A New Estimation System for the US CPI – Capabilities and Impacts

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Meeting of Group of Experts on CPIs – Session 4
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Agenda

- New Estimation System for US CPI – why and objectives
- Operational improvements - summary
- Methodology improvements
  - Imputation improvements
  - Calculation of annual averages for bimonthly areas
  - Chained CPI for all Urban Consumers enhancements
New Estimation System (NewEst)

- Redesigned, state-of-the-art system
- Improved flexibility and review capabilities
- More efficient processing - elimination of reliance on paper in all production steps
- Better support for BLS research efforts
- Incorporate methodology improvements
- Deployed with release of January 2015 CPI
Estimation Subsystems
NewEst Project Scope

- Creation of several new interactive subsystems
- Introduce significant flexibility in batch applications
- Add new functionality to CPI’s Modern Review Analysis System (MARS) – new tools & elimination of paper-based review of estimates
- Other changes to existing functionality
Operational Improvements

- Replacement of old labor-intensive processes and tools
- Parameter-driven interactive systems (e.g. Define Index Structures, Evaluate Corrections)
- User Interface designed to meet job needs of users (economists, statisticians, etc.) – typical flow of activities
Operational Improvements

- More flexibility built into both interactive and batch subsystems (e.g. easier to change formulas)
- Fully automated review of index estimates & new analysis tools - eliminates reliance on paper
- New tools to help evaluate and decide on corrections & formalized process for updating the CPI-U-RS
Methodology Improvements: Imputation

- Implement recommendations from Imputation Methodology Improvements Team
  - All price imputation is explicit
  - Allow flexibility in source information
  - Parameter-driven

- Missing prices can now be imputed by narrower set of item and geographic source data

- Off-cycle imputations will be done directly (more prices used in calculation of basic indexes)
Change in calculation of some annual averages

- Annual averages for bimonthly areas
- Based on average of 12 monthly indexes, including six on-cycle published indexes & estimate of off-cycle indexes
- NewEst calculates (instead of interpolates as was former practice) unpublished off-cycle indexes
- Net impact on CPI-U minimal
Methodology improvements: Chained CPI

- New formula for initial and interim C-CPI-U indexes
- More frequent weight updates and index revisions → shorter lag between initial and final
## Price Index Formula Relationships

<table>
<thead>
<tr>
<th></th>
<th>Modified Laspeyres (Lowe)</th>
<th>Geomeans (Young)</th>
<th>Superlative (Tornqvist)</th>
<th>CES (Lloyd Moulton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer Response to Price $\Delta$</td>
<td>No substitution across items</td>
<td>Substitution across all items</td>
<td>Substitution based on Monthly Weights</td>
<td>Parameter defines level of substitution</td>
</tr>
<tr>
<td>Weights Quantified as:</td>
<td>Fixed Base Period Quantities</td>
<td>Fixed Base Period Shares</td>
<td>Current &amp; previous month reflect substitution</td>
<td>$\sigma$ Represents degree of substitution</td>
</tr>
<tr>
<td>Substitution Elasticity</td>
<td>$\sigma = 0$</td>
<td>$\sigma = 1$</td>
<td>$\sigma =$ Observed</td>
<td>$\sigma =$ Evaluated</td>
</tr>
<tr>
<td>Price Index Formula</td>
<td>$I_X_{[0,t]} = \sum_i s_i^0 \left( \frac{p_i^t}{p_i^0} \right)$</td>
<td>$I_X_{[0,t]} = \prod_i \left( \frac{p_i^t}{p_i^0} \right)^{s_i^0}$</td>
<td>$I_X_{[0,t]} = \prod_i \left( \frac{p_i^t}{p_i^0} \right)^{\frac{s_i^0 + s_i^t}{2}}$</td>
<td>$I_X_{[0,t]} = \left[ \sum_i s_i^0 \left( \frac{p_i^t}{p_i^0} \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$</td>
</tr>
</tbody>
</table>
Chained CPI-U: New revision process

- Move from annual revision to quarterly revision basis (NewEst calculates monthly expenditure weights and revised C-CPI-U on quarterly basis)
  - Improved lag between CPI-U and final C-CPI-U from 13-24 months to 10-12 months
  - Initial C-CPI-U indexes still released concurrent with CPI-U and updated as interim C-CPI-U indexes with every quarterly revision until final is published
Chained CPI-U: Use of CES Formula

- Starting with release on 26 February 2015, Constant Elasticity of Substitution (CES) formula replaced geometric mean formula for initial and interim C-CPI-U indexes.

- CES formula more closely models consumer substitution behavior:
  - Better job of capturing amount of substitution as consumers respond to changing relative prices.
  - Preliminary C-CPI-U is expected to be closer estimate of Final C-CPI-U.
Why move to CES formula?

- Geomeans chosen in 2002 as “plausible, simpler approximate of the Tornqvist in real time”; CES considered but more research on issues needed

- Research done by John Greenlees indicated weaknesses could be addressed & that CES use would improve accuracy of preliminary values of C-CPI-U

- Smaller index revisions between preliminary and final C-CPI-U releases → could increase usefulness of C-CPI-U to data users
NewEst: Research Support

- New system includes separate Research Environment (insulated from production)
- Designed to allow for greater ease and efficiency for BLS staff to perform CPI program research
  - More control of data used for each research project – can edit data in database tables
  - Use of same code as that used in production
Contact Information

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