

## Improved Methods to Estimate PPPs for ICP 2011 and Possible Impact on Results

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### Abstract

A challenge facing the implementation of each round of the International Comparison Program (ICP) is to use methodology that is consistent over time; but to also use lessons learned from the past to improve results from the current round. The purpose of this paper is to provide an overview of major methodological changes being implemented in the 2011 ICP and their impact on the final results. The most significant change is moving from a list priced by only a few countries in each region to link regional Purchasing Power Parities ( PPPs), to a set of global core products priced by every country as part of their regional price collection. Once basic heading PPPs are linked across regions, they will be linked at higher levels of the GDP using a global aggregation rather than the two stage aggregation used in the past. In the 2005 ICP, only a few regions used productivity adjustments for the within region PPPs for government services and no adjustments were made for the linking process; this made it difficult to compare these PPPs and real expenditures between countries in different regions. To a lesser extent, methods to improve PPPs for housing are also being implemented.

Key words: Global Core List, Productivity, Purchasing Power Parities

### 1. Introduction

A challenge facing the implementation of each round of the International Comparison Program (ICP) is to use methodology that is consistent over time; but to also use lessons learned from the past to improve results from the current round. The purpose of this paper is to provide an overview of major methodological changes being implemented in the 2011 ICP and their impact on the final results.

The most significant methodological change in the estimation of Purchasing Power Parities (PPPs) by the International Comparison Program (ICP) for ICP 2005 was the statistical process to calibrate PPPs between countries within the same region to PPPs between countries in different regions based on a global currency. The paper begins with a review of the basic methodology to estimate PPPs. Section 2 describes the main differences between the methods used to compute household consumption PPPs between countries in different regions in ICP 2005 and ICP 2011. Section 3 discusses the use of productivity adjustments for government services, and section 4 provides measures being taken to improve the quality of data on dwelling services.

The main purpose of the ICP is to provide PPPs to convert national measures of the Gross Domestic Product (GDP) and aggregates to a common global currency based on the relative purchasing power between countries. In its simplest form, a PPP is the ratio of national annual average prices in national currencies of a well defined product. The PPP for the total consumption aggregate of the GDP, for example, is built up from the comparisons of prices of products purchased by households. The basic steps follow.

- The world is divided into regions, mainly geographically based.
- The GDP total expenditures are broken down into 155 basic headings which are a form of stratification to facilitate the selection of products to be priced. The consumption aggregate consists of over 100 basic headings of which food makes up 29 basic headings. Rice, other cereals, beef and veal, for example, are basic headings.
- Each region determines the products within each basic heading that its countries will price. The regionalization ensures that products most often consumed by consumers in their region are included. Quality measures and package sizes, for example, are region specific. The Eurostat-OECD region prices around 2,500 consumption items; the other regions price 600-1,000 consumer products.
- Within each region, the first step is to estimate PPPs for each basic heading. There are no expenditure weights for individual products, so the estimation is essentially an averaging of product level price ratios, using the GEKS or CPD method to derive transitive basic heading PPPs. See World Bank (2013) chapter 4.
- Basic heading PPPs for each country are averaged (aggregated) to higher levels of the GDP and to the GDP using expenditure weights. See World Bank (2013) Chapter 5. The basic heading PPPs between each bilateral pair of countries, say A and B, are first weighted using country A's weights (Paasche index), then again using country B's weights (Laspeyres index). The geo mean of the Paasche-Laspeyres indexes forms a set of bilateral PPPs or Fisher indexes for all countries in the region in a regional currency.
- The GEKS method converts the Fisher indexes into PPPs that are transitive and base country invariant at each level of aggregation and the GDP.

The above steps are first completed within each region. At this stage, each region has a set of PPPs for the GDP and its aggregates for every country calibrated to a regional currency. The dilemma is that at this stage, one cannot estimate PPPs between countries in different regions which is the main purpose of the ICP. The following section describes the method used in 2005 to link basic heading PPPs across regions, an assessment of the results, and lessons learned that are being applied to ICP 2011.

## 2. From Regional to Global PPPs

PPPs are first linked across regions at the basic heading level. The simplest way to link basic heading PPPs is the Bridge method used to link the CIS region to the Eurostat-OECD comparison in the 2005 ICP. In this case, Russia provided average prices for both the Eurostat-OECD and CIS products. Then the PPP between any country *t* in the CIS region and any country *s* in the Eurostat-OECD region can be derived as

$$(2.A) \quad PPP^{s,t} = PPP^{s,k} \cdot PPP^{k,t} \quad \text{where Russia is country } k.$$

The PPP between countries *s* and *t* is dependent on the choice of country chosen to price both regional lists. For that reason, a new approach coined the Ring method was chosen for the 2005 ICP. The PPP between country *s* in region A and country *t* in region B is described as follows:

$$(2.B) \quad PPP^{s,t} = PPP^{s,a} \times (PPP^{A,G} / PPP^{B,G}) \times PPP^{b,t}$$

where  $PPP^{s,a}$  is the PPP between country *s* and country *a* in region A.  $PPP^{A,G}$  is the between region PPP between region A and the global base (G), and  $PPP^{B,G}$  is the between region PPP for region B to the global base (G). The between region PPPs were determined as follows.

- As described above, each region developed its own list of products. These global lists were combined and used as the basis to define a set of products comparable between countries in at least two different regions. The outcome was the Ring list which contained about 1,000 consumer products with descriptions that could be applied across countries in different regions.
- A total of 18 countries, between 2 and 6 countries in each region, priced this Ring list in addition to their regional lists. It was treated as a separate survey. Recall from above that each region first computed basic heading PPPs expressed in the currency of a base country. These within region basic heading PPPs for each of the Ring countries representing their region were used to convert the Ring prices into the currency of the regional base country. When this was completed, there were five sets of regional prices for each basic heading, each in the currency of a regional base.
- On the basis of these regional prices, regional linking factors (or between-region PPPs) for each basic heading were calculated
- Multiplying these regional linking factors with the within region PPPs created a multilateral PPP allowing comparisons at the basic heading level between every country in the world. Since the same basic heading scalar value is used to adjust each within region basic heading PPP for every country in the region, the within region PPPs and their transitivity are preserved.

This method was a significant improvement over the bridge procedure because more countries were included in the estimation of the linking factors and a global set of products was priced.

At this stage there was a matrix of 5 between region PPPs for each basic heading and another matrix of the same size of total regional expenditures in the regional currency. The same aggregation methods to create within region PPPs were used to aggregate the between region PPPs for each level up to the GDP. These aggregated between region PPPs were scalar values applied to the within region PPPs at each level. This method was labeled the “two-stage linking” method.

There were several lessons learned. First, the price levels between Ring countries in the same region were not the same for the Ring and regional surveys. This was partly because the lists were different. However, many of the differences were caused by the fact that while a Ring country could provide a price for an item on the global Ring list, it may have only been available in a specialty shop and not commonly purchased. A weighting process based on relative price levels and volume of sales was attempted to classify the Ring prices as “representative” or “not representative”. The Ring countries were not able to consistently apply the concept, as a result all price ratios within basic headings were treated equally which raised the relative price levels for those countries for which the Ring list was the most unrepresentative.

The second issue is that while the linking was based on more countries, the outcome was conditional on the set of countries chosen. A post-survey review, World Bank (2013) Chapter 8, showed weaknesses from the choices of countries to be in the Ring; mainly that their price and economic structures for some of the Ring countries were considerably different from other countries in their region. Finally, the aggregated results depended on the choice of the country to be the base for each region. While the global PPPs were transitive, they were not base country invariant. Therefore, the following changes in methodology were made for ICP 2011.

- A “core” set of products has been priced by all countries. Analysis showed that there was more price variability across countries than between products. Therefore, a reduced list

- of core items was developed (about 600). This core list was made a part of the regional price comparisons and priced by every country in each region; therefore, removing the problems associated with the choice of countries used to compute the linking factors.
- All product prices are to be classified as “important” or “less important”, a simpler process to enable weights to be applied to products within basic heading. Product prices classified as important will receive a weight of 3; the weight will = 1 for the remaining products.
  - Between region basic heading PPPs (linking factors) will be computed as described above for ICP 2005 except that all countries will be represented and the weighted CPD method will bring in the importance weights.
  - Rather than aggregating between region PPPs as was done for ICP 2005, there will be a direct global aggregation of basic heading PPPs. Once the basic heading linking factors are determined for each region and applied to the within region basic heading PPPs, the outcome is a matrix of n countries times 155 basic headings. The same steps used to compute within region PPPs will be followed starting with the estimation of the Fisher matrix and using the GEKS method to provide the transitive and base country invariant properties. This global aggregation will not preserve the regional PPPs. This will be achieved by using a linking factor that is the ratio of the sum of regional expenditures in the regional base currency to the sum of regional expenditures from the global aggregation. In effect the sum of regional real expenditures from the global aggregation is distributed to the countries within each region per their shares from the within region aggregation. Within region PPPs are thus maintained, the results are transitive and base country invariant.

This new global aggregation method (labeled “Country Aggregation with Redistribution—CAR”) will provide different results from the two stage method used in ICP 2005. The global aggregation means that bilateral Paasche and Laspeyres PPPs will be computed for each country over all n-1 other countries. In addition, the GEKS method will be based on the direct PPPs between each country and through indirect PPPs through every other country. If the global aggregation had been used in ICP 2005, the Asia-Pacific and CIS regional world shares would increase by 2.5 and 6.3 percent, respectively, and decrease in the remaining regions most notably 7.0 percent in the African region (World Bank (2013), Chapter 19.) It is not possible to simulate the use of importance classification using the 2005 results. However, analysis of the 2011 results will show the impact of using or not using that classification.

The following sections provide a review of the other changes in methodology between ICP 2005 and 2011.

### **3. Productivity Adjustments for Government Services**

Basic heading PPPs for health and education goods and services that are purchased by households or government are based on price comparisons, for example, for pharmaceutical and other medical products, outpatient dental and medical services, and private education services. The services produced by government itself are difficult to price; instead the input cost approach is used. Basic heading PPPs for government expenditures for the production of health and education services and for collective services are based on the comparison of annual salaries for about 50 occupations. These comparisons are based on the annual compensation for different skill and employment categories based on international standard definitions.

These comparisons assume that the productivity in the provision of these services is the same across countries. This is an unlikely assumption given the different amounts of capital per worker across countries. In the 2005 ICP round, the equal productivity assumption resulted in implausible PPPs for the Asia-Pacific, Western Asia and African regions. Under the equal productivity assumption, poor countries such as Lao and Yemen had per capita volumes for government expenditures greater than those of neighboring richer countries or economies and even affected the level of the real GDPs. Therefore, in ICP 2005 productivity adjustments based on capital per worker in each economy as a whole were used to adjust the within region compensation basic heading PPPs in Asia-Pacific, Africa, and Western Asia. This assumes that the labor productivity in the government sector is the same as that in the overall economy.

The dilemma when computing the linking factors needed to combine the regional basic heading PPPs into a global comparison was dealing with three regions where no productivity adjustment was used and the other three making productivity adjustments. Therefore, linking factors were not adjusted for productivity.

Since 2005, the Eurostat-OECD region has introduced new methods for education and health, based on direct output measurement as far as possible. See Eurostat-OECD (2012), chapters 7 and 8, for information. This implies that the price and volume relatives for education and health services for the Eurostat-OECD countries are not comparable between the 2005 and 2011 rounds.

In ICP 2011, labor and capital stock data will be prepared for all countries. For the purpose of calculating the linking factors, productivity adjustments will be made in the global aggregation for all countries in each region to government collective services as well as for health and education, even if a region does not adjust its within region results for productivity, or uses a direct output method like Eurostat-OECD, the linking process preserves the within region PPPs.

#### 4. Dwelling Services

Household dwelling expenditures include market-rented housing and imputations for owner-occupied housing. The preferred method to estimate PPPs is to create size and type of housing strata and obtain market rents which are then applied to similar strata describing owner occupied dwellings. The problem is the lack of rental markets in some countries, which makes it difficult to impute rental rates to apply to owner-occupied housing. The recommended method to estimate PPPs in these situations is the direct volume approach (or quantity method) which requires information on number of dwelling units and total square meters, by location such as urban or rural, and by type of dwelling for each country. PPPs are computed indirectly using the relationship of Expenditures = Price times Quantity. The PPP between countries a and b is  $P_a/P_b = ((E_a/Q_a)/(E_b/Q_b))$  where E is the expenditures from the national accounts and Q is the quantity measure. See World Bank (2013) chapter 12 which describes these methods.

Countries in the African and Asia-Pacific regions had difficulties with both the imputed rental and quantity measures. Low-income countries with a high percentage of traditional dwellings and a low percentage of rentals, tend to underestimate the expenditures for owner-occupied housing in the national accounts. There were similar difficulties with the quantity data. Therefore, PPPs in these two regions were imputed. The PPP for housing was the PPP for individual consumption expenditures by households (excluding expenditures for dwellings). The problem is that housing had no effect on the overall PPPs for household consumption; thus the PPPs and per capita measures were not comparable across regions. The use of quantity data from a subset of countries to compute linking factors is described in World Bank (2013), chapter 12.

Data users were very critical of the imputation method for housing in Africa and Asia-Pacific. Therefore, several steps were taken for ICP 2011 to ensure that housing PPPs are directly measured in every region. The process begins with steps to improve the national accounts data for imputed rentals and traditional housing. All countries were requested to provide as many prices as possible for the rental strata. All countries were also provided a detailed form and methods to provide data on number and square meters of different types of housing units along with quality measures such as running water, etc. These data will be used to compute within region PPPs and also the between region linking factors.

The imputation method used in ICP 2005 can be used in ICP 2011 to provide a measure of the impact of this method.

## 5. Conclusions

The changes in methodology discussed above will provide results that will be difficult to compare with ICP 2005. Therefore, the Global Office will provide in-depth analysis to help data users understand the new benchmark data. For example, the global aggregation method to link the regions (CAR) can be applied to the 2005 results, and the two stage linking method to the 2011 data. The impact of the core list can be assessed by computing regional results that exclude the core data; the same can be done by including/excluding the importance classification. The same include/exclude analysis can be used for productivity adjustments and the imputation of dwelling services.

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