PPP Time Series

Robert Inklaar and Prasada Rao
5th TAG Meeting – February 20–21, 2020
**Background**

**Goal:** estimate annual global PPPs

**Important distinctions:**
1. Extrapolation vs. Interpolation
2. Level of calculation
## Background

<table>
<thead>
<tr>
<th></th>
<th>Extrapolation</th>
<th>Interpolation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aggregate level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BH level</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Background

<table>
<thead>
<tr>
<th></th>
<th>Extrapolation</th>
<th>Interpolation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aggregate level</strong></td>
<td>Old approach/consistency checks</td>
<td>Relevant for comparison</td>
</tr>
<tr>
<td><strong>BH level</strong></td>
<td>Earlier comparison</td>
<td>New results</td>
</tr>
</tbody>
</table>
Terminology

• Extrapolation (benchmark in period 1):

\[ PPP_{i,b,t} = PPP_{i,b,1} \times \frac{P_{i,t}}{P_{i,1}} \times \frac{P_{b,t}}{P_{b,1}} \]

• Interpolation (benchmarks in periods 1 and T):

\[ PPP_{i,b,t} = \left[ PPP_{i,b,1} \times \frac{P_{i,t}}{P_{i,1}} \times \frac{P_{b,t}}{P_{b,1}} \right]^{1-w_t} \times \left[ PPP_{i,b,T} \times \frac{P_{i,t}}{P_{i,T}} \times \frac{P_{b,t}}{P_{b,T}} \right]^{w_t} \]

With \( w = \frac{t-1}{T-1} \)

Weighted average of forward & backward extrapolation
Plan today

Discuss a general framework for publishing annual PPP time series.

• Integration of:
  – Global benchmarks
  – Regional benchmarks

• Deal with:
  – Interpolation between benchmarks (main focus)
  – Extrapolation to more recent years
  – ICP idiosyncracies
Plan today

1. Discuss implementation approach (based on note)
   a. General steps
   b. Specific issues

2. Illustrate using time series results
   a. Extrapolation vs. interpolation
   b. Interpolation at aggregate vs. at BH level
   c. Impact of RBMs
General approach

For the years 2012–2016:
1. Interpolate benchmark linked basic heading PPPs
2. Integrate regional benchmarks (RBMs)
3. Aggregation using 2011/2017 methodology
Implementation challenges

1. Interpolate linked basic heading PPPs between 2011 and 2017
   a. Estimate inflation and expenditure at BH level
   b. Apply ICP 2017 reference PPP mapping
   c. Apply annual productivity adjustment
2. Integrate regional benchmarks (RBMs)
   a. Use CAR-PPP method to maintain fixity
3. Aggregation using 2011/2017 methodology
   a. Deal with ‘regional switchers’
1a. Estimating inflation

Two GO-constructed datasets:
1. CPI indices
2. National Accounts deflators

Combine as follows:
- Use most detailed price data for each heading
- Use overall CPI if GDP deflator is missing
- Use GDP deflator if overall CPI is missing
1a. Estimating inflation

Household consumption:
• Typically COICOP-12 data
• Greater detail in EUO (CPI) and AFR (NA)

Beyond consumption:
• Typically Main Aggregates data
• GDP deflator needed most often in CAR, followed by ASI
1a. Estimating expenditure data

Combine:

• BH expenditure data in benchmark years
• Expenditure data at (typically) higher levels of aggregation

By interpolating expenditure shares in higher-level aggregates
1b. Reference headings

Reference headings:
  • Use 2017 reference PPP mapping for annual (interpolated) PPPs.
  • Advantages:
    – Use same method as in benchmark years
    – No need to rely on NA deflators for hard-to-deflate headings such as change in inventories
1c. Productivity adjustment

Two options:
1. Interpolate productivity-adjusted BH PPPs
2. Interpolate non-adjusted BH PPPs and apply PAFs in every year

Little practical difference for interpolation, but option 2 is more appealing for extrapolation, as government deflators will often be based on input costs.
2. Integrate RBMs

<table>
<thead>
<tr>
<th>Year</th>
<th>Africa</th>
<th>Asia-Pacific</th>
<th>CIS</th>
<th>Eurostat-OECD</th>
<th>Latin America</th>
<th>Caribbean</th>
<th>Western Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>ICP</td>
<td>ICP</td>
<td>ICP</td>
<td>ICP</td>
<td>ICP</td>
<td>ICP</td>
<td>ICP</td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td>RBM</td>
<td></td>
<td></td>
<td>RBM</td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
<td>RBM</td>
<td></td>
<td></td>
<td>RBM</td>
</tr>
<tr>
<td>2014</td>
<td></td>
<td></td>
<td></td>
<td>RBM</td>
<td></td>
<td></td>
<td>RBM</td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
<td>RBM</td>
<td></td>
<td></td>
<td>RBM</td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td></td>
<td></td>
<td>RBM</td>
<td></td>
<td></td>
<td>RBM</td>
</tr>
<tr>
<td>2017</td>
<td>ICP</td>
<td>ICP</td>
<td>ICP</td>
<td>ICP</td>
<td>ICP</td>
<td>ICP</td>
<td>ICP</td>
</tr>
</tbody>
</table>
2. Integrate RBMs

- Let:
  - $PPP^L$ be the interpolated linked BH PPPs,
  - $PPP^R$ the regional BH PPPs, and
  - $PPP^F$ the global BH PPPs based on the regional PPPs

- Then $PPP^F$ for country $j$ is calculated using the CAR-PPP method as:

$$PPP^F_j = PPP^R_j \times \frac{1}{\left( \prod_{c \in R} PPP^L_c \right)^{N_R}} \times \frac{1}{\left( \prod_{c \in R} PPP^R_c \right)^{N_R}}$$
3. Aggregation

• Follow ICP2011/ICP2017 methods
  – Maintains fixity within region using CAR-Volume method
  – Special treatment of CIS, CAR and special participation countries
  – See implementation note for a brief summary
• BUT: only for countries that are in the same region in 2011 and in 2017
3a. Dealing with switching countries

Two types:

1. Participants in 2011 but not in 2017 (GTM, MAC, VEN, YEM) or participants in 2017 but not in 2011 (ARG, GUY)

2. Switching between regions (COL*, CRI*, GEO**, MAS***, IRN**, UKR****)

* LAT in 2011, EUO since 2016
** Singleton countries in 2011 (IRN linked via TUR, GEO via ARM) and Special Participation countries in 2017 (IRN linked via WAS, GEO via EUO)
*** Only a dual-participation country from 2014 onwards
**** CIS in 2011, Special Participation in 2017
3a. Dealing with switching countries

**Step 1:** Estimate BH PPPs for all years
Type 1: only one set of benchmark BH PPPs => use extrapolation
Type 2: interpolation as for other countries

**Step 2:** Integrate RBMs
Only relevant for type 2, same method as for other countries
3a. Dealing with switching countries

Step 3: Aggregation

For type 1: Countries with extrapolated PPP should not affect PPP estimates for ‘continuing’ countries,

For type 2: Shifts between regions should be smooth (in the absence of RBMs)
Example: Argentina (type 1)

For any particular year and level of aggregation:

1. Estimate aggregate PPPs for continuing Latin American countries ($LAT_c$)

2. Estimate aggregate PPPs based on 2017 regional composition, $LAT_{2017}$ (i.e. including Argentina)

3. Use the CAR-PPP method to adjust Argentina’s PPP:

$$PPP_{ARG} = PPP_{ARG}^{LAT_{2017}} \times \frac{\left[ \prod_{c \in LAT_c} PPP_c^{LAT_{2017}} \right]^{\frac{1}{N_{LAT_c}}}}{\left[ \prod_{c \in LAT_c} PPP_c^{LAT_{2017}} \right]^{\frac{1}{N_{LAT_c}}}}$$
Example: Colombia (type 2)

For any particular year and level of aggregation:
1. Follow previous steps to link COL to its 2011 region (LAT), $PPP_{COL,t}^{LAT_{2011}}$
2. Follow previous steps to link COL to its 2017 region (EUO), $PPP_{COL,t}^{EUO_{2017}}$
3. Interpolate:
   
   $$PPP_{COL,t} = \left[PPP_{COL,t}^{LAT_{2011}}\right]^{1-w} \times \left[PPP_{COL,t}^{EUO_{2017}}\right]^w,$$

   for $t = 2012, ..., 2015$, with $w = \frac{t-2011}{2017-2011}$
Summary of differences

Notes: Each figure is based on comparing two series of PPPs for each country and computing the difference. Plotted is the median difference, the interquartile range and, in dashed lines, the 5th and 95th percentile across countries for each year.
Summing up

- Estimating time series introduces novel challenges:
  - Integrating RBMs
  - Regional switches
- Difference between interpolation at aggregate level or from basic heading level is relatively modest
- But greater credibility from basic heading level => Same reference PPP mapping, same aggregation procedure
  - Plus greater flexibility in terms of incorporating data detail
CLOSING – THANK YOU