The Chained CPI-U: Methods and Issues

John S. Greenlees
Washington Statistical Society Conference on the CPI
October 28, 2014
Outline

- Background on the Chained C-CPI-U
- Final C-CPI-U Values
- Preliminary C-CPI-U Values
- Use of the C-CPI-U in indexation
Three Official CPIs

• The CPI-U, the Consumer Price Index for All Urban Consumers: the “headline” CPI
• The CPI-W, the CPI for Urban Wage Earners and Clerical Workers: the index used to compute COLAs for Social Security, federal retirement, and other benefit programs
• The C-CPI-U, the Chained CPI for All Urban Consumers: the subject of my presentation
The C-CPI-U

• The Chained CPI-U differs from the CPI-U in formula and weighting
• Released monthly in preliminary form, with several scheduled revisions
• In final form, uses a Törnqvist formula, monthly-chain weighting
• BLS considers it a closer approximation to a cost-of-living index (COLI)
The C-CPI-U: Publication

• Published C-CPI-U values begin with January 2000 (December 1999=100)
• As of October 2014, final indexes are available through 2012; indexes through March 2014 will become final with the February 2015 CPI release
• Published only at the All-US level, for All Items, All Items Less Food and Energy, 8 Major Groups, and 18 other aggregates
• Unlike CPI-U and CPI-W, C-CPI-U series are not seasonally adjusted
The C-CPI-U: Usage

• Since first released in 2002, the C-CPI-U has not supplanted the CPI-U or CPI-W in public attention or usage
• Revisability is a drawback for many uses
• Outside researchers have done relatively little analysis of the C-CPI-U
• Interest periodically heightens in the context of Federal tax and budget reform
The C-CPI-U: Today

• We now have 13 years of evidence on the behavior of the final Chained CPI, and 12 years of experience on revisions

• In 2015 the CPI program will introduce a New Estimation System that will allow more options and greater flexibility:
  – In calculation of final indexes
  – In calculation of preliminary indexes
C-CPI-U Documentation


• Also see www.bls.gov/cpi/superlink.htm and the announcements on page 5 of http://www.bls.gov/news.release/pdf/cpi.pdf
C-CPI-U Final Index

- Employs a “superlative” Törnqvist formula; requires both base-period and current-period expenditure weights
- Uses monthly “chaining”; the base period is the previous month
- Uses the same 8,018 CPI area/item indexes as in the CPI-U and CPI-W
- Monthly expenditure weights are “smoothed” across areas
C-CPI-U Törnqvist Formula

\[ IX_{t,t-1}^{TQ} = \prod_{a,i} \left( \frac{p_{t,a,i}}{p_{t-1,a,i}} \right)^{0.5 \left( s_{t-1,a,i} + s_{t,a,i} \right)} \]

\[ = \exp \left( \sum_{a,i} 0.5 \left( s_{t-1,a,i} + s_{t,a,i} \right) \ln \left( \frac{p_{t,a,i}}{p_{t-1,a,i}} \right) \right) \]
Index Differences

- Over the 10 years from 2003 to 2012, C-CPI-U 12-month changes have averaged between 0.2 and 0.3 index points below those of the CPI-U.
- This is roughly in accord with expectations prior to the C-CPI-U’s introduction.
- CPI-U 12-month changes have not always been higher, however.
CPI-U vs. Final C-CPI-U: December Index Levels 2000-2012 (Dec. 1999=100)
Issues with Final C-CPI-U

• Lack of timeliness; 13-24 month lag
• Chain drift due to monthly chaining?
• Weighting issues:
  – Sampling error in monthly weights
  – Impacts of smoothing weights
Timeliness

• Final values for year $y$ have not been published until February of year $y+2$
  – Due to time required to obtain year $y$ data from Consumer Expenditure (CE) survey

• The CE program now produces data for CPI on a quarterly instead of annual cycle

• Permits quarterly updating of final C-CPI-U indexes, enhancing timeliness
Quarterly C-CPI-U Release Schedule

<table>
<thead>
<tr>
<th>Index Month</th>
<th>Release Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 2013 – March 2014</td>
<td>February 2015</td>
</tr>
<tr>
<td>April – June 2014</td>
<td>May 2015</td>
</tr>
<tr>
<td>July – September 2014</td>
<td>August 2015</td>
</tr>
<tr>
<td>October – December 2014</td>
<td>November 2015</td>
</tr>
</tbody>
</table>
Chain Drift

• Potentially, chaining monthly Törnqvist index changes could create an upward or downward bias due to seasonality, lags in consumer response, etc.

• However, comparing the C-CPI-U to an chained or fixed-base annually Törnqvist shows little or no evidence of such a drift
Annual C-CPI-U vs. Chained and Direct Törnqvists: Index Levels 2000-2010
Weighting Issues

• Reported monthly CE weights have small sample sizes and high volatility
• For the C-CPI-U, the total US monthly weights in each item category are “smoothed”: prorated to geographic areas based on the last 12 months of data
Smoothing Impact

• “Smoothing” could have unintended effects on index movements

• Using unsmoothed weights would have almost no effect between December 1999 and December 2010, however
  – C-CPI-U change: 26.14 percent
  – Alternative index change: 26.09 percent
C-CPI-U Preliminary Indexes

- During year $y$, the current-month indexes have been termed “Initial” values; the values for year $y-1$ were “Interim”
- These preliminary indexes do not use a superlative formula
- They have employed a geometric mean formula (as opposed to arithmetic in CPI-U)
  - But with allowance for an “adjustment factor”
C-CPI-U Preliminary Indexes

- Initial and Interim indexes use the same item/area weights as the CPI-U
  - Currently these are 2011-2012 weights
  - Weights updated biennially, next in 2016
- Preliminary indexes are linked onto the most recent final C-CPI-U values, currently December 2012
  - In February 2015, will link onto March 2014 values
Current Preliminary Index Formula

\[ IX_{t,t-1,b}^P \]

\[ = \lambda \prod_{a,i} \left( \frac{p_{t,a,i}}{p_{t-1,a,i}} \right)^{s_{b,a,i}} \]

\[ = \lambda \exp \left( \sum_k s_{b,a,i} \ln \left( \frac{p_{t,a,i}}{p_{t-1,a,i}} \right) \right) \]
The Adjustment Factor

• Based on research prior to 2002, the final C-CPI-U was expected to be close to a geometric mean index
  – The adjustment factor $\lambda$ was originally set equal to 1

• Revisions have been larger than expected, but not consistent in sign

• BLS continued to use 1 in each year for lack of strong evidence on optimal $\lambda$
December Revisions, Initial to Final C-CPI-U, 2002-2010

<table>
<thead>
<tr>
<th>Year</th>
<th>Initial</th>
<th>Final</th>
<th>Revision</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002.12</td>
<td>105.809</td>
<td>106.046</td>
<td>0.237</td>
</tr>
<tr>
<td>2003.12</td>
<td>107.499</td>
<td>107.821</td>
<td>0.322</td>
</tr>
<tr>
<td>2004.12</td>
<td>110.709</td>
<td>111.156</td>
<td>0.446</td>
</tr>
<tr>
<td>2005.12</td>
<td>114.036</td>
<td>114.418</td>
<td>0.382</td>
</tr>
<tr>
<td>2006.12</td>
<td>117.059</td>
<td>117.016</td>
<td>-0.043</td>
</tr>
<tr>
<td>2007.12</td>
<td>121.088</td>
<td>121.295</td>
<td>0.207</td>
</tr>
<tr>
<td>2008.12</td>
<td>120.661</td>
<td>121.557</td>
<td>0.896</td>
</tr>
<tr>
<td>2009.12</td>
<td>123.965</td>
<td>124.544</td>
<td>0.579</td>
</tr>
<tr>
<td>2010.12</td>
<td>126.866</td>
<td>126.045</td>
<td>-0.821</td>
</tr>
</tbody>
</table>
Issues with Preliminary C-CPI-U

• Formula only allowed a single upward or downward adjustment to geometric mean:
  – In both initial and interim indexes
  – In all months of the year

• Also, BLS desired the ability to adjust the preliminary values toward or away from the CPI-U, not necessarily up or down
New Preliminary Index Formula

In 2015, BLS will replace the adjusted geometric mean with the CES, or Lloyd-Moulton, formula

\[ IX_{t,b}^{LM} = \left[ \sum_{a,i} s_{b,a,i} \left( \frac{P_{t,a,i}}{P_{b,a,i}} \right)^{1-\eta} \right]^{1/1-\eta} \]
The CES formula

• The CES formula is, in effect, a weighted average of the current preliminary formula and the formula used in the CPI-U
  – When $\eta=1$, the CES reduces to a geometric mean
  – When $\eta=0$, it equals a Laspeyres

• In practice, the optimal $\eta$ is usually between 0 and 1
Evidence for the CES

• Reported in Greenlees *JESM* 2011, and at [www.bls.gov/osmr/pdf/st100060.pdf](http://www.bls.gov/osmr/pdf/st100060.pdf)

• The CES (Lloyd-Moulton) formula had significant value in improving C-CPI-U preliminary estimates

• Bias and MSE were substantially improved
Absolute Errors of Initial Forecast: Official and CES
Implementing the C-CPI-U in Indexation Programs

• Discussed in detail in “Using a Different Measure of Inflation for Indexing Federal Programs and the Tax Code” (Congressional Budget Office, 2010):

• The most convenient formula uses the Initial C-CPI-U values to determine COLAs
Using the Initial C-CPI-U

- The problem in using the C-CPI-U is that it is subject to revision.
- Use of the initial estimates automatically adjusts for past errors (with a lag):

\[
(I^3 - I^2) + \left[ (I^2 - I^1) - (I^2 - I^1) \right] \\
+ \left[ (I^1 - I^0) - (I^1 - I^0) \right] \\
= I^3 - I^2
\]