

Prices and currency conversions in WID.world

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Abstract

This technical note reviews the issues surrounding the use of price indexes and currency conversion factors in WID.world. We explain some of the main issues surrounding the measurement and construction of these data, we describe how the data in WID.world was constructed, and finally we clarify how to properly compare income and wealth levels in WID.world between countries and periods.

Introduction

The World Wealth and Income Database (WID.world) provides an extensive database on income, wealth, and their distribution, covering many countries over long periods of time. The database also includes exchange rates, purchasing power parities (PPPs), and price indexes, which are necessary to make estimates of income and wealth from different years and countries comparable. There is one variable for the price index. For market exchange rates and PPPs, we give conversion factors from local currencies to US dollars, euros, and yuan. Hence, there are three variables for market exchange rates. Similarly there are three variables for PPPs.¹

By default, all series in WID.world are expressed at constant prices in the local currency unit (LCU). You can then use the price index and the exchange rates to convert to current prices and/or to different currencies. This technical note explains how to perform such conversions properly. It also describes in detail how we constructed price indexes and PPPs, emphasizes some of the conceptual challenges behind the computation of these data, and justifies our methodological choices.

1 Price index

The basic identity to move from constant prices to current prices is the following:

$$\text{current prices} = \text{constant prices} \times \text{price index}$$

Several concepts of the “price index” can be used in the formula above. The two main ones are the GDP deflator and the consumer price index (CPI).² We use the GDP deflator as our preferred price index, following Piketty and Zucman (2014), although we resort to the CPI when no other data is available.

¹The price index variable is named `inyixx999i`. The market exchange rate variables are `xlcusx999i` for US dollars, `xlceux999i` for euros, and `xlcyux999i` for yuan. The PPP variables are `xlcuspp999i` for US dollars, `xlceup999i` for euros, and `xlcyup999i`.

²Other indexes are sometimes computed by national statistical institutes or central banks. For example, in the United States, the Bureau of Economic Analysis computes the personal consumption expenditures price index (PCE), a deflator that relates solely to the consumption part of GDP. The Federal Reserve uses the core PCE, which further excludes commodities with volatile prices such as food and energy, as its preferred measure of long-run inflation. However, these indexes do not have internationally agreed definitions and they are not calculated in many countries. They serve some very specific purposes such as fine-tuning monetary policy. Here we focus on the two most common indexes, for which we have data in a sufficiently large number of countries.

1.1 Measurement

The differences between the CPI and the deflator are twofold. First is their definition. The deflator measures the price level of domestic production (as defined by the GDP), while the CPI measures the price level faced by consumers. Therefore, the deflator only considers domestic goods and services, and nothing that is imported, while the CPI does include foreign goods. But the deflator measures the price level of all goods and services, while the CPI only considers what is bought by consumers.

The second difference has to do with methodology. There are three potential biases involved in comparing prices over time: how to account for new goods (“new good bias”), how to account for quality improvement (the “quality bias”), and how to account for changes in the consumer’s basket of goods and services when the prices change (the “substitution bias”). Statisticians have made progress in addressing the new good bias and the quality bias for both the CPI and the deflator. But for the substitution bias, more progress has been made on the deflator, essentially by switching to the chain-linking method (Lequiller and Blades, 2014; Piketty and Zucman, 2014). The CPI, on the other hand, is still generally calculated as a simple Laspeyres index.³

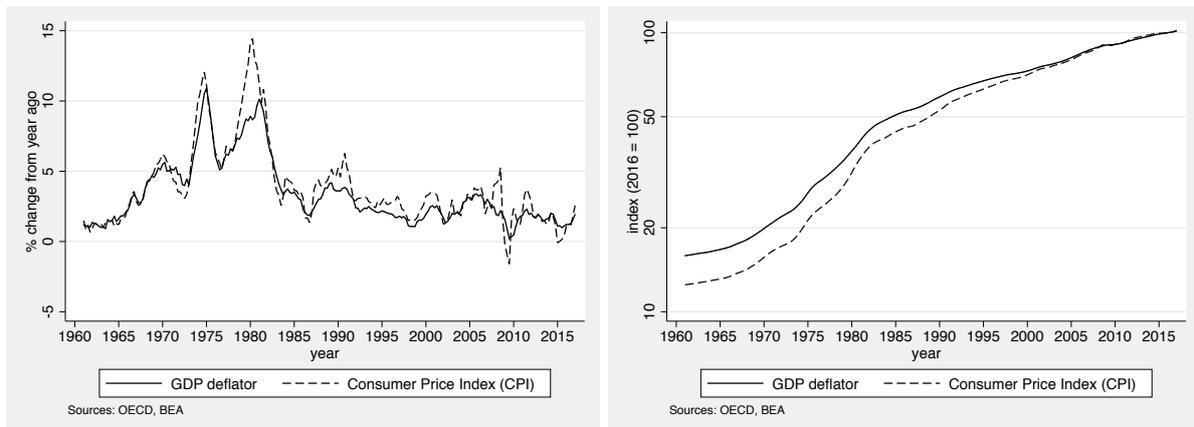


Figure 1: GDP deflator and the CPI in the United States

This is why we use the deflator as our preferred measure of the price level, especially when looking at distant periods of time. As shown in figure 1.1, there can be important short-run differences in the inflation rate as measured by the two indexes, mostly because the CPI incorporates volatile foreign goods such as oil. More importantly, those differences accumulate over time so that the total inflation since the 1960s has been significantly lower according to the deflator than the CPI. That is because the deflator is better at taking the substitution bias into account.

³See Piketty and Zucman (2014, data appendix, p. 38), for an in-depth discussion of the differences centered on the United States, and Lequiller and Blades (2014) for a detailed description of chain-linking methods.

We stress that choosing only one price index is an important simplification. In theory, we might wish to use a different price index for each series, one that would reflect the composition of goods and services of the series we are trying to deflate. That is, in fact, what the national accounts do: they compute GDP and each of its component both in prices and in volume. The deflator is the ratio the two. That ratio for a subcomponent of GDP (e.g. consumption) will not be equal to that of the whole GDP. The issue with that approach is that it ends up changing the relative shares of GDP components. Quantities that are dimensionless (e.g. saving rates) will be different if we compute them from volume or price quantities. The issue becomes critical with chain-linking, because it breaks the additivity of national accounts, so that standard accounting equations no longer hold exactly.⁴ The discrepancies are small and have no economic meaning, but they make it harder to get a consistent global view of the economy, and also to apply economic models that always rely on these identities. Bringing inequality into the mix raises even more questions (should the income of the top 1% be deflated differently from the rest?) All of this conflicts with WID.world's ultimate goal of providing a consistent view of macro aggregates and their individual distribution. Our solution of using only one price index has the advantage of simplicity and transparency, while yielding results extremely close to more sophisticated approaches.

1.2 Price indexes in WID.world

In WID.world, we combine different sources into a single price index series. These sources include official sources such as the United Nations System of National Accounts, the World Bank and the IMF. In some cases where official statistics on inflation have been seriously questioned (e.g. China or Argentina), we use alternative sources. We combine different series by preserving their inflation rate in each year. We use deflators whenever possible, but sometimes resort to the CPI when no better option is available. We provide more details in Blanchet and Chancel (2016).

We try to make it as easy as possible to track the origin of the data despite the use of a variety of sources. To that end, our construction procedure automatically generates metadata detailing the construction process. The metadata has two fields: "sources" and "technical notes", and can be accessed from any graph using the button "?" on the right. For example, in Ivory Coast, as of 31/07/2017, we have:

<p>Technical notes: From 1960 to 1970, we use the GDP deflator from the World Bank. From 1971 to 2015, we use the GDP deflator from the UN SNA. In 2016, we use the</p>
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⁴For example $GDP + imports = consumption + investment + exports$.

CPI from the World Bank.

Sources: WID.world computations using: World Bank; United Nations National Accounts Main Aggregates Database

The field “technical notes” says precisely for each year where the data comes from, while “sources” gives the list of sources with direct links to them whenever possible. By default, all series are provided in constant local currencies. Therefore, to get the series in current local currencies, you need to multiply them by the price index.

2 Currency conversion

WID.world provides currency conversion factors that users can use to convert from one currency to another, in the same way that price indexes can be used to convert from one year to another. For each country, we give a conversion factor in the form “local currency unit per foreign currency,” where the foreign currency can be US dollar, euro or yuan. Because series are in local currency by default, you can convert them using:

$$\text{series in foreign currency} = \frac{\text{series in local currency}}{\text{currency conversion factor}}$$

The conversion factor is here to reflect the relative purchasing power of each currency. We provide two conversion factors: market exchange rates and purchasing power parities (PPPs).

2.1 Market exchange rates and purchasing power parities

The most obvious currency conversion factor is the market exchange rate. For example, if you can buy 8 yuan with 1 euro, then the euro/yuan exchange rate is 8, which means that one euro offers eight times the purchasing power of one yuan. Therefore, to convert a series from yuan to euros, you divide it by 8.

The problem with market exchange rates is that they only reflect the relative purchasing powers of currencies in terms of tradeable goods: 1 euro or 8 yuan may get you the same amount of crude oil on international markets, but it doesn’t necessarily let you buy the same amount of food in Paris or Beijing. Yet the latter is more relevant to people’s standards of livings. Because non-tradeable goods and services tend to be cheaper in emerging economies (Penn and Balassa-Samuelson effects) market exchange rates underestimate their actual

income levels.

The solution to that problem is to use purchasing power parities. PPPs are conversion factors that estimate more accurately the actual relative purchasing power of currencies. It is now standard practice to use PPPs rather market exchange rates as the standard currency conversion factor to compare income levels between: in WID.world, we use them by default to convert all series. However, we also provide market exchange rates, and users can request them if they want to: for the graphs the website, they need to use the “more options” menu on the top right.

2.2 Currency conversion factors in WID.world

Market exchange rates are readily available as quoted values on the currency market. We only need one value per year, so we take yearly averages. For older periods, before the existence publicly available forex data, we use data from the World Bank that goes back to 1960.⁵

For PPPs, we use estimates from the OECD for OECD countries, and from the World Bank otherwise. Compared to exchange rates, PPPs raise more methodological difficulties. In many non-OECD countries, their computation started fairly recently. Moreover, new data arrives at infrequent intervals: the last two rounds of the international comparison program (ICP), which is in charge of their computation, happened in 2005 and 2011.

How, then, can we know the proper PPP conversion factors for years that fall outside of an ICP round? The solution is to extrapolate them based on the relative evolution of the price index in both countries (McCarthy, 2013). For example, we estimate the PPP in 2016 from the PPP in 2011 using:

$$PPP_{2016}^{\text{home/foreign}} = PPP_{2011}^{\text{home/foreign}} \frac{PI_{2016}^{\text{home}}/PI_{2011}^{\text{home}}}{PI_{2016}^{\text{foreign}}/PI_{2011}^{\text{foreign}}} \quad (1)$$

When we have access to several rounds of the ICP for a given country, two solutions are possible. The first one is to use solely the most recent round and discard previous ones: this the solution adopted by the World Bank. The other approach is to adapt formula (1) to interpolate between two ICP round: this is the solution adopted by the Penn World Table (Feenstra, Inklaar, and Timmer, 2015). We follow the World Bank’s approach. Indeed, the estimation of PPPs is difficult, and some changes from one round to the next are purely

⁵In Venezuela, the official market exchange rate in recent years has been maintained artificially low by local authorities. This official rate does not correspond to any economic reality, and leads to an unrealistically high GDP per capita in US dollars. Therefore, we have assumed that, after 2010, the actual market exchange rate with the US dollar has followed the relative evolution of price indexes in the United States and Venezuela, as in formula (1).

methodological. For example, the 2005 round stirred controversy because it led to a significant downward revision of China’s and India’s GDP (see Blanchet and Chancel (2016) for details). The methodological issue was solved in the 2011 round. Using both the 2005 and 2011 rounds of the ICP to compute India’s and China’s PPP would therefore lead overestimation of growth over the period for spurious methodological reasons.

The World Bank’s approach has its flaws, too: in particular it forces us to revise former PPP values every time a new ICP round is released, which retroactively changes values of, say, the world GDP. We still favor it because it preserves growth rates of individual countries.

2.3 Combining with price indexes

We use the price index to compare income levels between different periods, while we use currency conversion factors to compare them between countries. But how can we compare two incomes from two different places and two different years? The issue arises for example if we want to plot national income series of two countries on the same graph.

There are two ways to proceed, as illustrated by figure 2, and both methods may give different results. To illustrate, assume that we want to convert from 2005 yuan to 2016 US dollars.

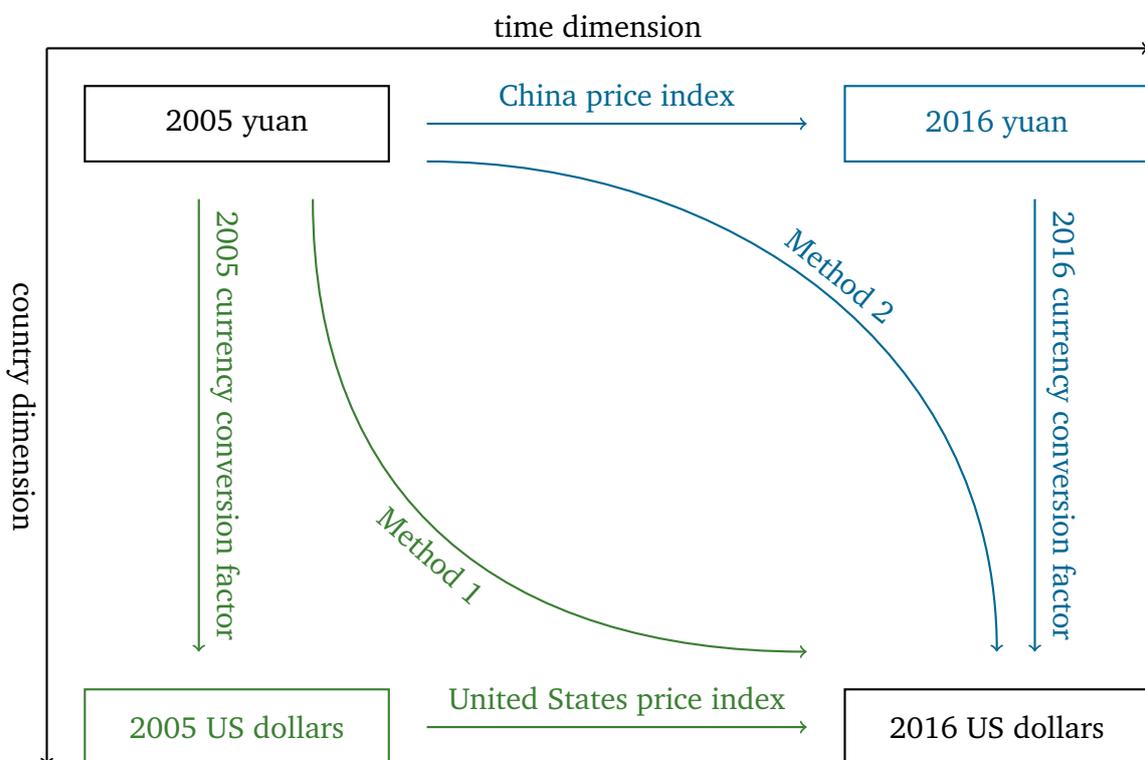


Figure 2: Two methods for converting series across time and currencies

With the first method (green), we first move along the country dimension, so we apply the

2005 currency conversion factor to get an amount in 2005 US dollars. Then we apply the United States price index to convert the 2005 US dollars in 2016 US dollars. The second method (blue) starts with the time dimension. So we first use the Chinese price index to convert in 2016 yuan, and then the 2016 currency conversion factor to convert into 2016 US dollars.

Which method is the most appropriate? When you are using the PPP conversion factors, both are strictly equivalent. This is because the extrapolation procedure in formula (1) makes both approaches identical by construction. Recall that, by default, WID.world series are in constant local currency. Therefore, you can use the PPP conversion factor of the reference year to convert the entire series (following method 2).

But if you are using the market exchange rates, the methods are not identical anymore. The right approach depends on your motivation for using market exchange rates over PPPs. The website uses method 2 because of slightly better data availability.

Conclusion

WID.world provides a price index in each country, mostly based on the GDP deflator, to compare income and wealth levels over time. It also provides currency conversion factors in the form of PPPs and market exchange rates to compare income and wealth levels between countries. We recommend using PPPs for most purposes, because they better reflect the actual relative purchasing powers of currencies.

To compare income of wealth levels both over time and between countries, you need to combine price indexes and currency conversion factors. When using PPPs, the solution is straightforward. Given that the series in WID.world are in constant local currency by default, all you need to do is apply the PPP conversion factor of the reference year. When using market exchange rates, two methods are possible, and the most appropriate choice depends on your problematic.

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