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Weighting Strategy for 2005-2007 CINCH Analysis

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WEIGHTING STRATEGY FOR 2005-2007 CINCH ANALYSIS

This paper adapts the weighting strategy used by Econometrica, Inc., in its components of inventory change (CINCH) analysis of changes in the national housing stock between 2003 and 2005.[1] The algorithm used for the 2005-2007 analysis differs from the one used for the 2003-2005 analysis in several ways; the two most important are:

- We modified both algorithms to take advantage of the information in the American Housing Survey (AHS) variable SAMEDU (same dwelling unit).
- We modified the backward-looking algorithm to adjust explicitly for a coding error in the AHS variable REUAD (reason unit added) and eliminated from the analysis all units added as sample adjustments.

These differences are explained in the section that describes the steps in the weighting algorithms.

An additional issue in the 2005/2007 CINCH analysis is a reduction in sample size between the 2005 and 2007 AHS surveys. For budgetary reasons, HUD eliminated approximately 5,000 units from the AHS sample prior to the 2007 national survey. Because CINCH analysis requires existing units to be in both surveys, these units had to be dropped from the 2005 AHS public use file (PUF) as well for this analysis.

The CINCH Objective

Figure 1 illustrates the question that CINCH analysis seeks to answer.

CINCH tries to explain how the housing stock evolves from one period to the next. Figure 1 contains four ovals and two rectangles. The Census Bureau provides estimates for both rectangles and one oval (units added through new construction between 2005 and 2007). No one estimates the other three ovals: the number of units that belong to both the 2005 and 2007 housing stock, units lost to the housing stock between 2005 and 2007, and other additions to the housing stock between 2005 and 2007.

Losses can be either permanent or temporary. Units destroyed by natural disasters or intentionally demolished are permanent losses. Temporary losses include units that are merged into other units or units that are used for nonresidential purposes.[2] Besides new construction, additions can include units resulting from splitting up larger units, mobile home move-ins, and units that had been used formerly for nonresidential purposes.

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[1] *Weighting Strategy for 2003-2005 CINCH Analysis* at:
http://www.huduser.org/datasets/cinch/cinch05/CINCHWeightingStrategy2007.pdf.
[2] "Potentially reversible" might be a better term than "temporary" for these types of losses.

In addition to determining the size of each oval, housing analysts find information about the characteristics of the units in the different ovals useful. Interesting characteristics include: structure type, age of the unit, size of the unit, location by region, location by metropolitan status, tenure, household size and composition, resident income, and resident race and ethnicity.

Figure 1: The CINCH Objective
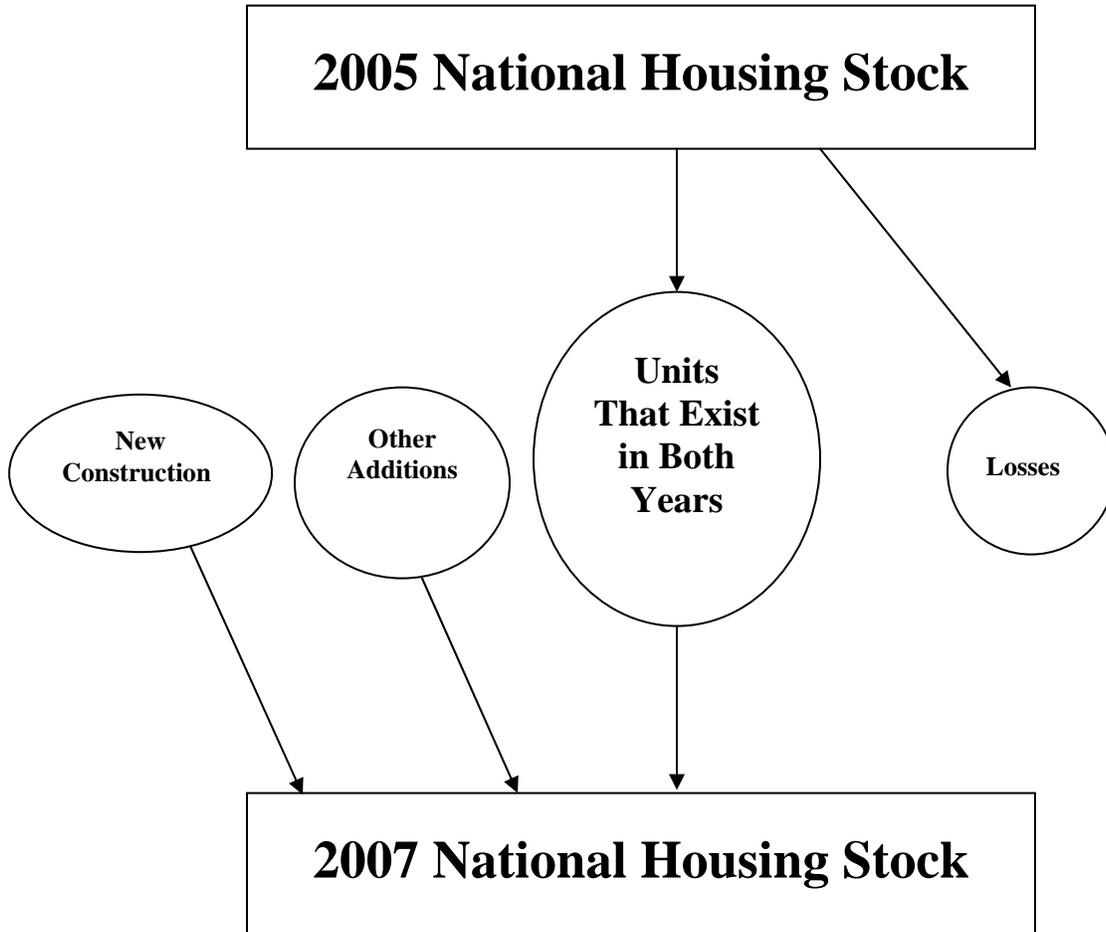
CINCH analysis has three goals:

- To provide estimates for all six components of Figure 1.
- To disaggregate losses and other additions into relevant component parts.
- To characterize the units that survive from one period to the next and the units that are added or lost between periods.

The AHS has four features that make CINCH analysis possible:

- Each unit has weights that can be used to estimate its share of the overall stock.
- The AHS tracks new construction and the various types of losses and other additions.
- The AHS has detailed information about the characteristics of each unit and its occupants.
- The AHS tracks the same unit from one period to the next so that changes in status and characteristics can be observed directly.

Weighting

Ideally, analysts would like to solve two simultaneous equations using CINCH analysis:[3]

(1) 2005 housing stock = units that exist in both years + losses.
(2) New construction + other additions + units that exist in both years = 2007 housing stock.

Unfortunately, previous experience with CINCH analysis has shown it is difficult to find satisfactory simultaneous solutions to the equations. For this reason, Econometrica, Inc. chose to solve the two equations separately in previous CINCH studies.

Solving equation (1) is termed forward-looking analysis because it tracks what happens to the units in the 2005 housing stock. In terms of Figure 1, forward-looking analysis deals with the top rectangle and the two ovals on the right. Solving equation (2) is termed backward-looking analysis because it tracks where units in the 2007 housing stock came from. In terms of Figure 1, backward-looking analysis deals with the bottom rectangle and the three ovals on the left. In analytical terms, backward-looking analysis reverses the arrows at the bottom of Figure 1 by taking the 2007 housing stock as its starting point.

Separating the analysis into forward-looking and backward-looking components results in each observation having two weights: a weight for the forward-looking analysis (FLCINCHWT) and a weight for the backward-looking analysis (BLCINCHWT).

Solving the equations separately also results in two independent estimates of "units that exist in both years," one based on each set of weights. This paper develops algorithms to carry out the forward-looking and backward-looking analyses. Table 1 shows that the separate algorithms result in estimates of "units that exist in both years" that differ by less than one million housing units, slightly less than 1 percent of the 2005 housing stock.

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[3] The equations are "simultaneous" because the term "units that exist in both years" appears in each equation.

Table 1: Comparison of Estimates of "Units that Exist in Both Years"

Units that Exist in Both Years	
Forward-looking estimate	122,073,840
Backward-looking estimate	122,996,452
Difference	-922,612
Percent different	-0.8%

Changes to the 2003/2005 CINCH Weighting Algorithms

In developing the new weighting algorithms for the national 2007 PUF, we incorporate changes to the algorithms used for the 2003-2005 CINCH that seek to make better use of the information in SAMEDU and that revise the treatment of cases added as sample adjustments (IN07_REUAD = 11). The changes related to SAMEDU can be implemented prior to the forward-looking and backward-looking algorithms. In the actual analysis, they were implemented as part of the forward-looking and backward-looking algorithms. The REUAD variable is revised in the backward-looking algorithm.

Use of SAMEDU

SAMEDU (same dwelling unit) is a categorical (yes/no) variable that takes a value of "1" if the same unit is interviewed in successive AHS surveys. Unfortunately, there are five reasons why SAMEDU might take a value of "2". The following is the explanation for SAMEDU from the AHS Frequently Asked Questions (FAQ):

Q. What, exactly, does a "no" answer for SAMEDU mean?

If you get a 'no' in the question for SAMEDU, it could mean that:
• the unit is the result of a conversion or merger since the previous survey
• the interviewer went to the wrong place last survey
• the current unit is a replacement mobile home (or, much less frequently, a replacement structure)
• the unit is a vacant mobile home site that was occupied in the previous survey
• the address identifies a location that is now a type C noninterview {2/29/2008}

Here is our approach to using SAMEDU: We presume that IN07_SAMEDU = 2 is correct; that is, the 2007 unit is <u>not</u> the same as the 2005 unit with same control number for one of the five reasons listed in AHS_FAQ. Then we try to distinguish among the five reasons using other variables. If the number of rooms is greater in 2007, we presume that this is <u>not</u> the result of alterations to the unit—otherwise SAMEDU would equal 1. Then we have to figure out whether the greater number of rooms results from a merger or because the Census Bureau went to the wrong unit. We need information from the 2003 PUF to make this distinction. If the number of rooms in 2003 and 2005 are equal, then we presume there was a merger. If the number of rooms

in 2003 and 2007 are equal but different than the number in 2005, we presume that the Census Bureau went to the wrong unit in 2005. If the number of rooms differs across all 3 years, we cannot determine what happened.

Here are steps used to create a new variable IN07_SAMEDU2:

1. Merge the 2003, 2005, and 2007 PUFs, keeping 2005-2007 matches and 2007-only cases.

MATCH_05_07	Frequency	Percent	Cumulative Frequency	Cumulative Percent
IN 05 AND IN 07	63116	88.49	63116	88.49
IN 05 ONLY	5904	8.28	69020	96.77
IN 07 ONLY	2303	3.23	71323	100

2. Create a new variable SAMEDU2 defined as follows:

IN07_SAMEDU2 = B

IF IN07_SAMEDU = 2, IN07_SAMEDU2 = 1

IF (IN07_SAMEDU = 2 AND (((IN03_NUNIT2 = IN07_NUNIT2) AND (IN05_NUNIT2 NE IN07_NUNIT2)) OR ((IN03_ROOMS = IN07_ROOMS) AND (IN05_ROOMS NE IN07_ROOMS)))) THEN IN07_SAMEDU2 = 2

IF (IN07_SAMEDU = 2 AND ((IN05_NOINT = "B" OR IN05_NOINT LT 30) AND IN07_NOINT GE 30)) THEN IN07_SAMEDU2 = 3

IF (IN07_SAMEDU =2 AND (IN05_NUNIT2 = 4 AND IN07_NOINT = 13)) THEN IN07_SAMEDU2 = 4

IF (IN07_SAMEDU =2 AND IN07_SAMEDU2 NE 2 AND (IN07_NUNIT2 = 4 AND (IN05_NUNIT2 = B OR (IN05_NUNIT2 = 4 AND (IN05_BUILT NE IN07_BUILT)) OR IN05_NUNIT2 LT 4))) THEN IN07_SAMEDU = 5

IF (IN07_SAMEDU = 2 AND IN07_NUNIT2 NE 4 AND (IN07_BUILT LT 2005 AND ((IN03_ROOMS = IN05_ROOMS) AND (IN05_ROOMS LT IN07_ROOMS))) AND IN07_NOINT = B) THEN IN07_SAMEDU2 = 6

IF (IN07_SAMEDU = 2 AND IN07_NUNIT2 NE 4 AND (IN07_BUILT LT 2005 AND ((IN03_ROOMS = IN05_ROOMS) AND (IN05_ROOMS GT IN07_ROOMS))) AND IN07_NOINT = B) THEN IN07_SAMEDU2 = 7

IF (IN07_SAMEDU = 2 AND IN07_NUNIT2 NE 4 AND (IN07_BUILT LT 2005 AND ((IN03_ROOMS = IN05_ROOMS) AND (IN05_ROOMS NE IN07_ROOMS))) AND 1 LE IN07_NOINT LE 12) THEN IN07_SAMEDU2 = 8

Interpret SAMEDU2 as follows:

> IN07_SAMEDU2 = B Not applicable
> IN07_SAMEDU2 = 1 Not clear why SAMEDU = 2
> IN07_SAMEDU2 = 2 Possibly the wrong unit was interviewed in 2005
> IN07_SAMEDU2 = 3 A new type-C non-interview
> IN07_SAMEDU2 = 4 Vacant mobile home lot that was occupied in 2005
> IN07_SAMEDU2 = 5 Mobile home move in (to a vacant lot, replacing an old mobile home, or replacing a non-mobile home structure) – note that, if IN05_NOINT NE B, this implies either a mobile home move out or a demolition of another structure type
> IN07_SAMEDU2 = 6 Possible merger
> IN07_SAMEDU2 = 7 Possible split IN07_SAMEDU2 = 8 Possible merger or split – we cannot tell because the work has not been completed or the unit was not interviewed

This table was computed after step 1b in the forward-looking algorithm.

IN07_SAMEDU2_GROUP	Frequency	Cumulative Frequency
1_Not clear why SAMEDU = 2	233	233
2_Possibly the wrong unit was interviewed in 2005	47	280
3_A new type-C non-interview	245	525
4_Vacant mobile home lot that was occupied in 2005	48	573
5_Mobile home move in	55	628
6_Possible merger	23	651
7_Possible split	10	661
8_Possible merger or split	10	671
B_Not applicable	60,040	60,711

Forward-Looking Weighting Algorithm: From 2005 to 2007

The following are the steps necessary to prepare the data to analyze what happened between 2005 and 2007 to units that existed in 2005. AHS variables are given their codebook names and presented in capital letters. We refer to 2005 variables by the prefix IN05_; 2007 variables are labeled IN07_.

1. Merge the 2005 (69,020 cases) and 2007 (65,419 cases) files, using the flat files. The 2007 file is smaller than the 2005 file because HUD dropped approximately 5,000 cases from the national sample in 2007 for budgetary reasons. The Census Bureau did not include records for these cases in the 2007 public use file (PUF).

MATCH_05_07	Frequency	Percent	Cumulative Frequency	Cumulative Percent
IN 05 AND IN 07	63,116	88.49	63,116	88.49
IN 05 ONLY	5,904	8.28	69,020	96.77
IN 07 ONLY	2,303	3.23	71,323	100

   a. Eliminate non-matches. (8,207 non-match cases) *(N = 63,116)*

   b. Eliminate cases where IN07_NOINT GE 38. (2,405 cases) This eliminates losses from sample changes. CINCH should ignore these losses because they are not physical losses and because we cannot say anything useful about what happens to them. This is the first place where the forward-looking algorithm differs from past procedures. (N=60,711)

   c. Eliminate cases where 1 LE IN07_SAMEDU2 LE 2. (280 cases) This eliminates cases where it is possible that the Census Bureau went to the wrong unit in 2005. This is the second place where the forward-looking algorithm differs from past procedures. N=60,431.

2. Eliminate all observations that were 2005 type B or type C losses (10 LE IN05_NOINT LT 38). These units were not part of the 2005 stock and therefore are not tracked in the forward-looking analysis. This step eliminates 8,951 cases, leaving a file with N=51,480 cases.

3. For all units let MXPWT = max (IN07_PWT, IN05_PWT). (PWT is the pure weight.) In general, IN07_PWT should be greater than IN05_PWT because of the elimination of 5,000 units to save costs.

   a. As a check, define:
    CHPWT = 1 if IN07_PWT GT IN05_PWT
        = 0 if IN07_PWT = IN05_PWT
        = -1 otherwise

CHPWT	Frequency	Percent
0	1,063	2.06
1	50,417	97.94

4. Obtain from the published report an estimate of the 2005 stock (BASECOUNT = 124,377,000).

   Compute SMXPWT = sum of MXPWT after step 3; this sum is a first estimate of the size of the housing stock based on the units retained for analysis. *N=51,480 and SMXPWT = 121,039,126*

5. Compute a FLCINCHWT = MXPWT*(BASECOUNT/SMXPWT). This computation ratios the weights up so that they sum to the 2005 stock.
   BASECOUNT/SMXPWT = 1.0275768

6. Identify *sames*, *losses*, and *interviewed losses*: Note that this is the third place where the forward-looking algorithm differs from past procedures.

   a. SAME = 1 if IN05_ISTATUS = 1, 2, or 3 AND IN07_ISTATUS = 1, 2, or 3 AND NOT(IN07_SAMEDU2 GE 4)   *N =41,468*

   b. LOSS = 1 if IN05_ISTATUS = 1, 2, 3, or 4 AND (10 LE IN07_NOINT LT 38 OR IN07_SAMEDU2 GE 4)   Note that the 2003/2005 analysis used LE rather than LT; this change results from the new step 1b. IN07_SAMEDU2 GE 4 means that the Census Bureau considers this a different unit than the unit in the 2005 sample and, therefore, we will treat the 2005 unit as a loss. *N=983*

      INTLOSS = 1 if IN05_ISTATUS = 1, 2, or 3 AND LOSS = 1   *N = 928*

7. Calculate:

   a. SSAME = sum of FLCINCHWT for all SAME = 1 *(N =41,468, SSAME = 100,113,549)*

   b. SLOSS = sum of FLCINCHWT for all LOSS = 1   *(N =987, SLOSS = 2,408,133)*

   c. SINTLOSS = sum of FLCINCHWT for INTLOSS = 1   *(N =932, SINTLOSS = 2,269,516)*

8. Here is the fourth place where the algorithm needs to be changed because we are using SAMEDU to identify losses. For CINCH analysis, we need information on the characteristics of units and their occupants in both 2005 and 2007 for all units that were part of the stock in both 2005 and 2007. For units that are part of the stock in only 2005, we need information on the characteristics of the units and their occupants in 2005 but only in 2005. Up to this point, we retained units that failed to meet these conditions so that we can get good estimates of the number of losses (SLOSS).

   In previous versions of the forward-looking algorithm, limiting the analysis to units with the required information was accomplished at this point by eliminating all units that were non-interviews in *either* 2005 or 2007. This approach does not work here because the use of SAMEDU =2 cases creates the anomaly of having units in the

current stock that have supposedly been lost. Not having an interview in 2007 is not a problem for these units. Now we will use a more direct approach in step 8 to eliminate units without the required information.

Keep for future analysis only those units where SAME =1 OR INTLOSS = 1. (9,084 cases deleted) N=42,396.

Note that this formulation keeps a few 2007 Type A non-interviews if the unit is interviewed in 2005 <u>and</u> is also an eligible SAMEDU = 2 case. Since we treat the 2007 version of the unit as a different unit, we do not know the characteristics of the unit or its occupants in 2007.

9. Calculate:

   a. Ratio1 = (BASECOUNT – SLOSS)/SSAME   (1.2183053)

   b. Ratio2 = SLOSS/SINTLOSS   (1.0610779)

10. Recalculate FLCINCHWT as follows:

   a. For SAME = 1, FLCINCHWT = Ratio1*FLCINCHWT

   b. For INTLOSS = 1, FLCINCHWT = Ratio2*FLCINCHWT

11. From published reports, obtain estimated 2005 counts for all owner-occupied units, all renter-occupied units, all vacant, and all seasonal units, distinguishing between mobile homes and all other structure types (non-mobile homes). Calculate new adjustment ratios using the formulas in columns C & D of the table:

Table for Forward-Looking Step 11

	A	B	C	D
		2005	**Sum of FLCINCHWT**	**Ratio Adjustment**
1	Housing Stock	124,377,000		
2	Occupied	108,871,000		
3	Owner-Occupied (mobile homes)	5,516,000	IN05_ISTATUS = "1" AND IN05_TENURE = 1 AND IN05_NUNIT2 = 4 ∑=4,856,349	D3 = B3/C3 =1.13583
4	Owner-Occupied (other)	69,415,000	IN05_ISTATUS = "1" AND IN05_TENURE = 1 AND IN05_NUNIT2 NE 4 ∑=67,888,014	D4 = B4/C4 =1.02249
5	Renter (mobile homes)	1,424,000	IN05_ISTATUS = "1" AND (2 LE IN05_TENURE LE 3) AND IN05_NUNIT2 = 4 ∑=1,266,494	D5 = B5/C5 =1.12436
6	Renter (other)	32,516,000	IN05_ISTATUS = "1" AND (2 LE IN05_TENURE LE 3) AND IN05_NUNIT2 NE4 ∑=32,055,363	D6 = B6/C6 =1.01437
7	Vacant (mobile homes)	1,047,000	(IN05_ISTATUS='2' OR IN05_ISTATUS='3') AND NOT(8 LE IN05_VACANCY LE 11) AND IN05_NUNIT2 = 4 ∑=1,044,175	D7 = B7/C7 =1.00271
8	Vacant (other)	10,613,000	(IN05_ISTATUS='2' OR IN05_ISTATUS='3') AND NOT(8 LE IN05_VACANCY LE 11) AND IN05_NUNIT2 NE 4 ∑=13,326,659	D8 = B8/C8 =0.79637
9	Seasonal (mobile homes)	644,000	(IN05_ISTATUS='2' OR IN05_ISTATUS='3') AND (8 LE IN05_VACANCY LE 11) AND IN05_NUNIT2 = 4 ∑=616,721	D9 = B9/C9 =1.04423
10	Seasonal (other)	3,201,000	(IN05_ISTATUS='2' OR IN05_ISTATUS='3') AND (8 LE IN05_VACANCY LE 11) AND IN05_NUNIT2 NE 4 ∑=3,323,145	D10 = B10/C10 =0.96324

12. Use the new adjustment ratios to make final adjustment in the FLCINCHWT.

   a. If IN05_ISTATUS = "1" (occupied units) AND IN05_TENURE = 1 (owner-occupied units) AND IN05_NUNIT2 = 4 (mobile homes), FLCINCHWT = D3*FLCINCHWT.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for owner-occupied mobile homes.

   b. If IN05_ISTATUS = "1" (occupied units) AND IN05_TENURE = 1 (owner-occupied units) AND IN05_NUNIT2 NE 4 (non-mobile home), FLCINCHWT = D4*FLCINCHWT.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for owner-occupied non-mobile homes.

   c. If IN05_ISTATUS = "1" (occupied units) AND (2 LE IN05_TENURE LE 3) (renter-occupied units) AND IN05_NUNIT2 = 4 (mobile homes), FLCINCHWT = D5*FLCINCHWT.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for renter-occupied mobile homes.

   d. If FLCINCHWT in which IN05_ISTATUS = "1" (occupied units) AND (2 LE IN05_TENURE LE 3) (renter-occupied units) AND IN05_NUNIT2 NE 4 (non-mobile homes), FLCINCHWT = D6*FLCINCHWT.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for renter-occupied non-mobile homes.

   e. If FLCINCHWT in which (IN05_ISTATUS='2' OR IN05_ISTATUS='3') AND NOT(8 LE IN05_VACANCY LE 11) (URE and vacant units) AND IN05_NUNIT2 = 4 (mobile homes), FLCINCHWT = D7*FLCINCHWT.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for vacant mobile homes.

   f. If FLCINCHWT in which (IN05_ISTATUS='2' OR IN05_ISTATUS='3') AND NOT(8 LE IN05_VACANCY LE 11) (URE and vacant units) AND IN05_NUNIT2 NE 4 (non-mobile homes), FLCINCHWT = D8*FLCINCHWT.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for vacant non-mobile homes.

   g. If FLCINCHWT in which (IN05_ISTATUS='2' OR IN05_ISTATUS='3') AND (8 LE IN05_VACANCY LE 11) (Seasonal units) AND IN05_NUNIT2 = 4 (mobile homes), FLCINCHWT = D9*FLCINCHWT.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for seasonal mobile homes.

h. If FLCINCHWT in which (IN05_ISTATUS='2' OR IN05_ISTATUS='3') AND (8 LE IN05_VACANCY LE 11) (Seasonal units) AND IN05_NUNIT2 NE 4 (non-mobile homes), FLCINCHWT = D10*FLCINCHWT.
This step ratio adjusts the FLCINCHWT for these observations so that they sum to the published total for seasonal non-mobile homes.

13. Calculate the sum of FLCINCHWT after final weighting for cases with SAME=1,cases with LOSS=1, cases with INTLOSS =1, and for all cases:

Table for Forward-Looking Step 13

	N	Sum of FLCINCHWT
SAME=1	41,468	122,089,652
INTLOSS=1	932	2,286,348
Total	42,400	124,376,000

14. Check on the estimate of mobile homes (IN05_NUNIT2 = 4) and single-unit, detached (IN05_NUNIT2 = 1):

Table for Forward-Looking Step 14

	2005 Published	2005 Estimate
Single-unit, detached	77,703,000	77,585,910
Manufactured (mobile) home	8,630,000	8,631,000

Except for rounding, the results in the Table for Step 13 total to the published count for the housing stock in 2005 and the results in the Table for Step 14 match the published count for mobile homes. The weights were designed to produce these exact matches. The estimate for units in single-unit, detached structures in the Table for Step 14 is within 0.2 percent of the published estimates. In CINCH studies before the 2003/2005 study, the adjustments in steps 11 and 12 were not included in the weighting algorithm. In those studies, the estimates of units in single-unit, detached structures had substantially higher error rates.

Backward-Looking Weighting Algorithm: From 2007 to 2005

The following are the steps necessary to prepare the data to analyze where 2007 units came from. AHS variables are given their codebook names and presented in capital letters. 2007 variables are labeled IN07_; we refer to 2005 variables by the prefix IN05_.

1. Merge the 2005 and 2007 files, using the flat files. Keep units that appear in both years and in the 2007 file only (*N =65,419*).

MATCH_05_07	Frequency	Percent	Cumulative Frequency	Cumulative Percent
IN 05 AND IN 07	63,116	88.49	63,116	88.49
IN 05 ONLY	5,904	8.28	69,020	96.77
IN 07 ONLY	2,303	3.23	71,323	100

2. Delete cases where:

    a. (IN07_NOINT GE 38). (2,406 cases) N=63,013 These are observations that were deleted in prelist subsampling or were inappropriate for the sample. The units may still be part of the housing stock, but the AHS provides no information on them in 2007. They are not part of the sample that is traced backwards. This is the first place where the backward-looking algorithm differs from past procedures. In the past, the algorithm combined steps 1a and 1b. The result is the same, but treating them as separate steps emphasizes the difference in rationales for deleting the cases.

    b. (10 LE IN07_NOINT LT 38). (9,893 cases) N=53,120 These are type B or type C losses in 2007. These units are not part of the 2007 stock, and therefore we do not track them backwards.

    c. (1 LE IN07_SAMEDU2 LE 2). (226 cases) N=52,894 These are cases where it is possible that the Census Bureau interviewed the wrong unit in 2005.   This is the second place where the backward-looking algorithm differs from past procedures.

    d. IN07_REUAD = 11. (13 cases) N=52,881 These are cases added as sample adjustments. They are part of the 2007 housing stock, but we cannot tell whether they were in the 2005 stock or added by new construction or other means between 2005 and 2007. This is the third place where the backward-looking algorithm differs from past procedures.

3. Create a new variable, REVREUAD as follows:

    REVREUAD = REUAD
    IF (1 LE IN05_ISTATUS LE 4 AND 3 LE IN07_REUAD LE 11), REVREUAD = B

    IN05_REUAD identifies units added to the sample in 2007, but 106 units also had values for IN05_ISTATUS, which indicates that they were part of the sample in 2005. Discussion with the Census Bureau indicates that the REUAD values for these cases are erroneous. Normally REUAD would be used in step 8 to identify additions to the stock, but these erroneous values would lead to double counting, that is, there would be 106 cases identified both as SAMES and as additions. Therefore a revised version of REUAD is needed.

4. For all units let MXPWT = max (IN07_PWT, IN05_PWT).   (PWT is the pure weight.) In general, IN07_PWT should be greater than IN05_PWT because of the elimination of 5,000 units to save costs.

a. As a check, define:

      CHPWT = 1 if IN07_PWT GT IN05_PWT

            = 0 if IN07_PWT = IN05_PWT

            = -1 otherwise

CHPWT	Frequency	Percent
0	1,050	1.99
1	51,831	98.01

5. Obtain an estimate of the 2007 stock (CURRENTCOUNT) from the AHS publication for 2007. *CURRENTCOUNT = 128,203,000*

6. Compute SMXPWT = sum of MXPWT (*N=52,881*, $\sum$ *=124,337,0354*) after step 4; this sum is a first estimate of the size of the 2007 housing stock based on units retained for analysis.

7. Compute a BLCINCHWT = MXPWT*(CURRENTCOUNT/SMXPWT). This computation ratios the weights up so that they sum to the 2007 stock. (CURRENTCOUNT/SMXPWT =*1.03109)*

8. Identify *sames*, *new construction, interviewed new construction*, *other adds*, and *interviewed other adds*.[4] This is the fourth place where the backward-looking algorithm differs from past procedures.

    a. SAME = 1 if IN05_ISTATUS = 1, 2, or 3 AND IN07_ISTATUS = 1, 2, OR 3 AND NOT(IN07_SAMEDU2 GE 4)

    b. NC = 1 if IN07_ISTATUS=1, 2, 3, or 4 AND ((IN07_REVREUAD = 3) OR (10 LE IN05_NOINT LE 11)) AND NOT(IN07_SAMEDU2 GE 4)

    c. INTNC = 1 IF NC=1 AND IN07_ISTATUS=1, 2, or 3

    d. ADD = 1 if IN07_ISTATUS=1, 2, 3, or 4 AND ((4 LE IN07_REVREUAD LE 11) OR (12 LE IN05_NOINT LE 17) OR (IN07_SAMEDU2 GE 4))

    e. INTADD = 1 if ADD =1 AND IN07_ISTATUS=1, 2, OR 3

    f. INTADD = 1 if ADD =1 AND IN07_ISTATUS=1, 2, OR 3

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[4] Other adds are units that were type B losses in 2005 but are in the 2007 housing stock plus new housing units that are not new construction, such as the conversion to residential use of a warehouse or mobile home move-ins.

9. Calculate:

    a. SSAME = sum of BLCINCHWT for all SAME = 1 (*N=41,460 ∑=100,440,344*)

    b. SNC = sum of BLCINCHWT for NC =1 (*N=1,473 ∑=3,401,039*)

        SNCMH = sum of BLCINCHWT for NC=1 AND IN07_NUNIT2 = 4 (*N=13 ∑=40,905*)

        SNCOTH = sum of BLCINCHWT for NC=1 AND IN07_NUNIT2 NE 4 (*N=1,460 ∑=3,360,134*)

    c. SINTNC = sum of BLCINCHWT for INTNC=1 (*N=1,469 ∑=3,391,312*)

        SINTNCMH = sum of BLCINCHWT for INTNC=1 AND IN07_NUNIT2 = 4 (*N=13 ∑=40,905*)

        SINTNCOTH = sum of BLCINCHWT for INTNC=1 AND IN07_NUNIT2 NE 4 (*N=1456 ∑=3,350,407)*

    d. SADD = sum of BLCINCHWT for ADD =1 (*N=725 ∑=1,958,593*)

    e. SINTADD= sum of BLCINCHWT for INTADD = 1 (*N=696 ∑=1,886,510*)

10. Here is the fifth place where the algorithm needs to be changed because we are using SAMEDU to identify other additions. For CINCH analysis, we need information on the characteristics of units and their occupants in both 2005 and 2007 for all units that were part of the stock in both 2005 and 2007. For units that are part of the stock in only 2007, we need information on the characteristics of the units and their occupants in 2007 but only in 2007. Up to this point, we retained units that failed to meet these conditions so that we can get good estimates of the number of newly constructed units (SNC) and other additions (SADD).

In previous versions of the backward-looking algorithm, limiting the analysis to units with the required information was accomplished at this point by eliminating all units that were non-interviews in *either* 2005 or 2007. This approach does not work here because the use of SAMEDU =2 cases creates the anomaly of having units in the 2005 stock that were supposedly "new" units in 2007. Not having an interview in 2005 is not a problem for these units. Now we will use a more direct approach in step 10 to eliminate units without the required information.

Keep for future analysis only those units where: SAME = 1 OR INTNC = 1 OR INTADD =1 (9,256 cases deleted) N=43,625.

11. Calculate:

   a. Ratio1 = (CURRENTCOUNT – (SADD + SNC))/SSAME
      (124,377,000 – (*1,958,593* + *3,401,039*))/ *100,440,344*) = 1.2230481)

   b. Ratio2 = SNCMH/SINTNCMH (*40,905* / *40,905* =1)

   c. Ratio3 = SNCOTH/SINTNCOTH (*3,360,134* / *3,350,407* =1.0029031)

   d. Ratio4 = SADD/SINTADD (*1,958,593* / = 1.0382099)

12. Recalculate BLCINCHWT as follows:

   a. For SAME = 1,   BLCINCHWT = Ratio1*BLCINCHWT

   b. For INTNC= 1 AND IN07_NUNIT2 = 4,   BLCINCHWT = Ratio2*BLCINCHWT

   c. For INTNC= 1 AND IN07_NUNIT2 NE 4,   BLCINCHWT = Ratio3*BLCINCHWT

   d. For INTADD = 1, BLCINCHWT = Ratio4*BLCINCHWT

13. From published reports obtain estimated 2007 counts for all owner-occupied units, all renter-occupied units, all vacant units, and all seasonal units, distinguishing between mobile homes and all other units.

Table for Backward-Looking Step 13

	A	B	C	D
		2007	**Sum of BLCINCHWT**	**Ratio Adjustment**
1	Housing Stock	128,203,000		
2	Occupied	123,801,000		
3	Owner-Occupied (mobile homes)	5,419,000	IN07_ISTATUS = "1" AND IN07_TENURE = 1 AND IN07_NUNIT2 = 4 ∑= 4870657	D3 = B3/C3 = 1.11258
4	Owner-Occupied (other)	70,228,000	IN07_ISTATUS = "1" AND IN07_TENURE = 1 AND IN07_NUNIT2 NE 4 ∑= 69157182	D4 = B4/C4 = 1.01548
5	Renter (mobile homes)	1,500,000	IN07_ISTATUS = "1" AND (2 LE IN07_TENURE LE 3) AND IN07_NUNIT2 = 4 ∑= 1288997	D5 = B5/C5 = 1.1637
6	Renter (other)	33,545,000	IN07_ISTATUS = "1" AND (2 LE IN07_TENURE LE 3) AND IN07_NUNIT2 NE4 ∑= 32325898	D6 = B6/C6 = 1.03771
7	Vacant (mobile homes)	1,053,000	(IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND NOT(8 LE IN07_VACANCY LE 11) AND IN07_NUNIT2 = 4 ∑= 1192545	D7 = B7/C7 = 0.88299
8	Vacant (other)	12,056,000	(IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND NOT(8 LE IN07_VACANCY LE 11) AND IN07_NUNIT2 NE 4 ∑= 15213534	D8 = B8/C8 = 0.79245
9	Seasonal (mobile homes)	733,000	(IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND (8 LE IN07_VACANCY LE 11) AND IN07_NUNIT2 = 4 ∑= 603715	D9 = B9/C9 = 1.21415
10	Seasonal (other)	3,669,000	(IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND (8 LE IN07_VACANCY LE 11) AND IN07_NUNIT2 NE 4 ∑= 3550472	D10 = B10/C10 = 1.03338

The algorithm adjusts the weights to match the bottom eight rows in the above table.

14. Use the new adjustment ratios to make final adjustment in the BLCINCHWT.

   a. If IN07_ISTATUS = "1" (occupied units) AND IN07_TENURE = 1 (owner-occupied units) AND IN07_NUNIT2 = 4 (mobile homes), BLCINCHWT = D3*BLCINCHWT.
      This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for owner-occupied mobile homes.

   b. If IN07_ISTATUS = "1" (occupied units) AND IN07_TENURE = 1 (owner-occupied units) AND IN07_NUNIT2 NE 4 (non-mobile home), BLCINCHWT = D4*BLCINCHWT.
      This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for owner-occupied non-mobile homes.

   c. If IN07_ISTATUS = "1" (occupied units) AND (2 LE IN07_TENURE LE 3) (renter-occupied units) AND IN07_NUNIT2 = 4 (mobile homes), BLCINCHWT = D5*BLCINCHWT.
      This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for renter-occupied mobile homes.

   d. If BLCINCHWT in which IN07_ISTATUS = "1" (occupied units) AND (2 LE IN07_TENURE LE 3) (renter-occupied units) AND IN07_NUNIT2 NE 4 (non-mobile homes), BLCINCHWT = D6*BLCINCHWT.
      This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for renter-occupied non-mobile homes.

   e. If BLCINCHWT in which (IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND NOT(8 LE IN07_VACANCY LE 11) (URE and vacant units) AND IN07_NUNIT2 = 4 (mobile homes), BLCINCHWT = D7*BLCINCHWT.
      This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for vacant mobile homes.

   f. If BLCINCHWT in which (IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND NOT(8 LE IN07_VACANCY LE 11) (URE and vacant units) AND IN07_NUNIT2 NE 4 (non-mobile homes), BLCINCHWT = D8*BLCINCHWT.
      This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for vacant non-mobile homes.

   g. If BLCINCHWT in which (IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND (8 LE IN07_VACANCY LE 11) (Seasonal units) AND IN07_NUNIT2 = 4 (mobile homes), BLCINCHWT = D9*BLCINCHWT.
      This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for seasonal mobile homes.

h. If BLCINCHWT in which (IN07_ISTATUS='2' OR IN07_ISTATUS='3') AND (8 LE IN07_VACANCY LE 11) (Seasonal units) AND IN07_NUNIT2 NE 4 (non-mobile homes), BLCINCHWT = D10*BLCINCHWT.
This step ratio adjusts the BLCINCHWT for these observations so that they sum to the published total for seasonal non-mobile homes.

15. Sum of weights after final adjustment:

Table for Backward-Looking Step 15

	N	Sum of BLCINCHWT
SAME	41,460	123,007,714
INTADD	691	1,944,981
INTNC	1,469	3,250,305
Total	43,620	128,203,000

16. Check on the estimate of mobile homes:

Table for Backward-Looking Step 16

	2007 Published	2007 Estimate
Single-unit, detached	80,406,000	80,041,165
Manufactured (mobile) home	8,705,000	8,705,000

The estimates of units that remained in the stock (SAME) and additions to the stock (INTADD and INTNC) equal the published count for the 2007 housing stock. The estimate of mobile homes equals the published count of mobile homes. The weights were created to produce these exact matches. The estimate of units in single-unit, detached structures is within 0.5 percent of the published count. In CINCH studies before the 2003/2005 study, the adjustments in steps 13 and 14 were not included in the weighting algorithm. In those studies, the estimates of units in single-unit, detached structures had substantially higher error rates.