AMERICAN HOUSING SURVEY

A Measure of (Poor) Housing Quality

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Prepared for

U.S. Department of Housing and Urban Development
Office of Policy Development and Research

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Preface

One primary purpose of the American Housing Survey (AHS) is tracking the quality of housing that Americans enjoy (or endure). The AHS collects more than 100 items related to quality. The AHS public use file includes the variable ZADEQ, which summarizes housing quality. This variable, however, is oriented toward the lowest level standard—housing adequacy. It uses a limited three-point scale, contrasting adequate housing with two levels of inadequacy. The ZADEQ scale does not offer any levels of contrast in housing that is deemed adequate. Analysts could make use of a housing quality index that would account for more quality-related features and provide a wider range of outcomes, especially for housing deemed adequate.

As part of its ongoing program of AHS-based research, the U.S. Department of Housing and Urban Development's (HUD's) Office of Policy Development and Research (PD&R) commissioned Econometrica, Inc., to conduct a study of the ZADEQ housing adequacy measure, including its primary underlying components and persistence over time. The research project also asked Econometrica to suggest how the measure might be made more useful. The findings concerning ZADEQ itself were presented in the first report under this project, *American Housing Survey: Housing Adequacy and Quality As Measured by the AHS*. The current report, the second report under this project, is concerned with developing an extended measure of housing quality that provides for a wider range of outcomes for housing deemed adequate. The authors chose to construct a numeric scale measuring housing defects. The scale was benchmarked to housing inadequacy, as measured by ZADEQ, but it has a wider range of outcomes. The index is more stable over time compared with the ZADEQ index.

PD&R presents this research as an example of how the housing quality data in the AHS can be summarized to produce a more tractable, one-dimensional measure that might be used to classify housing units or serve as a quality proxy in multivariate analysis. The index presented in this report is not an official part of the AHS, and it could be extended or refined in many ways. PD&R prepared this report to provide readers with the opportunity to increase their understanding of housing quality variables in the AHS and to gain understanding about how to use those variables in combination to create summary measures of housing quality.

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Executive Summary

This report develops a Poor Quality Index (PQI) that measures the level of physical deficiencies in American Housing Survey (AHS) sample housing units. The AHS already contains a measure of housing adequacy, but adequacy is a narrower concept than quality. For some research purposes, a measure that uses all the AHS information on housing deficiencies may be more useful. Compared with the AHS measure, the PQI recognizes a broader range of deficiencies and has greater stability on the problem side between surveys. The goal is not to replace the AHS measure but to give researchers an alternative.

1. Background

In *American Housing Survey: Housing Adequacy and Quality As Measured by the AHS*, Eggers and Moumen (2013) examined the American Housing Survey (AHS) measure of housing adequacy. The U.S. Department of Housing and Urban Development (HUD) created this measure to assess the extent to which the housing stock met the standard of "a decent home and a suitable living environment," established by the Housing Act of 1949 and, in general, the measure has served this purpose well.

Adequacy, however, is a narrower concept than quality. A unit can suffer from various deficiencies and still be considered adequate shelter. In fact, the AHS adequacy measure found that 94.5 percent of the occupied housing units in 2011 were adequate and only 1.8 percent were severely inadequate. For some research purposes, this AHS measure does not provide enough differentiation among units. In particular, the authors found that the AHS measure is not useful in observing any deterioration in quality that might accompany "filtering" in rental units.[1]

Filtering is the process by which rental units move over time from serving high-income families, to serving moderate-income families, to serving low-income families as the units decline in desirability through physical deterioration, obsolescence of features, or inadequate maintenance. Because the AHS has interviewed the residents of the same housing units every 2 years from 1985 to 2011, it is an ideal source of data on filtering. One would expect that the number and seriousness of housing deficiencies would increase during the filtering process, but the adequacy measure does not register this decline well because it takes serious deficiencies to categorize a unit as inadequate and because units rarely remain inadequate across surveys.

The 14 AHS surveys from 1985 to 2011 contain more than 60 variables that record various housing deficiencies.[2] In this report, the authors use these variables to create a measure of housing quality—the Poor Quality Index (PQI)—that is successful in portraying a wider range of quality problems and modestly successful in finding units with problems across successive surveys.

Section 2 explains the methodology used in creating this index. Section 3 constructs the index by selecting the variables and choosing appropriate weights. Section 4 tests how well the index differentiates among units and how stable the scores are across surveys. The final section discusses the limitations of the index and provides an overall assessment of the results. An appendix contains more details on the tests reported in section 4.

[1] The research mentioned in this sentence is funded by the John D. and Catherine T. MacArthur Foundation and is led by John C. Weicher of the Hudson Institute. The first phase of the research was reported in Weicher, Eggers, and Moumen (2010). A second phase, currently under way, extends the analysis to 2011.

[2] See section 3 of Eggers and Moumen (2013).

2. Methodology

This section lays out the general approach in creating the index, discusses the choice of weights, and explains why certain techniques were not used.

2.1. General Approach

Given the extensive information in the AHS on physical characteristics of units, one could develop a measure that incorporates both indicators of quality, such as number of rooms, number of bathrooms, air conditioning, balconies, garages, and so on, and indicators of problems, such as plumbing breakdowns, absence of a refrigerator, or signs of rodents. The authors focused only on problems because they want to see how the condition of a unit changes from survey to survey. When rental units filter from high rent to low rent, they nearly always retain the same number of rooms and other amenity characteristics, such as air conditioning, balconies, or a community pool. A reduction in quality during filtering most likely appears in either the advent or increased frequency of problems or quality deterioration in existing amenities.[3] Therefore, the index should be considered an index of poor quality instead of an index of quality.

The index incorporates as many of the AHS indicators of housing deficiencies as feasible to take full advantage of all the information in the AHS. Combining many variables into a single index necessitates weighting because some deficiencies, such as having no electricity, are much more serious than others, such as blown electrical fuses.[4] A review of the housing literature failed to identify any research on which weights could be based. Therefore, the authors based the weights on the rationale implicit in HUD's measure of adequacy.

2.2. Choice of Weights

The HUD measure is contained in the variable ZADEQ, which takes three values: 1 if a unit is considered adequate, 2 if a unit is considered moderately inadequate, and 3 if a unit is considered severely inadequate. The complex definition of ZADEQ sets 14 different conditions that lead to the determination that a unit is severely inadequate.[5] With the complex definition of ZADEQ in mind, weights are constructed so that each of the 14 conditions generates an index score of 10. For example, having no electricity would result in a ZADEQ categorization of severely inadequate; therefore, having no electricity is given a weight of 10. Alternatively, the combination of (1) having electrical wiring that is not concealed and (2) not having electrical plugs in every room and (3) having fuses blown or circuit breakers tripped three or more times in the past 90 days would also result in a ZADEQ categorization of severely inadequate. Therefore, having exposed wiring was given a score of 4, not having plugs in every room was given a score of 3, and each instance of a fuse being blown or a circuit breaker tripped was given a score of 1. With this weighting, the combination of (1) having electrical wiring that is not concealed and (2) not having electrical plugs in every room and (3) having fuses blown or circuit breakers tripped three or more times in the past 90 days would also result in a score of 10 or more. (The score would exceed 10 if four or more fuses were blown.)

Linking the weights to the definition of ZADEQ does not eliminate the need for judgment in choosing weights. For example, one could weigh exposed wiring, rooms without plugs, and blown fuses in different ways and still obtain a score of 10 for the combination of these conditions. The choice of a score of 4 for exposed wiring and 3 for having a room without plugs reflects the authors' judgment that exposed wiring is slightly more serious than a room or rooms without plugs. In addition, the index uses variables that are not used in ZADEQ, such as sagging roofs or a sewage disposal breakdown. The weights for these variables are based on the authors' judgment of how serious they are compared with other deficiencies.

2.3. Related Decisions

The authors did not pursue using market prices to set weights using a hedonic approach for practical and conceptual reasons. This report is a modest research effort; serious econometric analysis was beyond its scope. Even with more resources, the

[3] Eggers' parents lived in the same rental unit from 1949 to 1976, a period during which their neighborhood declined in quality. The deterioration in unit quality that Eggers observed during this period involved matters such as the elimination of doormen, less frequent painting of hallways, lower quality and uglier hall carpets, and the shifting of unit painting to tenants.

[4] In their proposal, the authors suggested a simple counting index with implicit weights of 1. They dropped this idea because of the obvious differences in seriousness among the AHS variables and because a simple counting index does not avoid the weighting problem; it simply gives up on weighting.

[5] For an explanation of the 14 conditions, see Eggers and Moumen (2013: 2). For the definition of ZADEQ, see HUD (2011: 281).

authors would have been reluctant to use market prices for two reasons. First, the statistical issues in translating market prices into weights through hedonic analysis are daunting. Emrath and Taylor (2012) chose a Box-Cox approach that resulted in relatively straightforward interpretation of how certain conditions affect market prices for the single-family regressions but required transformations of the regression coefficients for the multifamily regressions. Second, not all quality problems are fully or even partially incorporated into rents or values because some problems are not known at the time market prices are set.

Resource limitations also excluded the option of consulting real estate agents, building contractors, or structural engineers in setting weights.

Finally, the authors chose not to base the index on a well-defined scale such as 0 to 100 for two reasons. First, the index is intended to be a weighted count of deficiencies, and a numerical score coveys this concept better than a score based on a scale. Second, the score should be treated as an ordinal measure rather than a cardinal measure. A score of 20 indicates a higher level of deficiencies than a score of 10 but does not imply that the deficiencies are twice as serious. In the authors' opinion, scoring against a fixed scale would more likely lead to an improper cardinal interpretation.

3. Constructing the PQI

Table 1 lists the variables used in the PQI and the weights (or scoring) applied to those variables.

The starting point for the PQI is the components of the definition of a severely inadequate unit (ZADEQ = 3) that deals with electrical problems. As explained previously, not having electricity is sufficient in itself to have a unit declared severely inadequate under ZADEQ. For the alternative measure, a unit without electricity is given a score of 10 points (item 1, table 1). Having exposed wiring results in a score of 4 points, not having plugs in all rooms results in a score of 3 points, and 1 point is registered for each fuse blown or for each occurrence of a thrown circuit breaker (items 2 to 4, table 1). A combination of (1) having exposed wiring and (2) not having electric plugs in one or more rooms and (3) having three blown fuses results in a score of 10. Under the ZADEQ measure, having this combination results in a severely inadequate determination, but only if all three are present.

The next component of the alternative measure deals with the adequacy of the unit's heating system. If a unit was uncomfortably cold for 24 or more hours, the alternative measure adds 4 points to its PQI score (item 5, table 1). For each breakdown of the heating equipment, the alternative measure adds 2 points. The authors chose 4 points for being cold because that seemed to be the predicate for the ZADEQ determination of a severe problem. They chose 2 points rather than 1 point for each breakdown (item 6, table 1) because a heating breakdown is more serious than a blown fuse or a tripped circuit breaker, which was scored as 1 point. If the unit was cold for other reasons, the alternative measure adds 2 points for each reason items 7 through 10, table 1). From a unit quality perspective, a heating failure is a problem regardless of the cause. In the ZADEQ measure, a unit is severely inadequate if the unit was uncomfortably cold because of heating equipment breakdowns and at least three such breakdowns occurred. We constructed the weights in our alternative measure so that that specific combination would generate a score of 10 points. The PQI differs from ZADEQ in three ways: heating equipment breakdowns score points even if the unit was not uncomfortably cold for 24 or more hours, each heating equipment failure scores points, and heating failures due to other causes score points.[6]

In the ZADEQ measure, a unit is considered moderately inadequate if its main heating equipment is one or more unvented kerosene heaters. A unit with an unvented kerosene heater was assigned a score of 4 points to indicate a problem of moderate severity (item 11, table 1). The choice of a 4-point score balances several considerations. First, a condition that would result in a determination of moderately inadequate for ZADEQ is sufficiently serious to warrant a nontrivial score. Second, having an unvented kerosene heater is a yes or no situation; it either exists or does not, unlike toilet breakdowns or blown fuses, where seriousness depends upon the frequency of the problem. Third, in the authors' opinion, two moderate problems of this nature are not as serious as not having electricity or not having a full bathroom; therefore, a score of less than 5 seemed appropriate.

The third component of the alternative measure deals with problems used in the determination of ZADEQ that are visible from inside the unit and that relate to structural defects. That component identifies six problems that can be seen from inside a unit; having any five of these six problems will cause a unit to be classified as severely inadequate. The PQI expands the 6 problems into 11 by treating each type of outside water leak and each type of inside water leak as a separate problem. A unit with multiple leaks has more serious problems than a unit with only one leak. Each of these 11 problems adds 2 points to the PQI score, so that any 5 problems would sum up to 10 points (items 12 to 22, table 1). ZADEQ uses rats seen in unit. The PQI uses evidence of rodents (item 22) because the AHS has information on evidence of rodents for all surveys but has information on rat sightings only since 1997.

In the PQI, each problem results in a higher PQI score, whereas in the ZADEQ measure, units with two or fewer problems are adequate, units with three or four problems are moderately inadequate, and units with five or more problems are severely inadequate.

In the fourth component, the PQI assigns a score of 10 points if a unit does not have access to all three elements of a full bathroom in the ZADEQ determination of severely inadequate (hot piped water, a tub or shower, and a flush toilet)[7] (item 23,

[6] Scoring from 1985 to 1995 differs from scoring in 1997 or later. During the 1985-through-1995 period, one variable (WHYCLD) recorded reasons other than heating equipment failures for a unit being cold. Only one reason could be reported using this variable. Beginning in 1997, each alternative explanation for a unit being cold has its own variable (WHYCD1 to WHYCD5).

[7] In a previous version of the PQI, the authors scored each of the three elements separately, 10 points apiece. The overlap between the items resulted in a few units receiving very high scores. Emrath and Taylor (2012) used the absence of a bathroom sink as an element in their multifamily measure. We suspect overlap between this defect and the three elements in the PQI.

Table 1. Components and Weights for the PQI Score

Item	PQI Component	AHS Variable	Score (Weight)
	Electricity problems (15 points maximum)		
1	Unit does not have electricity	BUYE	10
2	Unit has exposed wiring	NOWIRE	4
3	Unit does not have electric plugs in every room	PLUGS	3
4	Each occurrence of a blown fuse or thrown circuit breaker[a]	NUMBLOW	1
	Heating problems (32 points maximum)		
5	Unit was uncomfortably cold for 24+ hours	FREEZE	4
6	Each heating equipment breakdown[b]	NUMCOLD	2
7	Unit cold due to utility interruption	WHYCD1	2
8	Unit cold due to inadequate heating capacity	WHYCD2	2
9	Unit cold due to inadequate insulation	WHYCD3	2
10	Unit cold due to other reason	WHYCD5	2
11	Main heating equipment is unvented kerosene heater(s)	HEQUIP	4
	Inside structural or other problems (22 points maximum)		
12	Water leak in roof	RLEAK	2
13	Water leak in wall or closed door/window	WLEAK	2
14	Water leak in basement	BLEAK	2
15	Water leak from other source	OTLEAK	2
16	Inside leak from leaking pipes	PILEAK	2
17	Inside leak from plumbing fixtures	PLEAK	2
18	Inside leak from other or unknown source	NLEAK (NLEAK1, NLEAK2)	2
19	Holes in the floor	HOLES	2
20	Open cracks wider than a dime	CRACKS	2
21	Peeling paint larger than 8 by 11 inches	BIGP	2
22	Evidence of rodents	EVROD (RATS)	2
	Bathroom problems (16 points maximum)		
23	Unit does not have hot and cold running water OR Unit does not have a bathtub or shower OR Unit does not have a flush toilet	HOTPIP, TUB, TOILET	10
24	Each breakdown leaving unit without a toilet for 6+ hours[c]	NUMTLT	2
	Kitchen problems (10 points maximum)		
25	Unit does not have a refrigerator OR Unit does not have a kitchen sink OR Unit does not have a cook stove or range	REFR, SINK, COOK	10
	Outside structural problems (35 points maximum)[d]		
26	Windows broken	EBROKE	5
27	Holes/cracks or crumbling in foundation	ECRUMB	5
28	Roof has holes	EHOLER	5
29	Roof missing shingles/other roofing materials	EMISSR	5
30	Outside walls missing siding/bricks/and so on	EMISSW	5
31	Roof's surface sags or is uneven	ESAGR	5
32	Outside walls slope/lean/slant/buckle	ESLOPR	5
	Water and sewer problems (32 points maximum)		
33	Each time unit is completely without water[e]	NUMDRY	2
34	Each sewage disposal breakdown[f]	NUMSEW	2
	Elevator problems (4 points maximum)		
35	No working elevator in building of four or more stories	EVEL, CLIMB	4

AHS = American Housing Survey. PQI = Poor Quality Index.

[a] NUMBLOW takes values of 1 to 7 from 1985 through 1995; 8 is not answered; 9 is not applicable; it takes 1 to 8 from 1997 through 2011.

[b] NUMCOLD takes values of 1 to 7 from 1985 through 1995; 8 is not answered; 9 is not applicable; it takes 1 to 8 from 1997 through 2011.

[c] NUMTLR takes values of 1 to 7 from 1985 through 1995; 8 is not answered; 9 is not applicable; it takes 1 to 8 from 1997 through 2011.

[d] Apparently, these questions applied to single-family units before 1997.

[e] NUMDRY takes values of 1 to 7 from 1985 through 1995; 8 is not answered; 9 is not applicable; it takes 1 to 8 from 1997 through 2011.

[f] NUMSEW takes values of 1 to 7 from 1985 through 1995; 8 is not answered; 9 is not applicable; it takes 1 to 8 from 1997 through 2011.

table 1). Each time a unit is without a toilet for 6 or more hours (item 24, table 1), the alternative measure adds 2 points to the PQI score. In the ZADEQ measure, three or more such occurrences result in a determination of moderately inadequate. Three toilet breakdowns would produce a score of 6 points, a total that we believe is consistent with ZADEQ's treatment of three breakdowns as a moderate inadequacy.

The PQI scores the absence of kitchen equipment (item 25, table 1) in the same manner as the absence of bathroom equipment whereas ZADEQ rates a unit without a complete kitchen as moderately inadequate and a unit with a complete bathroom as severely inadequate. Emrath and Taylor (2012) included the absence of a kitchen sink in their multifamily measure, giving this element equal importance to the absence of a bathroom sink.

The AHS does not use any of the indicators of external structural problems in the determination of ZADEQ. The PQI assigns a score of 5 to each of these seven indicators (items 26 through 32, table 1). The decision to score each component of this group at 5 points was a compromise between conflicting views about these items. On the one hand, these defects are serious. Emrath and Taylor (2012) used four of the items in their modified measure of adequacy for single-family structures. On the other hand, these items were excluded in the original formulation of ZADEQ after careful consideration of all relevant AHS variables. Moreover, this set of variables has changed over time. Formerly, the values assigned to these variables were based on the observations of the enumerator; with the switch to telephone interviewing, the values are based on respondents' answers.[8] Note that if a unit suffers from two of these problems, the combined score is 10, the score equivalent to the score of those conditions that results in a determination that a unit has severe physical problems under ZADEQ. This classification is consistent with the view that these problems are serious.

For each breakdown in water supply or sewage disposal, the alternative measure assigns 2 points to the PQI score (items 33 through 34, table 1). The authors gave these problems the same score assigned to a toilet breakdown because they create the same sort of problem, namely, a nonfunctioning bathroom. Units located four or more stories above street level receive an additional 4 points if the building has no working elevator (item 35, table 1) This score is the same as the one assigned to an unvented kerosene heater, a deficiency that results in a moderate inadequate determination using ZADEQ.

The maximum possible PQI score is 166 points. Some problems are mutually exclusive; for example, a unit without electricity cannot have exposed wiring, and a unit without a toilet cannot have a toilet breakdown. The maximum score observed in all 13 surveys analyzed was 100 points.

[8] A review of unweighted frequency distributions from 1993 and 2003 indicates that information on these variables was often missing in 1993 but not 2003. Although the old codebook is silent on this point, the authors believe that field agents entered this information only for single-family units.

4. Testing the PQI Score Index

Figure 1 shows the PQI scores for the 36,099 occupied units in the 1993 AHS survey. The frequency distribution is very skewed to the right. Of these units, 53 percent scored 0; that is, no problems were reported for these units. Also, 3 percent scored 1, 17 percent scored 2, and 3 percent scored 3; 42 percent scored between 1 and 10, and 5 percent scored between 11 and 20. Of the units, 1 percent scored greater than 20; the highest score in 1993 was 76.

The authors expected a skewed distribution but were surprised by the number of units without problems and the small number of units with scores greater than 10. We ran frequency distributions for key variables used directly or indirectly in the PQI score to see to what extent these units with 0 scores were missing information on these variables.[9] We repeated this process using 1993 and 2003 data and found that missing data were not a contributor to the number of units with no quality problems; that is, having a PQI score of 0.

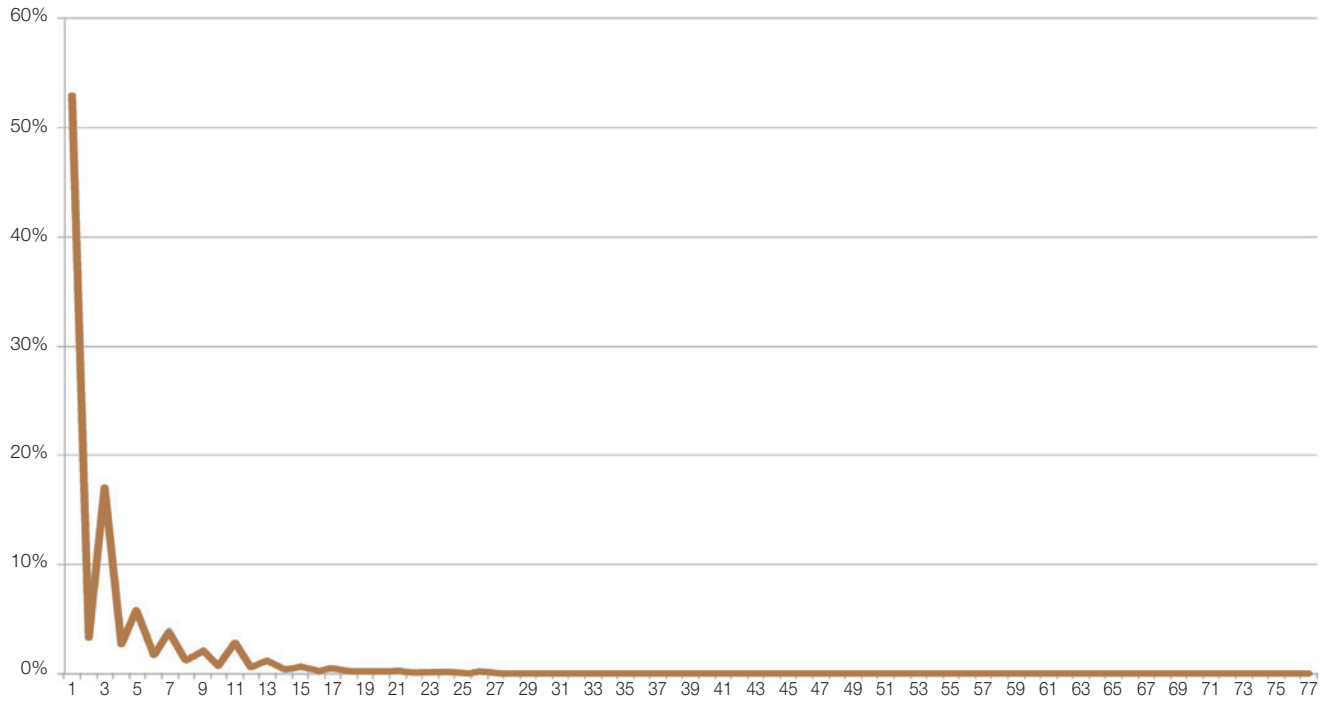
The authors had two goals in creating the PQI: to provide a broader differentiation among units with respect to quality problems and to observe less survey-to-survey variation in the presence or absence of deficiencies. This section examines how well the PQI achieves those objectives.

4.1. Differentiating Among Units

Table 2 shows that ZADEQ identified moderate or severe physical problems in 5 to 9 percent of occupied units. The PQI finds that some quality deficiencies exist in 43 to 53 percent of units, but the range of quality variation is narrow. Most of the units with positive PQIs have scores between 1 and 10.

The third column in table 2 (percent of units with PQI > 0) attests to the high quality of the American housing stock. Between 47 and 56 percent of all occupied housing units had no reported problems during the 1985-through-2009 period.

Figure 1. Percentage Frequency Distribution for the PQI Score Index in 1993



PQI = Poor Quality Index.

[9] The variable NUMBLOW (number of times a fuse is blown or a circuit breaker thrown) is used directly in the PQI. IFBLOW (has there been a fuse blown or a circuit breaker thrown?) is asked before deciding whether NUMBLOW should be asked; it is not used in the PQI code but is implicit in the PQI definition. The authors checked whether IFBLOW was missing, not whether NUMBLOW was missing.

Table 2. Percent of Units With Quality Problems, ZADEQ vs. PQI

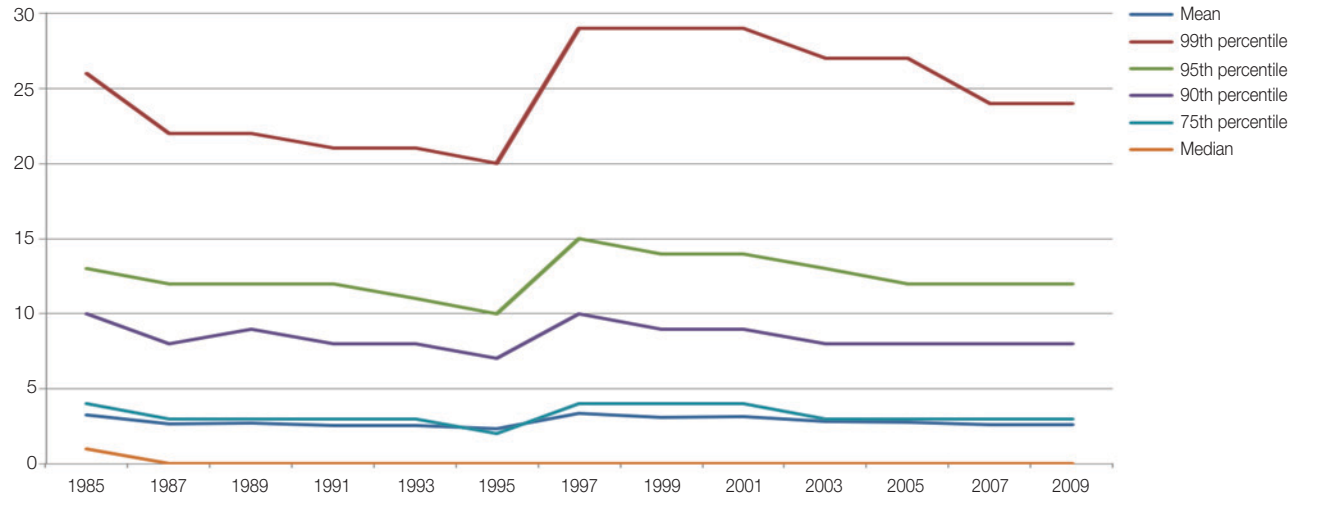
Survey Year	Percent Moderately or Severely Inadequate (ZADEQ > 1)	Percent of Units With PQI > 0	Percent of Units With PQI of 1–10	Percent of Units With PQI of 11–20	Percent of Units With PQI > 20
1985	8.3	52.7	44.9	5.9	2.0
1987	6.9	48.7	43.0	4.5	1.2
1989	8.1	48.1	42.1	4.8	1.2
1991	7.7	46.0	40.4	4.5	1.1
1993	6.4	46.9	41.5	4.5	1.0
1995	6.6	44.5	39.7	3.9	0.9
1997	7.0	50.0	41.4	6.1	2.5
1999	6.6	47.9	40.3	5.4	2.2
2001	6.2	47.2	39.3	5.5	2.4
2003	5.8	43.7	36.9	4.8	1.9
2005	5.6	43.4	36.8	4.7	1.9
2007	5.1	43.3	37.5	4.4	1.5
2009	5.0	43.0	37.1	4.4	1.5

PQI = Poor Quality Index.

This column also shows that the 1997 redesign of the AHS questionnaire affected the PQI scores. From 1985 to 1995, the percentage of units with some deficiency decreased nearly monotonically from 52.7 to 44.5 percent. With the redesign, the percentage jumped from 44.5 to 50.0 percent in 1997. (The same jump occurs for ZADEQ as well.) Afterwards, the percentage with positive PQI scores decreased monotonically to 43.0 percent in 2009. The PQI indicates that the American housing stock has improved in quality during the period.

Figure 2 tracks trends in PQI scores during the period; it reports survey means, medians, 75th percentiles, 95th percentiles, and 99th percentiles. In most survey years, the median had an index value of 0; that is, one-half or more of the occupied units had no reported deficiencies. The mean ranged from a high of 3.34 in 1997 to a low of 2.33 in 1995. The effect of the redesign on PQI scores is apparent in the trends for all six measures in figure 2, as is the general decline over time in quality problems.

Figure 2. Trends in PQI Scores During the 1985-Through-2009 Period



PQI = Poor Quality Index.

4.2. Note on the Relationship Between ZADEQ and the PQI

In the 1985-through-1995 period, all units that are judged by ZADEQ to be severely inadequate have positive PQI scores. During this period, HUD incorporated the concept of exclusive use into its determination of whether a unit has a sink, tub, or toilet. Beginning in 1997, HUD determined whether a unit has a sink, tub, or toilet independent of exclusive use and introduced a separate variable to indicate exclusive use. The authors did not incorporate exclusive use into the PQI for two reasons. Exclusive use accounts for much of the year-to-year variation in ZADEQ and approximately 60 percent of the units classified as severely inadequate. In addition, the concept of shared use expanded in 1997.[10] As a result of this decision, a number of units have ZADEQ values of 3 (severely inadequate) and PQI scores of 0 after 1995.

The decision not to use *exclusive use* in the PQI definition appears to have introduced only a small discontinuity into the PQI measurements. The percentage of housing units with 10 or more points on the bathroom components of the PQI fell from 1.73 to 0.63 percent between 1995 and 1997. The percentage of units with any points on the bathroom component fell from 4.32 to 2.83 percent between 1995 and 1997.

4.3. Survey-to-Survey Stability in PQI Status

Table 3 tracks survey-to-survey changes in adequacy of the housing stock as measured by ZADEQ. On the adequate side, the status of units was very stable between surveys. Roughly 95 percent of all units that were adequate in one survey were adequate in the next. (From the 1985-through-1987 row, 88.8 percent / 92.4 percent = 96.1 percent.) On the inadequate side, however, unit status changed frequently between surveys. Only 30 to 45 percent of units judged moderately inadequate or severely inadequate in one survey were in the moderately inadequate or severely inadequate categories in the next survey. (From the 1985-through-1987 row, {2.8 percent + 0.2 percent + 0.2 percent} / 7.6 percent = 43.2 percent.) The relative instability of inadequate status increased in the 1990s. Only 30 to 35 percent of units judged moderately inadequate or severely inadequate in one survey were in the moderately inadequate or severely inadequate categories in the next survey after 1989.

This pattern is not surprising for a measure that identifies only the most troubled units. Units with serious problems normally either get needed rehabilitation or drop out of the stock.

Table 4 shows that our broader measure of poor quality behaves differently in survey-to-survey comparisons. (For table 4, PQI scores were grouped by 10s; for example, 1 through 10, 11 through 20, and so on.) On the good-quality side, the status of units was only moderately stable between surveys. Between 58 and 68 percent of units that had no deficiencies in the first survey also had no deficiencies in the second survey. (From the 1985-through-1987 row, 30.6 percent / 47.9 percent = 63.9 percent.) Between 56 and 61 percent of units that had deficiencies in the first survey also had deficiencies in the second survey. (From the 1985-through-1987 row, {24.6 percent + 3.0 percent + 4.0 percent} / 52.1 percent = 60.7 percent.)

The authors regressed each PQI score on the same unit's PQI score in the preceding survey using ordinary least squares. The lagged PQI coefficients ranged from 0.33 to 0.43, and the intercepts ranged from 1.4 to 2.3. This exercise was designed simply to see if survey-to-survey linkages were evident in the PQI scores at the unit level. The regressions were primitive in the sense that they did not adjust for the predominance of PQI scores of 0 in both years or for the extreme skewness of the scores. The linkage appears to be weak, as the R-squares ranged from 10 to 19 percent.

[10] See page 6 and the appendix of Eggers and Moumen (2013).

Table 3. Percentage Distribution of Occupied Sample[a] by Type of Survey-to-Survey Changes in Adequacy[b]

Period	Unit Adequate in First Survey (percent)			Unit Moderately or Severely Inadequate in Second Survey (percent)				
	a	b	c	d	e	f	g	h
	ZADEQ = 1 in First Survey	ZADEQ = 1 in Second Survey	ZADEQ > 1 in Second Survey	ZADEQ > 1 in First Survey	ZADEQ = 1 in Second Survey	ZADEQ Same Value in Both Surveys	ZADEQ Increased From 2 to 3	ZADEQ Decreased From 3 to 2
1985–1987	92.4	88.8	3.6	7.6	4.3	2.8	0.2	0.2
1987–1989	93.6	88.4	5.1	6.4	3.6	2.3	0.3	0.1
1989–1991	92.4	87.5	4.8	7.6	5.0	2.2	0.2	0.2
1991–1993	92.7	88.7	4.0	7.3	5.0	1.9	0.1	0.2
1993–1995	93.9	89.3	4.6	6.1	4.2	1.6	0.2	0.2
1995–1997	93.8	88.9	4.9	6.2	4.3	1.5	0.2	0.2
1997–1999	93.6	89.5	4.1	6.4	4.1	2.1	0.1	0.1
1999–2001	93.8	89.9	3.9	6.2	3.9	2.0	0.2	0.1
2001–2003	94.1	90.5	3.6	5.9	3.9	1.7	0.1	0.2
2003–2005	94.6	91.2	3.5	5.4	3.5	1.6	0.1	0.1
2005–2007	94.8	91.5	3.3	5.2	3.5	1.4	0.1	0.1
2007–2009	95.3	91.8	3.5	4.7	3.2	1.3	0.1	0.1

[a] Each row represents the distribution of AHS sample units that were occupied in both survey years.

[b] Columns a + d = 100 percent; columns b + c = a; and columns e + f + g + h = d.

Table 4. Percentage Distribution of Occupied Sample[a] by Type of Survey-to-Survey Changes in Poor Quality[b]

Period	Unit Has PQI Score of 0 in First Survey (percent)			Unit Has PQI Score Greater Than 0 in First Survey (percent)				
	a	b	c	d	e	f	g	h
	PQI = 0 in First Survey	PQI = 0 in Next Survey	PQI > 0 in Next Survey	PQI > 0 in First Survey	PQI = 0 in Second Survey	PQI in Same Bracket in Next Survey	PQI Bracket Increased	PQI Bracket Decreased
1985–1987	47.9	30.6	17.3	52.1	20.5	24.6	3.0	4.0
1987–1989	51.6	32.4	19.2	48.4	19.4	23.1	3.1	2.9
1989–1991	52.2	33.7	18.5	47.8	20.2	21.8	2.9	3.0
1991–1993	54.1	34.1	20.1	45.9	18.9	21.6	2.7	2.6
1993–1995	53.1	34.7	18.4	46.9	20.5	21.2	2.5	2.7
1995–1997	55.5	32.2	23.3	44.5	17.3	20.2	5.0	2.0
1997–1999	50.1	31.5	18.6	49.9	20.3	21.3	4.0	4.3
1999–2001	52.2	33.1	19.1	47.8	19.1	21.0	4.0	3.6
2001–2003	52.9	35.6	17.3	47.1	20.6	19.2	3.4	3.9
2003–2005	56.5	38.0	18.6	43.5	18.3	18.8	3.2	3.2
2005–2007	56.4	37.4	19.0	43.6	18.7	18.8	2.9	3.2
2007–2009	56.5	38.4	18.2	43.5	18.3	19.4	3.0	2.8

PQI = Poor Quality Index.

[a] Each row represents the distribution of AHS sample units that were occupied in both survey years.

[b] Columns a + d = 100 percent; columns b + c = a; and columns e + f + g + h = d.

5. Overall Assessment of the PQI and Its Limitations

The PQI represents a much different measure of quality than ZADEQ, which is a measure of adequacy not quality. The PQI recognizes a broader range of deficiencies and has greater stability on the problem side between surveys. The authors had hoped to build these qualities into an alternative measure of housing quality. The goal was not to replace ZADEQ but to give researchers an alternative.

The PQI differs from ZADEQ in three important ways. First, the PQI is numerical, not categorical. The more deficiencies, the higher the PQI. Under ZADEQ, an occupied unit cannot receive a worse categorization than severely inadequate regardless of its condition. Second, the PQI responds to deficiencies not included in ZADEQ, such as sagging roofs. Third, every observed deficiency increases the PQI score, whereas sometimes in ZADEQ deficiencies have to occur in fixed combinations. For example, having exposed wiring results in a PQI score of 4 even if every room has plugs. In ZADEQ, exposed wiring, the absence of plugs, and blown fuses have to occur together to create an inadequacy.

The PQI has several built-in deficiencies that arise from changes over time in the information collected by the AHS. Although most of these deficiencies have been discussed in the preceding sections or footnotes, it is useful to list them here.

- The AHS changed from mainly onsite data collection to telephone interviewing during the course of the current sample. This shift produced wording and editing changes in a number of AHS questions. It also eliminated independent quality related observations by the interviewer.
- Changes in variable definitions affect the determination of whether a unit contains a complete bathroom or a complete kitchen. We are able to eliminate exclusive use from the determination of bathroom or kitchen problems after 1997, but before 1997 exclusive use is built into the relevant variables on the public use files.
- A number of questions that record the frequency with which certain problems occurred had coding changes in 1997 that resulted in an 8 rather than a score of 7 being the highest number recorded (for example, NUMBLOW or NUMCOLD).
- Other changes in variable definitions affect scoring. For example, before 1997, only one reason could be given for why a unit might have been cold.

Finally, the PQI deals only with unit problems and ignores neighborhood problems. This limitation may affect the usefulness of the PQI for some applications.

The HUD reviewers also noted that the weighting does not take into account the costs of making repairs. Although a broken window may present similar problems as holes in the roof, window repair is simpler and less expensive than roof repair. Whether to weight by the consequences of a problem or the cost of solving the problem is a methodology issue.

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Appendix. Additional Tabulations Using the Poor Quality Index

Table A-1 provides counts of sample units by survey year by PQI score brackets.

Table A-2 provides a percentage distribution of sample units by survey year by PQI score brackets.

Table A-3 contains the numbers used to construct figure 1.

Table A-4 contains the regression results.

Table A-1. Distribution of Sample Units by PQI Score

PQI Score	Survey Year												
	1985	1987	1989	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
0	15,599	17,595	18,014	19,078	19,151	19,937	17,663	19,130	19,765	21,449	21,468	21,366	22,588
1–10	14,805	14,759	14,623	14,281	14,966	14,274	14,625	14,792	14,716	14,055	13,952	14,144	14,696
11–20	1,949	1,534	1,664	1,608	1,613	1,403	2,142	1,996	2,077	1,829	1,797	1,642	1,747
21–30	441	298	318	276	258	254	593	517	582	445	451	378	403
31–50	124	90	71	71	77	52	192	203	206	200	169	114	140
41–50	56	23	24	20	25	13	67	55	75	54	46	39	36
51–60	18	11	3	7	5	8	20	18	21	23	26	14	5
61–70	5	2	2	1	2	0	6	13	12	6	11	8	4
71–80	2	0	0	1	2	0	6	2	3	3	0	2	3
81–90	1	0	0	1	0	0	1	0	0	0	1	1	0
91–100	0	1	0	0	0	0	0	0	1	0	0	1	0
Total	33,000	34,313	34,719	35,344	36,099	35,941	35,315	36,726	37,458	38,064	37,921	37,709	39,622

PQI = Poor Quality Index.

Table A-2. Percentage Distribution of Sample Units by PQI Score

PQI Score	Survey Year (percent)												
	1985	1987	1989	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
0	47.3	51.3	51.9	54.0	53.1	55.5	50.0	52.1	52.8	56.3	56.6	56.7	57.0
1–10	44.9	43.0	42.1	40.4	41.5	39.7	41.4	40.3	39.3	36.9	36.8	37.5	37.1
11–20	5.9	4.5	4.8	4.5	4.5	3.9	6.1	5.4	5.5	4.8	4.7	4.4	4.4
21–30	1.3	0.9	0.9	0.8	0.7	0.7	1.7	1.4	1.6	1.2	1.2	1.0	1.0
31–50	0.4	0.3	0.2	0.2	0.2	0.1	0.5	0.6	0.5	0.5	0.4	0.3	0.4
41–50	0.2	0.1	0.1	0.1	0.1	0.0	0.2	0.1	0.2	0.1	0.1	0.1	0.1
51–60	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0
61–70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71–80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81–90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
91–100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

PQI = Poor Quality Index.

Table A-3. Means, Medians, and Percentiles for PQI Scores by Survey Year

PQI Score	Survey Year												
	1985	1987	1989	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
Mean	3.22	2.62	2.67	2.55	2.55	2.33	3.34	3.06	3.11	2.77	2.74	2.59	2.60
99th percentile	26	22	22	21	21	20	29	29	29	27	27	24	24
95th percentile	13	12	12	12	11	10	15	14	14	13	12	12	12
90th percentile	10	8	9	8	8	7	10	9	9	8	8	8	8
75th percentile	4	3	3	3	3	2	4	4	4	3	3	3	3
Median	1	0	0	0	0	0	0	0	0	0	0	0	0

PQI = Poor Quality Index.

Table A-4. Intercepts, PQI Coefficients, and R-Squared for the Survey-to-Survey Regressions[a]

	Intercept	PQI Coefficient	R-Squared
1985–1987	1.406	0.393	19.0%
1987–1989	1.624	0.399	15.2%
1989–1991	1.564	0.370	13.4%
1991–1993	1.649	0.345	11.8%
1993–1995	1.549	0.309	10.3%
1995–1997	2.324	0.438	9.8%
1997–1999	1.882	0.362	13.3%
1999–2001	1.978	0.375	12.6%
2001–2003	1.744	0.333	12.3%
2003–2005	1.788	0.340	11.6%
2005–2007	1.754	0.317	10.9%
2007–2009	1.676	0.365	12.9%

PQI = Poor Quality Index.

[a] The F-tests were all significant at the 0.0001 level, and the intercepts and lagged PQI coefficients were all significant at the 0.0001 level.