Workshop 5
Higher-level indices: a practical guide

CPI expert group meeting
Geneva, 2014
Marcel van Kints
Objectives

• Outline the ‘traditional’ approach to compiling the higher-levels of a CPI

• Outline some weaknesses and proposals to address these weaknesses

• Outline a quality framework so countries can make their own decisions about improvements to their CPI

• Aim for this workshop to be a discussion
Workshop outline

• The fundamentals
  - terminology
  - purpose of a CPI

• Part 1: The ‘traditional’ approach to compiling the higher-levels of the CPI
Workshop outline con’t

• Part 2: Some weaknesses of the ‘traditional’ approach
  - substitution bias
  - proposals to address these weaknesses
    • Methods and data sources

• Part 3: A data quality assessment framework
  – Dimensions of data quality
Fundamentals

• Terminology
  – Higher-level index is an index for some expenditure aggregate above the level of an elementary aggregate. A higher-level index includes the overall CPI. E.g. beer, tobacco
  
  – Elementary aggregates are the smallest groups of similar (ideally homogenous) products for which weighting data are available. E.g. types of beer
Fundamentals – con’t

• Often the term ‘base period’ is used
• Weight reference period: period covered by the expenditure weights (usually a year).
• Price reference period: period for which prices are used in the denominator in index calculation.
• Index reference period: period for which the index is set to 100.0
Fundamentals – con’t

• Laspeyres: price reference period and weight reference period coincide

• Young: weight reference period is from some period prior to the price reference period.

• Lowe: weight reference period is from some period prior to the price reference period, with weights price updated to the price reference period.

• Laspeyres-type index label is imprecise

• Paasche and Fisher

• Superlative index which requires current period weights
Fundamentals – con’t

• Purpose of a CPI
  – Influences methodological and conceptual decisions
  – ABS CPI is a measure of household inflation (acquisitions approach)
  – ABS also has Living cost indexes (outlays approach)
  – ABS does not produce Cost of living index (COLI)
Fundamentals – con’t

• Fixed basket: quality and quantity (weights) of products remain fixed.
• COLI: quality fixed, quantities (weights) are allowed to vary.
• Many NSOs do not construct their CPI as a COLI. This is because the quantities in one period is unlikely to be observable in practice.
• This workshop focuses on the fixed basket.
Fundamentals – con’t

• Discussion
  – How do countries describe the purpose of their CPI?
Traditional approach

• The calculation of the CPI at the higher-levels requires two inputs:
  – Elementary aggregates (EAs); and
  – Weights

• Leads to two questions:
  – How to combine the EAs? and
  – What is the source of the weights?
Traditional approach – con’t

• The higher-levels of the CPI are traditionally calculated as weighted arithmetic averages of the EAs using weights from some earlier point in time.

• Lowe or Young? Depends on purpose.

• What are the views of participants?
Traditional approach – con’t

• Source of weights
  – Household Expenditure Survey
  – Very expensive
  – Infrequent in Australia
  – Under-reporting (alcohol, tobacco, gambling).

• Chain-linking when new weights available.
Part 2: Weaknesses

• Substitution bias
  – Comparison of the CPI versus the ideal index.
  – ABS 0.2ppts per year.
  – Statistics South Africa
Impact of methodology change on order of Laspeyres, Paasche and Fisher Indices

Statistics South Africa

May 2014
Introduction

• The official CPI is based on a Laspeyres-type (Young index) index, in which the weights are based in an historical period.

• Because consumers are believed to change their buying patterns away from higher inflation items over time, the Laspeyres index theoretically contains an inbuilt upward bias, the inverse is applicable to the Paasche-type index (both are fixed basket indices).

• The Fischer index is an approximation of a cost-of-living index (COLI).
Introduction

• A backward Paasche, forward Laspeyres and Fisher (based on the Paasche and Laspeyres) was calculated when the new weights were introduced in January 2013.

• For this exercise the base remained at 2008 = 100

• There were many methodological changes made in the CPI, most notable the use of the net weight for insurance and used vehicles and price-updating of the weights.

• The methodological changes introduced major shifts if the weights.
## Weights

<table>
<thead>
<tr>
<th>COICOP Division</th>
<th>Laspeyres</th>
<th>Adjusted Laspeyres</th>
<th>Paasche</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food and non-alcohol beverages</td>
<td>18.28%</td>
<td>20.59%</td>
<td>18.19%</td>
</tr>
<tr>
<td>Alcoholic beverages and tobacco</td>
<td>5.56%</td>
<td>5.43%</td>
<td>5.37%</td>
</tr>
<tr>
<td>Clothing and footwear</td>
<td>4.42%</td>
<td>3.74%</td>
<td>4.37%</td>
</tr>
<tr>
<td>Housing and utilities</td>
<td>21.04%</td>
<td>23.40%</td>
<td>23.14%</td>
</tr>
<tr>
<td>Household contents and services</td>
<td>6.14%</td>
<td>5.56%</td>
<td>4.93%</td>
</tr>
<tr>
<td>Health</td>
<td>1.48%</td>
<td>1.38%</td>
<td>1.39%</td>
</tr>
<tr>
<td>Transport</td>
<td>17.79%</td>
<td>14.80%</td>
<td>16.07%</td>
</tr>
<tr>
<td>Communication</td>
<td>3.13%</td>
<td>2.60%</td>
<td>2.54%</td>
</tr>
<tr>
<td>Recreation and culture</td>
<td>3.93%</td>
<td>4.65%</td>
<td>4.07%</td>
</tr>
<tr>
<td>Education</td>
<td>2.15%</td>
<td>2.02%</td>
<td>2.66%</td>
</tr>
<tr>
<td>Restaurants and hotels</td>
<td>2.78%</td>
<td>3.17%</td>
<td>3.33%</td>
</tr>
<tr>
<td>Miscellaneous goods and services</td>
<td>13.30%</td>
<td>12.67%</td>
<td>13.94%</td>
</tr>
</tbody>
</table>
Weights

• The Laspeyres weights set refers to the weight set that was used up till December 2012.

• The Paasche weights set refers to the set used from January 2013.

• The adjusted Laspeyres set is the weight set based on the set used up to December 2012, that is adjusted with all the methodological changes made to the 2013 set.
Results based on unadjusted Laspeyres
Results based on adjusted Laspeyres
Differences: Miscellaneous goods and services

Miscellaneous goods and services

- Paasche
- Laspeyres_adjusted
- Fisher
- Laspeyres
Differences: Transport

![Graph showing differences in transport]

- Transport
- Paasche
- Laspeyres_adjusted
- Fisher
- Laspeyres

Y200801 Y200803 Y200805 Y200807 Y200811 Y200901 Y200903 Y200905 Y200907 Y200911 Y201001 Y201003 Y201005 Y201007 Y201009 Y201011 Y201101 Y201111 Y201201 Y201203 Y201205 Y201207 Y201209 Y201211
Addressing weaknesses

• Source of weights
  – HES versus HFCE
  – Country experiences

• Methods – ‘Post Laspeyres’
HES v HFCE

- ABS study
- Examines the use of an alternative source of data for deriving the weights applied at higher levels of the CPI. Weights applied at the lower levels are subject to more frequent change and are derived from HES data and a range of supplementary sources.
HES v HFCE

• Experimental indexes from June 1998 to December 2013 inclusive were calculated using weights derived from the Australian System of National Account (ASNA), Household Final Consumption Expenditure (HFCE) estimates.

• The availability of detailed HFCE data on an annual basis allowed for the calculation of annually reweighted, chain-linked indexes. Results from this analysis show that the index calculated using HFCE weights, hereafter referred to as the “HFCE CPI”, follows the trend of the existing ABS CPI.
HES v HFCE

• There are some challenges to overcome.
• For example, HFCE excludes expenditure on home insurance and maintenance of dwellings, and imputes rental payments for owner-occupied dwellings. The CPI represents home ownership costs by actual net house purchase (excluding land) plus alterations and additions and installed appliances. This is one area in particular where further investigation is required.
HES v HFCE

• Concordance between HFCE and HES.

• Fairly significant differences exist between the weights derived from HFCE and HES for some ECs; such as the rents, automotive fuel, restaurant meals and take away and fast food ECs. These differences are due to the conceptual treatment and the data on which the expenditure estimates are based.
HES v HFCE

• What are the experiences of countries in this area?
Post Laspeyres proposal

• Post-Laspeyres: The Case for a New Formula for Compiling Consumer Price Indexes

Paul Armknecht and Mick Silver
International Monetary Fund

• NOTE: This is a summary of the presentation made by the authors to the Ottawa Group meeting in 2013. All changes to the original presentation have been made by Marcel van Kints and therefore any errors etc. are his.

• The views expressed herein are those of the authors and should not be attributed to the IMF, its Executive Board, or its management.
Methods – con’t

Figure 1: Arithmetic indexes

Lowe Young Laspeyres Paasche
Figure 2: Geometric Indexes

- Geometric Lowe
- Geometric Young
- Törnqvist
- Lowe
Concluding remarks

- Lowe is upwards bias against Laspeyres,
- Laspeyres upwardly biased against a superlative index.
- Young is problematic axiomatically and is volatile.
Alternatives:

• Are there alternative measures that National Statistical Offices (NSOs) can compile in real time that approximate the target indexes?
Alternative measures are available that can be compiled in real time using existing data:

- Geometric Lowe,
- Geometric Young
Data Used for Test Indexes

- 211 product groups for the large part derived using geometric means. Price updated from mean of mid-point to December prior to reweighting (every two years).

<table>
<thead>
<tr>
<th>Mean-annual expenditures weights for:</th>
<th>Basis of</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993-1995</td>
<td>Jan98-Dec01</td>
</tr>
<tr>
<td>1999-2000</td>
<td>Jan02-Dec03</td>
</tr>
<tr>
<td>2001-2002</td>
<td>Jan04-Dec05</td>
</tr>
<tr>
<td>2003-2004</td>
<td>Jan06-Dec07</td>
</tr>
<tr>
<td>2005-2006</td>
<td>Jan08-Dec09</td>
</tr>
<tr>
<td>2007-2008</td>
<td>Jan10-Dec11</td>
</tr>
<tr>
<td>2008-2009</td>
<td>Jan11-Dec12</td>
</tr>
<tr>
<td></td>
<td>Fisher</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Arithmetic formulas</strong></td>
<td></td>
</tr>
<tr>
<td>Lowe</td>
<td>0.161</td>
</tr>
<tr>
<td>Young</td>
<td>0.016</td>
</tr>
<tr>
<td><strong>Geometric formulas</strong></td>
<td></td>
</tr>
<tr>
<td>Geometric Lowe (GLowe)</td>
<td>-0.012</td>
</tr>
<tr>
<td>Geometric Young (GY)</td>
<td>-0.156</td>
</tr>
<tr>
<td><strong>Geometric means of formulas</strong></td>
<td></td>
</tr>
<tr>
<td>GY-Young</td>
<td>-0.070</td>
</tr>
<tr>
<td>GY-Lowe</td>
<td>0.002</td>
</tr>
<tr>
<td>GLowe-Young</td>
<td>0.002</td>
</tr>
<tr>
<td>GLowe-Lowe</td>
<td>0.075</td>
</tr>
<tr>
<td><strong>Lent-Dorfman (η using 2-year lag)</strong></td>
<td></td>
</tr>
<tr>
<td>GY-Young</td>
<td>-0.046</td>
</tr>
<tr>
<td>GY-Lowe</td>
<td>-0.046</td>
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<tr>
<td>GLowe-Young</td>
<td>-0.003</td>
</tr>
<tr>
<td>GLowe-Lowe</td>
<td>0.010</td>
</tr>
<tr>
<td><strong>Lloyd-Moulton (η using 2-year lag)</strong></td>
<td></td>
</tr>
<tr>
<td>L-M (Greenlees est of η)</td>
<td>-0.044</td>
</tr>
<tr>
<td>L-M (L-D est of η)</td>
<td>-0.028</td>
</tr>
</tbody>
</table>

*aCovers January 2002 to December 2010

*bJanuary 2002 to December 2003 uses a one-year lag
In the U.S. data, the Geo-Lowe performs well but there is no theoretical justification for its use.
Using simple geometric averages of an upward biased index with one that is downward biased can provide good real-time approximations of the target indexes.
US example more frequent updates than some countries and some smoothing of weights. Differences less pronounced.

This is an interesting area for additional research so that NSOs can rightly move beyond a Laspeyres-centric world of price index calculations.

Real purpose is to start a rethink of the Laspeyres-type position.
Part 3: Data Quality Framework

• Difficulty for many NSOs is to determine whether to implement proposed methodological changes or utilise alternate data sources to compile their CPI.

• Key question: What is the impact on the quality of the CPI?
Data quality framework – con’t

• Quality means much more than accuracy.

• Various frameworks available.

• ABS framework
  – Institutional environment
  – Relevance
  – Timeliness
  – Accuracy
Data quality framework – con’t

– Coherence
– Interpretability
– Accessibility

• Focus here on timeliness, accuracy, interpretability.
Data quality framework – con’t

• Accuracy
  – Results versus an ideal (superlative) index.

• Timeliness
  – Release soon after the reference period

• Interpretability
  – Can the change be explained to users.