AFFORDABLE RENTAL HOUSING: LOST, STOLEN, OR STRAYED?

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Losses of units affordable to poor renters have been repeatedly lamented. This study investigates the dynamics underlying net losses by exploiting the longitudinal capability of American Housing Surveys taken at 4-year intervals between 1985 and 1992 in 41 metropolitan areas (MAs). It examines six sources of gain or loss -- rent filtering, new construction, permanent loss, temporary loss to nonresidential use, tenure shifts, and unit conversion or merger -- to assess their gross and net effects on six affordability ranges of unsubsidized rental housing.

Wide variation is found. Some areas gained units affordable to incomes below 50 percent of area median, while such units declined sharply elsewhere. But almost *all* MAs lost the units most needed, as units affordable to incomes below *35* percent of median dropped by a third. The frequency of change was striking: fewer than two-fifths of units remained in the rental stock and the same affordability group over 4 years. Rent filtering was the major source of change in each category. New construction and tenure shifts mainly augmented higher rent groups, while permanent and temporary losses were most common (even though infrequent) among the lowest rent units.

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*Views expressed are those of the authors and should not be interpreted as representing the official position of HUD or any office therein.

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Since 1970, absolute declines and relative shortages in the numbers of rental units affordable to poor renters in the United States have been repeatedly documented and deplored (e.g., Center on Budget Policy and Priorities 1995). A 1996 report to Congress characterized the growing numbers of renters with incomes below 30 percent of area median income and the shrinking numbers of units affordable to them as "the fundamental structural mismatch confronting housing policymakers."[1] Figure 1 summarizes recent developments in that mismatch. In the United States between 1989 and 1993, as the number of renter households with such extremely low incomes surged by 1 million, the number of unsubsidized rental units affordable to those renters *fell* by almost 250,000. As the mismatch worsened, the number of extremely-low-income renters with worst case housing needs[2] -- most of them paying more than half of their income for rent -- rose by 680,000.

To investigate the reasons for continued shrinkage in the most affordable sector of the privately-owned rental stock in face of rising demand, this paper probes into the dynamic processes by which rental housing units are gained or lost at rent ranges affordable to six different income groups. The analysis exploits the longitudinal capability of the American Housing Survey to track what happened to individual housing units in 41 major metropolitan housing markets. We tracked changes over a four-year period for each metropolitan area (MA), with the first year falling between 1985 and 1988 and the second between 1989 and 1992. Changes were disaggregated to identify six sources of gross gain or loss in each rent category -- rent changes (filtering), new construction, permanent losses from the stock, temporary losses to or reinstatement from nonresidential use, shifts between rental and owner-occupied tenure, and conversions or mergers that increase or reduce numbers of housing units. After the next section introduces the rent categories used and the 41 MAs studied, the body of the paper explores six questions:

1. What have been the net changes in the private market units with rents affordable to households with incomes below 35% of area median family income, the "extremely low rent" stock (ELR)? What were the most important sources of losses and gains to that stock?

2. What were the gross and net sources of change for units in higher rent ranges?

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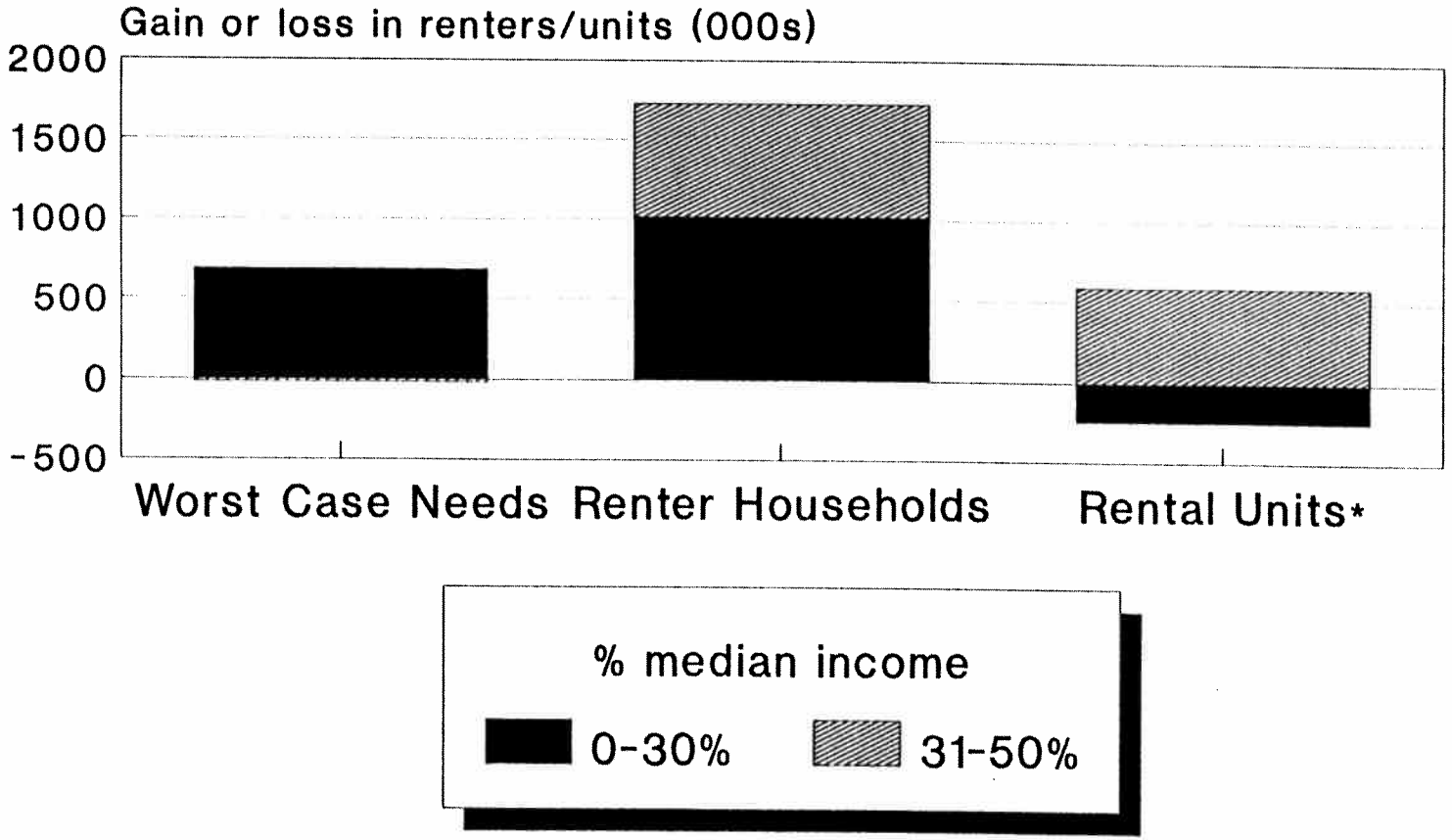
[1] U.S. Dept of Housing and Urban Development (HUD), *Rental Housing Assistance at a Crossroads: A Report to Congress on Worst Case Housing Needs*, March 1996. As that report illustrates, 30 percent of area median income is roughly equivalent to the national poverty line.

[2] "Worst case needs" refer to the severe housing problems of severely substandard housing, including homelessness, or paying more than half of income for rent, among unassisted renters with incomes below 50 percent of median family income in their area.

FIGURE 1

CHANGES IN WORST CASE NEEDS, RENTERS AND AFFORDABLE* RENTAL UNITS, 1989-1993, BY INCOME & RENT AS % OF AREA MEDIAN INCOME



*Rents assumed to be affordable if equal to 30% of household income.

1989 & 1993 American Housing Surveys

3. Because we find that rent changes were much more common than we had expected, how sensitive are these findings to different definitions of "filtering"?

4. How did dynamics vary across the 41 metropolitan housing markets?

5. How do results vary within metro areas within different types of submarkets?

6. How well do changes in the extremely-low- and very-low-rent stock explain changes in severe housing needs?

The rental affordability categories and metropolitan areas studied

The rental affordability categories used for the study are based on rents affordable to groups defined by income as a percent of an area's median family income, as used for most HUD rental programs. Table 1 shows the distribution of the rental units in the 41 MAs within these classes in the first and second years covered by the study. Rental units are categorized by the incomes to which they are "affordable" by assuming that 30 percent of income should be spent on gross rent, including utilities.[3] The category "Nonmarket" includes publicly assisted housing and units in which the occupants pay no rent (e.g., those provided free to employees or relatives of the owners).

Table 1
Distribution of Rental Units by Affordability
(Percentage of Rental Stock)

Rental Affordability Category*	41 MAs Year 1	41 MAs Year 2	Rest of U.S., 1985
Nonmarket	14%	15%	21%
1-35% (Extremely low rent)	9%	6%	11%
36-50% (Very low rent)	15%	15%	19%
51-65% (Low rent)	21%	21%	22%
66-80% (Moderate rent)	19%	19%	15%
81-100% (High rent)	13%	15%	8%
> 100% (Very high rent)	7%	9%	3%
Total units (millions)	18.05	18.91	19.46

* Household income, expressed as percentage of HUD-adjusted area median income (HAMFI), at which gross rent of unit equals 30 percent of income.

[3] The adjustments made by HUD in defining HUD-Adjusted Area Median Family Incomes (HAMFI) and other adjustments made in categorizing rental units into these affordability categories are discussed in the Appendix.

For comparison, Table 1 also shows the 1985 distribution of units among these rent categories in the rest of the U.S. Comparison shows that the 41 MAs studied here had lower shares of rental units affordable below either 50 percent or 35 percent of median income, and higher shares of the three highest rent categories, than the rest of the U.S. The 41 MAs are large, containing over one-third of U.S. households and 46 percent of the nation's rental stock. They also have tighter housing markets than the rest of the U.S., with lower vacancy rates as well as fewer affordable units. Between 1985 and 1993, such disparities worsened as they experienced higher rates of loss in extremely-low-rent units than the rest of the nation. On average, they also have higher shares of very-low-income renters and higher rates of worst case needs among them: 42 percent compared with 32 percent elsewhere.

Rent filtering was defined for the study as the movement of a unit's rent from one category of affordability in year 1 to another in year 2. If a rent increase moved a unit to a new category with higher rents in the second time period, the unit is said to have filtered up. Similarly, a rent decrease to a lower category would see the unit filtering down.

1. The dynamics of the extremely-low-rent stock.

In these 41 major metropolitan areas, the number of extremely-low-rent units with market-determined rents (those affordable to households with incomes at or below 35 percent of HAMFI) dropped by fully a third over the four-year periods studied. As Table 2 shows, very few housing units were physically added to the housing stock -- through new construction or conversion of non-residential buildings -- at rents affordable at these lowest income levels. More surprisingly, relatively few were lost through demolition, abandonment or conversion.

Most of the shrinkage in the stock of low-rent units occurred either because rents "filtered up" or because units switched to nonresidential use. By far the most common source for both gains and losses to the low-cost rental stock was "filtering," i.e., a change in rent category. Two-thirds of the net change (representing 21 percent of the first year stock) resulted from rent changes that on net moved units into higher (less affordable) rent ranges. About one percent switched to nonmarket housing. Physical changes on net removed only about 9 percent of the first year stock, and most of these were temporary losses to non-residential uses or net losses resulting from conversions and mergers. The net effect of new construction and permanent losses was to decrease the extremely-low-rent stock by 44,600 units, just under 3 percent of the beginning stock. Tenure changes (between rental and owner tenures) accounted for an even smaller net loss of 21,000 units, about one percent. Thus, rather than "dropping out of the bottom," units in the extremely-low-rent stock are being "skimmed off the top."

Table 2. Changes in the Extremely Low Rent Stock (Units Affordable at 1-35% of HAMFI)

	Gross Losses		Gross Gains		Net Change	
Cause	Units	Pct	Units	Pct	Units	Pct
Non-Market	121,362	7%	105,471	7%	-15,891	-1%
Market	756,623	47%	408,705	25%	-347,918	-21%
Total Filtering	877,985	54%	514,176	32%	-363,809	-22%
Conv'n/Merge	26,465	2%	6,217	0.4%	-20,248	-1%
Temp Loss	141,842	9%	64,708	4%	-77,134	-5%
Temporary Physical	168,307	10%	70,925	4%	-97,382	-6%
New Construction	NA	NA	6,298	0.4%	6,298	0.4%
Perm Loss	50,881	3%	NA	NA	-50,881	-3%
Permanent Physical	50,881	3%	6,298	0.4%	-44,583	-3%
Tenure Change	105,958	7%	85,120	5%	-20,838	-1%
Grand Total	1,203,131	74%	676,519	42%	-526,612	-33%

Through filtering, the extremely-low-rent stock suffered net losses to each other affordability class, as is illustrated in Figure 2. The biggest loss was to the next most affordable category, Very Low Rent units. Not surprisingly, the losses to less affordable categories decline steadily. Figure 2 also shows that only 26 percent of the stock that was extremely-low-rent in the first year was still in the rental stock with rents in the extremely-low-rent range at the end of four years.

Gross Flows Reveal Large Amount of "Churning". The small proportion of the extremely-low-rent stock that remained stable over the period implies that the net changes were achieved through a considerable amount of "churning." This is illustrated in Figure 2, with some of the gross gains and losses detailed in Table 2. The total of the inward and outward flows, almost 1.9 million units, is 116 percent of the original ELR stock. The largest part of these gross flows occurred because of filtering. Almost 1.4 million units, the equivalent of four-fifths of the beginning units, filtered either into or out of the extremely-low-rent stock.

The relatively small net effects of physical losses and tenure change are similarly the result of larger gross losses and gains. This is particularly true for temporary losses and recoveries, where the net loss of 6 percent was caused by a gross loss of 10 percent and a gross gain of 4 percent. Permanent changes were much more one-sided, as new construction of extremely-low-rent units added only 0.4 percent of the first year stock. Physical losses are quite small, and many that did occur are temporary. Some of the "temporary" losses indicated by the AHS may however *become* permanent, as dilapidated buildings are demolished rather than repaired or units are permanently converted to nonresidential uses. Even here, however, Table 2 suggests that the return flow is more than 40 percent of the losses. But tenure changes were quite evenly balanced. The net loss of around 21,000 units is the result of a combined gross flow of 191,000.

Thus, the conventional picture of housing units gradually shifting down to lower and lower rent categories before dropping out of the stock entirely is too simplified, if not thoroughly misleading. These results show that in these 41 MAs during the period studied rental units were if anything more likely to filter upward than downward.

2. Sources of change in the higher rent categories

At the same time that numbers of extremely-low-rent units declined by a third, the number of units affordable to households with higher incomes grew. While shortages of extremely-low-rent housing are serious and growing, markets appear to be supplying ample numbers of the "low and moderate rent" units that are affordable to households with incomes between 51 and 80 percent of median. Table 3 shows the detailed processes by which units were added and "lost" at different rent levels in the 41 MAs.

FIGURE 2

Sources of Change in ELR Stock

Percent of Year 1 ELR

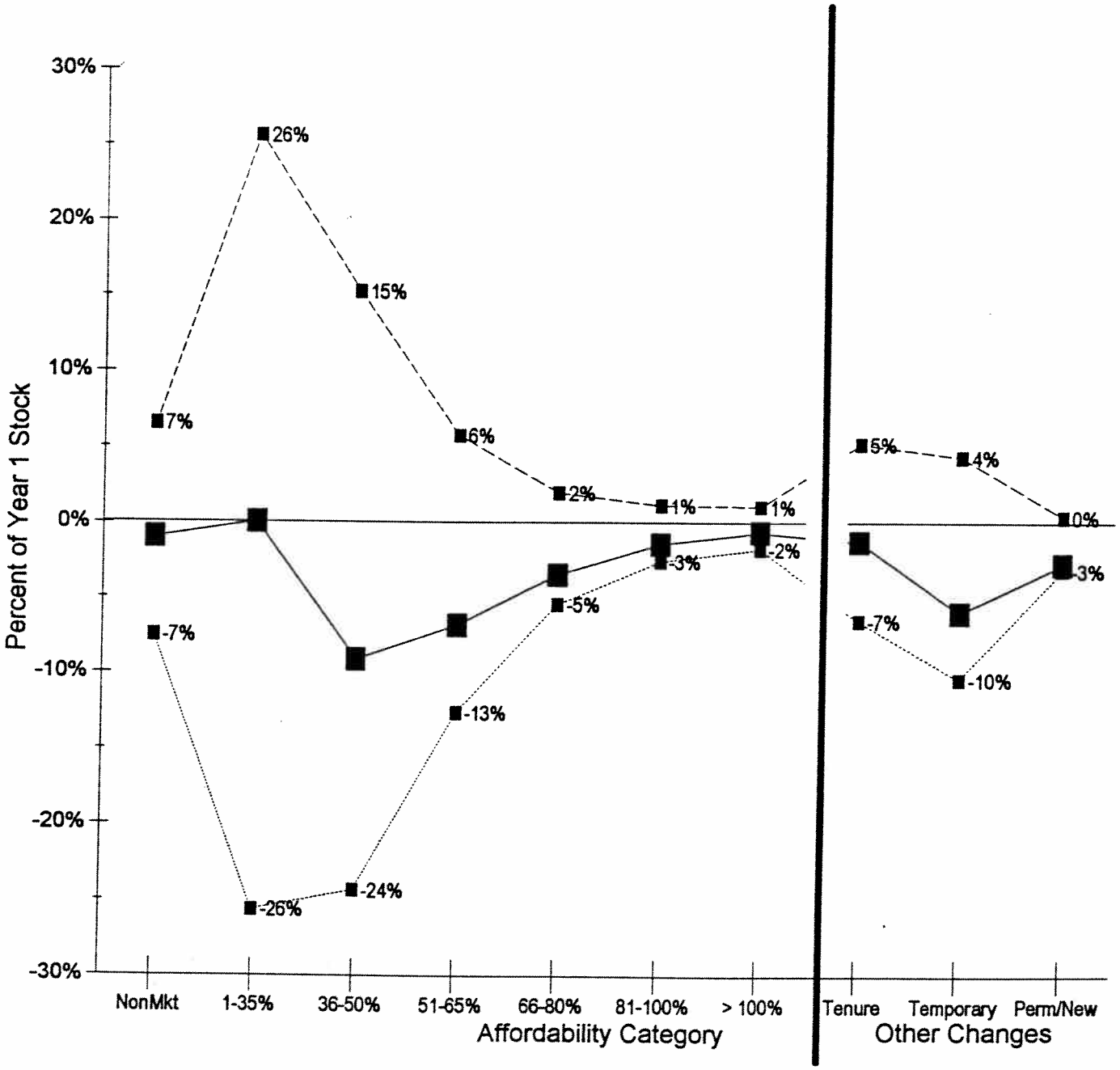


Table 3. Less Affordable Stock Gains at the Expense of the ELR Stock
(Changes as a percent of first year stock)

Affordability Category	Share of First Year Stock	Stable Rent	Total Change	**Net Changes**				
				Rent Change	Tenure Change	Temp Physical	New Constr.	Perm Loss
Non-Market	15.2%	59%	-1%	**3%**	3%	-6%	3%	-3%
1-35%	8.9%	26%	-33%	**-22%**	-1%	-6%	0%	-3%
36-50%	15.5%	39%	1%	**4%**	-1%	-2%	1%	-2%
51-65%	20.9%	40%	5%	**3%**	0%	0%	2%	-1%
66-80%	19.1%	37%	4%	**-2%**	-0%	1%	6%	-1%
81-100%	13.1%	39%	20%	**5%**	2%	3%	11%	-1%
> 100%	7.2%	46%	37%	**11%**	6%	4%	17%	-1%

Affordability Category	**Components of Filtering**				Total Two-Way Flow
	In From:		Out To:		
	Higher	Lower	Higher	Lower	
Non-Market	31%	NA	-29%	NA	60%
1-35%	25%	7%	-47%	-7%	86%
36-50%	29%	20%	-30%	-15%	94%
51-65%	25%	26%	-23%	-24%	98%
66-80%	18%	30%	-18%	-31%	97%
81-100%	11%	38%	-10%	-34%	92%
> 100%	NA	42%	NA	-31%	72%

About 40 percent of the stock in these categories remained stable over the period. (The somewhat higher stability in the highest class may merely reflect our definition, in which the highest category has all rents affordable only above median income and thus allows no way for these units to filter "up"). All the categories, except for those affordable at 66-80 percent of median, experienced net gains from filtering. Except for very-low-rent units, all the more expensive categories also received units from the temporarily lost units, suggesting that some of the temporary losses from the low end of the rent distribution may return at higher rent levels or as owner-occupied units, after renovation or "gentrification." The higher rent groups also experienced above- average new construction, while permanent and temporary loss rates were greatest in the lowest rent ranges, as indicated in Table 3.

At "moderate" rent levels (affordable to incomes between 66 and 80 percent of median) there was a 6 percent gain through new construction -- to a first-year base representing one-fifth of rental units. This gain was partly offset by a net loss of 2 percent through rent filtering.

In the "low rent" category (affordable to incomes at 51 to 65 percent of median), the net effect of rent change was to add 3 percent to an already large stock of housing units over a four-year period. New construction offset permanent losses so that the total stock grew by 5 percent.

Changes in the supply of units in the very-low-rent category were more complex. These are units with rents affordable at incomes between 36 and 50 percent of median. The net effect of rent filtering for this category was to add 4 percent to the number of these units in the 41 MAs studied. At the same time, one percent of these units were lost through conversion to homeownership, new construction added one percent, and 4 percent were permanently lost or otherwise taken out of residential use. On balance the number of "very-low-rent" units gained only 1 percent across these 41 metropolitan areas combined.

A closer look at the gross components of filtering shows that the more expensive stock also experienced high turnover such as that observed in the extremely-low-rent stock. Most of the net changes from filtering are in the single digits, but the gross flows are typically in the range of 20 to 30 percent. The average bidirectional flow is 86 percent of the original stock and at low and moderate rents approaches 100 percent. Thus, the small net changes resulting from filtering in all of the affordability categories with rents above the extremely-low-rent range mask intense filtering activity that was occurring in both directions.

3. Sensitivity of rental filtering to definitions of change in affordability categories

These results suggest that "filtering" due to a change in rent category was the main cause of shrinkage in the lowest-rent categories. Moreover, the total extent of filtering observed over the four-year periods was greater than had been expected. Fewer than half of the units that were in the rental stock in both years were also found to be in the same rent category in both years.

But this study defined "filtering" as *any* movement of a rental housing unit to a higher or lower affordability class, with no consideration given to whether the change in rent is large or small. It could be argued that this filtering definition is too specific, particularly since we adjusted our affordability measure to account for inflation and changes in the way the AHS measures utility cost as well as defining it in relation to area median income.[4] Small changes in affordability may be artifacts introduced by our adjustments and procedures. A more conservative approach would be to require changes in affordability that are large enough that we can be confident they represent real filtering. This section examines the degree to which the percentages of stock estimated to have filtered over time change if we require larger minimum thresholds on changes in housing affordability, measured in percentage points of HAMFI, to qualify as filtering.

Table 4 examines the disposition of first year rental units that remained rental units in the second year. These represent about two-thirds of the first year stock and are the only units for which the term "filtering" can possibly be relevant. The horizontal blocks of the table show the rental affordability categories of this study, plus the three kinds of disposition these units could have: filter down, stable, or filter up. The first vertical block shows the distribution of the first year rental stock by percentage points of change in rental affordability (measured relative to HAMFI). The second vertical block shows alternative estimates of filtering, first requiring only a change in category but no minimum threshold and then imposing thresholds of 3, 5, and 10 percentage points. The third block shows the effect on estimates of filtering of the alternative thresholds compared with the zero threshold method used in this study.

The table shows that the stable percentage of the stock increases (and the total amount of filtering decreases) by 2 to 5 percentage points, depending on the rent class, as the threshold increases from 0 to 5 percentage points. Increasing the threshold to 10 triples the change in most cases. Using a 5 point threshold changes the percent stable by around a tenth of the original figures. Thus, the zero-threshold method used by this study seems reasonably robust, unless *very* large uncertainties in the cost measure are suspected. The results in the Table suggest that the high rates of filtering found in this study are quite robust at all rent levels.

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[4] The appendix details the procedures and adjustments used.

Table 4. Measured Filtering is Little Affected by Modest Changes in Filtering Thresholds

First Year Affordability	Disposition	Percent of Year 1 Stock: Change in Affordability (Percentage Points of HAMFI) Any	0-2	3-4	5-9	> 10	Alternative Estimates of stock distribution: Filtering Threshold Zero	3%	5%	10%	Change in Estimate: Filtering Threshold 3%	5%	10%
	Filt Down	17	1	1	4	11	17	16	15	11	-1	-2	-6
ALL	Stable	32	13	6	9	4	32	34	36	43	+1	+3	+10
	Filt Up	18	1	1	3	14	18	18	17	14	-1	-2	-5
1-35%	Stable	26	11	4	6	4	26	27	28	33	+1	+2	+7
	Filt Up	47	1	1	5	40	47	46	44	40	-1	-2	-7
	Filt Down	9	1	1	3	4	9	8	7	4	-1	-2	-5
36-50%	Stable	39	18	8	10	2	39	41	44	53	+2	+5	+14
	Filt Up	30	1	2	6	20	30	29	27	20	-1	-3	-9
	Filt Down	19	1	1	5	11	19	18	16	11	-1	-2	-8
51-65%	Stable	40	18	8	11	2	40	42	45	55	+2	+5	+15
	Filt Up	23	1	2	5	16	23	23	21	16	-1	-2	-7
	Filt Down	27	1	2	6	18	27	26	24	18	-1	-3	-9
66-80%	Stable	37	15	8	11	2	37	39	41	51	+2	+5	+14
	Filt Up	18	1	1	3	13	18	18	16	13	-1	-2	-5
	Filt Down	32	1	1	7	22	32	31	29	22	-1	-2	-9
81-100%	Stable	39	15	7	11	6	39	40	42	50	+1	+3	+11
	Filt Up	10	0.2	0.4	1	8	10	9	9	8	-0.2	-1	-2
> 100%	Filt Down	29	1	1	4	24	29	28	27	24	-1	-2	-5
	Stable	46	9	6	11	20	46	47	48	51	+1	+2	+5

4. Variation across the 41 metropolitan housing markets

Aggregated across these 41 MAs, then, we find evidence that rent filtering is the main source of change in the rental stock, dwarfing changes caused by tenure shifts, physical losses, or new construction. Together, those sources resulted in extensive loss of the most affordable stock, as the number of extremely-low-rent units dropped by a third over only four years. But *net* changes appeared to be minimal for over two-thirds of the stock, as each of the rental categories affordable to incomes between 36 and 80 percent of median changed by less than 5 percentage points. These minimal average changes, however, conceal wide differences across MAs.

Examination of gains and losses in affordable units in the individual MAs reveals striking differences among them, with MAs -- and especially central cities -- on the East and West coasts tending to lose units in both the very-low- and extremely-low-rent categories. Table 5 lists the 41 MAs, ranking them by percentage change over 4 years in net numbers of market units affordable to incomes below 50 percent of area median, i.e., both the extremely-low-rent and very-low-rent stock.[5] The table identifies three groups of MAs, those with increases, slow loss, or rapid loss of private market units in these two most affordable categories.

The Anaheim, Boston, and New York MAs were the hardest hit: all lost well over a third of their extremely- or very-low-rent units. They were closely followed by Portland, Seattle, San Bernardino, and Los Angeles, metropolitan areas that lost between 30 and 33 percent of their very-low-rent stock. The only non-coastal cities with losses of one-fourth or more -- Houston and Phoenix -- had had very high rental vacancy rates at the start of the four-year period, as shown in the far right column of the exhibit. As Houston and Phoenix recovered from the "energy bust" and rental markets tightened, it is likely that rents rose among units with cyclically depressed rents.

While 12 MAs lost more than one-fourth of this affordable stock over four years, 17 had slow losses, losing up to one-fifth of very-low- and extremely-low-rent units. Yet over the same period, one-fourth of the MAs recorded net *gains* in extremely- or very-low-rent units, several of them at remarkable rates. The large increases in Denver, Dallas, Atlanta, and Fort Worth probably reflect energy "booms" and resulting overconstruction. Most of the other 12 MAs with gains were Midwestern.

Defining six types of MAs by changes in affordable units and growth. The MAs with increases, slow loss, or rapid loss of affordable stock were far from homogeneous on demand and supply factors such as population growth or housing construction often

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[5] To examine variation among MAs, we chose to examine net changes in both extremely-low-rent units and very-low-rent units combined because some MAs had unreliably small numbers of extremely-low-rent units.

Table 5. 41 MAs Ranked by 4-Year Percent Change in late 1980s in Market Units with Extremely Low or Very Low Rents

	YEAR 1	Year 1 MA Households	Share of Year 1 units very low rent	% change over 4 years: Private very low rent units	Renter households	Yr.1 Rental vacancy rates: All units
Denver	1986	721,508	31%	73%	1%	14%
Dallas	1985	871,173	31%	63%	7%	16%
Atlanta	1987	998,868	28%	36%	5%	17%
Newport News	1988	479,635	32%	23%	6%	13%
Fort Worth	1985	438,713	36%	19%	11%	20%
Saint Louis	1987	912,587	53%	10%	−3%	12%
Columbus	1987	507,744	45%	6%	1%	10%
Detroit	1985	1,555,768	58%	6%	−1%	8%
Oklahoma City	1988	372,938	71%	4%	2%	19%
Kansas City	1986	584,850	48%	2%	5%	15%
Pittsburgh	1986	876,768	52%	1%	4%	14%
New Orleans	1986	487,710	46%	1%	−12%	16%
Birmingham	1988	349,017	53%	−1%	4%	13%
Providence	1988	375,451	41%	−3%	3%	11%
Indianapolis	1988	475,373	52%	−4%	−1%	11%
Minneapolis	1985	855,768	43%	−5%	2%	8%
Salt Lake City	1988	344,124	68%	−6%	4%	15%
Memphis	1988	359,588	43%	−7%	2%	13%
Cincinnati	1986	534,510	55%	−8%	1%	10%
Cleveland	1988	719,851	62%	−8%	−4%	10%
Tampa	1985	784,968	25%	−8%	11%	18%
Rochester	1986	360,824	46%	−9%	4%	9%
San Diego	1987	769,324	15%	−10%	14%	9%
Baltimore	1987	846,381	47%	−12%	0%	8%
Chicago	1987	2,717,528	46%	−14%	−4%	12%
San Antonio	1986	431,108	40%	−14%	5%	17%
Miami	1986	1,155,860	24%	−19%	8%	14%
Hartford	1987	368,586	43%	−21%	6%	8%
Washington	1985	1,308,921	42%	−21%	2%	7%
Newark−No.N.J.	1987	2,080,809	34%	−25%	−5%	6%
San Francisco	1985	1,358,536	29%	−27%	1%	6%
Houston	1987	1,248,011	75%	−28%	3%	23%
Philadelphia	1985	1,736,590	38%	−28%	−10%	12%
Phoenix	1985	654,360	23%	−29%	19%	19%
Los Angeles	1985	2,858,181	22%	−30%	3%	6%
San Bernardino	1986	705,629	26%	−31%	27%	13%
Seattle	1987	928,362	42%	−32%	8%	9%
Portland, OR	1986	546,592	48%	−33%	2%	9%
New York	1987	4,392,170	36%	−37%	−9%	5%
Boston	1985	1,487,909	38%	−38%	0%	5%
Anaheim	1986	773,996	12%	−48%	8%	6%
Avg.		983,819	41%	−8%	3%	12%
Max		4,392,170	75%	73%	27%	23%
Min		344,124	12%	−48%	−12%	5%

considered important in explaining changes in housing markets. To probe the dynamics underlying different outcomes in more detail, we identified six groups of MAs, using rates of new housing construction over 8 years (from 4 years before year 1 until year 2) to distinguish high from low growth. As the summary at the bottom of Table 6 shows, within each of the three outcome groups, the high construction Type A areas had faster growth in both total households and renter households than their slower growth counterparts. Probably because of their higher rates of new construction, Type A groups also tended to have higher rental vacancy rates, particularly at the lower end of the market.

Two of the slow-growth groups, 1B and 2B, stand out for having the highest shares of market and nonmarket units with rents affordable below 50 percent of median. More than half of their Year 1 rental units were affordable to very-low-income renters, compared to around one-third in the other four groups. In this important respect, these two groups resemble the rest of the U.S. more closely than the other MAs in this study. Those MA groups also had relatively low rates of worst case needs among their very-low-income renters (41 or 42 percent), and relatively low Fair Market Rents (FMRs). As the right column shows, 2-bedroom FMRs there averaged 30 percent of income for families with incomes around 54 or 56 percent of area median income.

Slow growth does not *guarantee* affordability, however, as group 3B demonstrates. These six very large coastal MAs had the lowest share of affordable units, the lowest vacancy rates, and the highest FMRs, averaging 73 percent of HAMFI. Their rapid loss of private very-low-rent units (-31 percent) implies that they became even less affordable over the four-year periods studied, even though demand for rental housing apparently dropped in these areas as numbers of renter households fell.

Rent dynamics in these 6 MA groups. When we examine dynamics by rent category across these groups of MAs distinguished by great diversity in rental outcomes and in growth rates (Table 7), several important patterns emerge. Most notable is the consistency at which extremely-low-rent units were being lost because of upward filtering in **all** groups, even in those MAs with high new construction and net growth in affordable units. In each group, permanent and temporary losses were also greatest among extremely-low-rent units. Secondly, examining total rates of growth in each of the higher rent ranges, it is clear that the relatively small net changes shown for all 41 on average (in Table 2 above) mask considerable diversity across MAs. Nevertheless, thirdly, within most of these groups the dynamic forces appear internally consistent in tending to shift units toward the fastest-growing rent ranges.

Pervasive losses in extremely-low-rent stock: If the extremely-low-rent group were to grow anywhere, it might be expected to gain in the loosest markets, and thus in group 1A, where new construction outpaced household growth and increased the

Table 6. Rental and Renter Characteristics of 6 Groups of Metropolitan Areas, Grouped by 4-Year Percent Change in Private Market Units with Rents Affordable to Very Low Incomes and High or Low Rates of New Construction over 8 Years

	Share of Year 1 units very low rent	% change over 4 years in: Private very low rent units	MA households All	MA households Renter	Yr.1 Rental vacancy rates: All units	Rents < 65% of med.income	8 years of New Constrctn as % of Yr. 1	1994 FMR as % of med. income
Group 1A								
Dallas	31%	63%	8%	7%	16%	24%	43%	57%
Atlanta	28%	36%	8%	5%	17%	17%	41%	55%
Fort Worth	36%	19%	10%	11%	20%	31%	39%	53%
Newport News	32%	23%	7%	6%	13%	14%	28%	62%
Denver	31%	73%	3%	1%	14%	16%	23%	53%
Columbus	45%	6%	4%	1%	10%	9%	21%	50%
Kansas City	48%	2%	4%	5%	15%	15%	20%	49%
Group 1B								
Oklahoma City	71%	4%	2%	2%	19%	20%	15%	50%
Birmingham	53%	−1%	2%	4%	13%	14%	15%	55%
Saint Louis	53%	10%	1%	−3%	12%	12%	15%	47%
New Orleans	46%	1%	−7%	−12%	16%	18%	13%	63%
Detroit	58%	6%	3%	−1%	8%	8%	10%	54%
Pittsburgh	52%	1%	2%	4%	14%	14%	6%	57%
Group 2A								
Tampa	25%	−8%	7%	11%	18%	21%	34%	68%
San Diego	15%	−10%	14%	14%	9%	6%	33%	68%
San Antonio	40%	−14%	6%	5%	17%	24%	29%	67%
Miami	24%	−19%	6%	8%	14%	17%	28%	79%
Washington	42%	−21%	10%	2%	7%	6%	22%	60%
Minneapolis	43%	−5%	8%	2%	8%	9%	21%	54%
Baltimore	47%	−12%	4%	0%	8%	7%	20%	56%
Memphis	43%	−7%	2%	2%	13%	15%	20%	54%
Hartford	43%	−21%	11%	6%	8%	8%	20%	62%
Group 2B								
Salt Lake City	68%	−6%	7%	4%	15%	14%	19%	49%
Indianapolis	52%	−4%	5%	−1%	11%	12%	18%	52%
Cincinnati	55%	−8%	3%	1%	10%	9%	12%	49%
Providence	41%	−3%	1%	3%	11%	8%	12%	69%
Rochester	46%	−9%	4%	4%	9%	9%	12%	57%
Chicago	46%	−14%	−3%	−4%	12%	12%	12%	62%
Cleveland	62%	−8%	0%	−4%	10%	11%	7%	54%
Group 3A								
San Bernardino	26%	−31%	25%	27%	13%	8%	53%	67%
Phoenix	23%	−29%	21%	19%	19%	31%	49%	56%
Houston	75%	−28%	2%	3%	23%	24%	31%	57%
Seattle	42%	−32%	10%	8%	9%	9%	25%	59%
Anaheim	12%	−48%	8%	8%	6%	4%	23%	67%
Portland, OR	48%	−33%	6%	2%	9%	9%	14%	58%
Group 3B								
Newark−No.N.J.	34%	−25%	−0%	−5%	6%	6%	13%	68%
San Francisco	29%	−27%	4%	1%	6%	5%	12%	78%
Los Angeles	22%	−30%	4%	3%	6%	7%	11%	78%
Boston	38%	−38%	3%	0%	5%	4%	11%	70%
Philadelphia	38%	−28%	2%	−10%	12%	13%	10%	66%
New York	36%	−37%	−5%	−9%	5%	5%	5%	78%
# 1A Increase – High	36%	32%	6%	5%	15%	18%	31%	54%
# 1B Increase – Low	55%	4%	1%	−1%	14%	14%	12%	54%
# 2A Slow loss – High	36%	−13%	8%	6%	11%	13%	25%	63%
# 2B Slow loss – Low	53%	−7%	2%	0%	11%	11%	13%	56%
# 3A Rapid Loss – High	38%	−33%	12%	11%	13%	14%	33%	61%
# 3B Rapid Loss – Low	33%	−31%	1%	−3%	7%	7%	10%	73%

Table 7
Sources of Gains and Losses in Rental Stock by Rental Affordability Among 6 Groups of MAs Defined by Change in Affordable Units and High or Low Construction of New Housing
(Changes as Percent of Year 1 Stock)

Rent group	Year 1 % dist.	Total change	Stable rent	Net from filt'g up	Net Rent Change	Tenure Change	New Constructn	Perm Loss & other
Metro group 1A: VLR gain-high construction								
TOTAL		10	34	0	0	3	8	-1
Extremely l	9%	-33	21	-52	-23	1	0	-12
Very low	14%	84	43	-3	72	5	5	-2
Low	27%	31	41	7	18	4	9	1
Moderate	23%	-14	24	9	-27	1	11	2
High	12%	-31	21	7	-46	4	12	1
Very high	2%	-19	15	20	-41	7	15	2
Metro Group 1B: VLR gain-low construction								
TOTAL		0	40	0	0	2	3	-4
Extremely	16%	-22	31	-37	-10	1	0	-13
Very low	22%	21	43	2	20	0	1	-5
Low	24%	4	41	7	3	3	2	-3
Moderate	14%	-10	34	16	-16	0	5	2
High	6%	-4	27	23	-19	-2	19	-0
Very high	1%	-48	16	22	-23	-19	13	-13
Metro Group 2A Some loss - high construction								
TOTAL		8	43	0	0	1	7	-0
Extremely	7%	-30	27	-44	-17	1	1	-11
Very low	13%	-11	37	-24	-6	-1	1	-4
Low	21%	9	45	-3	9	-1	2	-1
Moderate	21%	21	44	13	12	0	8	2
High	16%	13	38	17	-8	3	15	3
Very high	6%	27	32	20	-16	6	28	9
Metro Group 2B Some loss - low construction								
TOTAL		1	47	0	0	0	2	-1
Extremely	13%	-27	32	-42	-17	-5	0	-7
Very low	24%	3	50	-10	2	2	0	-1
Low	25%	11	51	10	9	1	1	-1
Moderate	13%	9	41	23	4	-0	6	1
High	7%	-2	33	17	-7	-3	9	1
Very high	3%	-8	26	32	-19	1	6	6
Metro Group 3A Marked loss - high construction								
TOTAL		9	41	0	0	1	9	-1
Extremely	13%	-52	23	-51	-36	-2	0	-9
Very low	22%	-15	42	-10	-5	-3	0	-4
Low	20%	20	45	13	18	-1	4	-0
Moderate	17%	31	43	14	11	3	15	2
High	12%	37	45	22	6	3	22	5
Very high	5%	53	39	27	-4	12	37	7
Metro Group 3B Marked loss - low construction								
TOTAL		3	41	0	0	0	3	-1
Extremely	5%	-31	21	-52	-24	-2	1	-6
Very low	11%	-28	28	-33	-15	-3	0	-4
Low	17%	-20	30	-24	-16	-2	0	-1
Moderate	21%	-6	36	-1	-2	-2	1	-2
High	16%	32	44	31	21	1	6	1
Very high	12%	43	54	45	21	6	13	1

rental stock by 8 percent over 4 years, and where rental vacancy rates were above 15 percent. But even there, fully half of the extremely-low-rent stock was lost because of rent increases. On net, the extremely-low-rent stock fell 23 percent because of filtering and lost 12 percent from permanent and temporary losses.

The only MA group in which extremely-low-rent fell **more** rapidly than in 1A was the high growth group 3A in which new construction increased the total first year rental stock by 9 percent. Half of the extremely-low-rent stock was also lost there because of filtering up, but in this tighter market fewer units filtered down to replace them. The results were a net loss of more than a third (-36 percent) from filtering and total shrinkage of more than half of the extremely-low-rent stock (-52 percent).

Total losses in extremely-low-rent units were lowest, but still more than a fifth (-22 percent), in the relatively lethargic group 1B, in which renter households dropped by 1 percent over four years while the total number of rental units remained constant. *Here*, more of the net drop was due to temporary or permanent losses (-13 percent) than to net filtering (-10 percent), with many of the losses among inadequate units. Yet even in these loose markets, over one-third of the extremely-low-rent units filtered up to higher rent ranges. (As discussed below, these losses were greatest in low poverty areas.)

Wide variation across MAs in net and gross changes in the very-low-rent stock: Across the six groups of MAs, net changes in the very-low-rent group varied from a gain of 84 percent (in Group 1A) to a loss of -28 percent in group 3B. This was obviously the rent range responsible for the diversity in individual MA outcomes detailed in Table 5.

In Group 1A, the very-low-rent range gained stock equivalent to 75 percent of its original units through filtering down. New construction also added 5 percent directly to this range (more than in any other MA group). High rates of new construction and loose markets probably also contributed to the 5 percent net gain from tenure changes from ownership, since 1A's gain to the total rental stock of 3 percent from tenure changes is greater than that occurring in any other group.

In sharp contrast to gains in 1A, the tight markets of group 3B had the greatest *losses* in very-low-rent stock. Moreover, 3B was the only group to experience net losses of stock in ranges as high as those affordable to incomes between 50 and 80 percent of median. Net losses because of filtering occurred across these ranges, and were exacerbated by permanent and temporary losses there and by losses due to tenure change. These markets appear to be the ones most vulnerable to gentrification, since they lost 2-3 percent of stock to ownership in each rental category from extremely-low to moderate rents. In these MAs, the high and very high rent ranges were the *only* ones to gain units over four years, primarily because of filtering, but also from new construction. In these high-cost MAs, differentials by rent level in

gross and net filtering, new construction, and net growth all point to continued pressure to raise rents into our highest (open-ended) category of rents affordable only to incomes *above* area median.

Consistent dynamics within groups: Despite their very different experiences of growth or decline in the very-low-rent range, all of these groups other than 3B exhibit differentials in filtering by rent class that suggest some tendencies for rents to converge toward the rent ranges experiencing fastest growth. For two groups (1A and 1B), those differentials even suggest some downward pressure on rents, since above-average growth occurred in ranges *below* current FMRs during the period studied. For groups 2A and 3A, however, they imply upward pressure on FMRs despite high rates of new construction and high vacancy rates.

In 1A and 1B, the fastest growth occurred in the very-low-rent range, below the average FMR level of 54 percent of HAMFI, and also below the modal category. In group 2B, total gains and gains from filtering are both highest in the low rent range, which is roughly at the level of existing FMRs. In 2A, however, growth was greatest at moderate rents, suggesting some pressure to raise FMRs above their already high average of 63 percent. In 3A, filtering increased stock fastest in the low rent range, below current FMRs of 71 percent. However, total growth rates were higher in the higher rent ranges affordable above 65 percent of median, primarily because new construction was concentrated there.

5. Variations among submarkets

To further explore reasons for shrinkage of the lowest rent units, net changes and dynamics were also analyzed for zones within MAs categorized by poverty rates, minority composition, and age of the housing stock.[6] The findings generally support conventional wisdom. Rents were more likely to filter up in zones with low poverty rates, low shares of minority population, or older housing; rents more often filtered down in zones with older housing or in which poverty rates or minority shares exceeded 20 percent. The total rental stock was expanding most rapidly in low poverty or minority zones, because of both new construction and tenure conversions; it was contracting most in zones with high poverty or minority concentrations, because of relatively high permanent and temporary losses.

Table 8 illustrates how net filtering and total percent change varied by poverty of zone within each MA group. In each group, losses of extremely-low-rent units were greatest in low poverty areas, and relatively affordable units were most likely to increase (or less likely to decrease) in the zones with poverty rates above 20 percent.

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[6] AHS "zones" are aggregates of census tracts within MAs with at least 100,000 people each, selected to be relatively homogeneous with respect to income, housing age and structure type, and minority composition. The AHS sample size does not permit reliable analysis of individual zones.

Table 8.
Net Filtering and Total Change of Low Rent Market Units by Affordability and Zone Poverty for 6 Groups of Metropolitan Areas, Grouped by Change in Units Affordable to Very Low Incomes and Rate of Construction of Housing Units (Changes as a percent of first year stock)

MA group:	1A	1B	2A	2B	3A	3B
Change in units:	Increase		Slow loss		Rapid loss	
New construction:	High	Low	High	Low	High	Low
Net Filtering of Low Rent Market Units						
Extremely low rent units:						
Low poverty (<10%)	-36%	-27%	-13%	-20%	-49%	-22%
Medium	-16%	-21%	-29%	-21%	-39%	-23%
High poverty (20%+)	2%	7%	-6%	-15%	-13%	-27%
Very low rent units						
Low poverty (<10%)	101%	31%	-18%	-8%	-17%	-21%
Medium	60%	25%	5%	11%	-2%	-27%
High poverty (20%+)	22%	9%	3%	6%	17%	4%
Low rent units						
Low poverty (<10%)	28%	5%	3%	12%	15%	-20%
Medium	2%	5%	20%	11%	22%	-10%
High poverty (20%+)	-10%	-4%	11%	14%	17%	-17%
Total Percent Change in Low Rent Market Units by Zone Poverty						
Extremely low rent units:						
Low poverty (<10%)	-45%	-43%	-11%	-34%	-69%	-38%
Medium	-27%	-34%	-49%	-28%	-54%	-27%
High poverty (20%+)	-9%	-3%	-25%	-23%	-25%	-27%
Very low rent units						
Low poverty (<10%)	122%	32%	-22%	-8%	-17%	-26%
Medium	62%	31%	-5%	17%	-2%	-39%
High poverty (20%+)	26%	5%	5%	5%	17%	-16%
Low rent units						
Low poverty (<10%)	43%	11%	3%	12%	31%	-2%
Medium	12%	2%	19%	2%	32%	-8%
High poverty (20%+)	-12%	-3%	14%	22%	-4%	-28%

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6. Do changes in the extremely-low- and very-low-rent stock explain changes in severe housing needs?

The impetus for this study of changes in the affordable stock arose from worsening mismatches between extremely-low-income renters and units affordable to them and evidence that cross-sectional differences in worst case needs are correlated with shortages of affordable units. Having estimated changes in the extremely-low- and very-low-rent stock, we therefore sought to evaluate their role in short-term changes in worst case needs.

Regressions using changes in the housing stock and population to explain changes in worst case needs by metropolitan area indicate that the most important variables are on the demand side: percentage change in the proportion of extremely low income renters and total households (see Table 9). However, the first year vacancy rate and the change in the proportion of extremely-low-rent units are also significant and tend to decrease worst case needs. The ratio of affordable units to extremely low income households is a measure of the potential for putting every household in a unit it can afford. Increases in this ratio decrease changes in worst case needs, as expected. The only other significant variable is a dummy for the year 1990, to capture macroeconomic conditions (the default year for the regression is 1989).

It thus appears that changes in the supply of extremely-low-rent units are not as important as changes in demand in explaining short-run variations among MAs in changes in worst case needs.

Table 9. Regression on Percent Change in Worst Case Needs by MSA

(41 MSAs, Adjusted $R^2 = 0.74$)

Description	Mean	Coef	SE	t-Value	p-Value
Intercept/Dependent Variable	**6.99**	**76.38**	**24.50**	**3.12**	**0.003**
Change in Proportion Extremely Low Income Renters	**-2.56**	**4.20**	**0.93**	**4.54**	**0.000**
Percent Change in Total Households	**6.00**	**3.18**	**0.87**	**3.67**	**0.001**
Vacancy Rate Year 1	**12.14**	**-2.26**	**0.71**	**-3.20**	**0.003**
Change in Proportion of Extremely Low Rent Units	**-3.29**	**-4.46**	**1.48**	**-3.01**	**0.004**
Affordable units per ELI household in first year	**87.06**	**-0.29**	**0.12**	**-2.41**	**0.021**
Year 1990	*0.27*	*-8.55*	*4.83*	*-1.77*	*0.085*
Year 1991	0.27	-8.86	5.54	-1.60	0.118
Census Division 7	0.15	-19.52	12.74	-1.53	0.133
Change in Proportion of Very Low Income Renters	-0.61	2.33	1.63	1.43	0.161
Change in Proportion of Very Low Rent Units	0.69	0.73	0.52	1.40	0.169
FMR / HAMFI Ratio	57.89	-0.37	0.32	-1.17	0.247
Percent New Construction	5.43	-1.34	1.19	-1.13	0.266
Change in Proportion of Non-Market Units	0.33	1.16	1.77	0.65	0.518
Year 1992	0.20	-3.81	7.74	-0.49	0.625
Percent Change Total Rental Units	5.53	-0.30	0.84	-0.36	0.719

Note: Results in **boldface** are significant at the 5% level. Results in *italics* are significant at the 10% level.

Appendix

This appendix explains some of the technical operations performed on the data in this study. Two issues are addressed:

- Calculating the housing cost measure
- Constructing a consistently weighted longitudinal sample

Calculating housing cost

The housing cost measure used in this study reflects the eligibility requirements of HUD and other federal housing assistance programs. These programs typically consider the housing cost burdens on households whose incomes are some specified percentage of the local (PMSA) median income, with certain adjustments. The benchmark for eligibility is referred to as the HUD Adjusted Median Family Income, or HAMFI. Most assistance programs prescribe that a family should have to spend no more than 30% of their incomes on housing. Consequently, in this study, the housing cost of a given housing unit is expressed as the *minimum percentage of HAMFI that a family would have to earn in order to spend 30% of its income on housing while living in the unit.*

Use of First Year Income: Because the housing cost measure is tied to income, it is subject to variation from changes in income as well as changes in rent. Thus, a decline in the stock of housing affordable to households at a certain percentage of HAMFI may reflect a decline in income instead of an increase in rent. To simplify the interpretation of changes in affordability, all cost measures are expressed in terms of *first year* HAMFI. Second year housing costs are compared to inflation-adjusted first year HAMFI, where the inflation adjustment factor is 1.18, the average national four-year increase in the Consumer Price Index during the period 1985-92.

Bedrooms: HUD eligibility rules call for adjusting income limits according to the number of persons in the household. Although this study is concerned with measuring the cost of housing units and not the incomes of households, a

realistic evaluation of cost burden requires accounting for the sizes of families that units could accommodate, using the HUD standard of no more than two persons per bedroom. Consequently, the median income used in the housing cost calculation is adjusted by a factor that reflects the higher income limits for larger households. These adjustment factors are shown in Table A1.

Utility payments: There are two kinds of adjustments related to utility payments, one for vacant units and one for first year units. The AHS does not record utility costs for vacant units. These were estimated by allocating costs from occupied units in the same MSA, of the same type (single or multifamily), and in the same $100-wide rent class. A "hot deck" technique was used in which the vacant unit was assigned the same utility costs of the most recently encountered unit in its class.

Table A1. Income Adjustment Factors by Bedroom

Bedrooms	Adjustment Factor
0	0.70
1	0.75
2	0.90
3	1.04
4	1.16
5	1.28
6	1.40
7+	1.52 + 0.12 for each additional bedroom

Table A2. Percentage Adjustment in Utility Cost by Census Division

Census Division	Electric	Gas
New England	-2.4%	-13.8%
Mid. Atlantic	-4.3%	-10.1%
E.N. Central	-6.1%	-12.4%
W.N. Central	+8.6%	-16.7%
S. Atlantic	+0.5%	-26.3%
E.S. Central	-29.8%	-35.2%
W.S. Central	-1.0%	-35.2%
Mountain	-11.8%	-22.5%
Pacific	-13.8%	-13.9%

Source: Data from John Cannon, Census Bureau, 4/7/95

In 1989 the AHS made a change in the questions related to utility costs, which resulted in a decrease in the reported costs for most units. In order to avoid spurious changes in housing cost, this study adjusts first year housing costs to reflect the average reduction in gas and electric costs, by the nine Census divisions. The percentage adjustments are listed in Table A2. These apply to units whose respondents indicated that they paid for the utilities separately from rent.

Constructing a Consistently Weighted Sample

The rental stock dynamics study was intended to use the longitudinal features of the American Housing Survey to trace the changes of individual housing units as they moved into and out of the rental housing stock. However some problems in the AHS have to be addressed. The standard weights supplied with the AHS dataset are calibrated for each survey year in order to yield totals that are consistent with Census estimates of housing units for those years. The weights are not suitable for longitudinal analysis because this calibration essentially zeros out any unit whose status is unknown because of

changes in the sample size, refusal to be interviewed, failure of the interviewers to locate the units, and other administrative reasons. Of these causes, by far the most serious is the change in sample size.

Over the years of the survey, the number of units interviewed was reduced and expanded in response to budgetary changes. The result of these modifications is that the link between years is broken for many units. There are units that were present in the first year but whose dispositions in the second are unknown. There are also units in the second year that are not new construction but whose source is unknown. The data from the two years also have weights that cannot be compared with each other. Thus, it was necessary to extract a subsample of observations that could be reliably linked to both years and to devise a system of weights that would yield valid comparisons between and within years.

Choosing Panels and Observations: Each observation in the American Housing Survey is assigned to a panel, determined by the month (April through December) in which the first interview of that housing unit was conducted. The observations are divided among the panels in such a way that each panel is an unbiased subsample for that year. For the most part, changes in the sample sizes from one survey to the next were accomplished by adding or subtracting whole panels. Thus, by restricting the analysis to those panels that were present in both years for a particular metropolitan area, a longitudinally valid subsample can be extracted. Table A3 shows the number of observations that are available in both years for each metropolitan area and the first and last panels that were chosen for the consistent, linked sample. Except for certain metropolitan areas (see note 2 in Table A3), selected panels included the complete set from one year of each pair. In the exceptional cases, each year had one or more panels that its counterpart lacked, and the intersection of the sets had to be used. Except for the 1985/89 pair and the cases noted above,

the first year panels were used in their entirety, while some of the second year panels had to be dropped.

Table A3. Selected Panels and Reweighting Factors

SMSA	First Year	Base Year	Reweight Factor(1)	Panels First	Panels Last	Total Obs
Boston	85	second	1.1428	4	10	4499
Dallas	85	second	1.0000	4	10	3841
Detroit	85	second	2.0000	4	10	7078
Fort Worth	85	second	1.0000	4	10	3772
Los Angeles	85	second	2.0000	4	10	7010
Minneapolis	85	second	1.1428	4	10	4376
Philadelphia	85	second	2.0000	4	10	7266
Phoenix	85	second	1.1428	4	10	4424
San Francisco	85	second	2.0000	4	10	7214
Tampa	85	second	1.1428	4	10	4129
Washington	85	second	2.0000	4	10	7197
Anaheim	86	first	1.3524	6	12	5087
Cincinnati	86	first	1.3218	6	12	5077
Denver	86	first	1.3961	6	12	4934
Kansas City	86	first	1.3224	6	12	5402
Miami	86	first	1.4541	6	12	5508
New Orleans	86	first	1.3165	6	12	4831
Pittsburgh	86	first	1.3396	6	12	4688
Portland, OR	86	first	1.3654	6	12	5055
Rochester	86	first	1.3270	6	12	5078
San Antonio	86	first	1.3525	6	12	5086
San Bernardino	86	first	1.3938	6	12	5873
Atlanta	87	first(2)	1.1429	6	11	5072
Baltimore	87	first(2)	1.1429	6	11	4876
Chicago	87	first(2)	1.1429	6	11	4819
Columbus	87	first(2)	1.1429	6	11	4737
Hartford	87	first(2)	1.1429	6	11	4725
Houston	87	first(2)	1.1429	6	11	4091
New York	87	first(3)	1.2858	6	12	4755
Newark	87	first(3)	1.2858	6	12	4658
Saint Louis	87	first(2)	1.1429	6	11	4997
San Diego	87	first(2)	1.1429	6	11	4754
Seattle	87	first(2)	1.1429	6	11	4884
Birmingham	88	first	1.1250	5	12	5230
Cleveland	88	first	1.1250	5	12	4767
Indianapolis	88	first	1.1250	5	12	5143
Memphis	88	first	1.1250	5	12	5438
Newport News	88	first	1.1250	5	12	5490
Oklahoma City	88	first	1.1250	5	12	5203
Providence	88	first	1.1250	5	12	5307
Salt Lake City	88	first	1.1250	5	12	5090
Total						128311

Notes:

1. Reweight Factor is the ratio of the weight used (new or old) to the weight not used (old or new). It is used to adjust weight of new construction, etc.
2. non-nested panels: all weights must be increased by 1/6
3. different panels from the rest of 87/91: no weight adjustment of matching cases

In the 1985/89 pair the second year (1989) had the smaller number of panels. In five metropolitan areas in this group (Detroit, Los Angeles, Philadelphia, San Francisco, and Washington) the number of observations *within* each panel was reduced in the second year, by about half. This left first year observations in selected panels that could not be linked to second year observations. These observations were dropped. Since the second year pure weights (see below) are used as the basis of weighting for the 1985/89 cases, dropping these orphans from the first year did not require any adjustment to the weights of the other cases.

Reweighting: The "pure weight" was used instead of the standard weights. The pure weight is the inverse probability that the unit would be selected for inclusion in the survey. This is determined *a priori* by the sampling design and is not subject to modifications and calibration of the standard weight. Since most year pairs include the full sample from one of the years, the pure weight from this complete sample was used where possible. This is called the "base year" in the discussions below. The weights of a few sets of observations had to be adjusted. One set included the units that were not in the sample during the year whose pure weights are used. The most common of these were the new construction in the second year, for all of those year pairs that used first year pure weights. The "off year" pure weights are related to the base year weights but are generally smaller because of the larger number of panels in their survey (greater sample size means that each sampled unit represents fewer units in the population). To compensate for this difference the off year weights were multiplied by a "reweighting factor." The reweighting factor is the ratio of the base year pure weight to the off year pure weight, averaged over all the

observations that were present in both years. The values of the reweighting factors for each metropolitan area are listed in Table A3.

Except for New York and Newark/Northern New Jersey, the 1987 survey used panels 6 through 12, while the 1991 survey used panels 4 through 11. Thus data for each year include panels not present in the other. The overlapping panels, 6 through 11, were the ones used, with 1987 serving as the base year for weighting. All of the weights in the selected panels are increased by 1/6, in order to spread the weight of the lost panel (12) over the remaining six.

A more complicated problem is posed by the presence of observations that had pure weights in the base year but that could not be included in the analysis, such as:

- Type A units: these were not interviewed because the occupants refused, the unit could not be located, or some similar reason. The fate of any unit that was Type A in either year cannot be traced, because one or both of the links are missing.
- Missing second year: a few valid units were simply not interviewed in the second year, due to administrative errors.
- Excessive new construction sampling: In 1987 too many newly constructed units were added to the sample. In 1991 these excessive units were dropped, leaving observations for them in the first year but not the second.
- "Simple errors:" A very few observations had obvious and unresolvable coding errors in important variables.

The excess new construction sampling in 1987 was handled by dropping the "orphan" observations and increasing the weights of the remaining new construction observations proportionately. The other problem observations were also eliminated, but redistributing their weights was more complicated. The procedure was:

1. Find units as similar to dropped ones as possible.
2. Determine total weight of dropped observations as a proportions of the total weight of good observations.
3. "Ratio up" good weights to account for losses, provided that the weight increased by less than 100%, keeping any outliers for the next pass.
4. Drop one classification variable and repeat the process for the outliers, until none remain.

Similarity among units was defined as units sharing the same values for all the variables listed in Table A4.[1] The weights of the observations to be dropped were spread across the valid observations in the same cell. As was noted above, if this caused the weight of any valid observation to more than double (or if there were simply no *valid* observations in the cell), the observation was saved for the next pass. In each pass, the classification system was simplified by dropping one variable, until the weights of the dropped observations could be distributed without unduly magnifying the weights of any valid observations. The variables were dropped from bottom to top, as listed in Table A4, except that in the third pass the Metro variable was collapsed, as the table indicates. It took five passes to completely redistribute the weights of the dropped observations.

Recalibrating the consistent weights: As a final step, the consistent weights were recalibrated so that the total rental housing in each metropolitan area in the first year of each pair was equal to the total computed using the standard AHS weights for that year. This ensured that the beginning totals would be consistent with other studies of these markets. For each MSA, the AHS weights and consistent weights were summed over all rental units, and the

[1]The base year value for these variables was used whenever possible. If that was missing, the off-year value was substituted.

ratio of the former to the latter was calculated. Each consistent weight was then multiplied by this ratio.

Table A4. Variables Used in Redistributing Weights

Variable	Description	Comments
SMSA	Metropolitan area code	unmodified
Metro	Metropolitan status	Initially collapsed into three codes: 1. primary central city 2. secondary central city 3. suburb in the third pass, both central city codes were collapsed into one
ZoneCode	Zone w/ more than 25% very low income households	zero/one dummy variable, calculated by aggregating AHS income data (Zlinc2) over AHS zones
Tenure	Tenure (own/rent/vacant)	unmodified
Type	Unit Type	Collapsed into five codes: 1. house/apartment 2. mobile home 3. other housing 4. other non housing 5. missing/error
History	sample status	Collapsed into three codes: 1. in sample before 2. house/mobile moved in 3. other