International Comparison Program

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EXTRAPOLATING ICP DATA AND PPPs

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1. BACKGROUND

The International Comparison Program (ICP) is a worldwide statistical initiative aimed to estimate Purchasing Power Parities (PPPs) to be used as currency converters to compare the performance of economies around the world. The ICP directly addresses the issue of valuating goods and services on an international scale by producing detailed information on price levels in economies worldwide. Consequent to the ICP efforts, PPP exchange rates are the currency ratios that compare the cost of identical baskets of goods and services globally. The use of PPPs enable in depth views of the scarcity of resources worldwide as opposed to using currency exchange rates, which are tied to the fluxes of the financial market.

The ICP conducts surveys every five/six years to collect price and expenditure data for all goods and services that make up GPD in order to calculate the PPPs. As both currency converters and spatial price deflators, PPPs are utilized by the ICP to make the GDPs of different countries comparable. GDPs are not initially comparable because they are formulated in national currencies and valued at national price levels. The application of PPPs allows for the conversion of GDPs into a uniform price level. This uniform price level prevents the ramification of using contrasting country and region price levels. The outcome is that variances between GDPs reveal only variances in the volumes of final goods and services purchased.

The GDP volumes enable comparisons of the economic size of countries and their output along with the welfare of their inhabitants. They can also be used to monitor the incidence of poverty, measure labor costs, or point out investment potential of countries. International prices of goods, services and labor are core economic indicators of economies' outputs and prosperity, hence the need to make this knowledge available for economies worldwide by means of the calculated PPPs.

There is a considerable demand for PPPs evidenced by their large and diverse applications by development organizations, governments, corporations, and a medley of others. The demand for global statistics has increased and along with it the need for open and timely data. To provide timely data that reflects current realities would strengthen and further the applications of the data. An obvious setback to the current ICP process is the publication lag between benchmark ICPs, which are held every five/six years. Conversely, PPPs are extrapolated every year through the Penn World Tables and the World Development Indicators. These publications extrapolate PPPs at high levels (GDP or its main aggregates). The World Bank is exploring new approaches to improve the extrapolation method currently used in the World Development Indicators. This paper describes a proposed alternative statistical approach for extrapolating ICP underlying data to yield more robust results than extrapolating PPPs at higher levels.

2. DEMAND FOR PPP TIME SERIES AND ICP DATA

The ICP data and PPP time series data have many users for various purposes. The core users of the data generated by the ICP are international organizations and regional agencies. However, there is a growing demand for PPPs from an array of users at the national level: government agencies, universities, research institutes, public enterprises, private firms, banks, journalists and individuals.

Foremost uses are: classifying countries by national income, gauging economic activity, measuring trade and competition policies, finding international economic opportunities, examining trade and development issues, comparing wages and cost of living worldwide, and benchmarking international policies and effectiveness. Additionally, there is much potential to further expand on these uses by providing PPP time series data on a more frequent and detailed basis. More frequent and detailed data would enable a new wave of possible PPP applications.

With increasing globalization, national economies are much more open to the rest of the world. The flow of goods, services and labor has a much larger effect on countries as international trade and financial transactions have increased substantially over time. Economies now rely heavily on one another as each country's situation can more noticeably factor into the international scene. The amplified openness of national economies has created a need for countries to view and compare the statistics of their counterparts. International organizations also require this data to make important decisions. Worldwide data is therefore more necessary for basic measures of economies. Furthermore, it is essential for a globalized economy to have internationally comparable figures to monitor and guide policy responses to inflation, monetary imbalances and economic downturn. Up to date regional and global economic statistics will better serve to understand global, regional and national economic developments than traditional national data. International organizations and regional agencies will both gain from the accessibility to data that enables rapid and informed decision-making.

The demand for comparable international statistics can only grow. In response to globalization, data is needed to update and review government policies and private activities that are facilitated in an interrelated world across which goods, services, finance and people move in ever greater volumes. Those who obtain this information and understand how to use it will benefit. For example, there is significant headway to be made towards averting potential regional and global economic or financial crisis. By continuously reviewing the prices of many commodities it is more quickly apparent when the costs of items have risen rapidly and therefore may lead to an increase in poverty. This up-to-date knowledge and insight is a prime benefit to time series detailed data produced by the ICP.

PPP time series currently available in various publications is not yet capable of meeting the demand for detailed data. While the benchmark ICP results publish PPPs for 24 headings (GDP, main aggregates, and groups), the PPPs in the World Development Indicators are extrapolated between benchmark years for only two headings (GDP and Household Consumption). While the surveys that are conducted every five years are extremely comprehensive and useful, the extrapolated time series data is limited to two headings and is thus unable to respond to users' needs of more detailed data. Overall, it is important to build on the ICP rounds in order to capture the comprehensive data that may be utilized by progressive extrapolation methods to achieve desired results.

The ICP is working to meet the demand for global comparable economic statistics to respond quickly to and monitor global events. Specifically, the aim is to respond to the rising need for reliable detailed high-frequency time series PPP data. In order to accomplish this goal, a statistical method for extrapolating PPPs by extrapolating underlying data is being proposed in this paper.

3. OVERVIEW OF CURRENT METHODS

Chapter 18 of the ICP Book describes in length the various approaches currently used to extrapolate PPPs to non-benchmark years. These include: The World Development Indicators method, the Eurostat Rolling Benchmark method, and the Penn World Table method.

3.1. THE WORLD DEVELOPMENT INDICATORS METHOD

The Word Development Indicators (WDI) produce annual PPPs based on a macro approach. It involves interpolating between benchmark years or extrapolating from the latest benchmark year using the implicit price deflators (IPDs) for GDP for each country involved. The process is to divide the IPD for GDP for each country in turn by the IPD for GDP in a reference country and apply that ratio to the PPP for GDP in the relevant country in the benchmark year. The IPDs for all countries must be re–referenced to 100 in the benchmark year before calculating the ratio. The formula underlying this approach is:

$$PPP_{t+1}^A = PPP_t^A \; x \left(IPD_{t+1}^A \Big/ IPD_{t+1}^R \right)$$

where PPP_{t+1}^A equals the PPP for country A in year t + 1; PPP_t^A equals the PPP for country A in year t; IPD_{t+1}^A equals the IPD for GDP in country A in year t + 1 (base =100 in year t); and IPD_{t+1}^R equals the IPD for GDP in the reference country (R) in year t + 1 (base = 100 in year t).

The advantage of this method is that it is easy to implement and has a low cost of implementation. One disadvantage is that it is a bilateral extrapolation method and not a multilateral one. Also, Ravallion in his paper "Price Levels and Economic Growth: Making Sense of Revisions to Data on Real Incomes" argues that this method does not take into consideration the Dynamic Penn Effect (DPE). The DPE describes the tendency for the gap between exchange rate-based and PPP-based comparisons of GDP to narrow as the per capita real GDP for low-income countries increases relative to that of high-income countries. Ravallion suggests an alternative approach in which the DPE would be brought explicitly into the inter-temporal extrapolations for the price-level index, using market exchange rates to back out the implied PPPs for non-benchmark years. Ravallion argues that this proposed adjustment would yield more reliable estimates than the WDI macro method.

Deaton in his paper "Consumer price indexes, purchasing power parity exchange rates, and updating" also argues that the WDI method does not take into consideration the effect of the divergence between the purchasing power parity exchange rate and the differential rate of change of the CPIs. Deaton indicates that the WDI approach updates the PPPs from the previous round using the differential rate of change of the country's CPI and that of the US. This ignores the fact that the weights on the PPP index necessarily differ from the weights on the two CPIs, so that the updating will be incorrect by an amount that depends on the budget shares and rates of relative price change in the two countries. This bias can be eliminated by extrapolating at a more disaggregated level.

3.2. THE EUROSTAT ROLLING BENCHMARK METHOD

Eurostat extrapolates PPPs at the basic heading level, as part of its rolling benchmark exercise. The process is described in Chapter 5 of Eurostat's revised PPP manual as follows:

Following the rolling survey approach, each basic heading for consumer goods and services is priced only once every three years. PPPs for non-survey years are calculated by applying annual extrapolation factors to the PPPs of the survey years at basic heading level. The annual extrapolation factors are derived from the same set of data as provided for the temporal adjustment factors. They are calculated as the annual arithmetic average of the monthly temporal adjustment factors and would in most cases correspond to the annual CPI index.

If a basic heading is priced in year t, the PPP for that basic heading in year t+1 is derived as:

$$PPP_{t+1} = EXT_{t+1} * PPP_t$$

with EXT_{t+1} being the extrapolation factor for year t+1 (that is, a price index giving the change in prices between year t and t+1, relative to the average change in prices for the European Union). For year t+2, the PPP will be retropolated from the PPPs derived in the survey of year t+3:

$$PPP_{t+2} = PPP_{t+3} / EXT_{t+3}$$

This can only be done after PPPs for year t+3 have become available. Until then, the PPPs for year t+2 are derived as:

$$PPP_{t+2} = EXT_{t+2} * PPP_{t+1} = EXT_{t+2} * EXT_{t+1} * PPP_t$$

CPI indices are generally used as extrapolation factors for the PPPs. In this case, it is quite important to check the coherence of the PPP survey results with corresponding CPI data. The main advantages of the rolling benchmark are that reliable annual PPPs can be produced and national statistics offices can plan on a regular work cycle for their staff collecting prices. Another advantage of this method is that the extrapolation is done at a low level and that PPPs are aggregated in a multilateral way. However, the shortcoming is that it entails an annual cost borne by all countries to collect the required price data.

3.3. THE PENN WORLD TABLE METHOD

The Penn World Table (PWT) has been maintained by the Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania. It provides a time series of PPP-based national accounts data for more than 180 countries from 1950. The PPPs and real expenditures in the PWT are estimated by extrapolating and backcasting PPP-based estimates from benchmark ICP. The starting point is the global set of basic heading PPPs and expenditures from the benchmark ICP as reference. PPPs are estimated for actual consumption, collective government consumption, and gross fixed capital formation for benchmark countries and estimates for additional countries in the reference year. These were aggregated to Domestic Absorption (DA). A constant price series for DA is backcasted and forecasted to other years using national growth rates of DA. The net exports are then added to obtain GDP at reference year prices. A current price series is also provided. By the end of 2012 PWT 7.1, scholars at University of California Davis and Groningen University will introduce a new methodology,

termed PWT 8.0, first using 2005 ICP data and later using 2011 ICP data. PWT 8.0 will use a new methodology to extrapolate PPP based estimates to other years.

4. PROPOSED METHOD

4.1. OVERVIEW OF APPROACH

The approach puts forth a statistical extrapolation of ICP data (average prices and national accounts expenditure data) that would yield more robust and detailed results than extrapolating PPPs at higher levels using the current methods. The approach involves two stages. In the first stage, Regional PPPs are extrapolated. In the second stage, the Regional PPPs are linked to produce Global PPPs.

The first stage involves the extrapolation of regional PPPs, as per the following steps:

1. Extrapolating ICP benchmark average price data using national price indices to non-benchmark years;
2. Computing Basic Heading Regional PPPs from the extrapolated price data, using CPD or weighted CPD;
3. Extrapolating Basic Heading expenditure data using changes in prices and population and new survey data; and
4. Aggregating Basic Heading Regional PPPs to compute Regional PPPs for GDP and its main aggregates, using GEKS.

Next, the Global PPPs are computed following a similar approach to that used in Benchmark exercises. This approach would involve the following steps:

1. Using the extrapolated average prices for Global Core List items to compute linking factors; and
2. Linking Regional PPPs to produce Global PPPs, maintaining fixity.

If national price indices are not available for all GDP components for some countries, a reduced approach could be implemented for those countries. The reduced approach would consist in extrapolating Household Consumption only. This approach can be summarized by the following steps:

1. Extrapolating Household Consumption price data using Consumer Price Indices;
2. Computing Household Consumption Basic Heading PPPs;
3. Aggregating BH PPPs to higher aggregates up to Household Consumption;
4. Deducing a relationship between GDP PPPs and Household Consumption PPPs from the benchmark year exercise; and
5. Applying the relationship to non-benchmark years to compute GDP PPPs.

4.2. EXTRAPOLATING PRICE DATA

Average price data can be extrapolated using national indices including:

- Consumer Price Indices for Household Consumption price data

- Implicit deflators for Compensation of Government Employees
- Producer Price Indices/ Construction Price Indices/ Implicit deflators for Gross Fixed Capital Formation (Machinery and Equipment goods and Construction).

The proposal to use CPI data to extrapolate PPPs is not new. In their paper "Understanding changes in PPPs over time", Biggeri and Laureti indicate that it is necessary to carry out the extrapolation of PPPs at a disaggregated level and use adequate price index formula to obtain coherent extrapolation. They suggest "using the data collected in the CPI survey by rearranging them" to extrapolate PPPs at Basic Heading level. This approach is very useful but it would require access to the price data underlying the CPI. Thus, it can be very time-consuming and costly. This paper proposes using national indices, but rather than extrapolating Basic Heading PPPs, the suggestion is to extrapolate underlying average prices.

4.2.1. Household Consumption

The use of CPI to extrapolate/backcast Household Consumption price data is not new to the ICP. It is commonly used in computing national annual averages, when prices for one or more quarters are missing. It is also used when a country prices the ICP basket in periods outside the benchmark year and the resulting data needs to be backcasted to the benchmark year. This backcasting is usually done using CPI sub-indices.

The UN Classification of Individual Consumption According to Purpose (COICOP) is the classification underlying the CPI and the breakdown of household individual consumption expenditure in the ICP classification of GDP expenditures. Thus, the correspondence between CPI sub-indices and ICP basic headings is generally high. However, CPI sub-indices are usually more detailed than basic headings. Thus, one CPI sub-index may be used to extrapolate average prices for some products under a basic heading, while another CPI sub-index may be used to extrapolate average prices of other products under the same basic heading.

The 2011 ICP Operational Guide Chapter "Computation of National Annual Average Prices" provides examples of how CPI sub-indices are used for imputing missing average prices and for backcasting average prices. The example below illustrates the case of a country where quarterly average prices are partially missing.

	CPI Matrix				Quarterly National Average Prices Matrix				Annual Av. Price
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Product 1	102.3	103.5	103.4	103.3	7.17	7.25	7.21	7.23	**7.22**
Product 2	102.3	103.5	103.4	103.3	7.12	7.2	7.19	7.19	**7.17**

For Product 1, the 1st quarter average price is missing from the original price collection. This missing average price is imputed using CPI sub-indices from the next available quarter. If the 2nd quarter price is also missing, then we can take the 3rd quarter data for imputation and so on. In this case, 1st quarter average price can be computed as 7.17 = 7.25*(102.3/103.5). For Product 2, three quarter average prices are computed using one data point and relevant CPI sub-indices.

The example below shows the case of a country where price collection took place in 2012 instead of 2011. It is best to backcast on a quarter-on-quarter basis, but it can be done on an annual basis also. Thus in our example, Q1 2011 would be 7.08 = 7.12*(101.7/102.3), Q2 2011 would be 7.12 = 7.2*(102.4/103.5) and so forth.

	2011				2012			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
CPI Matrix	101.7	102.4	102.0	102.1	102.3	103.5	103.4	103.3
Quarterly National Average Prices	7.08	7.12	7.13	7.12	7.12	7.2	7.23	7.2

A similar approach can be applied to extrapolate annual average prices to non-benchmark years. The formula to be used is:

$$P_{i,n} = P_{i,b} * (CPI_{j,n} / CPI_{j,b})$$

where i is the product, n is the time period, b is the ICP benchmark period, and j is the group of products for which a CPI sub-index is available.

4.2.2. Compensation of Government Employees

Two approaches may be considered for the compensation of government employees. The easiest approach would be using the implicit deflators for Government to extrapolate the PPPs for Compensation of Government Employees. In general, implicit price indices can be derived from GDP time series at market and constant prices and can be used to estimate extrapolation factors at the appropriate GDP classification level.

Given that the salary scales are administrative data readily available in countries, the alternative and sounder approach would involve asking countries to provide the compensation of government employees on an annual basis. This is what the Eurostat Rolling Benchmark approach requires countries to do. This data can be used to directly compute the PPPs for Compensation of Government Employees.

4.2.3. Gross Fixed Capital Formation

In the case where a country produces a Construction Price Index, this index can be used to extrapolate the Construction PPPs. If this index is not available and given that the input prices needed for construction are those paid by construction contractors to their suppliers, the Producer Price Index may be a substitute to extrapolating construction input prices.

For Machinery and Equipment, implicit deflators can be used to extrapolate the prices for Machinery and Equipment. This is the method adopted by Eurostat in their Rolling Benchmark, where they use implicit price deflators for extrapolation and retropolation that are derived from national accounts for Machinery.

Alternatively the Price Factor Method (PFM) can be used to impute Machinery and Equipment PPPs on an annual basis. It involves the decomposition of the price of machinery and equipment into its component

"price factors". As the countries using the PFM import almost all if their equipment goods the PFM starts with the ex-factory price of an equipment good in the exporting country and follows it through to its final price when it is installed and ready to use on the importing country.

4.3. EXTRAPOLATING NATIONAL ACCOUNTS DATA

Statistical methods used in constructing GDP time series can assist in extrapolating GDP expenditure values for the spatial context of the ICP. To ensure that the resulting estimates are economically and statistically consistent, the assumptions underlying the estimation process as well as the parameters and indicators included should be tested and validated against the principles of the SNA accounting framework. Central to this consistency framework is the commodity-flow method and more so supply-use tables (SUTs) which are the most effective ways of estimating expenditure values of detailed components of GDP.

In principle, a detailed component of GDP expenditure, or basic heading (BH), consists of a set of similar goods or services. However, several basic headings are heterogeneous in nature, which makes it difficult to gather all key indicators required to estimate the relevant expenditures directly. Ideally, BH values should be estimated directly, thus compiling the vector of GDP expenditures from bottom-up.

To facilitate the process, the Global Office developed an Excel template, the Model Report on Expenditure Statistics (MORES) to support the countries in their efforts to provide a detailed metadata report showing how expenditures are estimated for each BH. Specifically, it assists countries to compile: (i) detailed expenditure values for each BH of the ICP classification; (ii) information on the splitting approach; and (iii) information on the indicators used to estimate the expenditure values.

The proposed approach will build on the national MORES compiled for a benchmark year. The approach proposes updating the MORES on an annual basis using:

- Changes in prices
- Changes in population
- Changes in production and imports whenever data is available
- New survey data

The MORES provides enough metadata on how countries compile their basic heading expenditure data, which allows for the extrapolation of this data. Alternatively, for countries that do not provide detailed data, per capita expenditures and/or per capita expenditures structure can be extrapolated to non-benchmark years.

4.3.1. Five splitting approaches

Countries that used the MORES followed 5 splitting approaches recommended by the Global Office:

1. Direct estimation – it is the preferred approach to be used when the key data sets required are readily available for the reference year.

2. Extrapolation from a recent year or from 2005 - If an expenditure breakdown is available for an earlier year, e.g. when the country participated in the 2005 ICP, the relevant detailed

expenditures could be at least partially updated, under specific assumptions on population growth, price evolutions, etc.

3. Borrowing a per capita quantity or volume from a country in the same cluster related to a particular BH. The per capita quantity or volume borrowed from a same-cluster country will be multiplied by the population of the borrowing country and a price factor representing the price level index between the two countries.

4. Borrowing a structure related to a class, sub-group or group from a country in the same cluster related to a particular higher level heading. The structure borrowed from a same-cluster country will be multiplied by the relevant aggregate expenditure to estimate the expenditures for the basic headings under the aggregate.

5. Splitting a category's volume or quantity (class, sub-group or group) into its composing BHs, using expert opinion. Expenditures estimated for a higher level of the classification should not be evenly divided among the BHs. This is an unsatisfactory solution, and an informed guess by a country's national accountants, even a rough estimate, is preferable to a simplistic split into even amounts. However, if none of the 4 other approaches can be implemented; the notional volume or quantity estimated for a higher level of the classification could be divided among the BHs using expert opinion. This might involve consulting retailers, manufacturers, marketing experts, chambers of commerce and other government departments. Each resulting BH notional volume or quantity will be multiplied by a price factor that expresses the price level of the BH in relation to the other BHs under the same higher level of the classification. This provides BH expenditure indicators that will be calibrated to the total expenditure value of the higher aggregate.

The task of splitting GDP expenditures into the detailed components (basic headings) required for the ICP would be relatively straightforward if the broad aggregates in the national accounts were based on combining detailed data from bottom up. In such a situation, detailed prices, production data and expenditures would be available fairly readily. However, the paucity of basic data sources precludes such a simple solution in most countries in the world.

It is essential to make the most of existing statistics to maximize the consistency in the national accounts activities for the ICP. Consistency is the key requirement: consistency between prices collected in the field and prices embedded in GDP expenditures, between production data and expenditure data, between import prices, producers' prices and purchasers' prices, between wholesale prices and retail prices. The MORES was recommended to countries as a consistency tool. Countries that effectively used it found it very advantageous. Metadata they have provided, explaining how they estimated each particular BH expenditure for the latest year for which they could compile detailed GDP expenditures, was reviewed by the Global Office. This relates to 49 countries in Africa, 20 in Latin America and 10 in Western Asia. These MORES metadata sets show which indicators were used in the process.

4.3.2. Learning from the MORES

Centrally organized extrapolation

Learning from the MORES implementation and review process, it is recommended here that, when the BH expenditures for the reference year 2011 have been finalized, the estimates for subsequent years can be compiled centrally for any country that does/will not update their expenditures on an annual basis or that does not do so timely. BH expenditures for statistically developed countries (e.g. OECD-Eurostat and CIS countries) will be obtained from OECD-Eurostat and CIS-STAT or from the countries concerned.

Categories of extrapolation indicators

Six major categories of indicators were used to extrapolate expenditures from 2005 or from another year to the year for which the MOREs was implemented: (i) Demographic indicators (e.g. Total Population; School population; Adult Population; Number of households; Civil service population); (ii) Supply indicators (Local Production; Imports); (iii) Health indicators (e.g. Hospital beds; Number of doctors per inhabitant); (iv) Inflation indicators (CPI); (v) Macroeconomic indicators (e.g. GDP growth); and (vi) Government Finance data (Government Budget). The mapping of basic headings to these indicators is shown in Annex: Categories of extrapolation indicators in MORES.

4.3.3. Proposed approach

For some countries, the MORES metadata include ratios -derived from SUTs, or commodity flows- or provided by experts which will be used in association with other relevant data to extrapolate the BH values from 2011 to a subsequent year. A ratio example for a given BH is the value of household expenditure divided by the local production for the BH concerned. This ratio can be higher than 1 if a large amount of relevant products is imported. When such ratios are not available, the extrapolation will be based only on internationally available data. For each country and a particular year, the overall approach has 8 steps:

- Step 1: Create an extrapolation matrix and insert in the matrix the estimated/forecast expenditure values of GDP and its main aggregates available in international databases;
- Step 2: Insert in the extrapolation matrix ratios extracted from a country's MORES, if available. The matrix will show the ratios used for each BH, as well as the names of the indicators for which the ratios refer. Only ratios related to indicators whose data can be found in international databases will be included in the matrix;
- Step 3: Include in the matrix, data related to other extrapolation indicators (see Section 5.2 below) available in international databases. A particular indicator value can be used for several basic headings;
- Step 4: Include in the matrix any expenditure value that may be readily available. This is likely to be the case for Government Consumption basic headings such as compensation of employees, as well as for exports and imports of goods and services;
- Step 5: Complete the matrix with appropriate relationships/formulas, showing how the ratios and the indicator values mentioned above will combine into basic headings estimates;

- Step 6: For basic headings that cannot be estimated through previous steps, use their share into their relevant main aggregate for 2011, and multiply it by the estimated value of the main aggregate for the subsequent year;
- Step 7: Check additivity and make any necessary adjustment. This step will be ran anytime an adjustment is made;
- Step 8: For all household consumption headings calculate the variations of per capita values between the subsequent year and 2011. If these variations are significantly different from those that would have been obtained if the per capita expenditure was extrapolated using price and population changes, find supporting and economically acceptable justifications, or make further adjustments to the estimated values.

5. ANALYSIS OF DATA AVAILABILITY

5.1. AVAILABILITY OF PRICE INDICES TO EXTRAPOLATE PRICE DATA

International databases including those of the World Bank Development Indicators, the IMF, and the United Nations have a wealth of indicators that can be used to extrapolate price data on an annual basis. Table 1 below shows a preliminary assessment of availability of indicators that can be used to extrapolate average prices. CPI sub-indices are usually not available in international databases and would need to be collected from countries on an annual basis.

Table 1: Availability of price data extrapolation indicators in international databases

Region		AFRICA		ASIA		CIS		LAC		WA		Pacific	
Total Nb. of Countries		50		23		10		38		12		21	
Source	Indicator	Nb. of countries	%	Nb. of countries	%	Nb. of countries	%	Nb. of countries	%	Nb. of countries	%	Nb. of countries	%
WDI	GDP (current LCU)	49	98%	22	96%	10	100%	31	82%	10	83%	10	48%
	GDP (constant LCU)	49	98%	22	96%	10	100%	30	79%	10	83%	10	48%
	Household final consumption expenditure, etc. (current LCU)	33	66%	19	83%	10	100%	21	55%	6	50%	2	10%
	Household final consumption expenditure, etc. (constant LCU)	25	50%	19	83%	9	90%	16	42%	3	25%	0	0%
	General government final consumption expenditure (current LCU)	33	66%	19	83%	10	100%	22	58%	6	50%	2	10%
	General government final consumption expenditure (constant LCU)	26	52%	19	83%	9	90%	17	45%	3	25%	0	0%
	Gross capital formation (current LCU)	37	74%	19	83%	10	100%	23	61%	6	50%	2	10%
	Gross capital formation (constant LCU)	24	48%	19	83%	9	90%	17	45%	3	25%	0	0%

Source	Indicator	Nb. of countries	%	Nb. of countries	%	Nb. of countries	%	Nb. of countries	%	Nb. of countries	%	Nb. of countries	%
	Consumer price index (2005 = 100)	47	94%	23	100%	9	90%	30	79%	10	83%	5	24%
	Wholesale price index (2005 = 100)	6	12%	10	43%	6	60%	11	29%	3	25%	0	0%
IMF	GDP current (LCU)	28	56%	20	87%	9	90%	30	79%	7	58%	1	5%
	GDP Constant (LCU)	1	2%	3	13%	1	10%	2	5%	0	0%	1	5%
	GDP Deflator	18	36%	21	91%	4	40%	26	68%	7	58%	1	5%
	CPI	48	96%	23	100%	9	90%	31	82%	10	83%	5	24%
	PPI or Wholesale Price Index	6	12%	10	43%	6	60%	11	29%	4	33%	0	0%
UN	GDP Current (LCU)	50	100%	22	96%	10	100%	37	97%	12	100%	14	67%
	GDP Constant (LCU)	50	100%	22	96%	10	100%	37	97%	12	100%	14	67%
	Implicit Price Deflator	50	100%	22	96%	10	100%	37	97%	12	100%	14	67%
	Household consumption expenditure Current (including Non-profit institutions serving households)	50	100%	22	96%	10	100%	37	97%	12	100%	14	67%
	Household consumption expenditure constant (including Non-profit institutions serving households)	50	100%	22	96%	10	100%	37	97%	12	100%	14	67%
	General government final consumption expenditure current	50	100%	22	96%	10	100%	37	97%	12	100%	14	67%
	General government final consumption expenditure constant	50	100%	22	96%	10	100%	37	97%	12	100%	14	67%
	Gross capital formation current	50	100%	22	96%	10	100%	37	97%	12	100%	14	67%
	Gross capital formation constant	50	100%	22	96%	10	100%	37	97%	12	100%	14	67%
	CPI - General Indices	27	54%	15	65%	1	10%	25	66%	10	83%	6	29%
	CPI - Food	25	50%	14	61%	1	10%	25	66%	10	83%	6	29%
	PPI - Domestic Supply	0	0%	6	26%	1	10%	5	13%	2	17%	0	0%
	PPI - Domestic Production	2	4%	2	9%	1	10%	6	16%	2	17%	0	0%
	PPI - Agricultural Products	4	8%	4	17%	3	30%	6	16%	3	25%	0	0%
	PPI - Industrial Products	5	10%	6	26%	8	80%	7	18%	2	17%	0	0%
	PPI - Imported Goods	1	2%	3	13%	1	10%	4	11%	0	0%	0	0%
	PPI - Raw Materials	1	2%	3	13%	1	10%	1	3%	1	8%	0	0%
	PPI - Intermediate Goods	1	2%	1	4%	2	20%	2	5%	2	17%	0	0%
	PPI - Consumer Goods	1	2%	2	9%	2	20%	2	5%	2	17%	0	0%
	PPI - Capital Goods	1	2%	2	9%	2	20%	2	5%	1	8%	0	0%

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5.2. AVAILABILITY OF INDICATORS NEEDED TO EXTRAPOLATE NATIONAL ACCOUNTS DATA

International databases also have indicators that can be used to extrapolate expenditure data on an annual basis. Table 2 below shows an indicative list of these extrapolation indicators that are found in these databases:

	Table 2: Indicative list of expenditure data extrapolation indicators available in international databases		
1	Access to electricity (% of population)	37	Health expenditure, public (% of total health expenditure)
2	Cereal production (metric tons)	38	Health expenditure, total (% of GDP)
3	Changes in inventories (current LCU)	39	Household final consumption expenditure (annual % growth)
4	Compensation of employees (% of expense)	40	Household final consumption expenditure (current LCU)
5	Compensation of employees (current LCU)	41	Household final consumption expenditure per capita growth (annual %)
6	Construction, value added (current LCU)	42	Imports of goods and services (% of GDP)
7	Consumer price index (2005 = 100)	43	Imports of goods and services (annual % growth)
8	Electric power consumption (kWh per capita)	44	Imports of goods and services (current LCU)
9	Expenditure per student, primary (% of GDP per capita)	45	Inflation, consumer prices (annual %)
10	Expenditure per student, secondary (% of GDP per capita)	46	Inflation, GDP deflator (annual %)
11	Expenditure per student, tertiary (% of GDP per capita)	47	Livestock production index (2004-2006 = 100)
12	Exports of goods and services (% of GDP)	48	Net current transfers from abroad (current LCU)
13	Exports of goods and services (annual % growth)	49	Official exchange rate (LCU per US$, period average)
14	Exports of goods and services (current LCU)	50	Other services, value added (current LCU)
15	External balance on goods and services (current LCU)	51	Out-of-pocket health expenditure (% of private expenditure on health)
16	Final consumption expenditure (current LCU)	52	Out-of-pocket health expenditure (% of total expenditure on health)
17	Food production index (2004-2006 = 100)	53	Ownership of dwellings, value added (current LCU)
18	Gas, electricity and water, value added (current LCU)	54	Population growth (annual %)
19	GDP (current LCU)	55	Population, total
20	GDP growth (annual %)	56	Primary education, duration (years)
21	GDP per capita growth (annual %)	57	Primary education, pupils
22	General government final consumption expenditure (% of GDP)	58	Public administration and defence, value added (current LCU)
23	General government final consumption expenditure (annual % growth)	59	Public spending on education, total (% of GDP)
24	General government final consumption expenditure (current LCU)	60	Public spending on education, total (% of government expenditure)
25	Gross capital formation (current LCU)	61	School enrolment, pre primary (% gross)
26	Gross fixed capital formation (% of GDP)	62	School enrolment, primary (% gross)
27	Gross fixed capital formation (annual % growth)	63	School enrolment, secondary (% gross)
28	Gross fixed capital formation (current LCU)	64	School enrolment, secondary, private (% of total secondary)

Table 2: Indicative list of expenditure data extrapolation indicators available in international databases

29	Gross fixed capital formation, private sector (% of GDP)	65	School enrolment, tertiary (% gross)
30	Gross fixed capital formation, private sector (current LCU)	66	Share of public expenditure for primary education (% of public education expenditure)
31	Gross fixed capital formation, public sector (current LCU)	67	Share of public expenditure for secondary education (% of public education expenditure)
32	Gross national expenditure (% of GDP)	68	Spending on teaching materials, primary (% of primary expenditure)
33	Gross national expenditure (current LCU)	69	Spending on teaching materials, secondary (% of secondary expenditure)
34	Health expenditure, private (% of GDP)	70	Teachers' salaries (% of current education expenditure)
35	Health expenditure, public (% of GDP)	71	Wholesale price index (2005 = 100)
36	Health expenditure, public (% of government expenditure)		

5.3. CONSISTENCY OF EXTRAPOLATION PROCESSES

The extrapolation of a basic heading underlying price data will result in de facto price indices for each basic heading. They are referred to as "Composite Price Variation" (CPC). For each country, the price extrapolation factor of a basic heading can be estimated as the geometric mean of the price indices used for that basic heading. Likewise, the extrapolation of a basic heading expenditure data includes an implicit price change component referred to as "Implicit Price Component" (IPC).

For each country, the CPC and IPC for each basic heading will be compared for validation purposes, with a view to:

- using the CPC instead of the IPC to extrapolate the basic heading per capita expenditure value and vice versa;
- reviewing the price extrapolation if the extrapolation of the expenditure value was done using a non-price related method which is deemed robust;
- reviewing the expenditure extrapolation method if it is based on questionable assumptions and/or parameters.

Ideally, the extrapolation matrix recommended under "4.3.3. Proposed approach" should be expanded to include parameters required to estimate the CPC. The reconciliation between CPC and IPC will be done in that global matrix.

6. ADVANTAGES AND DRAWBACKS OF THE PROPOSED METHOD

6.1. ADVANTAGES

The main advantages of this method are:

Linking Efficiency
- It is a multilateral extrapolation approach, where PPPs are computed and aggregated using multilateral methods.
- It maintains the same ICP process of computing regional PPPs first, then linking them to compute global PPPs, maintaining fixity.

Data Maximization
- It suggests extrapolation to take place at the lowest possible level (ICP average prices and National Accounts expenditure data).
- It would maximize the utilization of ICP data collected for the benchmark rounds. For example, in the 2011 Round, many countries are collecting price data for 2012. This data can be utilized when computing PPPs for 2012 in lieu of extrapolated data.
- It would maximize the utilization of ICP data from regional interim update exercises. Thus, when a region undertakes an interim exercise, as it was the case for Africa and Asia in 2009, the price data collected can be utilized in lieu of extrapolated data for that year.
- The set of core products used to link the regions could be used to obtain some prices between benchmarks, when and if needed.

Result Availability
- It would allow for publishing extrapolated PPPs for various aggregates and details, not just GDP or Household Consumption
- With this method, PPP data would be available even if ICP benchmark exercises are not organized on a regular basis.

Price-Expenditure Consistency
- This method would benefit from any improvements in National Accounts systems in countries, especially the use of SUTs and Commodity Flow approach.
- This method will ensure the consistency of extrapolations of price and expenditure data.

6.2. DRAWBACKS

The main drawbacks of this method are:

CPI-ICP Harmonization
- The main problem in extrapolating price data relates to the differences between PPP and CPI definitions of baskets of products and the collection of data. CPI baskets contain products that are representative of the country's expenditures pattern, while ICP baskets focus more on identifying products that are comparable across countries. To achieve this comparability, ICP products are more tightly specified, while CPI products are usually loosely specified.
- Also, the prices in a country's CPI are adjusted for quality changes over time, and countries do not use common methods to adjust for these changes. However, efforts to harmonize CPIs across countries will contribute to improved uses of CPIs for extrapolation. In the last few years, Latin America has successfully implemented a Harmonized CPI, and some African sub regions have also adopted a Harmonized CPI. It is worth noting that this issue is not specific to the proposed method.

Data Requirement

- The second drawback is in the amount of data required to extrapolate the price and expenditure data. The initial investment is high, but once the extrapolation process is automated and the 2011 average price and expenditure data are established, the recurrent annual activities involve: (i) obtaining from countries the extrapolation indices for the various aggregates and expenditure data, (ii) inputting this information in the automated tool, and (iii) processing the results following the steps highlighted in this paper.

7. CONCLUSION

In the spectrum of proposals available for extrapolating PPPs, the macro approach currently adopted by the World Development Indicators requires the least amount of additional data, while the Eurostat Rolling Benchmark approach requires the most data in the form of recurrent price collection undertaken by countries. The proposal set forth in this paper lies somewhat in the middle (see the diagram below). It requires extrapolation indices from countries but no additional price collection.

Data Requirement under Available Methods

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High

Data Requirement ↑

Rolling Benchmark approach

Extrapolation using "rearranged" CPI data

Proposed Approach

Penn World Table's approach

Macro approach with correction for Balassa-Samuelson effect

Low

Macro approach

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As mentioned in the body of the paper, one of the main advantages of this method is that the extrapolation is done at the lowest possible level (ICP average prices and National Accounts expenditure data), and it would allow for publishing extrapolated PPPs for various aggregates and details, not just GDP or Household Consumption. It would also maximize the utilization of ICP data collected for the benchmark rounds and from regional interim update exercises.

The use of the CPI to extrapolate the underlying ICP average price data may not be the most ideal solution; nevertheless, taking all caveats into account, it remains the most feasible option at this stage.

Annex: Categories of extrapolation indicators in MORES

		Demography					Supply		Health		Infla-tion	GDP	GFS
		Total Population	School population	Adult Population	Number of households	Civil service population	Production	Imports	Hospital beds	Number of doctors per inhabitant	Price Changes	GDP growth	Government Budget
11	**INDIVIDUAL CONSUMPTION EXPENDITURE BY HOUSEHOLDS**												
1101111	Rice	x					x	x			x		
1101112	Other cereals and flour	x					x	x			x		
1101113	Bread	x					x	x			x		
1101114	Other bakery products	x					x	x			x		
1101115	Pasta products	x					x	x			x		
1101121	Beef and veal	x					x	x			x		
1101122	Pork												
1101123	Lamb, mutton and goat												
1101124	Poultry												
1101125	Other meats and preparations	x					x	x			x		
1101131	Fresh or frozen fish and seafood	x					x	x			x		
1101132	Preserved fish and seafood	x					x	x			x		
1101141	Fresh milk	x					x	x			x		
1101142	Preserved milk and milk products	x					x	x			x		
1101143	Cheese	x					x	x			x		
1101144	Eggs and egg-based products	x					x	x			x		
1101151	Butter and margarine	x					x	x			x		
1101153	Other edible oils and fats	x					x	x			x		
1101161	Fresh or chilled fruit	x					x	x			x		
1101162	Frozen, preserved or processed fruits	x					x	x			x		
1101171	Fresh or chilled vegetables	x					x	x			x		
1101172	Fresh or chilled potatoes	x					x	x			x		
1101173	Frozen or preserved vegetables	x					x	x			x		
1101181	Sugar	x					x	x			x		
1101182	Jams, marmalades and honey	x					x	x			x		

		Demography					Supply		Health		Infla-tion	GDP	GFS
		Total Population	School population	Adult Population	Number of households	Civil service population	Production	Imports	Hospital beds	Number of doctors per inhabitant	Price Changes	GDP growth	Government Budget
1101183	Confectionery, chocolate and ice cream	x					x	x			x		
1101191	Food products n.e.c.	x					x	x			x		
1101211	Coffee, tea and cocoa	x					x	x			x		
1101221	Mineral waters, soft drinks, juices	x					x	x			x		
1102111	Spirits	x					x	x			x		
1102121	Wine	x					x	x			x		
1102131	Beer	x					x	x			x		
1102211	Tobacco	x					x	x			x		
1102311	Narcotics	x					x	x			x		
1103111	Clothing materials and accessories	x					x	x			x		
1103121	Garments	x					x	x			x		
1103141	Cleaning and repair of clothing	x					x	x			x		
1103211	Footwear	x					x	x			x		
1103221	Repair and hire of footwear	x					x	x			x		
1104111	Actual and imputed rentals				x						x		
1104311	Maintenance of the dwelling				x								
1104411	Water supply	x					x				x	x	
1104421	Miscellaneous dwelling services				x								
1104511	Electricity	x					x				x	x	
1104521	Gas	x					x				x	x	
1104531	Other fuels	x					x				x	x	
1105111	Furniture and furnishings				x		x				x		
1105121	Carpets and other floor coverings				x		x				x		
1105131	Repair of furniture				x		x				x		
1105211	Household textiles				x						x		
1105311	Major household appliances				x						x		
1105321	Small electric household appliances				x						x		
1105331	Repair of household appliances				x						x		

Code	Description	Demography					Supply		Health		Infla-tion	GDP	GFS
		Total Population	School population	Adult Population	Number of households	Civil service population	Production	Imports	Hospital beds	Number of doctors per inhabitant	Price Changes	GDP growth	Government Budget
1105411	Glassware, tableware and utensils				x						x		
1105511	Major tools and equipment				x						x		
1105521	Small tools and misc. accessories				x						x		
1105611	Non-durable household goods				x						x		
1105621	Domestic services				x						x		
1105622	Household services				x						x		
1106111	Pharmaceutical products	x					x	x			x		
1106121	Other medical products	x					x	x			x		
1106131	Therapeutic appliances and equipment	x					x	x			x		
1106211	Medical Services	x					x	x		x	x		
1106221	Dental services	x					x	x		x	x		
1106231	Paramedical services	x					x	x		x	x		
1106311	Hospital services	x					x	x	x	x	x		
1107111	Motor cars				x		x	x			x	x	
1107121	Motor cycles	x					x	x			x		
1107131	Bicycles	x					x	x			x		
1107141	Animal drawn vehicles						x	x				x	
1107221	Fuels and lubricants						x				x	x	
1107231	Maintenance of transport equipment						x				x		
1107241	Other services for transport equipment				x		x	x			x	x	
1107311	Passenger transport by railway	x					x				x		
1107321	Passenger transport by road	x					x				x	x	
1107331	Passenger transport by air	x					x				x	x	
1107341	Passenger transport by sea	x					x				x	x	
1107351	Combined passenger transport	x					x				x	x	
1107361	Other transport services	x					x				x	x	
1108111	Postal services	x					x				x	x	
1108211	Telephone and telefax equipment	x					x	x			x	x	

		Demography					Supply		Health		Infla-tion	GDP	GFS
		Total Population	School population	Adult Population	Number of households	Civil service population	Production	Imports	Hospital beds	Number of doctors per inhabitant	Price Changes	GDP growth	Government Budget
1108311	Telephone and telefax services	x					x				x	x	
1109111	Audio-visual, photog. and computer equip.	x					x				x	x	
1109141	Recording media	x					x	x			x		
1109151	Repair of a-v, photog. & computer equip.	x					x				x		
1109211	Major durables for recreation	x					x	x			x		
1109231	Maintenance of other major durables						x				x		
1109311	Other recreational items	x					x				x		
1109331	Garden and pets				x		x				x		
1109351	Veterinary and pet services				x		x				x		
1109411	Recreational and sporting services	x					x				x		
1109421	Cultural services	x					x				x		
1109431	Games of chance	x					x				x		
1109511	Newspapers, books and stationery	x					x				x		
1109611	Package holidays				x		x				x		
1110111	Education		x		x		x				x		
1111111	Catering services	x					x				x		
1111211	Accommodation services	x					x				x		
1112111	Hairdressing and grooming est.			x							x		
1112121	Personal care appliances and products	x					x				x		
1112211	Prostitution			x							x		
1112311	Jewellery, clocks and watches	x					x				x		
1112321	Other personal effects	x					x				x		
1112411	Social protection	x					x				x		
1112511	Insurance	x					x				x		
1112611	FISIM						x					x	
1112621	Other financial services						x					x	
1112711	Other services	x					x					x	
1113111	Purchases by residents in the rest of the world			x								x	

		Demography					Supply		Health		Infla-tion	GDP	GFS
		Total Population	School population	Adult Population	Number of households	Civil service population	Production	Imports	Hospital beds	Number of doctors per inhabitant	Price Changes	GDP growth	Government Budget
1113112	Purchases by non-residents in the country						x					x	
12	**INDIVIDUAL CONSUMPTION EXPENDITURE BY NPISHS**												
1201111	NPISHs consumption												
13	**INDIVIDUAL CONSUMPTION EXPENDITURE BY GOVERNMENT**												
1301111	Housing				x							x	x
1302111	Pharmaceutical products				x							x	x
1302112	Other medical products				x							x	x
1302113	Therapeutic appliances and equipment				x							x	x
1302121	Out-patient medical services				x					x		x	x
1302122	Out-patient dental services				x					x		x	x
1302123	Out-patient paramedical services				x					x		x	x
1302124	Hospital services				x					x		x	x
1302211	Compensation of employees			x		x						x	x
1302221	Intermediate consumption											x	x
1302231	Gross operating surplus											x	x
1302241	Net taxes on production											x	x
1302251	Receipts from sales											x	x
1303111	Recreation and culture											x	x
1304111	Education benefits and reimbursements											x	x
1304211	Compensation of employees					x						x	x
1304221	Intermediate consumption											x	x
1304231	Gross operating surplus											x	x
1304241	Net taxes on production											x	x
1304251	Receipt from sales											x	x
1305111	Social protection											x	x

		Demography					Supply		Health		Infla-tion	GDP	GFS
		Total Population	School population	Adult Population	Number of households	Civil service population	Production	Imports	Hospital beds	Number of doctors per inhabitant	Price Changes	GDP growth	Government Budget
14	**COLLECTIVE CONSUMPTION EXPENDITURE BY GOVERNMENT**												
1401111	Compensation of employees					x						x	x
1401121	Intermediate consumption											x	x
1401131	Gross operating surplus											x	x
1401141	Net taxes on production											x	x
1401151	Receipts from sales											x	x
15	**GROSS FIXED CAPITAL FORMATION**												
1501111	Fabricated metal products						x	x			x	x	
1501121	General purpose machinery						x	x			x	x	
1501131	Special purpose machinery						x	x			x	x	
1501141	Electrical and optical equipment						x	x			x	x	
1501151	Other manufactured goods						x	x			x	x	
1501211	Motor vehicles and trailers						x	x			x	x	
1501212	Other road transport						x	x			x	x	
1501221	Other transport equipment						x	x			x	x	
1502111	Residential buildings						x	x			x	x	
1502211	Non-residential buildings						x	x			x	x	
1502311	Civil engineering works						x	x			x	x	
1503111	Other products						x	x			x	x	
16	**CHANGES IN INVENTORIES AND ACQUISITIONS LESS DISPOSALS OF VALUABLES**												
1601111	Opening value of inventories											x	
1601112	Closing value of inventories											x	
1602111	Acquisitions of valuables											x	
1602112	Disposals of valuables											x	
17	**BALANCE OF EXPORTS AND IMPORTS**												
1701111	Exports of goods and services											x	
1701112	Imports of goods and services							x				x	

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