American Housing Survey

Components of Inventory Change And Rental Market Dynamics: Columbus 1995-2002

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Overview

Housing analysts use two techniques—Components of Inventory Change (CINCH) and rental market dynamics—to look at a housing market at two points in time and explain how the observed changes came about in physical (bricks and mortar) terms. CINCH focuses first on the overall number and then the characteristics of units at different times. Using CINCH methods, analysts answer such question as: "What happened to the x units that disappeared from the housing stock between the beginning and the end of the period?" or "Where did the increase in owner-occupied units come from?" Rental market dynamics, which is really a type of CINCH analysis, focuses on the rental market with particular emphasis on the affordability of rental housing. Using rental market dynamics techniques, analysts answer such questions as: "Have the number of rental units affordable to households with very low incomes increased or decreased over the period?" or "What happened to the units that were affordable to low-income households at the beginning of the period?"

Previously HUD commissioned CINCH and rental market dynamics analyses using the national American Housing Survey (AHS).[1] This report focuses on the Columbus metropolitan housing market over the period between 1995 and 2002. It is one of 13 reports based on local American Housing Surveys conducted in 2002; these 13 metropolitan areas were previously surveyed in either 1994 or 1995.

CINCH and rental market analysis have both forward-looking and backward-looking components. In the forward-looking components, analysts start with the housing stock available at the beginning of the period and then, looking at the end of the period, attempt to explain what happened to those units. Possible answers include some units still exist and serve the same market, some units still exist but serve a different market, some units have been demolished or destroyed in natural disasters, or some units are being used for nonresidential purposes. In the backward-looking component, analysts start with the housing stock available at the end of the period and, looking at the beginning of the period, attempt to explain where those units came from. Possible answers include some units existed at the beginning of the period and served the same market, some units existed at the beginning of the period but served a different market, some units were newly constructed over the period, or some units were being used for nonresidential purposes at the beginning of the period. Neither CINCH nor rental market dynamics try to track the experience of a unit over the entire period; both are interested only in the beginning and the end of the period. For example, a housing unit in 1995 may have become a medical office in 1997, but returned to being a housing unit in 2000. CINCH

[1] See http://www.huduser.org/datasets/cinch.html and http://www.huduser.org/datasets/ahs/ahsReports.html#2.

would record this unit as having undergone no change over the period from 1995 to 2002. In classical analytical jargon, CINCH and rental market dynamics are *comparative static* analyses.

Ideally one would want to combine the forward-looking and backward-looking analyses to produce a complete accounting that can explain the beginning and the end consistently in terms of units that existed in both periods, losses from the stock over the period, and additions to the stock over the period. The analysis in this report uses the AHS, which is a sample of units at both points in time; and, unfortunately, previous efforts using the AHS have demonstrated that creating sample weights that take both periods into account generates some inconsistent or inaccurate results. For this reason, the most recent analyses have separated the forwarding-looking and backward-looking components. This report will do the same. (Weighting is explained briefly in Appendix B and more fully in a separate paper cited in the Appendix.)

The remainder of this report consists of four sections:

- An explanation of how to read the CINCH tables.
- Two sets of four tables each: a set of forward-looking tables tracing the movement of units from 1995 to 2002 and identifying how units were lost to the housing stock; and a set of backward-looking tables tracing where 2002 units came from and distinguishing between units that were part of the stock in 1995 and units that were additions to the stock since 1995.
- A brief discussion of the rental market dynamics.
- Two rental market dynamics tables, one forward-looking and one backward-looking.

At various places, the discussion points out some of the limitations of these analyses or of using the AHS metropolitan samples for these analyses.

Two appendixes explain how the results were tested and how the weights were created.

How to Read CINCH Tables

Rows and columns serve different purposes in CINCH tables. The rows identify classes of units to be analyzed. The columns trace those units either forward or backward.

> The forward-looking tables are concerned with what happened to the 1995 housing stock by 2002. There are three basic dispositions of 1995 units: units that continue to exist in 2002 with the same characteristics (or serving the same market), units that continue to exist in 2002 but with different characteristics (or serving a different market), and units that were lost to the stock.

The backward-looking tables are concerned with where the 2002 housing stock came from in reference to 1995. There are three basic sources of 2002 units: units that existed in 1995 with the same characteristics (or serving the same market), units that existed in 1995 but with different characteristics (or serving a different market), and units that are additions to the housing stock.

Since the essence of the CINCH analysis is in the columns, we will explain the columns in detail.

Columns Common to Both Forward-Looking and Backward-Looking Tables:

- The first and last columns contain the row numbers. The row numbers are identical for the same tables in the forward-looking and backward-looking sets.

Columns A through E set up the analysis and track units that exist in both periods.

- Column A specifies the characteristic that defines the subset of the stock that is being tracked forward or backward in a particular row. For example, row 2 of Table 1 focuses on occupied units; row 15 focuses on units built in 1985 through 1989.

- Column B gives the estimate published in the AHS report for the number of units that satisfy the conditions specified in column A. For example, the 1995 AHS report for Columbus counted 556,200 occupied units (column B, row 2, Forward-Looking Table 1); the 2002 AHS report counted 613,200 occupied units (column B, row 2, Backward-Looking Table 1).

- Column C gives the CINCH estimate of the number of units that satisfy two conditions: (a) being part of the housing stock in the relevant year (1995 for the forward-looking tables and 2002 for the backward-looking tables); and (b) satisfying the condition in column A. CINCH uses different weights than those used in preparing the published reports. Therefore, CINCH estimates can differ from AHS estimates for particular subsets of the housing stock. As explained in Appendix B, the weights were created to match AHS published totals for rows 2 through 4 of Table 1. This perfect match will not be true of other rows.[2] In the case of the Columbus metropolitan area, the CINCH weights produce estimates that are very close to the published estimates with two exceptions: Backward-Looking Table 1 underestimates units built after 1989, and Backward-Looking Table 4 underestimates the number of owner-occupied units with low housing costs.

[2] Columns B and C will also match, except for rounding, in row 1 of Table 1 because row 1 is defined as the sum of rows 2 through 4.

- Column D is the CINCH estimate of the number of units from column C that (a) are also part of the housing stock in the *other* year, and (b) continue to belong to the subset defined by column A. For example, column D of row 2 of Forward-Looking Table 1 estimates that 496,020 of the occupied units were occupied in 2002.

- Column E is the CINCH estimate of the number of units from column C that (a) are also part of the housing stock in the *other* year, but (b) no longer belong to the subset defined by column A. Column E of row 2 indicates that 49,350 units that were occupied in 1995 are still part of the housing stock in 2002 but are no longer occupied. In some cases, the analysis will not allow a unit to change characteristics between the base year and the other year. Examples include type of structure, year built, and number of stories—characteristics that are considered impossible or unlikely to change.

Columns Unique to Forward-Looking Tables

In forward-looking tables, columns F through K track what happened to units that were lost from 1995 to 2002.

- Column F is the CINCH estimate of the number of units from column C that are not in the 2002 housing stock because they were merged with other units or converted into multiple units. Among occupied units, 1,100 units were lost to mergers and conversions.

- Column G is the CINCH estimate of the number of mobile homes from column C that were moved out during the period. Among occupied units, 160 mobile homes were moved out. The AHS does not follow a manufactured housing unit that is moved and, therefore, cannot distinguish between units that are relocated and units that are demolished. It treats all moves as losses.

- Column H is the CINCH estimate of the number of units from column C that became nonresidential at the end of the period. For example, a real estate firm, a tax preparation office, a palm reader, or some other business might buy or rent a house to use for business rather than residential purposes.[3] Among occupied units, 2,750 became nonresidential.

- Column I is the CINCH estimate of the number of units from column C that were demolished or were destroyed by fires or natural disasters by 2002. In this case, 4,100 units were demolished or destroyed.

- Column J is the CINCH estimate of the number of units from column C that by 2002 were condemned or that were no longer usable for housing because of

[3] If the owner or tenant both lives in a unit and conducts business out of the unit, the AHS considers the unit to be residential. So nonresidential means strictly no residential use.

extensive damage. Among occupied units, 480 units are no longer usable for housing.

- Column K is the CINCH estimate of the number of units from column C that were lost by 2002 for other reasons. These include units that the Census Bureau eliminated for sampling purposes and other miscellaneous losses. Among occupied units, there were 2,230 units lost for these miscellaneous reasons.

The columns form a closed system. Column C counts the number of units tracked; columns D through K account for all the possible outcomes. Therefore, column C minus the sum of columns D through K always equals zero, except for rounding.[4]

Columns Unique to Backward-Looking Tables

In backward-looking tables, columns F through I track where units came from that are part of the housing stock in 2002, but were not part of the housing stock in 1995.[5]

- Column F is the CINCH estimate of the number of mobile homes from column C that were moved in during the period. Among occupied units, 150 mobile homes were moved in (column F, row 2 of Backward-Looking Table 1).[6] Move-ins are treated as additions to balance the treatment of move-outs as losses.

- Column G is the CINCH estimate of the number of units from column C that had been nonresidential in 1995. Among occupied units, 910 had been nonresidential.

- Column H is the CINCH estimate of the number of units from column C that were newly constructed between 1995 and 2002. Among occupied units, 67,860 units were newly constructed.

- Column I is the CINCH estimate of the number of units from column C that were added by 2002 for other reasons. These include units that were considered temporary losses because occupancy was prohibited in 1995 or the interior of the unit was exposed to the elements, and also units that the Census Bureau considered temporarily lost to the housing stock for reasons "not classified." Among occupied units, 150 had been temporarily lost to the stock in 1995.

[4] The weighted numbers are rounded to the nearest 10. The AHS publication rounds to the nearest 100. We found that rounding to the nearest 10 worked better for the metropolitan sites. The weights were typically in the range of 100 to 300 and in many rows the numbers in columns F through K were small. With a weight of 149, rounding to the nearest hundred would mean that one sample observation would be rounded to 100, two sample observations to 300, and three sample observations to 400. Rounding to the nearest ten results in weighted totals of 150, 300, and 450 for these cases.

[5] This list does not contain a column for units added through mergers and conversions. The Census Bureau did not code the variable that would normally identify mergers and conversions in 2002 (REUAD=7 or 8).

[6] The Census Bureau did not code the variable that would normally identify mobile home move-ins in 2002 (REUAD=4). We estimated these from another variable (NOINT=13).

Table 1

Table 1 focuses on the general housing characteristics of the stock. Row 1 provides the highest level CINCH overview of the stock. For this row, column A specifies no conditions other than being part of the stock in the relevant year.

Rows 2-4 divide the housing stock by use. By Census Bureau definition, the number of occupied non-seasonal units equals the number of households. Because households are the basis for all the analyses in Tables 2 through 4, it is important to get a good starting point for these estimates. For this reason, the weights are designed to match published AHS totals for occupied units, vacant units, and seasonal units.

Rows 5-12 divide the housing stock by type of structure to identify what type of units account for losses.[7] The Census Bureau sometimes suppresses data to protect the confidentiality of respondents. For some metropolitan areas, suppression results in zero estimates for certain multiunit structures in the public data file, whereas the published tables contain estimates for these multiunit classes. Because of suppression, units in structures with 50 or more units are listed in row 10 instead of row 11 in Forward-Looking Table 1 for the Columbus metropolitan area.

Rows 13-23 divide the housing stock by year built.[8] The published reports use the categories 1990-1994, 1995-1999, and 2000-2004; we use 1990-1995 and 1996-2002 to isolate units newly constructed since the previous AHS survey.[9] Column I shows that the incidence of losses due to demolition or disasters was highest for units built in the 1930s and 1940s, or built in 1919 or earlier.

Rows 24-30 and 31-35 divide the housing stock by two different measures of interior space, the number of rooms and the number of bedrooms.[10] Column H in the forward-looking table and column G in the backward-looking table show that smaller units in terms of the number of rooms are more likely to move into and out of nonresidential use.

Rows 36-41 focus on multiunit structures only and divide them by number of stories. Column E is forced to be zero and, depending on the metropolitan area, the Census Bureau may suppress information, forcing some rows to be zero. In general, the published reports contain matching data for row 36 only.

Rows 42-43 divide the housing stock between central cities units and suburban residences to determine how the observed changes vary by location. Rows 44-45 divide the housing

[7] In general, the CINCH estimates exceed published AHS estimates for single-family detached units and fall short of the published AHS estimates for manufactured homes by roughly equal amounts.
[8] Row 13 is not included in the forward-looking tables, because the 1995 housing stock cannot contain units built after 1995.
[9] We use REUAD=3 and not year built to identify new construction. For this reason, there are units built after 1995 that are not considered new construction. In addition, year built is obtained from the respondent interview and may be inaccurate.
[10] Because of small sample sizes in the losses and additions columns, we combined room categories that the published reports list separately.

stock by whether or not the occupants have moved in within the last two calendar years to determine if certain units consistently have high turnover and to see if high turnover units are more susceptible to loss.

Table 2

This table pertains to issues related to the physical quality of units. Row 1 repeats the analysis from row 2 in Table 1. All the subsequent rows are based on row 1.

Rows 2-3 look at whether the units have complete kitchens; that is, have an installed sink with piped water, a mechanical refrigerator, and built-in burners for the exclusive use of the occupants. Rows 4-5 look at whether the units have complete plumbing facilities; that is, hot and cold piped water, a flush toilet, and a bathtub or shower inside the structure for the exclusive use of the occupants. Rows 6-8 look at each of these requirements separately. In the 1995 AHS, the published reports separate out the "exclusive use" category; in the data used for this report, these units show up in row 8. Rows 2-3, 4-5, and 6-8 attempted to separate out good units from the least desirable units, based on kitchen and bath equipment, to compare how they changed over the period.

Rows 9-13 pertain to how units obtain water and dispose of sewage.

Rows 14-19 look at units with serious problems. Rows 15-19 identify specific types of serious deficiencies. Row 14 counts the units having one or more of these deficiencies. Rows 20-25 look at units with moderate problems. Rows 21-25 identify specific types of deficiencies. Row 20 counts the units having one or more of these deficiencies.[11] These rows are in the analysis to answer two questions: whether poor-quality units in one year are also poor-quality units in the other year, and whether poorer quality units are more likely to be lost. Both the forward-looking and backward-looking analyses indicate that there is virtually no continuity over the 7 years with respect to having serious physical problems. Fewer than 3 percent of the units with serious problems in 1995 had serious problems in 2002, and fewer than 4 percent of the units with serious problems in 2002 had had serious problems in 1995. Slightly more continuity was shown with respect to units with moderate problems. Of the units with moderate problems in 1995, 11 percent still had moderate problems in 2002, and approximately 10 percent of the units with serious problems in 2002 had had serious problems in 1995. Fewer than 2 percent of the units had serious problems in either year, and fewer than 4 percent had moderate problems in either year.

[11] For definitions of serious and moderate problems see pages 998 and 999 of the AHS Codebook, version 1.77, at http://www.huduser.org/intercept.asp?loc=/Datasets/ahs/AHS_Codebook.pdf.

Table 3

This table pertains to the characteristics of occupants. Row 1 repeats the analysis from row 2 in Table 1. All the subsequent rows are based on row 1.

Rows 2-3 look at the age of the householder. Rows 4-5 look at whether the household includes children. Rows 6-11 look at the race or ethnicity of the householder. Rows 12-14 look at three possible sources of household income. In all cases, the analysis seeks to determine how stable the occupancy characteristics are over time, and what part of the market was served by units that lost between 1994 and 2002. Units occupied by Black householders were seven times more likely to be demolished or destroyed than units occupied by White householders (3.0 percent versus 0.4 percent).

Table 4

Table 4 pertains to tenure, income, and housing costs. Row 1 repeats the analysis from row 2 in Table 1. All the subsequent rows are based on row 1.

Rows 2-4 focus on tenure to determine the extent to which units change tenure characteristics and whether rental or owner-occupied units are more likely to be lost. Rental units in Columbus were more than eight times as likely to be lost due to demolition or disasters as owner-occupied units (1.7 percent versus 0.2 percent).

Rows 5-11 contain a partial rental dynamics analysis.[12] Row 5 identifies non-market units, a class that includes subsidized units and units provided for no cash rents; for example, units given to maintenance or management personnel or to relatives. The remaining rows divide market rental units into affordability classes. In defining affordability, the analysis sets boundaries for each class based on the highest rent a household in an income group could afford without spending more than 30 percent of its monthly income on rent. Ideally there would be six categories in each metropolitan area:

- Extremely-low-rent units (rents affordable to households with incomes equal to 35 percent of area median family income).
- Very-low-rent units (rents not affordable at 35 percent, but affordable at 50 percent of area median family income).
- Low-rent units (rents not affordable at 50 percent, but affordable at 65 percent of area median family income).
- Moderate-rent units (rents not affordable at 65 percent, but affordable at 80 percent of area median family income).

[12] The rental dynamics analysis is partial because it traces movement out of, but not into, particular rental classes. Tables A and B in the final section of this report contain a complete rental dynamics analysis.

- High-rent units (rents not affordable at 80 percent, but affordable at 100 percent of area median family income).

- Very-high-rent units (rents not affordable at 100 percent of area median family income).

For most metropolitan areas studied, the number of categories is fewer than six, because the Census Bureau had to place an upper limit on the rents reported in the public-use data to protect the confidentiality of respondents. In Columbus, there are only four classes, with moderate-rent, high-rent, and very-high-rent units grouped into one class.

Rows 12-16 track rental units by household income; rows 22-26 track owner-occupied units by household income.[13]

Rows 17-21 identify owner-occupied units by total monthly housing costs.[14]

[13] Because of small sample sizes in the losses and additions columns, we combined income categories that the published reports list separately.
[14] Because of small sample sizes in the losses and additions columns, we combined cost categories that the published reports list separately.

Forward-Looking Table 1: Structural and Location Characteristics – All Housing Units

	A Characteristics	B Published numbers	C Present in 1995	D 1995 units present in 2002	E Change in character-istics	F '95 units affected by conversion /merger	G '95 mobile homes moved out	H '95 units changed to nonresidential use	I '95 units lost through demolition or disaster	J '95 units badly damaged or condemned	K '95 units lost in other ways	
1	**Total Housing Stock**	604,900	604,900	589,470	0	1,550	580	3,320	5,980	620	3,380	1
	Occupancy Status											
2	Occupied	556,200	556,200	496,020	49,350	1,110	160	2,750	4,100	480	2,230	2
3	Vacant	46,800	46,800	11,750	30,580	430	290	580	1,870	140	1,150	3
4	Seasonal	1,900	1,900	590	1,180	0	130	0	0	0	0	4
	Units in Structure											
5	1, detached	370,900	378,470	373,120	0	0	420	1,440	2,110	140	1,230	5
6	1, attached	87,600	85,260	82,310	0	0	0	940	1,690	160	160	6
7	2 to 4	45,900	47,030	45,150	0	940	0	320	320	0	300	7
8	5 to 9	31,700	31,150	29,730	0	0	0	320	620	160	320	8
9	10 to 19	24,900	25,200	23,980	0	460	0	300	160	0	290	9
10	20 to 49	16,700	26,340	24,970	0	140	0	0	930	0	300	10
11	50 or more	10,000	0	0	0	0	0	0	0	0	0	11
12	Mobile Home/trailer	17,200	11,450	10,210	0	0	160	0	140	160	780	12
	Year Built											
14	1990-1995	60,600	58,720	57,960	0	0	0	40	120	0	610	14
15	1985-1989	43,600	42,470	41,860	0	0	0	140	0	0	460	15
16	1980-1984	20,900	20,120	20,120	0	0	0	0	0	0	0	16
17	1970-1979	182,300	181,890	177,170	0	320	160	1,110	1,870	160	1,100	17
18	1960-1969	89,400	88,590	86,800	0	140	0	610	430	160	450	18
19	1950-1959	63,700	65,340	64,100	0	160	0	300	620	0	160	19
20	1940-1949	34,200	34,590	32,910	0	140	0	480	610	0	450	20
21	1930-1939	21,800	22,170	20,820	0	160	280	0	910	0	0	21
22	1920-1929	25,800	26,860	26,390	0	300	0	160	0	0	0	22
23	1919 or earlier	62,500	64,150	61,330	0	320	140	480	1,420	300	160	23

Forward-Looking Table 1 (continued): Structural and Location Characteristics – All Housing Units

	A Characteristics	B Published numbers	C Present in 1995	D 1995 units present in 2002	E Change in character-istics	F '95 units affected by conversion /merger	G '95 mobile homes moved out	H '95 units changed to nonresidential use	I '95 units lost through demolition or disaster	J '95 units badly damaged or condemned	K '95 units lost in other ways	
	Rooms											
24	1 – 4 rooms	163,400	162,280	126,540	28,500	1,230	290	1,240	2,470	320	1,680	24
25	5 rooms	123,700	121,890	67,320	50,530	320	0	930	2,010	0	780	25
26	6 rooms	121,500	121,810	58,940	59,950	0	140	800	1,040	160	770	26
27	7 rooms	83,100	84,440	32,500	51,290	0	140	360	140	0	0	27
28	8 rooms	60,000	61,950	21,420	40,230	0	0	0	300	0	0	28
29	9 rooms	30,400	30,820	8,710	21,950	0	0	0	0	0	160	29
30	10 rooms or more	22,900	21,720	8,060	13,510	0	0	0	0	140	0	30
	Bedrooms											
31	None	7,200	7,720	2,020	4,650	0	0	320	140	0	590	31
32	1	64,400	63,780	52,850	7,980	300	0	140	1,720	320	460	32
33	2	181,400	178,100	147,970	24,790	930	290	1,240	1,480	0	1,400	33
34	3	244,400	246,490	208,930	32,670	320	140	1,460	2,200	160	610	34
35	4 or more	107,500	108,810	86,300	21,310	0	140	160	430	140	320	35
36	**Multiunit Structures**	129,200	129,720	123,830	0	1,550	0	940	2,030	160	1,210	36
	Stories in Structures											
37	1		11,120	10,660	0	160	0	0	160	0	140	37
38	2		46,510	45,730	0	160	0	160	300	0	160	38
39	3		57,790	54,860	0	1,080	0	620	620	0	610	39
40	4 to 6		14,300	12,590	0	140	0	160	940	160	300	40
41	7 or more		0	0	0	0	0	0	0	0	0	41
	Metro Status											
42	In central cities		300,970	291,870	0	1,230	160	1,900	3,980	620	1,210	42
43	In suburbs		303,930	297,600	0	320	420	1,430	1,990	0	2,170	43
	Mover Status											
44	Moved in last 2 years		139,070	39,540	95,230	800	160	1,270	1,430	0	640	44
45	Not a recent mover		417,130	349,970	60,640	320	0	1,470	2,670	480	1,590	45

Forward-Looking Table 2: Condition of Unit – All Occupied Units

	A Characteristics	B Published numbers	C Present in 1995	D 1995 units present in 2002	E Change in character-istics	F '95 units affected by conversion /merger	G '95 mobile homes moved out	H '95 units changed to nonresidential use	I '95 units lost through demolition or disaster	J '95 units badly damaged or condemned	K '95 units lost in other ways	
1	**Occupied Units**	556,200	556,200	496,020	49,350	1,110	160	2,750	4,100	480	2,230	1
	Kitchen											
2	With complete kitchen	550,700	550,730	484,610	55,770	1,110	160	2,430	4,100	480	2,070	2
3	Lacking complete kitchen facilities	5,400	5,470	690	4,300	0	0	320	0	0	160	3
	Plumbing											
4	With all plumbing facilities	552,100	552,120	487,770	53,990	1,110	160	2,590	3,940	480	2,070	4
5	Lack some plumbing	4,100	4,080	350	3,260	0	0	160	160	0	160	5
6	No hot piped water	200	670	170	170	0	0	160	0	0	160	6
7	No bathtub/shower	200	670	170	170	0	0	160	160	0	0	7
8	No flush toilet	200	3,920	170	3,430	0	0	160	160	0	0	8
	Water											
9	Public/private water	497,700	493,570	437,210	47,010	1,110	160	2,390	3,780	480	1,430	9
10	Well	57,300	61,430	48,960	11,150	0	0	360	320	0	640	10
11	Other water source	1,100	1,200	520	520	0	0	0	0	0	160	11
	Sewer											
12	Public sewer	483,800	480,590	426,010	45,230	1,110	160	2,390	3,780	480	1,430	12
13	Septic tank/cesspool	72,300	75,430	61,630	12,330	0	0	360	320	0	800	13
14	**Severe Problems**	7,100	7,180	170	6,210	0	0	320	320	0	160	14
15	Plumbing	4,100	4,080	170	3,430	0	0	160	160	0	160	15
16	Heating	2,100	2,070	0	1,910	0	0	0	160	0	0	16
17	Electric	0	0	0	0	0	0	0	0	0	0	17
18	Upkeep	1,000	1,030	0	870	0	0	160	0	0	0	18
19	Hallways	0	0	0	0	0	0	0	0	0	0	19
20	**Moderate problems**	17,200	17,290	1,910	15,060	0	0	320	0	0	0	20
21	Plumbing	200	0	0	0	0	0	0	0	0	0	21
22	Heating	500	520	0	520	0	0	0	0	0	0	22
23	Kitchen	4,700	5,470	690	4,300	0	0	320	0	0	160	23
24	Upkeep	12,000	12,660	1,040	11,460	0	0	160	0	0	0	24
25	Hallways	0	0	0	0	0	0	0	0	0	0	25

Forward-Looking Table 3: Household Characteristics – All Occupied Units

	A Characteristics	B Published numbers	C Present in 1995	D 1995 units present in 2002	E Change in character-istics	F '95 units affected by conversion /merger	G '95 mobile homes moved out	H '95 units changed to nonresidential use	I '95 units lost through demolition or disaster	J '95 units badly damaged or condemned	K '95 units lost in other ways	
1	**Occupied units**	556,200	556,200	496,020	49,350	1,110	160	2,750	4,100	480	2,230	1
	Age											
2	Under 65	459,000	457,410	375,180	73,310	1,110	160	2,430	2,990	480	1,750	2
3	65 or older	97,300	98,790	58,250	38,630	0	0	320	1,110	0	480	3
	Children											
4	Some	204,000	204,980	115,370	86,590	160	0	1,110	960	0	800	4
5	None	352,200	351,220	250,480	92,930	960	160	1,630	3,150	480	1,430	5
	Race/Origin											
6	White	478,700	479,840	399,010	73,180	960	160	2,430	2,030	160	1,910	6
7	Hispanic	3,300	3,130	870	2,260	0	0	0	0	0	0	7
8	Non-Hispanic	475,400	476,710	393,980	75,090	960	160	2,430	2,030	160	1,910	8
9	Black	65,100	63,590	41,580	19,140	160	0	320	1,910	320	160	9
10	Other	12,400	12,780	4,340	8,120	0	0	0	160	0	160	10
11	Total Hispanics	5,900	5,510	1,220	4,300	0	0	0	0	0	0	11
	Income Source											
12	Wages and salaries	450,900	449,970	361,640	81,170	1,110	160	2,110	2,190	320	1,270	12
13	Welfare or SSI	36,100	37,530	8,160	26,820	0	0	640	1,110	320	480	13
14	Social security or pension	145,100	146,260	81,640	62,550	0	160	320	1,110	0	480	14

Forward-Looking Table 4: Market Dynamics and Affordability – All Occupied Units

	A Characteristics	B Published numbers	C Present in 1995	D 1995 units present in 2002	E Change in character-istics	F '95 units affected by conversion /merger	G '95 mobile homes moved out	H '95 units changed to nonresidential use	I '95 units lost through demolition or disaster	J '95 units badly damaged or condemned	K '95 units lost in other ways	
1	**Occupied units**	556,200	556,200	496,020	49,350	1,110	160	2,750	4,100	480	2,230	1
	Tenure											
2	Owner occupied	350,500	353,110	315,550	35,330	160	160	520	600	0	800	2
3	Percent own occupied	63.0%	63.5%	63.6%	71.6%	14.3%	100.0%	18.8%	14.6%	0.0%	35.7%	3
4	Renter occupied	205,700	203,090	144,620	49,870	960	0	2,230	3,500	480	1,430	4
	Rental Affordability											
5	Non-market		30,120	12,890	13,890	160	0	480	1,910	320	480	5
6	Extremely low rent		71,530	41,620	26,560	320	0	960	1,270	0	800	6
7	Very low rent		70,500	22,400	46,360	480	0	640	320	160	160	7
8	Low rent		20,690	2,260	18,270	0	0	160	0	0	0	8
9	Moderate to very high rent		10,240	1,910	8,330	0	0	0	0	0	0	9
	Renter Hsd Income											
12	Less than $20,000	84,900	85,250	30,950	48,570	480	0	1,270	2,870	160	960	12
13	$20,000 to $34,999	64,100	61,740	12,800	46,700	320	0	640	640	160	480	13
14	$35,000 to $59,999	41,300	41,700	9,680	31,380	160	0	320	0	160	0	14
15	$60,000 to $99,999	13,200	12,670	1,390	11,290	0	0	0	0	0	0	15
16	$100,000 or more	2,100	1,740	170	1,560	0	0	0	0	0	0	16
	Owner Monthly Housing Costs											
17	Less than $499	133,600	135,720	71,570	63,200	0	160	320	160	0	320	17
18	$500 to $699	56,100	56,390	10,500	45,530	0	0	40	0	0	320	18
19	$700 to $999	82,100	85,280	21,270	63,410	160	0	160	280	0	0	19
20	$1,000 to $1,499	52,700	51,160	18,490	32,510	0	0	0	160	0	0	20
21	$1,500 or more	26,600	24,550	13,060	11,330	0	0	0	0	0	160	21
	Owner Hsd Income											
22	Less than $20,000	48,500	47,790	12,150	35,160	0	0	160	160	0	160	22
23	$20,000 to $34,999	77,300	77,110	17,970	58,510	160	0	0	160	0	320	23
24	$35,000 to $59,999	103,000	106,280	28,340	77,300	0	160	200	280	0	0	24
25	$60,000 to $99,999	83,100	84,620	30,470	53,990	0	0	160	0	0	0	25
26	$100,000 or more	38,700	37,300	21,790	15,190	0	0	0	0	0	320	26

Backward-Looking Table 1: Structural and Location Characteristics – All Housing Units

	A Characteristics	B Published numbers	C Present in 2002	D 2002 units present in 1995	E Change in character-istics	F '02 mobile homes moved in	G '02 units derived from nonresidential use	H '02 units added by new construction	I '02 units added from temporary losses	
1	**Total**	682,600	682,600	604,210	0	150	1,320	76,630	290	1
	Occupancy Status									
2	Occupied	613,200	613,200	509,280	34,850	150	910	67,860	150	2
3	Vacant	67,600	67,600	12,190	46,210	0	410	8,640	140	3
4	Seasonal	1,800	1,800	560	1,120	0	0	120	0	4
	Units in Structure									
5	1, detached	426,300	434,320	383,370	0	0	150	50,650	140	5
6	1, attached	114,200	112,190	94,130	0	0	150	17,760	150	6
7	2 to 4	46,800	46,780	42,990	0	0	590	3,200	0	7
8	5 to 9	31,400	31,530	28,750	0	0	150	2,630	0	8
9	10 to 19	22,100	21,730	20,300	0	0	140	1,290	0	9
10	20 to 49	13,500	13,590	12,360	0	0	140	1,100	0	10
11	50 or more	9,300	8,900	8,900	0	0	0	0	0	11
12	Mobile Home/trailer	18,900	13,560	13,410	0	150	0	0	0	12
	Year Built									
13	1996-2002	Incldd in 14	78,570	9,510	0	0	300	68,760	0	13
14	1990-1995	163,000	70,840	62,970	0	0	0	7,870	0	14
15	1985-1989	53,600	52,460	52,310	0	0	150	0	0	15
16	1980-1984	24,700	25,670	25,670	0	0	0	0	0	16
17	1970-1979	128,100	130,270	129,970	0	0	150	0	150	17
18	1960-1969	98,600	100,600	100,450	0	150	0	0	0	18
19	1950-1959	71,800	73,070	72,930	0	0	140	0	0	19
20	1940-1949	38,000	39,460	39,320	0	0	140	0	0	20
21	1930-1939	22,100	23,120	22,980	0	0	0	0	140	21
22	1920-1929	30,400	32,630	32,330	0	0	300	0	0	22
23	1919 or earlier	52,200	55,910	55,770	0	0	140	0	0	23

Backward-Looking Table 1 (continued): Structural and Location Characteristics – All Housing Units

	A Characteristics	B Published numbers	C Present in 2002	D 2002 units present in 1995	E Change in character-istics	F '02 mobile homes moved in	G '02 units derived from nonresidential use	H '02 units added by new construction	I '02 units added from temporary losses	
	Rooms									
24	1 – 4 rooms	182,600	181,020	129,830	32,960	150	870	17,060	150	24
25	5 rooms	154,800	151,810	69,010	68,660	0	150	13,990	0	25
26	6 rooms	134,000	135,800	60,340	62,600	0	0	12,720	140	26
27	7 rooms	88,900	91,250	33,320	45,910	0	0	12,010	0	27
28	8 rooms	60,400	61,150	21,970	28,610	0	150	10,420	0	28
29	9 rooms	37,200	37,960	8,940	22,800	0	0	6,220	0	29
30	10 rooms or more	24,500	23,600	8,320	10,920	0	150	4,210	0	30
	Bedrooms									
31	None	4,100	3,450	2,020	1,020	0	410	0	0	31
32	1	70,800	70,400	54,270	11,540	0	150	4,440	0	32
33	2	195,300	193,620	151,680	22,600	150	450	18,580	150	33
34	3	279,000	280,790	214,200	37,700	0	0	28,750	140	34
35	4 or more	133,400	134,340	88,650	20,530	0	300	24,860	0	35
36	**Multiunit Structures**	123,100	122,530	113,300	0	0	1,020	8,220	0	36
	Stories in Structures									
37	1		12,360	10,530	0	0	0	1,830	0	37
38	2		56,640	51,340	0	0	300	5,000	0	38
39	3		47,420	45,310	0	0	720	1,390	0	39
40	4 to 6		4,350	4,350	0	0	0	0	0	40
41	7 or more		1,770	1,770	0	0	0	0	0	41
	Metro Status									
42	In central cities		336,140	299,630	0	0	870	35,350	290	42
43	In suburbs		346,460	304,580	0	150	450	41,280	0	43
	Mover Status									
44	Moved in last 2 years		140,350	40,600	75,450	150	450	23,550	150	44
45	Not a recent mover		472,850	350,230	77,850	0	450	44,320	0	45

Backward-Looking Table 2: Condition of Unit – All Occupied Units

	A Characteristics	B Published numbers	C Present in 2002	D 2002 units present in 1995	E Change in character-istics	F '02 mobile homes moved in	G '02 units derived from nonresidential use	H '02 units added by new construction	I '02 units added from temporary losses	
1	**Occupied Units**	613,200	613,200	509,280	34,850	150	910	67,860	150	1
	Kitchen									
2	With complete kitchen	602,300	602,730	497,560	37,120	150	600	67,140	150	2
3	Lacking complete kitchen facilities	10,900	10,470	710	8,730	0	300	720	0	3
	Plumbing									
4	With all plumbing facilities	607,400	607,210	500,810	37,480	150	760	67,860	150	4
5	Lack some plumbing	5,800	5,990	360	5,480	0	150	0	0	5
6	No hot piped water	600	710	180	530	0	0	0	0	6
7	No bathtub/shower	200	180	180	0	0	0	0	0	7
8	No flush toilet	200	180	180	0	0	0	0	0	8
	Water									
9	Public/private water	560,200	553,510	448,900	40,460	0	910	63,100	150	9
10	Well	52,100	58,800	50,270	3,610	150	0	4,770	0	10
11	Other water source	900	890	530	360	0	0	0	0	11
	Sewer									
12	Public sewer	543,500	541,080	437,400	40,550	150	910	61,920	150	12
13	Septic tank/cesspool	69,700	72,120	63,280	2,900	0	0	5,940	0	13
14	**Severe Problems**	9,400	9,440	360	8,820	0	150	110	0	14
15	Plumbing	5,800	5,990	360	5,480	0	150	0	0	15
16	Heating	2,800	2,920	0	2,810	0	0	110	0	16
17	Electric	500	360	0	360	0	0	0	0	17
18	Upkeep	400	360	0	360	0	0	0	0	18
19	Hallways	0	0	0	0	0	0	0	0	19
20	**Moderate problems**	20,900	20,070	1,960	16,930	0	150	1,020	0	20
21	Plumbing	1,100	1,250	0	1,250	0	0	0	0	21
22	Heating	900	860	0	710	0	0	150	0	22
23	Kitchen	10,600	10,470	710	8,730	0	300	720	0	23
24	Upkeep	8,900	8,890	1,070	7,670	0	0	150	0	24
25	Hallways	1,100	1,250	0	1,250	0	0	0	0	25

Backward-Looking Table 3: Household Characteristics – All Occupied Units

	A Characteristics	B Published numbers	C Present in 2002	D 2002 units present in 1995	E Change in character-istics	F '02 mobile homes moved in	G '02 units derived from nonresidential use	H '02 units added by new construction	I '02 units added from temporary losses	
1	**Occupied units**	613,200	613,200	509,280	34,850	150	910	67,860	150	1
	Age									
2	Under 65	514,300	512,890	385,210	63,280	150	600	63,490	150	2
3	65 or older	98,800	100,310	59,810	35,830	0	300	4,380	0	3
	Children									
4	Some	226,100	225,280	118,450	72,860	150	150	33,510	150	4
5	None	387,100	387,920	257,180	95,630	0	760	34,350	0	5
	Race/Origin									
6	White	503,200	505,200	409,680	39,750	150	300	55,310	0	6
7	Hispanic	5,000	5,200	890	3,740	0	0	570	0	7
8	Non-Hispanic	498,100	500,000	404,510	40,290	150	300	54,750	0	8
9	Black	81,100	79,880	42,690	28,650	0	300	8,080	150	9
10	Other	29,000	28,120	4,460	18,900	0	300	4,460	0	10
11	Total Hispanics	12,200	11,560	1,250	8,910	0	0	1,400	0	11
	Income Source									
12	Wages and salaries	512,400	511,080	371,310	75,000	150	760	63,860	0	12
13	Welfare or SSI	25,000	25,000	8,380	15,600	0	0	870	150	13
14	Social security or pension	137,700	140,540	83,830	48,170	0	300	8,240	0	14

Backward-Looking Table 4: Market Dynamics and Affordability – All Occupied Units

	A Characteristics	B Published numbers	C Present in 2002	D 2002 units present in 1995	E Change in character-istics	F '02 mobile homes moved in	G '02 units derived from nonresidential use	H '02 units added by new construction	I '02 units added from temporary losses	
1	**Occupied units**	613,200	613,200	509,280	34,850	150	910	67,860	150	1
	Tenure									
2	Owner occupied	401,400	403,220	323,980	26,430	0	300	52,510	0	2
3	Percent own occupied	65.5%	65.8%	63.6%	75.8%	0.0%	33.3%	77.4%	0.0%	3
4	Renter occupied	211,800	209,980	148,490	45,230	150	600	15,350	150	4
	Rental Affordability									
5	Non-market		29,520	13,410	13,730	0	150	2,230	0	5
6	Extremely low rent		101,380	42,740	55,620	150	450	2,270	150	6
7	Very low rent		58,480	23,000	28,790	0	0	6,700	0	7
8	Low rent		14,630	2,320	9,710	0	0	2,600	0	8
9	Moderate to very high rent		5,960	1,960	2,450	0	0	1,550	0	9
	Renter Hsd Income									
12	Less than $20,000	67,900	66,860	31,770	32,180	0	150	2,610	150	12
13	$20,000 to $34,999	59,200	59,490	13,150	41,670	0	300	4,380	0	13
14	$35,000 to $59,999	54,800	54,130	9,940	39,930	150	150	3,960	0	14
15	$60,000 to $99,999	23,900	24,000	1,430	19,560	0	0	3,010	0	15
16	$100,000 or more	5,900	5,490	180	3,920	0	0	1,390	0	16
	Owner Monthly Housing Costs									
17	Less than $499	140,600	130,250	73,490	48,440	0	0	8,320	0	17
18	$500 to $699	44,100	45,580	10,780	31,510	0	0	3,290	0	18
19	$700 to $999	72,000	71,250	21,840	43,580	0	150	5,680	0	19
20	$1,000 to $1,499	87,600	94,970	18,980	57,490	0	0	18,500	0	20
21	$1,500 or more	57,100	61,170	13,410	30,880	0	150	16,720	0	21
	Owner Hsd Income									
22	Less than $20,000	36,300	36,270	12,480	22,500	0	150	1,140	0	22
23	$20,000 to $34,999	58,300	58,800	18,450	36,720	0	0	3,630	0	23
24	$35,000 to $59,999	97,300	97,360	29,100	56,910	0	0	11,350	0	24
25	$60,000 to $99,999	119,900	122,230	31,280	71,610	0	0	19,330	0	25
26	$100,000 or more	89,400	88,560	22,370	48,980	0	150	17,060	0	26

Rental Market Dynamics[15]

Table A expands the analysis in rows 5-11 in Forward-Looking Table 4 into a full rental dynamics analysis by examining in more detail what happened to the units in each row. In particular, the "present in 2002" and "change in characteristics" columns (column D and E in the CINCH tables) are disaggregated into the following options: each of the other rent affordability columns (new columns *D* through *J*), owner-occupancy (new column *K*), and vacant or seasonal status (new column *L*). The remaining columns (columns F through K in the CINCH tables) are collapsed into a "Lost to stock" column (new column *M*). Table B does the same for the analysis of rows 5-11 in Backward-Looking Table 4, with column *M* being additions through new construction and column *N* being additions from other sources.[16] Because the Census Bureau put a cap on the rents it reported for Columbus in both 1995 and 2002, we cannot distinguish among units in the moderate-rent, high-rent, and very-high-rent categories, and therefore have collapsed these three categories into one category, moderate-to-very-high-rent units (column *J*).

Table A shows that there were 203,090 rental units in the Columbus metropolitan area in 1995. In 2002, 58,470 of these were no longer rental units; 17,270 were owner-occupied, 32,600 were either vacant or being used seasonally, and 8,600 had been lost to the stock. Taken as a proportion of the units in 1995, movement into owner-occupancy was concentrated among the low-rent and moderate-to-very-high-rent categories, and losses to the stock were concentrated among non-market units.

Table B shows there were 209,980 rental units in the Columbus metropolitan area in 2002, of which 61,490 were not rental units in 1995. The new units came from units that had been owner-occupied (19,070), units that had been vacant or in seasonal use (26,160), newly constructed units (15,350), and other additions (910). Most of the formerly owner-occupied units went to the extremely-low-rent and the very-low-rent categories; most of the newly constructed rental units went to the extremely-low-rent, the very-low-rent, and the low-rent categories.

Looking at both tables, we see that the overall number of rental units was approximately equal in 1995 and 2002. The number of extremely-low-rent and very-low-rent units combined grew from approximately 140,000 in 1995 to approximately 160,000 in 2002.

[15] This rental dynamics analysis differs from previous analyses in two ways: we do not adjust rents for bedroom sizes and we do not adjust area median family income for inflation.

[16] These tables use all the AHS observations for which we have relevant rent data, including observations where the Census Bureau provided an estimate of contract rent when the respondent did not provide an answer to the rent question. These observations are said to have "allocated" rents. The Watson-Eggers paper cited in footnote 1 studied the effect of allocations on rental dynamics analysis. They found that unallocated data show less dispersion. In their study of the six metropolitan areas surveyed as part of the national AHS, they found that the proportion of rental units that remain in the same rent category increased for all categories except non-market, where the proportion decreased slightly. There also appeared to be less movement of more than one rent category.

Table A: Forward-Looking Rental Dynamics Analysis

Forward looking	*C* Number in 1995	*D* Non-market in 2002	*E* Extremely low rent in 2002	*F* Very low rent in 2002	*G* Low rent in 2002	*J* Moderate to very high rent in 2002	*K* Owner-occupied in 2002	*L* Vacant or seasonal in 2002	*M* Lost to stock
Non-market	30,120	13,060	6,770	1,740	520	170	1,910	2,600	3,340
Extremely low rent	71,530	3,820	41,620	2,260	350	0	5,900	14,240	3,340
Very low rent	70,500	2,950	26,560	22,400	520	170	5,030	11,110	1,750
Low rent	20,690	350	1,560	9,980	2,260	170	2,430	3,780	160
Moderate to very high rent	10,240	350	520	870	3,730	1,910	2,000	870	0
Column sum	203,090	20,530	77,040	37,240	7,380	2,430	17,270	32,600	8,600

Table B: Backward-Looking Rental Dynamics Analysis

Backward looking	*C* Number in 2002	*D* Non-market in 1995	*E* Extremely low rent in 1995	*F* Very low rent in 1995	*G* Low rent in 1995	*J* Moderate to very high rent in 1995	*K* Owner-occupied in 1995	*L* Vacant or seasonal in 1995	*M* New construc-tion	*N* Other additions
Non-market	29,520	13,410	3,920	3,030	360	360	3,740	2,320	2,230	150
Extremely low rent	101,380	6,950	42,740	27,270	1,600	530	6,600	12,660	2,270	760
Very low rent	58,480	1,780	2,320	23,000	10,250	890	4,680	8,870	6,700	0
Low rent	14,630	530	360	530	2,320	3,830	3,030	1,430	2,600	0
Moderate to very high rent	5,960	180	0	180	180	1,960	1,020	890	1,550	0
Column sum	209,980	22,860	49,330	54,010	14,710	7,580	19,070	26,160	15,350	910

Appendix A – Internal and External Checks

For the CINCH analysis, we performed two tests of internal consistency:

- For each row, we tested whether the sum of possible outcomes (columns D though K in the forward-looking analysis and columns D through I in the backward-looking analysis) equaled the number of units present in the base year. In every case, equality was achieved except for differences created by rounding.

- Throughout the tables, various sets of rows are related to each other. For example, the year-built rows (13-23) in Table 1 are a disaggregation of the total stock in row 1. Similarly, rows 6 (Whites), 9 (Blacks), and 10 (Other race) in Table 3 are a disaggregation of row 1 (occupied households). In these cases, there should be equality between the parent row and the sum of the break-out rows for all columns except D and E. The difference between column D in the parent row and the sum of column D for the break-out rows should equal the negative of the difference between column E in the parent row and the sum of column E for the break-out rows. In every case, equality was achieved except for differences created by rounding.

Column B provides an external check of how well the CINCH weighting performed. In general, the CINCH estimates are within 5 percent of the AHS published totals and many of the CINCH estimates are very close to the AHS estimates. We have footnoted two places where our coding does not seem to produce the same results as the published estimates. We observed that the correspondence between the CINCH and published estimates were closer in the slower growing metropolitan areas. We also noticed that the CINCH weighting tends to underestimate the number of units built since 1989 and the number of Hispanic households.

Appendix B – Weighting

CINCH separates the AHS samples in 1995 and 2002 into three components: units that exist and are part of the housing stock in both years (SAMES), units that are part of the 1995 housing stock but are not part of the 2002 housing stock (LOSSES), and units that are not part of the 1995 housing stock but are part of the 2002 housing stock (ADDITIONS). ADDITIONS are split into NEW CONSTRUCTION and RECOVERIES (structures that existed in 1995 but were not in the housing stock).

Because CINCH looks at various subsets of the housing stock, we need to know the characteristics of units and their occupants. Therefore, we can use only those SAMES observations that were interviewed in both years. For the same reason, we can use only those LOSSES that were interviewed in 1995 and those ADDITIONS that were interviewed in 2002.

For the forward-looking analysis, we started with the AHS pure weights and used the AHS weighted count in 1995 of SAMES to create weights for the interviewed SAMES. We used the AHS weighted count in 1995 of LOSSES to create weights for interviewed LOSSES. We then adjusted the weights of SAMES and LOSSES to equal the AHS published totals for occupied units, vacant units, and seasonal units in 1995.

For the backward-looking analysis, we started with the AHS pure weights and used the AHS weighted count in 2002 of SAMES to create weights for the interviewed SAMES. We used the AHS weighted counts in 2002 for NEW CONSTRUCTION and for RECOVERIES to create weights for interviewed NEW CONSTRUCTION and interviewed RECOVERIES. We then adjusted the weights for SAMES, NEW CONSTRUCTION, and RECOVERIES to equal AHS published totals for occupied units, vacant units, and seasonal units in 2002.

The logic behind the weighting and the procedures used to create the weights is explained in *Weighting for CINCH and Rental Dynamics Analysis*.