BASIC ICP CONCEPTS AND PPP METHODS

Yuri Dikhanov
World Bank

ydikhanov@worldbank.org
Presentation Outline

- Background
- BH Level: The Country-Product-Dummy (CPD) Method
- BH Level: The EKS (Jevons) Method
- BH Level: CPD vs EKS (Jevons)
- Aggregate level: The EKS Method
- Conclusion
Background
Basic heading is the lowest level of final expenditures on GDP for which weights will be applied under the 155 basic heading structures (for ICP).

A higher level aggregate is an expenditure class, group or category obtained by combining two or more basic headings.
ICP PPP Estimation:

Stages in Aggregation Process

1. Aggregating prices to basic heading level parities
2. Aggregating basic heading parities to GDP/HH and other sub-aggregates
3. Computing national/regional/provincial annual averages of price observations
Data Requirements for PPP Calculation (above BH)

Complete set of basic heading expenditures in national/regional/provincial currencies

Basic heading PPPs, with area 1 acting as the reference area and its currency as the numeraire
### PPP Calculation:

**Properties of Price and Volume Indices**

<table>
<thead>
<tr>
<th>Base country invariant</th>
<th>Commensurability</th>
<th>Transitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>• all participating countries are symmetrical so the results are no different to the chosen base country</td>
<td>• All produce results that are invariant to changes in the units of measurement for prices and quantities</td>
<td>• Requires that every indirect parity ( \text{PPP}<em>{jk} ) should equal the corresponding direct parity ( \text{PPP}</em>{jk} )</td>
</tr>
</tbody>
</table>
## PPP Calculation: Properties of Price and Volume Indices

<table>
<thead>
<tr>
<th>Characteristicity</th>
<th>Additivitiy</th>
</tr>
</thead>
<tbody>
<tr>
<td>- requires the transitive multilateral comparisons between members of a group of countries to retain the essential features of the intransitive binary comparisons that existed between them before transitivity.</td>
<td>- values of the expenditure aggregates of participating countries are equal to the sum of the values of their components when both aggregates and components are valued at international prices.</td>
</tr>
</tbody>
</table>
BH Level Aggregation: The CPD Method
Example of price data

<table>
<thead>
<tr>
<th>Product</th>
<th>Country A</th>
<th>Country B</th>
<th>Country C</th>
<th>Country D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R/I</td>
<td>N</td>
<td>R/I</td>
<td>N</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>250</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>270</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td></td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>280</td>
<td>100</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>120</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

R/I – representative
(important)

N – non-representative
(not-important)
Salient Features:

• It is multilateral.
• Estimates PPPs by statistical inference rather than by a price index.
• It is transitive, not affected by change of base country.
• It works on all observations -- does not discard any available price.
• Used mostly on basic heading PPP.
• May be subject to large residual errors (it explicitly estimates them).
The PPPs is log of price observations against a set of dummy variables defined with respect to the products price and the participating countries.

$$\ln p_{cp} = y_{cp} = x_{cp} \beta + \epsilon_{cp}$$  \hspace{1cm} (1) \hspace{1cm}

where $p_{cp}$ - price of product $p$ in country $c$;

$Dc_j$ and $Dp_i$ - country and product dummies;

$Np$ and $Nc$ - number of products and countries, respectively;

$$x_{cp} = \begin{bmatrix} Dc_2 & ... & Dc_{Nc} & Dp_1 & Dp_2 & ... & Dp_{Np} \end{bmatrix}$$ \hspace{1cm} (2)

$$\beta = \begin{bmatrix} \alpha_2 & \ldots & \alpha_{Nc} & \gamma_1 & \gamma_2 & \ldots & \gamma_{Np} \end{bmatrix}^T$$

$Dp_{ij}$ and $Dc_{ij}$ are equal to 1 when product $i$ is priced in country $j$, otherwise they equal 0.

Once this regression equation is estimated, the PPP for currency of country $k$ with country $j$ as base can be obtained by the exponential of the difference in the estimates of $\pi_j$ and $\pi_k$ taken from the regression equation.
BH Level Aggregation: The Jevons Method
Geometric Laspeyres, Paasche and Fisher Indexes

Geometric Laspeyres index between country A & B: $L_{AB}$

$$L_{AB} = \prod_{i \in \mathcal{R}_A} \left[ \frac{p_iB}{p_iA} \right]^{1/n_A}$$

Geometric Paasche index between country A & B: $P_{AB}$

$$P_{AB} = \prod_{i \in \mathcal{R}_B} \left[ \frac{p_iB}{p_iA} \right]^{1/n_B}$$

$L_{AB}$ and $P_{AB}$ are given equal weight in calculating Fisher Index $F_{AB}$

$$F_{AB} = \sqrt{L_{AB} \cdot P_{AB}}$$
Aggregate Level Aggregation: The EKS Method
Laspeyres index between country A & B: \( L_{AB} \)

\[
L_{AB} = \frac{\sum p_B Q_A}{\sum p_A Q_A}
\]

Paasche index between country A & B: \( P_{AB} \)

\[
P_{AB} = \frac{\sum p_B Q_B}{\sum p_A Q_B}
\]

\( L_{AB} \) and \( P_{AB} \) are given equal weight in calculating Fisher Index \( F_{AB} \)

\[
F_{AB} = \sqrt{L_{AB} P_{AB}}
\]
Background:

- named after Elteto, Koves, Szulc
- used by Lazlo Drechsler in the "Weighting of the index numbers in multilateral comparisons"
- used in the 1960s for comparisons between the centrally planned economies of eastern Europe
- Formula was proposed 40 years earlier by Gini in "On the circular test of index numbers", international review of statistics, Vol. 9, No. 2., 1931
Salient features of the EKS Method

- EKS is a multilateral index; comparison between two countries will be affected by a third country.
- It is transitive. Not affected by change of base.
- It is based on binaries so it is most characteristic of the two countries being compared. Gives equal weight to all countries. Least affected by a third country.
- May discard prices even if they are available
EKS PPP

\[
EKS_{jk} = \left\{ F_{jk}^2 \cdot \prod_{l \neq j, k} \frac{F_{jl}}{F_{kl}} \right\}^{\frac{1}{n}}
\]

\[
EKS_{jk} = \left\{ F_{jk}^2 \cdot \prod_{l \neq j, k} F_{jk}^{l} \right\}^{\frac{1}{n}}
\]

\[
EKS_{jk} = j, k, l \in N
\]

- EKS PPP is the geometric mean of the direct PPP and all the indirect PPPs between a pair of countries.
- Direct PPP must have twice the weight of each indirect PPP.
BH Level: EKS(Jevons) vs. CPD
EKS(JEVONS) METHOD:
Applying the EKS formula to geometric Fisher indexes at BH level one can obtain BH PPPs.

\[
EKS_{jk} = \left\{ F_{jk}^2 \cdot \prod_{l \neq j, k} \frac{F_{jl}}{F_{kl}} \right\}^{\frac{1}{n}}
\]

\[
EKS_{jk} = \left\{ F_{jk}^2 \cdot \prod_{l \neq j, k} F_{jk} \right\}^{\frac{1}{n}}
\]

\[
EKS_{jk} = j, k, l \in N
\]
EKS(Jevons) METHOD:
Fisher type PPPs are intransitive to begin with however transitivity is achieved through applying the EKS procedure.

CPD METHOD:
CPD method produces transitive PPPs to begin with unlike EKS (Jevons).
Considered to be more transparent.
CPD does not require direct matches because missing prices can be estimated using regression coefficients of the respective dummy variables based on prices collected of the basic heading.
Sampling errors can be estimated for the PPPs computed using CPD.
What is the best method to use for PPP calculation at the BH level?

- CPD and EKS methods give same results at basic heading PPPs on the condition that all products have been priced and representivity is not taken into account.

- Experiments with actual data suggest that the differences in results are not usually significant, but it seems that EKS (Jevons) is more susceptible to sampling errors and can be more unstable under certain conditions.
Thank you