Technical Note: Sources of purchasing power parities (PPPs)[1]

Draft, November 3, 2021

1. Introduction

The concept of purchasing power parities (PPPs) is well known and widely used within economics. The primary use of PPPs is to convert volume and per capita measures of gross domestic product (GDP) and its expenditure components into a common currency, while also controlling for differences in price levels between economies. Without PPPs, cross-country comparisons of GDP expenditures would rely on market exchange rates, which do not take into account differences in price levels between economies and tend to underestimate the purchasing power of low- and middle-income economies and overstate that of high-income economies.

PPPs and PPP-based indicators are a critical tool in data-led policy making, ranging from efforts to measure poverty against the international poverty lines to cross-country comparisons of material well-being, productivity, labor costs, wages and incomes, health and education expenditures, energy efficiency and emissions, investment, research and development, and the cost of connectivity and technology for example. PPPs are also applied in administrative uses by the European Union, International Monetary Fund (IMF), and the World Bank. The World Bank 2021 publication *Purchasing Power Parities for Policy Making: a Visual Guide to using Data from the International Comparison Program* provides a comprehensive account on the myriad applications of PPPs and elaborates on the recommended uses and the limitations of PPPs.

PPPs are available from several sources. This technical note outlines the commonalities and differences between the better-known datasets available as of October 2021. It contrasts the International Comparison Program (ICP) PPPs against those by (i) the World Bank World Development Indicators (WDI); (ii) the Penn World Table (PWT); (iii) the IMF World Economic Outlook (WEO), and (iv) the Central Intelligence Agency (CIA) World Factbook. The ICP is chosen as the base for the comparison given its official status and because other datasets base their PPPs on the ICP results or on its underlying data.

"Global PPPs" in this note encapsulates PPP datasets covering the seven World Bank geographical regions. Furthermore, this note focuses only on the global PPPs provided by each data source. It will not examine differences resulting from the source or vintage of national accounts and/or population data used by each dataset.[2]

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[1] This note was drafted by the staff of the International Comparison Program (ICP) Global Office at the World Bank; staff of the Penn World Table project at the University of Groningen; and staff of the Research Department at the International Monetary Fund.

[2] Users of each dataset will often access PPP-based national accounts data, and not PPPs, which are not always directly published. These PPP-based national accounts data, such as PPP-based GDP per capita, may differ from one source to the other not only because of the PPPs used, but also due to differences in national accounts and/or population data.

2. Overview of global PPPs sources

Table 1: Summary of global PPP datasets published by ICP, PWT, WDI, WEO, and the CIA World Factbook.

	Coverage of PPPs			Type of ICP data used to produce PPPs			Temporal coverage of latest PPP-based dataset	Typical production frequency of PPP-based results		
	GDP	One or more major GDP components	Detailed GDP expenditure categories	Item-level average prices	GDP expenditures in local currency units (LCU)	Global and/or regional PPPs		Annual or more frequent	Every 2-4 years	Every 4+ years
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
ICP Global 2017 results	✓	✓	✓(44)	✓	✓	✓	2005, 2011-2017[1/]	X	✓	X
WDI (Sep 2021)	✓	✓	X	X	X	✓	1990-2020	✓	X	X
PWT Version 10.0	✓	✓	X	X	✓	✓	1950-2019	✓	X	X
IMF WEO (Oct 2021)	✓	X	X	X	X	✓	1980-2026[2/]	✓	X	X
CIA - The World Factbook (Sep 2021 Edition)	✓	X	X	X	X	✓	2019 or latest year available	✓	X	X

1/ 2005 ICP covers fewer than 44 headings; 2011 = revised ICP 2011 benchmark year; 2017= ICP 2017 benchmark year; 2012-2016 = years in-between benchmarks.
2/ Data beyond 2020 are forecasts.

Columns [1] through [3] show that the ICP produces and disseminates global PPPs for more headings than other sources. The ICP publishes global PPPs for 44 detailed GDP expenditure categories, for example, food and non-alcoholic beverages, clothing and footwear, transport, etc. The WDI publishes PPPs at the level of GDP and household (or "private") consumption. PWT calculates PPPs for GDP and the main components of GDP and publishes PPP-based data at these levels, while the WEO and CIA World Factbook use PPPs at the level of GDP only.

Columns [4] to [6] assess the extent to which each dataset uses (i) price data collected by the ICP, (ii) GDP expenditure data compiled by the ICP, and (iii) regional and global PPPs published by the ICP. All datasets,

other than the ICP, use just the latter - published ICP PPPs - and make no *direct* use of the ICP's price and expenditure data.[3]

The temporal coverage of each PPP-based dataset varies in terms of calendar years covered (column [7]). PWT publishes PPP-based national accounts data going back to the 1950s and extrapolates PPPs over more years than all other sources to create its widely recognized long time series of PPP-adjusted national accounts.

In terms of frequency of publication, columns [8] through [10] show that WDI, WEO, and the CIA World Factbook publish PPPs at a higher frequency than PWT and the ICP. The calculation of PPPs for the latter two involves more methodological steps and requires more details than the former three, and thus takes longer to produce, resulting in a less frequent publication timetable.

3. Global PPP datasets in detail

This section reviews each PPP dataset in more detail. In doing so, it compares global PPP datasets along different dimensions such as:

(i)   the publishing institutions' motivation or goal for producing PPPs;
(ii) aspects related to methodology and/or input data; and
(iii) the publishing institutions' publication timeline and frequency, including revision policies or lack thereof.

3.1.   International Comparison Program (ICP)

The ICP is one of the largest statistical initiatives globally and the main source of data for other PPP datasets. The ICP's main purpose is to produce global PPPs, price level indices (PLIs), and PPP-based expenditures, to measure the global economy in both aggregate and per capita form.

The ICP is managed by the ICP Global Office at the World Bank. It coordinates with six regional implementing agencies[4] that oversee the ICP data collection and compilation work of the nearly 200 national implementing agencies, typically national statistical offices. Regarding those economies covered by the Eurostat-OECD PPP Programme, both agencies collect price data and produce PPPs under their own production schedules. PPPs for the Eurostat-OECD region are estimated annually and revised frequently, outside of the ICP publication and revision schedule.

Overall, the ICP methodology has three major components. The first is the System of National Accounts (SNA) definition of final expenditures on GDP and the compilation of expenditure data. The second is the basket of goods and services from which items are selected for price data collection; these items should be comparable across economies and should represent an significant portion of each economy's final

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[3] It is noted, however, that the PWT computations start from the basic heading level, utilizing global PPPs and expenditure data (i.e., below the published level), and then aggregating basic heading level data up to main aggregates level.

[4] The ICP regional implementing agencies disseminate regional PPPs and other PPP-indicators through related databases and web-portals. They are the African Development Bank (AfDB); the Asian Development Bank (ADB); the Interstate Statistical Committee of the Commonwealth of Independent States (CIS-STAT); the United Nations Economic Commission for Latin America and the Caribbean (UN-ECLAC); and the United Nations Economic and Social Commission for Western Asia (UN-ESCWA). Eurostat and OECD run their own annual PPP programme and contribute data for their member states to the ICP.

purchases. The national annual average prices or related data collected for these goods and services must be consistent with the underlying values in the national accounts. The third component is the methodology used to compute PPPs, first within regions for the regional comparisons and then across regions for the global comparison.

The ICP is the only PPP data source that collects and compiles national input data for PPP estimation, which are benchmarked to a reference year. Prices are collected using ICP-specific price surveys conducted in each ICP participating economy. These price surveys are designed to suit the characteristics of the GDP expenditure component under consideration. Thus, slightly different approaches are used to collect prices for household consumption, government, machinery and equipment, and construction. Expenditures are compiled based on ICP participating economies' national accounts. An ICP participation requirement is that economies report detailed GDP expenditures following an ICP-specific breakdown, that is, the ICP Classification.

In terms of frequency of publication, ICP results were previously published every six years. However, starting with the ICP 2017 cycle, they are published every three years, as per the United Nations Statistical Commission (UNSC) recommendation to increase the frequency of the ICP global comparisons. At the same time, the UNSC recommended that the ICP become a permanent element of the global statistical program. While the ICP 2020 cycle was due to start following the completion of the 2017 ICP cycle, it was postponed to 2021 (and is subsequently referred to as the "ICP 2021 cycle") due to the Covid-19 pandemic interrupting statistical activities across participating economies.

The ICP 2017 cycle included both revisions to results from the previous ICP cycle benchmark year of 2011 and a time series of annual PPPs for the years 2012 to 2016, effectively providing a linking between the two most recent ICP cycles benchmarked to 2017 and 2011. Similarly, every future ICP cycle will publish results for the current benchmark year as well as revised results for the previous cycle and a time series interpolating between the two benchmarks.

The ICP Revision Policy sets out the policy, triggers and procedures for revising previously published and unpublished results from the ICP, to ensure the program's outputs reflect the latest available information and methodologies, are of the highest quality, and remain relevant to users. It describes the timing of revisions and the steps to be taken to communicate these revisions to users.

The possible triggers for revision of PPPs are (i) revisions and changes in input data (national accounts expenditure structure; consumer price index and national accounts deflators; currency units; and correction of errors), and (ii) new methodology (PPP computation and aggregation; global linking; retropolation, interpolation, and extrapolation; and ICP classification of final expenditure).

PPPs and PLIs may be revised depending on the level of detail of the GDP expenditure structure revisions, and/or a change to the ICP classification of final expenditure on GDP. When economies revise their expenditure data for major components, categories, groups, classes, or basic headings, then PPPs (and resulting PLIs) may be revised at levels above the lowest level for which expenditures were revised. These revisions are introduced in conjunction with the release of new benchmark results and are limited to the PPPs and PLIs from the previous benchmark exercise only. This will in turn trigger a revision to the time series of PPPs and PLIs for non-benchmark years. The timeseries of PPPs and PLIs for non-benchmark years may also be revised if CPI and national accounts deflator timeseries are revised.

As a widely used global public good, methodological consistency between benchmark years is a priority of the ICP. The ICP 2017 cycle maintained the same methods and procedures applied in the 2011 cycle, further strengthened data quality assurance approaches using the latest technology, and introduced a fully documented and more transparent process for producing results.

3.2.   Penn World Table (PWT)

The Penn World Table (PWT) was originally developed at the University of Pennsylvania by Robert Summers, Irving Kravis, and Alan Heston, the main academic driving forces behind the ICP in the 1960s.[5] The main purpose of PWT was to use ICP PPPs to extend coverage to additional countries and years. The first paper in 1978 used data for the 16 economies that participated in the first round of ICP to provide estimates for comparative income levels for 100 economies. Data from later ICP rounds and longer time series were subsequently integrated and enabled much academic research on the cross-country sources of growth and development. Up to PWT version 7.1, the database was developed at the University of Pennsylvania under the auspices of Alan Heston, working closely with Bettina Aten. From version 8.0 onwards, PWT is managed by the University of Groningen and the University of California, Davis, by Robert Feenstra, Robert Inklaar, and Marcel Timmer. As of 2021, PWT is one of the largest databases on relative levels of income, output, input, and productivity. The latest version, Penn World Table version 10.0 covers up to 183 economies for the period 1950 to 2019 and incorporates ICP PPP data from 1970 to 2017.

The institutional background and intended audience of the PWT differs from that of the ICP and that leads to differences in methodological choices. The ICP operates under an official governance framework, following an established statistical methodology. The resulting methodological consistency ensures comparability between ICP benchmark years. The PWT is widely used in academic research and teaching, and is maintained as an independent academic research project. Consequently, it undertakes experimental developments, which may lead to new methodologies being considered and adopted by the ICP at a later point in time. As PWT does not face some of the institutional constraints of the ICP, such as maintaining regional fixity, a greater emphasis is put on developing a methodology that can be replicated by its users and providing the programs and data files to do so.

These approaches are complementary, as the PWT depends on the ICP institutional framework to collect reliable data, while the ICP benefits from the PWT experimentation to improve its own methodology. The main methodological differences between the ICP and the PWT are threefold:

(i)   PPP aggregation methods:
   a.   The ICP uses the Gini-Éltető-Köves-Szulc (GEKS)[6] method to aggregate PPPs from the basic heading level up to GDP.
   b.   The PWT uses the GEKS method to aggregate PPPs from the basic heading level up to Household final consumption expenditure, gross capital formation, and general government final consumption expenditure, and then the Geary-Khamis (GK) method to aggregate individual government consumption and exports and imports to GDPᵒ.[7]
(ii) Treatment of regional data:

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[5] Alan Heston's memoir provides a comprehensive account of the history of the ICP.
[6] A method used to calculate PPPs for basic headings or to aggregate basic-heading PPPs to obtain PPPs for each level of aggregation up to GDP. See glossary of ICP 2017 report for details.
[7] The PWT distinguish between expenditure side GDP (GDPᵉ) and output side GDP (GDPᵒ).

a. The ICP first computes PPPs within each ICP region. These regional PPPs are then linked by computing global PPPs with regional fixity. This means the relative size of every economy within each region is not altered when global PPPs are computed.

b. The PWT incorporates Eurostat-OECD benchmark PPPs and then computes global PPPs simultaneously for all other economies, so not imposing regional fixity.

(iii) Treatment of trade balance:

a. The ICP uses the same PPP for imports and exports, based on the market exchange rates.

b. [The PWT computes specific PPPs for exports and imports](), based on quality-adjusted trade unit value ratios.

In addition, there are important distinctions in relative to the ICP in terms of the data sources used:

(i) National Accounts expenditure data:

a. The ICP collects expenditure data directly from participating economies. These data are disaggregated into relevant expenditure components according to the ICP expenditure classification.

b. [The PWT uses]() the expenditure data from the United Nations National Accounts Main Aggregates Database for the main components of GDP, while applying ICP's expenditure structure for more detailed levels.

(ii) Concepts of individual and collective consumption:

a. The ICP uses actual individual consumption (AIC) and collective government consumption. AIC equals individual household consumption, plus nonprofit institutions serving households (NPISHs), plus individual government consumption.

b. The PWT uses the concepts of household consumption plus nonprofit institutions serving households (NPISHs), and total government consumption, aggregating both individual and collective consumption.[8]

(iii) Basic heading data:

a. The ICP data are collected directly from participating economies through their respective national implementing agencies (NIAs). These data are subject to a process of validation and confirmed by the NIAs before the publication of ICP results.

b. The PWT does not collect data directly and relies on ICP data for data on the composition of expenditure at the basic heading level. At the level of main aggregates (household consumption, etc.), the most recent vintages of United Nations National Accounts data are used.

Another major difference between the ICP and PWT is the treatment of historical data. The ICP currently hosts the [results]() from the [2005]()[9], [2011](), and [2017]() cycles, and for the years [2012-2016](). Other historical data are not electronically accessible. The PWT database begins in 1950 and includes data from all ICP benchmark years, providing a valuable data source for any researchers looking for historical data.

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[8] This occurs because the PWT source of expenditure data, the United Nations National Accounts, only distinguishes household consumption and government consumption, not AIC and collective government consumption.

[9] The methodology employed by the ICP 2005 cycle differs from that used for the 2011 and 2017 cycles, and thus caution should be employed in comparing 2005 data with 2011 and 2017 data and [adjustments to the official 2005 data]() may be warranted for research purposes.

The PWT also covers a broader range of variables than ICP, not just on expenditure and population, but also on data on labor, capital, and productivity. Especially where it comes to cross-country comparisons of productivity levels, there is a broad academic literature on the calculation and interpretation, but no official statistical source that makes such information broadly available. These variables are not directly related to the compilation of PPPs, but serve the academic community and can provide insights into the relationship between various parts of PPP accounts.

Regarding the extrapolation of PPPs beyond the latest ICP benchmark year, PWT extrapolates PPPs using relative inflation rates. For economies participating in the Eurostat-OECD Programme, for which PPPs are published more frequently, the PWT incorporates these updates when available.

Lastly, regarding the revision policy, PWT does not follow a strict revision schedule but tends to incorporate a new ICP benchmark in each major revision: PWT 8.0 included ICP 2005 results, PWT 9.0 incorporated ICP 2011, and PWT 10.0 included ICP 2017 results, with all the notable methodological differences.

3.3.   World Development Indicators (WDI)

The World Development Indicators (WDI) is the World Bank's flagship database of development data. It features global PPPs and numerous global PPP-based indicators from 1990 onwards. WDI extrapolates ICP PPPs, as necessary, for non-ICP benchmark years and for years not covered by the annual PPPs provided by the ICP.

For years before 2011 and after 2017, PPPs provided by the ICP are extrapolated to create a time series from 1990 to the latest year available. The method used is to apply the difference between the rate of inflation observed in the economy over each period from 2011 (for years before 2011) and 2017 (for years after 2017), compared with inflation in the United States over the same period, to the benchmark PPP estimates. Extrapolation of PPPs at the GDP level uses the GDP implicit deflator and the consumer price index (CPI) for household, or private, consumption level PPPs.

Hence, unlike the ICP and PWT, the WDI PPPs are solely the result of extrapolating global ICP PPPs to cover years other than those covered by the ICP. No other PPP estimation processes are carried out by the WDI.

In the case of the economies participating in the Eurostat-OECD PPP Programme, the WDI incorporates the Programme's annual PPPs and extends these data back to 1990, if necessary and where possible, using the regular WDI extrapolation method described above.

GDP PPPs in the WDI database are updated twice a year alongside updated national accounts data. Household consumption PPPs are updated a few times a year when new CPI data are released. At the same time, the most recent results of Eurostat and OECD PPPs are regularly incorporated into WDI data.

3.4.   World Economic Outlook (WEO)

The World Economic Outlook (WEO) is the IMF's flagship report, which presents the IMF's analyses of global economic developments in the near and medium term, including projections. It is released twice a year at the IMF's Spring and Fall meetings. The report includes a database containing a wide set of

different macroeconomic indicators covering several years, including three series that use global ICP PPPs: PPP-adjusted GDP per capita in current and constant prices, and PPP-adjusted GDP in current prices.

Following the release of the ICP 2017 cycle results, the WEO incorporated the ICP results for benchmark year 2017, the revised ICP results for benchmark year 2011, and the time series results for the 2012-2016 period into its own PPP time series.[10]

The WEO extrapolates ICP PPPs backwards from 2011 and forwards from 2017 by employing the same extrapolation technique as the WDI, that is, using the growth in relative GDP deflators between each economy and the United States.[11] The source of the underlying GDP deflators are the IMF's own data and estimates, and hence the resulted extrapolated PPPs can be slightly different from those in the WDI.

3.5.   The Central Intelligence Agency (CIA) World Factbook

The Central Intelligence Agency (CIA) produces and continually updates its CIA World Factbook for use by United States government officials based on information collected from – and coordinated with – a wide variety of United States Government agencies and from hundreds of published sources. The CIA World Factbook provides a wide range of information for economies and territories. The style, format, coverage, and content are designed to meet their specific requirements. Its frequency of publication and revision has been weekly since late 2010, even though it was initially updated on an annual basis.

The economy section of the World Factbook presents PPP-based GDP figures for economies around the world. However, based on the explanatory reference note, the CIA does not exclusively use ICP PPPs, considering that "many countries do not formally participate in the World Bank's PPP project that calculates these measures."

The CIA extrapolates PPPs from ICP benchmark results and other historical sources, at least for some economies. For instance, World Factbook estimates for North Korea "are derived from [PPP] GDP estimates that were made by Angus Maddison in a study conducted for the OECD; his figure for 1999 was extrapolated to 2015 using estimated real growth rates for North Korea's GDP and an inflation factor based on the US GDP deflator; the results were rounded to the nearest $10 billion."

Further details on the sources for the economic data used is not publicly provided, as noted by the CIA: "The Factbook staff uses many different sources to publish what we judge are the most reliable and consistent data for any particular category. Space considerations preclude a listing of these various sources."

4. Conclusion

This technical note outlined the commonalities and differences between the PPPs disseminated by the ICP, World Bank, PWT, IMF and CIA with the purpose of supporting users on their use and application of PPPs.

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[10] See Box 1.1 of the October 2020 WEO for a summary of the revised purchasing-power-parity-based weights.
[11] See Section 4 of the Frequently Asked Questions.