

Estimating Poverty Counts Using Modified PPPs from the 2005 and 2011 Rounds of the International Comparison Program

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Background

The release of the 2011 ICP posed a number of problems of consistency with the poverty counts and other results of the 2005 ICP. Important differences between the 2005 and 2011 ICP rounds were treated in the 2011 ICP report (2014) and in the work of by Deaton and Aten (2014) and Inklaar and Rao (2014). Deaton (2010) provided a major critique of the methods used by the Bank in estimating the poverty line and share in poverty based on the 2005 ICP. Many of Deaton's concerns are addressed in extensive review provided by Dean Jolliffe and Espen Prydz (2015, hereafter JP) as part of the overall review of the poverty methodology of the Bank. The aim of this paper is to explore an approach complementary to that of Jolliffe and Prydz and to take account of the recent paper of Ferreira et. al. (2015)

A Main Differences of Present Approach for 2005

1 The Measure of consumption

Table 1 sets out the main differences between the World Bank approach as set out by Ravillion, Shaohua and Sangraula (2009) for 2005, the JF modifications and our method. The Table also covers the 2011 ICP which will be treated after examination of the 2005 results. We begin with a discussion of Step 1, the concept of consumption. The purchasing power of household consumption from the various rounds of the ICP have commonly been used as the conversion factor to express poverty lines in a common unit, like dollars. However the ICP uses the SNA 1993 measure of household consumption C, which includes some headings that are of doubtful relevance for the consumption bundles of the very poor, for example *FISIM* and *Net expenditures of residents abroad* that covers mainly tourist expenditures. We also exclude *Other services not elsewhere classified, Insurance, and Social Protection*, a total of 5 headings. The very poor may consume some of these services but most of these PPPs are imputed and not priced so little information is lost. There are more headings and items that could be removed from the

computations if our approach appears useful, one being the value of rental services which typically are not estimated well and are often not recorded at all in household expenditure surveys.

We term this more limited concept of household consumption, C^* . We define R_{it} as;

(1) $R_{it} = (C_{Nit}^*/C_{Nit})$, where the subscript, N , is national currency, i is country and t refers to ICP benchmark year, in this paper 2011 or 2005. The ratio, R , varies from under 1 percent to over 10 percent within both low and high income countries.

2 The number of Countries

Our purpose is to primarily look at the methods of estimating poverty thresholds so we have concentrated on 60 countries that have at least 1 million in extreme poverty in 2005. This contrasts with the more universal approach of Jolliffe and Prydz who are focused on global poverty goals in the next decades. While we concentrate on the 60 countries we do take a global approach to PPPs for the very poor as discussed below.

3 Linking the poverty PPP to the US dollar

We estimate the GEKS PPP over C^* for only countries that have been included in the Bank poverty group and are in the 2005 and 2011 ICP rounds. In order to link to the rest of the world we also estimate GEKS PPPs for C^* over all countries in both the 2005 and 2011 ICP. The reference for all ICP countries is the US, and for the countries in poverty, India is the reference. The price level (PL) of India with respect to the US for C^* can be obtained from the aggregation of all 146 countries in 2005. The geo-mean of the binary Fishers of all the poverty countries with respect to India provides the price level of India with respect to the poverty countries. That factor is used to adjust the price level of C^* of India to the US dollar so that poverty thresholds in dollars are independent of India as reference country for the poverty countries. During the 2005 and 2011 period the price level of India has been about 80% of the reference group of 70 poverty countries.

4 The initial poverty line or threshold

The Bank approach has been to use the poverty line of the poorest countries in national currencies and to convert this to dollars based on the PPP of C . Early on India was the only poverty country, later on one of a group and from 2005 onward not in the poverty group used to determine the poverty line. The Bank took the arithmetic average of national poverty thresholds in US dollars converted at PPPs of household consumption of the lowest 15 countries in 2005. One consequence of this decision was to put an additional 100 million people into poverty in India as explained by Deaton (2010). We start with 15

countries the Bank used for 2005 only for the initial iteration. This allows us to obtain an initial number of persons in poverty and the share in poverty for all poverty countries. However these are only starting values because the initial poverty counts are not necessarily consistent with the initial poverty threshold of the 15 countries.

The rationale put forward for using the 15 countries besides being very poor, was that their poverty lines were more or less flat when plotted against their per capita GDP. Joliffe and Prydz question that claim and point out that the poverty lines of countries rise fairly continuously with income across the 70 countries that the Bank classifies as low income. This led JP to use the average poverty line of all low income countries as their preferred threshold for 2011. We also begin with 2005 and the poverty lines for the 15 poorest countries in Table 1.

The 2005 thresholds of the 15 Bank countries presented in column (1) of Table 1 have been adjusted as shown in column (2). The arithmetic mean in column (1) of \$1.25 a day (\$38 a month) is the basis for the Bank poverty threshold for 2005 and their projections forward. We prefer to work with the geo-means, which are given in columns (1) and (2). What is the adjustment in column (2)? Deaton and Aten (2014) argue that the linking of the regions in ICP 2005 tended to yield PPPs for Africa, Asia and Western Asia that were 20% too high on average for countries in these regions. Their argument is persuasive in aggregate, though not necessarily for each country. We show in column (2) the effect of applying this adjustment on the poverty threshold in 2005. Because the country expenditure distributions are based on the \$1.25 threshold, they need to also be adjusted for the countries in these 3 regions.¹ In our application we will use the \$1.47 poverty line for 2005.

(5) Final Poverty Line and Total for 2005

¹ PovCalnet is the Bank portal that provides a rich set of data as well as software to allow users to estimate by country the number in poverty for various poverty thresholds.¹ Dykstra S., B. Dykstra and J. Sandefur (2014, hereafter DDS) of the Global Development Center (GDC) have searched the PovCalnet query system to provide interested users the distributions of expenditures (or for some countries, incomes). The GDC distribution for each country provides for each percentile of population the corresponding per capita consumption expenditures in national currencies converted at the PPP for C into US dollars. The GDC distribution is in 2005 prices. We have adjusted this distribution for the countries that Deaton and Aten have proposed. With a given poverty threshold one can search for the percent of the population above or below that level of per capita consumption per month from DDS.

Three modifications need to be made to this distribution for each country. First, we are using the modifications of Deaton and Aten of the consumption prices of 2005 to compute a new GEKS aggregation for only the poverty countries. Call this, PPP_{i2005}^{DA} . Second, the PPPs for C^* will be different than the PPPs for C from the ICP for 2005. Third C is typically $> C^*$ since most of the items deducted from C are positive values so we usually need to reduce the expenditure values by C^*/C . These modified entries are given in (2) below:

$$(2) C_{i2005}^* = C_{i2005} * R_{i2005} * (PPP_{C^*}/PPP_C)_{i2005} * (PPP_{i2005}^{DA}/PPP_{i2005}), \text{ where } i \text{ is the country index, and } R_i \text{ is from (1), and the superscript } DA \text{ refers to the Deaton-Aten adjustment.}$$

These modifications of the GDC distribution are done for all centiles of the population in each country for 2005.

(6) Method for Estimating new Poverty Lines and Levels

The entries in the modified GDC distribution consist of 100 C^* s for each country beginning with the lowest centile of the population. The poverty share PS is defined in (3) below. The next step is to obtain the poverty share.

$$(3) PS_i = NP_i / POP_i, \text{ where } NP \text{ is the number in poverty and } POP \text{ the population of country } i.$$

The poverty threshold from Table 1 of 1.47 is used for all countries as a starting point to obtain the initial poverty share for each country. Using equation 3 we obtain the number in poverty, NP for each country. We then re-estimate the poverty threshold, PT , weighting the initial C^* s in each iteration that correspond to the NP in iteration j as in equation (4).

$$(4) PT_{j2005} = \sum_i^{nc} (C_i^* * NP_{ij}) / \sum_{ij}^{nc} NP_{ij}, \text{ where } PT \text{ is the poverty threshold for iteration } j, nc \text{ is the number of countries. The new poverty threshold will produce a new } NP \text{ value for each country. These } NP \text{ values will not be the same as were obtained from the } \$1.47 \text{ threshold, } PT_1. \text{ To bring the poverty threshold in line with the number in poverty we continue to estimate new poverty thresholds until } PT_{ij} - PT_{ij-1} < .01 \text{ for each country.}$$

B. Results for 2005

The results in Table 2 compare the numbers in poverty using the \$1.25 threshold of the Bank with our estimates with the \$1.47 threshold after the 5th iteration². A major source of difference between columns 1 and 2 will be the different thresholds which, everything else the same, will tend to increase the number in poverty in all but the countries in the Americas. The total number in poverty using \$1.25 is 1383.7 million and using the higher \$1.47 a day it is 1811.8 million.³ However introducing the methods discussed in A above including a somewhat smaller measure of HH consumption, C* and carrying out the iteration, the results are much changed. The total given in column 2 of 1148.0 million is but 63% of its starting point of 1811.8 million and is smaller than using the \$1.25 poverty line as applied by the Bank.

The broad result is that changes in method more than offset the larger threshold so that the total number in poverty using the \$1.47 threshold is less than that using \$1.25 a day. Put another way, if our method was used with the \$1.25 threshold it would have produced a substantially lower poverty count than 1383.7 million. A perusal of Table 2 suggests that the use of numbers in poverty as the weights is probably the most important factor because most of the large poverty count countries have relatively big drops in their numbers in poverty. It is worth noting that the threshold we use of \$ 1.47 in the first iteration turns out by the 5th iteration to be \$ 1.27, very close to the initial Bank number.

The reader may ask how can the estimates in column 2 be as different from column (1) if the final thresholds are so close to each other? The answer is that we have also modified the GDC distributions as well as the entry points to that distribution, we have new PPPs because we are aggregating only over the poverty countries, and we use of C* not C. Essentially our linking to the dollar means that we are trying to capture a threshold that measures the same quantity of goods across countries similar to what the Bank and Joliffe and Prydz do, but the dollar value is not strictly comparable in interpretation.

C. Incorporating the 2011 ICP

We use the same method as Joliffe and Prydz for moving from 2005 to 2011, namely updating the 2005 line by movement in national CPIs and converting that number at ICP 2011 PPPs. Using this approach for the 15 countries of Table 1, JP arrive at a 2011 line of \$1.82 (GM = \$1.73). In fact their

² In our aggregation for 2005 we treated the urban and rural populations of China, India and Indonesia as separate entities, and then added the the two entities to obtain the country totals.

³ The 1811.8 million total is simply the starting point for our iterations.

preferred line would use the average of all those countries classified as low income (less than \$1045 per capita in 2013). Jolliffe and Prydz provide a thoughtful justification for this procedure.

$$(5) PT_{2011} = PT_{2005} \times \left(\frac{CPI_{2011}}{CPI_{2005}} \right) / PPP_{2011}$$

First, the rationale for using only 15 countries in 2005 was that the relationship between country real incomes and national poverty lines was relatively flat for this group and only began to rise at higher incomes. J=P did not find this in the data but argued rather that the upward relationship was continuous from very low incomes on up the ladder. Choosing to use the Bank low income countries provided an independent cut-off that removed their result from their choice of a particular country cutoff. Their decision expanded the number of countries determining the poverty threshold, which also improved the basis for that determination. The additional countries increased the currency of the underlying country surveys and offset somewhat the fact that the poorest countries typically have weaker statistical systems.

The next step of Jolliffe and Prydz was to average the 2011 estimates for the low income countries. They applied an unweighted and weighted averages. In our experience choice of weights turns out to be an important decision for our 60 countries because it substantially affects the poverty threshold. As noted above we used an average weighted by the number in poverty in each country in 2005 producing quite different results for many countries. With regard to 2011 the Poverty Global Practice Group and the Development Data and Research Groups of the Bank recently reviewed various approaches to integrating the 2011 ICP into the estimation of a new poverty threshold. (Ferreira et al 2015). The review of recent practice and pros and cons of alternative methods in the paper are valuable in their own right. Their operational outcome is to propose a poverty line for 2012 of \$1.92, which provides a plausible reconciliation of numbers in poverty by region between the two ICP benchmarks. We have not had access to the individual country poverty totals so are not able to compare individual country estimates between 2005 and 2012.

In our own update to 2011 our estimates of the country price levels vary significantly among the countries, partly a reflection of the quality of CPI estimates across countries. Several are over \$2 a day, but most substantially under \$1.92. However, as discussed, our metric, though in dollars, is really not comparable to those in Ferreira et, al. (2015). We hope to do more with 2011 by the time of our presentation.

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Table 1: Differences between Bank and Present Approach

Step in Estimation	Bank for 2005	Jolliffe and Prydz	Present Approach
(1) Measure of Consumption	Household Expenditures per Capita	Household Expenditures per Capita	HH Expenditures less 5 headings not relevant to poverty

(2) Countries in PPP Estimation	All ICP Benchmark countries and imputations for others	All ICP Benchmark countries and imputations for others	Only Poverty Countries
(3) Link to US dollar	Directly from All ICP aggregation	Directly from All ICP aggregation	Linked by Poverty Countries in All ICP Aggregation
(4) Initial Poverty Threshold 2005	Mean of PPP Poverty Lines of 15 Poorest Countries	Mean of PPP Poverty Lines of 15 Poorest Countries	GeoMean of PPP Poverty Lines of 15 Countries as starting point
(5) Final Poverty Totals and Threshold	The Initial Poverty Line and Total Number in Poverty	The Initial Poverty Line and Total Number in Poverty	Obtained After Iteration from Initial Poverty Line
(6) Update final 2005 poverty threshold to 2011 prices		Use 2011 PPPs to convert 2005 Poverty in 2011 prices for 'Low Income' countries	Same as JP except only for 15 countries.

Table 2: Adjusted Poverty Threshold for 2005

Country	2005 PPPs	DA adjust
Malawi	0.86	1.075
Mali	1.38	1.725
Ethiopia	1.35	1.688
Sierra Leone	1.69	2.112
Niger	1.1	1.375
Uganda	1.27	1.588
Gambia, The	1.48	1.850
Rwanda	0.99	1.238
Guinea-Biss	1.51	1.888
Tanzania	0.63	0.788
Tajikistan	1.93	1.93
Mozambique	0.97	1.212
Chad	0.87	1.088
Nepal	0.87	1.088
Ghana	1.83	2.288
Mean	1.248	1.528
Geomean	1.190	1.466

Table 3: Original and Adjusted Number in Poverty 2005

Country	Country ICOCODE	Millions At \$1.25 1	Iteration5 At \$1.46 2	Ratio (2)/(3) 3	PerCapita HHC
Angola	AGO	8.4	8.2	0.981	62
Burundi	BDI	6.6	6.8	1.023	25
Benin	BEN	4.6	5.0	1.082	100
Burkina Faso	BFA	7.3	7.8	1.070	75
Bangladesh	BGD	80.8	65.8	0.814	82
Bolivia	BOL	1.8	1.5	0.842	171
Brazil	BRA	14.7	11.1	0.750	74
Botswana	BWA	0.7	0.7	1.051	275
Central Afr Rep	CAF	2.8	3.1	1.085	58
China All	CHN	211.3	192.2	0.909	165
China Rural	CHNR	198.0	178.9	0.903	
China Urban	CHNU	13.3	13.3	1.000	
Côte d'Ivoire	CIV	6.3	6.7	1.061	110
Cameroon	CMR	3.2	3.5	1.111	138
Comoros	COM	0.3	0.4	1.055	82
Djibouti	DJI	0.2	0.2	1.143	101
Ecuador	ECU	0.9	0.7	0.714	292
Egypt	EGY	3.5	4.9	1.400	333
Ethiopia	ETH	32.4	46.1	1.422	39
Georgia	GEO	1.1	0.8	0.720	255
Ghana	GHA	8.1	9.0	1.105	91
Guinea	GIN	5.1	5.4	1.055	63
Gambia, The	GMB	0.6	0.7	1.093	52
Guinea-Bissau	GNB	0.8	0.9	1.113	39
India All	IND	535.1	357.4	0.668	113
India Rural	INDR	395.2	258.4	0.654	
India Urban	INDU	140.0	99.0	0.707	
Indonesia All	IDN	59.1	41.7	0.705	180
Indonesia Rural	IDNR	28.4	18.9	0.667	
Indonesia Urban	IDNU	30.7	22.8	0.741	
Iran	IRN	2.7	1.4	0.500	149
Kenya	KEN	19.0	20.8	1.093	108
Cambodia	KHM	4.3	3.0	0.710	90
Lao PDR	LAO	2.7	2.1	0.792	80
Liberia	LBR	2.9	3.0	1.022	24
Sri Lanka	LKA	2.2	1.0	0.455	206
Lesotho	LSO	1.0	1.0	1.038	163
Morocco	MAR	1.8	3.3	1.833	193

Madagascar	MDG	15.0	15.3	1.023	70
Mexico	MEX	2.1	1.0	0.500	80
Mali	MLI	7.5	8.1	1.078	69
Mozambique	MOZ	13.6	14.4	1.057	50
Mauritania	MRT	0.9	1.1	1.121	103
Malawi	MWI	8.9	8.8	0.986	48
Namibia	NAM	0.8	0.9	1.098	230
Niger	NER	7.3	8.1	1.103	43
Nigeria	NGA	86.3	90.2	1.045	120
Nepal	NPL	9.6	14.2	1.474	70
Pakistan	PAK	57.0	37.0	0.649	165
Peru	PER	2.2	1.4	0.625	309
Philippines	PHL	23.9	16.2	0.679	175
Paraguay	PRY	0.6	0.4	0.700	230
Rwanda	RWA	6.4	6.8	1.055	52
Senegal	SEN	4.3	5.0	1.150	121
Sierra Leone	SLE	3.3	3.6	1.077	55
Swaziland	SWZ	0.6	0.6	1.082	64
Chad	TCD	6.2	6.5	1.041	269
Togo	TGO	2.0	2.2	1.132	72
Tajikistan	TJK	1.5	0.9	0.591	86
Tanzania	TZA	27.5	28.9	1.051	112
Uganda	UGA	13.2	14.6	1.100	72
Venezuela	VEN	2.4	3.7	1.556	68
Vietnam	VNM	22.4	15.8	0.704	73
Yemen, Rep.	YEM	5.9	6.3	1.069	98
South Africa	ZAF	10.3	10.8	1.045	137
Zambia	ZMB	9.3	9.4	1.012	14
All 60	Countries	1383.7	1148.0	0.830	