

# Purchasing Power Parities used in Global Poverty Measurement

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## Abstract

Given substantial differences in price levels across countries, international spatial deflators are needed to compare welfare aggregates to a common international poverty line. This note describes the sources of the purchasing power parities that are used for every country included in the World Bank's estimates of global poverty, published in PovcalNet. These exchange rates are used to express welfare aggregates in 2011 international dollars.

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## 1. Introduction

In measuring global poverty, the World Bank compares welfare aggregates from more than 160 countries to a common international poverty line. To compare living standards across countries, it is important to account for differences in price levels across countries; i.e. the fact that \$1 can purchase more goods in Ghana than the US. Purchasing power parity (PPP) exchange rates are used to adjust for these differences in price levels. This note describes the sources of the PPP exchange rates used by the World Bank in the global poverty estimates published in PovcalNet. The simple framework outlined by Azevedo et al. (2018) refers to this as the between-country spatial adjustment.<sup>1</sup>

The use of PPP exchange rates in global poverty measurement has been subject of considerable debate and criticism (e.g. Deaton, 2010). For example, the switch from the 1993 to 2005 PPPs had a drastic impact on the overall level and geographic distribution of global poverty. The poverty rate for the developing world increased from 17% (1993 PPPs, \$1.08 poverty line) to 25% (2005 PPPs, \$1.25 poverty line), equivalent to an additional 400 million poor people (Chen and Ravallion, 2010a). In China alone, the number of poor people increased from 72 million to 204 million (Chen and Ravallion, 2010b). The release of the 2011 PPPs also prompted a debate over their reliability (Deaton and Aten, 2014; Ravallion, 2014). Ferreira et al. (2016) provide a careful discussion of how the World Bank has adopted the 2011 PPPs. Given these concerns, Prof. Anthony Atkinson advised in his report of the Commission on Global Poverty, that until 2030 the global poverty estimates should not be revised in light of future rounds of the ICP (World Bank, 2017).

For all but six countries, PovcalNet currently uses the ICP 2011 PPP exchange rates for household final consumption expenditure. In the World Development Indicators (WDI), this is variable

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<sup>1</sup> In Azevedo et al. (2018), the between-country spatial adjustment is denoted by  $S_{c,t}^{BC_{PPP}}$ . The PPPs are applied after welfare aggregates have been expressed in constant local prices using the domestic consumer price index (CPI) in the PPP benchmark year. Other components of the global price adjustment are described elsewhere; for example, Lakner et al. (2018) describe the CPIs that underpin the global poverty numbers.

PA.NUS.PRVT.PP in year 2011.<sup>2</sup> In the remainder of this note, we explain why these official PPPs are not used for Egypt, Iraq, Jordan, Lao PDR, Myanmar and Yemen, and how alternative PPP conversion factors for those countries are obtained instead.<sup>3</sup> Table 1 compares these predicted PPP exchange rates that are used in PovcalNet with the official rates.

**Table 1.** Official and Predicted 2011 PPP Exchange Rates for Household Consumption

	Official	Predicted (Used in PovcalNet)
Egypt	1.803	2.777
Iraq	573.418	1,003.799
Jordan	0.319	0.446
Lao	2,914.847	3,325.204
Myanmar	275.828	320.604
Yemen	82.094	111.303

*Note:* Exchange rates are expressed in LCU per international \$.

## 2. Alternative PPPs

In October 2015, when the World Bank released global poverty estimates based on the 2011 PPPs, eight countries—Bangladesh, Cabo Verde, Cambodia, Egypt, Iraq, Jordan, Lao PDR, and Yemen—were identified as outliers (Ferreira et al., 2016). These countries showed large differences between the price changes implied by the 2005 and 2011 PPPs, and domestic consumer price index (CPI) inflation. Ferreira et al. (2016) made it clear that being an outlier did not mean that the PPP data were necessarily the problem; there could well be something wrong with the measures of local inflation—or the divergence between PPPs and inflation rates might simply be an accurate reflection of what the different measures capture (changes in international price comparisons vs. domestic inflation). At the same time, there were concerns over the coverage and

<sup>2</sup> It is important to note that the WDI variable incorporates more frequent price collection updates for some high-income countries. To replicate PovcalNet, users need to take this variable only for 2011 and rely on the domestic CPI for inter-temporal deflation.

<sup>3</sup> These PPPs have been used since October 2017. Previously, PovcalNet used the official 2011 PPP for Lao PDR. Egypt, Iraq, Jordan and Yemen used a predicted PPP based on the ICP’s model (equation 1 below), but updated to July 2016 WDI data. Myanmar was not included in PovcalNet because household survey data were not yet available. As explained below, several other countries were subjected to closer scrutiny of their PPP exchange rates, but we ended up choosing their official PPP.

quality of the underlying ICP price collection for Egypt, Iraq, Jordan, and Yemen.<sup>4</sup> Given large changes in poverty rates between 2005 and 2011 PPPs, the 2011 PPP for West Bank and Gaza was also subjected to closer scrutiny.

This section explains in greater detail how PPPs have been predicted. For Egypt, Iraq, Jordan, Lao PDR, Myanmar and Yemen we use regression-based 2011 PPP exchange rates estimated from a revised model.<sup>5</sup> For Bangladesh, Cabo Verde, and West Bank and Gaza, the official 2011 PPP is used after closer analysis confirmed the credibility of these exchange rates.<sup>6</sup> The welfare aggregate for Cambodia has been removed from PovcalNet until further analytical work is carried out.<sup>7</sup>

## 2.1. The model

The ICP uses the following model to predict 2011 PPPs for non-benchmark countries (World Bank, 2015):

$$PLI_i - PLI_{USA} = b * (\mathbf{X}_i - \mathbf{X}_{USA}) + e_i \quad (1)$$

where  $PLI_i$  is the price level index of country  $i$ , calculated as the ratio of the PPP exchange rate to the market exchange rate (MER). The vector of explanatory variables ( $\mathbf{X}$ ) includes GDP per capita in U.S. dollars (based on market exchange rates), imports as a share of GDP, exports as a share of GDP, and the age dependency ratio. Dummy variables are included for Sub-Saharan Africa, the OECD, island economies, and landlocked developing economies. Interaction terms between GDP per capita and the country-dummy variables are also included. All continuous variables are expressed in logs. As shown by equation (1), variables are normalized to the United States, which is used as a base in the global multilateral comparison. The dependent variable thus shows the price level for a country relative to the US. Equation (1) is estimated separately for the PPP

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<sup>4</sup> Given conflicts and difficult political situations, it may not be surprising that there are coverage and data collection problems in many MNA countries. For example, in Yemen the survey covered only 3 out of 21 provinces reaching 16 percent of population.

<sup>5</sup> Although not part of the original Ferreira et al. (2016) list, Myanmar is also treated as an exception because the official PPP results in a PLI that is too high to be credible. Due to concerns over the exchange rate, we use the 2012 exchange rate in the prediction, which is when the market had become more liberalized.

<sup>6</sup> Yoshida and Yanez-Pagans (2017) analyze the Bangladesh PPP exchange rate in some detail. For Cabo Verde, and West Bank and Gaza, the official and predicted 2011 PPPs imply very similar inflation rates between 2005 and 2011 (Figure 1 below).

<sup>7</sup> Close examination of the household survey and price data suggested problems with the household survey-based welfare aggregate, producing implausibly low poverty rates. According to these estimates, Cambodia's poverty rate was much lower than what is expected from its GDP per capita. Furthermore, some non-income welfare indicators are much lower in Cambodia than in countries with comparable extreme poverty rates.

exchange rates for GDP and private consumption using Zellner's Seemingly Unrelated Regression method.<sup>8</sup>

We make the following revisions to this model:

1. The model was re-estimated using the July 2016 version of the WDI.
2. The following countries were dropped from the regression model: Cabo Verde, Cambodia, Egypt, Iraq, Jordan, Lao PDR, and Yemen and Myanmar. The first seven are among the outlier countries identified by Ferreira et al. (2016), while Myanmar is included because of an unrealistically high PLI.<sup>9</sup> Given the concerns over the PPP exchange rates in these countries, they should not be included in estimating the prediction model; in other words, the PPPs for the exception countries are out of sample predictions.
3. Duan's (1983) smearing was used in transforming log consumption PLI (PPP/MER) to absolute numbers. This smearing factor adjusts for the fact that the prediction model is in log form and assumes log normality of the error structure. Smearing corrects for the nonzero expectation of the error structure in levels.
4. Finally, the specification of the regression was changed slightly by (a) introducing a dummy for conflict-affected countries as defined in the World Bank 2011 list of fragile situations; (b) including the sum of export and import shares as a measure of openness instead of having them separately in the model; and (c) dropping the OECD and landlocked dummy for the private consumption PPP model.<sup>10</sup>

The regression results from the baseline and the revised models are shown in Table 2. The baseline model uses July 2015 WDI data, while the revised model uses July 2016 WDI data. The two new variables that are part of the revised model are highly significant and have the expected sign.

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<sup>8</sup> The specifications are slightly different; e.g. the regression used to predict the PLI for private consumption does not contain the exports, imports, and landlocked dummies.

<sup>9</sup> As explained above, Yoshida and Yanez-Pagans (2017) show that the official PPPs appear to be credible for Bangladesh.

<sup>10</sup> The list can be found here: <http://www.worldbank.org/en/topic/fragilityconflictviolence/brief/harmonized-list-of-fragile-situations>.

**Table 2.** Prediction Model for 2011 PPPs

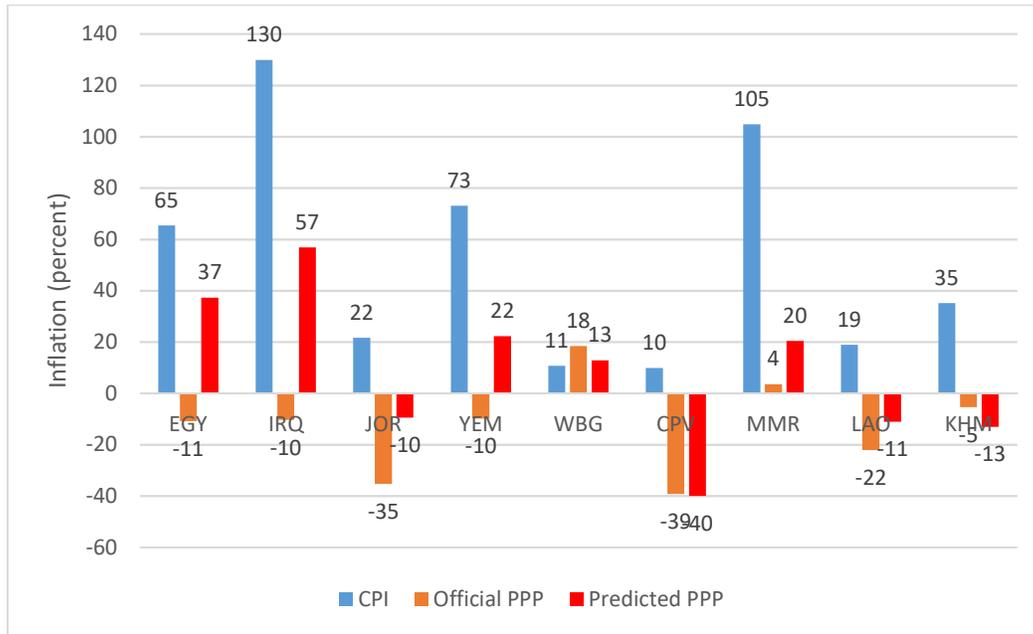
	Regression results for official non-benchmark prediction (baseline model)		Revised model	
	log GDP PLI	log consumption PLI	log GDP PLI	log consumption PLI
GDP per capita	0.307***	0.290***	0.331***	0.321***
Share of exports in GDP	-0.0276**			
Share of imports in GDP	-0.00844			
Dependency ratio	0.395***	0.385***	0.560***	0.561***
GDP*Island	-0.0783***	-0.0447	-0.0825**	-0.0439
GDP*SSA region	-0.104***	-0.0980***	-0.118***	-0.112***
OECD	0.200***	0.229***		
SSA region	0.934***	0.872***	0.924***	0.871***
Island	0.816***	0.603**	0.784**	0.499
Landlocked	0.0345		0.0350**	
GDP*Landlocked		0.00066		
Share of exports and imports to GDP			0.0325*	0.0841***
Fragile countries			0.128***	0.146***
Observations	151	151	151	151
R-squared	0.95	0.94	0.94	0.92

## 2.2. Assessment of alternative PPPs

The results from the revised model are assessed according to three criteria: (a) Comparison of the inflation rates implied by the PPPs with the domestic CPI; (b) the existence of a “Penn effect”, which means that PPPs approach market exchange rates as incomes rise; and (c) the correlation of international monetary poverty rates under different PPPs with nonmonetary indicators, such as infant mortality and stunting.

Figure 1 compares the change in price levels from 2005 to 2011, between the different PPPs and the domestic CPI. For all countries except Cabo Verde, Cambodia, and West Bank and Gaza, the predicted PPPs show a substantial improvement over the (nearly orthogonal) trends between CPI and the official 2011 PPPs. In Egypt, for example, inflation between 2005 and 2011 was about 65 percent using the CPI but using official PPPs there was a disinflation of -11%; once predicted PPPs are used, the gap narrows substantially with an implied inflation rate of 37%. For Cabo Verde and West Bank and Gaza, there is no large difference between the official and the predicted PPP trends, while in Cambodia there is an even larger discrepancy.

**Figure 1.** Inflation Trends between 2005 and 2011 for CPI, official and predicted PPPs

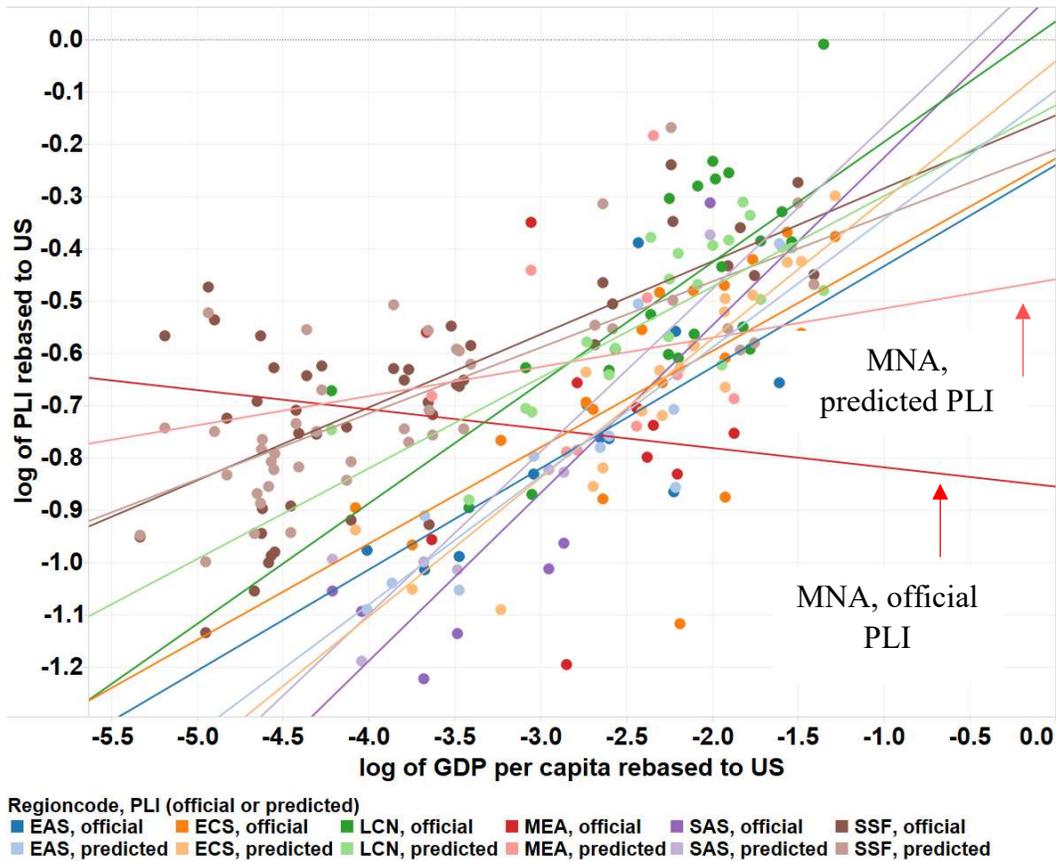


*Note:* Countries are denoted by the three-letter codes used by the World Bank. The predicted PPPs use the revised model.

*Source:* CPI is from WDI and adjusted for the US inflation between 2005 and 2011.

Figure 2 plots the PLIs against GDP per capita, for different regions. According to the “Penn effect”, richer countries generally have higher price levels for nontraded goods due to higher labor productivity and wages, so one would expect a positive relationship in Figure 2 (Bergstrand 1991; Ahmad 1992; Prasada Rao, Rambaldi and Doran 2010; Ravallion 2012). When using the official PPPs, the Middle East and North Africa (MNA) was the only region where there was no such positive relationship. However, once PLIs predicted by the revised regression model are used, the positive relationship is (weakly) observed.

**Figure 2.** Official and Predicted PLIs versus GDP per Capita



*Note:* All estimates are for 2011. Figure shows linear fit by region. Only benchmark countries are included. EAS stands for East Asia and Pacific, ECS for Europe and Central Asia, LCN for Latin America and Caribbean, MEA for Middle East and North Africa, SAS for South Asia and SSF for Sub-Saharan Africa.

*Source:* WDI and authors' calculation.

Finally, we consider the correlation between the monetary poverty rates at international lines (using official and predicted PPPs), and nonmonetary indicators of development such as infant mortality and stunting. Table 3 shows Kendall's rank correlation coefficients for the MNA countries.<sup>11</sup> For example, the rank correlation between poverty at \$1.90 and infant mortality (panel A) improves from 0.35 to 0.61 when the predicted PPPs from the updated model are used instead of the official PPPs. Similar results are observed for stunting (panel B), although the country sample is much smaller. In all cases, when the predicted PPPs are used, the strength of the correlation is similar to the levels observed with the 2005 PPP (and a \$1.25 poverty line).

<sup>11</sup> Only country-years with micro data are included. For stunting, only the most recent year is used, given the infrequent data availability. Results are similar when other exception countries such as Cabo Verde and Laos PDR are added to the sample.

**Table 3.** Correlation between Monetary Poverty and Nonmonetary Indicators, Different PPP Factors and Different Poverty Lines, MNA Countries Only

PPP exchange rates	Poverty Lines		
	\$1.25–\$1.90	\$2.00–\$3.10	\$4.00–\$5.50
<b>A. Correlation with Infant Mortality</b>			
2005 PPP	0.65	0.59	0.58
2011 PPP, official	0.35	0.46	0.62
2011 PPP, predicted	0.61	0.63	0.65
N	28	28	28
<b>B. Correlation with Stunting</b>			
2005 PPP	0.50	0.61	0.67
2011 PPP, official	0.11	0.11	0.28
2011 PPP, predicted	0.44	0.56	0.61
N	9	9	9

*Note:* Table shows Kendall’s rank correlation coefficient between monetary poverty and infant mortality (panel A) or stunting (panel B). Egypt, Iran, Iraq, Jordan, Lebanon, Morocco, Tunisia, West Bank and Gaza, and Yemen are included. The following poverty lines (PPP-adjusted USD per day) are used for the different PPPs: 2005 PPPs: 1.25, 2.00, 4.00; 2011 PPPs: 1.90, 3.10, 5.50.

Based on the analysis, regression-based PPPs of 2011 from the revised model are used for estimating and reporting poverty for Egypt, Iraq, Jordan, Lao PDR, Myanmar and Yemen.

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