

Africa Rising?

Using Micro Surveys to Correct Macro Time Series

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PRELIMINARY & INCOMPLETE – PLEASE DO NOT CITE

Abstract

While sub-Saharan Africa's economic performance has improved since 2000, considerable doubt remains about the reliability of official statistics for many economies in the region. Here I focus on one highly visible, often politicized macroeconomic variable – consumer price inflation – which directly determines changes over time in international databases of purchasing-power parity exchange rates, real economic growth, and poverty. I demonstrate how household survey data can be used to check and correct these CPI series, and present a new data set of alternative price deflators for 35 growth spells between 1980 and 2010 spanning 18 countries [to be extended to 94 spells across 33 countries]. Preliminary results show that these alternative deflators yield rates of growth and poverty reduction that are modestly slower on average, with larger double-digit revisions in a handful of countries. Finally, I revisit the World Bank's methodology for constructing up-to-date regional poverty aggregates, and show that imputation of missing values after the most recent survey year using national accounts data leads to perennial over-optimism about recent poverty reduction.

Keywords: Africa, poverty, growth, inflation, purchasing power parity

JEL Classification Numbers: E31, I32, N17, O47

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1 Introduction

During the last decade, both the popular and academic narrative regarding Africa’s economic performance shifted dramatically, from a “growth tragedy” (Easterly and Levine 1997) to a potential “growth miracle” (Young 2012). While the May 2000 cover of *The Economist* declared Africa a “hopeless continent,” by December 2011 the magazine cover was celebrating “Africa rising,” noting that “[o]ver the past decade six of the world’s ten fastest-growing countries were African. In eight of the past ten years, Africa has grown faster than East Asia, including Japan”.

The story is very similar for the evolution of absolute poverty in the region. Dollar-a-day poverty – i.e., the proportion of the population living in households with income or consumption below \$1.25 per person per day in purchasing-power parity terms – has been declining quite rapidly over the past decade in the Sub-Saharan Africa region (henceforth, “Africa”). Chen and Ravallion (2010) find that absolute poverty in the region peaked at 78.1% in 1993, remained relatively steady at 77.6% up to 1999, then dropped to 69.2% by 2008. More recent World Bank updates to these figures show continued poverty reduction since 2008, amounting to “an impressive decline of 17 percent in one decade” (World Bank 2013).

The calculations underlying these trends in real GDP growth and poverty reduction rely on indices of purchasing power parity (PPP) which have been the subject of enormous controversy in the academic literature. The 2005 update to the PPP indices produced by the International Comparison Program (2008) resulted in significant revisions to the price levels – and hence poverty and GDP levels – in several regions. Deaton (2010) notes that these revisions imply poverty in East Asia in 1993, previously estimated at 25.2%, is now estimated at 50.8%. The revisions for Africa were smaller but still economically significant, implying a 1993 poverty level 56.9% instead of 49.7%.

Controversy around the PPP indices has focused on revisions to the index *levels* for cross-national comparisons. As Johnson, Larson, Papageorgiou, and Subramanian (2013) demonstrate, these revisions also have large implications for the *growth* of GDP measured in PPP terms. I focus here on the changes over time to the PPP indices themselves within a single version of the series (International Comparison Program 2008). These changes, which have first-order effects on rates of growth and poverty reduction, do not rely on independent data from the International Comparison Program, but are calculated using official consumer price indices (CPI) reported by national statistics offices. In this paper, I show that for many African countries these CPI series may severely understate true inflation, and thus provide overly optimistic trends of real GDP growth and poverty reduction.

I present a new database of national poverty lines and their changes over time, based on comparable household surveys, expanding on the work of Ravallion, Datt, and van de Walle (1991) and Ravallion, Chen, and Sangraula (2009). Africa is a natural focus for this exercise because, unlike in Latin America for instance, poverty rates and poverty lines are typically calculated on the basis of consumption and expenditure surveys, rather than income surveys. Poverty lines derived from consumption and expenditure surveys are typically defined as a measure of the cost of living for the poor measured in current local currency units, comparable to a consumer price index. A downside of poverty lines as an alternative to consumer price indices is that they are produced quite infrequently, usually at intervals of five years or more. However, these intervals correspond by construction to the periods for which data on household welfare is available to calculate PPP poverty numbers. Furthermore, poverty lines have the advantage of being completely independent from the often-politicized official CPI.

In Section 5, I use this database of poverty lines to construct new PPP deflators for 23 growth spells in African economies.¹ These revised deflators enable me to revise the local-currency value of dollar-a-day poverty lines, and thus calculate new dollar-a-day poverty rates and poverty-reduction trajectories for each country.

The revised PPP deflators also present a new picture of real GDP growth rates in the region. This analysis is still preliminary, but in future drafts I propose to apply these new survey-based deflators to national accounts data to calculate new rates of real final household consumption and, in turn, real GDP growth.

These revised national accounts figures are also instrumental in calculating poverty rates for Africa as a whole, which involves imputing values for country-year cells without survey data. Because the sample of countries covered by recent surveys fluctuates from year to year (and even decade to decade), World Bank estimates for global or regional poverty rates rely on imputation to fill in missing values and maintain a consistent sample of countries over time. As described in Ravallion (2008), imputation is done by applying the growth rate of total consumption in the national accounts to the distribution of consumption from the most recent survey, implicitly assuming that economic growth was evenly distributed across the distribution. Ravallion (2003) provides justification for this assumption by showing that growth in consumption from surveys and national accounts are the same, on average, in a sample of developing and transition countries in the 1980s and 1990s, after excluding Eastern and Central Europe. However, I show this is no longer the case using revised deflators.

¹These results are preliminary and incomplete. The eventual goal is to complete this analysis for all 96 spells listed in Figure 5 in the appendix, i.e., all spells for which I have been able to identify comparable household surveys over time in Sub-Saharan Africa from 1980 to 2010.

Imputation using national accounts data leads to overestimation of poverty reduction in the years since the most recent survey, leading to perpetual over-optimism about recent economic performance, and propose revised imputed measures of poverty for years without survey data. In future drafts I plan to implement alternative imputation procedures that require less stringent assumptions and avoid this pitfall.

The rest of the paper is organized as follows. The following section provides an introduction to PPP indices, focusing on the particular challenges in an African context. Section 2 presents a case study of Tanzania which is essentially a condensed version of the full paper, demonstrating systematic biases in the official inflation series and illustrating how household survey data can produce revised estimates of inflation, poverty reduction, and real GDP growth. Sections 3 and 4 attempt to demonstrate these same problems exist more broadly in the region, showing that trends in national and international poverty rates frequently diverge and that this divergence stems from underestimation of inflation. Section 5 turns from diagnosis to cure, calculating estimates of inflation, poverty, and growth for a set of 23 country growth spells with available survey data. Section 6 exposes and attempts to correct an additional problem with current poverty estimates which arises in the imputation of missing values required for aggregating country-specific estimates to produce regional and global poverty figures. Once again, current official estimates appear over-optimistic about the pace of poverty reduction in Africa. Section 7 concludes.

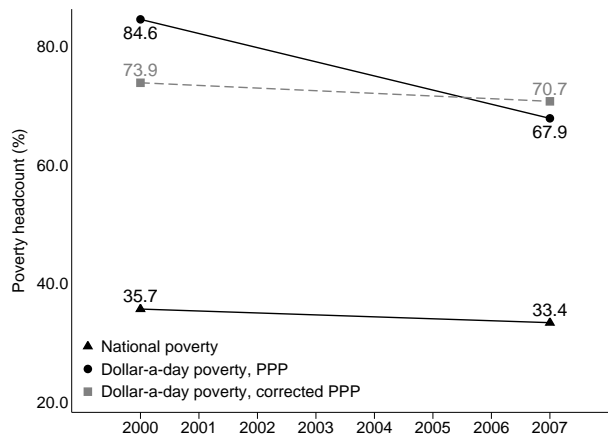
2 Case study: Tanzania, 2000-2007

Recent Tanzanian history illustrates how mismeasurement or misreporting of official consumer price indices may lead to overly optimistic estimates of poverty reduction and growth based on PPP exchange rates.

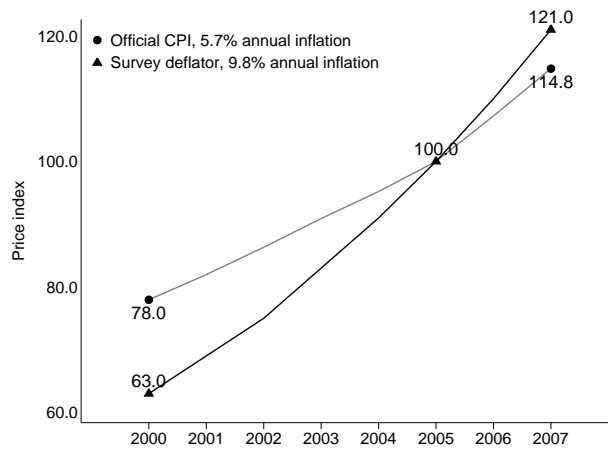
One of the central mysteries in the macroeconomic policy debate in Tanzania in recent years has been the apparent failure of rapid growth in the early 2000's to translate into significant poverty reduction (Mkenda, Luvanda, and Ruhinduka 2010). From 2000 to 2007, real per capita GDP in PPP dollars as reported in the World Bank's World Development Indicators grew at 4.2%. Meanwhile, poverty as defined by Tanzania's National Bureau of Statistics fell modestly by less than one percentage point per annum, from 38.7% to 33.4% (National Bureau of Statistics 2009). An obvious explanation for this contrast is that growth was simply concentrated among more affluent households, yet the Gini coefficient of inequality was unchanged over this period (National Bureau of Statistics 2009, p. 53). Atkinson and Lugo (2010) review possible explanations that might reconcile this pattern of rapid growth without significant poverty reduction or rising inequality, including the

Figure 1: Tanzania

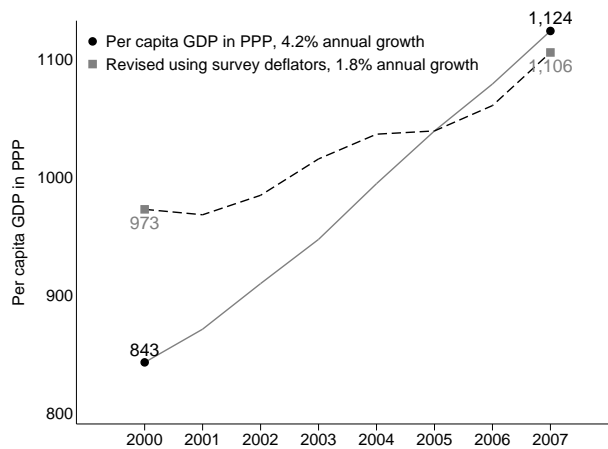
(a) Alternative measures of poverty



(b) Alternative consumer price indices



(c) Alternative real per capita GDP series



possibility that growth rates may be overstated due to errors in the price deflators.

One piece of evidence in favor of the price deflator explanation is the divergence between national and international poverty rates. While national poverty fell very slowly, the World Bank's PovCalNet website reports that between 2000 and 2007, dollar-a-day poverty in PPP terms in Tanzania fell by 16.7 percentage points, from 84.6% to 67.9% as shown in Figure 1a. Note that both the national and dollar-a-day poverty headcount rates are calculated from the same data source – three successive rounds of Tanzania's Household Budget survey, a comparable, nationally representative survey of household consumption and expenditure conducted by the statistics bureau in 1991, 2000, and 2007 (National Bureau of Statistics 2002, National Bureau of Statistics 2009). Note also that while the national poverty line is considerably lower than the \$1.25 international PPP line, both lines are intended to remain constant over time in terms of real purchasing power.

However, the deflators applied to the national and international poverty lines to calculate changes over time are based on completely independent information. For the international poverty line measured in PPP dollars, changes in the PPP exchange rate are calculated using the official consumer price index (CPI), as is the case for all countries. Tanzania's CPI is based on monthly surveys of markets in 22 major urban areas, despite the fact that over 80% of Tanzania's population lives in rural areas. From a base in 2000, the CPI reported an increase of 47.3% up to 2007, or an average annual inflation rate of 5.7% (see Figure 1b).

In contrast, Tanzania's national poverty line is adjusted over time based on changes to the cost of living for the poor as measured by the same nationally-representative household survey data used to measure poverty. For each round of the survey, a new poverty line is calculated using a consistent "cost of basic needs" methodology, which measures the price of consuming 2,200 calories per person based on typical consumption patterns plus a proportional allowance for non-food expenditure (?). The prices in this calculation are derived from unit values in the survey data, i.e., the amount paid by households per physical unit of each item in the consumption basket. From 2000 to 2007, the nominal value of this national poverty line rose by a factor of 1.93, implying an average annual inflation rate of 9.8%.

This discrepancy – between an inflation rate of 5.7% versus 9.8% per annum over several years – has obvious implications for the calculation of both poverty reduction and economic growth in real terms. The release of the 2007 survey data, which revealed the magnitude of this discrepancy, prompted joint efforts by the World Bank and IMF to reassess the validity of the official consumer price index. Public skepticism of the CPI series increased during 2008 and 2009 as the index failed to register the effects of the world food price crisis. While household surveys showed rapidly rising price levels in excess of 20% per annum, the CPI

Table 1: Regressing international on national poverty reduction

| | Change in poverty rate, international line | | | | | |
|---------------------------------|--|------------------|----------------------|---------------|----------------------|----------------|
| | All spells | | Increases in poverty | | Decreases in poverty | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Change in pov. rate, nat'l line | .49 (.13)*** | .40 (.11)*** | .01 (.20) | .34 (.34) | .78 (.14)*** | .37 (.25) |
| Constant | | -.78 (.19)*** | | -.66 (.56) | | -.86 (.44)* |
| Obs. | 34 | 34 | 14 | 14 | 20 | 20 |

Each column reports a separate, OLS regression. The dependent variable is the percentage point change in the international dollar-a-day poverty headcount between two surveys. The 34 observations in the sample span 21 countries for which multiple consecutive household surveys are available. Columns 3 and 4 (5 and 6) restrict the sample to spells where the national poverty rate increased (decreased). Columns 1 and 2 (likewise, 3 and 4, 5 and 6) differ from each other only in the inclusion of a constant term.

continued to report single digit inflation (National Bureau of Statistics 2010). Furthermore, re-analysis of the CPI raw data showed that the underlying CPI prices and unit values from household surveys both produced much higher inflation rates when using a common methodology (*op cit.*). Under both domestic and international pressure, the National Bureau of Statistics overhauled the consumer price index in 2010.

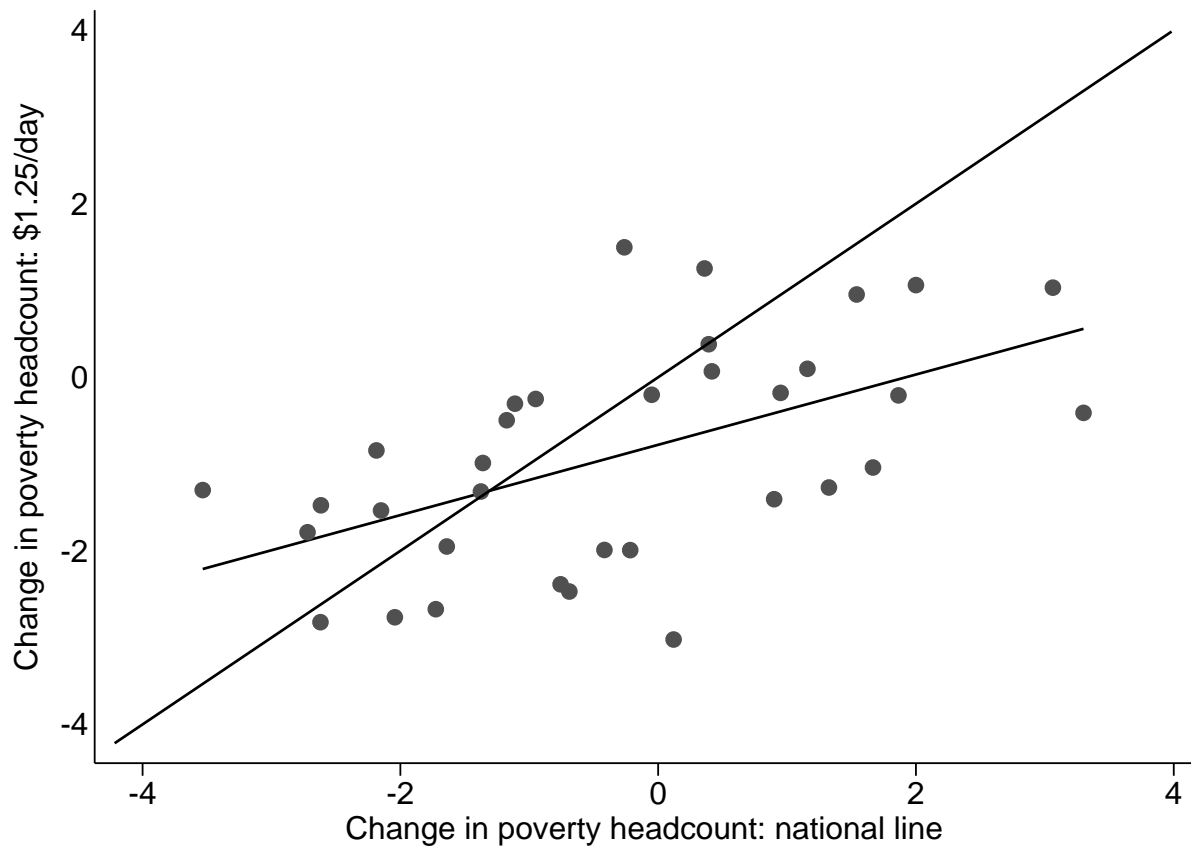
Given the apparent underreporting of inflation in the official CPI, the implicit price index contained in the national poverty lines for 1991, 2000, and 2007 appears to provide a more reliable set of deflators for poverty measurement. As shown in Figure 1a, the survey-based deflators can be applied to create revised PPP conversion factors and calculate alternative estimates of the dollar-a-day poverty rate. This readjustment implies that instead of falling by 16.7 percentage points, dollar-a-day poverty was relatively unchanged, dropping just 3.5 points over seven years from 84.6% to 67.9%.

3 Discrepancies between national & international poverty rates

Consider a country with population N . Let C_{it} denote nominal, per capita, household consumption for individual i in period t . If Z_{2005}^{int} measures the international poverty line in 2005 PPP dollars, and Z_t^{int} the national poverty line in current local currency units, then the two respective headcount poverty rates can be defined as follows.

$$\text{Dollar-a-day poverty} \equiv P^{int} = \frac{1}{N} \sum_i I[Z_{2005}^{int} > C_{it} \frac{PPP_{2005}}{CPI_t}]$$

Figure 2: Changes in poverty headcount rate by national and international definitions



$$\begin{aligned}
\text{National poverty} \equiv P^{nat} &= \frac{1}{N} \sum_i I[Z_t^{nat} > C_{it}] \\
&= \frac{1}{N} \sum_i I[Z_{2005}^{int} > C_{it} \frac{Z_{2005}^{int}}{Z_t^{int}}]
\end{aligned}$$

There are essentially three reasons why changes in national and dollar-a-day poverty may differ when using the same survey data. First, the levels of the poverty lines may differ. As is well known, the growth-elasticity of poverty reduction will differ depending on where the poverty line is set (Bourguignon 2002). In much of Sub-Saharan Africa, national poverty lines are set much lower than the dollar-a-day level.

Second, national poverty lines may differ over time, rendering them incomparable. In what follows, I attempt to construct a dataset of comparable national poverty lines over time within countries, taken from similar household surveys and using a comparable definitions and methodologies to construct a cost-of-basic-needs poverty line.

Third, changes in national and dollar-a-day poverty may differ because the underlying deflators applied to consumption data differ in the two calculations. All else equal, a relatively larger increase in the national compared to the international poverty line ($\Delta Z_t^{int} / \Delta CPI_t$) will imply a larger increase in national poverty relative to international dollar-a-day poverty ($\Delta P^{nat} / \Delta P^{int}$).

As a preliminary step though, it is notable that the poverty rates as measured relative to the poverty lines set by national governments has been declining much more slowly. Figure 2 shows the relationship between the annual percentage-point change in dollar-a-day poverty (y -axis) and national poverty (x -axis) for thirty-four periods between repeated consumption surveys, covering a sample of twenty countries. Note that both rates reported by the World Bank's World Development Indicators, and calculated using the same survey data for the same years.

Table 1 explores this relationship in more detail. The slope coefficient on the regression of changes in international (dollar-a-day) poverty rates on national poverty rates is 0.49 when suppressing the constant term, and is significantly different from unity at the 1% level. When including a constant, results show that international poverty falls by an average of 0.78% more with a slope coefficient of just 0.4. In short, changes in national poverty do not translate into changes in international poverty one-for-one.

Perhaps more importantly, there is a marked asymmetry between increases and decreases in poverty in this relationship. Column 3 shows that a 1-percent increase in national poverty correlations with roughly zero change in international poverty, while column 5 shows that a 1-percent *decrease* in national poverty yields a 0.78 percentage point decrease in international poverty.

The next section focuses on showing that this divergence between national and international poverty rates is in fact attributable to the third explanation above, and that the deflators applied in the calculation of dollar-a-day poverty rates are likely incorrect.

4 Discrepancies between alternative measures of inflation

4.1 Price indices in theory and practice

Currently, national poverty lines in Sub-Saharan Africa are typically computed in a way that allows for comparisons of poverty rates over time that are properly grounded in welfare theory. The core of the cost of basic needs (CBN) methodology used to draw national poverty lines is the cost of consuming 2,200 calories, as measured by relevant local prices. Both the prices and weights used in this calculation are based on the consumption patterns of the poor.

In contrast, international poverty lines such as the World Bank's \$1.25 per day line measured in PPP dollars are not suited for making meaningful comparison of poverty over time, although they are commonly used for this purpose. This deficiency stems from two factors, one theoretical and one practical. First, changes over time in the \$1.25 per day line are based on the consumer price index (CPI) from national accounts. Both the prices (measured only for urban markets in many African countries) and weights (defined for the average consumer, rather than the poor) are theoretically inappropriate for comparing the well-being of the poor over time. Second, as I attempt to show below, CPI series in many African countries systematically understate actual inflation. In practice, there is some evidence from at least one country (Tanzania) that the latter practical problem introduces errors of much greater magnitude than the former theoretical consideration.

A separate problem with the use of existing PPP exchange rates for welfare measurement relates to cross-country comparisons. Johnson et al (2013) demonstrate that because PPP exchange rates are updated using national CPI series from each country, they cease to provide theoretically coherent metrics for comparing purchasing power across countries for any year except the benchmark year.

In response to this concern raised by Johnson et al, new rounds of the Penn World Tables, starting with version 8.0, will provide an alternative measure of GDP which uses deflators over time based in part on successive rounds of the ICP's own price data. Feenstra et al (2013) derive this new measure of real GDP which is intended to be "real" in both the cross-sectional and time-series dimension. Notably, from the perspective of problems with African

Table 2: Inflation: official and revised estimates

| | Mean | Median |
|-------------------------------------|-------------------|------------------|
| | (1) | (2) |
| Official CPI inflation | 8.75 | 6.79 |
| Inflation in national poverty lines | 10.41 | 6.89 |
| Gap (official minus revised) | -1.66 (0.79)** | -0.56 (0.48) |
| Absolute gap | 3.04 (0.66)*** | 1.34 (0.58)** |

All numbers in the table refer to annualized percentage changes. The sample includes 35 observations spanning 18 countries. For the list of all countries and periods included, see Table 5. “Revised” refers to inflation estimates derived from national poverty lines.

macro time series which are the focus of the current paper, the revised PWT 8.0 methodology will prevent any long-run divergence of reported real growth rates from (unobserved) actual real growth rates due to errors in the official CPI, as PPP calculations will be pinned down by the ICP’s own data in benchmark years.

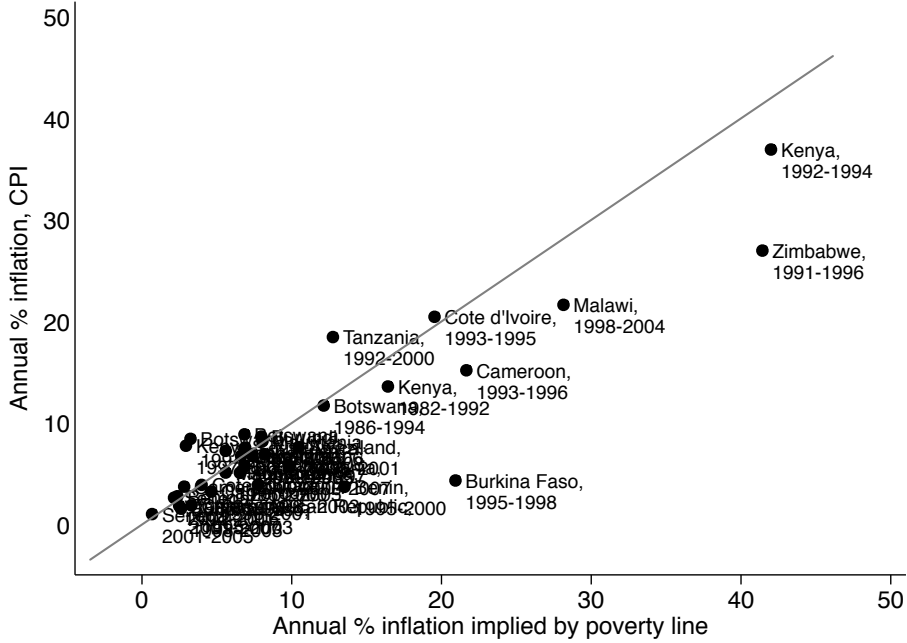
A few problems remain with the use of PPP values for comparison of welfare over time; problems which are not unique to the African context, but arguably more relevant there. First, between benchmark years – and more problematically, for current data after the most recent benchmark – PPP exchange rates will continue to be based exclusively on official CPI series from individual countries. This is especially relevant in countries with limited statistical capacity and or politicized statistics offices where those CPI series are prone to error. Second, like the CPI series, the ICP’s independently collected prices and independently calculated price indices are collected and calibrated to deflate aggregate household consumption in the national accounts. They do not necessarily reflect the prices available to, or the consumption patterns of the poor. Thus while the revised PPPs proposed in Feenstra et al (2013) are designed to provide theoretically-grounded estimates of real GDP, they are less appropriate for calculating poverty rates.

4.2 A new data set of survey-based deflators

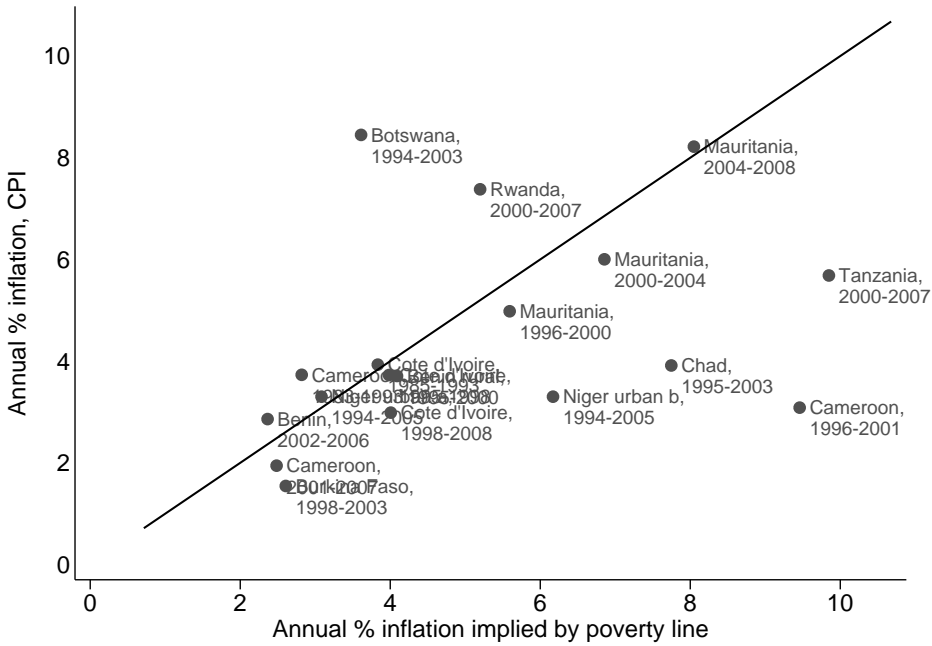
This section describes a new data set of national poverty lines which provide an alternative to the official consumer price indices currently used to adjust PPP exchange rates over time. These national lines were assembled from a wide variety of official documents published by national statistics offices and international organizations, including the reports accompanying household surveys, Poverty Reduction Strategy Papers (PRSP), and World Bank Poverty Assessments. The key features of the lines included here is that they measure the cost of a

Figure 3: Official versus survey-based inflation

(a) Full sample



(b) Sub-sample with inflation $\leq 10\%$ per annum



consumption basket defined comparably over time and presented in nominal local currency units.

There is no single standardized approach used by national governments in setting poverty lines, nor any official repository of such lines as there is for, say, national accounts statistics. As part of the process to select the World Bank’s original \$1 poverty line, Ravallion, Datt, and van de Walle (1991) compiled poverty lines for 33 countries, of which 22 were developing countries and only 4 were in Africa. Ravallion, Chen, and Sangraula (2009) updated and expanded this list to cover 75 developing countries including 23 in Africa using the most recent information available within a window from 1988 to 2005.

About 80% of the poverty lines documented by Ravallion, Chen, and Sangraula (2009) were chosen using a “cost of basic needs” (CBN) methodology, discussed in detail in Ravallion (2008). This method estimates the cost of achieving an adequate food basket (e.g., 2,200 calories per adult equivalent) at prevailing prices for the relevant population (e.g., median unit values reported in a consumption or expenditure survey by households living in the middle or lower quantiles of the aggregate consumption distribution). This value is then scaled up to allow for non-food expenditures, typically based on the consumption patterns of households near the line.

From a theoretical perspective, poverty lines derived through a CBN approach provide an attractive measure of consumer prices for the purposes of poverty analysis because, unlike many official consumer price indices, they are based on the consumption patterns of the poor and the prices faced by the poor. Deaton and Dupriez (2011) build on this idea to construct indices of purchasing-power parity for the poor (PPPP) as an alternative to standard PPP indices used for cross-national comparisons. From a practical perspective, CBN poverty lines have the added advantage of drawing on the same survey data used to measure household welfare, thus ensuring comparability in terms of sample coverage and timing.

Notably, neither the databases compiled by Ravallion, Datt, and van de Walle (1991) nor Ravallion, Chen, and Sangraula (2009) present any information on changes to national poverty lines over time within countries. This paper attempts to fill that gap, and exploit changes in CBN poverty lines over time to provide an independent measure of inflation in consumer prices in Africa.

This new data set contains information on 96 spells of growth and poverty reduction, where a spell is defined for a given country as a period between two comparable household surveys with data on consumption and poverty. Table 5 shows the raw, unadjusted, information for each of these spells that I take as my starting point. This includes information on three basic concepts: mean household consumption growth, changes in the headcount poverty rate, and inflation in consumer prices. I present two measures of each concept. Con-

sumption growth can be measured either by final household consumption per capita from the national accounts, or by the mean household consumption from the survey data. Poverty reduction can be measured by the percentage-point change in dollar-a-day poverty, or in the poverty headcount relative to the national poverty line. Finally, inflation is measured by the official CPI series or – the main innovation of this paper in terms of new data for cross-country growth and poverty analysis – by comparing the survey deflators implicit in national poverty lines.

Of these six indicators, four are based on the same underlying survey data.² The 96 spells listed in Table 5 were screened on the basis of having data for at least one of these four survey-based sources. In principle, if data is available for one of these indicators, it should be possible to produce figures for all four. In practice, changes in dollar-a-day poverty are available for 63 spells, growth in mean consumption for 60 spells, but changes in national poverty are only available for only 30 spells, and inflation in survey deflators for only 23 spells.

While PPP conversion factors across countries are based on independently collected data from the International Comparison Project, changes in PPP over time within countries are based on official consumer price indices reported by national governments. As an alternative to these official CPI series, I present a new data set of national poverty lines based on repeated expenditure surveys for over thirty countries, measuring changes in the cost of basic needs for poor households in current local-currency units.

Figure 3 shows the comparison of inflation rates from official CPI series as reported in the World Bank’s World Development indicators (y -axis) and inflation as measured by changes in national poverty lines (x -axis). Overall, official inflation appears to dramatically understate changes in the prices experienced by the poor as measured in survey data. As seen in the top panel, for several country-year spans, this discrepancy is in excess of 10 percentage-points per annum. But even setting aside these extreme cases, the magnitude of the discrepancies remains economically significant. As seen in the bottom panel, which focuses on cases of inflation below 10% per annum, discrepancies of several percentage points per annum remain for several countries.

Table 2 presents summary statistics for both the official and revised inflation numbers. On average, official inflation in this sample of 35 growth spells spanning 18 countries was 8.75% per annum, while the revised inflation series average 10.41% per annum. The average discrepancy of 1.66% higher inflation in the revised figures is even higher, 3.04%, when

²The four survey-based indicators are mean consumption growth in household surveys, changes in headcount poverty relative to the national poverty line, changes in headcount poverty relative to the international dollar-a-day poverty line, and inflation in survey deflators.

focusing on the average absolute value of the discrepancy. The right column of Table 2 shows that these gaps are partially driven by a minority of cases; the difference at the median is considerably smaller than at the mean, with revised figures showing inflation just 0.56% higher.

5 Revised estimates of poverty reduction and growth

The previous two sections focused on diagnosing errors in poverty rates and inflation series; this section turns to the more constructive task of computing corrected estimates.

5.1 Methodology

Revised poverty rates are computed in two steps. The first step is to calculate new PPP exchange rates for each country-year for which survey data is available, denoted with a prime, PPP'_{it} . For comparability with existing figures, I use a base year of 2005 for these revised PPPs. The ICP's benchmark PPP exchange rates rely on survey data for 2005 and are calibrated for other years as:

$$PPP_{it} = \frac{CPI_t}{CPI_{2005}} PPP_{2005}.$$

Thus revised exchange rates are defined as

$$PPP'_t = \frac{Z_t}{Z_{2005}} PPP_{2005}.$$

where Z_{2005} is calculated by extra- or interpolation for the majority of cases where survey data is not available for 2005.

The second step uses these revised PPP exchange rates to calculate new dollar-a-day poverty rates using the original household survey data for each country. This can be done for country-years with and without survey data, but the process is quite different. This section focuses on the former case, and Section 6 focuses on the latter. For country-years with both survey data and a comparable national poverty line, calculation of revised dollar-a-day poverty headcount rates and mean per capita consumption in PPP terms is straightforward. The revised PPP'_{it} conversion factors are applied to the raw household survey data on per capita consumption, taken from the World Bank's *PovCalNet* database.

$$P'_{it} = \frac{1}{N} \sum_i I \left[1.25 \frac{PPP'_t}{PPP_t} > C_{it} PPP_t \right]$$

Table 3: Poverty reduction: official and revised estimates

| | Mean | Median |
|----------------------------------|-------------------|-------------------|
| World Bank PovcalNet | -5.63 | -5.73 |
| Using revised PPP exchange rates | -4.09 | -4.44 |
| Gap (official minus revised) | -1.53 (1.36) | -0.87 (0.78) |
| Absolute gap | 6.71 (1.03)*** | 3.78 (1.27)*** |

All numbers in the table refer to annual percentage-point changes. The sample includes 54 observations spanning 25 countries. For the list of all countries and periods included, see Table 5. “Revised” refers to poverty rates estimated using revised PPP exchanges rates based on inflation rates derived from national poverty lines.

The left hand side of the inequality in brackets reflects the practical reality of the calculations that are performed on PovCalNet. Because the micro data (expressed in conventional purchasing power parity terms as $C_{it}PPP_t$) cannot be directly accessed or deflated for reasons of confidentiality, all revisions must be done to the poverty line rather than the distribution of consumption.

5.2 Results

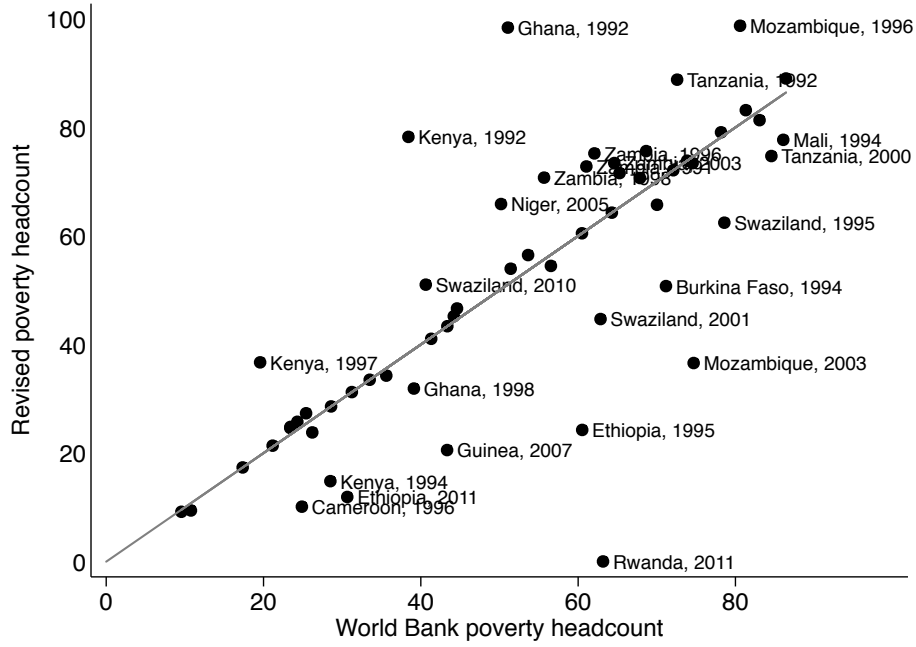
Figure 4 shows the comparison of poverty rates as reported in the World Bank’s World Development indicators (y -axis) and poverty as measured when PPP deflators are revised using national poverty lines (x -axis). The top panel presents the comparison in levels, and the bottom panel in changes. In levels, no clear pattern emerges, as anticipated. Changing deflators may lead to higher or lower rates of poverty depending on the direction of the change and whether the data point in question falls before or after the benchmark year used to compute the deflators.

The bottom panel of Figure 4, however, shows some sign of a systematic discrepancy between poverty reduction before and after revising the PPP deflators. While countries are clustered near the 45-degree line (as one would hope), a disproportionate number fall above the line, implying that revised figures show more pessimistic patterns than the official figures.

Table 3 presents summary statistics for changes in both the official and revised poverty numbers. On average, official dollar-a-day poverty in this sample of 58 growth spells spanning 21 countries fell 5.63 percentage points, while the revised dollar-a-day poverty rate fell by just 4.09 points. This average discrepancy of 1.53 percentage points does not appear to be driven by outliers; the median rates of poverty reduction are 5.73 points and 4.44 points for official and revised rates, respectively.

Figure 4: Revised versus World Bank estimates of absolute poverty

(a) Poverty headcount rates



(b) Changes in poverty headcount rates

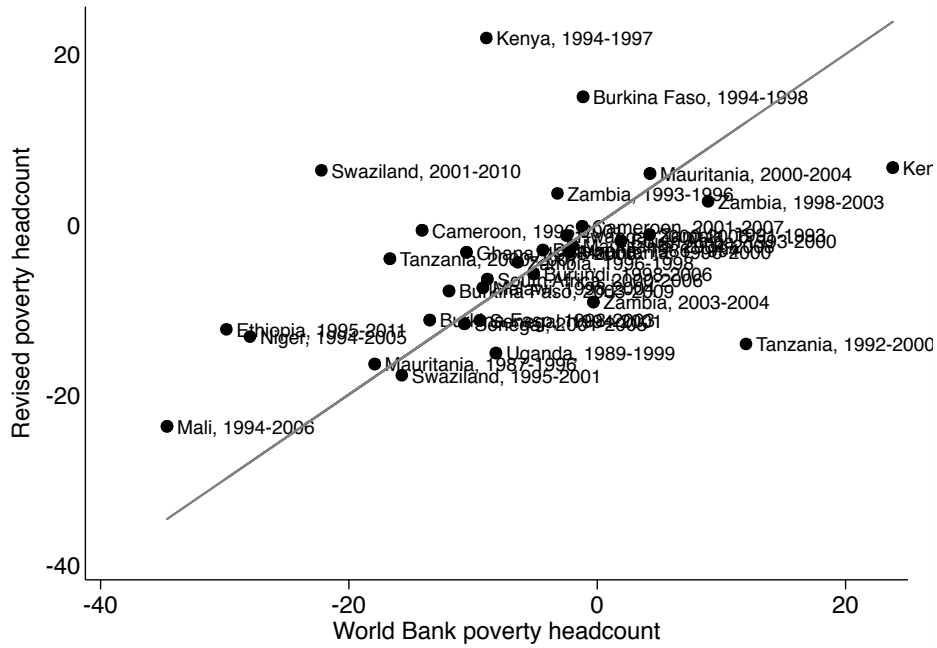


Table 4: Regressing imputed on actual poverty rates

| | Imputed poverty headcount | |
|--------------------------|---------------------------|------------------|
| | (1) | (2) |
| Actual poverty headcount | .83 (.02)*** | 0.96 (.06)*** |
| Constant | | -7.8 (3.8)** |
| Observations | 58 | 58 |

Each column reports a separate, OLS regression. The dependent variable is the imputed poverty rate. Imputations were performed using national accounts data (following the methodology described on the World Bank’s PovcalNet website) for years when actual survey data on poverty also exists. The 58 observations in the sample span 21 countries for which multiple consecutive household surveys and corresponding national accounts data are available. Columns 1 and 2 differ only in the inclusion of a constant term.

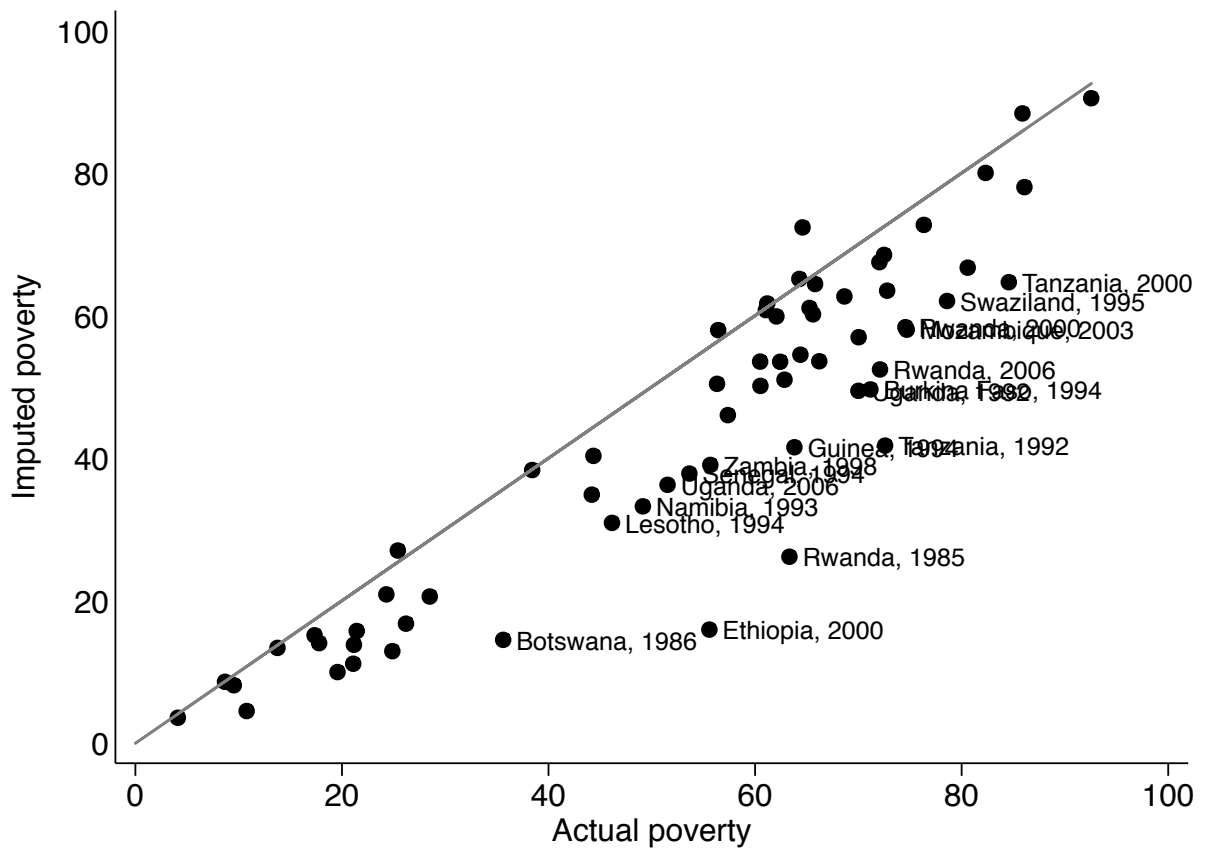
6 Imputation for regional aggregates and “now-casting”

The previous section calculated revised poverty rates for country-years in which household survey data are available. Now consider the problem of estimating poverty rates for country-years without survey data.

Imputation is desirable for two main reasons. The first is to compute regional aggregates. Because household surveys are conducted infrequently and in different years in different countries, without imputation regional averages in any given year would be forced to rely on a small, non-random sub-sample of countries which would change from year to year. Thus a central task in producing regional or global poverty estimates such as those published by the World Bank is to interpolate and extrapolate the poverty series to a common benchmark year for all countries. The second motivation for imputation is policymakers’ high demand for up to date information. In a process akin to “now-casting” (), poverty estimates from the most recent survey round – often several years prior – are combined with more recent macroeconomic aggregates to estimate current poverty rates.

Ravallion (2008) describes the imputation methodology employed in official World Bank statistics. I replicate this approach here, and then explore robustness to alternatives. The World Bank approach involves applying the growth rate of total consumption in the national accounts to the distribution of consumption from the most recent survey. From the description in the text, this appears to imply that poverty headcount rates are imputed

Figure 5: Actual versus imputed poverty rates, using World Bank methodology



as follows for benchmark years after the most recent survey round:³

$$\tilde{P}_{ct} \equiv \frac{1}{N} \sum_i I \left[1.25 \frac{C_{ct}^{NA}}{C_{cs}^{NA}} \frac{PPP_{cs}}{PPP_{ct}} > C_{ict} PPP_{ct} \right]$$

where s indicates the most recent survey round with survey data prior to period t , and C^{NA} denotes consumption measured by national accounts (as opposed to consumption in the household survey data, C_{it}).

This procedure requires two central assumptions: (i) that national accounts and survey measures of consumption move in parallel, and (ii) that economic growth is evenly distributed across the distribution, increasing consumption by an equal proportion at all points. Dollar and Kraay (2002) provide justification for the first assumption, showing that mean income in the bottom quintile grows proportionally with growth in mean incomes overall for a sample of 92 countries. Ravallion (2003) provides justification for the second assumption by showing that growth in consumption from surveys and national accounts are the same, on average, in a sample of developing and transition countries in the 1980s and 1990s, after excluding Eastern and Central Europe.

I propose a more direct test of the imputation procedure, and an alternative set of imputations based on the results. It is possible to test both assumptions jointly by examining – for years with survey data, for which imputation is not necessary – the correspondence between actual changes in poverty and the values this imputation procedure would imply. I regress imputed on actual values calculated using the alternative survey-based deflators:

$$\tilde{P}_{ct} = \alpha + \beta P'_{ct} + \varepsilon_{ct} \tag{1}$$

The null hypothesis that the imputation procedure is a reasonable approximation of reality for years with data is $H_0 : \beta = 1$.

Results from estimating equation (1) are reported in Table 4. The sample consists of 58 poverty headcounts across 21 countries, and is limited by the necessity of having multiple, comparable surveys for the same country over time and the national accounts data from the same period to do the imputation. Column 1 shows that imputed poverty rates are, on average in this sample, 17% lower than actual rates (i.e., when suppressing the constant term). Column two shows that this differential is roughly equal regardless of the poverty rate, with imputed rates roughly 8 percentage points lower than actual rates. In short, the

³For missing values in intermediate years, the imputation combines the preceding and subsequent survey rounds. This prevents imputed changes in poverty for these intermediate years from diverging from actual trends based on years with survey data. As we note below, systematic divergence due to overoptimistic imputation procedures appears to afflict imputations for years after the most recent survey round.

results show that a central assumption in the imputation of poverty rates used in widely-cited regional aggregates is rejected by the data for sub-Saharan Africa. This result implies that imputation leads to perennial over-optimism about poverty reduction until new survey data arrives.

7 Conclusion

Many African countries have made enormous progress on non-monetary indicators of human welfare and development progress in recent decades. Most notably, child mortality rates in several countries (including Senegal, Rwanda, and Kenya) have fallen at rates unprecedented anywhere in the world (Demombynes and Trommlerová 2012). Similarly, average years of schooling in the region have soared, with many former colonies reporting higher levels of schooling in 2010 than did their former colonial rulers at the time of independence (Barro and Lee 2012). But progress in economic development (narrowly defined) and income growth has been more mixed, and – when and where substantial economic growth or poverty reduction has been reported – questions remain about the reliability of the underlying statistics (Devarajan 2013, Henderson, Storeygard, and Weil 2012, Jerven 2010).

This paper confirms these concerns and uncovers the specific weak link in calculations of poverty reduction and growth in Africa: error-ridden purchasing-power parity deflators based on highly politicized consumer price indices. While the potential pitfalls of purchasing power parity indices have received considerable attention in the literature, rather little attention has been paid to the reliability of the underlying CPI inflation series that lie at the heart of growth and poverty calculations using PPP indices. I have attempted to show that especially in Africa – a region with particularly weak capacity in national statistics offices – errors in the CPI series are large enough to force a reconsideration of some of the region’s biggest economic success stories.

While this is mostly bad news for economic policymakers, I also offer some good news for analysts in search of more reliable data. The good news is that if the inflation statistics for African countries are particularly unreliable, the region is also unique in possessing a readily available data source to correct these statistics. Unlike Latin America and much of Asia, poverty rates in Sub-Saharan Africa are generally based on consumption rather than income surveys. Poverty lines based on consumption surveys provide a measure of the cost of living for poor households roughly comparable to a consumer price index. I present a new database of these lines culled from official reports, and demonstrate how they can be used to produce revised estimates of poverty and economic growth for country-years where household survey data exists.

Preliminary results from an incomplete sample show that, on average, official CPI series in sub-Saharan Africa undercount price increases by an average of 1.66% per annum, relative to the revised deflators based on independent survey data. This discrepancy has important implications for, among other things, the pace of absolute poverty reduction. Using the revised deflators for this sample of growth spells from 1985 to 2011, I show that poverty in the region declined on average 1.53 percentage points slower per annum than reported in World Bank databases.

What do these results mean for future measurement of poverty and growth in Africa? The methodologies critiqued in this paper are likely to change soon in any case. Motivated by a separate but related set of concerns, upcoming revisions to the Penn World Tables will effectively circumvent any large, non-transitory errors in national CPI series by anchoring long-term trends in PPP exchange rates to independently collected price data from the International Comparison Project (Feenstra, Inklaar, and Timmer 2013). The results in this paper will remain relevant even after the advent of this new PPP methodology from the Penn World Tables for two reasons. First, PPPs are calibrated to compare total GDP across countries, rather than the household consumption of the poor. Thus the internal price deflators produced by consumption surveys will remain the preferred method for comparing the welfare of the poor over time within countries.⁴

Second, and perhaps more importantly, the World Bank has up to now been reluctant to fully embrace the Penn World Tables methodology for its own real GDP and poverty calculations recorded in the World Development Indicators. Instead, the Bank relies solely on official CPI series to calculate changes in PPP over time, thereby placating member states who would object if real GDP growth in PPP dollars recorded in international databases differed radically from real GDP growth in domestic currency as reported by national statistics offices. The results here make clear that for many African economies, this political compromise introduces large errors into macroeconomic time series.

Finally, Section 6 highlighted an additional possible bias in official poverty estimates that arises when imputing data to create regional aggregates in a common benchmark year. Imputation methods such as those used by the World Bank which rely on an assumption of equiproportional growth lead to over-optimistic estimates of recent poverty reduction. In future, I hope to outline imputation methods that relax this assumption and avoid this bias.

⁴Note however that poverty lines based on internal deflators cease to become internationally comparable over time. The new PWT methodology proposed by Feenstra, Inklaar, and Timmer (2013) overcomes this problem for real GDP calculations. In theory, it should be possible to devise a hybrid index combining the advantages of survey deflators designed for poverty calculations with the cross-country comparability offered by the revised PWT methodology. This is left for future work.

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Appendix

Table 5: Growth & poverty spells with available household survey data

| Country | Period | Nominal Consump. Growth | | Change in Pov. Headcount | | Inflation | |
|---------|-----------|-------------------------|--------|--------------------------|----------|-----------|--------|
| | | Nat'l Acct | Survey | \$/day | National | CPI | Survey |
| | 1992-1998 | 60.2 | 125.2 | 2.2 | | 180.2 | |
| BDI | 1998-2006 | 184.6 | 85.9 | -5.1 | | 93.1 | |
| BEN | 1995-2000 | 39.5 | | | | 20.0 | 22.2 |
| BEN | 2000-2002 | 17.0 | | | | 6.6 | 45.7 |
| BFA | 1995-1998 | 39.3 | | | | 14.1 | 76.9 |
| BFA | 1998-2003 | 38.6 | 7.5 | -13.5 | | 8.0 | 13.7 |
| BFA | 2003-2009 | | 26.3 | -11.9 | -2.5 | 22.9 | |
| BWA | 1986-1993 | 212.5 | | | -26.1 | 119.5 | |
| BWA | 1994-2003 | 191.0 | | | | 107.5 | 37.6 |
| BWA | 2003-2010 | 179.6 | | | | 80.7 | 53.7 |
| CAF | 1992-2003 | 44.9 | 116.0 | -20.7 | | 67.8 | |
| CAF | 2003-2008 | 30.2 | 24.3 | 0.4 | | 18.6 | |
| CIV | 1985-1986 | 5.6 | -2.0 | -5.4 | | 9.7 | |
| CIV | 1986-1987 | -1.9 | 1.2 | 4.6 | | 6.9 | |
| CIV | 1987-1988 | -2.6 | -18.2 | 5.1 | | 6.9 | |
| CIV | 1988-1993 | -8.8 | -22.1 | 4.0 | | 8.5 | |
| CIV | 1993-1995 | 54.3 | 27.3 | 3.3 | | 44.1 | 42.9 |
| CIV | 1995-1998 | 25.0 | 14.1 | 3.0 | | 11.6 | 12.4 |
| CIV | 1998-2002 | -0.8 | 14.8 | -0.7 | 3.8 | 11.0 | |
| CIV | 2002-2008 | 18.8 | -12.5 | 0.4 | 2.5 | 20.9 | |
| CMR | 1983-1993 | 19.1 | | | | 44.2 | 32.1 |
| CMR | 1993-1996 | 23.1 | | | | 53.1 | 43.7 |
| CMR | 1996-2001 | 26.0 | 40.6 | -14.1 | -13.1 | 16.4 | 57.1 |
| CMR | 2001-2007 | 25.0 | -0.7 | -1.2 | -0.3 | 12.2 | 15.9 |
| COG | 2005-2011 | 120.0 | | | -3.6 | 31.5 | |
| ETH | 1982-1995 | 95.1 | | -5.7 | | 151.9 | |
| ETH | 1995-1999 | 5.9 | -7.3 | | -1.3 | 7.6 | |
| GHA | 1987-1988 | 36.2 | 31.1 | | | 31.4 | |
| GHA | 1988-1989 | 30.7 | | -1.2 | | 25.2 | |
| GHA | 1992-1998 | 384.5 | | -12.0 | -12.2 | 434.6 | |

Table 5: (continued)

| Country | Period | <u>Nominal Consump. Growth</u> | | <u>Change in Pov. Headcount</u> | | <u>Inflation</u> | |
|---------|-----------|--------------------------------|--------|---------------------------------|----------|------------------|--------|
| | | Nat'l Acct | Survey | \$/day | National | CPI | Survey |
| GHA | 1998-2005 | 384.3 | 277.0 | | | 252.7 | |
| GIN | 1991-1994 | 33.4 | | -28.7 | | | |
| GIN | 1994-2003 | 60.5 | | -7.5 | | | |
| GIN | 2003-2007 | 195.3 | | -13.0 | | | |
| GMB | 1998-2003 | 32.6 | 139.8 | -32.0 | | 39.0 | |
| GNB | 1991-1993 | 142.9 | 62.7 | 10.8 | | 151.2 | |
| GNB | 1994-2002 | 188.8 | | | -13.4 | 300.7 | |
| GNB | 2002-2012 | | | | 6.1 | | |
| KEN | 1982-1992 | 179.8 | | | | 255.8 | 823.4 |
| KEN | 1992-1994 | 32.1 | 48.8 | -9.9 | | 88.0 | -50.4 |
| KEN | 1994-1997 | 118.8 | 42.8 | -8.9 | | 23.1 | 155.5 |
| KEN | 1997-2005 | 45.9 | -0.0 | 23.8 | | 80.9 | |
| LSO | 1987-1993 | 99.9 | | 12.1 | | 122.8 | |
| LSO | 1993-1994 | 3.3 | 66.5 | -10.3 | | 8.2 | |
| LSO | 1994-2002 | 116.1 | -18.0 | | | 35.3 | |
| MDG | 1980-1993 | 430.8 | 497.8 | -13.4 | | 594.2 | |
| MDG | 1993-1997 | 140.1 | 115.4 | -0.4 | 3.3 | 159.2 | |
| MDG | 1997-1999 | 18.9 | -11.7 | 10.3 | -2.0 | 16.8 | |
| MDG | 1999-2001 | 6.0 | 35.3 | -6.0 | -1.7 | 19.6 | |
| MDG | 2001-2002 | 8.7 | | | 11.1 | 15.9 | |
| MDG | 2002-2004 | 28.3 | | | -8.6 | 12.4 | |
| MDG | 2004-2005 | 22.5 | | | -3.4 | 18.5 | |
| MDG | 2005-2010 | | -11.1 | 13.5 | | 58.9 | |
| MLI | 1987-1994 | 44.8 | | | | | 7.2 |
| MLI | 1994-1996 | 32.0 | | | | 21.2 | 33.4 |
| MLI | 1996-1998 | 1.8 | | | | 3.7 | 0.2 |
| MLI | 2006-2010 | | -0.0 | -1.0 | -3.8 | 14.4 | |
| MOZ | 1996-2002 | 116.5 | 71.1 | | | 60.9 | |
| MRT | 1993-1995 | 3.2 | 16.7 | | | 10.9 | |
| MRT | 1996-2000 | 24.7 | | -2.2 | | 21.5 | 24.3 |
| MRT | 2000-2004 | 43.2 | 4.8 | 4.3 | 0.4 | 26.3 | 30.4 |
| MRT | 2004-2008 | 51.3 | 26.2 | -2.0 | -4.7 | 37.2 | 36.3 |

Table 5: (continued)

| Country | Period | Nominal Consump. Growth | | Change in Pov. Headcount | | Inflation | |
|---------|-----------|-------------------------|--------|--------------------------|----------|-----------|--------|
| | | Nat'l Acct | Survey | \$/day | National | CPI | Survey |
| MWI | 1998-2004 | 407.0 | | -9.2 | -12.9 | 222.6 | |
| MWI | 2004-2010 | 94.3 | | | -1.7 | 79.8 | |
| NER | 1992-1994 | 43.3 | 12.2 | 5.4 | | 34.4 | |
| NER | 1994-2005 | 33.2 | 95.4 | -28.0 | | 42.9 | 39.7 |
| NER | 2005-2007 | | -9.1 | | | 0.1 | |
| NGA | 1986-1992 | | | 8.0 | | 353.9 | |
| NGA | 1992-1996 | | 383.5 | 6.6 | | 451.4 | |
| NGA | 1996-2003 | | 82.8 | | | 108.3 | |
| RWA | 1985-2000 | 239.5 | | 11.2 | | 323.6 | |
| RWA | 2000-2005 | 74.2 | 33.7 | | | 38.6 | |
| SEN | 1991-1994 | 27.6 | 34.6 | -12.2 | | 31.4 | |
| SEN | 1994-2001 | 32.4 | 16.9 | -9.5 | | 19.4 | |
| SEN | 2001-2005 | 11.9 | 8.2 | -10.7 | -6.9 | 4.5 | |
| SEN | 2005-2011 | 34.3 | | | -1.6 | 18.4 | |
| SLE | 1990-2003 | 795.3 | | -9.4 | | | |
| TGO | 2006-2011 | 32.8 | | | -3.0 | 18.0 | |
| TZA | 1992-2000 | 350.5 | | 12.0 | | 287.5 | |
| TZA | 2000-2007 | 84.9 | 76.9 | -16.7 | | 47.3 | 93.0 |
| UGA | 1989-1992 | 172.4 | 102.9 | 1.4 | | 123.0 | |
| UGA | 1992-1996 | 68.2 | 18.3 | -5.6 | -12.0 | 25.9 | |
| UGA | 1996-1999 | 24.0 | 21.8 | -3.9 | -10.6 | 14.5 | |
| UGA | 1999-2002 | 18.9 | 8.6 | -3.1 | 5.0 | 5.0 | |
| UGA | 2002-2005 | 27.7 | 18.2 | | -7.7 | 22.2 | |
| UGA | 2006-2009 | 45.3 | | -13.5 | | 34.4 | |
| ZAF | 1993-1995 | 24.7 | 2.9 | -2.9 | | 18.4 | |
| ZAF | 1995-2000 | 50.5 | 18.7 | 4.8 | 7.0 | 38.1 | |
| ZAF | 2000-2005 | 59.0 | 92.4 | | | 28.1 | |
| ZMB | 1991-1993 | 725.4 | 541.2 | 4.2 | | 652.8 | |
| ZMB | 1993-1996 | 175.1 | 201.1 | -3.2 | | 198.5 | |
| ZMB | 1996-1998 | 42.6 | 79.5 | -6.4 | | 54.8 | |
| ZMB | 1998-2002 | 157.8 | 59.0 | | | 137.1 | |
| ZMB | 2003-2004 | 0.9 | | -0.3 | | 18.0 | |

Table 5: (continued)

| Country | Period | <u>Nominal Consump. Growth</u> | | <u>Change in Pov. Headcount</u> | | <u>Inflation</u> | |
|---------|-----------|--------------------------------|--------|---------------------------------|----------|------------------|--------|
| | | Nat'l Acct | Survey | \$/day | National | CPI | Survey |
| ZMB | 2004-2006 | 19.7 | 18.9 | 4.2 | | 29.0 | |
| Obs. | 2004-2006 | 88.0 | 60.0 | 63.0 | 30.0 | 90.0 | 23.0 |