare and juvenile justice system involvement were also significantly higher than all other groups, including the HCV households, at the start of the Transformation. By 2008, very few of the evicted households appeared to be employed (fewer than 8 percent), and they were employed in the fewest number of quarters. They were no more likely to receive TANF or food stamps, however, than any group that remained in subsidized housing.[22]

Households that exited CHA housing voluntarily after permanent placement were also larger and had spent fewer years in public housing as of 1999 than households that were in mixed-income, scattered-site, and traditional public housing developments in 2008. At the start of the Transformation, approximately 35 percent of these households were employed, and they earned more than the households that would be using vouchers. They were no more likely to receive TANF or food stamps or to be involved in the child welfare or juvenile justice systems than the other subsidized housing groups in 1999. By 2008, these households were earning significantly more (by more than $10,000 annually) than all other groups and were working in more quarters than employed HCV and traditional public housing households. Their TANF and food stamp receipt rates declined between 1999 and 2008 to much lower relative rates, and they remained no more likely than other households to be involved in the child welfare or juvenile justice systems.

It appears, then, that households evicted from CHA housing during the course of the Transformation did show some signs of greater vulnerability in 1999, including low rates of (and unstable) employment, low earnings, and a greater likelihood to be involved in the child welfare and juvenile justice systems. By 2008, after these families had lost their housing subsidies, they were even more likely to be unemployed, yet were also less likely to be receiving TANF and food stamp benefits, suggesting that these households may be having great difficulty accessing needed support.

On the other hand, households that exited CHA housing voluntarily looked relatively similar at the start of the Transformation to their counterparts who remained in subsidized housing. Nearly a decade later, these households had experienced large gains in earnings, which may have facilitated their exit from public housing.

[21] Demographic data reflect household composition at the time the household left CHA-subsidized housing.

[22] The administrative databases we used were limited to the state of Illinois. To the extent that households that were evicted or voluntarily exited left the state, we could be underestimating employment, earnings, benefit receipt, and services involvement.

Discussion

The Plan for Transformation was launched in Chicago in October 1999 with the stated goal of deconcentrating poverty in public housing. After 10 years into what has become a 15-year initiative, the Transformation has accomplished much. The highrise towers, so emblematic of public housing failure in Chicago, are gone. Developers have constructed, or are in the process of constructing, 10 major new mixed-income developments that are home to thousands of residents with dramatically different social and economic backgrounds. Thousands of residents have relocated into these new mixed-income developments and into rehabilitated traditional and scattered-site public housing units and private market units subsidized with vouchers.

Our analyses, although limited by the administrative data currently available, reveal much about the residents who have relocated, the types of subsidized housing into which they have moved, and their current well-being in a number of domains. Some of these findings have important implications for relocation practice and policy.

Our geographic analysis, which we intended simply to provide a visual representation of the dispersal that has occurred as a result of relocation, raises questions about the extent to which residents have been able to relocate to less racially segregated communities of opportunity. Although some residents used HCVs to relocate to more affluent and integrated neighborhoods, the overall pattern appears to be one of relocation within high-poverty and predominantly African-American neighborhoods, consistent with the patterns found in studies of relocation efforts in other U.S. cities. This finding deserves more attention using more sophisticated spatial analysis methods.

Regarding the question of whether patterns of relocation indicate systematic creaming of more high-functioning households into mixed-income developments and relegating households with multiple barriers into traditional public housing or voucher-subsidized housing in the private market, our findings are quite revealing. Contrary to our expectations, the households that were using HCVs in the private market 10 years into the Transformation were, if anything, faring worse in 1999 than those that ended up in other types of subsidized housing, at least according to the indicators that we used. Even more unexpectedly, the households that relocated to mixed-income developments were not significantly better off in 1999 than the households living in traditional public housing in 2008. Although households that would move to mixed-income developments were more likely to have earnings from employment in 1999 than households that would be in scattered-site and traditional public housing developments, their earnings and employment stability among workers were comparable, and their TANF receipt rate was higher. Also contrary to expectations, the households that were living in traditional public housing in 2008 were not faring particularly poorly in 1999 compared with the other groups.

Turning to how relocated households were faring in 2008 compared with 1999, we observed substantial changes across subsidized housing types on a number of our indicators of well-being. Both the percentage of households with earnings from employment and the total earnings among workers increased. Although food stamp receipt remained steady, the percentage of households receiving TANF dropped dramatically. Consistent with what one would expect, given that children aged during this period, juvenile justice system involvement increased. Although the HCV

households continued to stand out as faring worse than other households in 2008, households in the new mixed-income developments were, by contrast, surprisingly indistinguishable across most of these indicators from the households living in traditional public housing and scattered-site developments.

We can venture several possible explanations for our findings. The fact that households using vouchers in 2008 seem to be faring less well than those in other subsidized housing types may reflect a systematic sorting. Residents with greater challenges may have preferred to keep their vouchers out of a desire to avoid the increased assessment, monitoring, and screening in the new era of Chicago public housing. Administrative priorities on the part of the CHA could also have driven this circumstance. For example, the CHA may have wanted to move families out of the old developments as quickly as possible to facilitate building demolition, particularly if those families had multiple problems. Once in the private market, these families may have had more difficulty meeting the screening requirements to return to new or revitalized housing, and they may have become disconnected from the formal and informal support networks on which they had depended before relocation. Although households that elected to take temporary vouchers had access to some services through CHA, the providers were typically located near the former developments, far from many of the neighborhoods in which voucher holders were living in 2008, likely making them more difficult to access.

Several factors could account for the lack of significant differences between the households that relocated to mixed-income developments and those that were living in scattered-site and traditional public housing developments in 2008. According to CHA, almost 30 percent of households in mixed-income developments have an exemption from the work requirements because of a disability or some other reason. In addition, households that failed to meet one of the screening criteria, including the work requirement, could be deemed eligible for up to 1 year of occupancy if they were actively engaged with a service provider. After this year has passed, it is up to the discretion of individual property managers to decide whether noncompliant families can remain in the developments. It is also possible that a longer timeframe is needed to detect the benefits of relocating to mixed-income developments, particularly given the severity of the recent recession.

Residents living in scattered-site housing in 2008 might be faring particularly well for several reasons. First, as we alluded to previously, 90 percent of these households were already living in scattered-site housing in 1999, meaning that many had already managed to move out of (or avoid) the severely distressed traditional public housing developments before 1999. When it came time to rehabilitate the scattered-site units, residents already living in those units received first priority in returning, and the timeline for completion was significantly shorter than at the mixed-income and traditional public housing developments. As a result, many of the scattered-site households had a less disruptive relocation experience than the thousands of other CHA households that often experienced multiple moves over several years. In addition, the scattered-site households are the one group of which a substantial number are living in the more affluent and racially integrated north side of the city, where there may be better amenities and greater opportunities (such as better schools and access to employment). This finding would seem to indicate that the scattered-site program, which was developed as a means of deconcentrating public housing, has been relatively successful on this front.

Why residents living in traditional public housing in 2008 seem to be doing better than expected on our indicators of well-being is more puzzling. One reason may be in part because of the significant improvements to the physical environments and neighborhood safety in these developments post-renovation (Buron and Popkin, 2010; Popkin and Price, 2010). Another may be that, although residents of traditional public housing in 2008 may have moved temporarily because of renovation, 84 percent had been in the same development in 1999, and were perhaps able to retain more of their previous social support networks. How these hypotheses may relate to outcomes such as employment and income, however, is less than clear.

Thus our analysis complicates the picture of what the Plan for Transformation has wrought. Although poverty among families in subsidized housing is, without question, less concentrated than it was before 1999, most of these households remain in higher poverty, predominantly African-American neighborhoods on the city's south and west sides. The lack of clear differences in well-being between households living in mixed-income developments and households living in other subsidized housing types, both in 1999 and 2008, can be framed in two different ways. On the one hand, it does not appear that the assessment and screening processes associated with the Transformation led to a systematic sorting of less challenged households into the new mixed-income developments. On the other hand, given the tremendous investment of resources in mixed-income housing—more than $2 billion of the approximately $3.2 billion invested in the first 10 years of the Transformation—it is concerning that the families in mixed-income developments do not appear to be faring better over time.

Regarding the group of residents who were no longer living in CHA-subsidized housing in 2008, the picture is mixed. A group larger than the number of households now living in mixed-income developments was evicted and lost their eligibility for subsidized housing. These households faced even more challenges in 2008 than those who were using vouchers. Of positive note, a smaller group of households, which has voluntarily moved out of subsidized housing after exercising their right to return by moving into a new or rehabilitated public housing unit, showed significant gains in earnings between 1999 and 2008.

Conclusion

These findings have several implications for policy and practice. First, post-occupancy support for households relocated to mixed-income developments appears critical. The CHA originally planned to end social services to households after they had moved into a mixed-income development, and, more recently, the contracts to service providers have been for 1 year of post-occupancy support. Our findings suggest that these households may need longer term support if they are to benefit from their new environments. The implication for ongoing and future mixed-income efforts, such as the federal government's recently launched Choice Neighborhoods initiative, is that far more intensive employment and other social service supports will likely be required to meaningfully affect individual-level employment trajectories.

Second, voucher holders appear to be especially vulnerable and in need of policy intervention. Households using vouchers in 2008, a group more than three times larger than the group living in mixed-income developments, have been dispersed across the city, many into neighborhoods that do not appear to be communities of opportunity. The demographic characteristics of these households in 2008 (younger heads, more and older children), combined with their lower rates of labor force participation and higher rates of systems involvement suggest that they are more disadvantaged than the other groups. The Transformation, however, has paid relatively little attention to the support service needs of HCV households. Our results suggest that these households could benefit from outreach, assessment, and supportive services tailored to their specific circumstances. Despite the difficulties of providing intensive services to a widely dispersed voucher population, a recent demonstration project in Chicago found that doing so at relatively little additional cost may be feasible (Popkin et al., 2010b).

Similarly, it may be worth rethinking the relative emphasis on and potential benefits of scattered-site public housing as a strategy for deconcentrating poverty. The CHA recently began using project-based vouchers as a means of reaching the Transformation's goal of 25,000 public housing units. As with scattered-site public housing, project-based vouchers have the potential to deconcentrate poverty, but without the expense of building new developments. Moreover, unlike portable vouchers, which require public housing residents to find available units and negotiate with private landlords with help from a housing counselor, project-based vouchers shift those responsibilities to the CHA.

The goal of the Transformation was to integrate public housing families into the social and economic mainstream. Achieving this goal will require both more extensive efforts on the part of the CHA and much greater involvement on the part of community-based social service organizations in neighborhoods throughout the city than had been anticipated in the original Plan.

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Data Shop

Data Shop, a department of Cityscape, *presents short articles or notes on the uses of data in housing and urban research. Through this department, PD&R introduces readers to new and overlooked data sources and to improved techniques in using well-known data. The emphasis is on sources and methods that analysts can use in their own work. Researchers often run into knotty data problems involving data interpretation or manipulation that must be solved before a project can proceed, but they seldom get to focus in detail on the solutions to such problems. If you have an idea for an applied, data-centric note of no more than 3,000 words, please send a one-paragraph abstract to david.a.vandenbroucke@hud.gov for consideration.*

The Importance of Using Layered Data To Analyze Housing: The Case of the Subsidized Housing Information Project

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Abstract

The Furman Center for Real Estate and Urban Policy recently developed a new database through its Subsidized Housing Information Project (SHIP). The SHIP database combines more than 50 disparate data sets to catalogue every privately owned, publicly subsidized affordable rental property developed in New York City with financing and insurance from the U.S. Department of Housing and Urban Development (HUD), HUD project-based rental assistance, New York City or State Mitchell-Lama financing, or the federal Low-Income Housing Tax Credit Program. The pooling and layering of data, as well as combining the data with other local housing and neighborhood information, in databases like the SHIP allow for a clearer understanding of the existing affordable housing stock and enable practitioners to more effectively target resources toward the preservation of affordable housing.

Introduction

The Subsidized Housing Information Project (SHIP) is a comprehensive, publicly accessible database that New York University's Furman Center for Real Estate and Urban Policy (the Furman Center) developed. The SHIP database catalogues the nearly 235,000 units of privately owned, publicly subsidized affordable rental properties ever developed in New York City with financing and insurance from the U.S. Department of Housing and Urban Development (HUD), HUD project-based rental assistance, New York City or State Mitchell-Lama financing, or the federal Low-Income Housing Tax Credit (LIHTC) Program.[1] This database combines more than 50 government and public data sources to give an overview of the majority of privately owned, publicly subsidized housing in New York City. A database like SHIP can aid in efforts to preserve and manage these properties by providing a clear understanding of the number of units subsidized, an improved capability for assessing challenges to the existing subsidized housing stock, and a sharper view of the potential for properties to leave subsidy programs.

History

In 2007, concerned that the subsidized housing stock was rapidly declining in an overheating housing market, the John D. and Catherine T. MacArthur Foundation funded a Preservation Capacity Assessment for the city. The assessment resulted in a series of recommendations to the five city, state, and federal agencies charged with administering New York City's housing programs, including a suggestion that the agencies create an interagency working group to devise strategies to protect the affordability of subsidized properties. The assessment also highlighted the need for an independent and objective source of information about the subsidized housing stock (Begley et al., 2011). Accordingly, the Inter-agency Working Group (IWG) was formed in 2008 and selected the Furman Center to create a single database of all properties ever subsidized by HUD, the Mitchell-Lama programs, and the LIHTC Program. The Furman Center then applied to the MacArthur Foundation and received funding to develop the database.

The MacArthur Foundation, recognizing the need for local data on the privately owned and publicly funded multifamily rental stock, has supported similar efforts across the country. For example, the foundation funded several government agencies' efforts to develop databases for internal use, including the Los Angeles Housing Department. The foundation also funded other research centers, including DePaul University's Institute for Housing Studies and the University of Florida's Shimberg Center for Housing Studies, to create publicly accessible databases that catalogue the local affordable rental housing stocks.

The SHIP database is part of a larger national effort toward integrating disparate housing data into databases and making that information accessible to the public. HUD has also recognized the need for more comprehensive data and is looking into models for creating a national preservation database.

[1] For a more detailed explanation of these programs, see Furman Center, Institute for Affordable Housing Policy (2011).

Description of the Database

The fundamental value of the SHIP database is its ability to track multiple funding sources associated with a single property. The underlying data sets range from Oracle® databases designed for active asset management, to Microsoft® Excel® spreadsheets containing historical data to paper files of land disposition agreements. Unfortunately, these data sets—almost 50 in total—did not contain a unique identifier to track properties. Within each agency, and across agencies, there were often multiple distinct data sets that had different ways to identify properties. Some used only street addresses; others used Borough, Block, and Lot (BBL) numbers;[2] and others used agency-specific identification numbers.

To link data sets, we first standardized the spelling and punctuation of all of the property addresses and used those standardized addresses to match properties to BBL numbers. We then used the BBL numbers to merge properties across portfolios. Many of the properties that the SHIP database catalogued had multiple buildings or are scattered-site developments, so we often had to identify multiple BBL numbers and ensure they connected to the correct property.

After merging properties across portfolios, the next step was to standardize the data that each agency attached to its subsidies. For example, we found disparities in the way agencies measured indicators such as the number of units in a development, with some agencies counting superintendents' units in the total and others not. In some cases, we compared the data provided to the city's tax roll data to determine which was most reliable.

Advantages of Layering Data

The SHIP database enables users to view the layering of subsidies, which leads to more accurate counts of how many units have been developed and preserved and how many properties will expire from their subsidy program. When we look at all programs together, we see that 29 percent of the properties that received a subsidy from an agency at some point in their history also received a subsidy from another agency (Furman Center, 2011).[3] When we look only at the currently affordable properties, we find that more than 15 percent of these properties are subsidized through multiple programs. Exhibit 1 shows the level of subsidy overlap across the currently affordable properties.

If we ignored this overlap and counted a property each time it appeared in a portfolio, we would conclude that 2,485 properties were currently affordable, containing more than 230,000 units. By taking the overlap into account, however, we find there are currently only 2,129 affordable properties containing about 170,000 units. The fact that the number of units falls much more substantially than the number of properties when the merge is performed highlights that properties with multiple subsidies tend to be larger than properties with a single subsidy source. The average size of a property

[2] New York City uses BBL numbers to uniquely identify a taxable property.

[3] All data in this report come from The Furman Center's Subsidized Housing Information Project Data Search Tool (Furman Center, 2011).

Exhibit 1

Overlap of Financing Sources Across Currently Affordable Properties

LIHTC	Mitchell-Lama	HUD Financing and Insurance	HUD Project-Based Rental Assistance	Number of Properties	Number of Units
✔				1,469	70,373
	✔			36	11,408
		✔		21	4,884
			✔	274	34,912
Total, properties with one subsidy				1,800	121,577
✔		✔		2	82
✔			✔	21	2,898
	✔	✔		8	1,730
	✔		✔	19	10,607
		✔	✔	253	23,611
Total, properties with two subsidies				303	38,928
✔	✔		✔	1	559
✔		✔	✔	11	1,018
	✔	✔	✔	13	9,230
Total, properties with three subsidies				25	10,807
✔	✔	✔	✔	1	146
Total, properties with four subsidies				1	146
Total				**2,129**	**171,458**

HUD = U.S. Department of Housing and Urban Development. LIHTC = Low-Income Housing Tax Credit Program.

with one current subsidy is 68 units. The average size of a property with three current subsidies is 432 units. Counting these properties three times would significantly skew any survey of the affordable housing stock.

The layered data also reveal that some subsidies are more often combined with other forms of subsidy. For example, more than 50 percent of the properties with HUD project-based rental assistance have an additional form of subsidy, whereas only 2 percent of LIHTC properties have more than one form of subsidy. This finding makes sense because many of the older HUD programs coupled project-based rental assistance with some form of mortgage insurance. The LIHTC program is often layered with some form of soft debt or tax-exempt bond financing that does not necessarily mandate an affordability restriction beyond that of the tax credit. If we explore this layering further, however, we also see that every multiple-subsidy property has either HUD project-based rental assistance or HUD financing and insurance that compels affordability. The merged data illustrate that state and local financing programs consistently leverage HUD resources.

Practitioners have generally been unable to know all of the financing layers on any given property. Without taking layering into account, we would believe that all of the 108 properties that no longer receive HUD project-based rental assistance have converted to market-rate rents. The SHIP database, however, shows us that 23 of these properties are still affordable through another subsidy program. Furthermore, more than one-half of the properties that have left a HUD financing or insurance program still receive funding from another subsidy program that restricts rents.

A failure to take subsidy layering into account would also lead us to overstate opt-out risks. Looking at the merged data sets, we find that 62,000 housing units are in developments that no longer receive a subsidy that the SHIP database catalogues. Had we instead simply counted the number of units that had exited one of our subsidy programs, we would have estimated that 108,402 units were in properties that no longer receive a subsidy. In addition, a property often leaves one subsidy program because it refinances through another program that extends its affordability requirements. For example, since 2000, 106 properties containing 24,173 units had an expiring subsidy but were preserved thorough another program. These units amount to almost 15 percent of the units in properties that are currently affordable and would have shown up as opted out in some agency's portfolio. Layered data sets like the SHIP database enable us to know that these properties are still affordable and that the subsidy was used to preserve an existing property as affordable housing rather then develop new housing.

Databases like the SHIP also provide a more accurate count of properties with expiring subsidies. As we see in exhibit 2, if we counted the number of units that will reach the expiration date for each subsidy source, we would believe that more than 480 properties with 81,242 units will no longer have affordability restrictions in the next 5 years. If we layer all of these data sets, however, we see that most of these properties have multiple forms of subsidy and only 226 properties with 38,608 units are actually eligible to leave all affordability restrictions in the next 5 years.

The SHIP database then enables us to look at the list of expiring properties and better assess the effect of subsidy expiration. For example, when we look at properties with project-based Section 8, we see that 364 properties with 45,870 units are set to expire in the next 5 years. These contracts are renewable, however, and in recent years HUD has offered owners only short-term contract renewals. When we layer on the other forms of subsidies, we see that more than 120 of the expiring properties have at least one other form of subsidy that compels affordability beyond the next 5 years. We might therefore assume that, because those properties are still required to be affordable through another program, it is likely that those owners will choose to renew their Section 8 contracts.

Some forms of project-based rental assistance, namely the Rental Assistance Program and the Rental Supplement Program, are nonrenewable. If we look at these properties, we find that 17 properties with nearly 8,000 units are expiring between 2011 and 2015. Only one of these properties will still have some form of affordability restriction that compels it to be affordable after the project-based rental assistance expires. The challenge with these expiring properties is that they have a subsidy that provides direct rental income to the property and ensures tenants do not pay more

Exhibit 2

Subsidies Expiring in the Next 5 Years

Program	Properties	Units
HUD project-based rental assistance	382	47,353
Mitchell-Lama	67	29,188
HUD financing and insurance	29	4,600
LIHTC	2	101
Total—without layering	480	81,242
Total—with layering	226	38,608

HUD = U.S. Department of Housing and Urban Development. LIHTC = Low-Income Housing Tax Credit Program.

than 30 percent of their income on rent. Because this subsidy is not renewable, the property's financial structure will undergo a serious change, which could result in increased rents for low-income tenants or deteriorating property conditions. Using databases like the SHIP helps practitioners know that these subsidies are expiring and that no other subsidies on these properties will extend affordability restrictions.

Advantages of Pooling Data

The SHIP pools data sets, which allows for the analysis of financing trends. As shown in exhibit 3, more affordable housing was developed in the 1970s than in any other decade in the past 50 years. The Mitchell-Lama program and HUD's project-based rental assistance programs supported much of that development. New developments stopped using the Mitchell-Lama program by the 1980s, when project-based rental assistance and HUD financing and insurance became the most common subsidies. Since 1990, the LIHTC program has financed almost all new affordable housing developments.

Exhibit 3

Number of Units Developed by Decade and Program Subsidy Category

	1960s	1970s	1980s	1990s	2000s
HUD financing and insurance	3,079	11,361	14,898	995	173
HUD financing and insurance/project-based rental assistance	467	7,494	22,797	5,326	2,915
Project-based rental assistance	891	4,889	11,803	2,164	1,390
Project-based rental assistance/ Mitchell-Lama	0	22,996	248	0	0
Mitchell-Lama	14,772	19,199	0	0	0
Mitchell-Lama/HUD financing and insurance	0	1,788	0	0	0
HUD financing and insurance/project-based rental assistance/Mitchell-Lama	0	9,029	0	0	0
LIHTC	0	0	2,928	29,697	38,383
LIHTC/HUD financing and insurance	0	0	327	1,358	0
LIHTC/project-based rental assistance	0	0	0	103	0
LIHTC/HUD financing and insurance/ project-based rental assistance	0	0	0	0	82

HUD = U.S. Department of Housing and Urban Development. LIHTC = Low-Income Housing Tax Credit Program.

Advantages of Leveraging Existing City Data

Databases like the SHIP provide a platform for combining housing data with other local data about these properties and the neighborhoods where properties are located. The SHIP database includes more than 360 neighborhood-based indicators. These indicators range from detailed information about the physical and financial condition of properties to changes in local market and neighborhood characteristics.

Assigning each property a BBL creates new opportunities to link housing data with city data about physical or financial distress. Government officials might want to compare how different portfolios have performed when developing preservation priorities. The SHIP database enables us to compare

the property characteristics—such as housing code violations and tax delinquencies—across portfolios. For example, 8.7 percent of properties with HUD insurance in New York City have been delinquent on their taxes by at least $1,000 per unit for more than 1 year, whereas 5.1 percent of properties receiving project-based rental assistance have been delinquent. Mitchell-Lama properties have only a 1.3-percent delinquency rate. By using the SHIP database, we can see that none of the 22 properties that currently receive both HUD insurance and Mitchell-Lama financing are delinquent on their taxes, whereas 2.9 percent of properties that receive both HUD project-based rental assistance and Mitchell-Lama financing are delinquent.

The combination of housing and market data can also assist researchers. For example, the Furman Center is working on a model to predict which properties are likely to leave the Mitchell-Lama housing program. One theory is that the difference between restricted rents and potential market rents can predict an owner's likelihood of opting out of the program. Between 2002 and 2007, 56 Mitchell-Lama properties opted out. Of those properties, 36 were located in community districts where multifamily properties appreciated in price at a rate higher than the city average.

Finally, this information could help local officials target specific neighborhoods for preservation efforts. For example, government officials might want to prioritize preserving properties located in areas with high-performing schools. In New York City, the Upper East Side was one of the community districts with the highest share of students performing at or above grade level in 2009, so policymakers may want to focus resources on the 1,600 units in properties with expiring subsidies in that neighborhood over the next 5 years. The SHIP database also shows that the per-unit median price in 2010 for a multifamily rental building on the Upper East Side was almost twice the citywide median, which would suggest that these properties are relatively more expensive to preserve. Neighborhood-level quality of life and housing cost indicators such as these are critical as government officials, researchers, and advocates analyze properties and design preservation initiatives.

Conclusion

The SHIP database represents a proactive effort from government, advocates, researchers, and funders across the country to better understand the privately owned, publicly subsidized affordable multifamily rental housing stock. Integrated data sets like the SHIP database are important because they enable us to arrive at better estimates of how many properties have been developed, offer richer descriptions of property characteristics, enable more effective tracking of how many properties have left affordability programs, and help identify which properties will be eligible to leave their affordability programs in the near future. This information will help local, state, and federal government officials in their efforts to preserve affordable housing, enabling them to be more proactive. These data also provide a platform for researchers to better understand the intricacies of these programs and ultimately produce policy-relevant research. Integrated data sets like the SHIP database will become all the more crucial going forward, as older subsidies expire and new ones are used to finance the development and preservation of affordable housing.

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Additional Reading

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Impact

A regulatory impact analysis must accompany every economically significant federal rule or regulation. The Office of Policy Development and Research performs this analysis for all U.S. Department of Housing and Urban Development rules. An impact analysis is a forecast of the annual benefits and costs accruing to all parties, including the taxpayers, from a given regulation. Modeling these benefits and costs involves use of past research findings, application of economic principles, empirical investigation, and professional judgment.

Using American Community Survey Data for Formula Grant Allocations

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Abstract

This article discusses the use of census data to support grants from the federal government to state and local governments and shows how the Census Bureau's new American Community Survey affects grants through the Community Development Block Grant program.

Introduction

The U.S. Department of Housing and Urban Development (HUD) administers funding for a number of community development programs that rely on local entities (such as city or county governments, public housing agencies, and community-based nonprofits) to carry out the activities. These community development funds typically are distributed in one of two ways: by grant competition or by formula.

With a grant competition, HUD publishes a Notice of Funding Availability (NOFA) that establishes the purpose of the program and the criteria by which funds will be awarded. Interested organizations submit applications, and HUD staff review the applications using the criteria established

in the NOFA. HUD administers major programs such as HOPE VI, Choice Neighborhoods, and round 2 of the Neighborhood Stabilization Program on a competitive basis. Competitive programs enable HUD to influence the types of projects funded and to limit grants to high-quality projects and capable organizations. One challenge in administering these programs is determining accurately and fairly which projects are high quality and which organizations are capable.

Formula grant programs are designed to simplify the federal role and to allow grantees to make key decisions about which projects are appropriate. Formula grant programs also provide funds to all applicants that meet the specified qualification criteria. HUD's major formula grant programs include the Community Development Block Grant (CDBG) program, the HOME Investment Partnerships Program, and the Public Housing Capital Fund. Each of these programs has an established formula that specifies the variables and variable weights that HUD must use to distribute funding. Each year, HUD updates the underlying data and the total funds available, and the results of the formula determine how much each particular grantee gets. Data used to run the formula must be available and consistently collected across the universe of potential grantees. As a result, the Census Bureau—and particularly the decennial census—has historically been the authoritative source.[1] The detailed survey component of the decennial census (the "long form") has been replaced by the American Community Survey (ACS), which will provide annual estimates of demographic, social, and economic characteristics of neighborhoods across the United States. For programs that are required to use census data for distributing formula grants, the ACS is likely to be the new standard. The rest of this article will address the transition from decennial census data to ACS data, particularly for HUD's CDBG program.

Introducing ACS Data Into the CDBG Formula

The Census Bureau released the first ACS estimates in 2010, based on surveys completed from 2005 through 2009. HUD is using these data in formula allocations for the first time in fiscal year (FY) 2012. A recent HUD report, *Redistribution Effect of Introducing 2010 Census and 2005–2009 ACS Data Into the CDBG Formula*, discusses how that transition affects grants under the CDBG program (Joice, Winter, and Johnson, 2011). This article presents the key findings and implications from that research.

HUD bases CDBG allocations on two formulas, Formula A and Formula B, which rely on five variables specified by Section 5306 of the Housing and Community Development Act: population, people in poverty, overcrowded households, housing units built before 1940, and population growth lag. Exhibit 1 shows the source for each of these variables for the CDBG allocations made in FY 2011 and the source that will be used in FY 2012. For each grantee, HUD computes these variables as a share of the nationwide total.[2] HUD then multiplies the grantee's share of that

[1] For more information about the use of formulas for distributing federal funding and the role of Census Bureau data in this process, see Reamer (2010).

[2] The three basic CDBG grantee types are entitlement city, urban county, and state-administered nonentitlement. HUD computes the shares of each variable differently for different grantee types and different variables. For a full explanation, see Joice, Winter, and Johnson (2011) and Richardson and Meehan (2003).

Exhibit 1

Comparison of Formula Variables and Data Sources From FY 2011 and FY 2012 Allocations

	Variables	FY 2011 Allocation	FY 2012 Allocation
Formula A variables	Population	2009 population estimates	2010 Census
	People in poverty	2000 Census	2005–2009 ACS
	Overcrowded households	2000 Census	2005–2009 ACS
Formula B variables	Population growth lag	2009 population estimates and 1960 Census	2010 Census and 1960 Census
	People in poverty	2000 Census	2005–2009 ACS
	Housing units built before 1940	2000 Census	2005–2009 ACS

ACS = American Community Survey. FY = fiscal year.

variable by the variable's weight and the overall allocation amount, adds the variables, and applies a pro rata reduction to get to the final grant amount.[3]

For several of these variables, the difference between the values used in FY 2011 and the values that will be used in FY 2012 are remarkable. Across all metropolitan areas, the 2005–2009 ACS estimate of overcrowding is 46.4 percent lower than the 2000 Census estimate of overcrowding. The number of people in poverty in metropolitan areas is estimated by the 2005–2009 ACS to be 16.3 percent higher than it was according to the 2000 Census. A substantial difference also exists in pre-1940 housing measurements; the 2005–2009 ACS estimate is 7.7 percent higher than the 2000 Census estimate. These figures and estimates of population change appear in exhibit 2, broken down by entitlement cities and the balance of metropolitan areas (which includes CDBG urban county grantees and some nonentitlement areas).

Exhibit 3 shows that trends are similar in entitlement communities and nonentitlement areas, with two exceptions. In nonentitlement areas, there is only a minimal difference between the 2000 Census and 2005–2009 ACS estimates of pre-1940 housing, and the difference in overcrowded housing is less extreme.

In the past, HUD updated most of the data in the CDBG formula with every decennial census. As shown in Richardson and Meehan (2003), substantial changes in CDBG variables are common with the introduction of new data. This time, however, is different. The new data not only reflect nearly a decade of changing neighborhood conditions, they also reflect one-time adjustments from the decennial census to the ACS. It is important to understand whether the apparent changes from the 2000 Census to the 2005–2009 ACS represent actual changes in conditions, or changes in measurement.

The methodology of the ACS differs from the methodology of the decennial census in some important ways. The most widely discussed difference is the sample size. Both the long form of the decennial census and the ACS are surveys, but substantially more households received the long form (1 in 6 households, which was approximately 18 million households in 2000) than receive the ACS

[3] The pro rata reduction is necessary because HUD runs Formula A and Formula B for each grantee, and the grantee gets whichever total is higher. This procedure leads the sum of individual grants to be greater than the total funds available. This article will not extensively discuss the mechanics of the CDBG formula; for more background, see Joice, Winter, and Johnson (2011) and Richardson and Meehan (2003).

Exhibit 2

Change in Formula Variables in Metropolitan Areas

	Entitlement Cities	Balance of Metropolitan Areas	Total Metropolitan Areas
Population			
2009 population estimates	126,330,750	134,795,096	261,125,846
2010 Census	125,843,466	136,008,672	261,852,138
Percent change	– 0.4	0.9	0.3
People in poverty			
2000 Census	18,401,833	10,308,189	28,710,022
2005–2009 ACS	20,671,664	12,724,840	33,396,504
Percent change	12.3	23.4	16.3
Overcrowded households			
2000 Census	3,861,310	1,813,634	5,674,944
2005–2009 ACS	2,002,160	1,037,538	3,039,698
Percent change	– 48.1	– 42.8	– 46.4
Housing units built before 1940			
2000 Census	8,338,128	5,032,353	13,370,481
2005–2009 ACS	9,320,169	5,084,319	14,404,488
Percent change	11.8	1.0	7.7

ACS = American Community Survey.

Exhibit 3

Change in Formula Variables in Entitlement and Nonentitlement Areas

	Entitlement Communities	Nonentitlement Areas
Population		
2009 population estimates	201,180,773	108,932,489
2010 Census	201,270,119	110,340,632
Percent change	0.0	1.3
People in poverty		
2000 Census	23,471,950	11,978,807
2005–2009 ACS	27,014,044	14,008,083
Percent change	15.1	16.9
Overcrowded households		
2000 Census	5,019,582	1,232,717
2005–2009 ACS	2,630,534	778,680
Percent change	– 47.6	– 36.8
Housing units built before 1940		
2000 Census	10,576,185	6,825,438
2005–2009 ACS	11,578,443	6,882,096
Percent change	9.5	0.8

ACS = American Community Survey.

(3 million households per year).[4] Indeed, the Census Bureau did not even publish margins of error for the numbers generated from the decennial census long form survey, giving some data users the false impression that they were true population parameters rather than survey estimates.

As a result of the smaller sample, the ACS is less precise than the decennial Census; that is, the ACS has higher sampling error. Thus, it is possible that differences between the 2000 Census and the 2005–2009 ACS are simply random variation. This concern applies to all ACS estimates, not only to those used for the CDBG formula. Differences between the two surveys may also relate to *accuracy* rather than to *precision*. The extent to which a survey accurately estimates a population parameter is known as nonsampling error. In the following sections, we discuss some of the variables in the CDBG formula and consider how nonsampling error in the 2000 Census and the 2005–2009 ACS influence apparent changes.

Poverty

Of all the significant changes in CDBG formula variables, the increase in poverty (16.3 percent across all metropolitan areas) seems the most likely to reflect real changes. Between the 2000 Census and the 2005–2009 ACS were two recessions and 6 years of growth that did not reach many of the most vulnerable in society.[5] *Across all metropolitan areas*, an increase in poverty—even an increase as substantial as 16.3 percent—seems accurate. When looking at particular places or metropolitan areas, however, changes in poverty might be partly the result of differences between the decennial census and ACS—in particular, the result of the "residence rule" used to determine who should respond to a survey. The decennial census required a household to respond based on its "usual place of residence." The ACS requires a household to respond if it has lived, or plans to live, for 2 months at the unit where the survey was mailed. This change in the residence rule can affect the population being surveyed in places with a large percentage of seasonal residents (Love et al., 2004). For example, if Arizona households residing in Maine during the summer are consistently high income, then the ACS would indicate higher household incomes in Maine and lower household incomes in Arizona when compared with the 2000 Census (independent of any actual change in income).

Overcrowded Housing

The change in overcrowding from the 2000 Census to the 2005–2009 ACS is remarkable for its size (a reduction of 46.4 percent for a national-level statistic in less than a decade) and for the fact that it happened over a period of great turmoil in the housing market. It is likely that this change is more reflective of differences in measurement from the decennial census to the ACS than it is of real changes between 2000 and the period 2005 through 2009. The Census Bureau thinks that, historically, survey respondents have been confused about how to respond correctly to the question of how many rooms are in a housing unit, based on discrepancies between the number of

[4] When the ACS began, 3 million households represented 2.5 percent of all housing units, but the sample size did not increase with the number of U.S. households. In FY 2011, the Census Bureau budget included funds to expand the sample size to approximately 3.5 million.

[5] The "Great Recession" officially began in December 2007 and is only partly reflected in the 2005–2009 ACS. Poverty will likely increase again in FY 2013 and FY 2014 with the introduction of 2006–2010 and 2007–2011 ACS estimates.

bedrooms and the total number of rooms respondents reported (Woodward, Wilson, and Chesnut, 2007). Residents of units with unusual layouts, such as small studio and efficiency units, may have been unaware in 2000 that they should count the kitchen as a room distinct from the attached living and sleeping area. Questions that confuse or mislead respondents are more problematic for the decennial census than for the ACS, because the decennial census relied more on mail-in responses. The ACS extensively uses telephone and in-person interviewers who are able to explain to respondents what does and does not count as a room. This follow-up likely played a large role in the fact that the percentages of units with one and two rooms declined 36.8 and 42.3 percent, respectively, from the 2000 Census to the 2005–2009 ACS.

The estimated overcrowding rate from the 2005–2009 ACS (3 percent) is also very similar to the estimated overcrowding rate from the American Housing Survey (AHS) (2.4, 2.5, and 2.2 percent in 2005, 2007, and 2009, respectively). All of this evidence suggests that the apparent decline in overcrowding from the 2000 Census to the 2005–2009 ACS is largely the result of a technical change in measurement, but that technical change is a positive development that more accurately reflects actual conditions.

Housing Units Built Before 1940

The change in pre-1940 housing from the 2000 Census to the 2005–2009 ACS is also likely the result of methodological changes from the decennial census to the ACS. If these data were true population parameters, such an increase would hardly be possible; pre-1940 units can be removed from the housing stock through demolition but can be added in only a few circumstances. If a pre-1940 housing *structure* is renovated and additional units are added (such as splitting a four-bedroom apartment into two two-bedroom apartments), the number of pre-1940 housing *units* would increase. Also, because the census and ACS do not survey nonresidential buildings, converting an old industrial or commercial building to residential use could increase the number of pre-1940 housing units. These scenarios may explain part of the apparent increase in pre-1940 housing, but it is likely that the number of pre-1940 units removed from the housing stock each year substantially exceeds the number of pre-1940 units added to the housing stock. The Components of Inventory Change reports that HUD issues using data from the AHS confirm this conclusion. Between 2001 and 2007, a total of 726,000 pre-1940 housing units were added to the national housing stock, whereas 1,507,000 were removed from the housing stock. The net change of -781,000 suggests that, at a national level, the pre-1940 housing stock did not actually increase from the 2000 Census to the 2005–2009 ACS.

As with the measurement of overcrowding, the measurement of structure age is influenced by the fact that the ACS relies more heavily than the Census on telephone and in-person interviewers. Survey respondents may not immediately know the age of their building; one might expect this to be particularly true for renters in old multifamily buildings. ACS interviewers may be able to help respondents determine their building's true age. Administrative data from New York City show even higher levels of pre-1940s housing than those captured by the ACS, but the ACS estimates are much closer than the 2000 Census estimates (Salvo et al., 2007). As with overcrowding, the apparent changes in pre-1940 housing seem to be the result of a technical change in measurement, but again, that technical change is a positive development that more accurately reflects actual conditions.

Impact

The previous section discussed how certain variables changed—and speculated about why they changed—at the national level. This section will focus more on the effects of the new data on individual grantees and types of grantees, using the total appropriation amount and grantee universe from FY 2011. Exhibit 4 demonstrates how each variable affected principal cities, satellite cities, and urban counties. Exhibit 5 demonstrates how each variable affected grantees in the different HUD administrative regions (see exhibit 6).[6]

Exhibit 4

Change in Funding Allocated by Variable, by Grantee Type

Jurisdiction Type	Due to Switching Formulas	Percent Change by Variable					
		Formula A			Formula B		
		Population	People in Poverty	Overcrowded Households	Population Growth Lag	People in Poverty	Housing Units Built Before 1940
Principal city	– 0.4	0.0	0.1	– 0.2	0.2	– 0.9	1.3
Satellite city	0.2	0.0	– 1.1	– 1.1	– 0.8	0.0	– 0.3
Urban county	0.0	0.3	2.7	0.1	– 0.5	0.0	– 1.4

Exhibit 5

Change in Funding Allocated by Variable, by Region

Region	Due to Switching Formulas	Percent Change by Variable					
		Formula A			Formula B		
		Population	People in Poverty	Overcrowded Households	Population Growth Lag	People in Poverty	Housing Units Built Before 1940
New England	0.0	0.0	0.0	0.0	– 1.1	– 0.7	3.2
New York/ New Jersey	0.1	0.0	– 0.1	0.1	– 0.4	– 2.8	2.6
Mid-Atlantic	– 0.1	0.1	– 0.1	– 0.4	– 0.8	– 0.9	– 2.8
Southeast	– 1.3	0.1	3.9	– 3.3	0.6	– 0.2	0.2
Midwest	0.1	0.1	1.8	0.2	0.5	0.6	2.0
Southwest	0.0	0.1	4.2	0.6	0.0	– 0.7	– 0.7
Great Plains	0.4	0.1	2.3	0.4	0.7	0.8	2.1
Rocky Mountain	—	– 0.1	9.1	1.7	– 0.3	0.4	– 1.3
Pacific/Hawaii	0.0	0.0	– 4.0	1.0	0.0	– 0.2	0.0
Northwest/ Alaska	0.0	0.1	3.6	0.2	– 0.6	0.1	– 1.2
Puerto Rico	– 4.2	– 0.5	– 10.0	– 7.9	—	—	—
Total	**– 0.2**	**0.0**	**0.5**	**– 0.2**	**– 0.1**	**– 0.6**	**0.6**

[6] Satellite city is not an official HUD designation but is used here in reference to any entitlement city that is not the central city of its metropolitan statistical area. Puerto Rico is not officially a HUD administrative region, but it is grouped separately for this analysis.

Exhibit 6

Map of HUD Administrative Regions

Regarding poverty, three distributional changes are particularly notable. First, the ACS indicates that poverty is spreading out from central cities into suburban and exurban communities (Kneebone and Garr, 2010). Exhibit 2, which shows that poverty increased by 12.3 percent in entitlement cities, but nearly twice that amount (23.4 percent) in the balance of metropolitan areas (including urban counties and nonentitlement areas), corroborates this finding. Exhibit 4 shows that Formula A urban county grantees experience a 2.7-percent increase in funding as a result of the poverty variable. Funding increases only 0.1 percent for principal cities and goes down 1.1 percent for satellite cities as a result of the poverty variable. The second major change resulting from the poverty variable is the drastic reduction in funding for entitlement grantees in Puerto Rico. All 27 Puerto Rico entitlement grantees see their funding decrease because of the introduction of ACS data, by an average of 22.7 percent. Exhibit 5 shows that almost one-half of that decrease (10 percent) derives from the poverty variable, and overcrowding is responsible for another 7.9 percent. Richardson and Meehan (2003) found similar results from the introduction of 2000 Census data to the CDBG formula; 95 percent of jurisdictions in Puerto Rico experienced declines in CDBG funding in FY 2003, largely as a result of the poverty variable. Finally, the influence of the poverty variable—particularly in Formula A—varies widely by region. The 10-percent decrease in Puerto Rico is the most extreme example, but several other regions have significant changes. Exhibit 5 shows that Formula A grantees in the Southeast (Region IV), Southwest (Region VI), Rocky Mountain (Region VIII),

and Northwest/Alaska (Region X) regions see average funding increases of at least 3.6 percent as a result of the poverty variable. Formula A grantees in the Pacific/Hawaii (Region IX) region (which includes California, Nevada, and Arizona) and Formula B grantees in the New York/New Jersey (Region II) region have their average grant decrease by 4.0 and 2.8 percent, respectively, as a result of the poverty variable.

As discussed in the previous section, the declining measure of overcrowding appears to stem from more reliable information about unit size; considerably fewer households reported units with one or two rooms. This change has a minimal effect on Formula A principal cities and urban counties (-0.2-percent and 0.1-percent changes, respectively) but does cause satellite cities to lose a more substantial 1.1 percent. By region, the Southeast (Region IV) and Puerto Rico lose substantially (-3.3 percent and -7.9 percent, respectively), whereas no regions see their funding increase more than 2 percent as a result of the overcrowding variable. Individual grantees that lose a substantial amount of funding as a result of the overcrowding variable include several large grantees in Florida: Hialeah (-41 percent), Miami (-26 percent), Miami-Dade County (-27 percent), Miami Beach (-35 percent), and Tampa (-10 percent). At this point, the reason why the improved measurement of overcrowding would manifest itself differently in different regions and among types of grantees is not clear.

The pre-1940 housing variable is the one that most clearly has a systematic effect on certain types of grantees. Exhibits 4 and 5 show that the pre-1940 housing variable causes funding to increase by 1.3 percent in principal city entitlement grantees and by at least 2 percent in the New England (Region I), New York/New Jersey (Region II), Midwest (Region V), and Great Plains (Region VII) regions. Specific grantees that benefit from the changing measurement of pre-1940 housing include New York City, Chicago, Indianapolis, and Detroit, which would have their funding from the pre-1940 housing variable increase by 6.8, 6.7, 7.5, and 4.9 percent, respectively.[7] As described in the previous section, the jump in pre-1940 housing appears to be the result of improved information about the true age of multifamily buildings, specifically buildings inhabited by residents with limited knowledge of their building's age. Exhibit 7 shows that change in pre-1940 housing from the 2000 Census to the 2005–2009 ACS is positively correlated with multifamily rental stock and negatively correlated with owner-occupancy rate and single-family housing stock. Formula B grantees with a large multifamily housing stock, small single-family housing stock, and low owner-occupancy rate appear most likely to gain from the changing measurement of pre-1940 housing.

[7] These numbers are the change in funding from the pre-1940 housing variable divided by the total FY 2011 grant amount. These grantees would see their overall grant amount go up by 2.9, 6.5, 10.5, and 11.9 percent, respectively.

Exhibit 7

Correlation of Change in Pre-1940 Housing With Select Census 2000 Data[a]

		Change in Pre-1940 Housing
Owner-occupancy rate	Pearson correlation	– .254
	sig. (2-tailed)	.000
	N	3,215
Units in single-unit structures	Pearson correlation	– .232
	sig. (2-tailed)	.000
	N	3,215
Renter-occupied units in large multifamily buildings (10 or more units in structure)	Pearson correlation	.374
	sig. (2-tailed)	.000
	N	3,215

sig. = statistical significance.

[a] Using county-level data, I calculate correlation coefficients between these three variables and the change in pre-1940 housing units (calculated as the ACS value minus the 2000 Census value).

Conclusion

The 2005–2009 ACS data that HUD is using for FY 2012 formula allocations partially represent changes that have occurred since the 2000 Census in communities across the country. However, the ACS also measures some things differently than the 2000 Census. As shown by allocations through the CDBG program, these differing methodologies can play a substantial part in any changes observed from the 2000 Census to the 2005–2009 ACS.

The ACS methodology has been rigorously tested and justified. The benefits that the ACS offers—particularly its low nonsampling error and annual updates—are substantial, and the ACS is rightfully *the* authoritative and comprehensive data source from the Census Bureau. The CDBG allocation changes that may result in FY 2012 are substantial for some grantees, but FY 2012 may be the last time such drastic changes occur as the result of new data. By using annual updates of the ACS 5-year estimates, HUD expects future allocations to be stable and to accurately reflect conditions in communities across the country.

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