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Prices for Poverty Analysis in Africa

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Abstract

Measuring poverty requires adjusting nominal consumption (or income) into a real value of consumption, across geographic areas and over time. To this end, data on consumer prices are used to construct a price index. There are a range of approaches to do this, from using the consumer price index, to survey-based unit values, which differ in the underlying sources of price data and methodologies for indexing. These different approaches can have large impacts on poverty measures and trends. Surprisingly little attention has been focused on this topic. This study reviews a range of issues and the evidence on how prices matter for measuring poverty, particularly in Africa. It draws on a wide literature, much from developed countries, and offers suggestions for future work in this area.

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Prices for Poverty Analysis in Africa

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1. Introduction

Prices matter for the estimation of poverty levels and trends in Africa (and elsewhere).[1] The importance of prices is well illustrated using an example from Tanzania. Between 2001 and 2007, Tanzania's national poverty rate only showed a modest (and statistically insignificant) decline from 36 to 34 percent. To estimate this trend, the 2001 poverty line (expressed in 2001 prices) was updated to 2007 prices using a price index, which was computed directly from national household budget survey (HBS) data.[2] Had Tanzania used the national consumer price index (CPI) to update the 2001 poverty line to 2007 prices, a common practice in neighboring Uganda, its poverty rate would have shown a much larger decline, from 36 percent in 2001 to 18 percent in 2007.[3] Given that both the survey-internal price index and the CPI appear from the outset as reasonable choices, this example demonstrates that poverty trends can be sensitive to (often discretionary) decisions about price adjustments of nominal consumption measures or poverty lines.

Price data are used at different stages in the process of poverty analysis. For any given survey, measuring poverty typically requires price data for three broad purposes (see Gibson 2007 for a comprehensive overview). First, some components of consumption, specifically own-produced food items, will draw on price data to assign a monetary value to quantities consumed (if households only report quantities) or to vet respondent-reported values (if households were required to provide an estimated value of own-produced consumption). Second, price data are used to adjust nominal consumption for intra-survey price differences, whether spatial (for example, to adjust for differences in the cost of living across geographical areas) or temporal (for example, if the survey was conducted over the course of several months). Third, price data are required to construct cost-of-basic-needs (CBN) poverty lines (Ravallion 1998, 2008), which represent the most commonly used method for setting national poverty lines in Africa.

In a dynamic context, prices are also required to estimate trends in poverty. Absolute poverty lines (which include most poverty lines in Africa, for example, those based on the CBN method) seek to remain "fixed in terms of the standards indicator being used, and fixed over the entire domain of the poverty comparison" (Ravallion 1992, 25). In other words, poverty lines are designed to represent a fixed real standard of living, adjusted over time only for changes in nominal prices. As the above case of Tanzania illustrates, different assumptions about inflationary trends can have a significant impact on estimated poverty trends, especially in countries where a large share of the population is clustered around the poverty line (which is typical in low-income countries in Africa).

The complexities of inflation adjustment relate to two main underlying challenges. The first is the measurement of prices. One of the main difficulties is that prices should be measured for precisely defined goods and services. However, this can be difficult even in the context of specialized price collection programs in countries such as the United States, because product specifications may change over time. In such cases, price changes may be intimately linked with quality changes and difficult to separate. In developing countries, additional practical and logistical challenges related to the collection of price data, particularly in rural areas, often make matters worse.

The second challenge is the aggregation of item-level price quotations into a single index. Even if prices are well-defined and accurately measured, there remain significant conceptual and empirical difficulties in

[1] Throughout this paper, Africa refers to Sub-Saharan Africa.

[2] HBS is used in this study to reference national household surveys which collect consumption data, this includes a range of surveys that go by different labels, such as Living Standards Survey, Income Expenditure Consumption Survey, and others. Price index refers to a weighted average of the prices of items relative to their prices in a base-year. It is also sometimes called a price deflator.

[3] Discrepancies between alternative measures of inflation in Tanzania are discussed by Atkinson and Lugo (2010), Sandefur (2013) and Arndt et al. (2015), among others. Poverty estimates are cited in Wane and Morisset (2011).

collapsing relative changes in prices and quantities of different items into a price index. From a theoretical viewpoint, index number theory provides different possible solutions to the underlying aggregation problem, which can ultimately lead to different estimates of inflation. This is compounded by empirical challenges, such as outdated information on quantities/weights because of infrequent HBSs.

This paper reviews the academic literature and similar analytic work about prices for poverty measurement in Africa with a focus on temporal price adjustment to measure trends in poverty.[4] While this paper is concerned with poverty measurement in Africa, much of the reviewed literature comes from other parts of the world. In the United States and other high-income countries, the measurement of consumer price changes has received significant academic (and even popular) attention, partly because social security payments, wages, rental payments and pensions are often indexed to the CPI. It often remains unclear to what extent the insights from developed countries can be generalized to economies in Africa. For this reason, the results are put into context and there is a discussion about how the situation may differ in Africa. But, clearly, significant research gaps remain.

The remainder of the paper is structured as follows. Section 2 reviews sources of price data available for poverty analysis in Africa, while section 3 describes commonly used price indexes and related approaches to price-adjust poverty lines over time. Section 4 concludes with a set of recommendations for research and policy.

2. Sources of Price Data

2.1 Price collection for the consumer price index

Most national statistical offices (NSOs) regularly collect consumer price data for the purpose of computing the monthly CPI. In the United States, the Bureau of Labor Statistics (BLS) collects prices from 27,000 retail outlets and 7,500 housing units; combined, this amounts to 107,500 attempted price quotations. Statistics South Africa attempts to collect 65,000 price quotations from 27,000 outlets. While the scope of price collection exercises is somewhat smaller in other parts of Africa, these exercises are an important source of price data in virtually all countries in the region, with between 1,150 (São Tomé and Príncipe) and 51,170 (Ethiopia) attempted regular price quotations (figure 1).

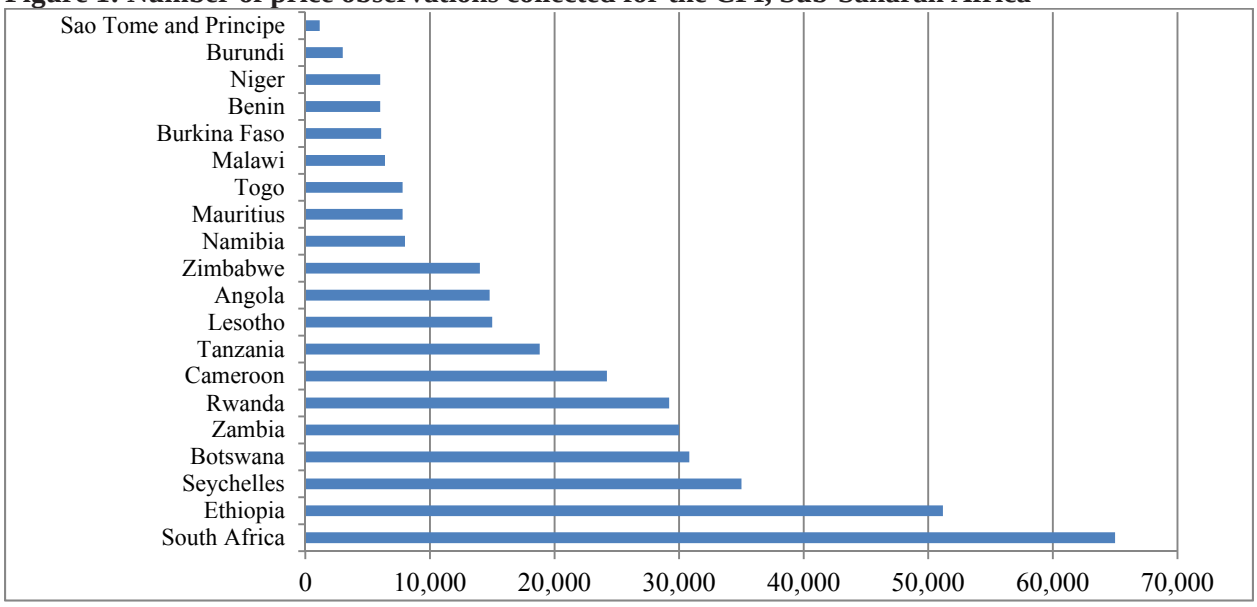
The main advantage of the consumer price data collection is its frequency: most prices are collected monthly or quarterly.[5] In these efforts there is usually a precise specification of the type of product for which enumerators are instructed to collect price data, which minimizes the potentially confounding influence of quality variations.[6] Nonetheless, quality differences may still play a role, especially for items such as consumer durables, where product specifications are changing regularly.

[4] Comparisons of price levels across countries (that is, purchasing power parity [PPP] comparisons), which are used to convert local currency units into a common currency and compute international poverty estimates based on an international poverty line (now $1,90-a-day) are not the focus of this study. There is also a related literature about the economic and welfare consequences of price changes that are partly determined by the extent to which households are able to respond to price signals in their roles as consumer and producers. These broader economic effects and, particularly, second-round behavioral responses are also not discussed in this paper.

[5] Selected prices may be collected in less frequent intervals. Statistics South Africa, for instance, collects prices for most commodities monthly or quarterly, whereas prices for services are collected quarterly or annually (ILO 2013).

[6] An alternative data collection strategy is described in ILO et al. (2010) as the characteristics approach. The idea is to collect prices, along with detailed product characteristics, rather than pricing narrowly defined, specific items. However, so far, this approach has been rarely practiced in consumer price data collection.

Figure 1: Number of price observations collected for the CPI, Sub-Saharan Africa



Source: ILO 2013.
Note: The figure only shows African countries that reported on the number of price observations.

In many countries, CPI data collection allows for spatial variations in product characteristics, even when there is consistency over time. In the United States, for instance, the commodities for which price data are collected are specific to the local area and not identically defined across regions, and the BLS (2011) cautions that "area CPIs cannot be used to compare levels of living costs or prices across areas" (see also Kokoski 1991; Boskin et al. 1998). Similarly, the statistical offices in China and Vietnam also collect prices for different product brands (with similar specifications) in different parts of the country so that consumer prices may not be comparable across regions (see Brandt and Holz 2006; Gibson 2009). The same approach, though not explicitly documented, might be practiced by statistical agencies in Africa. Generally speaking, spatial (interarea) price comparisons pose different demands on the data collection and sampling methodology than temporal price comparisons.[7] This holds especially for large countries, where regional consumption baskets overlap only partially and where product characteristics may be highly variable across regions. The methodological and sampling approach of the CPI data collection, which is designed for a temporal price index, does not necessarily meet the requirements for a spatial price index, though some authors have proposed econometric techniques to recover interarea price indexes from CPI price data (for instance, Aten 2006, 2008 for the United States).

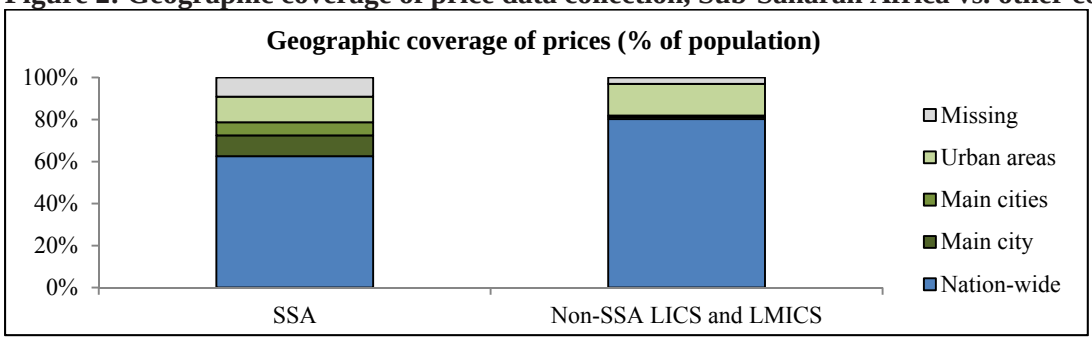
A problematic feature of the consumer price data collection for the purpose of measuring poverty is that price data are collected often only from urban areas. Even in the United States, price data collection for the CPI covers urban areas only, though this appears acceptable, given that above 80 percent of the U.S. population lives in urban areas and markets are fairly integrated. Although Africa is urbanizing heavily, its population remains predominantly rural: In the majority of countries, 65–70 percent of the population resides in rural areas (World Bank 2015b).

This urban bias in consumer price data collection appears larger in Africa than in other regions, even when the comparison is restricted to countries with similar income levels. According to CPI metadata published by the International Labour Organization (ILO 2013), 28 percent of the African population lives in countries

[7] In addition, spatial price comparisons and temporal price comparisons require different analytical techniques for the aggregation of price relatives. Spatial comparisons lack a chronological ordering of price observations, thus requiring the use of multilateral comparison and aggregation approaches (ILO et al. 2010).

where the consumer price data are collected only in urban areas or main cities. This share is lower in non-African low-income countries (LICs) and lower-middle-income countries (LMICs), at 17 percent (figure 2). Even in countries where the consumer price data collection has reportedly nationwide coverage, considerable doubts remain if rural areas are really included. Kenya, for instance, is listed as having nationwide coverage in the ILO database, but reports in its CPI publication that (outside of Nairobi) urban centers were selected to represent each province (KNBS 2010).[8] Hence, the extent of urban bias may be larger than what is suggested by figure 2.

Figure 2: Geographic coverage of price data collection, Sub-Saharan Africa vs. other countries



Source: ILO 2013.
Note: Weighted using population in 2013. Excludes countries with other coverage.

A number of factors can explain this urban bias in price data collection in Africa, such as logistical difficulties and large unit cost associated with collecting regular price data in remote and sparsely populated rural areas, where markets may assemble irregularly and only at specific hours of the day (Gibson and Rozelle 2005). Moreover, NSOs generally try to revisit the same outlets in each collection cycle, which poses difficulties for including mobile vendors, such as rural and urban street hawkers, in the sample. Looking ahead, new technologies have a significant potential to reduce unit cost of rural price data collection and increase geographic coverage. For example, a recent pilot study (which, in Africa, included Kenya and Nigeria) documents the feasibility of crowd-sourced price data collection through mobile phones (Hamadeh, Rissanen, and Yamanaka 2013). But this also raises new questions, such as how to validate price quotations provided by untrained enumerators to ensure the integrity of the data.

Does it matter that many CPIs in Africa are urban-biased? There is empirical evidence that food prices can differ between urban and rural areas. The high cost of transport and limited market integration may undermine spatial arbitrage and can lead to urban-rural differences in price levels and trends (see appendix table A1). Rural prices are expected to be lower for unprocessed raw food stuffs (which are typically transported from rural to urban areas), while they may be higher for processed packaged goods (transported in the reverse direction). This pattern is documented for Nigeria by Nakamura et al. (2016). Deaton and Dupriez (2011a) show that, in India, quality-corrected urban food prices are about 10 percent higher than rural food prices, largely driven by the lower implicit prices of own-produced consumption items, though, in Brazil, the urban-rural food price gap is much smaller (around 3 percent).[9] Evidence of higher urban than rural food prices is also presented by Majumder, Ray, and Sinha (2012) for India. Conversely, analysis in

[8] For the logistical reasons discussed in the next paragraph, NSOs in most countries sample geographically convenient outlets. In Vietnam, for instance, provincial statistical offices collect prices from the largest towns in rural districts for the rural CPI. As discussed in Gibson (2009), these prices may be more reflective of urban than of genuine rural prices.
[9] Their method, however, is not based on price quotations, but on unit values estimated from household surveys, which (as discussed below) may be contaminated by quality effects. The estimated rural-urban price differentials reported here (and in appendix table A1) are purged of quality effects (at least partially) by means of a regression that controls for household per capita expenditure.

Gibson (2009) for Vietnam suggests that towns (in rural districts) have lower food prices than average rural communities.

Urban-rural price gaps may be even larger for non-food items, particularly non-traded goods, but empirical evidence for developing countries is scant. As discussed in Li and Gibson (2014), increasing market integration is expected to reduce the spatial variation of traded goods. Hence, as countries develop, regional price differences should increasingly reflect price differences for nontradables, particularly housing/real estate and services.

From the perspective of gauging the effect of urban bias in consumer price data collection on measured rates of inflation, differential rates of urban and rural price changes (at the item level) are the relevant criterion, rather than urban-rural price (level) differences per se. Some authors have documented differences in inflation between rural and urban areas based on urban and rural price indexes (for example, Brandt and Holz 2006 using urban and rural CPI series for China). However, this potentially reflects differences in the underlying commodity basket, rather than different price trends for the same items. Under certain assumptions, economic theory predicts that urban prices increase more quickly than rural prices. According to the Balassa-Samuelson theorem and related theoretical models, increases in labor productivity in the tradable sector trigger wage increases in the nontradable sector (Balassa 1964; Samuelson 1964; Baumol and Bowen 1966). Hence, if labor productivity grows more rapidly in (urban) manufacturing than in (rural) agriculture and is not fully equilibrated by urban-rural migration, service prices should increase more quickly in urban than in rural areas (see also Li and Gibson 2014; Gibson 2015). Yet, robust empirical evidence for these within-country patterns is difficult to come by, especially for countries in Africa.

Finally, most African countries use nonprobability sampling techniques to sample localities, outlets, and products for the collection of consumer prices. While judgmental sampling is reportedly practiced also by several NSOs in high-income countries (see ILO 2013 for details), nonprobability sampling raises questions about the representativeness of the collected price data, especially if combined with limited geographic coverage, and it would be useful if NSOs could provide further information on how outlet samples are chosen. Moreover, HBSs should collect basic information about the types of shops and outlets that households purchase from (e.g. as part of the expenditure section), as this would allow for a more informed judgement of the representativeness of the CPI outlet sample.

2.2 Unit values from HBSs

Many HBSs ask respondents to report expenditure values in local currency and quantities of purchased food items. Unit values can be computed as the ratio of expenditure to quantity. Unit values are often regarded as a proxy for the prices paid by the households (Deaton 1988, 1998). One of the main advantages of the unit values in household surveys is the sample size. A household survey with a sample size of 10,000 households that collects expenditure data through a recall module could have (in theory) up to 10,000 unit values for frequent staples, though, in reality, this number will be smaller because not all households would purchase a particular item during a specific reference period. The number of unit values is even greater in diary surveys, where households record all purchasing transactions over a reference period (often several weeks).[10] The Tanzania HBS 2011/12, for instance, uses a four-week diary to collect consumption data and yields approximately 90,000 unit values for white maize flour and above 100,000 for tomatoes and onions

[10] The unit values estimated from diary surveys differ from the unit values estimated from recall surveys. Since diaries record expenditures and quantities at the transaction level, these unit values resemble an unmoderated price quotation obtained from an untrained respondent. Even though diary respondents sometimes record expenditures and quantities by brand, this information gets lost when the entries are coded to a standardized product list (such as the Classification of Individual Consumption According to Purpose [COICOP]), so that the analyst faces problems that are similar to those faced in using unit values from recall surveys. However, because transaction diaries often use finer levels of item disaggregation than recall surveys, quality contamination may be less severe.

each. Moreover, to the extent that the household survey is nationally representative, these unit values cover the entire country and are available for the different strata of the survey. This makes them potentially useful for intra-survey (spatial or seasonal) price adjustment, in addition to inflation adjustment across surveys.

However, unit values may not reliably measure prices because of quality variations in the underlying products. Unlike specialized price surveys where enumerators are instructed to collect prices for well-defined products, unit values are computed at the level of aggregation at which the survey collects expenditures. For instance, a survey that collects expenditures on rice through a recall module implicitly averages over a number of different subproducts. This is because households purchase a variety of different grades and varieties of rice, but report all expenditures and quantities under the item heading rice. The unit value computed for rice will, hence, be a weighted average over prices of different grades and varieties of rice, where the weights are the (nonobserved) quantities of the different subproducts. The magnitude of potential quality contamination depends on the level of aggregation at which the household survey collects expenditure data. While some household surveys use detailed recall modules (for example, the 2005/06 Kenya Integrated HBS with more than 150 food items in the recall module), others use a much smaller and therefore more aggregated list of items (for example, the 2010/11 Tanzania National Panel Survey with slightly over 70 food items or the 2006 Zambia Living Conditions Monitoring Survey with less than 40 different food items).

Trends in unit values may provide a biased picture of inflation if the underlying quality mix changes over time. Theory does not provide clear guidance on the direction of the bias. The key difficulty for comparisons of unit values over time or space is not the use of an average price, but rather the fact that the relative weights (that is, the consumed quantities) of the different subproducts are unknown and changing so that quality variations may be mistakenly interpreted as price variations (for a discussion, see Olivia and Gibson 2005; Gibson and Kim 2013). Changes in the quality mix can arise because of income effects, price effects, and so on (see also Deaton 1997). It is well documented that consumers substitute *across* products with rising income. Ravallion and Bidani (1994), for instance, show that urban households in Indonesia consume fewer staples than rural households (for example, more meat and vegetables than starches) and also more expensive variants of staple foods (for example, more rice than cassava). Similar substitution effects may arise at the elementary level *within* the same product group in the form of substitution from lower-quality to higher-quality grades of the same product. These income effects alone suggest that unit values *overestimate* true price changes in growing economies. However, quality substitution can also be a direct response to a price change. If households, for example, switch to lower-quality varieties of meat in response to an increase in the price of meat, unit values *underestimate* true price changes (as argued by McKelvey 2011 for Indonesia). These substitution effects can be important because different varieties of the same broad product are likely to be close substitutes. Which effects prevail in a specific setting is an empirical question.

Measurement errors can further contaminate unit values, especially if quantities are recorded in nonstandardized units. Because unit values are computed as the ratio of expenditure to quantity, measurement errors in either of these two variables or in the unit in which the quantity is recorded lead to measurement errors in the resulting unit values. As discussed by Gibson (2007), the accuracy of quantity measurements in household surveys depends partly on the characteristics of the food product (for example, grains are easier to measure than root crops) and the validity of conversions from nonstandardized, traditional units (for example, heaps, bunches, plates, other traditional measurement units) into standardized units (for example, kilograms). The quality of the fieldwork, survey supervision, and data entry also plays a key role. Gibson and Rozelle (2005) argue that measurement error problems associated with unit values are even more severe than problems arising from quality contamination.

Unit values also cannot be suitably defined for most nonfood items. Physical quantities are difficult to define for nonfood items and usually not recorded in HBSs. Also, quality variations tend to be large.

Exceptions are a few fairly homogenous and easily measurable nonfood items, such as fuel.[11] Unit values will hence increasingly lose relevance in growing economies, where consumption patterns shift from food to nonfood; arguably, this presents the most serious limitation to the use of unit values in the long run.

Finally, selection issues can also play a role because unit values are often available only for a subset of households reporting purchases during the reference period. Because unit values are typically computed based on households that report actual purchases, they may be more reflective of the prices paid by more well-off households, which are less likely to consume own-produced food and more likely to consume a wider selection of different food items.[12]

The above points render unit values a noisy and potentially biased proxy of prices, though the empirical evidence is not conclusive. Gibson and Rozelle (2005) argue that unit values are not only significantly more noisy than price data collected from local markets (which they consider as the benchmark), but even systematically overstate market prices.[13] Deaton (1997), on the other hand, views unit values more favorably and maintains that they are useful as an indicator of seasonal and spatial price variations. Some have argued that unit values tend to perform less well in African countries than elsewhere. According to Deaton and Grosh (2000), most of the successful experiences in the measurement of quantities and the use of unit values are in Asia (and, in some cases, Latin America), whereas surveys in Africa often encounter more serious difficulties. This may be attributable to the widespread use of nonstandardized units and the prevalence of subsistence agriculture in the region.

2.3 Market price questionnaires in household surveys

HBSs occasionally collect price data from local markets as an auxiliary questionnaire. This has traditionally been the case in most Living Standard Measurement Study (LSMS) surveys (Scott 2008). The usefulness of these market price data for poverty measurement has been hampered by practical difficulties. Many studies have reported quality problems with price data collected through market surveys (Glewwe 1991), often linked to the logistical difficulties of rural price data collection described in section 2.1. Survey enumeration areas also do not always correspond to actual villages with a common market center (Gibson and Rozelle 2005). Furthermore, because price data can only be collected for items that are available at local markets, missing values are a common problem. Finally, the process of price data collection via enumerators may not reflect purchases by local residents because the latter are characterized by repeated interlinked transactions, opportunities for bargaining, and so on (Deaton and Grosh 2000; Muller 2008).

There is no agreed position whether market price data are preferable over unit values from the HBS. Gibson (2007) and Gibson and Rozelle (2005) argue that unit values are substantially biased and consider price data collected through a market survey more reliable. Deaton and Grosh (2000) argue that the literature provides little guidance on whether unit values or market prices are preferable for food items (in cases

[11] The pitfalls of mechanically computing unit values for nonfood items can be illustrated using the example of the 2005/06 Kenya Integrated HBS, which, among other items, collected data on cell phone air time expenditures. Dividing expenditures by quantity (number/pieces) gives unit values between K Sh 100 and K Sh 1,000 per piece. Of course, these vastly different unit values do not reflect price differences, but different values of top-up cards.

[12] Some authors (for example, Gibson and Rozelle 2005) compute unit values from purchases only. However, Deaton and Dupriez (2011a, 10) compute unit values over both purchases and own-produced consumption and argue that "the prices of subsidized and own-produced foods should be included in the price indexes." The latter is only possible if households provide an estimated value for the consumption of own-produced food; otherwise, unit values are missing for this part of consumption.

[13] The greater dispersion of unit values relative to market prices could also reflect quantity discounts (bulk purchases) or fire sales, two sources of price variation that would not necessarily be captured by market price surveys. In addition, whether unit values systematically over- or understate market prices should depend, at least in part, on the exact specification of the item priced in the market survey (for example, whether enumerators were instructed to price a high-grade or low-grade variety).

where both are available), though they acknowledge that the prices of nonfood items have to be collected through a community market survey. Muller (2008) finds that market prices and unit values in Rwanda do not differ systematically for elementary-level food items. In some cases, market price data are collected, but are not properly entered electronically, which reflects the lack of attention often paid to this part of the survey compared with the main household questionnaire (Deaton and Grosh 2000).

Based on a desktop review of several recent national poverty assessments published by NSOs and related academic studies for Africa, only one study (for Malawi) used market price data for between-survey price adjustments on nonfood items (a food price index was estimated based on the unit values of the expenditure section). All other studies used survey unit values and CPI price data, including both the (disaggregated) consumer price data and the (composite) CPI (see appendix table A2).

2.4 Price opinion questionnaires in household surveys

Some surveys have experimented with price opinions from knowledgeable household members or other key informants. This idea was originally put forth in the early stages of LSMS design, where it was suggested to experiment with creative forms of price data collection and to "interview a group of housewives and ask them about 'normal' prices" (Saunders and Grootaert 1980, 31). Even though the idea was ultimately never pursued in the LSMS, other surveys put variants of the approach into practice. For instance, the Indonesia Family Life Surveys ask key informants in the community about the prices of various food and nonfood items at local markets (Gibson 2007). Experimental surveys in Papua New Guinea and Tanzania have also collected price opinions from, respectively, household respondents and community informants.[14]

There is suggestive evidence that opinion surveys can deliver useful information about prices, but further research would be necessary to recommend this method more broadly. Gibson and Rozelle (2005) argue that, in the case of purchases in Papua New Guinea, price opinions show significantly less dispersion than unit values and are also closer to (benchmark) prices in market questionnaires. While these results are promising, more experimental work would be needed to judge whether the approach works in different contexts and could be scaled up in the context of HBSs. At this stage, price opinion surveys have little practical relevance for poverty measurement in Africa.

2.5 Other special-purpose price collections

There are several other price collection exercises in African countries, but with limited relevance for the analysis of poverty trends. This is because most specialized price collections (at least, the ones reviewed here) do not have the scale or regularity to be useful for the systematic analysis of poverty trends in the region. However, they may yield useful complementary information in specific contexts.

The International Price Comparison (ICP) Program collects price data for the computation of international PPP exchange rates. In the 2011 round, 45 countries in Africa participated. PPP conversion factors are used to convert local currency units of the HBS into the currency of the international poverty line (US dollars) (Ravallion, Chen, and Sangraula 2009). However, they are not suitable for measuring national-level price changes over time. The various ICP rounds to date have used different definitions and methods to collect price data (often improving upon the experiences of previous rounds) and are therefore not comparable with each other (for a discussion, see Deaton 2010; Deaton and Heston 2010; Deaton and Aten 2014). The periodicity of ICP rounds—the latest three were conducted in 2011, 2005, and 1993—is also too irregular for the purpose of inflation adjustment over time in HBSs.

[14] For Papua New Guinea, see Gibson and Rozelle (2005). For Tanzania, see "Shwalita" under "Publications" on the website of the EDI Group, High Wycombe, Buckinghamshire, United Kingdom, http://edi-global.com/publications/.

Price data collected for the ICP could yield useful complementary information on price differences within countries. In some countries, the ICP collects urban and rural prices, and these data (if accessible) could be usefully exploited to assess price differences between urban and rural areas.

A second area of special purpose price collection are the prices of staple foods. These are often collected as part of market information and monitoring systems, but coverage is limited. The Global Information and Early Warning System of the Food and Agriculture Organization of the United Nations (FAO) collects the retail and wholesale prices of food items across Africa, but only covers staple foods and a handful of markets. Another country specific example is Burkina Faso, where the Ministry of Trade collects data on cereal prices from regional markets through the Grain Market Price Surveillance System (see Günther and Grimm 2007). However, in general, the scope of these price collections in terms of commodity and geographical coverage is too limited for systematic use in the context of poverty measurement.

2.6 Summary comparison

Table 1 summarizes the advantages and disadvantages of the three sources of price data most commonly used for poverty measurement, that is, consumer price data (unit records from the CPI effort), unit values from HBSs, and market prices collected in conjunction with an HBS. Each source is evaluated with respect to a set of characteristics desirable for the purpose of poverty measurement. These traits are:

- Nationally representative: Price data should be representative at the national level and cover both urban and rural areas.
- Representative for survey strata: Price data should also be representative at the survey strata-level (for example, regions) to allow for survey-internal deflation and strata-specific inflation rates.
- Sample size: there should be a sufficiently large number of price observations per item.
- Food and nonfood coverage: Both food and nonfood commodities should be covered.
- Precisely defined items: Items for which price data are collected should be exactly defined to avoid quality contamination.
- Direct price measurement: To minimize measurement error, prices should be directly observed.
- Collection process resembles actual transactions: The way the price data are collected should reflect as closely as possible the purchasing situation encountered by local residents.

Table 1: Stylized comparison of different sources of prices

	Consumer price data	Unit values from HBSs	Market price data
Nationally representative	(–) *(often only urban, purposive sampling)*	✓ *(but potentially biased toward purchasing households)*	✓ *(but a potentially large number of missing values)*
Representative for survey strata	(–) *(data collection delinked from household survey)*	✓	✓ *(but a potentially large number of missing values)*
Sample size / number of observations	(–) *(limited number of price observations per item)*	✓ *(large number of price observations, especially for diary surveys)*	(–) *(only few price observations per item and cluster, missing values)*
Food and nonfood coverage	✓	(–)	✓ *(often only few nonfood items)*
Precisely defined items	✓ *(typically well-trained enumerators, every month)*	(–) *(generally not, especially recall surveys with aggregated item list)*	✓ *(if enumerators are well instructed)*
Direct measurement	✓	(–) *(computed as value divided by quantity)*	✓
Collection process	(–) *(nonresident enumerators)*	✓ *(based on actual transactions)*	(–) *(especially with nonresident enumerators)*

The comparison shows that no source of price data unambiguously dominates. Consumer price data basically have the mirror properties of survey unit values, while market price data come in between. This can also explain why there is significant heterogeneity in practice (as illustrated in appendix table A2). Most of the disadvantages of the price data collected for the CPI are related to their limited geographical coverage. If progress could be made to ensure more representative coverage of consumer price data collections, these would likely emerge as the preferable source of price data.

Even though unit values may be considered a useful source of price data in developing countries today, they are expected to lose relevance in the future. As described above, unit values can be reasonably defined only for food items and perhaps fuel. As countries develop and households spend an increasing share of their budgets on nonfood goods, unit values will cover an ever declining share of household consumption. Moreover, with rising income and increased consumption of processed foodstuffs, specific marketing margins (that are not ad valorem) may become more relevant, which further challenges the usefulness of unit values (see Minten and Kyle 1999; Gibson and Kim 2015 for further discussion). This reinforces the notion that, from a forward-looking perspective, more attention ought to be paid to regular consumer price data collection.

3. Price Adjustments to Measure Poverty Trends

3.1 Introduction

Because consumption is measured in HBSs in current prices, analysis of poverty trends (by an absolute definition of poverty) requires adjustments for price changes. This is because the poverty line—the threshold that separates the poor from the nonpoor—ought to be anchored in a real standard of living that is independent from the level of nominal prices. There are two broad ways to adjust for price changes between two periods (for example, t and $t + 1$) in the context of poverty measurement.

The first approach is to compute a price index that measures inflation between the two periods. This price index can draw on any of the sources of price data that are outlined in the previous section. In addition, it requires information on quantities (budget shares) to estimate a weighted average of all price changes in the economy; these quantities typically come from an HBS. The price index can then be used to deflate the poverty line over time (to be compared with current consumption), or, equivalently, to deflate nominal consumption into real values (to be compared with a fixed poverty line).[15]

The second approach is to price-update the base year poverty line directly, for example, by repricing a fixed basic needs basket in current prices without the use of a price index. Again, this can draw on any of the sources of price data that are described in the previous section. Under certain conditions, this second approach is equivalent to the first method (deflation using a price index) and would yield identical results. In particular, if (1) the quantities that underlie the basic needs poverty line basket are kept constant over time and correspond to the weights in the price index, (2) the same input price data are used, and (3) the price index employs a simple, one-stage aggregation approach, then the two approaches ought to be equivalent. However, in practice, they may yield different results because weights/quantities, input prices, or the process of aggregation differ, often in ways that are not immediately obvious to the analyst. Even

[15] In most cases, the poverty line will be expressed in the prices of the base year of the comparison (t) either because the poverty line was redrawn from scratch in that year or because it had been price adjusted from an even earlier survey. The composite price index will then be used to update the poverty line to end-year ($t + 1$) prices or (equivalently) to deflate ($t + 1$) consumption into prices in (t). However, the reverse is also possible and happens occasionally when poverty trends are revised retroactively; in this case, either the poverty line is deflated backward from ($t + 1$) to (t), or consumption is deflated from (t) to ($t + 1$).

though this second approach does not compute a price index from the outset, obtaining an implicit price index as the ratio of nominal poverty lines in the two periods is always possible.

The next section describes in detail the methods that are commonly used for price adjustments in the context of measuring poverty trends. It starts with a comprehensive review of the CPI, which is, by far, the most popular price index and plays a particular role in poverty measurement because the CPI is used to price-update the international $1.90-a-day poverty line (in a given country over time). It then proceeds to describe different approaches used to adjust prices in the context of national poverty estimation. Finally, it summarizes the advantages and disadvantages of each method.

3.2 The consumer price index

3.2.1 Overview

The CPI is the most well-known price index in all countries, and it is used for a variety of purposes. CPI inflation is generally regarded as a core economic indicator used, for instance, to index pensions, wages, rents, taxes, and social security benefits, to anchor monetary policy (that is, most central banks target either headline or core CPI inflation), to adjust inflation-indexed bonds and stocks, and to measure changes in economic output and living standards. Because of this broad array of applications, the CPI is often described as a general-purpose price index. The general nature and objectives of the CPI, however, also imply that statistical agencies have to balance the technical requirements of the different purposes. This involves a variety of trade-offs, because no single price index can be optimally suited to all potential applications. Many of the concerns about the use of the CPI for the analysis of poverty trends are related to the fact that the CPI is not specifically designed as a cost-of-living price index for the poor.

The CPI is widely used to adjust nominal poverty lines for inflation, but there are concerns that this may sometimes not adjust properly for changes in the cost of living of the poor. Trends in international poverty depend on the behavior of national CPIs because the CPI is typically used to update the international poverty line ($1.90-a-day in 2011) to the year of the HBS.[16] National poverty estimates based on country-level poverty lines are also sometimes (though not typically) price-updated using the CPI.[17] Because poverty lines are anchored to a minimum standard of living, the question arises whether the CPI mirrors changes in the cost of living of poor households. Some researchers have argued that, under specific circumstances, CPIs can give a misleading picture of the price changes experienced by the poor in Africa (for example, Günther and Grimm 2007 for Burkina Faso).

To understand the limitations of the CPI, it is useful to recap the CPI computation method. The ILO, the agency with the mandate on technical aspects of the CPI, produces guidelines for NSOs and other agencies authorized to construct the CPI (ILO et al. 2010). Most countries use a fixed-base Laspeyres-type index and staged aggregation approach (see Boskin et al. 1996 on the United States; United Nations 2009 on developed countries).[18] In a first step, individual price quotations are combined to lower-level (elementary) aggregates for categories of products (often by region and outlet type). Expenditure weights are not available for this aggregation step because the HBS data are not sufficiently disaggregated. In the next steps, elementary aggregates are combined to commodity-group indexes (for example, food and beverages, apparel, transport) and ultimately the all-item CPI. This upper-level aggregation typically uses weights

[16] In a few exceptional cases, alternative measures of inflation are used (under the 2015 global poverty update, these were only Ghana and Malawi in Africa).
[17] See table 6 for examples.
[18] Because the base period price and quantity data are often collected at slightly different periods, most national CPIs are more accurately described as base-weighted modified Laspeyres, also known as a Lowe index (ABS 2011). For most practical purposes, the difference is likely to be small, and this note follows the convention of labeling the CPI as a Laspeyres-type or simply Laspeyres index.

(computed as budget shares) from a HBS. While most NSOs broadly follow this approach, national practices can differ substantially in terms of details.

Because most CPIs measure the price changes of a fixed basket of goods and services, they effectively amount to a cost-of-goods index (COGI) rather than a cost-of-living index (COLI). The latter would measure the changes in nominal expenditure required to maintain a constant standard of living (for details, see Diewert, Greenlees, and Hulten 2009; Konus 1939; Pollak 1998; Schultze and Mackie 2002, Schultze 2003). COGIs may differ from COLIs partly because they do not allow for substitution effects, but also because they abstract from changes in external conditions that affect the cost of living (see Schultze and Mackie 2002). COLIs, in turn, while theoretically appealing, are an elusive concept because a household's true standard of living (that is, utility) cannot be observed. Moreover, it remains controversial whether a CPI should reflect changes in public goods and bads (such as crime rates, environmental factors), or whether the COLI should be restricted to private goods and services (as a conditional COLI). Even if one opts for a conditional COLI, there can still be ambiguity about the precise factors that should be held constant as the conditioning variables (for a discussion, see Diewert, Greenlees, and Hulten 2009; Lebow and Rudd 2003). There has been a long-standing controversy in the United States about the extent to which the BLS should embrace the cost-of-living framework for the U.S. CPI, and this debate has been echoed in other high-income countries (Triplett 2001).[19] In the late 1990s, following the Boskin commission report (Boskin et al. 1996), the BLS implemented a series of revisions to the U.S. CPI to move closer to the concept of a conditional COLI, but many have argued that further revisions would be needed (for example, Hausman 2003). The conditional COLI also provides the guiding framework for the large empirical literature seeking to quantify various CPI biases (see below).

3.2.2 Biases from commodity substitution, outlet substitution, quality change, and new goods

Conceptually, most academic studies define CPI bias as the difference between the CPI and a conditional COLI. Typically, this encompasses four main types of bias (see Hausman 2003; Rossiter 2005): (1) (commodity) substitution bias, (2) outlet substitution bias, (3) quality change bias, and (4) new product bias, which are described in the following paragraphs and have been the focus of academic literature in the United States and other high-income countries. However, these biases do not capture all potential sources of bias in the CPI that may occur in practice.[20] Other forms of bias, which are described in sections 3.2.3–3.2.4, may be as important for poverty analysis in Africa as the four types of bias discussed here.

Commodity substitution

Commodity substitution bias relates to the use of a fixed basket and leads to an overstatement of inflation. Laspeyres-type price indexes, such as most CPIs, hold quantities fixed in the base (reference) periods. Substitution behavior is disregarded and, hence, changes in the cost of living are overstated. This substitution bias occurs both at the lower and upper levels of aggregation. An alternative approach is the Paasche index, which uses as weights the quantities in the end (comparison) period and displays the mirror properties of the Laspeyres, that is, because quantities are held fixed at end-of-period values after all substitution has taken place, the Paasche index understates changes in the cost of living. Superlative indexes (for example, the Fisher index, the Törnqvist index), which involve some sort of averaging over the base-

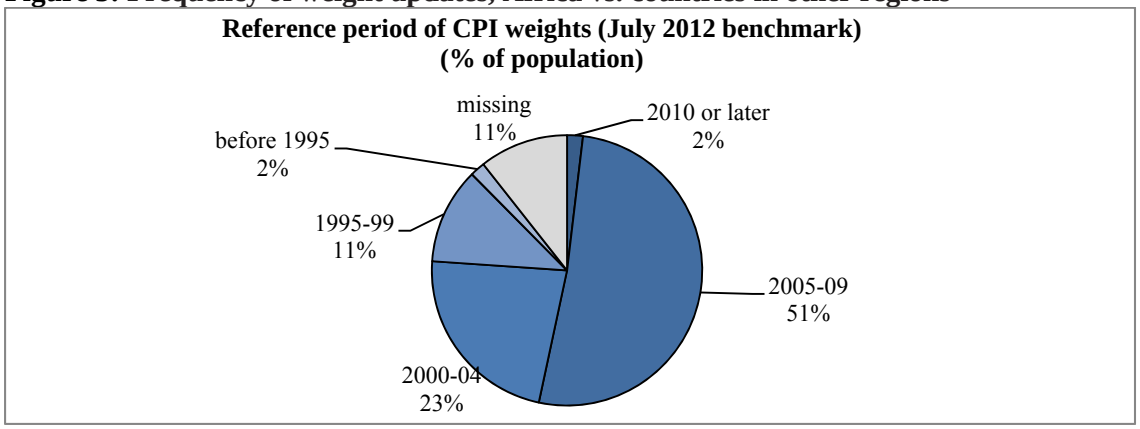
[19] In the context of the United States, two influential reports—the 1961 Stigler Report (Stigler et al. 1961) and the 1996 Boskin Report (Boskin et al. 1996)—advocated the COLI as the guiding theoretical concept for the CPI, whereas a 2002 report by the National Research Council (Schultze and Mackie 2002) took a more nuanced position. For a discussion of these and related issues, see Diewert, Greenlees, and Hulten (2009).

[20] Bias here refers loosely to any "systematic tendency for the calculated CPI to diverge from some ideal or preferred index, resulting from the method of data collection or processing, or the index formula used" (ILO et al. 2010, 443).

and end-year quantities, could, in theory, solve this problem.[21] However, indexes involving end-year quantities (for example, Paasche, Fisher, and Törnqvist) are operationally infeasible in real time and can only be computed with a delay. This is because current quantity data are generally not available, especially not on a monthly basis, which is the typical publishing schedule of the CPI. HBSs from which the quantities are computed are usually conducted once every few years. As a result, CPIs are typically computed as variants of a Laspeyres index.

CPI weights are less frequently updated in Africa than in other regions and can be seriously out of date there. This is illustrated in figure 3, which also shows that, as of July 2012, 13 percent of the African population was living in countries where the CPI basket was based on data from the 1990s or earlier (an additional 11 percent show missing information). Even though longer time lags between weight updates do not necessarily imply a greater extent of overestimation of inflation (see Deaton 1998), highly outdated weights are clearly a concern.

Figure 3: Frequency of weight updates, Africa vs. countries in other regions



Source: ILO 2013.
Note: Weighted using population in 2013.

Commodity substitution bias can be reduced through the use of geometric averages. In 1999, the BLS moved from an arithmetic to a geometric mean formula to calculate most elementary indexes within the U.S. CPI to allow for consumer substitution as a response to relative price changes (Boskin 2005; Lebow and Rudd 2003).[22] The CPI manual of the ILO et al. (2010) also highlights the attractive statistical properties of geometric indexes. Only a few African countries captured by the ILO (2013) metadata provide detailed information on the specific aggregation process used, but, from this, it seems that arithmetic averages continue to be frequently used in the region. This may be changing, however. In East Africa, Kenya (in 2010) was reportedly the last country (after Tanzania and Uganda) to move from arithmetic to geometric averaging (Keeler 2010).

Outlet substitution

Outlet substitution bias is related to changes in the retail landscape. In developed countries, discount retail stores (such as Walmart in the United States) offer goods at prices that are substantially lower than the prices in traditional stores. This change in outlet mix is typically not reflected in the CPI because prices are

[21] Under the assumption of a specific functional form of consumer preference (that is, a quadratic utility function), the Fisher price index is an exact measure of a COLI (ILO et al. 2010).
[22] In 2002, the BLS also introduced the C-CPI-U (Chained CPI for All Urban Consumers), a superlative index that uses a Törnqvist formula to average price changes across item categories, as an alternative measure of urban inflation. The C-CPI-U suffers less from substitution bias than the traditional CPI-U, but, because it requires current quantities, its values are not final when released for the first time (see BLS 2015, chapter 17).

only compared over time within the same type of outlet. In the United States, for instance, discount outlets are gradually rotated into the CPI calculation, but any price variations between discount and traditional outlets are effectively discounted as quality differences (that is, differences in the level of the service provided in the two types of outlet). This fails to account for gains to consumers from the shift toward retail outlets and leads to an overestimation of inflation (Hausman 2003; Rossiter 2005).

Outlet substitution bias in developed countries induces the CPI to overstate inflation. However, there are potentially some differences with respect to African countries. First, the retail landscape in Africa has changed in different ways compared with the developed world, with an expansion in supermarkets in urban areas, which may even have higher prices for certain goods than traditional outlets.[23] Second, outlet substitution bias depends to a large degree on the procedure adopted by statistical agencies to rotate new outlets into the sample, whether prices are treated as noncomparable across outlets, or whether some comparisons are drawn. There is little information on how this is handled by NSOs in Africa.

Quality change

Quality change bias occurs because of inadequate adjustments for quality change and typically implies that the CPI overstates inflation. Statistical offices in developed countries use different approaches to incorporate products with new specifications into the CPI either through linking or splicing procedures, which attribute a certain fraction of the overall price change to quality, or by using hedonic estimation techniques, which explicitly model quality. Evidence from the developed world suggests generally that quality change bias is positive, typically because some degree of quality improvement is not captured. However, negative quality change bias is possible, especially for certain types of products.[24] In the case of Africa, it seems likely, but not certain, that quality change bias is positive and hence leads to an overstatement of inflation.[25]

New products

New product bias is tied to the belated inclusion of new goods and services into the CPI basket and is similar to quality change bias. The introduction of new products and brands increases consumer living standards and should be reflected in a conditional COLI, but is typically not captured by CPIs. This is compounded by the infrequency of weight adjustment, whereby it may take several years until new goods are rotated into the CPI basket. Hausman (1996, 1999) describes a method to value the introduction of new goods (breakfast cereals, mobile phone services) by estimating virtual (reservation) prices. There has been significant controversy in the United States about the conceptual validity and empirical feasibility of these econometric techniques. In particular, the influential National Research Council report (Schultze and Mackie 2002) argues against the inclusion of the virtual price reductions associated with the introduction of new goods into the CPI, though it endorses more frequent weight updates. New product bias leads to an overstatement of inflation in the CPI.

[23] Minten and Reardon (2008) review evidence from supermarket expansions in developing countries, including in Africa. They find that supermarkets are generally cheaper than traditional retailers for processed food items. For fresh produce, supermarkets are often more expensive than traditional stores, but tend to become more price-competitive over time. While this suggests that the expansion of modern retailers lowers consumer prices, there is also evidence that supermarkets focus on higher-quality varieties, at least initially.

[24] As discussed by Rossiter (2005) in the context of Canada, quality change has potentially been negative for services, for which quality changes are particularly difficult to measure.

[25] However, quality change bias could lead to the underestimation of inflation if (i) quality changes in products treated as comparable are negative (somewhat possible), (ii) NSOs tended to overcorrect for quality improvements using hedonic techniques (unlikely), or (iii) NSOs attributed all price differences between old and new product varieties to quality, thus missing out on simultaneous price increases (possible).

Empirical studies from the late 1990s and early 2000s, which quantify the different components of CPI bias in Canada and the United States, find that CPIs in both countries were upwardly biased by 0.5 to 1.0 percentage points per year (Boskin et al. 1998; Shapiro and Wilcox 1996; Lebow, Roberts, and Stockton 1994; Lebow and Rudd 2003; Boskin 2005; Rossiter 2005; Crawford 1998). Assuming an average annual inflation rate of 2.5 percent, this would imply that CPIs overstate inflation by 20 to 40 percent. No comparable studies have been found on developing countries. There is a parallel literature pioneered by Costa (2001) and Hamilton (2001) that quantifies overall CPI bias using Engel's Law. These studies have obtained similar results for the United States relative to studies that analyze CPI bias component-by-component. Because the Engel curve estimation requires fewer disaggregated data, it is easier to extend it to developing countries (see section 3.2.5 for a more detailed discussion).

3.2.3 Plutocratic bias

The plutocratic bias reflects the fact that CPI weights represent consumption patterns of households at the upper end of the distribution. As discussed by Prais (1959) and Nicholson (1975), the CPI implicitly attaches a weight to each household in proportion to the household's total expenditures; this is because the weights are computed as the consumption shares of an aggregate reference population, rather than as average consumption shares across households. The alternative would be a democratic price index, which would weight all households equally. In the academic literature, plutocratic bias is often treated separately from other types of CPI bias. Unlike the types of bias described in the previous paragraph, there is a stronger element of choice, and plutocratic weights are, in fact, preferred for some purposes of the CPI.

CPI inflation may not be representative of the price changes experienced by poor households because of this plutocratic weighting if the following three conditions are met. First, there needs to be inequality in household consumption so that distributional patterns can arise. This condition is always met, though the degree of inequality differs across countries. Second, consumption patterns need to vary systematically across households with different levels of spending, as is typically the case. Together, these two conditions imply that plutocratic CPI weights are biased toward the spending patterns of more well-off households. Empirical studies across the world confirm that CPI weights are representative of households located between the 60th and 95th percentile of the consumption distribution; this bias toward the spending patterns of the more well-off is most pronounced in high-inequality countries, such as South Africa or Latin American countries (table 2). However, these skewed weighting patterns only lead to biased inflation if a third condition is also met, namely, the prices of different items have to move nonuniformly, that is, relative prices have to change over time, and these changes need to be systematically related to the variation in consumption patterns across income groups (see Deaton 1998; Ley 2005).

Table 2: CPI weights reflect consumption patterns among high-income households

Country	*Location of consumer represented by CPI in the income distribution*	*Study*
United Kingdom	71th percentile	Muellbauer (1974), cited in Ley (2005)
Brazil, Colombia, Mexico, Peru	Brazil, Mexico, Peru: 80th–85th percentiles; Colombia: 85th–90th percentiles	Goñi, López, and Servén (2006)
United States	75th percentile	Deaton (1998)
South Africa	95th percentile	Oosthuizen (2007)
Spain	61st percentile	Izquierdo, Ley and Ruiz-Castillo (2003)

Plutocratic weights are the natural choice for the deflation of economic aggregates, such as national accounts, but not ideal for poverty and welfare measurement. According to Pollak (1998, 73), "in positive economics (say, in demand analysis or industrial organization), the right way to aggregate over households is to 'follow the money' and count every dollar equally." At the same time, there is almost uniform

agreement that plutocratic weights are not appropriate for normative analysis, such as welfare economics, and that democratic weights are preferred in this context (Deaton 1998; Pollak 1998; Schultze and Mackie 2002). Given that many purposes of the CPI are normative (for example, the indexation of social security and pensions, analysis of poverty and living conditions), it is striking that CPIs in virtually every country use a plutocratic weighting scheme.

Democratic weighting is practically infeasible at the level of elementary aggregates, which explains the near universality of plutocratic weights for CPIs. The computation of the CPI proceeds in two steps. First, individual price quotations are aggregated to elementary aggregates that represent broad goods categories purchased by consumers in a specific locality and type of outlet (for example, rice in traditional stores in a specific region). Second, elementary indexes are aggregated to commodity-group indexes and, ultimately, the CPI is computed using weights estimated from a HBS. At the second stage, democratic weighting is straightforward because HBS data allow household-level budget shares to be computed and averaged for broad product groups. At the first (elementary-level) stage, however, democratic weights are unattainable because individual price data are collected at the store level, and the sampling process mimics plutocratic weighting, especially under probability sampling methods, where outlets and locations are selected proportional to size.[26] Computing demographic weights at this (first) stage of aggregation would require household-level (as opposed to store-level) price data, which are generally not available. In other words, the current CPI data collection system cannot provide the necessary information to assign an equal weight to all households at the level of elementary aggregates (Schultze and Mackie 2002). The only feasible alternative is to weight households equally only at the upper level of aggregation. This quasi-democratic CPI differs from the regular CPI solely in terms of the upper-level weighting pattern, whereas the elementary indexes remain unchanged.

In the context of the United States, moving from plutocratic to democratic weights at the upper level of aggregation has historically made little difference to the overall index. Schultze and Mackie (2002) argue that moving to quasi-democratic weights would only lead to modest differences in the overall trend of the index and that important differences are more likely to arise at the lower levels of aggregation. Kokoski (2003) shows that there is little difference between a plutocratic and a quasi-democratic index in the United States for 1987–97 because relative price changes were modest and not systematically associated with differences in consumption patterns across income groups (with the exception of medical care). Hobjin and Lagakos (2005) also find that for the period 1987 to 2001 inflation differences across demographic groups are small, though they can be more sizable on a year-to-year basis. On the other hand, Deaton (1998) argues that historic price trends are not necessarily predictive of future price trends and considers the inability of the CPI to capture different inflation across the income distribution a serious flaw in the statistical system.

A few studies show that inflation inequality can be relevant for poverty measurement in Africa. This is illustrated by Günther and Grimm (2007) in Burkina Faso, where grain prices skyrocketed over 1994–98 because of a drought in 1997/98 and liberalization policies. While the prices for food crops went up by 252 percent between 1994 and 1998, the prices of other consumption items (that is, the CPI without food crops) only increased by 108 percent. As a result, poor households, which spent much of their total budget on calorie-rich grains, experienced much higher rates of inflation than wealthier households. Differential inflation across the income distribution is also documented in Brazil, Colombia, Indonesia, Mexico, Peru, South Africa, Tanzania, and Uganda (table 3).[27]

[26] As discussed by Ley (2005), citing Theil (1967), plutocratic weights arise naturally if prices are drawn randomly such that each currency unit of spending has the same chance of being selected (also, see Gibson 2009).

[27] The World Bank (2015a) is ambivalent on this topic. Its report mentions the potential for plutocratic bias in the CPI, but also refers to the results of Deaton and Dupriez (2011b) that PPPs calculated specifically for the poor (and their consumption patterns) do not differ markedly from general PPPs. However, it is not entirely clear if cross-country

Table 3: Review of studies analyzing inflation differences across the distribution

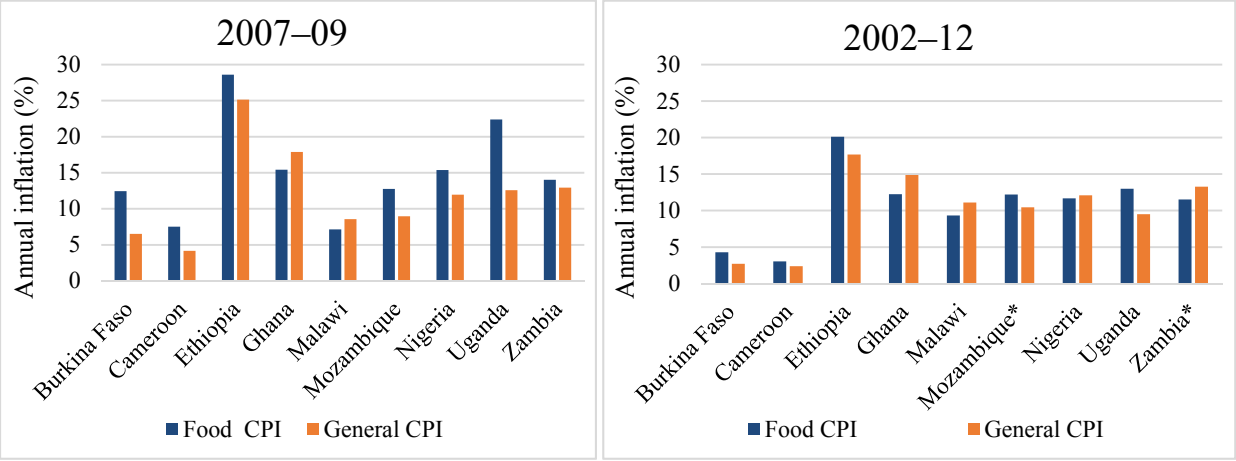
Country	*Time period*	*Author*	*Summary of main findings*
Brazil, Colombia, Mexico, Peru	Different time spells, 1984–2003	Goñi, López, and Servén (2006)	With the exception of the 1994-96 Tequila crisis in Mexico, households in the upper quintiles had higher rates of inflation than households in the lower quintiles.
Burkina Faso	1994–98, 1998–2003	Günther and Grimm (2007)	Poor households had higher inflation 1994–98 and lower inflation 1998–2003.
Indonesia	1993–2000	McCulloch, Weisbrod, and Timmer (2007)	Poor households had higher inflation (because of a larger consumption share devoted to food): the CPI underestimates inflation among the poor.
South Africa	1998–2006	Oosthuizen (2007)	Only minor inflation differences in the period as a whole, but more significant differences (positive and negative) in subperiods.
Tanzania	Weights: 2000/01 Prices: 2003–06	Mkenda and Ngasamiaku (2009)	Poor households had higher inflation 2003–06 (democratic inflation between 1.2 and 5.5 percentage points higher than plutocratic inflation).
Uganda	1997–2007	Okidi and Nsubuga (2010)	Poor households had lower inflation 1997–2004 and higher inflation 2005–07 (some additional month-to-month variation).
United States	~1980–98	Deaton (1998)	Inflation differences – between the CPI representative household at the 75th percentile of the distribution and poor households - are reported to have been very small.
United States	1987–2001	Hobjin and Lagakos (2005)	Annual household-specific inflation rates can differ considerably from the mean inflation rate, but there is little persistence over time.

Plutocratic bias can go in either direction. Table 3 summarizes findings from the empirical literature, including four papers relating to Africa. There are examples where poor households experienced higher inflation than rich households, but also vice versa, where more well-off groups were more strongly affected by inflation than the poor. Even within the same country, the bias can turn around over time. Oosthuizen (2007) finds that, in South Africa, the plutocratic gap changed from positive to negative values (or vice versa) seven times between January 1998 and December 2006 (see Hobjin and Lagakos 2005 for a similar finding). Such reversals would be consistent with supply-side shocks (for example, drought or other weather-related incidences) that trigger abrupt price increases in specific commodities. Once the underlying conditions that caused the price rise ease off, a process of mean-reversion may set in, whereby prices revert to their long-run steady-state trajectory.

As a broad-gauge assessment of whether differential inflation has worked in favor of or against the poor in Africa over the past decade, a comparison of changes in food prices with overall inflation is useful. Because the poor typically spend a larger proportion of their budgets on food, higher food price inflation should hurt them disproportionally. Of course, this does not capture differential inflation across disaggregated commodity groups (let alone elementary level items), but it should be indicative of one major factor of plutocratic bias. Figure 4, based on data from the ILO and FAO, compares trends in food and general CPI inflation in African countries with long-run CPI series for two different periods, 2007–09 (which coincides with the 2008 global food price crisis) and 2002–12 (to give a longer, 10-year perspective).

comparisons are analogue to within-country comparisons over time. Moreover, plutocratic bias could be more important in Africa than in other regions.

Figure 4: Food vs. general CPI inflation



Sources: LABORSTA (database) and ILOSTAT (database), ILO, Geneva, http://laborsta.ilo.org/; FAOSTAT, Food and Agriculture Organization of the United Nations, Rome, http://faostat3.fao.org/home/E (accessed July 17, 2015).
Notes: * Mozambique and Zambia series run only to 2011.

Food inflation clearly exceeded general inflation during the 2008 food price crisis, but this is less evident over the entire decade. Most countries experienced significantly higher food price inflation over 2007–09, when the global food price crisis soared, than over the 2000s as a whole (that is, comparing the blue bars across the left and right panels in figure 4). Between 2007 and 2009, food CPIs rose more quickly than general CPIs in seven of nine countries (left panel), but trends were more even in 2002–12 (right panel). Over this longer period, food CPIs rose more quickly than general CPIs in some countries (Burkina Faso, Ethiopia, Mozambique, and Uganda), but the opposite trend is observed in Ghana, Malawi, and Zambia. In Nigeria, which, because of its large population, has a pivotal role in the regional poverty trend, the two inflation rates almost coincide. These patterns might look different if one would zoom in on price indexes that are even more tailored to the consumption patterns of the poor than the food CPIs (for example, staple indexes). However, the available evidence suggests that plutocratic bias could be a serious issue if one explores changes in poverty over short periods, especially periods characterized by large swings in global prices, but may matter less for poverty changes over longer periods.

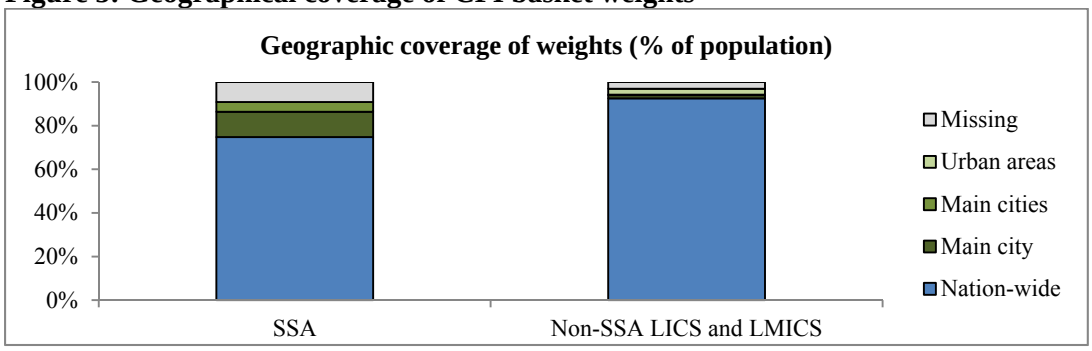
3.2.4 Other types of bias

Urban bias

Many CPIs in the region reflect the prices and quantities of urban consumers. Section 2.1 points out that CPI price data are often collected only in urban areas. Some countries also use urban expenditure weights. Even in cases where HBS data are nationally representative, some countries compute quantities and basket weights among urban households only (figure 5). While this may enhance the internal consistency of the CPI in the sense that prices and quantities correspond to the same underlying reference population, it effectively exacerbates the plutocratic bias of the CPI described above.

Most likely, the urban bias of the CPI was even larger historically; hence, it may matter, particularly, in poverty trends over longer periods of time. As part of periodic CPI revisions, many African countries have expanded the geographical scope of their price data collection exercises and the representativeness of CPI basket weights in recent years. In Tanzania, for instance, CPI weights until 2009 were based on consumption patterns among urban households in the 2001 HBS. In 2010, as part of the process of rebasing the index to the HBS 2007, the reference population for the weights was broadened to include rural households (NBS 2010).

Figure 5: Geographical coverage of CPI basket weights

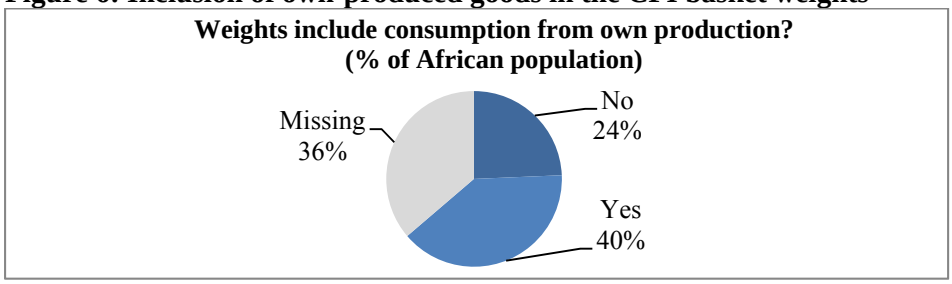


Source: ILO 2013.
Notes: Weighted using population in 2013. Excludes countries with other coverage.

The treatment of own consumption

Some African countries exclude the consumption of own production from the basket weights, which reinforces the plutocratic bias. As shown in figure 6, this is handled heterogeneously across countries in the region: 40 percent of the African population lives in countries that include consumption from own production, while 24 percent exclude it, and 36 percent lack this information.

Figure 6: Inclusion of own-produced goods in the CPI basket weights



Source: ILO 2013.
Note: Weighted using population in 2013.

Official CPI guidelines leave it to the discretion of countries whether to include or exclude consumption from own production in the weights, contingent on the main purpose of the index. The United Nations states that "the ILO Resolution is not prescriptive on the inclusion of own account production in a CPI, but does advise that, 'when consumption from own account production is within [the] scope of the index, the weights should be based on the value of quantities consumed from own production'" (United Nations 2009, 108). It adds that "the precise scope of a CPI is influenced by what is intended to be the main use of the index" (United Nations 2009, 110). It is, of course, true that if the main purpose of the CPI is to serve as an anchor for monetary policy, then an index that is restricted to purchases is preferred over a general consumption index, which includes weights from own-consumed production (see United Nations 2009 for a discussion). However, for the purpose of poverty analysis, where own-consumed goods are typically included in the consumption measure and valued at (proximate) market prices, the weights of the CPI should include consumption from own production.

Political economy bias

CPI-measured inflation might be downward biased if statistical agencies are not independent. When price changes are politically sensitive, governments might have an incentive to exert pressure on their statistical

agencies to misreport inflation or strategically time methodological changes to lower measured inflation.[28] If statistical agencies are not independent, CPI-measured inflation may be biased downward, leading to an underestimation of poverty in subsequent years. This may be exacerbated if the international community does not focus attention, technical assistance, and funding on price statistics. Since the early 2000s, the international community has increasingly directed its efforts toward survey-based indicators that directly measure progress toward the Millennium Development Goals (Jerven 2013). However, hard evidence is difficult to acquire on this type of bias.

Computation and measurement errors

Finally, the CPI might not accurately depict inflation trends because of various measurement and computation errors. In Tanzania, for instance, the CPI underestimated inflation in 2002–05 because of flawed outlier cleaning protocols and other computational errors. Eventually, these were corrected, and the CPI series was revised, though concerns remained about the potential underestimation of inflation (World Bank 2007, Adam et al. 2012). Similar computation errors are reported in Ghana for 1999–2001 (IMF 2003a, 2007).

3.2.5 Empirical evidence on Africa

In theory, CPI bias can lead to the under- or overestimation of true inflation. As described above, CPI bias can occur for different reasons, and, only in some of these cases, is measured inflation distorted decidedly into one direction (see table 4 for a summary). This holds for commodity and outlet substitution as well as new product bias, which more plausibly result in an overestimation of true inflation. Conversely, political economy bias is expected to lead to an underestimation of inflation. The question of whether CPIs in Africa under- or overstate inflation is ultimately an empirical matter. This subsection reviews the empirical evidence about CPI bias in Africa.

Table 4: Likely directions of CPI bias, by type

Type of bias	*Direction of bias*
Commodity substitution bias	positive
Outlet substitution bias	positive
Quality change bias	positive (negative possible)
New products bias	positive
Plutocratic bias	negative/positive
Urban bias	negative/positive
Neglect of own consumption	negative/positive
Political economy bias	negative
Measurement error	negative/positive

Notes: Positive = the CPI is upward biased (overstates inflation). Negative = the CPI is downward biased (understates inflation).

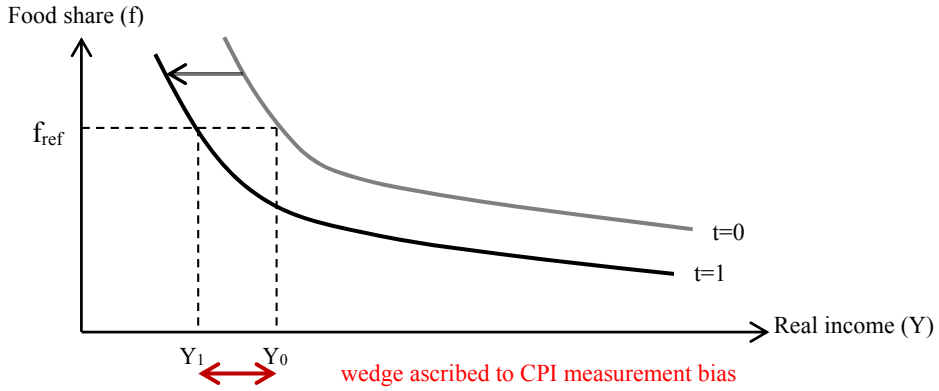
Engel curve method

A large literature estimates CPI bias based on the empirical regularity with which food budget shares decline with real income, that is, Engel's Law. The method, which has been pioneered by Hamilton (2001) and Costa (2001), is based on the notion that, if Engel's Law holds, changes in food budget shares over time reveal changes in real incomes. Assuming further there is no systematic measurement error in nominal incomes, any wedge between the estimated changes in real incomes derived from demand functions for food (that is, Engel curves) and measured changes in real incomes (that is, CPI-deflated nominal incomes) can be attributed to CPI measurement bias. Hamilton (2001) shows that Engel curves for the United States

[28] A well-known example is the controversy about price statistics in Argentina (see Barrionuevo 2011; Berumen and Beker 2011). Similarly, IMF (2013) concludes that Uzbekistan's CPI systematically underestimates inflation.

from 1974 to 1991 consistently drift to the left, so that, over time, any given food budget share is associated with a smaller level of real income (see figure 7 for a schematic illustration). This is interpreted as an indication that the U.S. CPI overstates increases in the cost of living and that real incomes are increasingly underestimated. Estimates of CPI bias in the United States based on the Engel curve method are, in order of magnitude, similar to those obtained independently from methods that quantify and sum across individual components of CPI bias. There are several advantages to the Engel curve method. First, it requires fewer disaggregated data and, hence, can be applied more easily to developing countries. Second, the method, at least in theory, gives an estimate of the overall discrepancy between the trend in the CPI and the COLI by aggregating over the different sources of CPI bias, including some those not addressed by the studies that quantify CPI-bias component by component.[29] Olivia and Gibson (2013) point out that the method is therefore more useful as a diagnostic tool to cross-triangulate trends in real living standards rather than as a guide to statisticians seeking to improve the CPI methodology. Finally, the method allows for disaggregation by population group.

Figure 7: Illustration of the Engel curve method



Engel curve estimates suggest that CPIs overstate increases in the cost of living in many developed and middle-income countries. As shown in appendix table A3, Engel curve estimates indicate that national CPIs are upwardly biased in Australia, Brazil, Canada, China, the Republic of Korea, Mexico, New Zealand, the Russian Federation, and the United States at least in the periods under investigation. Only in Indonesia and Norway during the 1990s and (marginally) historical U.S. periods is the CPI bias estimated to be negative.

Recent Engel curve estimations for a large number of African countries yield similar results, suggesting that CPIs often overstate (urban) inflation. Dabalen, Gaddis, and Nguyen (2016) show Engel curve estimates of the CPI bias in 16 African countries. The results suggest that national CPIs often overestimate inflation, though there are also examples (such as Ghana in 2005–12 and Uganda in 2009–12), where the results point in the opposite direction. This analysis suggests that poverty reduction in Africa may be underestimated, though results from more countries and including rural households would be useful in corroborating these findings.

How reliable are Engel curve estimates of inflation? Most empirical applications (for example, Gibson, Le, and Kim 2014; Hamilton 2001; Olivia and Gibson 2013; Dabalen, Gaddis, and Nguyen 2016) control for broad relative prices and household-level factors that impact on the share of the budget spent on food, such as demographic composition. However, any movement in the Engel curve that cannot be explained by the covariates included in the regression model will be attributed to CPI bias (Hamilton 2001). Essentially, CPI bias is estimated as a residual, which leaves scope for measurement error. The Engel curve method detects

[29] For example, as discussed by de Carvalho Filho and Chamon (2012), plutocratic bias can be captured by the Engel curve method if the estimation weights households by the population share rather than the expenditure share.

an upward bias in the CPI (as in most empirical studies) if the Engel curve shifts to the left, so that, over time, a given food budget share is associated with a declining level of real income (as illustrated in figure 7). Because nominal incomes are assumed to be measured correctly, the method attributes this wedge to an overestimation of inflation in the CPI. In other words, if CPI inflation were lower, real incomes would increase more quickly over time, and a given food budget share would be associated with a constant level of real income, as postulated by Engel's Law. As noted above, however, this conclusion may not hold if there are additional, unobserved forces that shift the Engel curve to the left. This could include, for instance, (1) the more effective capture of nonfood consumption over time because of improvements in survey design, (2) increases in the share of food eaten away from home (at the expense of traditional food consumption) that are often insufficiently captured by HBSs, (3) preference shifts toward certain nonfood consumption items, or (4) the greater availability of such items over time.[30] More readily observable factors such as relative price shifts or demographic factors may also influence the share of household budgets spent on food (see, for instance, Nicholson 1976). Yet, given that the model controls for these variables, they are arguably less likely to bias the results.[31]

Empirical studies confirm that results from Engel curve estimations are not necessarily robust, especially in spatial contexts. Gibson, Le, and Kim (2014) compare Engel curve–based spatial deflators and spatially disaggregated inflation rates with multilateral price indexes computed from repeated spatial price surveys in Vietnam. In this validation exercise, the price indexes derived through Engel curve estimations appear to be poor proxies for cost-of-living differences. The weak performance of the Engel curve method in this context may partly arise from the spatial scope of application, whereby the assumption that differences in food budget shares across households reflect welfare differences is often viewed as more problematic than in a temporal context (for example, Deaton and Dupriez 2011a). However, it also illustrates that the price indexes derived through this method are not necessarily robust. This concern holds true particularly in African countries, where there are often doubts about whether household surveys measure consumption consistently over time (because of inconsistencies in survey design, implementation, and so on), which could lead to variations in food budget shares unrelated to changes in real incomes (see Beegle et al. 2016 for a review of household surveys in Africa).

Poverty line ratios

Another way to assess if CPIs capture changes in the cost of living is to take the ratio of national poverty lines (the cost of buying a basic basket of food and nonfood items). Sandefur (2013) compiles national poverty lines for African countries, drawing on reports published by statistical agencies, international organizations, and so on. He argues that CPI inflation is often lower than the ratio of national poverty lines and that this results in an overestimation of progress in poverty reduction measured by the international poverty lines (which are based on CPI price trends).

Under specific conditions, poverty line ratios can proxy for changes in the cost of living and therefore be viewed as an alternative price index to the CPI. If the poverty lines are anchored to a constant standard of living, the rate at which nominal poverty lines increase over time should proxy for changes in the cost of living. Of course, as discussed in subsection 3.2.1, the national poverty lines in African countries are sometimes themselves updated based on the CPI, in which case the poverty line ratio simply reflects CPI inflation and cannot be used as an independent measure of price changes. But, in many cases, poverty lines

[30] An example of the greater availability of nonfood consumption items over time, potentially combined with preference shifts, would be the expansion of cell phone technology; see Harttgen, Klasen, and Vollmer (2013) for a discussion in the context of using asset indicators to corroborate poverty trends.

[31] Logan (2008) argues that Engel curve estimates of CPI bias fail to account for the changing effect of household demographics and that this represents 25 to 50 percent of the Engel curve drift. More generally, Engel curve estimates may be biased because the regressions use a specific functional form to control for demographics and relative prices.

are updated in a subsequent survey year through a process that makes no direct use of the CPI. In these cases, poverty line ratios may be viewed as an alternative price index that avoids some of the pitfalls of the CPI. Particularly, the food baskets underlying CBN-type poverty lines are typically representative of the consumption patterns of poor households, which appear more suitable for poverty analysis than the plutocratic weights of the CPI. In cases where poverty lines draw on survey unit values rather than CPI prices to estimate the cost of a basic needs food basket, they also avoid the urban bias in CPI price data collection, though (as discussed in section 2.2) unit values are not necessarily preferred. In addition, poverty lines are often under the auspices of a different branch in the NSO than the CPI, which may have advantages if consumer price inflation is politicized.

If the consumption measures or poverty lines are not comparable over time, or if the basic needs basket changes, poverty line ratios can give a distorted picture of inflation. CBN poverty lines are typically computed based on a two-step approach. In a first step, a food poverty line is estimated as the cost of acquiring a food basket that delivers a predefined calorie level (for example, 2,100 kilocalories per person) given the consumption patterns of households close to the poverty line. In a second step, an allowance for basic nonfood requirements is added to the poverty line, typically based on the average nonfood spending of a reference population. Various procedures are used to update poverty lines over time, which differ in the extent the underlying consumption bundle is allowed to change (see also section 3.3). In general, caution must be exercised in treating the ratio of poverty lines as a price indexes if the basket is not fixed. [32] [33] Chen and Ravallion (2010) show that poverty lines across countries increase in real terms with mean consumption, though with an elasticity at less than unity. This suggests that even absolute poverty lines have an element of relativity as minimum needs are defined and redefined within the context of a society's overall standard of living. Likewise, changes in the definition of consumption (particularly related to nonfood items) can necessitate an adjustment of the poverty line unrelated to price changes. Sandefur (2013, 10) argues that his database is restricted to national poverty lines from "similar household surveys and using comparable definitions and methodologies to construct a cost-of-basic-needs poverty line," but closer investigation of the poverty line ratios reported in his paper suggests that these poverty lines are often, in fact, not comparable over time (see appendix table A4).

Case study evidence

Case studies show examples of CPI bias in both directions in countries in Africa. Table 5 summarizes a number of empirical studies that make an assessment of CPI inflation in countries in Africa. While these studies differ in scope and methodology (some focus explicitly on price trends among the poor; others are concerned with general inflation), they nonetheless provide a useful picture of some of the practical problems of CPIs in the region.

In Ghana, Kenya, Malawi and Tanzania, assessments (often conducted by the International Monetary Fund [IMF]) reveal that the official CPI series over several years in the late 1990s and early 2000s did not measure general inflation trends correctly. In Ghana, Tanzania, and probably also Malawi, this mismeasurement was the result of computational errors, whereas, in Kenya, it appeared to be related to a specific aggregation approach. In Kenya (in 2010), Malawi (in 2013), and Tanzania (in 2006), this led to a revision of the official CPI series. In the case of Zambia, the food CPI shows much higher inflation than the increase in the nominal cost of a fixed food basket (priced using disaggregated CPI data). Because both approaches draw on the same input price data, the gap is likely related to the weighting or aggregation procedures of the CPI. In Burkina Faso, Günther and Grimm (2007) document inflation inequality across the distribution. Table 5

[32] In this case, the only real anchor of the two poverty line baskets is the nutrition requirement underlying the food poverty line.

[33] There could be exceptional cases wherein reestimating the nonfood component of the poverty line yields meaningful comparisons of real welfare (see Lanjouw and Lanjouw 2001 and subsection 3.3).

documents both underestimation of inflation (Burkina Faso 1994–98, Ghana, Malawi, and Tanzania) and overestimation (Burkina Faso 1998–2003, Kenya, and Zambia).

Table 5: Summary of case study evidence

Country	***Main findings***
Burkina Faso	Günther and Grimm (2007) compare CPI inflation 1994–2003 with percentile-specific proxy deflators. The proxy price indexes are based on food-crop and grain prices (from an external source) and price changes for other consumption goods as measured by the official CPI. Percentile-specific consumption patterns from the household survey allow inflation inequality to be estimated across the distribution. The study finds that the *CPI understates inflation among the poor in 1994–98 and overstates inflation among the poor in 1998–2003* because of changing relative prices and the CPI's plutocratic bias.
Ghana	IMF (2003a, 2007) finds that data cleaning protocols (where missing data were treated as no change in prices) resulted in an *underestimation of inflation in 1999–2001*. It is unclear from the reports if a revised series was eventually released.
Kenya	IMF (2010a, 2012) finds that the *CPI overstated general inflation between the late 1990s and 2009* because of the aggregation method used, the linked-Carli method, which amounts to an (unweighted) arithmetic average of price relatives. In 2010, the Kenya National Bureau of Statistics released a revised series in which aggregation is based on geometric means that corrects the upward bias and backcasts inflation back to 2005.
Malawi	World Bank (2015c) reports on a 2012 review of the CPI, which found that food inflation in 2005–11 was underestimated and caused the NSO to release a new, rebased CPI series in 2013. Among other recommendations, the review suggested enhanced data collection and better handling of missing values.
Tanzania	The IMF AFRITAC mission reviewed the Tanzanian CPI in 2006. The review was triggered by a peculiar index pattern showing that, for several years, all inflation occurred in January. As discussed in World Bank (2007), the mission concluded that the *CPI underestimated general inflation in 2002–05* because of outlier cleaning protocols and other computational errors, though the official report was not released to the public. The mission assessment led to an official revision of the CPI in 2006 (as a revised series). However, case study evidence suggests that the *CPI may have continued to underestimate inflation in 2006–09*. This notion is based on a comparison of the official CPI with a proxy CPI built up from disaggregated CPI data (see World Bank 2007; Adam et al. 2012). No further empirical evidence is available after 2010 when the Tanzania CPI went through a complete overhaul (which included a rebasing of index weights to 2007).
Zambia	*The food CPI shows much higher inflation over 1996–2006 than the cost increase of a basic needs food basket*, whereby the basket weights are fixed as end-of-period quantities, and the prices are built up from the disaggregated CPI database (see CSO 2010a, 2010b for details). The discrepancy is too large to reflect only discrepancies between Laspeyres- and Paasche-type weights and may be related to inflation inequality across the distribution or the data aggregation and cleaning procedures in the official CPI.

Note: The Zambia example is based on earlier consultancy work of the author; details are available on request.

3.3 Alternative approaches used for price adjustment in national poverty estimates

While CPIs are used to update the international $1.90-a-day poverty line over time (at the country level), the deflation/inflation methods used for national poverty estimates differ significantly across countries and, sometimes, even within countries over time. This subsection examines the price adjustment methods (other than the CPI) utilized by statistical agencies in Africa and academic studies to measure trends in poverty. Table 6 shows examples of each approach. This review is not meant to be comprehensive, but to give a flavor of the different approaches that exist and the degree of diversity in methods.

Survey-based price indexes vs. price indexes combining multiple data sources

This distinction is essentially about the source of price data. Survey-based price indexes rely solely on the HBS. In most cases, these price indexes are based on quantities and unit values from the consumption module, though other survey-internal sources of price data (such as market price modules) may also be used. Because unit values are difficult to define for nonfood items, survey-based price indexes are often either designed narrowly as food price indexes or include an ad hoc basket of a few nonfood items (deemed reasonably homogenous). In contrast, price indexes combining multiple data sources draw on external

information that is not available through the household survey. For example, unit record prices or elementary aggregates from the CPI database can be combined with quantity data from the household survey to compute a price index for the poor. Compared with the CPI, this approach has the advantage that the analyst has full control over the weights and the aggregation approach. This allows, for instance, for the use of quasi-democratic weights and permits concerns about computation errors and related issues in the CPI to be addressed.

Primary vs. derived price indexes

This distinguishes between price indexes that are computed directly from price and quantity data and those that are derived indirectly based on other price indexes. The defining feature of derived price indexes is that the analyst lacks access to the full set of price and quantity data. Survey-based price indexes are typically primary price indexes because they are computed directly from the underlying microdata. At the other end of the scale are price indexes that draw explicitly on the CPI, including subcomponents, or other published price indexes. Günther and Grimm (2007), for instance, estimate poverty trends in Burkina Faso based on a price index that is a weighted average of trends in grain market prices and price trends in other consumption items as measured by the CPI, excluding food crops (that is, CPI price changes with food crops netted out). Likewise, though not in Africa, McCulloch, Weisbrod, and Timmer (2007) analyze poverty trends in Indonesia over 1993–2002 using a price index that reweighs the commodity-level subindexes of the CPI according to the consumption patterns of the bottom quintile. Similarly, Chen and Ravallion (2013), in a global assessment of poverty, reweigh the CPIs of 15 countries so that the weight of food corresponds more closely to the food budget shares of households close to the poverty line.

The distinction between primary and derived price indexes may require a degree of judgment. For instance, price indexes that draw on CPI data often do not use the item- and store-level price quotations of the CPI price data collection, but, rather, elementary aggregates computed by the statistical office on which some degree of aggregation has already taken place. This note refers to these price indexes as primary price indexes because a large part of the upper-level aggregation is performed by the analyst.

Price index vs. poverty line updating

In many cases, price adjustments are not performed through a price index, but by updating an existing poverty line. In this case, an implicit price index is only computed ex post as the ratio of nominal poverty lines (compare the discussion in the previous section). The characteristic feature of this approach is that the starting point of the price adjustment is the poverty line, especially the food poverty line. Under certain conditions, deflation using a price index and poverty line updating can be equivalent, but often they are not. Assuming the same input data sources are used, the price updating of a fixed basket of goods resembles a Laspeyres or Paasche index, depending on whether the basket weights are fixed as base or end-of-period quantities. However, in practice, there are sometimes important differences between poverty line ratios and price indexes, often because the poverty lines allow quantities to vary over time (as illustrated in table 6 and appendix table A4). Generally, while the CBN method allows the quantities of consumed food items to be held constant, fixing nonfood quantities cannot be easily carried out because the nonfood component is estimated as a markup to the food poverty line. This is illustrated below using three common approaches to updating an existing CBN poverty line over time. The more quantities are allowed to vary, the more the poverty line update parts from what is commonly understood as inflation.

(1) A fixed food basket with a constant nonfood share. This method re-prices a fixed (that is, constant in quantity) food basket at current prices to update the food poverty line, while the nonfood share of the overall poverty line in both years is kept constant as a share of the food poverty line. If the food basket quantities are fixed at initial (start-of-period) values, this approach to updating the food poverty line effectively amounts to inflation using a Laspeyres food price index (with weights tailored to the poverty line). Recall that a Laspeyres index can be expressed as the ratio of the current- to the initial-period cost of a basket of

goods purchased in the base period. Conversely, if the quantities are fixed at current (end-of-period) values, as is sometimes the case if poverty lines are revised retroactively, the approach is identical to deflation using a Paasche food price index. Because the nonfood component is estimated as a constant markup over the food poverty line, this approach implicitly assumes that the inflation in nonfood items corresponds to food price inflation.

(2) A fixed food basket with a re-estimated nonfood share. The approach of updating the food basket is the same as described in (1). However, the nonfood component is estimated in both the initial and current periods as the average nonfood consumption of a (fixed) reference population. Because, under this approach, any changes in the value of the nonfood component may reflect both price and quantity changes, ratios of poverty lines computed using this method already depart considerably from the concept of changes in the cost of living. This holds true, especially, if the living standard of the average person in the reference population differs between the two periods so that income effects may drive substitution from food to nonfood items. Assume, for instance, that the nonfood component is estimated as the average nonfood consumption of the poorest 40 percent of the population (the bottom 40). If there is growth in real incomes among the bottom 40, Engel's Law predicts that this group increases the share of its budgets spent on nonfood items, irrespective of any change in prices. Price indexes based on poverty line ratios estimated using this method would erroneously identify this as a price increase.

Only under certain conditions does the re-estimation of the nonfood component yield a robust poverty comparison. Lanjouw and Lanjouw (2001) show that estimating the nonfood component of the poverty line based on the upper-bound approach proposed by Ravallion (1998) allows robust comparisons of poverty rates, under certain conditions. While this method is designed for situations where the definition of consumption has changed, it could also be used to obtain a proxy price index (see World Bank 2015a). However, the robustness of the method hinges on several assumptions. In particular, consumption patterns have to follow Engel's Law (or an equivalent regularity, depending on how the items are grouped), and there should be no fundamental change in relative prices. Because the latter is precisely the context in which inflation trends tend to become difficult to assess, the relevance of the method to obtain an alternative estimate of inflation is somewhat limited.[34]

(3) A re-estimated poverty line. In some cases, statistical offices compute an entirely new poverty line for a new HBS, rather than update an existing poverty line. There are different justifications for such an approach, including changes in the measurement of consumption in the latter survey, concerns about outdated consumption patterns underlying the food basket, and so on. If the poverty line is redrawn using a methodology that is similar to the one underlying the previous poverty line (in terms of calorie anchor and so on), the resulting poverty estimates are sometimes treated as broadly comparable. However, strictly speaking, this is not the case because any change in the value of the poverty line reflects both price and quantity changes, so that the poverty line is no longer explicitly anchored on a constant standard of living. In other words, the challenges described above for the nonfood component of the poverty line now also extend to the food poverty line, which is no longer based on a fixed basket of goods.[35]

African countries use different variants of the approaches described in this section to measure poverty trends at the national level. This is shown in table 6, which describes the various inflation approaches used for

[34] With these caveats in mind, the Lanjouw and Lanjouw (2001) method and similar techniques (for example, the Engel curve estimations, following Costa 2001 and Hamilton 2001) can be used to cross-triangulate the CPI trend or generate an alternative series of poverty measures (see World Bank 2015a for an example in Bangladesh).

[35] The food poverty line, unlike the nonfood component, has a nutritional anchor. Hence, pure quantity effects (for example, a proportional increase in all consumed quantities) would not play a role because the basket would be rescaled to deliver the predefined calorie norm. Only quantity changes that involve some substitution (such that the average price per calorie changes) would play a role. With respect to the nonfood component, even a proportionate increase in consumed quantities could affect the level of the overall poverty line and, hence, the poverty line ratio.

official national poverty estimates as outlined in this section. This shows that national practices cover a wide spectrum, including price updates using the CPI (or other price indexes, for example, the GDP deflator), survey-internal price indexes, poverty line updates with fixed or varying quantities, and so on. The lack of uniformity in methods demonstrates that there is little guidance on how to update poverty lines for inflation. Arguably, a single gold standard does not exist, and countries tend to use ad hoc approaches based on historical legacies, advice provided by specific technical consultants, and so on.

4. Conclusion

Price trends are critical for measuring poverty. Yet, the methods used for price adjustment of consumption data in the context of national poverty estimations in Africa are often ad hoc. The international ($1.90-a-day) poverty estimates are more consistent in the use of CPI to measure and adjust for inflation, but CPIs in the region can be seriously biased and may not be suitable indicators of the prices changes experienced by the poor. Accurate measurement of poor people's inflation experience is relevant not only for poverty measurement, but also for social protection programs, to adjust benefit levels over time, as well as other fiscal policy instruments directed towards households.

The CPI is the most widely used measure of price changes. Much of the academic literature on CPI bias is based on the experience in the United States and other high-income countries with mature consumer price data collection programs. In these countries, researchers have focused on biases arising from consumer substitution behavior, new goods, and quality improvements. However, NSOs in Africa face additional challenges related to the limited geographical coverage of price data collection programs and errors introduced by flawed data cleaning protocols. These first-generation issues are arguably of greater importance for African countries than the more sophisticated measurement techniques that are being debated in the developed world.

Price data collected in household surveys will continue to play an important role in many countries in the medium future. CPI data, important though they are, currently do not meet all price data requirements for poverty analysis. In many countries, consumer price data do not have relevant spatial coverage and, hence, may not easily allow for the computation of inter-area price indexes. In some countries, there may also be challenges in accessing CPI unit record data or elementary aggregates. Poverty analysts need to consider these issues routinely in the planning of household surveys to ensure that appropriate alternative price data sources are produced through those surveys.

Looking ahead, several areas emerge as important for the agenda to improve the quality and methods used to assess price changes and, thereby, trends in poverty and household living standards.

More methodological research on price data collection in household surveys and related analytical work is needed. The results of survey experiments in Papua New Guinea (Gibson and Rozelle 2005) suggest that unit values are a poor proxy for market prices and that price opinion surveys (administered to knowledgeable key informants) perform more effectively. There is no evidence on this issue for Africa. In countries were CPI programs only collect urban prices, further analysis of existing household survey-based price data may help to get a better understanding of urban-rural differences in prices levels and trends.

Data collection based on mobile phones and other information and communication technologies (ICTs) have the potential to bring down the cost of CPI programs and other price statistics significantly. This could enable collecting more price observations from rural areas. It also allows for easily georeferencing price data collection points. However, more research is needed to test the validity and feasibility of crowd-sourced and other ICT-based price data collection methods (e.g. as in Hamadeh, Rissanen, and Yamanaka 2013). The experience of private sector companies – such as mobile phone operators or data technology

start-ups like Premise[36] (Assar 2013) – in collecting local producer and/or consumer prices through smartphones can also bring insights.

A better understanding of inflation inequality would be important. Plutocratic bias may be more relevant in the developing world (especially Africa) than in high-income countries, particularly in times of rapidly increasing food prices. There is scope for more systematic evaluation of inflation inequality in African economies with reliable price data series, for instance, by reweighting existing CPI series. In addition, it would be useful to review the experiences of those NSOs that already publish separate inflation rates for different consumer segments or a 'CPI for the poor'.

More detailed guidelines for integrating CPI activities with other price statistics are needed. There are significant challenges in reverse engineering existing CPI data to obtain spatial deflators, especially in large countries. However, such efforts would greatly benefit from closer alignment between different price statistics programs. ILO et al. (2010) discuss strategies for the more effective integration of CPI and ICP activities and outline a sequence of steps to achieve progressively greater integration. NSOs currently mostly engaged in the extreme ends of the spectrums -- that is, national CPI and global ICP activities. There could be a natural middle ground for extending CPI and ICP programs to collect data that would ultimately also allow for inter-area price comparisons within countries.

Periodic cross-triangulation of CPI inflation would help to identify problems. In countries where NSOs share CPI unit record data or elementary aggregates, proxy CPIs could be used to cross-triangulate the CPI inflation trend and help diagnose more severe forms of CPI mismeasurement at an early stage (for an example, see World Bank 2007).

Given that NSOs are the source of most of these efforts, funding and technical assistance for statistics should not only be directed at the HBSs, but also cover price statistics programs (and potentially other core economic indicators). Targeted support for NSOs with weak CPI programs should be considered.

NSOs also need to look for more synergies between their CPI program and HBSs. To support the analysis of poverty trends, CPI programs should ensure good coverage of food items with a large budget share in the food poverty line in addition to basic nonfood items. CPI programs would also become more useful for poverty analysis if the sample of localities drew from the enumeration areas used for the HBSs. On the other hand, HBS data could inform CPI programs, particularly the sampling of outlets, if they collected nationally representative data on the types of markets, traditional stores, supermarkets, and so on that are frequented by households.

[36] See https://www.premise.com/.

Table 6: Price adjustment methods for national poverty estimation differ widely across African countries

Country	*Period*	*Approach used for between-survey price adjustment*							*Data sources*		*Reference*
		Price index			*Poverty line update*				*HBSs*	*Multiple sources*	
		(X=yes)	*If yes, what type of index?*		*(X=yes)*	*If yes, are quantities fixed?*					
			CPI or other price index (as is)	*Primary (commodity-specific price and quantity data)*		*Fixed food basket with constant nonfood share*	*Fixed food basket with reestimated nonfood share*	*Reestimated poverty line*			
Benin	2002–06	**X**	GDP deflator							X	Government of Benin (2007)
Burkina Faso	1994–2003				**X**			X		X	World Bank (2005)
Cameroon	1983–96	**X**	Yaoundé price index							X	World Bank (1995)
Ethiopia	2000–05	**X**	CPI								World Bank (2015d)
Ethiopia	2005–10				**X**		X		X		World Bank (2015d)
Ghana	2005/06–12/13	**X (f*)**		X	**X (nf*)**		X			X	World Bank (2015e)
Malawi	2004/05–2013	**X**		X					*X*		World Bank (2015c)
Mali	1994–98	**X**		X (rice)					*No information*		Government of Mali (2000)
Mauritania	1996–2008	**X**	CPI								MAED (2011)
Tanzania (HBS)	2001–11/12	**X**		X					X		World Bank (2015f)
Tanzania (National Panel Survey series)	2008/09–12/13	**X**		X					X		NBS (2012, 2014)
Uganda	1993/94–2009/10	**X**	CPI							X	UBOS (2006)
Zambia	1996–2006				**X**	X				X	CSO (2010a, 2010b)

* In the case of Ghana, a food price index is combined with a reestimated nonfood share.

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Appendix

Table A1: Rural-urban price differences

Author	*Country*	*Period*	*Method*	*Finding*
Differences in price levels				
Deaton and Dupriez (2011a)	India	2004/05	Quality-adjusted unit values	Food prices in urban areas around 11% higher than in rural areas
Deaton and Dupriez (2011a)	Brazil	2002/03	Quality-adjusted unit values	Food prices similar in urban and rural areas
Majumder, Ray, and Sinha (2012)	India	1999/2000, 2004/05	Estimation of demand systems; unit values with quality adjustment	Food prices higher in urban areas than in rural areas
Brandt and Holz (2006)	China	1990, 2000	National basket priced at urban/rural prices in 1990, updated to 2000 using urban/rural CPI	Aggregate food and nonfood prices around 24% (31–39%) higher in urban areas than in rural areas in 1990 (2000)
Differences in price trends				
Brandt and Holz (2006)	China	1990–2000	Urban/rural CPI	Urban inflation (7.9% annually) higher than rural inflation (6.6% based on official rural CPI; 7.3% based on adjusted/reweighted rural CPI)

Table A2: Sources of price data for recent poverty analysis in Africa

Country	*Period*	*Within-survey deflation*	*Across-survey deflation*	*Source*
Official and semiofficial poverty estimates				
Kenya	2005/06	Unit values from survey expenditure module	New poverty line	KNBS (2007)
Malawi	2004/05, 2010/11, 2013	Disaggregated CPI price data and regional CPIs	Unit values from survey expenditure module for food and prices from community/market module for nonfood items (cross-triangulated with disaggregated CPI data)	World Bank (2015c)
Rwanda	2000/01, 2005/06	External price data program (MINAGRI Mercuriale) for food and disaggregated CPI data for nonfood items	(same as within-survey deflation)	McKay and Greenwell (2007)
Sierra Leone	2003/04	Regional CPIs	New poverty line	SSL (2004)
Tanzania HBS	2001, 2007, 2011/12	Unit values from survey expenditure module	(same as within-survey deflation)	World Bank (2015f)
Tanzania, **National Panel Survey**	2008/09, 2010/11, 2012/13	Unit values from survey expenditure module	(same as within-survey deflation)	NBS (2012, 2014)
Uganda	1999/2000, 2002/03, 2005/06	Unit values from survey expenditure module	CPI	UBOS (2006)
Zambia	1996, 1998, 2004, 2006	Disaggregated CPI price data	(same as within-survey deflation)	CSO (2010a, 2010b)
Academic papers				
Burkina Faso	1994, 1998, 2003	Regional price indexes provided by the NSO	External price data (Burkinabe Grain Market Price Surveillance System) and CPI (subcomponent indexes)	Günther and Grimm (2007)

Table A3: CPI bias estimates using Engel curves

Country	*Time period*	*Author*	*CPI bias*	*Periodicity*
United States	1888/90–1917/19	Costa (2001)	*−0.1*	annual
United States	1917/19–1935/36	Costa (2001)	0.7	annual
United States	1960–72	Costa (2001)	0.4	annual
United States	1972–82	Costa (2001)	2.7	annual
United States	1982–94	Costa (2001)	0.6	annual
United States	1974–81	Hamilton (2001)	3.0	annual
United States	1981–91	Hamilton (2001)	1.0	annual
Canada	1978–2000	Beatty and Larsen (2005)	1.3–1.9 (depending on demographic group)	
Norway	1990–99	Larsen (2007)	*−1.2*	annual
Australia	1975/96–2003/04	Barrett and Brzozowski (2010)	~1.0	annual
New Zealand	1984–2001	Gibson and Scobie (2010)	~1.0	annual
Korea, Rep.	2000–05	Chung, Gibson, and Kim (2010)	0.7	annual
Indonesia	11/1993–11/1997	Olivia and Gibson (2013)	*−18.9*	annual
Indonesia	11/1997–09/2000	Olivia and Gibson (2013)	*−5.4*	annual
Indonesia	09/2000–02/2008	Olivia and Gibson (2013)	10.6	annual
Russian Federation	1994–2001	Gibson, Stillman, Le (2008)	0.9	monthly
Brazil	1987/88–2002/03	de Carvalho Filho and Chamon (2012)	3.0	annual
Mexico	1984–2006	de Carvalho Filho and Chamon (2012)	~3.0	annual
China	1993–2005	Chamon and de Carvalho Filho (2014)	1.0	annual

Note: CPI bias is expressed in percentage points per year (or month, depending on periodicity) and needs to be compared to the level of official inflation. For example, if the headline inflation rate is 2.0 percent a year, a CPI bias of 1.0 implies that half of the officially measured inflation is attributable to bias, and the true increase in the cost of living amounts to only 1.0 percent a year. Some studies provide different estimates of aggregate bias (for instance, by demographic group) or use various sensitivity checks (for example, ordinary least squares versus instrumental regressions). Some authors give rounded or other approximate estimates. Negative estimates are highlighted in italics and show the extent to which the CPI understates inflation (in percentage points).

Table A4: Review of Sandefur (2013) poverty lines

Country, period		*Inflation in Sandefur (2013)*		*Poverty lines in source document*			*Summary evaluation*
		CPI	*Survey*	*Year 1*	*Year 2*	*Ratio Y2/Y1*	
BEN	1995–2000	20.0	22.2	CFAF 42,075	CFAF 51,413	22.2	CBN-type (rural) poverty lines, possibly redrawn in the two years, that is, the basket may not be fixed (see IMF 2003b).
BEN	2000–02	6.6	45.7	CFAF 51,413	CFAF 74,886	45.7	CBN-type poverty lines, likely redrawn and noncomparable because a rural poverty line for 2000 is compared with a national poverty line for 2002; see Government of Benin (2007).
BFA	1995–98	14.1	76.9	CFAF 41,099	CFAF 72,690	76.9	CBN-type poverty lines, likely redrawn (see the reference to a revised consumption basket in Fofack, Monga, and Tuluy 2001)
BFA	1998–2003	8.0	13.7	CFAF 72,690	CFAF 82,670	13.7	CBN-type poverty lines, redrawn and noncomparable (see World Bank 2005 for a discussion).
BWA	1994–2003	107.5	37.6	P 415.40	P 571.65	37.6	Likely a mixture of CPI updates and repricing (with some adjustments to the basket), but this is not clear (see IPC-UNDP and BIDPA 2005).
BWA	2003–10	80.7	53.7	P 571.65	P 878.87	53.7	Likely a mixture of CPI updates and repricing as above, but no additional information.
CIV	1993–95	44.1	42.9	CFAF 101,340	CFAF 144,800	42.9	An initial relative poverty line is adjusted over time for inflation; the close correspondence between the poverty line and CPI inflation suggests that the CPI was used for inflation adjustment. See also Government of Côte d'Ivoire (2002) and World Bank (2006).
CIV	1995–98	11.6	12.4	CFAF 144,800	CFAF 162,800	12.4	As above.
CMR	1983–93	44.2	32.1	CFAF 78,000	CFAF 103,000	32.1	An initial relative poverty line (1983) is price adjusted to 1993, most likely using a price index for Yaoundé (see World Bank 1995).
CMR	1993–96	53.1	43.7	CFAF 103,000	CFAF 148,000	43.7	Most likely as above.
CMR	1996–2001	16.4	57.1	CFAF 148,000	CFAF 232,547	57.1	An inflation adjusted 1983 poverty line (in 1996 prices) is compared with a newly redrawn poverty line in 2001. IMF (2003c) explicitly mentions that the poverty lines are not comparable and mentions that the 1996 line was reestimated to CFAF 185,490.
CMR	2001–07	12.2	15.9	CFAF 232,547	CFAF 269,443	15.9	Unclear, price updated or redrawn (lines tabulated in IMF 2010b). But the inflation difference is not large in any case.
KEN	1982–92	255.8	823.4	K Sh 105.9	K Sh 485.0	357.8	Survey inflation rates cannot be reproduced using the source document and also do not appear plausible. The rural poverty lines cited in Kabubo-Mariara and Ndeng'e (2004) show inflation rates that are closer to the CPI, though there is still a substantive gap. These poverty lines are likely based on a fixed or nearly fixed food basket and a reestimated nonfood share.
KEN	1992–94	88.0	−50.4	K Sh 485.0	K Sh 978.3	101.7	As above.
KEN	1994–97	23.1	155.5	K Sh 978.3	K Sh 1239.0	26.7	As above.
MLI	1994–96	21.2	33.4	CFAF 77,204	CFAF 102,971	33.4	Inflation update based on the price of rice (rice equivalent method, as discussed in Government of Mali 2000). Marouani and Raffinot (2003) raise concerns about the method in general and the associated inflation trend.
MLI	1996–98	3.7	0.2	CFAF 102,971	CFAF 103,130	0.2	As above.
MRT	1996–2000	21.5	24.3	UM 58,400	UM 72,600	24.3	International poverty line, updated for inflation (MAED 2011). The close correspondence between the poverty line and CPI inflation and the fact that the poverty rates are based on income (not consumption) suggest that the CPI was used for inflation adjustment.
MRT	2000–04	26.3	30.4	UM 72,600	UM 94,650	30.4	As above.
MRT	2004–08	37.2	36.3	UM 94,650	UM 129,000	36.3	As above.
NER	1994–2005	42.9	39.7	CFAF 75,000	CFAF 144,750	93.0	The 1994 urban poverty line—CFAF 75,000—is probably based on an ad hoc or relative procedure; this notion is supported by the round values of the rural and urban extreme and overall poverty lines and the description in Government of Niger (2002). The CFAF 104,750 poverty line for 2005 should likely be CFAF 144,750. The CFAF 144,750 poverty line for urban areas cited in the document is based on the CBN method and is therefore not comparable to 1994; see also Government of Niger (2006).
TZA	2000–07	47.3	93.0	T Sh 7,253	T Sh 13,998	93.0	Inflated using the Fisher price index (food and nonfood).

Source: Based on poverty lines reported in Sandefur (2013).
Note: Red indicates a mismatch between the survey inflation reported in the table and the poverty lines in the source document.