The Quality of Assisted Housing in the United States

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Abstract

This article uses the 2011 American Housing Survey to develop three indices of housing quality, test their validity, apply them to both the assisted and unassisted stock, and assess whether the Fair Market Rent (FMR) aligns with good assisted housing quality. The market value index, developed using hedonic regression, performs poorly and is dropped from further consideration. The consumer rating index, based on an ordered logistic regression of the respondent house rating on a 1-to-10 scale, and the normative standards index, based on a factor analysis, perform well, are highly correlated, and achieve convergent and predictive validity. Both of these indices indicate that the quality of assisted housing is comparable to that of unassisted housing. The analysis also supports the 40th percentile of rents definition of the FMR, which is roughly the inflection point for maximizing assisted housing quality on both housing quality indices tested. The findings demonstrate that the current inspection and quality control systems appear to be achieving the goal of providing physically adequate housing to assisted housing residents.

Introduction

The U.S. Department of Housing and Urban Development (HUD) plays a key role in designing, implementing, and monitoring most of the nation's assisted housing programs, including public housing, privately owned, publicly subsidized housing (commonly referred to as "multifamily"), and vouchers.[1] Central to this responsibility is ensuring that the units receiving HUD assistance are physically adequate. This, in turn, verifies that recipient households live in decent and safe dwellings and reassures the public that tax dollars are not supporting deficient housing, or worse.

[1] This article is based heavily on Newman and Holupka (2017), which contains greater detail along with additional analyses, tables, and appendices.

To accomplish this objective, HUD imposes a set of housing quality standards (HQS) that assisted units must meet, requires periodic inspections to confirm that standards are being met, and when necessary, issues citations of violations that must be corrected within a specified time frame.[2]

Several recent circumstances prompt a reexamination of assisted HQS. First, HUD's *Strategic Plan 2014–2018* calls for the development of a "uniform asset risk assessment management model," which requires systematic evidence on the most meaningful approaches to measuring the quality of the assisted housing stock (HUD, 2014: 19). Second, the fiscal year 2013 Senate Appropriation Committee Report raises concerns about violations of HQS in housing units participating in the Section 8 voucher program and "directs HUD to take meaningful and timely steps to strengthen oversight and quality control" of the public housing agency (PHA) inspection process (U.S. Senate, 2012: 92). An additional concern is that reports by HUD's Office of the Inspector General and the U.S. Government Accountability Office note poor reliability of assisted housing inspections using the HQS (HUD OIG, 2008; GAO, 2000). This conclusion is based on a comparison of the PHA inspector scores with those collected by an independently trained rater.

This article is designed to contribute to the reexamination of assisted housing quality. We develop composite measures or indices of housing quality, test their validity, and apply them to both assisted and unassisted housing to examine possible disparities in quality between these two housing stocks. We also examine how well assisted housing quality aligns with HUD's Fair Market Rent (FMR). A longstanding policy question is whether good housing quality in the assisted stock aligns with the FMR, now generally set at the 40th percentile of rents in each housing market. One objective in setting the FMR at a particular point in the distribution of rents is the household's ability to find physically decent rental housing at or below the FMR threshold.

The analysis relies on rich data from the 2011 American Housing Survey (AHS) to describe the quality of the assisted housing stock and to highlight geographic areas, types of households, housing types, and housing assistance programs most likely to experience quality problems. The 2011 AHS sample was matched to administrative records on assisted housing receipt, alleviating concerns about the validity of self-reported housing assistance receipt.

It is important to acknowledge at the outset that the concept of housing quality is not based on definitive criteria and has no precise quantifiable definition of where "bad" ends and "good" begins (Newman, 2008). As we subsequently explain more fully, because we lack a consensus definition of housing quality, we construct measures that characterize the dwelling's physical integrity (for example, holes in the floor) or housing systems (for example, heating system breakdown) and exclude those that are more likely to reflect the resident's housekeeping or behavior (for example, leaving unsafe chemicals within a child's reach).

We find that the quality of assisted housing is comparable to the quality of unassisted housing. Multivariate models reveal modest heterogeneity in assisted housing quality, with the Northeast region and households that include a disabled member experiencing lower housing quality than

[2] Inspection protocols and processes differ by program. Public housing and multifamily housing—for example, Section 8 new construction; Section 221(d)(3)—must meet property standards, while Section 8 vouchers must meet HQS. Inspectors employed by the local public housing agency conduct inspections on public housing and voucher housing, while inspectors contracted by the HUD regional offices inspect multifamily housing.

average. The analysis also provides hard evidence supporting HUD's definition of the FMR as the 40th percentile of rents. The FMR is set at a level that is roughly at the inflection point for maximizing assisted housing quality as measured by the housing quality indices developed in this article.

The next section reviews the literature on housing quality, emphasizing past research on *assisted* housing quality. This is followed by a discussion of the research approach, including a description of the AHS data, analysis samples, methods, alternative measures of housing quality, and tests of their validity. We then examine assisted housing quality compared with unassisted housing quality, whether assisted housing quality varies by where it is located, such as in a central city or a suburb, or the characteristics of the residents. We also explore how well assisted housing quality aligns with the FMR. The final section discusses the results and their implications for policy and future research.

Literature Review

The substantial literature on housing quality spans nine decades and demonstrates both the importance and the challenges of conceptualizing and measuring housing quality. Three relevant strands characterize past work: housing quality measurement and data collection methods, the AHS measurement of housing quality, and the quality of assisted housing.

Housing Quality Measurement and Data Collection Methods

The American Public Health Association provided some of the earliest contributions to the housing quality literature. APHA (1938) highlighted the connection between housing conditions and health, and APHA (1945) recommended that data be collected through a field survey of many individual features of each dwelling unit, with penalty scores for each feature that falls below an established standard. The sum of all scores represents the quality of the dwelling. This methodology is roughly similar to that used for physical inspections of assisted housing under HUD's Uniform Physical Condition Standards (UPCS).[3]

Another important early contribution was the U.S. Census Bureau's methodological study of housing quality measurement (Census Bureau, 1967).[4] For decades, the decennial census included interviewer observations of housing features. In 1940, housing condition was measured by a dwelling's "state of repair," with trained enumerators rating the structure as either needing "major" repairs or not. In 1950, this approach was replaced by another dichotomous classification of structures as either "dilapidated" or "not dilapidated." This dichotomy was refined in 1960 by further classifying those structures designated as "not dilapidated" as either "sound" or "deteriorating." Following the 1960 census, the Census Bureau launched a detailed and thorough evaluation of its approach to measuring housing conditions that resulted in the 1967 publication. Its unambiguous conclusion was that

[3] UPCS currently exists for public housing and for multifamily housing. A version for the voucher program, UPCS-V, is under development and will replace the current HQS system (Cota, 2017).

[4] This discussion draws on Newman (2008).

housing conditions collected through interviewer observations are unreliable and, therefore, inaccurate. As a result, subsequent decennial censuses that relied on interviewers to administer the survey dropped the interviewer observations of housing unit condition. The AHS followed suit in 1997.[5]

Alongside concerns in the literature about the best way to collect data on housing quality is the issue of the best way to measure housing quality. Curiously, much more attention has been paid to developing a summary measure than to identifying the individual housing features that should comprise the summary measure. The pioneering work of Kain and Quigley (1970) established the feasibility of using housing unit measures of quality as predictors of house prices and rents, also known as hedonic models. The coefficients in these models can be viewed as weights in a hedonic price index. Kain and Quigley's work led to a burgeoning of hedonic modeling over the ensuing decades (for example, Coulson and Li, 2013; Kriström, 2008; Merrill, 1980; Thibodeau, 1995). Three features of Kain and Quigley's approach are particularly relevant to the current article. First, they apply factor analysis to reduce the 39 separate measures of housing quality in their St. Louis survey data to a manageable number. Second, they find that the seven survey measures pertaining to the quality of the individual dwelling unit interior formed a single index or factor.[6] Third, in multivariate hedonic regressions, the dwelling unit quality factor has a statistically significant effect on rent. Consistent with most of the literature in this area, the authors do not take on the question of how best to conceptualize housing quality and, instead, assume that this concept is captured by their 39 variables pertaining to "the physical or visual quality of the bundle of residential services" (Kain and Quigley, 1970: 534).

AHS Measurement of Housing Quality

The AHS is the most comprehensive data source on the U.S. housing stock.[7] Policymakers, practitioners, and researchers seeking answers to questions about the conditions, costs, and various other attributes of the nation's housing rely on it. It is also relied on as a source of housing questions for those developing their own surveys. A prominent example is the Moving to Opportunity for Fair Housing Demonstration (Shroder, 2001). Of particular interest to many users is the AHS composite measure of housing inadequacy available on the public use database, which is a variable labeled ZADEQ. The measure combines multiple items on housing conditions into an index, setting numerical thresholds for the presence or absence of physical deficiencies in the dwelling to distinguish among "adequate," "moderately inadequate," and "severely inadequate" units. Both the AHS and data users refer to this composite as the "AHS housing quality measure." Numerous published articles include the AHS measure in their analyses (for example, Carter, 2011; Friedman and Rosenbaum, 2004; Khadduri, 2007; Ross, Shlay, and Picon, 2012). It plays a prominent role in HUD's *Worst Case Housing Needs* reports (for example, HUD, 2015) and is also included in the frequently cited Joint Center for Housing Studies' *The State of the Nation's Housing* reports (for example, JCHS, 2017) and Millennial Housing Commission (2002). However, not until the last few years was the AHS quality measure subjected to careful examination.

[5] The AHS began interviewing returning households by phone, when possible, in 1997. In 2011, a phone-first policy was instituted for both new and returning households (Vandenbroucke, 2016).

[6] Their survey included many other items focusing on the condition of adjacent structures, parcels, and block faces, along with the structure's exterior condition.

[7] Drawn in part from Newman and Garboden (2013).

Eggers and Moumen's (2013a) analysis of the 2005, 2007, and 2009 AHS data implicitly raises some concerns about whether the ZADEQ measure accurately reflects the quality of the housing stock. The measure produces a very low prevalence of severe inadequacy (2 percent); only two items—sharing a bathroom and heating problems—account for most of the cases considered severely inadequate, and these problems generally do not persist over a 2-year period. The authors also conclude that the shared bathroom item is likely to have been measured incorrectly. More generally, they conclude that the AHS quality measure may provide a reasonable cross-sectional estimate of the most severely inadequate units, but provides little information on the roughly 91 percent of units considered adequate.[8]

In a second paper, Eggers and Moumen (2013b) proposed an alternative to ZADEQ that is designed to provide more information about gradations within the adequate housing stock. A major motivation is their particular interest in being able to study filtering, which requires a measure that reveals increases in deficiencies or inadequacies over time as a unit deteriorates and is presumably filtered down from higher income to lower income residents. They develop an alternative measure, the poor quality index (PQI), which is a numeric scale of housing defects that draws on additional measures in the AHS (for example, exterior structure) along with those included in ZADEQ. Lacking a reliable source on how to weight each item in the index, they assign weights based on a combination of ZADEQ's definitions and their own judgment. The PQI appears to achieve the goals of its creators. By contrast to ZADEQ, which estimates that a large majority of units had no problems, 47 percent of units had at least one PQI inadequacy.[9] The stability of the classification of the unit also differs for the two indices (Eggers and Moumen, 2013b). With ZADEQ, 95 percent of adequate units in one survey remain adequate 2 years later, whereas roughly 30 to 35 percent of units categorized as moderately or severely inadequate in one survey remained inadequate in the subsequent survey. Using the PQI, a smaller share, 63 percent of units, remained adequate from one survey to the next, and a greater share of inadequate units, roughly 60 percent, retained that designation over 2 years.

Emrath and Taylor (2012) examined the AHS ZADEQ index using a hedonic model. Because of the multicollinearity among the individual measures that comprise ZADEQ, the authors test each ZADEQ item separately, along with other features of the dwelling (for example, number of rooms, geographic region, and square footage). They report that none of the ZADEQ items reach statistical significance and, in some cases, have an unexpected sign. A major policy concern of the authors is that the very small rate of housing units meeting the definition of physically inadequate using ZADEQ leads to the conclusion that the nation's housing stock has no serious housing problems. They challenge this conclusion by identifying measures in the AHS, many of which are not included in ZADEQ, that have a strong effect on rents and prices. These items are similar to those included in Eggers and Moumen's (2013b) PQI. It is likely that Emrath and Taylor's ZADEQ results occur because of the very low variance of each individual item. This was part of Kain and Quigley's (1970) motivation for using factor analysis, which produced a single dwelling unit quality factor.[10]

[8] Authors' estimate based on the 2011 AHS.

[9] The PQI rate is based on the 1993 AHS. Because the two Eggers and Moumen reports (2013a; 2013b) rely on different AHS years, it is impossible to make direct comparisons between ZADEQ and PQI results.

[10] Merrill (1980) applied a somewhat similar approach in her hedonic modeling using data from the Experimental Housing Allowance Program demand experiment.

A fourth recent paper assesses the reliability, consistency, and validity of the AHS ZADEQ index (Newman and Garboden, 2013). Like Eggers and Moumen (2013a; 2013b) and Emrath and Taylor (2012), the authors conclude that the index identifies only a very small share of units with multiple inadequacies and provides little information about variations among units classified as adequate. They also find that the items included in the index do not appear to be tapping the same underlying construct of housing quality. However, the two subindices within ZADEQ, moderate inadequacy and severe inadequacy, are strong and statistically significant predictors of residents' housing satisfaction.

Quality of Assisted Housing

The research literature on the physical quality of the assisted housing stock is sparse, at least in part, because the AHS, the main data source on housing, typically relies on respondent self-reports of the receipt of housing assistance, which are known to be unreliable (Shroder, 2002). The present article utilizes the 2011 AHS data, which identifies assisted housing receipt, by program type, on the basis of a match to administrative records, not self-reports. Validation of assisted housing receipt was previously done in the 1989 AHS.[11] One paper used these validated data and a version of ZADEQ to study the assisted housing profiles of households with children (Newman and Schnare, 1993). The authors report that 15 percent of public housing units occupied by households with children had either a moderate or severe defect, compared with 5 percent of multifamily housing and 12 percent of voucher units. The average number of defects, however, was generally similar across the programs.

A more recent study examined the quality of housing in the voucher program (Buron et al., 2003). Data on voucher housing come from the 2000 Customer Satisfaction Survey (CSA). The authors developed two measures of housing quality, one relying on all quality-related items in the CSA and another using CSA items that align with those in the AHS. The CSA-based measure was used to explore voucher-housing quality, and the CSA-AHS measure was used to compare housing quality in the voucher program with housing quality in a matched comparison sample of unassisted renters. The CSA-based summary measure combined items into four categories: (1) severely inadequate quality, (2) moderately inadequate quality, (3) adequate quality, and (4) high quality. Based on voucher respondent reports to the CSA, 41 percent of voucher housing was considered high quality, 33 percent adequate quality, 4 percent moderately inadequate, and 23 percent severely inadequate (numbers rounded). The rate of severe inadequacy is higher than the 12- to 21-percent range in Gray, Haley, and Mast (2008), HUD's report on the first-year results of the CSA, which relied on similar though not identical quality measures. Buron et al. (2003) based their analysis of voucher and comparable nonvoucher housing quality on a statistical match between the households in the CSA voucher sample and households in the AHS. They use two different measures of housing quality, one a simple count of problems aggregated into four categories (0, 1–2, 3–4, and 5+ problems) and another indicating whether at least one problem was reported for each of five housing dimensions (for example, kitchen and bathrooms; electrical). Both measures yield the similar finding of lower-quality housing of voucher users than housing occupied by unassisted

[11] Documentation on this validation can be found in Newman and Schnare (1993).

renters. For example, 59 percent of voucher renters reported no housing problems compared with 66 percent of unassisted renters. The authors cautioned that differences between the CSA and AHS may account for some or most of these disparities.

Research Approach

In the next section, we describe the AHS data we use in the analysis, the analysis samples and the different facets of our methodological approach. We also review the three main alternative measures of housing quality that are the focus of our analysis.

Data

The main data source for the current analysis is the 2011 AHS. The AHS began in 1973 and is sponsored by HUD and conducted by the Census Bureau. As previously noted, the 2011 assisted housing cases are identified based on matching sample addresses to HUD administrative data on HUD-assisted housing programs.[12] The sample includes 9,721 assisted housing units[13] and 40,030 unassisted rental housing units in single-family or multifamily properties, the housing types that dominate the assisted stock.[14] Because we will ultimately apply the quality indices to the assisted stock, we rely on the unassisted sample to develop the housing quality indices. These indices are based on 33 housing quality items that are collected from both single-family and multifamily rental units.

Methods

Construction of the Comparison Groups

We compare the quality of assisted housing to two comparison groups of unassisted housing, one including all rentals and the other limited to units with rents at or below the FMR. For both comparison groups, we limit cases to units in a single-family or multifamily property and exclude unassisted cases that are rare or nonexistent in the assisted stock (for example, manufactured housing; reduced rents because of relationship between renter and landlord). We also exclude vacant or vacation units and units where no interview was conducted.[15]

Housing Quality Indices

Because the concept of housing quality is not based on explicit criteria, the large number of housing quality indices that have been developed with the AHS yield dramatically different prevalence rates (Newman and Schnare, 1988). The core challenge is well known; a housing unit is a bundle of attributes that extend beyond the dwelling itself, and it is unclear which of these attributes

[12] The match to HUD data excludes housing units assisted by state and local programs and the federal Low-Income Housing Tax Credit (LIHTC) program, which is under the auspices of the Department of the Treasury. However, because a sizable share of LIHTC units also receives HUD subsidies, such as vouchers, these units are included in the HUD administrative files. O'Regan and Horn (2012) estimated that 46 percent of LIHTC households receive some form of rental assistance, Buron et al. (2000) put the estimate at 37 percent, and GAO's (1997) estimate is 39 percent.

[13] Based on sample design appendix to 2011 AHS documentation (HUD, 2011).

[14] See Newman and Holupka (2017), table A1 for all selection criteria for the unassisted sample.

[15] Supplementary analysis using propensity score matching to create comparison groups produce similar results.

should be included in the definition of the dwelling's quality and how each should be weighted in determining overall quality (Aaron, 1972; Merrill, 1980). In the absence of a consensus view, the next best option is to rely on an external criterion, as suggested by Merrill (1980). We examine three alternatives: market value, consumer rating, and normative standards.

Market Value Index. The market value approach assumes that the unit's rent is correlated with the quantity and quality of housing such that higher rents reflect better quality. Consistent with the literature (for example, Coulson and Li, 2013; Kriström, 2008; Thibodeau, 1995), this theory can be tested with a hedonic regression where the dependent variable is the natural log of rent and covariates include characteristics of the housing bundle. In this article, covariates include multiple features of the housing unit, geographic location, the respondent's rating of the neighborhood (the only neighborhood measure available in the 2011 AHS), and the FMR. Although our main interest is the contribution of housing quality to market value, this effect could depend on the nonhousing features included in the model, such as perceived neighborhood quality or location in a central city or suburb. Because of substantial multicollinearity among the 33 housing quality items, we estimate two hedonic models, one including all 33 items despite this collinearity problem, and the other testing each of the 33 items separately.

Consumer Rating Index. The consumer rating criterion identifies the dwelling features that are most closely associated with the resident's assessment of the dwelling as a good place to live, regardless of what the market price of these features might be. This criterion broadens the concept of housing quality beyond specific housing features to the welfare of residents as they themselves report it (Goodman, 1978). It is consistent with the renewed interest by economists in happiness and subjective well-being as a measure of the utility an individual derives from goods and services (Dolan, Peasgood, and White, 2008).

The AHS question asks the respondent: "On a scale of 1 to 10, how would you rate your unit as a place to live?" Although the original coding designates 10 as best and 1 as worst, we reverse these codes for consistency with the normative standards index (discussed next). Thus, a higher value on this ordinal scale indicates lower housing quality. We test the consumer rating model using ordered logistic regression, which generates coefficients expressed as odds ratios: how much a unit change in housing quality item X changes the house rating. As with the market value criterion, we test the consumer rating index using each individual quality item separately and all quality items combined. Because the results are similar, we only present the results from the separate quality measure tests.

Normative Standards Index. The normative standards criterion is designed to reflect community concerns and policy decisions about housing quality, such as state building codes and assisted housing physical inspection standards. We use factor analysis to develop the normative standards index. Factor analysis examines the correlations among measures to determine the amount of common variance among them. The analysis produces factor "loadings," which indicate how much variance is shared among the observed measures and the unobserved construct (here, housing quality). The loadings or scores constitute the weights that we use to create the factor analysis index. Because many of the quality measures are dichotomous, we estimate polychoric correlations

(Jöreskog and Sörbom, 1996). Following Preacher et al. (2013), we select the smallest number of factors for which the root mean square error of approximation (RMSEA) is below 0.05. This approach identifies the measures that most accurately reflect housing quality.

Assessing Index Validity. We assess the convergent and predictive validity of the resulting housing quality indices (Carmines and Zeller, 1979). Convergent validity is based on the correlations among the indices and between each index and other attributes with which the index should be associated, such as the resident's house rating or satisfaction. Predictive validity is based on the predictive power and significance of the indices in multivariate models predicting two outcomes, the resident's house rating on a 0-to-10 scale and rent.

Assisted Housing Quality

The analysis of assisted housing quality proceeds in three steps. First, we begin by examining differences between the assisted and unassisted housing stock for each of the 33 individual housing quality measures included in the housing quality indices. This analysis also includes three additional measures from the 2011 AHS Healthy Homes modules. Second, we look at variations in quality within the assisted housing stock by program type, household type, and location. Because most of these analyses are based on the large sample sizes available in the AHS, measures of statistical significance are not very useful to gauge substantive importance. Therefore, we rely heavily on the size of the effect as measured by Cohen's *d*.[16] In a final step, we estimate a series of multivariate models predicting each housing quality index controlling for housing, location, and household characteristics. The first set of models is limited to the assisted housing sample, and includes assisted housing program type as one of the explanatory variables. The second set of models includes both assisted and unassisted housing, initially testing assisted housing as a whole, and then distinguishing this stock by program type. Because the data are heavily skewed, and the distributions have considerable dispersion, we use negative binomial modeling as the estimation technique.

Assisted Housing Quality and FMRs

To explore the alignment between the FMR and assisted housing quality, we calculate each household's housing cost relative to the FMR (that is, gross rent divided by the FMR). We then divide this relative housing cost scale into equal units (for example, 40 to 45 percent of the FMR, 45 to 50 percent of the FMR, and so on) so that the FMR, the 40th percentile, sits in the middle of the distribution.

Results

Exhibit 1 lists the AHS housing quality measures in this analysis and their means. Consistent with much past AHS housing quality research, the prevalence rates of almost all problems are very low. Most (55 percent) dwellings have no problems, and fewer than 5 percent of units account for more than 75 percent of problems.

[16] Cohen's *d* is the difference in means between two groups divided by the standard deviation for the pooled sample of the two groups (Cohen, 1977).

Exhibit 1

2011 AHS Housing Quality Measures, Mean Prevalence Rates for U.S. Rental Housing

	Mean Prevalence Rate	Average for Counts
Not all rooms have plugs	1	
# times blown fuses last 3 months	9	0.23
Exposed wiring	2	
Unit does not have electricity	0.03	
Unvented room heaters	1	
No heating equipment	1	
Use stove/oven for heat	0.1	
# heating breakdowns last winter	3	0.8
Unit cold 24+ hours last winter	10	
Cold due to utility interruption last winter	1	
Cold due to inadequate heating capacity last winter	2	
Cold due to inadequate insulation last winter	2	
Cold due to other reason last winter	2	
Roof leak last 12 months	5	
Leak in wall/closet last 12 months	3	
Leak in basement last 12 months	1	
Leak other source last 12 months	1	
Leaking pipes last 12 months	5	
Leaking plumbing fixture last 12 months	2	
Leak unknown source last 12 months	4	
Crack in wall	7	
Holes in floor	1	
Peeling paint	3	
Signs of rodents last 12 months	3	
Signs of rats last 12 months	1	
Signs of mice last 12 months	9	
Signs of cockroaches last 12 months	5	
Incomplete plumbing	0.3	
# times toilet broke 6+ hours last 3 months	2	0.05
Share plumbing facility	2	
Incomplete kitchen	4	
# sewage disposal breakdowns last 3 months	1	0.03
No working elevator	5	
Any mold	5	
Broken/missing steps	1	
Broken/missing stair railings	1	

AHS = American Housing Survey.

Notes: N = 40,830 unassisted rental units from 2011 AHS. Excludes manufactured housing and units where a relationship exists between renter and landlord. See Newman and Holupka (2017) text and Appendix Table A-1 for more details. Weighted data. Average times for counts = average for entire sample, including zeros for those not reporting the problem. "# times no water last 3 months" never reported and we do not include in the exhibit. Last three items from Healthy Homes module.

Housing Quality Indices

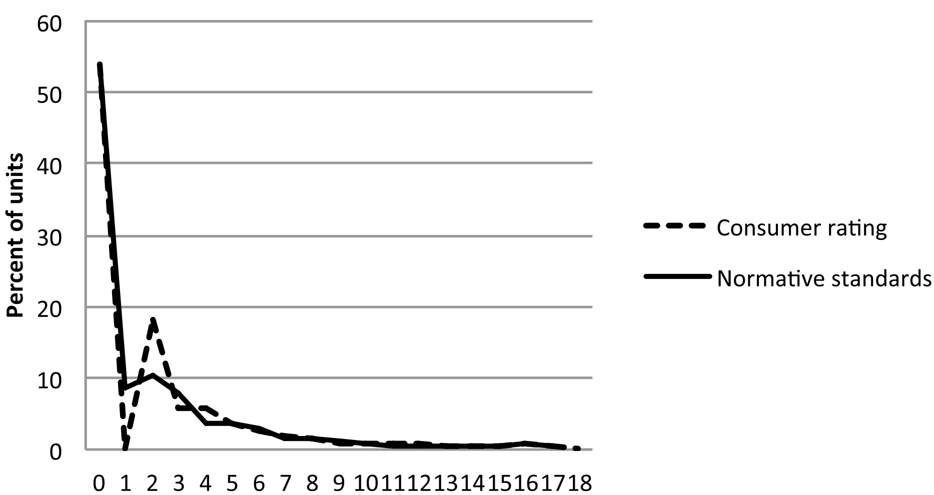
Despite its intuitive appeal and the rich hedonic literature, the market value index performs poorly. Roughly 85 percent of the AHS housing quality items either do not reach statistical significance despite the very large sample, or operate in the opposite direction of expectations. The results do not appreciably improve after adjusting the threshold required for statistical significance using the Bonferroni correction to account for multiple comparisons. The results also are remarkably consistent whether each item is tested separately or they are combined. It is likely that the rarity of each individual quality problem provides too little variance to make a meaningful contribution to the rent. In addition, rent appears to have a nonlinear relationship with the quality index. Rents are essentially flat across most of the distribution of the housing quality index but then fall significantly at the tail that represents the most housing problems. However, the hedonic formulation assumes a linear relationship between rent and dwelling features. Given its poor performance, we drop the market value housing quality index from the rest of the analysis.[17]

In contrast to the market value index, both the consumer rating index and the normative standards index perform well. The scores on both of these indices are highly skewed, as vividly demonstrated in exhibit 2. Most housing units have none of the 33 housing quality problems included in this analysis, with only a small fraction experiencing one or more problems.

As shown in exhibit 3, the consumer rating index model has strong explanatory power and the large majority of items operate in the expected direction (that is, odds ratio greater than 1).[18] Most of the items are also statistically significant although, as previously noted, this is a less useful test given the large sample size. The five measures that make the largest contribution to house rating are (1) holes in the floor, (2) peeling paint, (3) cracks in the walls, (4) presence of rodents, and (5) cold due to inadequate insulation. For example, the presence of holes in the floor makes it 3.5 times more likely that the consumer's house rating is poorer, peeling paint makes a poorer score 3.3 times more likely, and rodents make this 2.7 times more likely. To create a housing quality index based on the consumer rating criterion, we use the odds ratio for each quality measure as a weight.

Exhibit 2

Distribution of Consumer Rating and Normative Standards Index Scores



Note: High values for both indices converted into categories: 16 = 15 to 20; 17 = 20 to 30; and 18 = 30+.

[17] See Newman and Holupka (2017), table 3.

[18] One exception is the use of an oven for heat, which affects a very small proportion of rental units (see exhibit 1).

Exhibit 3

Housing Quality Predictions of Consumer Rating Index

	Odds Ratio	*p*-Value	
Not all rooms have plugs	1.973	.000	***
# times blown fuses last 3 months	1.175	.000	***
Exposed wiring	1.363	.000	***
Unit does not have electricity	1.770	.573	
Unvented room heaters	1.075	.588	
No heating equipment	1.261	.106	
Use stove/oven for heat	0.725	.269	
# heating breakdowns last winter	1.225	.000	***
Unit cold 24+ hours last winter	2.017	.000	***
Cold due to utility interruption last winter	1.731	.000	***
Cold due to inadequate heating capacity last winter	2.212	.000	***
Cold due to inadequate insulation last winter	2.656	.000	***
Cold due to other reason last winter	1.531	.000	***
Roof leak last 12 months	1.987	.000	***
Leak in wall/closet last 12 months	1.801	.000	***
Leak in basement last 12 months	1.921	.000	***
Leak other source last 12 months	1.541	.000	***
Leaking pipes last 12 months	1.678	.000	***
Leaking plumbing fixture last 12 months	1.904	.000	***
Leak unknown source last 12 months	1.482	.000	***
Crack in wall	2.708	.000	***
Holes in floor	3.509	.000	***
Peeling paint	3.253	.000	***
Signs of rodents last 12 months	2.657	.000	***
Signs of rats last 12 months	2.127	.000	***
Signs of mice last 12 months	1.626	.000	***
Signs of cockroaches last 12 months	2.052	.000	***
Incomplete plumbing	1.430	.197	
# times toilet broke 6+ hours last 3 months	1.275	.000	***
Share plumbing facility	1.111	.172	
Incomplete kitchen	1.208	.000	***
# sewage disposal breakdowns last 3 months	1.243	.000	***
No working elevator	1.262	.002	**

*** $p < .001$. ** $p < .01$.

Notes: Results from 33 separate ordinal logistic regressions on subjective housing rating (reverse coded so high score = poorer quality). Other covariates in each regression include dummy variables for room air conditioner, central air conditioner, dishwasher, garbage disposal, clothes dryer, washing machine, electric heat, gas heat, oil heat, den/TV room, dining room, family room, working fireplace, garage/carport, half-bathrooms, laundry room, porch/deck/patio, connected to public sewer, use well water, electricity included in rent, gas included in rent, oil included in rent, and other fuel included in rent. Also included in the regressions are number of bathrooms; number of bedrooms; number of floors in unit; number of floors in building; building age; building age squared; building age cubed; unit type (for example, single-family, single-family attached, multifamily); number of months in unit; neighborhood self-rating; and U.S. Department of Housing and Urban Development Fair Market Rent. N = 36,833. Odds ratio = e^{β} where "β" is the coefficient from the logistic model.

In the normative standards index based on a factor analysis, the RMSEA results support the use of a one-dimensional index for measuring housing quality. These results also provide weights for an index based on the factor scores.[19] The factor loadings, shown in exhibit 4, are consistent with

[19] Both the average and lower bound of the RMSEA scores are below 0.05, the criterion set by Preacher et al. (2013) for selecting the number of factors. See Newman and Holupka (2017), table 6.

Exhibit 4

Housing Quality Components of the Normative Standards Index

	Factor Analysis Weights
Not all rooms have plugs	1.000
# times blown fuses last 3 months	0.921
Exposed wiring	1.465
Unit does not have electricity	1.649
Unvented room heaters	0.968
No heating equipment	– 1.435
Use stove/oven for heat	– 1.497
# heating breakdowns last winter	0.747
Unit cold 24+ hours last winter	3.340
Cold due to utility interruption last winter	2.593
Cold due to inadequate heating capacity last winter	2.626
Cold due to inadequate insulation last winter	—
Cold due to other reason last winter	2.184
Roof leak last 12 months	2.019
Leak in wall/closet last 12 months	1.920
Leak in basement last 12 months	1.755
Leak other source last 12 months	1.454
Leaking pipes last 12 months	1.812
Leaking plumbing fixture last 12 months	1.787
Leak unknown source last 12 months	1.263
Crack in wall	2.667
Holes in floor	2.702
Peeling paint	2.685
Signs of rodents last 12 months	3.629
Signs of rats last 12 months	2.441
Signs of mice last 12 months	2.783
Signs of cockroaches last 12 months	2.071
Incomplete plumbing	1.629
# times toilet broke 6+ hours last 3 months	0.717
Share plumbing facility	0.270
Incomplete kitchen	0.707
# sewage disposal breakdowns last 3 months	0.207
No working elevator	0.482

Notes: Factor analysis estimated in Mplus using polychoric correlations. "Cold due to inadequate insulation last winter" dropped from factor analysis because perfectly it correlated with other measures.

the odds ratios produced by the consumer rating model. The highest factor loadings are presence of rodents; number of times the dwelling was cold for 24 hours or longer; presence of mice; holes in the floor; peeling paint; and cracks in the walls. Items with the lowest factor loadings include using the oven for heat; lacking heating equipment; number of toilet breakdowns lasting 6 hours or longer; incomplete plumbing; and sharing plumbing facilities.[20]

[20] The reference variable is whether all rooms have electrical outlets ("plugs" in exhibit 1).

Validity Tests

The consumer rating and normative standards indices are highly correlated (r =.967, p =.000 with two-tailed test), suggesting that they appear to be measuring the same underlying phenomenon and, therefore, have strong convergent validity. It is worth noting that two additional indices we developed that are more ad hoc versions of a normative standards index also are highly correlated with both the consumer rating and normative standards factor analysis indices. One ad hoc index applies the weights from Eggers and Moumen (2013b), which are based on a combination of the AHS ZADEQ housing quality measure and the authors' judgment, whereas the other simply assigns a weight of 1 to each of the 33 housing quality items (see Newman and Holupka, 2017, table 8).

Exhibit 5 shows the results for a second test of convergent validity—the correlations between each housing quality index and other AHS measures associated with housing quality. In addition to actual and logged rent, house rating, and building age, we also include the AHS' ZADEQ.[21] All of the correlations are statistically significant and operate in the expected direction. Although the correlation between each index and ZADEQ is higher than it is with rent, house rating, and building age, it is less than half the correlation between the consumer rating and normative standards indices.

The predictive validity of the two housing quality indices is somewhat mixed. As shown in exhibit 6, both the consumer rating index and the normative standards factor analysis index are significant predictors of the respondent's rating of their house on a 10-point scale. Poorer housing quality, indicated by higher scores on each index, is associated with a worse (that is, higher) house rating even after controlling for household and geographic location characteristics. The coefficients suggest that a one standard deviation increase in each index produces nearly a 20-percent improvement (that is, reduction) in house rating. However, the consumer rating index is not a statistically significant predictor of rent (although it has the expected negative sign), and the normative standards index is statistically significant only at the more liberal .10 level. The unusual shape of the relationship between rent and each index—essentially flat until the highest values at the tail of the index—may contribute to the muted statistical significance.

Exhibit 5

Convergent Validity: Correlations With AHS Measures Related to Housing Quality

	Consumer Rating Index	Normative Standards Index
Rent	– .017***	– .022***
	(.000)	(.000)
Log rent	– .015***	– .019***
	(.000)	(.000)
House rating	– .341***	– .338***
	(.000)	(.000)
Building age	.214***	.223***
	(.000)	(.000)
ZADEQ	.419***	.375***
	(.000)	(.000)

AHS = American Housing Survey.
*** $p < .001$.
Notes: Weighted data. Two-tailed significance test. ZADEQ is a measure of housing unit quality computed in the AHS.

[21] The respondent's housing rating is distinct from the consumer rating index. The house rating measure is the respondent's rating, from 1 to 10, of the dwelling as a good place to live, without any direct reference to the 33 quality measures. By contrast, the index assigns weights to each of the 33 quality measures based on the respondent's dwelling rating.

Exhibit 6

Predictive Validity of Housing Quality Indices: Regression Results for Rent and House Rating

	Consumer Rating Index	Normative Standards Index
Log rent	– 1.518	– 2.376+
	(.157)	(.055)
House rating	.848***	.830***
	(.000)	(.000)

+ p < *.10. **** p < *.001.*

Notes: Top number is regression coefficient for rent, odds ratio for house rating. Bottom number is p*-value. Log rent uses ordinary least squares, house rating uses ordinal logistic regression. Log rent models also control for log household income; household head's age, race, and ethnicity; air conditioning; washer and dryer; type of heat; fireplace; garage; laundry room; porch; number of rooms; pay for utilities; number of months in unit; age of building; area Fair Market Rent; number of bedrooms; number of bathrooms; and geographic location (region and central city, suburban, or rural). House rating models also control for log household income; household head's age, gender, race, and ethnicity; and geographic location (region and central city, suburban, or rural).*

Assisted Housing Quality

Exhibit 7 compares the quality of the assisted and unassisted stock. As shown in the column headings, we define two unassisted housing comparison groups: housing units with rents that equal or fall below the FMR, and all rental units. Results from a more rigorous approach to matching assisted and unassisted cases through propensity score matching (PM) produced similar results to those shown in the table.[22] The table includes 36 housing quality items—the 33 we have referred to throughout this article plus three additional items from the AHS Healthy Homes module: mold, broken railings, and broken steps.

Although the difference in housing quality between the assisted and unassisted stock is statistically significant in more than half of the 36 quality items, statistical significance is not a sensitive test with very large samples. A more useful metric is the effect size, measured by Cohen's *d*. As the table shows, none of the housing quality items that achieve statistical significance at the $p \leq .001$ (for example, problems with heating, roof leaks, or rodents) attains a Cohen's *d* of 0.2, the accepted threshold for a small effect. Thus, it is not surprising that the consumer rating and the normative standards index scores also do not differ for the two housing stocks. This leads to the conclusion that, based on the housing quality items examined here, the quality of assisted housing is comparable to the quality of unassisted housing. This conclusion applies whether we limit the unassisted stock to units with rents at or below the FMR, to all unassisted rental units, or to propensity score-matched assisted and unassisted units.

Within the assisted housing stock, although the consumer rating and normative standards housing quality index values are always worst for public housing and best for multifamily housing, the effect sizes never reaches the 0.2 threshold for a small effect (not shown). Characterizing assisted housing by a three-category household type measure—elderly, nonelderly family, nonelderly disabled—reveals that assisted housing for the elderly enjoys the best housing quality and housing for

[22] PM models controlled for an array of both household and housing unit characteristics. Results available from the authors.

Exhibit 7

Prevalence Rates of 2011 Housing Problems, by Housing Assistance Receipt

	Assisted Housing Versus Rentals ≤ FMR				Assisted Housing Versus All Rentals		
	Assisted Housing	**Unassisted Housing**		**Cohen's *d***	**Assisted Housing**	**Unassisted Housing**	
Not all rooms have plugs	1.3	1.1	+		1.3	0.9	**
Ever blown fuses	8.6	8.9			8.6	9.3	+
# times blown fuses	22.1	22.3			22.1	23.3	
Exposed wiring	2.8	2.3	*		2.8	2.2	**
Unit does not have electricity	0.00	0.02			0.00	0.03	
Unvented room heaters	0.3	1.3	***	.091	0.3	1.0	***
No heating equipment	0.2	1.0	***	.094	0.2	0.7	***
Use stove or oven for heat	0.1	0.2			0.1	0.1	
Ever heating breakdowns	4.6	3.4	***	.060	4.6	3.1	***
# times heating broke down	11.3	9.4	+		11.3	8.1	***
Unit cold 24+ hours last winter	17.5	12.3	***	.100	17.5	11.3	***
Cold: utility interruption	1.2	1.1			1.2	1.0	
Cold: inadequate heating	3.0	2.2	**		3.0	1.9	***
Cold: inadequate insulation	2.3	1.8	*		2.3	1.7	***
Cold: other reason	2.3	1.8	*		2.3	1.5	***
Roof leak last 12 months	3.2	5.3	***	.098	3.2	4.9	***
Leak in wall/closet	3.4	3.0	+		3.4	2.9	*
Leak in basement	1.3	1.2			1.3	1.4	
Leak other source	1.4	1.3			1.4	1.3	
Leaking pipes	5.4	5.2			5.4	4.9	
Leaking plumbing fixture	2.4	2.4			2.4	2.4	
Leak unknown source	5.0	3.7	***	.069	3.6	5.0	***
Cracks in walls	7.5	7.7			7.5	6.9	
Holes in floor	2.1	1.6	*		2.1	1.4	***
Peeling paint	3.9	3.7			3.9	3.1	***
Signs of rodents	5.3	4.0	***	.066	5.3	3.1	***
Signs of rats last	1.1	1.3			1.1	1.2	
Signs of mice last	12.8	10.2	***	.087	12.8	9.0	***
Signs of cockroaches	5.8	6.3			5.8	4.5	***
Incomplete plumbing	0.2	0.5	**		0.2	0.3	
Toilet ever broke	3.3	2.5	***	.048	3.3	2.3	***
# times toilet broke	6.7	4.9	**		6.7	5.0	**
Share plumbing facility	2.3	1.7	**		2.3	1.6	***
Incomplete kitchen	4.8	4.3			4.8	4.0	**
Ever sewage breakdown	1.5	1.5			1.5	1.3	
# sewage breakdowns	3.8	3.2			3.8	3.0	
No working elevator	6.1	4.7	***	.066	6.1	5.0	***
Any mold	8.0	8.5			8.0	7.9	
Broken/missing steps	0.6	0.8			0.6	0.8	
Broken/missing stair railings	0.9	1.2			0.9	1.3	+

FMR = Fair Market Rent.

+ p < *.10.* * p *< .05.* ** *p < .01.* *** p *< .001.*

Notes: Assisted housing N = 8,472; All rentals unassisted housing N = 40,830; Rentals ≤ FMR unassisted housing N = 24,190. Weighted data. Average for counts ("#") = average for entire sample, not just those reporting the problem. Cohen's d *computed for all effects significant at .001 or less. Values < 0.2 indicate virtually no difference.*

the nonelderly disabled has the worst.[23] As shown in exhibit 8, the difference in the index scores of these two household types reaches a medium effect size (0.50 for consumer rating and 0.51 for normative standards). Bivariate analysis of additional housing, household, and location attributes suggests other variations in housing quality within the assisted stock. These include whether the unit is located in a central city, suburb or rural area, household size, and region. A central city location is associated with a worse score on both housing quality indices (Cohen's d = 0.24 to 0.25), as the household size grows, quality worsens (Cohen's d = 0.65 to 0.68), and assisted housing in the Northeast has the worst quality ratings (Cohen's d = 0.41 to 0.45).

Multivariate models predicting the housing quality score on each of the two indices, controlling for housing, location, and household characteristics, produce very similar results to those in the bivariate descriptive analysis. We estimate two sets of regression models using negative binomial modeling to account for the severe skew in the housing quality indices.[24] The first is limited to the assisted housing sample and the policy variable of primary interest is assisted housing program type (the voucher program is the excluded category). Next, we pool the assisted and unassisted housing samples and test whether, all else equal, living in assisted housing has a sizable effect on the housing quality index score, and then test whether the assisted housing program type affects the housing quality index score.

Exhibit 9 displays the results. Regardless of whether the sample is limited to the assisted housing stock (the top set of rows) or includes both the assisted and unassisted stock (the bottom set of rows), none of the odds ratios on any of the assisted housing measures, whether the general category or distinguished by program type, achieves even a small effect size despite several statistically significant coefficients (Chen, Cohen, and Chen, 2010). Among the other covariates, only two—whether anyone in the household is disabled and whether the household lives in the Northeast region—have small effect sizes in each of these models. Holding other characteristics constant, households living in the Northeast and those with a disabled member have worse housing quality.

Exhibit 8

Housing Quality Index Ratings of 2011 Assisted Housing Units, by Household Type

	Consumer Rating Index	Normative Standards Index
Elderly	1.71	1.57
< 62 disabled	3.79	3.45
< 62 family	2.57	2.31
p-value	.000	.000
Cohen's *d*	.500	.514

Notes: Weighted data. Elderly n = 3,165; < 62 disabled n = 1,597; < 62 family n = 2,648. Excludes 14 percent of assisted housing cases where head < 62, not disabled, and no children. p*-value tests significance of difference among all three groups. Cohen's* d *compares "elderly" to "< 62 disabled." Values < 0.2 indicate virtually no difference.*

[23] The AHS does not identify housing for the elderly, families, or young disabled. To construct these categories, we assume a household head 62 years of age or older is living in elderly housing, that families with children 18 or younger and without a disabled member are living in family housing, and that nonelderly persons younger than 62, even if they are living with family members, are in housing for the disabled. This is admittedly a very blunt approach but is the best that can be done with the AHS data.

[24] More than one-half of the samples report no housing quality problems in either index, the dispersion ratios are roughly 1.8, and the standard deviation is nearly twice as large as the mean.

Exhibit 9

Multivariate Models Predicting Housing Quality Index Ratings

	Negative Binomial	
	Odds Ratio	*p*-Value
Assisted housing only		
Consumer rating index		
Public housing	.952	
Multifamily	.987	
Normative rating index		
Public housing	.924	
Multifamily	.962	
Assisted and unassisted (≤ FMR) housing		
Consumer rating index		
Assisted housing	.925	*
Normative rating index		
Assisted housing	.956	
Consumer rating index		
Public housing	.869	*
Multifamily	.942	
Voucher	.934	+
Normative rating index		
Public housing	.894	*
Multifamily	.966	
Voucher	.970	

FMR = Fair Market Rent.

*+ p < .10. * p < .05.*

Notes: Total unweighted n = 25,808. Weighted data. Covariates: census region; metropolitan location; head's age, race, gender, and marital status; number of persons in household; whether anyone in household disabled; income quartile; and structure type. Because negative binomial models cannot use decimals, dependent variables multiplied by 100 and rounded. A small effect, equivalent to a Cohen's d of 0.2, would be an odds ratio > 1.4 if > 1 or < .71. Odds ratios between .71 and 1.4 are not significant. Vouchers excluded from assisted housing models; unassisted housing excluded from models pooling assisted and unassisted housing.

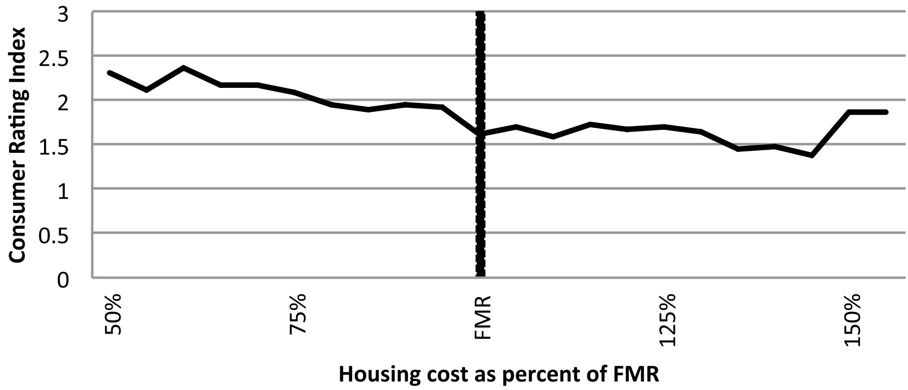
Assisted Housing Quality and Fair Market Rents

As noted in the discussion of methods, we develop a relative housing cost scale, gross rent divided by the FMR, to examine the relationship between the consumer rating housing quality index and the FMR. The results, graphed in exhibit 10, indicate that housing quality is maximized roughly at the FMR, indicated by the vertical line. The worst housing quality occurs at about the 24th percentile of rent.[25] In some cases, HUD approves payment standards up to 120 percent of the FMR, such as when a disabled household member requires reasonable accommodations in the voucher program. The figure shows no appreciable difference in housing quality between the FMR and 120 percent of the FMR. The results are similar for the normative standards index.

[25] This occurs at approximately the 60th percentile; that is, 60th x 40th (the FMR) = 24th.

Exhibit 10

Consumer Rating Index, by Relative Cost and FMR



FMR = Fair Market Rent.

*Notes: Housing cost = rent + utilities obtained from the U.S. Department of Housing and Urban Development Housing Affordability Data System. Housing cost relative to FMR = (Housing Cost / FMR) * 100. The consumer rating index top-coded at the 99th percentile to avoid outliers. FMR scale excludes top and bottom 5 percent to avoid outliers.*

Discussion

The substantial literature on housing quality demonstrates both the importance and the challenges of conceptualizing and measuring housing quality. The growing interest in how housing matters, primarily in the low-rent unassisted housing stock, and the ongoing concerns about HQS in the assisted stock, make this an opportune time to revisit housing quality. In this article, we review the relevant literature, develop alternative housing quality indices, test their validity, and apply them to both the assisted and unassisted housing stock. We focus on indicators of physical integrity of housing systems and exclude measures that are more likely to reflect residents' housekeeping or behaviors.

Because no consensus exists about the features of the housing bundle that should be included in the definition of a dwelling's quality and how each should be weighted in determining overall quality, we rely on three external criteria first suggested by research on the Experimental Housing Allowance Program (EHAP; Merrill, 1980): market value, consumer rating, and normative standards. We test the market value criterion with a hedonic approach. The consumer rating criterion identifies the dwelling features most associated with a resident's assessment of the dwelling as a good place to live regardless of what the market price of these features might be. This criterion is consistent with the renewed interest by economists in happiness and subjective well-being. The normative standards criterion reflects community concerns and policy decisions such as building codes. We rely on the 2011 national AHS for the analysis, which provides large national samples of the assisted and unassisted stock, and identifies assisted housing based on address matching to HUD administrative data, not respondent self-report.

Despite its intuitive appeal, the market value criterion performs poorly. This could occur because of the rarity of each item, or the nonlinearity of the relationship between rents and the housing quality index, which cannot be accommodated by the hedonic approach. However, it may also occur because the national sample comprises widely varying housing markets, and our controls for market attributes are relatively coarse. Another explanation is that the individual dwelling quality measures may not be the main drivers of rents, as suggested by Merrill (1980). Therefore, we drop this market value criterion from further analysis. These poor results call into question the applicability of hedonic models using individual measures of physical inadequacies as predictors for rental properties (for example, Emrath and Taylor, 2012). Merrill (1980) raised this same issue in her EHAP analysis.

For the consumer rating index, we use the odds ratios from ordered logistic regressions as the weights. For the normative standards index, we use weights derived from a factor analysis. Both of these indices perform well. Consistent with much past AHS housing quality research, the prevalence rate of almost all problems is very low, with most dwelling units having no problems. However, notable overlap occurs between the measures that are the strongest predictors of the consumer ratings index and the factor analysis normative standards index. These are presence of rodents, cold dwelling unit, holes in the floor, peeling paint, and cracks in the walls. These represent a mix of high and low prevalence dwelling conditions, which make this overlap of items between the two indices unlikely to be driven by simple math. The indices also achieve both convergent validity and predictive validity.

We find that the quality of assisted housing is comparable to the quality of unassisted housing. This conclusion applies whether we limit the unassisted stock to units with rents at or below the FMR, to all unassisted rental units, or to housing units emerging from statistically matching the assisted and unassisted units using PM techniques.

The type of assisted housing program does not appear to have an appreciable effect on housing quality. Although we control for an array of housing, household, and location characteristics in multivariate models predicting the housing quality score on either index, only two of these covariates—whether anyone in the household is disabled and whether the household lives in the Northeast region—achieves even a small effect, in both cases reducing housing quality.

This research provides hard evidence supporting the current 40th percentile of rents definition of the FMR. We find that the FMR is set at a level that is roughly at the inflection point for maximizing assisted housing quality as measured by the consumer rating and normative standards housing quality indices.

Overall, these positive findings demonstrating the comparable quality of the assisted and unassisted housing stock suggest that the current assisted housing inspection and quality control systems appear to be achieving the goal of providing physically adequate housing to assisted housing residents. They also lend support to the shift to biennial inspections in the voucher program and the biennial and triennial inspections for standard and high performers, respectively, in the public housing program. The findings reported may also be useful to HUD as it finalizes plans for a demonstration program to test a new approach to physical inspections including a single inspection protocol for public housing and voucher units.[26]

[26] See the joint Explanatory Statement accompanying the Consolidated Appropriations Act, 2016 (Pub. L. 114–113).

We view this research as one step along the path toward improving our understanding of housing quality. One important enhancement of this work would be to expand the measures to include additional aspects of the full housing bundle, particularly neighborhood features. Linking the AHS data via confidential geocodes to census tract data and an array of administrative data at the neighborhood level could accomplish that goal. Another extension would be to compare these results with housing inspection scores from HUD's administrative data (that is, the Public Housing Assessment System and Real Estate Assessment Center housing inspection ratings for public housing and multifamily housing, respectively). At the more conceptual end of the continuum, this article does not focus on what measures *should be* included in a measure of housing quality, only on how well the measures included in the AHS appear to be reliable and valid and form a coherent index. A consideration of what measures currently missing from the AHS should be included in the future is worth serious attention.

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