Weighting Strategy for 2007-2009 CINCH Analysis

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WEIGHTING STRATEGY FOR 2007-2009 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 2005 and 2007.1

The CINCH Objective

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

Figure 1: The CINCH Objective

2007 National Housing Stock

Units That Exist in Both Years

New Construction

Other Additions

Losses

2009 National Housing Stock

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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 2007 and 2009). No one estimates the other three ovals: the number of units that belong to both the 2007 and 2009 housing stock, units lost to the housing stock between 2007 and 2009, and other additions to the housing stock between 2007 and 2009.

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. 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.

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.

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:

1. \(2007 \text{ housing stock} = \text{units that exist in both years} + \text{losses}\).
2. \(\text{New construction} + \text{other additions} + \text{units that exist in both years} = 2009 \text{ housing stock}\).

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2 “Potentially reversible” might be a better term than “temporary” for these types of losses.
3 The equations are “simultaneous” because the term “units that exist in both years” appears in each equation.
Unfortunately, previous experience with CINCH analysis has shown it is difficult to find satisfactory simultaneous solutions to the equations. For this reason, Econometrica 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 2007 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 2009 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 2009 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 198,511 housing units, 0.2 percent of the 2007 estimate.

<table>
<thead>
<tr>
<th>Units that Exist in Both Years</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward-looking estimate</td>
<td>126,118,583</td>
</tr>
<tr>
<td>Backward-looking estimate</td>
<td>126,317,094</td>
</tr>
<tr>
<td>Difference</td>
<td>198,511</td>
</tr>
<tr>
<td>Percent different</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

**Creation of SAMEDU2**

In developing the new weighting algorithms for the national 2007 PUF, we changed the algorithm to make better use of the information in SAMEDU. The changes related to SAMEDU are implemented prior to the forward-looking and backward-looking algorithms.

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 IN09_SAMEDU = 2 is correct; that is, the 2009 unit is not the same as the 2007 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 2009, we presume that this is not 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 2005 PUF to make this distinction. If the number of rooms in 2005 and 2007 are equal, then we presume there was a merger. If the number of rooms in 2005 and 2009 are equal but different from the number in 2007, we presume that the Census Bureau went to the wrong unit in 2007. If the number of rooms differs across all 3 years, we cannot determine what happened.

Here are steps used to create a new variable, IN09_SAMEDU2:


<table>
<thead>
<tr>
<th>MATCH_07_09</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Frequency</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN 07 AND IN 09</td>
<td>65,419</td>
<td>89.34</td>
<td>65,419</td>
<td>89.34</td>
</tr>
<tr>
<td>IN 09 ONLY</td>
<td>7,803</td>
<td>10.66</td>
<td>73,222</td>
<td>100</td>
</tr>
</tbody>
</table>

2. Create a new variable, SAMEDU2, defined as follows:

IN09_SAMEDU2 = B

IF IN09_SAMEDU = 2, IN09_SAMEDU2 = 1

IF (IN09_SAMEDU = 2 AND (((IN05_NUNIT2 = IN09_NUNIT2) AND (IN07_NUNIT2 NE IN09_NUNIT2)) OR ((IN05_ROOMS = IN09_ROOMS) AND (IN07_ROOMS NE IN09_ROOMS)))) THEN IN09_SAMEDU2 = 2

IF (IN09_SAMEDU = 2 AND ((IN07_NOINT = “B” OR IN07_NOINT LT 30) AND IN09_NOINT GE 30)) THEN IN09_SAMEDU2 = 3

IF (IN09_SAMEDU =2 AND (IN07_NUNIT2 = 4 AND IN09_NOINT = 13)) THEN IN09_SAMEDU2 = 4

IF (IN09_SAMEDU =2 AND IN09_SAMEDU2 NE 2 AND (IN07_NUNIT2 NE 2 AND (IN07_NUNIT2 = B OR (IN07_NUNIT2 = 4 AND (IN07_BUILT NE IN09_BUILT)) OR IN07_NUNIT2 LT 4)))) THEN IN09_SAMEDU = 5
IF (IN09_SAMEDU = 2 AND IN09_NUNIT2 NE 4 AND (IN09_BUILT LT 2007 AND ((IN05_ROOMS = IN07_ROOMS) AND (IN07_ROOMS LT IN09_ROOMS))) AND IN09_NOINT = B) THEN IN09_SAMEDU2 = 6

IF (IN09_SAMEDU = 2 AND IN09_NUNIT2 NE 4 AND (IN09_BUILT LT 2007 AND ((IN05_ROOMS = IN07_ROOMS) AND (IN07_ROOMS GT IN09_ROOMS))) AND IN09_NOINT = B) THEN IN09_SAMEDU2 = 7

IF (IN09_SAMEDU = 2 AND IN09_NUNIT2 NE 4 AND (IN09_BUILT LT 2007 AND ((IN05_ROOMS = IN07_ROOMS) AND (IN07_ROOMS NE IN09_ROOMS))) AND 1 LE IN09_NOINT LE 12 ) THEN IN09_SAMEDU2 = 8

Interpret SAMEDU2 as follows:

IN09_SAMEDU2 = B Not applicable
IN09_SAMEDU2 = 1 Not clear why SAMEDU = 2
IN09_SAMEDU2 = 2 Possibly the wrong unit was interviewed in 2007
IN09_SAMEDU2 = 3 A new type-C non-interview
IN09_SAMEDU2 = 4 Vacant mobile home lot that was occupied in 2007
IN09_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 IN07_NOINT NE B, this implies either a mobile home move out or a demolition of another structure type
IN09_SAMEDU2 = 6 Possible merger
IN09_SAMEDU2 = 7 Possible split
IN09_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.

<table>
<thead>
<tr>
<th>IN09_SAMEDU2_GROUP</th>
<th>Frequency</th>
<th>Cumulative Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1_Not clear why SAMEDU = 2</td>
<td>209</td>
<td>209</td>
</tr>
<tr>
<td>2_Possibly the wrong unit was interviewed in 2007</td>
<td>63</td>
<td>272</td>
</tr>
<tr>
<td>3_A new type-C non-interview</td>
<td>202</td>
<td>474</td>
</tr>
<tr>
<td>4_Vacant mobile home lot that was occupied in 2007</td>
<td>38</td>
<td>512</td>
</tr>
<tr>
<td>5_Mobile home move in</td>
<td>41</td>
<td>553</td>
</tr>
<tr>
<td>6_Possible merger</td>
<td>15</td>
<td>568</td>
</tr>
<tr>
<td>7_Possible split</td>
<td>10</td>
<td>578</td>
</tr>
<tr>
<td>8_Possible merger or split</td>
<td>3</td>
<td>581</td>
</tr>
<tr>
<td>B_Not applicable</td>
<td>62,369</td>
<td>62,950</td>
</tr>
</tbody>
</table>
**Forward-Looking Weighting Algorithm: From 2007 to 2009**

The following are the steps necessary to prepare the data to analyze what happened between 2007 and 2009 to units that existed in 2007. AHS variables are given their codebook names and presented in capital letters. We refer to 2007 variables by the prefix IN07_; 2009 variables are labeled IN09_.

1. Merge the 2007 and 2009 files, using the flat files.

<table>
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<tr>
<th>MATCH_07_09</th>
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<td>7,803</td>
<td>10.66</td>
<td>73,222</td>
<td>100</td>
</tr>
</tbody>
</table>

a. Eliminate non-matches. (7,803 non-match cases) \(N = 65,419\)

b. Eliminate cases where IN09_NOINT GE 38. (2,469 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. \(N= 62,950\)

c. Eliminate cases where 1 LE IN09_SAMEDU2 LE 2. (272 cases) This eliminates cases where it is possible that the Census Bureau went to the wrong unit in 2007. \(N= 62,678\)

2. Eliminate all observations that were 2007 type B or type C losses (10 LE IN07_NOINT LT 38). These units were not part of the 2007 stock and, therefore, are not tracked in the forward-looking analysis. This step eliminates 9,829 cases, leaving a file with \(N= 52,849\) cases.

3. For all units, let MXPWT = max (IN09_PWT, IN07_PWT). (PWT is the pure weight.)

4. Obtain from the published report an estimate of the 2007 stock (BASECOUNT = 128,203,000).

Compute \(SMXPWT = \text{sum of MXPWT after step 3}; \text{this sum is a first estimate of the size of the housing stock based on the units retained for analysis.} \ N=52,849 \text{ and } SMXPWT = 124,483,713\)

5. Compute a FLCINCHWT = MXPWT*(BASECOUNT/SMXPWT). This computation ratios the weights up so that they sum to the 2007 stock.

\(BASECOUNT/SMXPWT = 1.0298777\)
6. Identify *sames*, *losses*, and *interviewed losses*:
   a. \( \text{SAME} = 1 \) if \( \text{IN07\_ISTATUS} = 1, 2, \text{or} 3 \) AND \( \text{IN09\_ISTATUS} = 1, 2, \text{or} 3 \) AND \( \text{NOT(\text{IN09\_SAMEDU2 GE 4})} \) \( N = 42,736 \)
   b. \( \text{LOSS} = 1 \) if \( \text{IN07\_ISTATUS} = 1, 2, 3, \text{or} 4 \) AND \( (10 \leq \text{IN09\_NOINT LT 38} \text{ OR} \text{IN09\_SAMEDU2 GE 4}) \) \( \text{IN09\_SAMEDU2 GE 4} \) means that the Census Bureau considers this a different unit than the unit in the 2007 sample and, therefore, we will treat the 2007 unit as a loss. \( N= 864 \) 
   \( \text{INTLOSS} = 1 \) if \( \text{IN07\_ISTATUS} = 1, 2, \text{or} 3 \) AND \( \text{LOSS} = 1 \) \( N = 804 \)

7. Calculate:
   a. \( \text{SSAME} = \text{sum of FLCINCHWT for all SAME} = 1 \) \( (N = 42,736, \text{ SSAME} =103,456,211) \)
   b. \( \text{SLOSS} = \text{sum of FLCINCHWT for all LOSS} = 1 \) \( (N = 864, \text{ SLOSS} =2,187,780) \)
   c. \( \text{SINTLOSS} = \text{sum of FLCINCHWT for INTLOSS} = 1 \) \( (N = 804, \text{ SINTLOSS} =2,045,696) \)

8. For CINCH analysis, we need information on the characteristics of units and their occupants in both 2007 and 2009 for all units that were part of the stock in both 2007 and 2009. 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 losses (SLOSS).

   Keep for future analysis only those units where \( \text{SAME} = \text{1 OR INTLOSS} = \text{1}. \) 
   (9,309 cases deleted) \( N=43,540 \).

   Note that this formulation keeps a few 2009 Type A non-interviews if the unit is interviewed in 2007 and is also an eligible \( \text{SAMEDU} = \text{2 case} \). Since we treat the 2009 version of the unit as a different unit, we do not need to know the characteristics of the unit or its occupants in 2009 for the forward-looking analysis.

9. Calculate:
   a. \( \text{Ratio1} = (\text{BASECOUNT} – \text{SLOSS})/\text{SSAME} \) \( (1.2180537) \)
   b. \( \text{Ratio2} = \text{SLOSS}/\text{SINTLOSS} \) \( (1.0694553) \)

10. Recalculate FLCINCHWT as follows:
    a. For \( \text{SAME} = \text{1} \), \( \text{FLCINCHWT} = \text{Ratio1*FLCINCHWT} \)
    b. For \( \text{INTLOSS} = \text{1} \), \( \text{FLCINCHWT} = \text{Ratio2*FLCINCHWT} \)

11. From published reports, obtain estimated 2007 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

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Housing Stock</td>
<td>128,203,000</td>
<td>Sum of FLCINCHWT</td>
<td>Ratio Adjustment</td>
</tr>
<tr>
<td>2</td>
<td>Occupied</td>
<td>110,692,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 3 | Owner-Occupied     | 5,419,000 | \[\text{IN07\_ISTATUS} = "1" \text{\ AND IN07\_TENURE} = \text{1 AND IN07\_NUNIT2} = \text{4} \]
|   | (mobile homes)     |       | \[\sum = 4,820,798\]                  | \[D3 = B3/C3 = 1.12409\] |
| 4 | Owner-Occupied     | 70,228,000 | \[\text{IN07\_ISTATUS} = "1" \text{\ AND IN07\_TENURE} = \text{1 AND IN07\_NUNIT2} \neq \text{4} \]
|   | (other)            |       | \[\sum = 68,773,843\]                | \[D4 = B4/C4 = 1.02114\] |
| 5 | Renter             | 1,500,000 | \[\text{IN07\_ISTATUS} = "1" \text{\ AND (2 \leq IN07\_TENURE \leq 3) \text{\ AND IN07\_NUNIT2} = 4} \]
|   | (mobile homes)     |       | \[\sum = 1,258,852\]                | \[D5 = B5/C5 = 1.19156\] |
| 6 | Renter             | 33,545,000 | \[\text{NOT}(8 \leq \text{IN07\_VACANCY} \leq 11) \text{\ AND IN07\_NUNIT2} \neq \text{4} \]
|   | (other)            |       | \[\sum = 32,502,819\]                | \[D6 = B6/C6 = 1.03206\] |
| 7 | Vacant             | 1,053,000 | \[\text{IN07\_ISTATUS}=\text{2 OR IN07\_ISTATUS}=\text{3}\] \text{\ AND NOT}(8 \leq \text{IN07\_VACANCY} \leq 11) \text{\ AND IN07\_NUNIT2} = 4
|   | (mobile homes)     |       | \[\sum = 1,147,863\]                | \[D7 = B7/C7 = 0.91736\] |
| 8 | Vacant             | 12,056,000 | \[\text{IN07\_ISTATUS}=\text{2 OR IN07\_ISTATUS}=\text{3}\] \text{\ AND NOT}(8 \leq \text{IN07\_VACANCY} \leq 11) \text{\ AND IN07\_NUNIT2} = 4
|   | (other)            |       | \[\sum = 15,552,355\]                | \[D8 = B8/C8 = 0.77519\] |
| 9 | Seasonal           | 733,000 | \[\text{IN07\_ISTATUS}=\text{2 OR IN07\_ISTATUS}=\text{3}\] \text{\ AND (8 \leq \text{IN07\_VACANCY} \leq 11) \text{\ AND IN07\_NUNIT2} = 4}
|   | (mobile homes)     |       | \[\sum = 579,253\]                   | \[D9 = B9/C9 = 1.26542\] |
| 10| Seasonal           | 3,669,000 | \[\text{IN07\_ISTATUS}=\text{2 OR IN07\_ISTATUS}=\text{3}\] \text{\ AND (8 \leq \text{IN07\_VACANCY} \leq 11) \text{\ AND IN07\_NUNIT2} = 4}
|   | (other)            |       | \[\sum = 3,567,216\]                | \[D10 = B10/C10 = 1.02853\] |
12. Use the new adjustment ratios to make final adjustment in the FLCINCHWT.

   a. If IN07_ISTATUS = “1” (occupied units) AND IN07_TENURE = 1 (owner-occupied units) AND IN07_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 IN07_ISTATUS = “1” (occupied units) AND IN07_TENURE = 1 (owner-occupied units) AND IN07_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 IN07_ISTATUS = “1” (occupied units) AND (2 LE IN07_TENURE LE 3) (renter-occupied units) AND IN07_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 IN07_ISTATUS = “1” (occupied units) AND (2 LE IN07_TENURE LE 3) (renter-occupied units) AND IN07_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 (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), 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 (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), 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 (IN07_ISTATUS=’2’ OR IN07_ISTATUS=’3’) AND (8 LE IN07_VACANCY LE 11) (Seasonal units) AND IN07_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 (IN07_ISTATUS=’2’ OR IN07_ISTATUS=’3’) AND (8 LE IN07_VACANCY LE 11) (Seasonal units) AND IN07_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>
<thead>
<tr>
<th>N</th>
<th>Sum of FLCINCHWT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAME=1</td>
<td>42,736</td>
</tr>
<tr>
<td>INTLOSS=1</td>
<td>804</td>
</tr>
<tr>
<td>Total</td>
<td>43,540</td>
</tr>
</tbody>
</table>

14. Check on the estimate of mobile homes (IN07_NUNIT2 = 4) and single-unit, detached (IN07_NUNIT2 = 1):

<table>
<thead>
<tr>
<th></th>
<th>2007 Published</th>
<th>2007 Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-unit, detached</td>
<td>80,406,000</td>
<td>80,038,089</td>
</tr>
<tr>
<td>Manufactured (mobile) home</td>
<td>8,705,000</td>
<td>8,705,000</td>
</tr>
</tbody>
</table>

Except for rounding, the results in the Table for Step 13 total to the published count for the housing stock in 2007 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 0.5 percent of the published estimates. In CINCH studies before the 2005/2007 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 2009 to 2007**

The following are the steps necessary to prepare the data to analyze where 2009 units came from. AHS variables are given their codebook names and presented in capital letters. 2009 variables are labeled IN09_; we refer to 2007 variables by the prefix IN07_.

1. Merge the 2007 and 2009 files, using the flat files. Keep units that appear in both years and in the 2009 file only (N = 73,222).

<table>
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<tr>
<th>MATCH_07_09</th>
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2. Delete cases where:

   a. (IN09_NOINT GE 38). (2,469 cases) N=70,753 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 2009. They are not part of the sample that is traced backwards.

   b. (10 LE IN09_NOINT LT 38). (10,838 cases) N= 59,915 These are type B or type C losses in 2009. These units are not part of the 2009 stock, and therefore we do not track them backwards.

   c. (1 LE IN09_SAMEDU2 LE 2). (220 cases) N=59,695 These are cases where it is possible that the Census Bureau interviewed the wrong unit in 2007.

   d. IN09_REUAD = 11. (3,448 cases) N=56,247 These are cases added as sample adjustments. They are part of the 2009 housing stock, but we cannot tell whether they were in the 2007 stock or added by new construction or other means between 2007 and 2009. This eliminated 3,339 cases from the metropolitan areas for which supplemental sample cases were drawn for the first time in 2009.

   e. IN09_REUAD = 10. (1,192 cases) N=55,055. This will eliminate an additional 1,166 cases from the metropolitan areas for which supplemental sample cases were drawn for the first time in 2009 and an additional 26 that were coverage improvements. Only 2 cases were legitimate “others.”

3. For all units let MXPWT = max (IN09_PWT, IN07_PWT). (PWT is the pure weight.)

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4 In the initial CINCH run, we eliminated only 1,164 cases from the metro supplement but further communication from the Census Bureau indicated that it was better to eliminate all the cases. 3-7-11 email from Mousumi Sarkar: *We ran some crosses with some other sample identifier variables and our conclusion is that almost all those cases should be coded as 11. Of the 1,192 cases that are REUAD=10, 1,166 were added as supplemental sample for the Big 5 and hence can be coded as 11, and another 26 were added for coverage improvement and hence can also be coded as 11. Only 2 (1 each) were adds and extras. I hope that helps and let me know if you have other questions or need anything else.*
4. Obtain an estimate of the 2009 stock (CURRENTCOUNT) from the AHS publication for 2009. \( \text{CURRENTCOUNT} = 130,112,000 \)

5. Compute \( \text{SMXPWT} = \text{sum of MXPWT} \ (N=555,055, \sum =127,382,954) \) after step 4; this sum is a first estimate of the size of the 2009 housing stock based on units retained for analysis.

6. Compute a \( \text{BLCINCHWT} = \text{MXPWT} \times \left( \frac{\text{CURRENTCOUNT}}{\text{SMXPWT}} \right) \). This computation ratios the weights up so that they sum to the 2009 stock. \( \left( \frac{\text{CURRENTCOUNT}}{\text{SMXPWT}} = 1.0214239 \right) \)

7. Identify \textit{sames, new construction, interviewed new construction, other adds,} and \textit{interviewed other adds}.

This is the fourth place where the backward-looking algorithm differs from past procedures.

a. \( \text{SAME} = 1 \) if \( \text{IN07\_ISTATUS} = 1, 2, \text{or 3 } \text{AND } \text{IN09\_ISTATUS} = 1, 2, \text{OR 3 } \text{AND NOT(\text{IN09\_SAMEDU2 GE 4})} \)

b. \( \text{NC} = 1 \) if \( \text{IN09\_ISTATUS} = 1, 2, 3, \text{or 4 } \text{AND ((IN09\_REUAD = 3) OR (10 LE \text{IN07\_NOINT LE 11})) AND NOT(\text{IN09\_SAMEDU2 GE 4})} \)

c. \( \text{INTNC} = 1 \) IF \( \text{NC=1 AND IN09\_ISTATUS=1, 2, or 3} \)

d. \( \text{ADD} = 1 \) if \( \text{IN09\_ISTATUS} = 1, 2, 3, \text{or 4 } \text{AND ((4 LE IN09\_REUAD LE 11) OR (12 LE IN07\_NOINT LE 17) OR (IN09\_SAMEDU2 GE 4))} \)

e. \( \text{INTADD} = 1 \) if \( \text{ADD =1 AND IN09\_ISTATUS=1, 2, OR 3} \)

8. Calculate:

a. \( \text{SSAME} = \text{sum of BLCINCHWT for all SAME} = 1 \ (N=42,736 \ \sum =102,606,991 \)

b. \( \text{SNC} = \text{sum of BLCINCHWT for NC =1} \ (N=1,448 \ \sum =2,631,889) \)

\( \text{SNCMH} = \text{sum of BLCINCHWT for NC=1 AND IN09\_NUNIT2 = 4} \ (N=12 \ \sum =20,263) \)

\( \text{SNCOOTH} = \text{sum of BLCINCHWT for NC=1 AND IN09\_NUNIT2 NE 4} \ (N=1,436 \ \sum =2,611,626) \)

\( \text{TNC} = \text{sum of BLCINCHWT for INTNC=1} \ (N=1,430 \ \sum =2,593,146) \)

\( \text{SINTNCMH} = \text{sum of BLCINCHWT for INTNC=1 AND IN09\_NUNIT2 = 4} \ (N=12 \ \sum =20,263) \)

\( \text{SINTNCOTH} = \text{sum of BLCINCHWT for INTNC=1 AND IN09\_NUNIT2 NE 4} \ (N=1,418 \ \sum =2,572,883) \)

d. \( \text{SADD} = \text{sum of BLCINCHWT for ADD =1} \ (N=564 \ \sum =1,251,070) \)

e. \( \text{SINTADD} = \text{sum of BLCINCHWT for INTADD = 1} \ (N=553 \ \sum =1,224,572) \)

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\( \text{Other adds} \) are units that were type B losses in 2007 but are in the 2009 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. For CINCH analysis, we need information on the characteristics of units and their occupants in both 2007 and 2009 for all units that were part of the stock in both 2007 and 2009. For units that are part of the stock in only 2009, we need information on the characteristics of the units and their occupants in 2009 but only in 2009. 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).

Keep for future analysis only those units where: SAME = 1 OR INTNC = 1 OR INTADD =1 (10,336 cases deleted) N=44,719.

10. Calculate:
   a. Ratio1 = (CURRENTCOUNT – (SADD + SNC))/SSAME
      \[ (130,112,000 – (1,251,070 + 2,631,889))/102,606,991 \] = 1.2302187
   b. Ratio2 = SNCMH/SINTNCMH (20,263 / 20,263)
   c. Ratio3 = SNCOTH/SINTNCOTH (2,611,626/2,572,883 = 1.0150581)
   d. Ratio4 = SADD/SINTADD (1,251,070/ 1,224,572 = 1,0216384)

11. Recalculate BLCINCHWT as follows:
   a. For SAME = 1, BLCINCHWT = Ratio1*BLINCINCHWT
   b. For INTNC= 1 AND IN09_NUNIT2 = 4, BLCINCHWT = Ratio2*BLINCINCHWT
   c. For INTNC= 1 AND IN09_NUNIT2 NE 4, BLCINCHWT = Ratio3*BLINCINCHWT
   d. For INTADD = 1, BLCINCHWT = Ratio4*BLINCINCHWT

12. From published reports obtain estimated 2009 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.
The algorithm adjusts the weights to match the bottom eight rows in the above table.
13. Use the new adjustment ratios to make final adjustment in the BLCINCHWT.
   
a. If IN09_ISTATUS = “1” (occupied units) AND IN09_TENURE = 1 (owner-occupied units) AND IN09_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 IN09_ISTATUS = “1” (occupied units) AND IN09_TENURE = 1 (owner-occupied units) AND IN09_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 IN09_ISTATUS = “1” (occupied units) AND (2 LE IN09_TENURE LE 3) (renter-occupied units) AND IN09_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 IN09_ISTATUS = “1” (occupied units) AND (2 LE IN09_TENURE LE 3) (renter-occupied units) AND IN09_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 (IN09_ISTATUS='2' OR IN09_ISTATUS='3') AND NOT(8 LE IN09_VACANCY LE 11) (URE and vacant units) AND IN09_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 (IN09_ISTATUS='2' OR IN09_ISTATUS='3') AND NOT(8 LE IN09_VACANCY LE 11) (URE and vacant units) AND IN09_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 (IN09_ISTATUS='2' OR IN09_ISTATUS='3') AND (8 LE IN09_VACANCY LE 11) (Seasonal units) AND IN09_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 (IN09_ISTATUS='2' OR IN09_ISTATUS='3') AND (8 LE IN09_VACANCY LE 11) (Seasonal units) AND IN09_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.
14. Sum of weights after final adjustment:

### Table for Backward-Looking Step 14

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Sum of BLCINCHWT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAME</td>
<td>42,736</td>
<td>126,317,094</td>
</tr>
<tr>
<td>INTADD</td>
<td>553</td>
<td>1,247,614</td>
</tr>
<tr>
<td>INTNC</td>
<td>1,430</td>
<td>2,547,292</td>
</tr>
<tr>
<td>Total</td>
<td>44,719</td>
<td>130,112,000</td>
</tr>
</tbody>
</table>

15. Check on the estimate of mobile homes:

### Table for Backward-Looking Step 15

<table>
<thead>
<tr>
<th></th>
<th>2009 Published</th>
<th>2009 Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-unit, detached</td>
<td>82,472,000</td>
<td>81,718,324</td>
</tr>
<tr>
<td>Manufactured (mobile) home</td>
<td>8,769,000</td>
<td>8,770,000</td>
</tr>
</tbody>
</table>

The estimates of units that remained in the stock (SAME) and additions to the stock (INTADD and INTNC) equal the published count for the 2009 housing stock. Except for the rounding error, the estimate of mobile homes is equal to 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 1.0 percent of the published count. In CINCH studies before the 2005/2007 study, the adjustments in steps 12 and 13 were not included in the weighting algorithm. In those studies, the estimates of units in single-unit, detached structures had substantially higher error rates.