ICP PPP Time Series Implementation Note

November 19, 2019

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This note is a companion piece to the conceptual paper by Inklaar and Rao,[1] which provides a broader set of principles and methods for constructing PPP time series. This note discusses several more specific issues relevant for constructing time series of PPPs and real expenditures for the years 2012 to 2016 based on the ICP data available for 2011 and 2017, regional benchmarks for interim years, National Accounts (NA) expenditure data for interim years, and detailed CPI and NA deflator time series.

1. General approach

The following table outlines for which of the five core regions there is regional benchmark (RBM) data in the 2012-2016 period.

	Africa	Asia-Pacific	Eurostat-OECD	Latin America	Western Asia
2011	ICP	ICP	ICP	ICP	ICP
2012					RBM
2013			RBM		RBM
2014			RBM		RBM
2015			RBM		RBM
2016			RBM		RBM
2017	ICP	ICP	ICP	ICP	ICP

Given this structure and, more in general, the need for a flexible system to incorporate regional data when available and maintain fixity of those results with respect to other regions, the time series estimation is done in four steps:

[1] "ICP: Extrapolation and Interpolation of PPPs and Real Expenditures for the Years 2012 tot 2016" Paper prepared for the October 28-29 TAG Meeting.

1. Interpolate the regional comparisons between ICP benchmarks and RBMs at the basic heading level,
2. Interpolate the global linking factors for the five regions at the basic heading level,
3. Compute aggregate PPPs for each of the higher aggregates within the region using the GEKS method,
4. Apply the CAR-Volume method using linked PPPs and expenditure data for each year.

This means the global linking and aggregation is done at the same level of detail (basic headings) and using the same method in the global benchmark years (2011 and 2017) as in the off-benchmark years (2012–2016). Implementing these steps requires inflation and expenditure data for all countries and years at the basic-heading level, both of which are discussed below.

Step 1:

Interpolation in steps 1 and 2 follows the 'geometric PWT' approach discussed in Inklaar and Rao, Section 4. PPP_c^t for country c and time t between the first benchmark ($t = 1$) and the subsequent benchmark ($t = T$) is then estimated as:

$$PPP_c^t = \left[PPP_c^1 \times \frac{P_c^t / P_c^1}{P_b^t / P_b^1}\right]^{1-w^t} \times \left[PPP_c^T \times \frac{P_c^t / P_c^T}{P_b^t / P_b^T}\right]^{w^t} \quad (1)$$

Here P_c^t is the deflator in country c, the regional base country is denoted by b and the weight given to the benchmark at time T is given by $w^t = \frac{t-1}{T-1}$. A more extensive discussion of this method and alternatives is given in Inklaar and Rao, Section 4.

Step 2:

Equation (1) can be applied in every region in step 1. For step 2, an estimate of regional inflation is needed, to represent price changes for each of the five core regions. For that, we us a geometric mean of price changes across the C_R countries in region R:

$$\frac{P_R^t}{P_R^{t-1}} = \left[\prod_c \frac{P_c^t}{P_c^{t-1}}\right]^{\frac{1}{C_R}} \quad (2)$$

In addition, there are a number of specific issues that come up. Most notable is the issue of how to treat countries that are 'regional switchers', i.e. those that move between region (notably Columbia and Costa Rica that move from Latin America to Eurostat-OECD), from participating to non-participating (e.g. Guatemala, Macao) and from non-participating to participating (e.g. Argentina, Guyana). Another issue is how to deal with productivity adjustment, namely whether to interpolate the productivity-adjusted basic heading PPPs or the non-adjusted PPPs and apply a productivity adjustment in every year. Finally, the non-core regions and special participation countries will need to be incorporated in the computations.

2. Constructing the inflation data

As argued in our conceptual paper, estimation of PPPs for years not covered by official ICP data or regional benchmarks, the principle should be to use the most detailed price data available. This led to concerns about the relevance of more detailed price series given possible mismatches between ICP and CPI samples. In practice, though, NA deflators are not available below the level of Main Aggregates and CPI indexes are not available below the level of Categories, i.e. the COICOP-12 level.

A more practical challenge is that data coverage varies across countries and over the years. For instance, COICOP-12 CPI indexes may be available for some years but not others or Main Aggregate deflators are missing. To construct a complete inflation dataset, we apply the following rules:

1. All CPI and deflator data are converted to annual changes, so $\frac{P_{i,c}^{t}}{P_{i,c}^{t-1}}$ for index i.
2. Since CPIs are always based directly on price observations, while NA deflators may be estimated in a variety of ways, CPI data is given preference over NA deflators
3. For a basic heading in a year, the most detailed price change is used, so for Rice, the Food and Non-Alcoholic Beverages CPI is used when available, otherwise the total CPI, otherwise the NA deflator for Individual Consumption Expenditure by Households, and otherwise the GDP deflator.
4. Whenever the change in the GDP deflator is missing for a country/year, the change in the total CPI is used.

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6. The annual price changes for each basic heading/country/year combination are transformed into an index with 2011=1.

Following these steps results in a complete set of inflation data, i.e. covering 155 basic headings for 7 years and 213 countries, including non-benchmark countries.

3. Constructing the expenditure data

To construct a complete set of expenditure data at the basic-heading level, we also start from data at varying levels of detail. For instance, in the Asia-Pacific region, expenditure is reported at the Category level while in the CIS region, coverage is restricted to the Main Aggregate level. For 2011 and 2017, data is available at the level of basic headings. This allows for computing expenditure shares of each basic heading within their Group, Category, Main Aggregate or GDP in (at least) those two years. These benchmark shares are interpolated and applied to the more aggregate expenditure data at the most detailed level available.

4. Regional switchers

The four steps described at the start of this note cannot be implemented for countries that switch region, which includes those that move from participation to non-participation and vice versa. For example, for Colombia there are regional PPPs data for 2011 as part of Latin America, so Brazil=1, and for 2017 as part of Eurostat-OECD, so USA=1. Likewise, if the set of countries in a region differs between 2011 and 2017, linking factors can only be interpolated after a choice has been made which countries to include in the geometric mean inflation calculation of equation (2).

We propose here to distinguish two groups of countries in each region, namely the *continuing countries* and the *switchers*. The four steps can be implemented 'as is' for the continuing countries and these countries are used in equation (2) to estimate regional inflation. For switchers, we can only extrapolate from their 2011 regional PPPs or their 2017 regional PPPs.

Colombia and Costa Rica can be viewed as a new type of dual-participation country: in 2011 they are fully and only part of Latin America, in 2017 only of Eurostat-OECD, but we propose that in the interim years, they are gradually moved from one to the other. This can be done

by 1) extrapolating forward from 2011 to 2017 their 2011 regional basic heading PPPs using inflation relative to Brazil to 2017 and using the Latin America linking factors to estimate global basic heading PPPs; then 2) extrapolating backwards from 2017 to 2011 their 2017 regional basic heading PPPs using inflation relative to the United States and using the Eurostat-OECD linking factors to estimate global basic heading PPPs; and finally 3) computing a weighted geometric average of 1 and 2 using the same weights w_t as in equation (2).

For aggregation above the basic heading level, the switchers should also be treated differently outside the benchmark year in which they are part of the region. For instance, in 2011, the aggregates for Latin American countries should not be influenced the extrapolated data for Argentina. Likewise, the Latin American aggregates should no longer be affected by Colombia and Costa Rica after 2011.

We propose to compute aggregate PPPs (using GEKS) for the years 2012 to 2016 within the region first for the continuing countries (2011 AND 2017) and then for the full set of countries (2011 OR 2017). The aggregate PPPs that will be used for continuing countries will based on the aggregation over continuing countries, while for the switchers we use the PPPs from the aggregation over the full set of countries. This procedure bears a resemblance to how Georgia and Ukraine are linked to Eurostat-OECD (at least for aggregation above the basic heading level).

5. Productivity adjustment

For the compensation basic headings, there are two possible approaches. Option 1 would be to use the PPP post productivity adjustment, i.e. post-PA PPPs, and interpolate those between 2011 and 2017. Option 2 would use the pre-PA PPPs, interpolate those between 2011 and 2017 and then apply the PAFs for each year. For both options, the PA would be done separately within the region (where applicable) and for the linking across regions.

For the interpolation, it seems probable that both options will yield similar results, because the beginning and endpoints are given, and the only matter is how the change between these two points is distributed over the years. But especially when the current computation framework will be used to extrapolate to 2018 and beyond, the two options will likely yield different results.

To the extent that countries outside Eurostat-OECD currently rely on input-based deflators rather than (implicit) output-based deflators, Option 2 would be preferable, because the extrapolation will be done using changes in labour compensation (and possibly other costs), so the extrapolated (pre-PA) PPP will still conceptually be a compensation PPP that should be adjusted for productivity differences. Given the likely widespread prevalence of input-based deflation, we will therefore follow Option 2.

6. Linking CIS, CAR and SPP countries

The four steps outlined at the start of this note can be applied for the five core regions. In addition, the countries in CIS and the Caribbean as well as the special-participation countries (SPP) will need to be linked into the global comparison. In the case of the CIS, the basic-heading level PPPs for RUS will be set equal to those of RUT, thereby rebasing the CIS PPPs for 2012, 2013, 2015 and 2016. For aggregates above basic heading, the CAR-PPP method employed first in 2014 can be implemented for those years, too – see the CIS-Stat paper on the so-called partially multilateral comparison. The Caribbean region is linked through Latin America in ICP 2011 and 2017 so the same procedure will be followed for the years 2012-2016. The note by Lana and Savio is not clear whether a CAR-PPP or CAR-Volume approach was followed. Finally, as mentioned above, the SPP countries are essentially treated like all switchers, so the same procedure will be followed.