Low-Income Renter Housing: Another View of the Tough Choice

Margaret S. Murray*

Abstract

This article describes a method that offers an alternative view of the affordability, quality, and crowding choices facing low-income renters. It provides information on the housing tradeoffs made by low-income households and is directly applicable to the formulation of housing policy. By using a sequential logit model, the research explicitly accounts for the increase in the probability of securing adequate, affordable housing.

Affordability problems clearly constitute the biggest hurdle for the low-income renter household. Regional location is also a significant factor influencing the probability of multiple housing problems. For example, households in the western United States are more likely to experience multiple housing problems. The receipt of housing assistance improves the housing condition for all low-income groups but helps very low income households the most. These results support the need for housing programs tailored to local housing conditions.

Keywords: low-income households; housing deprivation; housing subsidies; sequential logit model

Introduction

Understanding the housing problems of low-income households requires an understanding of several factors, including the cost associated with obtaining a housing unit, the quality of the housing unit, and the size of the unit. These factors are introduced as elements in a sequential decision model of housing choice. When low-income urban renter households make a housing decision, they reveal preferences about the cost, quality, and size of a housing unit. The categorical methods commonly used to document patterns of problems in low-income households do not reflect the probability that a particular household will occupy acceptable shelter. The method presented in this article, however, explicitly considers the tradeoffs facing low-income renter households. The estimated parameters of this housing choice model are used to address questions about who should be served by housing assistance programs.

Because government assistance is a vital resource for low-income households, many studies have evaluated recipient households. This study departs from the traditional line of inquiry and shows how receiving assistance leads to a substantially larger increase in the probability of achieving adequate housing for the very lowest income group than for those at the upper end of the low-income range.

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An established goal of U.S. housing policy is to improve the housing condition of the poor.[1] Since the landmark Housing Act of 1937, a variety of government programs have addressed the condition, availability, and affordability of housing for the poor. Many researchers find these programs both inefficient and inequitable. This study compares the likelihood of multiple housing problems for unassisted low-income renters with those of renters who do receive government assistance.

Related Research

This study complements and extends current research that addresses the dilemma faced by low-income renters in securing affordable shelter of adequate quality. Two themes in housing research provide the structure for the model developed here. The first is found in studies of affordability and quality generally directed at reporting patterns of housing problems. The basis for many of these studies is aggregate demand and supply at the market level, not the disaggregate choice process at the household level. The second theme is found in more rigorous studies that use discrete choice modeling to evaluate housing choices. This article adds to the literature by drawing on both themes and provides insight into the probability that a particular combination of problems will exist.

Studies of Affordability and Quality

The burden of costly housing continues to dominate the housing literature. Apgar (1991) states that the cost of obtaining housing has superseded inadequate quality as the primary housing problem of the poor. In describing the housing problems facing low-income households, he argues that the affordability problem reflects the disappearance of low-cost housing caused by disinvestment and selective upgrading. Apgar uses American Housing Survey data from 1974, 1980, and 1987 to substantiate his claim that more and more low-income households are faced with housing cost burdens in excess of 30 percent of income. He also claims that any increase in the number of poor households able to secure adequate and affordable housing since 1974 is due to an increase in the number of subsidized households. The data compiled by Apgar indicate that the number of low-income, unsubsidized renter households living in costly units has more than doubled since 1974.

Linneman and Megbolugbe (1992), in contrast, see the affordability problem as primarily income related and only partly due to inadequate housing supply. Changes in tastes for luxury features, in the nature of the mortgage market, and in local public finance all contribute to the affordability problem, which they consider to be part myth and part reality. Another contributing factor is the higher standard of quality found in housing today.

The difficulty in finding an objective measure of housing quality has been addressed by many researchers. Clemmer and Simonson (1983) examined the trends in substandard housing with respect to quality changes. They defend the U.S. Department of Housing

[1] In this context, housing policy serves as social welfare policy (Hayes 1995). It can also serve as community development policy and macroeconomic policy.

and Urban Development (HUD) definition of quality as "state of the art" and support its use in measuring year-to-year qualitative changes. The HUD definition of physically deficient housing, or some modification of it, is used in a variety of other studies (Frieden and Solomon 1977; Goedert and Goodman 1977; Newman and Schnare 1988; Newman and Struyk 1983).

"Housing deprivation" is a term commonly used to describe households whose housing conditions fall below current standards. Researchers typically use housing deprivation to draw attention to the numbers of households in housing that is expensive relative to their income, of poor quality or in poor physical condition, or overcrowded (Apgar 1991; Frieden and Solomon 1977; Nelson and Khadduri 1992; Newman and Struyk 1983). More specifically, housing deprivation is defined as a high rent burden, a low-quality unit, a crowded unit, or some combination of these (Frieden and Solomon 1977; Newman and Struyk, 1983).

Studies of Housing Choice

Housing choice problems are frequently evaluated in a probabilistic choice context. Statistical models that forecast the probability that a decision-maker will select a particular alternative have been in widespread use since the 1970s. These models permit the dependent variable to assume discrete values, such as buy versus rent or single-family versus multifamily. A number of researchers (Börsch-Supan 1990; Börsch-Supan and Pitkin 1988; Ellickson 1981; Kain and Apgar 1977; King 1980; Quigley 1976, 1983) estimate discrete models of tenure choice or housing and neighborhood choice. These researchers variously modeled the consumer's problem as a choice among anywhere from 9 to 50 housing types. Most of the studies address methodological considerations in modeling residential choice, not specific policy applications.

Sequential models of housing choice decompose the choice process into a series of related decisions and may more closely reflect the actual way that housing decisions are made. That is, the decision to move is followed by decisions regarding location, dwelling type, and dwelling unit (Clark and Onaka 1985). A type of sequential model used by Boehm (1979, 1980) describes the housing choice problem as a hierarchy of choices related to mobility, tenure, size, and quality. He modeled mobility and tenure as a joint decision and size and quality as separate decisions that followed the mobility-tenure decision. Boehm argues that this type of model offers additional insight into the results of government policies on the housing choices of families. He suggests that once the coefficients of a housing choice system are determined, the effect of housing programs on housing choice can be determined with greater knowledge. Likewise, by applying a sequential model of housing choice to low-income renter data, I am able to explicitly account for the influence of government assistance on the probability of achieving adequate shelter.

Qualitative Choice

The empirical analysis in this article is based on a random utility model of consumer choice that characterizes utility in terms of both an observed component and an unobserved component. The unobserved component is considered random; that is, it is

not constant across households and permits the estimation of choice probabilities. Probabilistic choice models have been used extensively in transportation demand studies (Ben-Akiva and Lerman 1985; Train 1986), and much of the theory developed to model travel-mode choice is applicable to modeling housing choice. Several other housing researchers have used the random utility model in discrete choice situations (see Van Lierop 1986, chap. 9). According to the choice models, housing markets are classified in spatial dimensions (neighborhoods, cities, regions) by dwelling type, tenure, public versus private housing, and price. Households make choices related to each of these classifications, and each is in turn influenced by policy decisions. Housing choice also determines access to many public and private services because of their location-specific nature.

Van Lierop (1986) describes housing models as following one of three tracks: residential mobility, housing choice, or relocation. Residential mobility models focus on housing dissatisfaction due to changes in the socioeconomic characteristics of the household (Goodman 1990). Housing choice models extend the theory of housing demand to include the combined choice of location and housing type (Kain and Apgar 1977; Lerman 1979; Quigley 1976). Relocation models attempt to integrate the mobility and choice models into a dynamic framework of the decision to move and settle elsewhere (Boehm 1979; Onaka and Clark 1983; Van Lierop and Rima 1985). The present research follows a housing choice model framework. Qualitative choice analysis provides a method for predicting the probability that, given a particular set of characteristics, a household will occupy affordable, adequate-quality, uncrowded housing.

Housing Choice Hierarchy

The primary assumption underlying this research is that a choice hierarchy exists: Affordability decisions are made first, followed by quality and crowding decisions. The justification for using this type of choice hierarchy lies in the distribution of housing problems among the low-income population. The most prevalent housing problem for low-income households is a high rent burden, followed by quality and crowding problems.

Selecting affordability as the first household decision is not based on any theory of consumer choice. Many households might pursue quality first and affordability second, or they might make these decisions simultaneously or interrelatedly. Urban consumer theory does suggest, however, that households make housing consumption decisions with respect to expenditure and location without knowing how the quality of housing services translates into housing satisfaction (Turnbull 1995).

A critical distinction must be made between the housing choice hierarchy specified and the true hierarchy, if one exists. In this research, the model specified is empirically tractable and avoids the problem of independence of irrelevant alternatives (IIA). The IIA problem, frequently called the "red bus/blue bus" problem, plagues discrete-choice models that use polytomous dependent variables seen as comparable rather than independent (Maddala 1983). Briefly, the IIA assumption states that "the ratio of the probabilities of choosing one alternative over another is unaffected by the presence or absence of any additional alternatives in the choice set" (Hensher and Johnson 1981, 38). In other words, the relative probabilities of two alternatives do not change when other

alternatives are added or removed from the choice set. Using a series of binary models rather than a single multinomial model permits the present study to disregard the IIA assumption, greatly simplifying the modeling process and the subsequent analysis.[2]

The housing choice hierarchy (see figure 1) illustrates the conditional nature of the decision process. The affordability decision, expressed as the probability of finding affordable housing, or $P(A)$, precedes the quality decision. The quality decision, $P(Q \mid A)$, estimated at the second level, is conditioned on the affordability choice. Finally, the crowding decision, $P(C \mid Q, A)$, is conditioned on both earlier decisions. (See the appendix for an alternative specification of the model.)

Data and Research Method

The analysis uses a sample of low-income urban households from the 1989 American Housing Survey (AHS; U.S. Bureau of the Census 1991). Low-income status was defined as 80 percent or less of regional median income. To ensure a degree of similarity in housing choices, the sample was restricted to households living in urban areas. Finally, only those households whose residence changed during the previous 12 months are included in the sample.[3] Because the analysis is confined to recent movers, housing choices should better reflect concurrent market and policy conditions; also, mobility indicates a new housing choice (Megbolugbe, Marks, and Schwartz 1991). Recent movers are usually assumed to be at or near an equilibrium level of housing consumption.[4] Households occupying any form of publicly owned housing were excluded from the sample. The sampled households are categorized by the amount of income spent on housing, the quality of the housing unit, and whether the unit is defined as crowded or not crowded. The descriptive statistics associated with the sample are presented in table 1.

The categories of affordability, quality, and crowding are the binary dependent variables used in the analysis.[5] The first binary variable, affordability, classifies households by the proportion of income spent on housing. Households spending 30 percent or less of income on housing are designated as occupying affordable housing. Housing that consumes more than 30 percent of income is considered nonaffordable. The quality variable is based on a modified HUD index and is the same as that used by Newman and Schnare (1988).[6] Households are classified as occupying either adequate-quality or inadequate-quality

[2] For a complete discussion of the IIA problem, see Ben-Akiva and Lerman (1985).

[3] There are 16,663 renter households in the 1989 AHS data set. Of those, 10,399 fell at or below 80 percent of regional median income. After elimination of renters living in rural areas, nonmovers, occupants in publicly owned units, and observations with missing information, the sample contained 3,238 households.

[4] Recognizing that a low-income household's reasons for moving differ from the reasons among households with higher incomes, I use "equilibrium" somewhat cautiously. Arguably, many low-income households are faced with constant disequilibrium moving to avoid disaster, not to reach equilibrium.

[5] The model described in this section uses dependent categorical variables. The process of assigning those variables to categories and thus rendering them discrete reflects the fundamental questions posed by policy makers about housing conditions. Those questions relate to classifying households as living in affordable, adequate-quality, uncrowded housing.

[6] This index makes extensive use of AHS data on individual housing unit quality. The information is related to plumbing facilities, kitchen facilities, structural and common area problems, and frequency of occurrence of problems such as toilet or heating breakdowns.

Figure 1. **Housing Choice Hierarchy**

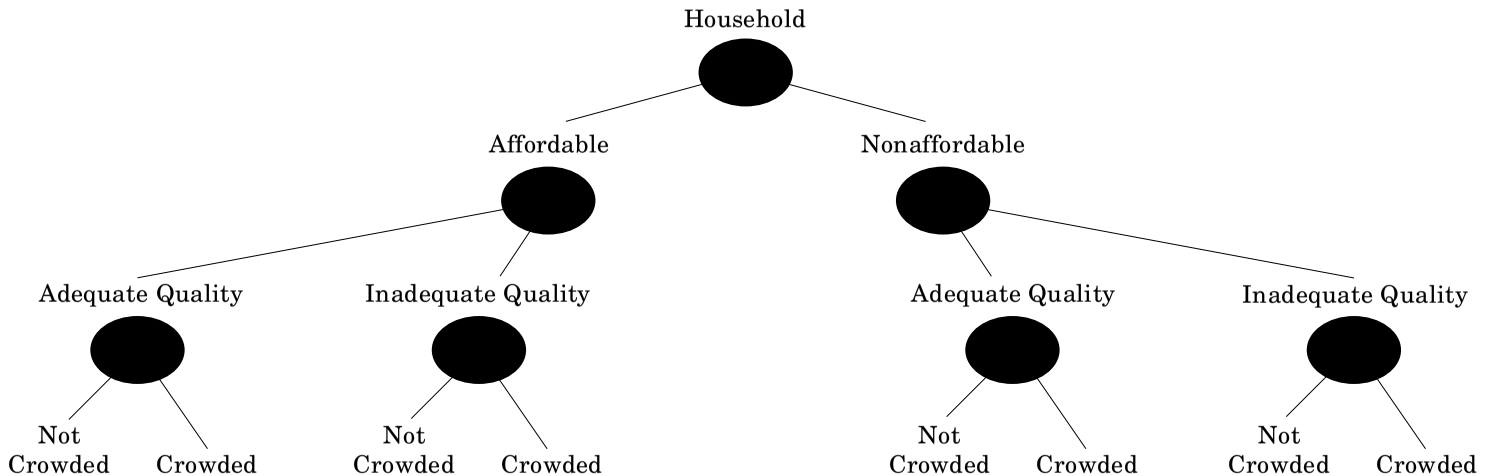


Table 1. **Independent Variables**

Variable	Description	Distribution
Demographic		
White	Race of household head	78%
Female	Sex of household head	47%
Persons	Number of persons in the household	Mean = 2.3684 (SD = 1.5274)
Married	Marital status of household head	28%
Age	Age of household head	Mean = 34.0299 (SD = 14.1313)
Grade	Education of household head	
Grade ≤ 8		9%
Grade ≤ 12		54%
Grade > 12		37%
Socioeconomic		
Income	Total annual household income in dollars	Mean = 14,336 (SD = 7,528)
Federally assisted	Federal housing assistance	5%
Locally assisted	Local housing assistance	2%
Geographic		
Region	Region of the country	
Northeast		15.23%
North Central		24.09%
South		33.57%
West		27.12%
Central city	Relative location within the urban area	51.08%
Housing-related		
Multifamily	Housing unit is classed as multifamily	72.30%
Unit age	Approximate age of dwelling unit	
Unit age < 10		21.20%
10 ≤ unit age ≤ 20		44.70%
Unit age > 20		34.10%

Note: SD = standard deviation.

housing. Finally, households are classified as crowded if the persons-per-room indicator exceeds one.

The socioeconomic and demographic characteristics of the households included in the study (table 2) provide the household-specific independent variables in the logit models.

Many demographic factors must be considered when evaluating housing choice models. The issue of taste frequently justifies the inclusion of particular demographic variables in housing models (Megbolugbe, Marks, and Schwartz 1991). For example, a large family may prefer larger housing (Goodman 1990). The set of demographic variables found in discrete-choice studies commonly includes age, sex, race, marital status, and education of the household head. The number of persons in the household is also included. Although most housing choice research relates demographic variables to the tenure decision (Börsch-Supan and Pollakowski 1990; Henderson and Ioannides 1987), this study uses demographic variables to evaluate the probability of decisions related only to rental housing.

Table 2. **Low-Income Renters by Location and Housing Problem (Percent)**

	Northeast	North Central	South	West
All low-income[a]				
Affordability				
R/I ≤ 30%	43.46	50.00	45.28	39.97
R/I > 30%	56.54	50.00	54.72	60.03
Quality				
Adequate	76.29	78.70	68.32	60.21
Inadequate	23.71	21.30	31.68	39.79
Crowding				
PPR ≤ 1	96.01	96.20	94.89	90.78
PPR > 1	3.99	3.80	5.11	9.22
Recent movers[b]				
Affordability				
R/I ≤ 30%	34.49	45.65	40.80	35.34
R/I > 30%	65.51	54.35	59.20	64.66
Quality				
Adequate	76.49	76.64	70.10	62.91
Inadequate	23.51	23.36	29.90	37.09
Crowding				
PPR ≤ 1	95.57	94.99	94.64	89.61
PPR > 1	4.43	5.01	5.36	10.39

Source: Tabulations of the 1989 American Housing Survey.
Note: R/I = rent-to-income ratio; PPR = persons per room.
[a] n = 10,119.
[b] n = 3,429.

The variables included in this study are household income; race, sex, marital status, age, and education of the household head; number of persons occupying the housing unit; and whether the household receives housing assistance. Income is a continuous variable that includes total household income from all sources.[7] Housing opportunities are certainly greater for relatively wealthier households; however, less wealthy households have more housing opportunities if they receive some type of housing assistance. Since the sample is restricted to households with incomes at or below 80 percent of the regional median income, the sample households are generally eligible for housing assistance. However, few households actually receive any assistance. Households not receiving assistance should have a lower probability of occupying affordable, adequate-quality, uncrowded housing than assisted households. The analysis includes two binary variables (federally assisted and locally assisted) to evaluate the contribution housing assistance makes to housing outcome.

The remainder of the independent variables relate to factors that are external to the individual household. They include geographic variables and housing-related variables. The geographic variables identify regions of the country[8] and whether the household lives

[7] The income variable is not adjusted for household size because the number of persons occupying the housing unit is included as a separate variable.

[8] The regions of the country correspond to the four census regions as described in the codebook for the AHS.

in the central city or in a suburban area. The central city variable serves as a proxy for a more specific location variable and reflects the important role of location in housing choice. Although the inclusion of neighborhood-specific influences on housing choice would further our understanding of the tradeoffs made by low-income households, the neighborhood variables included in the AHS data are strictly subjective and present a potential source of measurement error (Hensher and Johnson 1981). The four housing-related variables reflect factors the household presumably considers when making a housing decision. In the United States, households prefer single-family housing to multifamily housing (buildings with more than one unit). The multifamily variable is therefore included to evaluate the role that preference plays when low-income renters select housing. Because housing quality generally declines as a unit ages, two variables (unit age less than 10 years and unit age 20 years or less) were used to capture the extent to which that decline influences the quality of housing people are able to find.

Model Estimation

The empirical portion of this article presents a series of logistic regression models that relate the probability of finding affordable, adequate-quality, uncrowded housing to characteristics of the household, the location of the housing unit, and the characteristics of the housing unit. The binary logit models take the form

$$\log\left(\frac{P_i}{1-P_i}\right) = \boldsymbol{\beta}'\mathbf{x}_i, \tag{1}$$

where P_i is the probability that the dependent variable takes on the value 1 and $b9\mathbf{x}_i$ represents $b_0 + \mathrm{S}b_j x_{ij}$. The left side of equation (1) is called the log odds. Thus the revealed preference of an individual i with a set of characteristics $\mathbf{x}_i$ is expressed as a ratio of the probabilities. The models reflect the probability that a household is able to find an affordable, adequate-quality, uncrowded housing unit. The initial affordability function and the subsequent conditional quality and crowding functions are illustrated in figure 2.

Because estimates of the probability of living in adequate-quality housing depend on the earlier determination of affordability, the data are divided into two groups before estimating the quality models: households spending 30 percent or less on housing and households spending more than 30 percent on housing. The crowding models, which are estimated last, predict the probability that a household occupies an uncrowded unit. The data were divided into four groups based on the joint combination of affordability and quality before estimating the model.

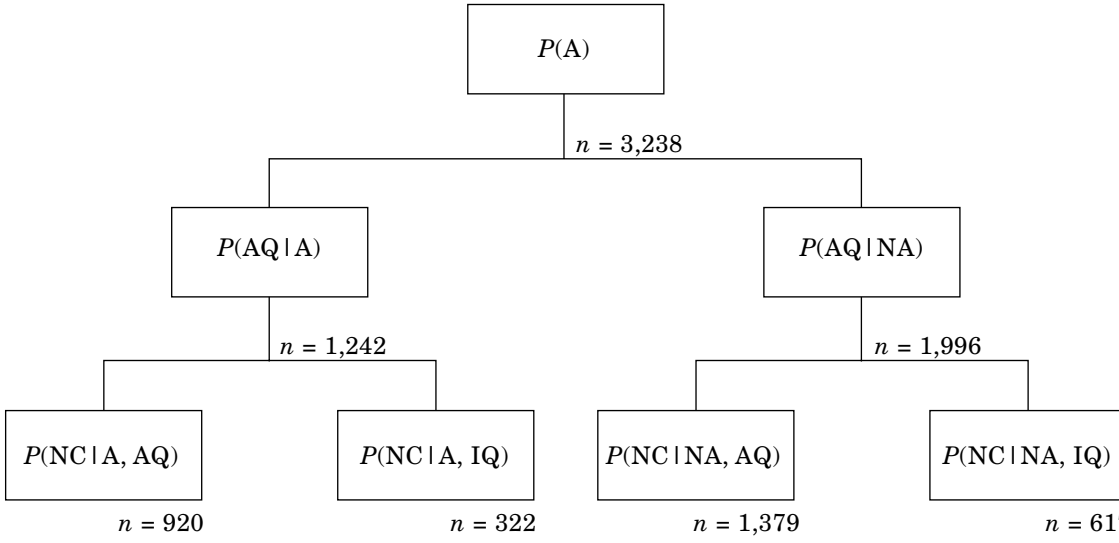
Empirical Results

Affordability Model

The results of the affordability model are presented in table 3. For all 16 independent variables, estimated coefficients are, collectively, significantly different from zero as confirmed by the –2 log likelihood statistic.[9] The statistic has an asymptotic χ^2

[9] The –2 log likelihood statistic is a goodness-of-fit measure that evaluates the degree to which the model approximates the observed data. The significance of individual parameters is measured with a t statistic.

Figure 2. **Probability Models**



Note: A = affordable; NA = nonaffordable; AQ = adequate quality; IQ = inadequate quality; NC = noncrowded.

Table 3. **Affordability: Probability of an Affordable Unit**

Variable	Coefficient	Standard Error	*t* Value	Odds Ratio
Constant	–4.0225	0.2875	13.9913	—
Income	0.2444	0.0089	27.3526	1.2769
White	–0.0785	0.1160	0.6771	0.9245
Female	–0.3005	0.1023	2.9382	0.7404
Persons	–0.2544	0.0382	6.6570	0.7754
Married	–0.1429	0.1236	1.1562	0.8668
Age	–0.0123	0.0036	3.9295	0.9878
Grade ≤ 8	0.8220	0.1921	4.2780	2.2750
9 ≤ grade ≤ 12	0.3799	0.1021	3.7203	1.4621
Federally assisted	2.4640	0.2180	11.3017	11.7517
Locally assisted	1.6534	0.3561	4.6426	5.2247
Northeast	–0.3921	0.1557	2.5184	0.6756
North Central	1.0830	0.1332	8.1306	2.9535
South	1.0695	0.1239	8.6332	2.9139
Multifamily	0.0138	0.1081	0.1277	1.0139
Central city	–0.0179	0.0929	0.1924	0.9823

Note: –2 (log likelihood) = 1,344.568 (p = 0.0001); pseudo R^2 = 0.3118; number of observations = 3,238.

distribution with k–1 degrees of freedom if the null hypothesis is correct. The appropriate statistic to evaluate the independent variables is t.

As anticipated, income is a significant predictor of finding affordable housing. The housing assistance variables (federal assistance and local assistance) are also significant. The sign associated with the sex of the household head (female) is negative and significant. That is, female-headed households are less likely to live in affordable housing. In addition to reflecting the generally lower earnings of women, the result may

reflect discrimination in rental markets. Landlords may be reluctant to rent to women with children or to women who depend on financial assistance from the government as a source of income. The estimated coefficient on the household size variable (persons) is negative and significant. Larger households have a lower probability of occupying affordable housing. Although rental assistance is given disproportionately to older renters, they still have a lower probability of obtaining affordable housing: The coefficient for the continuous age variable is negative and significant at the 1 percent level.

The fact that the effect of the race of the head (white) is not significant suggests that whites and nonwhites do not differ in their ability to locate affordable housing. However, the lack of significance may not be due to race per se but to nonwhites being prevented from living in areas where rents would consume more of their income (Galster 1987). Next, the regional variables are compared in both sign and level of significance. Being in the Northeast is negatively associated with the probability of finding affordable housing at a 5 percent level of significance, while both the North Central and the South have strong positive associations. Since the omitted or contrast variable in the set of design[10] variables identifying regions of the country is West, affordability problems are more prevalent on either coast than in the rest of the country.

Quality Models

As modeled here, households are expected to consider quality variations at the second level of the housing choice hierarchy. In the quality submodel conditioned on finding an affordable housing unit (see table 4), an indicator of education level (grade $\leq$ 8) is the only significant demographic variable. The negative sign of the coefficient for this variable suggests a willingness to trade quality for affordability. The submodel produces significant regional variations. Living in either the Northeast or the North Central significantly increases the probability of finding adequate-quality housing. The location variable (central city) is not significant. Evidently, relative location within the urban area does not constrain a household's ability to find housing of adequate (or inadequate) quality when rent consumes less than 30 percent of income. However, the coefficients for variables indicating the approximate age of the structure are both positive and significant at the 1 percent level. The estimated coefficient for newer housing (unit age < 10) is larger than that for older housing (10 $\leq$ unit age $\leq$ 20), confirming expectations that newer housing units are of better quality or at least in better repair.

The results obtained for the second quality submodel (see table 5) differ somewhat from those discussed above. These households do not occupy affordable housing, and more independent variables are significant predictors of the adequate-quality choice. Household income is significant at the 1 percent level as is the race-related variable. The outcome suggests that whites are more likely to find adequate-quality housing when they spend more than 30 percent of their income on housing. Alternatively, even if nonwhites

[10] Independent variables with $k > 2$ categories are modeled as a set of design variables. The variable grade $\leq$ 8 and the variable 9 $\leq$ grade $\leq$ 12, reported in the tables, are contrasted with the reference group variable grade > 12. West is the reference group variable for regions of the country, and unit age > 20 is the reference group variable for age of the unit in the quality models.

Table 4. **Quality: Probability of an Adequate-Quality, Affordable Unit**

Variable	Coefficient	Standard Error	*t* Value	Odds Ratio
Constant	–0.6740	0.4779	1.4104	—
Income	0.0262	0.0145	1.8001	1.0265
White	0.1436	0.1795	0.8000	1.1544
Female	0.0440	0.1561	0.2821	1.0450
Persons	0.0015	0.0563	0.0894	1.0015
Married	–0.3377	0.1817	1.8585	0.7134
Age	–0.0034	0.0058	0.5924	0.9966
Grade ≤ 8	–0.6278	0.2773	2.2639	0.5338
9 ≤ grade ≤ 12	–0.1331	0.1560	0.8531	0.8754
Federally assisted	0.4044	0.3550	1.1390	1.4984
Locally assisted	0.2703	0.5901	0.4580	1.3104
Northeast	0.9241	0.2574	3.5902	2.5196
North Central	0.8681	0.1993	4.3557	2.3824
South	0.3231	0.1877	1.7217	1.3814
Multifamily	0.5041	0.1585	3.1808	1.6555
Central city	–0.2217	0.1435	1.5445	0.8012
Unit age < 10	1.6035	0.2299	6.9761	4.9704
10 ≤ unit age ≤ 20	0.9961	0.1603	6.2134	2.7077

Note: –2 (log likelihood) = 137.970 (p = 0.0001); pseudo R^2 = 0.0971; number of observations = 1,242.

Table 5. **Quality: Probability of an Adequate-Quality, Nonaffordable Unit**

Variable	Coefficient	Standard Error	*t* Value	Odds Ratio
Constant	–1.9636	0.3093	6.3476	—
Income	0.0376	0.0091	4.1533	1.0383
White	0.5494	0.1247	4.4069	1.7322
Female	0.1963	0.1207	1.6262	1.2169
Persons	–0.0185	0.0386	0.4800	0.9817
Married	0.2074	0.1489	1.3926	1.2304
Age	0.0065	0.0039	1.6451	1.0065
Grade ≤ 8	–0.5154	0.2001	2.5758	0.5973
9 ≤ grade ≤ 12	–0.2528	0.1230	2.0557	0.7766
Federally assisted	0.7793	0.3076	2.5338	2.1799
Locally assisted	–0.2522	0.3452	0.7304	0.7771
Northeast	1.5608	0.1844	8.4653	4.7626
North Central	1.5600	0.1669	9.3488	4.7588
South	0.7805	0.1370	5.6956	2.1826
Multifamily	0.2623	0.1236	2.1220	1.2999
Central city	0.0030	0.1114	0.0205	1.0030
Unit age < 10	1.9834	0.1854	10.6965	7.2674
10 ≤ unit age ≤ 20	1.0290	0.1298	7.9290	2.7983

Note: –2 (log likelihood) = 322.944 (p = 0.0001); pseudo R^2 = 0.1308; number of observations = 1,996.

spend more than 30 percent of income on housing, they have a lower probability of finding a housing unit of adequate quality. Assuming that nonwhites do not have a different perception of quality, the result may provide additional evidence of discrimination in housing markets. The coefficients for both education variables (grade ≤ 8 and 9 ≤ grade ≤ 12) are negative and significant, at least at the 5 percent level, suggesting that individuals with lower levels of education have a lower probability of finding adequate-quality

housing despite the fact that they spend more on housing. These households may lack knowledge about how to locate housing or evaluate housing quality.[11]

Three regional variables (Northeast, North Central, and South) are positively and significantly associated with adequate-quality housing, indicating that lower quality housing is more prevalent in the West. The result seems to refute the common perception of poor-quality housing in the South. However, the analysis covers only urban renters, and much of the low-income southern population is rural and not included in the analysis. Finally, the variables related to the housing unit type (multifamily) and age of the unit are considered. Multifamily units may be better quality housing because many apartment owners are large corporations whose property management departments oversee day-to-day operations. In contrast, the single-family rental unit may be owned by an individual who performs maintenance more sporadically or not at all. Households that spend more than 30 percent of their income in multifamily structures may secure better quality dwellings. As in the first quality submodel, coefficients for both of the unit age-related variables are positive and significant at the 1 percent level.

The number of significant variables differs markedly between the quality submodels. The empirical results suggest that the probability of finding adequate-quality housing is more closely tied to socioeconomic and demographic variables when households spend more than 30 percent of income on housing than when they spend less. This point raises a critical question about who actually has a choice in housing-quality decisions. For example, race is not significant when the household occupies an affordable unit, but the race coefficient is positive and significant at the 1 percent level when the unit is not affordable. If housing choice is constrained by tastes and budgets, perhaps nonwhites have a different taste for quality or are otherwise constrained by the market. Income, a high school education, and federal housing assistance all influence the probability of finding adequate-quality housing when the low-income renter household spends more than 30 percent of income on housing. Alternatively, low-income households that spend less than 30 percent of income on housing may not be identifiable by their socioeconomic and demographic characteristics because they have found discontinuities in the housing market and use them to their advantage.

Crowding Models

The crowding models, estimated at the third level of the hierarchy, are conditioned on choices made at the previous two levels.[12] The models predict the probability of not being crowded, defined as having a person-per-room indicator less than one. The two variables that strongly and consistently influence the probability of no crowding in all four submodels are household size and unit type. Both have negative and significant coefficients in each of the four models. Households living in multifamily housing are more likely to find crowding a problem, irrespective of the affordability or quality choice.

[11] There is also speculation that many low-income households lack the motivation to move out of familiar neighborhoods to achieve better housing or schools (Rosenbaum 1991).

[12] Because of the small amount of crowding in these data and the limited additional insight provided, these tables are not included in this article. For a complete set of tables, please contact the author.

Furthermore, as the age of the household head increases, the probability of no crowding increases; that is, young families are more likely to be crowded.

Summary of Signs and Significance Levels

The signs and levels of significance for the coefficients of each of the independent variables included in the submodels are displayed in table 6. It provides a concise picture of the positive and negative influences on the probability of falling into a particular category. No one variable has a consistently positive and significant influence on the probability of finding affordable, adequate-quality, uncrowded housing.

Estimation of Joint Probabilities

The statistical approach employed in this research provides estimates of marginal (affordability) and conditional (quality and crowding) probabilities. Eight joint probabilities are possible, ranging from the probability of finding affordable, adequate-quality, uncrowded housing to the probability of finding nonaffordable, inadequate-quality, crowded housing. The combined probability of each of the eight possible housing choices is easily determined.[13] The joint probabilities are combinations of the marginal and conditional probabilities. For each example, the following probabilities form joint probabilities:

$P(\mathrm{A})$ = the probability that a household finds affordable housing;

$P(\mathrm{AQ} \mid \mathrm{A})$ = the probability that a household finds a unit of adequate quality, given that it resides in affordable housing; and

$P(\mathrm{NC} \mid \mathrm{A}, \mathrm{AQ})$ = the probability that a household chooses an uncrowded unit, given that it lives in affordable, adequate-quality housing.

The probability of *not* fitting the definition of housing deprivation or the probability of acceptable shelter (AS) is determined as follows:

$$\begin{aligned} P(\mathrm{AS}) &= P(\mathrm{A}) \cdot P(\mathrm{AQ} \mid \mathrm{A}) \cdot P(\mathrm{NC} \mid \mathrm{A}, \mathrm{AQ}) \\ &= P(\mathrm{A}, \mathrm{AQ}, \mathrm{NC}). \end{aligned} \tag{2}$$

Predicted Probabilities

Predicted probabilities can be calculated for every household in the sample, although performing such calculations presents a practical problem given the initial large sample size. To provide additional information about the housing choices of particular types of low-income households, joint probabilities were calculated for three representative households: a married-couple household with a male head and two children (table 7); a three-person household headed by an unmarried female (table 8); and a single, elderly, unmarried woman living alone (table 9).

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[13] The equation used to calculate each probability for the individual binary logit equations is $P_i = (\exp \boldsymbol{b9}\mathbf{x}_i)/(1 + \exp \boldsymbol{b9}\mathbf{x}_i)$.

Table 6. **Signs and Significance of Coefficients for Independent Variables by Submodel**

Variable	*P*(A)	*P*(AQ | A)	*P*(AQ | NA)	*P*(NC | A, AQ)	*P*(NC | A, IQ)	*P*(NC | NA, AQ)	*P*(NC | NA, IQ)
Constant	– **	– *	– **	+ **	+ *	+ **	+ **
Income	+ **	+	+ **	+	+	+	+
White	–	+	+ **	+	+	–	–
Female	– **	+	+	+	+ *	–	+
Persons	– **	+	–	– **	– **	– **	– **
Married	–	–	+	+	–	–	–
Age	– **	–	+	+ *	+	+ **	–
Grade ≤ 8	+ **	– *	– **	– *	–	– **	– *
9 ≤ grade ≤ 12	+ **	–	– *	–	+	–	–
Federally assisted	+ **	+	+ *	+	–	+ *	na
Locally assisted	+ **	+	–	+	–	+ *	+
Northeast	– *	+ **	+ **	+	+	+	+ *
North Central	+ **	+ **	+ **	+ *	+	+ *	+
South	+ **	+	+ **	+ **	+	+	+
Multifamily	+	+ **	+ *	– **	– **	– **	– **
Central city	–	–	+	+	–	–	+
Unit age < 10	na	+ **	+ **	na	na	na	na
10 ≤ unit age ≤ 20	na	+ **	+ **	na	na	na	na

Note: Unit age variables were only included in the housing quality models. A = affordable; NA = nonaffordable; AQ = adequate quality; IQ = inadequate quality; NC = noncrowded; na = not applicable.
* $p < 0.05$; ** $p < 0.01$.

Table 7. **Housing Probabilities by Household Type and Region for Married, Male Head, Four-Person Household**

	Northeast	North Central	South	West
Income 35% of median				
No assistance				
P(A, AQ, NC)	0.0712	0.1691	0.1151	0.0467
P(NA, AQ, NC)	0.6320	0.5524	0.4201	0.3029
P(A, IQ, NC)	0.0142	0.0256	0.0330	0.0122
P(NA, IQ, NC)	0.2183	0.1678	0.2992	0.4067
P(A, AQ, OC)	0.0047	0.0144	0.0048	0.0098
P(NA, AQ, OC)	0.0377	0.0093	0.0236	0.0209
P(A, IQ, OC)	0.0002	0.0128	0.0122	0.0196
P(NA, IQ, OC)	0.0210	0.0464	0.0903	0.1727
Federal assistance				
P(A, AQ, NC)	0.4668	0.6540	0.5504	0.3651
P(NA, AQ, NC)	0.3928	0.1935	0.2116	0.2417
P(A, IQ, NC)	0.0572	0.0297	0.0538	0.0173
P(NA, IQ, NC)	0.0590	0.0266	0.0657	0.1400
P(A, AQ, OC)	0.0132	0.0237	0.0108	0.0402
P(NA, AQ, OC)	0.0018	0.0003	0.0009	0.0013
P(A, IQ, OC)	0.0029	0.0641	0.0856	0.1199
P(NA, IQ, OC)	0.0057	0.0079	0.0198	0.0594
Income 80% of median				
No assistance				
P(A, AQ, NC)	0.7502	0.7600	0.6472	0.4936
P(NA, AQ, NC)	0.0948	0.0585	0.0948	0.0762
P(A, IQ, NC)	0.0931	0.1081	0.1685	0.1835
P(NA, IQ, NC)	0.0172	0.0113	0.0451	0.0661
P(A, AQ, OC)	0.0394	0.0526	0.0240	0.0974
P(NA, AQ, OC)	0.0024	0.0005	0.0027	0.0024
P(A, IQ, OC)	0.0001	0.0043	0.0067	0.0217
P(NA, IQ, OC)	0.0006	0.0012	0.0060	0.0108
Federal assistance				
P(A, AQ, NC)	0.8978	0.8847	0.8258	0.7280
P(NA, AQ, NC)	0.0101	0.0059	0.0118	0.0106
P(A, IQ, NC)	0.0718	0.0714	0.1241	0.1151
P(NA, IQ, NC)	0.0008	0.0005	0.0025	0.0041
P(A, AQ, OC)	0.0191	0.0250	0.0135	0.0695
P(NA, AQ, OC)	0.0000	0.0000	0.0000	0.0000
P(A, IQ, OC)	0.0002	0.0122	0.0212	0.0585
P(NA, IQ, OC)	0.0000	0.0001	0.0003	0.0007

Note: A = affordable; NA = nonaffordable; AQ = adequate quality; IQ = inadequate quality; NC = noncrowded; OC = overcrowded.

To facilitate comparisons between the representative households, several independent variables were held constant: race (a white household head), age (set at the mean of the distribution, 34 years old, in tables 7 and 8 and at 65 in table 9), education (grade $\leq$ 12), unit type (multifamily), and location (suburban dwelling). The unit age variable, used in the quality submodel, indicates a unit between 10 and 20 years old. The income levels of these hypothetical households represent a percentage of the median income for the particular region. Table 7 describes a four-person household with a 34-year-old male

Table 8. **Housing Probabilities by Household Type and Region for Unmarried, Female Head, Three-Person Household**

	Northeast	North Central	South	West
Income 35% of median				
No assistance				
P(A, AQ, NC)	0.0870	0.2079	0.1428	0.0743
P(NA, AQ, NC)	0.6593	0.5491	0.4344	0.3191
P(A, IQ, NC)	0.0113	0.0299	0.0366	0.0264
P(NA, IQ, NC)	0.2280	0.1895	0.3441	0.4965
P(A, AQ, OC)	0.0009	0.0028	0.0009	0.0024
P(NA, AQ, OC)	0.0055	0.0013	0.0034	0.0031
P(A, IQ, OC)	0.0000	0.0000	0.0000	0.0001
P(NA, IQ, OC)	0.0079	0.0188	0.0373	0.0757
Federal assistance				
P(A, AQ, NC)	0.5175	0.7162	0.6149	0.4635
P(NA, AQ, NC)	0.3743	0.1798	0.1987	0.2306
P(A, IQ, NC)	0.0445	0.0679	0.1043	0.1049
P(NA, IQ, NC)	0.0589	0.0284	0.0717	0.1631
P(A, AQ, OC)	0.0024	0.0042	0.0019	0.0080
P(NA, AQ, OC)	0.0002	0.0000	0.0001	0.0002
P(A, IQ, OC)	0.0000	0.0002	0.0002	0.0011
P(NA, IQ, OC)	0.0020	0.0028	0.0078	0.0249
Income 80% of median				
No assistance				
P(A, AQ, NC)	0.8203	0.8437	0.7279	0.6695
P(NA, AQ, NC)	0.0889	0.0539	0.0896	0.0723
P(A, IQ, NC)	0.0666	0.0805	0.1299	0.1542
P(NA, IQ, NC)	0.0160	0.0109	0.0446	0.0666
P(A, AQ, OC)	0.0070	0.0095	0.0043	0.0206
P(NA, AQ, OC)	0.0003	0.0001	0.0004	0.0003
P(A, IQ, OC)	0.0000	0.0000	0.0000	0.0000
P(NA, IQ, OC)	0.0002	0.0004	0.0021	0.0039
Federal assistance				
P(A, AQ, NC)	0.9363	0.9308	0.8798	0.8439
P(NA, AQ, NC)	0.0092	0.0054	0.0107	0.0097
P(A, IQ, NC)	0.0504	0.0588	0.1043	0.1258
P(NA, IQ, NC)	0.0008	0.0005	0.0024	0.0041
P(A, AQ, OC)	0.0033	0.0043	0.0023	0.0128
P(NA, AQ, OC)	0.0000	0.0000	0.0000	0.0000
P(A, IQ, OC)	0.0000	0.0000	0.0000	0.0001
P(NA, IQ, OC)	0.0000	0.0000	0.0000	0.0002

Note: A = affordable; NA = nonaffordable; AQ = adequate quality; IQ = inadequate quality; NC = noncrowded; OC = overcrowded.

head who has a high school education and lives in a suburban multifamily dwelling. Table 8 describes a household with a single female head and two dependents. Table 9 describes an elderly female living alone. The mean income level for all households in the sample occupying affordable, adequate-quality, noncrowded housing is $19,629, contrasted with $9,995 for those in nonaffordable, inadequate-quality, crowded housing. The most severe problems are associated with very low income households, a finding confirmed by Nelson

Table 9. **Housing Probabilities by Household Type and Region for Unmarried, Elderly Female Head, One-Person Household**

	Northeast	North Central	South	West
Income 35% of median				
No assistance				
P(A, AQ, NC)	0.0975	0.2292	0.1563	0.0862
P(NA, AQ, NC)	0.6943	0.5656	0.4738	0.3672
P(A, IQ, NC)	0.0199	0.0362	0.0442	0.0321
P(NA, IQ, NC)	0.1937	0.1675	0.3227	0.5078
P(A, AQ, OC)	0.0000	0.0000	0.0000	0.0000
P(NA, AQ, OC)	0.0000	0.0000	0.0000	0.0000
P(A, IQ, OC)	0.0000	0.0000	0.0000	0.0000
P(NA, IQ, OC)	0.0006	0.0014	0.0030	0.0066
Federal assistance				
P(A, AQ, NC)	0.5438	0.7322	0.6280	0.4900
P(NA, AQ, NC)	0.3583	0.1676	0.1926	0.2362
P(A, IQ, NC)	0.0519	0.0772	0.1186	0.1219
P(NA, IQ, NC)	0.0459	0.0228	0.0602	0.1458
P(A, AQ, OC)	0.0000	0.0000	0.0000	0.0000
P(NA, AQ, OC)	0.0000	0.0000	0.0000	0.0000
P(A, IQ, OC)	0.0000	0.0000	0.0000	0.0000
P(NA, IQ, OC)	0.0001	0.0002	0.0006	0.0020
Income 80% of median				
No assistance				
P(A, AQ, NC)	0.8314	0.8524	0.7329	0.7004
P(NA, AQ, NC)	0.0822	0.0497	0.0867	0.0725
P(A, IQ, NC)	0.0746	0.0896	0.1448	0.1714
P(NA, IQ, NC)	0.0118	0.0082	0.0354	0.0553
P(A, AQ, OC)	0.0000	0.0000	0.0000	0.0001
P(NA, AQ, OC)	0.0000	0.0000	0.0000	0.0000
P(A, IQ, OC)	0.0000	0.0000	0.0000	0.0000
P(NA, IQ, OC)	0.0000	0.0000	0.0001	0.0003
Federal assistance				
P(A, AQ, NC)	0.9352	0.9296	0.8731	0.8489
P(NA, AQ, NC)	0.0082	0.0048	0.0099	0.0091
P(A, IQ, NC)	0.0746	0.0652	0.1151	0.1387
P(NA, IQ, NC)	0.0118	0.0004	0.0018	0.0032
P(A, AQ, OC)	0.0000	0.0000	0.0000	0.0000
P(NA, AQ, OC)	0.0000	0.0000	0.0000	0.0000
P(A, IQ, OC)	0.0000	0.0000	0.0000	0.0000
P(NA, IQ, OC)	0.0000	0.0000	0.0000	0.0000

Note: A = affordable; NA = nonaffordable, AQ = adequate quality; IQ = inadequate quality; NC = noncrowded; OC = overcrowded.

and Khadduri (1992), who suggest that very low income families are most in need of housing assistance.

The tables reveal several interesting similarities. For all three household types, the greatest problems relate to affordability when household income is at 35 percent of the regional median and the household does not receive assistance. At that income level, the probability of living in nonaffordable, adequate-quality, noncrowded housing,

P(NA, AQ, NC), ranks first for every region but the West. The second-highest probability is that of nonaffordable, inadequate-quality, noncrowded housing, *P*(NA, IQ, NC). However, in the West the position of those two joint probabilities is reversed, suggesting that households in the West have more difficulty finding adequate-quality housing, even when they spend more than 30 percent of income on housing.

For unassisted households at the 80 percent income level, the highest probability is that of affordable, adequate-quality, noncrowded housing, *P*(A, AQ, NC). These are the households with no defined problems.

The probability of affordable, adequate-quality, and noncrowded housing, *P*(A, AQ, NC), is 75.02 percent for a married household living in the Northeast and earning 80 percent of median income (table 7). That probability increases to 89.78 percent with federal assistance. However, if household income is 35 percent of the median, the percentages are 7.12 and 46.68, respectively. Clearly, the benefit of federal housing assistance increases dramatically as income level declines. Similar though not directly proportional results occur in other regions of the country and with the other two household types (tables 8 and 9). Low-income renter households receiving federal assistance are 11.75 times as likely to live in affordable housing (see the odds ratio in table 3) as similar households not receiving federal assistance.

Conclusion

This article provides a method for determining the probability that a low-income renter household will secure acceptable shelter. Consistent with other research, this study confirms that households at 80 percent of median income have a reasonably high probability of occupying acceptable housing. Policies to alleviate the housing problems of low-income households must be based on a clear understanding of the nature and magnitude of the problems facing these households (Linneman and Megbolugbe 1992). The analysis strongly supports Nelson and Khadduri (1992), who make a case for targeting housing policy to worst-case needs—households with housing cost burdens in excess of 50 percent of income or renters without assistance in severely inadequate housing. Arguments to focus housing assistance on very low income households are supported by the results presented here.

The model used in this research provides useful estimates of the housing condition of particular demographic groups. However, rather than documenting differences, the model seems to document similarities among low-income groups. A household living in the Northeast earning less than 35 percent of regional median income has less than a 10 percent chance of finding affordable, adequate-quality housing whether the household consists of a married couple, a single mother, or an elderly woman. The importance of this result is better understood when the proportion of households in a particular category that have housing problems is considered. What enumeration of the data does not show is that a single, very low income, elderly woman has about the same probability of occupying affordable, adequate housing as other very low income demographic groups. The present research also draws attention to striking regional differences. Households of every type living in the western United States have a much lower probability of finding adequate shelter.

The results of this research suggest that federal housing assistance programs substantially increase the probability of finding affordable, adequate-quality, and noncrowded housing. Limits on the information available in the AHS data about existing programs restrict application to broad classifications of federal housing assistance and local housing assistance. However, the low incidence of any type of housing assistance (federal or local) makes a strong case for targeting the resources available to households with the lowest incomes. Federal housing assistance increases the probability that a very low income household finds acceptable shelter by almost 500 percent; for a household earning 80 percent of median, the probability increases by less than 20 percent. Housing policy must address the real constraints on housing choice faced by individual households. Permitting local housing providers more discretion in the distribution of program funds would be facilitated by modeling the housing tradeoffs made by particular households with more specific local data. Decision-makers could then evaluate the housing tradeoffs for various household groups and target funds to those with the greatest need. Future research would benefit from the inclusion of more market-specific information and more specific information on individual housing assistance programs.

Appendix A

These tables present probabilities associated with an alternative specification of the model described in the article. This specification suggests that low-income renter households evaluate quality first, followed by affordability and crowding. Tables A.1, A.2, and A.3 are comparable to tables 7, 8, and 9 in the text. Results obtained for this specification of the model are similar to those obtained from the original specification. That is, while the associated probabilities are slightly different, the ranking of combinations of problems remains essentially the same.

Table A.1. **Housing Probabilities by Household Type and Region for Married, Male Head, Four-Person Household**

	Northeast	North Central	South	West
Income 35% of median				
No assistance				
P(AQ, A, NC)	0.0425	0.1243	0.1638	0.0582
P(AQ, NA, NC)	0.5627	0.4853	0.3335	0.2543
P(IQ, A, NC)	0.0248	0.0489	0.1234	0.0389
P(IQ, NA, NC)	0.2979	0.2222	0.2511	0.4044
P(AQ, A, OC)	0.0004	0.1237	0.0091	0.0223
P(AQ, NA, OC)	0.0365	0.0088	0.0171	0.1625
P(IQ, A, OC)	0.0004	0.0311	0.0340	0.0507
P(IQ, NA, OC)	0.0317	0.0669	0.0679	0.1586
Federal assistance				
P(AQ, A, NC)	0.3283	0.5162	0.5271	0.3623
P(AQ, NA, NC)	0.3672	0.1614	0.0906	0.1144
P(IQ, A, NC)	0.1311	0.0622	0.1449	0.0517
P(IQ, NA, NC)	0.1514	0.0684	0.0525	0.1239
P(AQ, A, OC)	0.0009	0.0197	0.0113	0.0535
P(AQ, NA, OC)	0.0018	0.0002	0.0003	0.0006
P(IQ, A, OC)	0.0012	0.0016	0.0011	0.0037
P(IQ, NA, OC)	0.0013	0.0016	0.0011	0.0037
Income 80% of median				
No assistance				
P(AQ, A, NC)	0.5137	0.5623	0.5672	0.3883
P(AQ, NA, NC)	0.1474	0.0732	0.0221	0.0199
P(IQ, A, NC)	0.2373	0.2669	0.3648	0.4352
P(IQ, NA, NC)	0.0636	0.0306	0.0129	0.0140
P(AQ, A, OC)	0.0305	0.0438	0.0236	0.1086
P(AQ, NA, OC)	0.0044	0.0006	0.0005	0.0005
P(IQ, A, OC)	0.0002	0.0181	0.0073	0.0315
P(IQ, NA, OC)	0.0026	0.0040	0.0013	0.0019
Federal assistance				
P(AQ, A, NC)	0.7097	0.7030	0.6731	0.5628
P(AQ, NA, NC)	0.0168	0.0073	0.0022	0.0021
P(IQ, A, NC)	0.2498	0.2055	0.2878	0.2849
P(IQ, NA, NC)	0.0058	0.0027	0.0009	0.0001
P(AQ, A, OC)	0.0163	0.0211	0.0108	0.0606
P(AQ, NA, OC)	0.0001	0.0001	0.0001	0.0001
P(IQ, A, OC)	0.0013	0.0602	0.0250	0.0886
P(IQ, NA, OC)	0.0000	0.0000	0.0000	0.0000

Note: A = affordable; NA = nonaffordable; AQ = adequate quality; IQ = inadequate quality; NC = noncrowded; OC = overcrowded.

Table A.2. **Housing Probabilities by Household Type and Region for Unmarried, Female Head, Three-Person Household**

	Northeast	North Central	South	West
Income 35% of median				
No assistance				
P(AQ, A, NC)	0.0397	0.1186	0.1617	0.0636
P(AQ, NA, NC)	0.5532	0.5024	0.3497	0.2813
P(IQ, A, NC)	0.0218	0.0689	0.1367	0.0643
P(IQ, NA, NC)	0.2748	0.1964	0.2231	0.3411
P(AQ, A, OC)	0.0027	0.0105	0.0080	0.0217
P(AQ, NA, OC)	0.0654	0.0166	0.0326	0.0332
P(IQ, A, OC)	0.0000	0.0011	0.0009	0.0021
P(IQ, NA, OC)	0.0429	0.0851	0.0869	0.1924
Federal assistance				
P(AQ, A, NC)	0.3161	0.5137	0.5343	0.3774
P(AQ, NA, NC)	0.3901	0.1776	0.1016	0.1301
P(IQ, A, NC)	0.1271	0.2034	0.2884	0.2613
P(IQ, NA, NC)	0.1525	0.0705	0.0542	0.1368
P(AQ, A, OC)	0.0085	0.0176	0.0102	0.0498
P(AQ, NA, OC)	0.0085	0.0176	0.0102	0.0498
P(IQ, A, OC)	0.0035	0.0004	0.0007	0.0012
P(IQ, NA, OC)	0.0018	0.0023	0.0016	0.0060
Income 80% of median				
No assistance				
P(AQ, A, NC)	0.5132	0.5707	0.5849	0.4182
P(AQ, NA, NC)	0.1588	0.0813	0.0247	0.4334
P(IQ, A, NC)	0.2228	0.2696	0.3522	0.4334
P(IQ, NA, NC)	0.0651	0.0307	0.0130	0.0158
P(AQ, A, OC)	0.0273	0.0398	0.0218	0.1046
P(AQ, NA, OC)	0.0087	0.0014	0.0010	0.0011
P(IQ, A, OC)	0.0000	0.0004	0.0001	0.0007
P(IQ, NA, OC)	0.0039	0.0058	0.0019	0.0030
Federal assistance				
P(AQ, A, NC)	0.7178	0.7134	0.6865	0.5847
P(AQ, NA, NC)	0.0188	0.0082	0.0024	0.0024
P(IQ, A, NC)	0.2421	0.2543	0.2993	0.3527
P(IQ, NA, NC)	0.0062	0.0028	0.0010	0.0009
P(AQ, A, OC)	0.0147	0.0191	0.0098	0.0563
P(AQ, NA, OC)	0.0000	0.0000	0.0000	0.0000
P(IQ, A, OC)	0.0000	0.0018	0.0006	0.0027
P(IQ, NA, OC)	0.0000	0.0000	0.0000	0.0000

Note: A = affordable; NA = nonaffordable; AQ = adequate quality; IQ = inadequate quality; NC = noncrowded; OC = overcrowded.

Table A.3. **Housing Probabilities by Household Type and Region for Unmarried, Elderly Female Head, One-Person Household**

	Northeast	North Central	South	West
Income 35% of median				
No assistance				
P(AQ, A, NC)	0.0582	0.1689	0.2183	0.1203
P(AQ, NA, NC)	0.6173	0.4948	0.3586	0.3232
P(IQ, A, NC)	0.0279	0.0855	0.1600	0.1384
P(IQ, NA, NC)	0.2954	0.2483	0.2607	0.4130
P(AQ, A, OC)	0.0000	0.0000	0.0000	0.0000
P(AQ, NA, OC)	0.0000	0.0000	0.0000	0.0000
P(IQ, A, OC)	0.0000	0.0000	0.0000	0.0000
P(IQ, NA, OC)	0.0009	0.0023	0.0021	0.0049
Federal assistance				
P(AQ, A, NC)	0.3865	0.5786	0.5826	0.4759
P(AQ, NA, NC)	0.3418	0.1414	0.0798	0.1066
P(IQ, A, NC)	0.1441	0.2248	0.2967	0.3536
P(IQ, NA, NC)	0.1274	0.0549	0.0406	0.0636
P(AQ, A, OC)	0.0000	0.0000	0.0000	0.0000
P(AQ, NA, OC)	0.0000	0.0000	0.0000	0.0000
P(IQ, A, OC)	0.0000	0.0000	0.0000	0.0000
P(IQ, NA, OC)	0.0000	0.0000	0.0000	0.0000
Income 80% of median				
No assistance				
P(AQ, A, NC)	0.5862	0.6417	0.6298	0.5536
P(AQ, NA, NC)	0.1325	0.0633	0.0195	0.0184
P(IQ, A, NC)	0.2293	0.2683	0.3400	0.4209
P(IQ, NA, NC)	0.0517	0.0263	0.0105	0.0068
P(AQ, A, OC)	0.0000	0.0000	0.0000	0.0000
P(AQ, NA, OC)	0.0000	0.0000	0.0000	0.0000
P(IQ, A, OC)	0.0000	0.0000	0.0000	0.0000
P(IQ, NA, OC)	0.0000	0.0000	0.0000	0.0000
Federal assistance				
P(AQ, A, NC)	0.8745	0.7432	0.7084	0.6575
P(AQ, NA, NC)	0.0140	0.0061	0.0018	0.0018
P(IQ, A, NC)	0.2361	0.2485	0.2889	0.3402
P(IQ, NA, NC)	0.0044	0.0020	0.0007	0.0003
P(AQ, A, OC)	0.0000	0.0000	0.0000	0.0000
P(AQ, NA, OC)	0.0000	0.0000	0.0000	0.0000
P(IQ, A, OC)	0.0000	0.0000	0.0000	0.0000
P(IQ, NA, OC)	0.0000	0.0000	0.0000	0.0000

Note: A = affordable; NA = nonaffordable; AQ = adequate quality; IQ = inadequate quality; NC = noncrowded; OC = overcrowded.

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