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Keep it real

Measuring real inequality using survey data from developing countries

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Abstract: This paper investigates how two effects drive wedges between nominal and real inequality estimates. The effects are caused by (i) differences in the composition of consumption over the income distribution coupled with differential inflation of consumption items; and (ii) quantity discounting effects for the non-poor. Household-specific deflators are estimated using 15 surveys collected in six countries in the period 1999–2011. In some countries (Mozambique, Tanzania, Malawi, and Pakistan), nominal inequality is lower than real inequality. In other countries (Ethiopia and Madagascar), no differences are found. Finally, I argue that poverty estimation based on national account consumption means and estimates of inequality from consumption surveys should employ real, rather than nominal, inequality estimates. This increases the level and reduces the decline of poverty over time, but the magnitude of the adjustment is country- and year-specific.

Keywords: real inequality, consumption structure, quantity discounting, food and non-food inflation, poverty measurement
JEL classification: D12, D63, I32, O57

Figures and Tables: at the end of the paper.

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1 Introduction

Measures of inequality are often used to direct and evaluate policy. In developing countries, inequality estimates are typically based on a consumption module included in nationally representative surveys. Based on this, a consumption aggregate is constructed. This aggregate is a measure of the value of consumption by a household. There are some technicalities involved with estimating the consumption aggregate: for instance, housing costs are often imputed, and the cost of durable goods must be spread out over multiple years (Grosh and Deaton 2000; Deaton and Zaidi 2002). Nevertheless, at its heart, the value of consumption is reached by multiplying current prices with quantities. As such, the standard consumption aggregate is a nominal concept. Inequality indices derived from nominal consumption aggregates are therefore also nominal in their nature.

There are at least two reasons why basing inequality estimates on a real consumption aggregate—and thereby estimating what I refer to as real inequality—is relevant. First, the poorest households tend to dedicate a higher share of their spending towards basic food items, the prices of which have been rising faster than other prices in recent years. I refer to this as the composition effect. Second, if there is a systematic difference in the prices faced by households over the income distribution, nominal inequality will differ from real inequality. Specifically, this can arise when the poor tend to purchase items in smaller quantities which can lead to higher prices. I refer to this as the quantity discounting effect. This paper aims to empirically estimate deflators of these two effects, proceed to estimate real consumption aggregates, and use these to compute estimates of real inequality.

I overcome the substantial data requirements for this task by building on the set of country-specific databases that were constructed as part of the UNU-WIDER project on 'Reconciling Africa's Growth, Poverty and Inequality Trends: Growth and Poverty Project' (GAPP).[1] Using 15 surveys from six different countries (Ethiopia, Madagascar, Malawi, Mozambique, Pakistan, and Tanzania), collected in the period 1999–2011, and covering over 220,000 households, I construct household-specific indices of the composition and the quantity discounting effects.

The paper proceeds by investigating how real inequality estimates affect poverty figures when estimated using a method developed in the series of studies by Sala-i-Martin and Pinkovskiy (hereafter SiMP). This method finds poverty rates by fitting two-parameter consumption distributions using inequality estimates obtained from survey data and national account information on income per capita (Pinkovskiy and Sala-i-Martin 2009, 2014; Sala-i-Martin 2006; Sala-i-Martin and Pinkovskiy 2010). Using this approach, the authors find that poverty is falling much faster than that observed by other methods of poverty estimation. Sala-i-Martin and Pinkovskiy (2014) state that the discrepancy is mainly caused by differences in the growth rates of mean per capita consumption observed in the surveys and the mean per capita gross domestic product (GDP) observed in the national accounts. These differentials are not disputed; however, this paper shows that using the proper inequality estimates also matters.

The composition and the quantity discounting effects have been studied before. This paper contributes to the existing literature by providing empirical evidence for six different developing countries. I also develop a method to estimate the quantity discounting effect using existing nationally representative consumption data. Finally, the investigation of how the use of real

[1] See more on the project website: https://www.wider.unu.edu/project/reconciling-africa%E2%80%99s-growth-poverty-and-inequality-trends-growth-and-poverty-project-gapp.

inequality indices affects poverty estimates using the SiMP methodology provides insight of the robustness of results using this method.

The strength of the two estimated effects differ substantially across countries. In some countries, the poorest households were subject to a double penalty which is the result of a combination of high food inflation rates for the consumption bundle of the poor and of the poor buying in smaller quantities. In continuation of this, the decline in poverty using the SiMP methodology may be overestimated, and the level of poverty underestimated. This paper therefore explains part of the gap between the very optimistic results of Pinkovskiy and Sala-i-Martin (2014) and other, more mixed findings.

2 Empirical framework

This section explains how the two effects described briefly in the introduction arise and how they are estimated.

2.1 The composition effect

The composition effect occurs when the relatively poor spend a larger part of their income on basic food items and there are disproportionate increases in the prices of these items. This effect has been studied in some detail for developed countries (see, for instance, Cage et al. 2002; Leicester et al. 2008; Muellbauer 1974). A higher consumption share of food items by the poor has also been found in developing countries, even though the impact on inequality has not been the focus of the majority of this body of work (Aksoy and Isik-Dikmelik 2008; Deaton 2003; Günther and Grimm 2007; Pritchett et al. 2000).

The hike in food price inflation after 2000, culminating in the price spike of the food price crisis of 2007–09, provides a rationale for estimating the magnitude of such effects (Mitchell 2008; Wiggins et al. 2010). A few recent papers have explored the link between the composition effect and inequality in developing countries more directly (Goñi et al. 2006; Mohsin and Zaman 2012). The work most closely related to this paper in its approach to estimating the composition effect is that of Arndt et al. (2015). The authors find that the structure of consumption bundles varies across the income distribution. Owing to more rapid inflation in the prices of basic goods, nominal inequality was found to underestimate real inequality by several Gini points for Mozambique in 2008.

In this paper, I follow the method proposed by Arndt et al. (2015).[2] Consumption items are divided into three groups: core food items, non-core food items, and non-food items. A household-specific Paasche price index that takes into account differential inflation rates of these three groups of items is then given by

$$CPI_{COMP}^{i,t} = \left(\frac{p_c^1}{p_c^t} s_c^{i,t} + \frac{p_{nc}^1}{p_{nc}^t} s_{nc}^{i,t} + \frac{p_{nf}^1}{p_{nf}^t} s_{nf}^{i,t}\right)^{-1}. \tag{1}$$

[2] Arndt et al. (2015) also consider spatial differences in price levels. If poorer households are overrepresented in spatial domains with higher price levels, failing to correct for this will underestimate inequality. I do not consider spatial differences in prices in the estimation of the composition effect; instead, a spatial price index is applied throughout where available. Thus, the ‘nominal’ inequality estimates of this paper contain spatial price corrections.

Here, p_a^t is the index price in year t of group a products, where a can be core (c), non-core (nc), or non-food (nf), and $s_a^{i,t}$ is the share of consumption used for group a products purchased by household i in year t.[3]

There are two principal challenges associated with implementing this approach consistently across countries. The first is how to choose which food items should be included in the core and the non-core food groups, respectively. This choice should be country-specific since food consumption patterns vary substantially between countries. It should also be general since cross-country results can only be meaningfully compared if the decision rule is consistent across countries. An option that fits both of these criteria is to define the core food items as those included in the food poverty lines estimated by GAPP in year t of each country. The poverty food basket is chosen consistently across countries, and across surveys within countries, in order to represent the most important food items for the poor. This makes this group of products an ideal candidate for the core food group. I do not use the inflation rates of the food poverty line as an estimate of the temporal change in p_c^t, since items are allowed to move in and out of the food poverty bundle over time, and since the prices used to estimate the poverty lines are often estimated specifically for the poor. Instead, I re-estimate weights and price increases for the food items in the food poverty bundle directly from the survey data. Since the poverty lines vary at the sub-national level, and since this paper is concerned with estimating food inflation at the national level, a procedure to reconcile this difference is needed. I choose to keep only items that are present in the poverty lines of two or more spatial domains of year t, and also present in the first survey ($t = 1$), though not necessarily part of the poverty basket in the first survey. In order to increase precision of the estimated unit prices, I further restrict the group of food items to those items where each survey has at least 200 recorded purchases.

The second challenge is to estimate price changes of core foods, non-core foods, and non-food items separately. It is feasible to estimate all price changes from survey information alone owing to missing prices and few purchases of some goods. Furthermore, detailed consumer price index (CPI) information at the product level is not always available, especially for rural areas. For the core food items, the surveys contain sufficient information to calculate price changes directly from the survey. However, this is not the case for the non-core food items and the non-food items. The non-core food items are not observed as frequently in the data, and using the survey prices is not an option. The non-food items are typically only reported as (nominal) values, not as prices and quantities. Instead of using the survey data, I use external sources of CPI information that is available separately for food and non-food items. For the non-food group of items, the non-food CPI series can be directly used.

For the non-core food items, I proxy the non-core food inflation by the total food CPI series. One can think of the total food CPI series as a weighted average of core food and non-core food CPI series. Therefore, estimation of the core food inflation from the household data means that the direction of the bias of the non-food inflation index is known. As it will become clear, the bias tends to attenuate the magnitude of the composition effect; the estimates presented here can therefore be seen as a lower bound on the true effect sizes.

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[3]Arndt et al. (2015) do not use a Paasche index. This paper uses a true Paasche index as its properties are well known. Specifically, if there is substitution towards goods that become relatively cheaper, a Paasche index will underestimate the rate of inflation. This means that inflation estimates reported here are a lower bound on the true inflation rates in the presence of substitution. The Paasche index is written in share expenditure form to ease estimation.

2.2 The quantity discounting effect

The quantity discounting effect arises when the poor purchase smaller amounts at a time, thereby missing out on quantity discounts. There are several explanations for why the poor would do so; I list four potential ones here. First, the poor may consume less. For perishable items, smaller purchases are rational, especially if poor households lack the capacity to securely store food items. Second, the poor may be credit constrained, leading to smaller and more frequent purchases. Third, the poor may not have the means to transport large amounts at a time. Fourth, the state of being poor increases stress and takes up mental capacity which impedes cognitive function, leading to suboptimal decisions (Mani et al. 2013).

The quantity discounting effect has been studied using unit prices, that is, prices calculated from quantities and values reported by households. The main pitfall with this approach is that the quality of the consumed items is variable and unobserved. A specific item code in the consumption module of a questionnaire must by necessity cover a variety of qualities, but higher quality items will have higher unit prices. This is difficult to separate from a potential quantity discounting effect: when high- and low-quality items share the same survey code. The problem of separating quality issues from true price variation has been referred to as the unit value problem (Beatty 2010; Chung et al. 2005; Crawford et al. 2003; Deaton 1988; McKelvey 2011). One popular approach to deal with this was proposed by Deaton (1988). His study assumes that all differences in unit prices are caused by quality differences within sufficiently small geographical areas. By getting rid of the between-area price variation, remaining unit price variation can be used to estimate quality differences of purchases. However, as argued by Attanasio and Frayne (2006), another potential source of price variation within geographical areas is quantity discounting. Using a consumption survey from Colombia, the authors find that unit values are in fact negatively related to monthly spending and to quantities bought, conditional on monthly spending which is included to control for varying demand for quality between households.

One way of reducing the confounding of quality effects and quantity discounting effects is to use a survey instrument specifically tuned to separate different qualities of the same product into different questionnaire items (Aguiar and Hurst 2007; Rao 2000). However, such specialized datasets are often not available, especially in developing countries. Alternatively, one could limit the study to reasonably homogenous items (Attanasio and Frayne 2006). However, when the topic of interest is national inequality, it is necessary to use a method that works with all items of consumption in addition to using the nationally representative surveys that exist.

In the following, I develop such a method that exploits information about the size of the purchases. By exploiting this information, one can non-parametrically estimate a household-specific price index which at least partially controls for quality differences. As a point of departure, I take the expensiveness index of Aguiar and Hurst (2007). The authors construct a household-specific expensiveness index in order to compare how expensively households bought their specific basket of goods. The index is given by

$$p_{AH}^{i} = \frac{\sum_m [p_m^i * q_m^i]}{\sum_m [\bar{p}_m^i * q_m^i]}. \tag{2}$$

Here, p_m^i is the price paid for product *m* by household *i*, $\bar{p}_m^i$ is the average price paid for product *m* in a geographical area where *i* resides, and q_m^i is the quantity household *i* bought of product

m.[4] This measure compares actual expenditures of household i with the cost of this bundle of food items, priced at the average prices. If the index is larger than one, the household is paying more for its bundle compared with the average household. Next, I introduce product-specific quantity bins. Using these bins, a more specific version of the index can be calculated, where u denotes the quantity bin of each purchase:

$$p_{AH-u}^{i} = \frac{\sum_m \sum_u [p_{m,u}^{i} * q_{m,u}^{i}]}{\sum_m \sum_u [\bar{p}_{m,u}^{i} * q_{m}^{i}]}. \tag{3}$$

This version of the index only compares products that were in the same quantity bin. Both Equations (2) and (3) are affected by quality in the same way. The quantity discounting effect can now be isolated by taking the ratio of the two indices and exploiting that the numerator in both Equations (2) and (3) is total household expenditure. This gives the final household-specific quantity discounting price index:[5]

$$CPI_{QUANT}^{i} = \frac{p_{AH}^{i}}{p_{AH-u}^{i}} = \frac{\sum_m \sum_u [\bar{p}_{m,u}^{i} * q_{m,u}^{i}]}{\sum_m [\bar{p}_{m}^{i} * q_{m}^{i}]}. \tag{4}$$

The necessary assumption for the quantity discounting index to exactly isolate the quantity discounting effect is that the quantity of purchase is uncorrelated with quality. If there is a correlation between quality and quantity of purchase it will continue to affect Equation (4). Since one can expect richer households to buy higher-quality items, this effect will bias results in the opposite direction of quantity discounting. Therefore, if it is found that the poor pay more for their food, the estimated effect can be seen a lower bound on the true effect size. As a baseline, I construct four bins separated at the 25th, 50th, and 75th percentile of the product-specific unit price distribution, but I check that results are robust to other numbers of bins. For a few surveys, the usage of quantity bins can be sidestepped altogether by using the unit of purchase instead. In these surveys, households are asked to report the unit of purchase. For instance, for the surveys of Malawi, respondents have the option of choosing between more than 20 units for each item. These include cups and plates but also kilograms and litres. We can exploit the variation in the unit directly by using units instead of quantity bins in Equation (4).[6]

The index of Equation (4) makes use of all variations in prices in the survey. However, if there is real price variation between geographical areas (Deaton 1988), the performance of the quantity adjusting index can be improved by estimating average prices at a smaller geographical area than the national level. This will matter if the poor are disproportionately likely to live in either high- or low-price areas. The final index is shown in Equation (5). Here, $\bar{p}_{m,u}^{g}$ denotes the average price of unit size u of item m in geographical area g where household i lives. In this version, the household-specific deflator of household i is based only on variation within the geographical area of household i.

$$CPI_{QUANT}^{i} = \frac{\sum_m \sum_u [\bar{p}_{m,u}^{g} * q_{m,u}^{i}]}{\sum_m [\bar{p}_{m}^{g} * q_{m}^{i}]}. \tag{5}$$

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[4] Some of the surveys employed for the empirical section of this paper do not allow separation between what is purchased and what is consumed from other sources, such as barter, gifts, and own production. The first-best is to use prices of purchased items only, so this is done wherever possible. This is possible to do for the surveys of Malawi, Mozambique, and Tanzania. However, not being able to do this does not invalidate the method.

[5] The index is subsequently normalized to have a mean of one.

[6] This method requires a correspondence between the unit of purchase (i.e. the object of interest) and the unit of consumption (i.e. what is measured). The two are likely to be highly correlated.

The geographical area employed in the remainder of the paper is the survey stratum. This means that any differences in prices between strata do not affect the quantity discounting effect. The number of strata is survey-specific; the surveys used in this paper have between 8 and 31 strata.

Perhaps the best way to illustrate the mechanics of the quantity index is with an example, which can be found in Table 1. Consider the purchase decision of a single good (Good 1) with four cases determined by whether the good is bought in a high- or low-quality version and in either a small or a large amount. Or, alternatively, one can think of four different households buying four different versions of the same good. For simplicity, the total cost of all other goods is set to one.[7] Buying the high-quality version is more expensive and buying the small-amount version is also more expensive. Since the price of purchase varies between the four cases, the two indices of Equations (2) and (3) also vary between the four purchases. However, the ratio between the two, as found in the last column of Table 1, only varies between the small and big units since the quality effect has been divided.

2.3 Estimating inequality

The deflated consumption aggregate for household *i* in year *t* is estimated as

$$Y_{real}^{i,t} = \frac{(y_c^{i,t} + y_{nc}^{i,t})/CPI_{QUANT}^{i,t} + y_{nf}^{i,t}}{CPI_{COMP}^{i,t}}, \qquad (6)$$

where y_c, y_{nc}, and y_{nf} denote nominal consumption aggregates of core, non-core, and non-food consumption, respectively, and $Y_{real}^{i,t}$ is real consumption. All other notation is the same as described earlier. Using population weights, nationally representative real Gini coefficients are estimated.

2.4 Estimating poverty

The poverty rate is the share of people who consume less than a given poverty line. A standard approach to estimating national poverty lines is to use information on consumption from nationally representative surveys and a calorie requirement in order to estimate the cost of consuming the calories needed, given the actual consumption structure of the poor. Subsequently, non-food requirements are estimated. The sum of the food and non-food requirements equals the total poverty line. This is the so-called cost of basic needs (CBN) approach (Ravallion and Bidani 1994; Tarp et al. 2002). The CBN methodology can be made robust to both the composition and the quantity discounting effects. The composition effect is implicitly handled since the poverty line is by definition the cost of a certain amount of the consumption bundle consumed by the poor. It is therefore price changes of the poor that influence the intertemporal change in the poverty line. The quantity discounting effect can be handled by pricing the consumption bundle using the prices paid by the poor, which is frequently done in practice. Another common approach is to impose an exogenously defined poverty line. The leading example of such a poverty line is USD 1.25 PPP (purchasing power parity)-adjusted in 2005 prices, as proposed by Ravallion et al. (2009).

Recently, Sala-i-Martin and Pinkovskiy have proposed a third approach (Pinkovskiy and Sala-i-Martin 2009, 2014; Sala-i-Martin and Pinkovskiy 2010). This approach uses inequality estimates and national accounts information on GDP to fit a two-parameter consumption distribution for

[7] One can also think of a household that makes consumption decisions under a binding budget constraint. If we let other expenditure adjust such that total expenditure is the same in all four cases, the result is unchanged.

each country. For most developing countries (and all countries considered in this paper), the inequality information based on the same consumption surveys is used to estimate poverty. Using the fitted distribution and the USD 1.25-a-day poverty line, Pinkovskiy and Sala-i-Martin (2014) estimate poverty using the cumulative distribution function. The USD 1.25-a-day poverty line is measured in real 2005 international (PPP-adjusted) prices. For this reason, Pinkovskiy and Sala-i-Martin (2014) use a real measure of GDP to anchor the income distribution. If all households face the same prices, it is unnecessary to deflate inequality estimates, because the Gini coefficient is unaffected by scalar multiplications. However, as argued above, the deflator need not be constant over the income distribution. Therefore, if one wants to take seriously the notion of estimating poverty using a fitted distribution, the use of a real inequality estimate is necessary.

The final section therefore investigates the impact of using real inequality poverty rates when following the baseline methodology of Pinkovskiy and Sala-i-Martin (2014), that is, by fitting a log-normal distribution using mean GDP per capita from the World Bank's development indicators (World Bank 2012) and estimates of inequality.[8]

In addition to the earlier discussion, there are at least four differences between the CBN and the SiMP methodologies (see also Arndt, McKay, and Tarp 2016, forthcoming; Guénard and Mesplé-Somps 2010).

First, consumption surveys often fail to sample sufficiently from the very top end of the distribution (Guénard and Mesplé-Somps 2010). This is not an issue under the CBN methodology since this part of the consumption distribution does not affect these poverty estimates. However, it can severely affect estimates of inequality, especially given that inequality estimates are quite sensitive to changes in the top end of the distribution. Second, the motivation behind using GDP instead of the survey consumption mean is that 'for a meaningful analysis of the impact of growth on poverty, the income distribution used to calculate poverty must be consistent with observed growth rates' (Pinkovskiy and Sala-i-Martin 2014: 313). However, there are several valid explanations for why GDP growth rates should not equal the growth rate of consumption, as defined in the surveys. First, GDP contains components other than household consumption. For example, expansion of public services increases GDP but does not affect direct household expenditures. Third, even if one used the growth rate of final consumption instead of GDP from national accounts, the population coverage is different from that of the surveys. Household surveys usually cover only 'ordinary' households whereas GDP also covers non-ordinary household members such as prison populations and religious groups. Fourth, the USD 1.25-a-day poverty rate was defined keeping in mind the consumption definition of household surveys and cannot be directly transferred to the GDP measure of national income.

To conclude, the definition of poverty used in the SiMP methodology differs fundamentally from the theoretical concept underlying the CBN estimates. Comparing the two directly is like comparing apples and oranges and I refrain from doing so in this paper. Instead, I compare SiMP measures of poverty using nominal and real consumption aggregates.

[8] Pinkovskiy and Sala-i-Martin (2014) adjust estimates of consumption inequality to make them comparable with other surveys based on income. For the sake of simplicity, and since only consumption-based surveys are used in this paper, I do not make an adjustment here.

3 Data

The various data sources used for this paper, as well as some descriptive statistics, are detailed in Table 2. As mentioned previously, the results build upon work done in relation to GAPP. Building on this body of work, I have compiled a standardized database of consumption information that allows real inequality measures to be computed at the household level for the more than 220,000 household observations in the database. In particular, the consumption aggregates used to calculate poverty rates are used to calculate the Gini coefficient. Nationally representative consumption questionnaires are often collected over an extended period of time, typically an entire year. Since prices change within this time frame, all prices and consumption aggregates presented are deflated using a temporal (within-survey) price index. Such an index is available for each of the GAPP country studies.[9] Since prices also vary spatially, I also deflate consumption aggregates by the spatial indices. Units of purchases are available for the surveys of Madagascar 2001 and the two surveys of Malawi. For these surveys, I estimate the quantity discounting effect using both the approach exploiting the units of consumption as well as the approach that relies on binning of quantities.

The countries cover a range of different experiences. Consider the survey mean consumption, converted to 2005 constant US dollars using the PPP-adjusted exchange rate. The mean per capita consumption in Pakistan in 2007/08 was more than double that of Tanzania (in 2007) and three times that of Madagascar (in 2005). Trends also differ: at one end of the spectrum is Madagascar where the mean per capita consumption in 2001 was USD 0.91 a day; this fell slightly to USD 0.83 in 2005. At the other end of the spectrum are Ethiopia and Pakistan where mean per capita consumption increased annually by 4 per cent annually from the first to the last survey (from USD 1.4 to 2.07 in Madagascar; from USD 1.74 to 2.52 in Pakistan). The picture in terms of trends is generally consistent if one looks at GDP per capita instead; however, the level is generally substantially higher. This difference in levels is consistent with the existing literature (Pinkovskiy and Sala-i-Martin 2014).

The level of inequality also varies across countries: Madagascar and Malawi are the most unequal; here, the 10th percentile of the population consume between 0.27 and 0.35 of mean income, whereas the 90th percentile consume between 1.72 and 2.06 of mean income. There are differences in inequality trends as well: while the consumption spread has decreased in Madagascar, it has increased in Malawi. Pakistan is the least unequal of the countries: the 10th and 90th percentiles consumed, respectively, 0.50 and 1.65 of mean consumption in the latest survey round.

Information on nominal inequality in the form of Gini coefficients can be readily obtained from the World Income Inequality Database (WIID) (UNU-WIDER 2014). However, I use nominal Gini coefficients estimated directly from the household level consumption aggregates of the database. This is necessary since only by using the micro-level datasets can the household specific deflators be applied. For the estimation of poverty using the SiMP methodology, I obtain time series of PPP-adjusted GDP per capita in constant 2005 US dollars from the 2012 version of the World Bank's world development indicators (World Bank 2012). The same data sources were used by Pinkovskiy and Sala-i-Martin (2014). Therefore, the inequality estimates are the only source of difference.

[9] The Madagascar surveys and the Ethiopia survey in 2000 and 2005 are exceptions where no such indices are used since those surveys were collected over a relatively short period of time (i.e. over a couple of months).

4 Results

4.1 The composition effect

Table 3 shows CPI used for the price changes of core food, non-core food, and non-food inflation. Taking the first survey in each year as the baseline, prices of core food items rise faster than the prices of non-core food (proxied by the food CPI) items in all countries except Ethiopia and Madagascar. Since total food inflation is a weighted average of core and non-core food inflation rates, in the four (two) countries where core inflation is higher (lower) than total food inflation, the use of total food inflation as a proxy measure of non-core food inflation overestimates (underestimates) the true rate of non-core inflation.

Why do core food prices in Ethiopia and Madagascar behave differently? Between 2000 and 2005, Ethiopia experienced several good harvests which put downward pressure on food prices (Durevall et al. 2013). In particular, prices of domestically produced foods, which constitute the majority of core food items, were subjected to downward pressure. From 2004/05 to 2010/11, core food prices rose faster than non-core food prices. A partial explanation in the Malagasy case could be that in 2004, as a result of a partially failed harvest of rice, the main staple of Madagascar, the Malagasy government intervened in the rice market by slashing import tariffs and by importing state-bought rice (Dorosh and Minten 2006). This, combined with a better domestic rice harvest in 2005, contributed to downward pressure on rice prices near the end of 2005, which is when the second Malagasy survey was conducted.

In all countries except for Ethiopia, the prices of core foods outpace those of non-food, compared to the first survey of each country. The magnitude of the price differentials vary between countries. For instance, core prices in Mozambique rose 63 per cent faster than non-food prices from 2002 to 2008. However, in Madagascar, the difference was only 2 per cent from 2001 to 2005. To conclude, the data presented here shows that in many, but not all, of the included countries, food price inflation has been higher than non-food price inflation in the period considered.

Figure 1 shows the mean consumption shares of the three groups of items for each percentile of the consumption distribution, across countries and survey. The percentile-specific means are calculated for ease of illustration; deflators are household specific as indicated by Equation (1). A consistent picture, which matches what Arndt et al. (2015) found for Mozambique, emerges: as one moves up through the income distribution, the share of consumption expenditures allocated to core foods decline. Instead, the non-food and in many cases also the non-core food shares increase. The core food consumption profiles of Madagascar and Mozambique have somewhat more U-shaped curves, where the very poorest spend less on food and more on non-food compared with those who consume a little more.

In all countries except Ethiopia, the non-core food share increases along the income distribution. This empirical regularity, combined with the use of the general food inflation index as the non-core food index that overestimates non-core inflation for all countries except Ethiopia and Madagascar, means the increase in inequality due to the composition effect is underestimated in all countries except Madagascar, where the composition effect may be overestimated.

Figure 2 shows the composition CPI for each percentile of the consumption distribution. Results are as expected, given the inflation rates and the consumption shares reported here. In all countries except Ethiopia and Madagascar, the composition CPI is highest for the lower part of the distribution. This indicates that the consumption structure of the poor combined with the observed price changes results in higher price increases for the poor. The magnitudes of the effects are country-specific. For instance, there is only a slight slope over the consumption distribution in Malawi. In Pakistan for the year 2005/06, only the top percentiles are notably different.

4.2 The quantity discounting effect

Figure 3 shows the simple expensiveness indices of Equations (2) and (3). The results shown are estimated using quantity bins rather than units, since the quantity bins approach is applicable to all surveys. Using either expensiveness index, less-poor households face higher unit prices across almost all of the country survey observations considered. This is consistent with richer households buying higher quality. However, for Tanzania, Mozambique, and Malawi, there is a tendency for the index estimated without quantity bins to be higher than the index with quantity bins in the lower parts of the income distributions and for a reversal of this trend as one moves further along the distribution. This is precisely what one would expect in the presence of quantity discounting effects.

For Ethiopia and Pakistan as well as Madagascar in 2005, there is almost no difference between the two expensiveness indices: the percentile averages almost completely overlap. This complete lack of variation between the two expensiveness indices for some surveys is surprising. Even with just random variation in prices, one would expect some differences in the two indices. A closer look at the price data reveals that the prices of the most common food items in the surveys of Ethiopia in 1999/2000 and 2004/05, Pakistan in all survey years, and Madagascar in 2005 have lower coefficients of variation than prices of other country surveys (Appendix Table A1). In Pakistan, most unit prices come out as integers when dividing values with quantities. This is unlikely to be the case if quantities and values were recorded separately. This is also not the case in the other studied countries, and it leads to some concerns regarding the amount of adjustments that the raw survey data of Pakistan may have undergone before being made available.

Figure 4 shows the mean of the estimated quantity discounting CPI by percentiles. The figure shows CPIs estimated based on the approach of quantity binning for all surveys. For the surveys where it is possible (Madagascar in 2001, Malawi, Mozambique), the CPIs estimated based on the approach of units of purchase are also shown. The quantity binning-based CPIs exhibit a downward slope over the consumption distribution for the surveys of Mozambique, Tanzania, and Malawi. In these three countries, it appears that the quantity discounting effect is indeed at work in the sense that the poorest are paying higher unit prices solely because of the size of their purchase. On the other hand, Ethiopia, Pakistan, and Madagascar show no sign of a quantity discounting effect. The unit of purchase-based CPIs are in general not very different from their quantity bin-based counterparts in the three surveys where both can be estimated. The results of inequality and poverty in the following sub-section are therefore estimated using the quantity bin-based quantity discounting CPIs.

4.3 Inequality and poverty

Table 4 shows the real Gini coefficients estimated by applying the household-specific deflators shown in the previous section. The first thing to note is that even the nominal Gini coefficients of WIID and those of the GAPP database differ. In some cases, such as Malawi, this is partly caused by the re-estimation of the consumption aggregate by Pauw et al. (2016, forthcoming). Another source of variation is the temporal and spatial deflation of the nominal consumption aggregates. However, these differences are not driving the results in the following case: the effects on the Gini coefficients would have been qualitatively similar if the household-specific deflators had been applied to consumption aggregates that exactly reproduce WIID Gini coefficients.

The composition effect means that real inequality is higher than nominal in all countries except Ethiopia and Madagascar where the effect is slightly negative. For example, although one would draw the conclusion from the nominal Gini coefficients that inequality in Mozambique was unchanged (or decreasing, using WIID information), the real Gini coefficients show an increase of 2.8 Gini points (i.e. 41.5 to 44.3). This is qualitatively consistent with the conclusion drawn by Arndt et al. (2015). In Tanzania, the nominal (GAPP) inequality measure increases by 1.1 Gini points from 2000 to 2007. However, applying the composition deflator more than doubles this to 2.5 Gini points (i.e. 34.2 to 36.7).

The annual change in the composition-adjusted Gini coefficient compared to the annual change in the nominal (GAPP) Gini varies from 0.1 Gini points (for Pakistan from 2007/08 to 2010/11) over 0.47 (for Mozambique from 2002 to 2008) to 1.08 (for Pakistan from 2005/06 to 2007/08. To give an idea about magnitudes, these figures can be compared to the average annual absolute change in the nominal (GAPP) Gini coefficients which is 0.5 Gini points. This means that composition adjustments of Gini coefficients are in some cases substantial, compared to the average change in the nominal Gini. Thus, the composition effect severely alters the inequality track record for some, but not all, countries as well as for different time spans of the same country.

The quantity discounting effect is also found to increase the level of inequality substantially in some cases. In Mozambique, the level of inequality increases by between 0.6 and 1.3 Gini points, depending on the survey. In Tanzania, the increase is between 0.6 and 0.9 Gini points. In Malawi, the effect is 0.8 Gini points in both survey rounds. However, the effect is not found in all countries: Pakistan and Ethiopia show no signs of quantity discounting effects.

The rightmost column in Table 4 ('Both minus nominal') shows the results when both deflators are applied. In general, the combined effect is close to the sum of the two effects. The combination of the quantity discounting effect and the composition effect means that nominal inequality tends to underestimate the level of inequality and overestimate reductions in inequality. Since country growth performance and policy effectiveness are often evaluated in the context of such changes, it is important to consider the possibility that nominal inequality measures may be severely downwards biased.

I conduct robustness checks of two choices made in the estimation of the quantity discounting effect, namely, the number of bins chosen and the geographical area over which prices are compared. Appendix Table A2 reports Gini coefficients using 2, 4, 8, or 16 quantity bins. Varying the number of bins has only a limited effect on the estimated quantity discounting effect. The largest change in any of the alternative estimations, compared to the baseline option of four bins is seen in the case of Mozambique in 2008, where the 2-bin Gini estimate is 0.5 Gini points lower. Going from more to fewer bins has no systematic effect. For Malawi, Mozambique, and Tanzania, 2 bins produce lower equality estimates compared to 4 bins, but the reverse is true for Madagascar in 2001, and the estimate for Malawi in 2010/11 is also lower using 8 and 16 bins. To conclude, the choice of number of bins does not appear to be driving the results of the quantity discounting effect. Appendix Table A3 reports Gini coefficients using either no spatial adjustment, using the strata as the spatial unit (the baseline option) and using the enumeration area, of which there are many within each strata. Compared to the within-strata estimation, the Gini coefficients increase in most instances when no spatial unit is employed. The increase is substantial for some country survey observations such as the two Malawian surveys (1.4 and 1.9 Gini points) and the 2002 Mozambican survey (1.0 Gini points). This indicates a positive correlation between the average strata price level and the average strata consumption level, even though prices are deflated before estimation using regional spatial price indices. This correlation affects estimates using no spatial unit, but does not affect estimates when the household-specific deflator is based solely on within-strata price variation. However, it is not clear that the between-strata price variation could not also be caused by quantity discounting effects. Employing the strata as the spatial unit therefore provides a conservative estimate of the true effect. The final column of Table A3 uses the enumeration area as the spatial unit. This brings Gini estimates very close to the nominal Gini coefficients. This indicates that there is not sufficient price variation at the level of the enumeration area to meaningfully estimate the quantity discounting effect. To conclude, the level of the strata seems to be a reasonable choice of spatial unit as it is conservative, compared to using no spatial unit. The strata level still retains some amount of price variation that can be used to estimate the quantity discounting effect.

Table 5 shows the poverty rates calculated using the national accounts means and the Gini coefficients of Table 4. For countries such as Mozambique and Tanzania where substantial differences in inequality were found, sizable differences in poverty are also found. For instance, a combination of the quantity discounting and the composition effect raises the poverty rate by 4.2 percentage points in Mozambique in 2008, by 2.7 percentage points in Tanzania in 2007, and by 1.8 percentage points in Malawi in 2010/11. In Ethiopia and Madagascar, the estimated effect is smaller and sometimes even slightly negative. Since the composition effect builds up over time, the discrepancy in poverty estimates is bigger in later surveys. The composition effect alone raises the poverty estimate by 3.0 percentage points in the 2008 Mozambique survey and by 1.7 percentage points in the 2007 Tanzania survey. Given this background, the optimistic picture of very fast poverty reduction in sub-Saharan African countries presented by Pinkovskiy and Sala-i-Martin (2014) should be interpreted with caution: although the technique still shows substantial poverty reductions when real inequality estimates are used, the level is higher and the pace of reduction is slower overall.

5 Conclusion

This paper shows how two different effects can drive wedges between estimates of nominal and real inequality. The first effect works through the combination of differential consumption structures across the consumption distribution and differential price increases of different product groups. The second effect works through quantity discounting: the poor may pay more for their food consumption since they buy smaller quantities. Household-specific deflators are calculated for 15 surveys from six different countries, covering a range of varying experiences in terms of consumption levels and trends over time. A key advantage of this method is that it relies only on information that is available in existing nationally representative surveys of developing countries.

A composition effect was found in Malawi, Mozambique, Pakistan, and Tanzania but not in Ethiopia and Madagascar. Non-negligible quantity discounting effects were found in Mozambique and Tanzania; a smaller effect was found in Malawi; and no effects were found in Pakistan, Madagascar, and Ethiopia.

In most cases, the estimated effects are lower bounds on the true effect sizes. Nonetheless, the impacts on inequality and on the derived poverty estimates are in some cases substantial. Estimated real Gini coefficients are between −0.6 and 4.0 Gini points higher than nominal Gini coefficients. In some countries (Malawi, Mozambique, Pakistan, and Tanzania), real inequality is higher than nominal inequality. Using real inequality indices can also affect inference on the speed of inequality reduction (Malawi, Pakistan, and Tanzania). In the most extreme cases, it can change the direction of inequality change so that a decrease in nominal inequality conceals an increase in real inequality (Mozambique). However, in some countries (Ethiopia and Madagascar), real inequality does not appear to be different from nominal inequality.

Finally, inequality estimates matter for estimating poverty based on national account means and an estimate of inequality. In countries where the composition and quantity discounting effects affect the Gini coefficients, the poverty rates are also affected. While the quantity discounting effect potentially affects inequality indices in every year, the composition effect builds up over time as prices diverge. This means that in countries where later surveys are more heavily influenced by the composition effect, the use of nominal inequality indices does not only introduce a source of bias in the *level* of poverty but may also overestimate the *rate* of poverty reduction.

The effects are highly country-specific. Why do effect sizes differ from country to country? For the composition effect, this is caused by differences in consumption structures and in inflation rates. Inflation rates are affected by a complex interaction of domestic conditions such as harvests and government policies, as well as international changes in world market prices. Especially for the surveys conducted in the years of the food price crisis of 2007–09, world market prices of basic food items were very high. As new survey rounds become available it will be interesting to see whether the composition effect shrinks or whether it is a longer-lasting phenomenon. For the quantity discounting effect, the cross-country differences are likely caused by a mix of real differences in the magnitude of quantity discounting present and of differences due to varying survey instruments and methodologies. The latter appears to be important for estimates of the quantity discounting effect in Pakistan and Ethiopia where there is little price variation for the most common food items.

Since the estimation of the composition and the quantity discounting effects requires only data which is generally available, and since the two effects are easily estimated, I suggest doing so for other countries, and whenever a new survey becomes available, in order to check whether keeping inequality in real terms matters in the country- and time-specific contexts.

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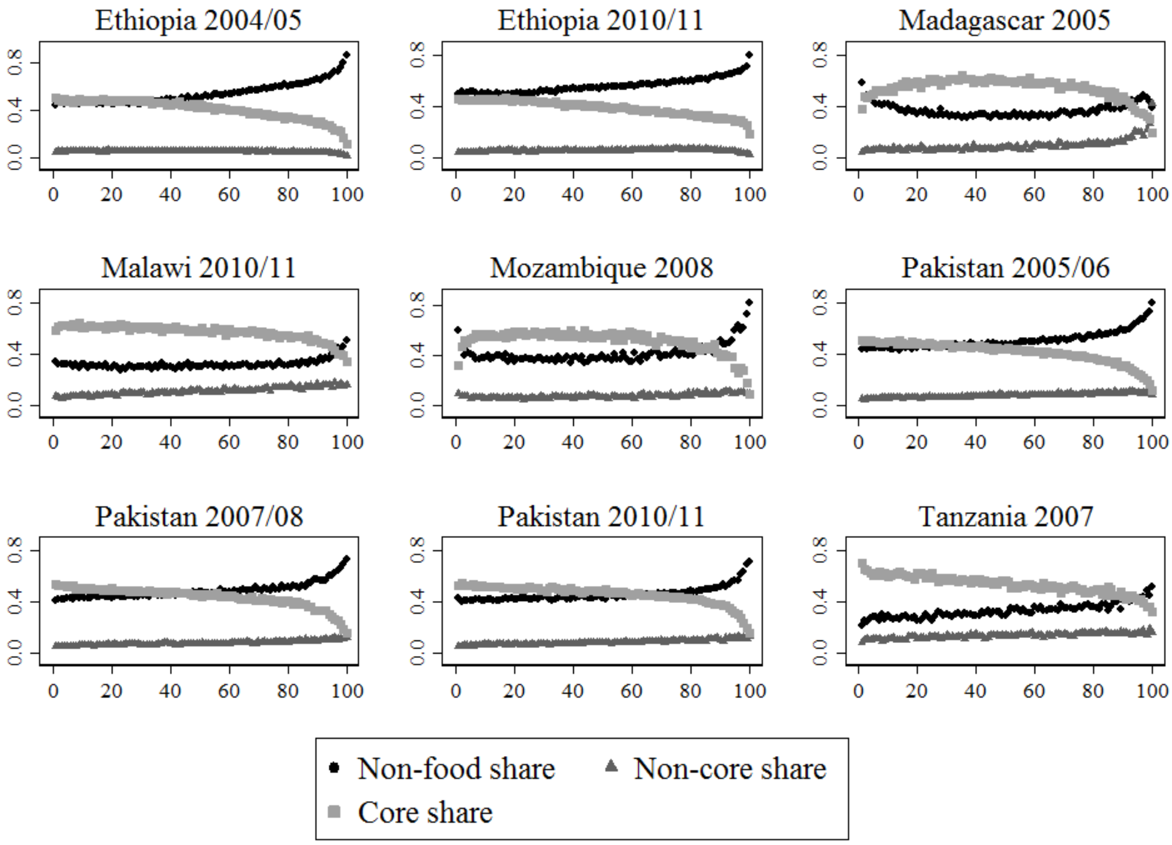
Figures

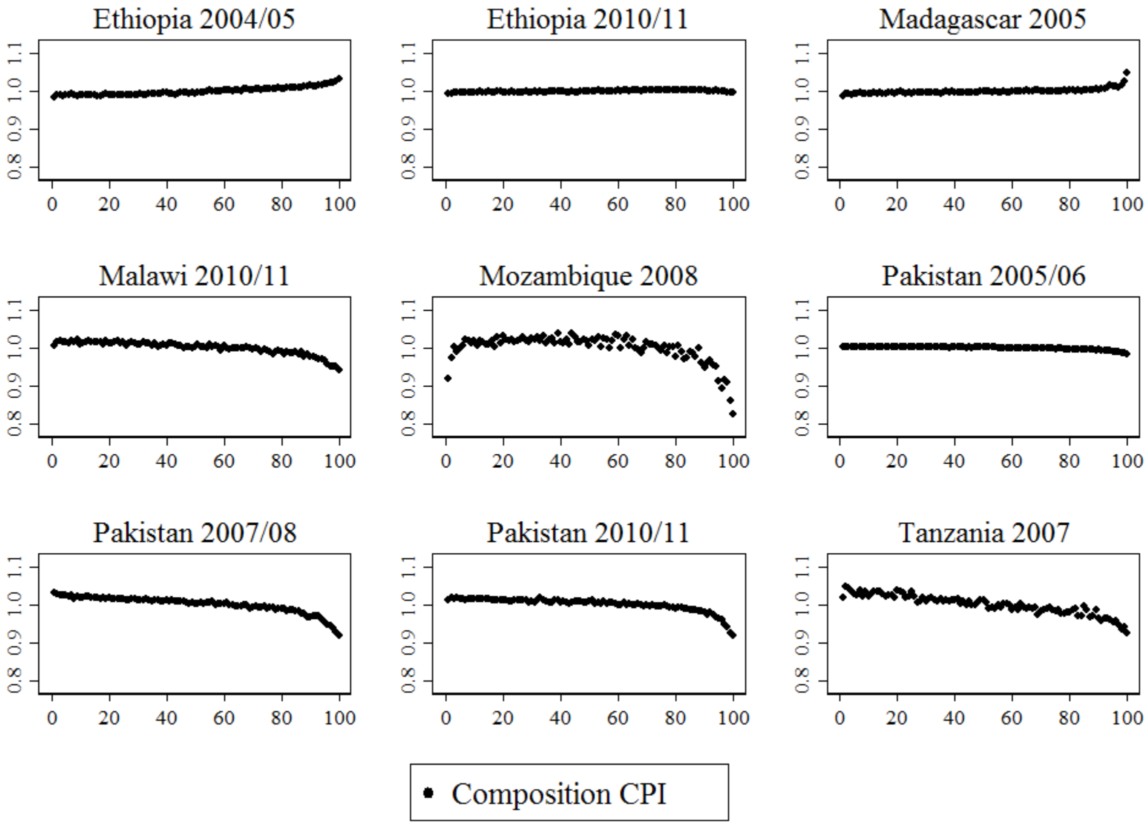
Figure 1: Consumption shares by consumption percentiles



Note: In each scatter plot, each point represents the average for a percentile of the consumption distribution.

Source: Author's calculations.

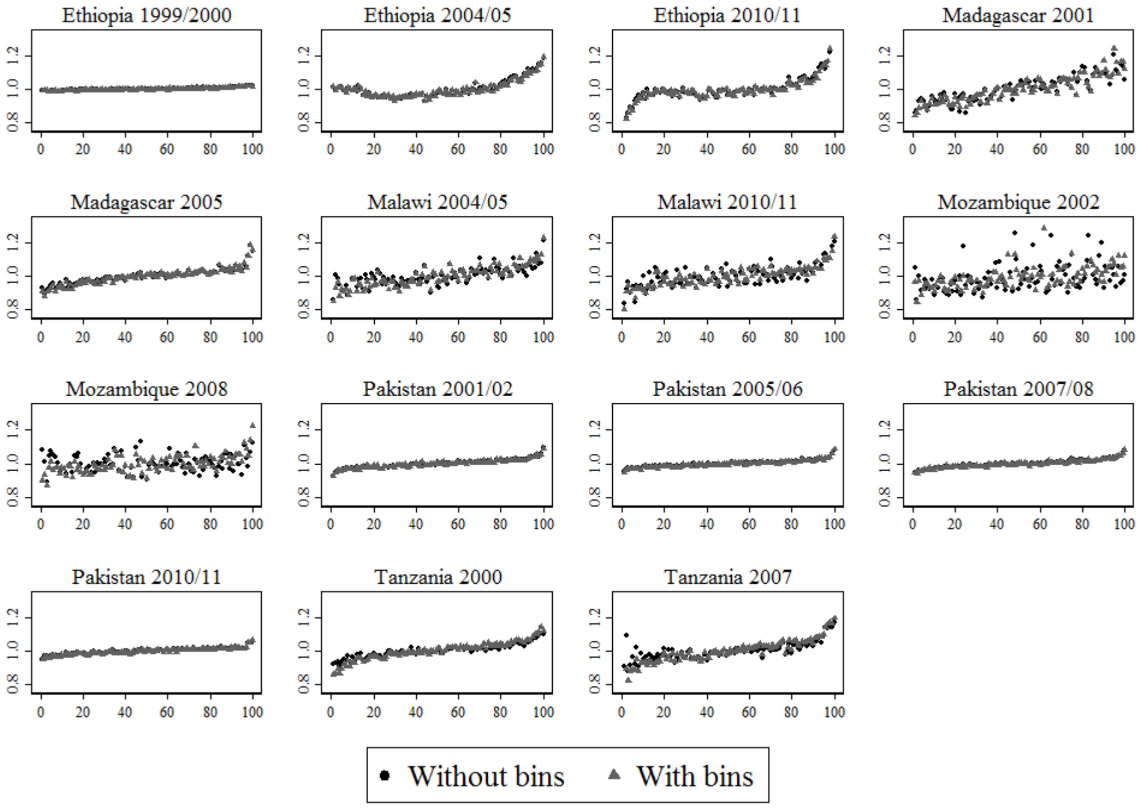
Figure 2: Composition CPI by country



Note: In each scatter plot, each point represents the average for a percentile of the consumption distribution. A few points at the extreme ends of the consumption distributions are outside the graph areas. The year of first survey for each country against which the effects are calculated are as follows: Ethiopia: 1999/2000; Madagascar: 2001; Malawi: 2004/05; Mozambique: 2002; Pakistan: 2001/02; Tanzania: 2000.

Source: Author’s calculations.

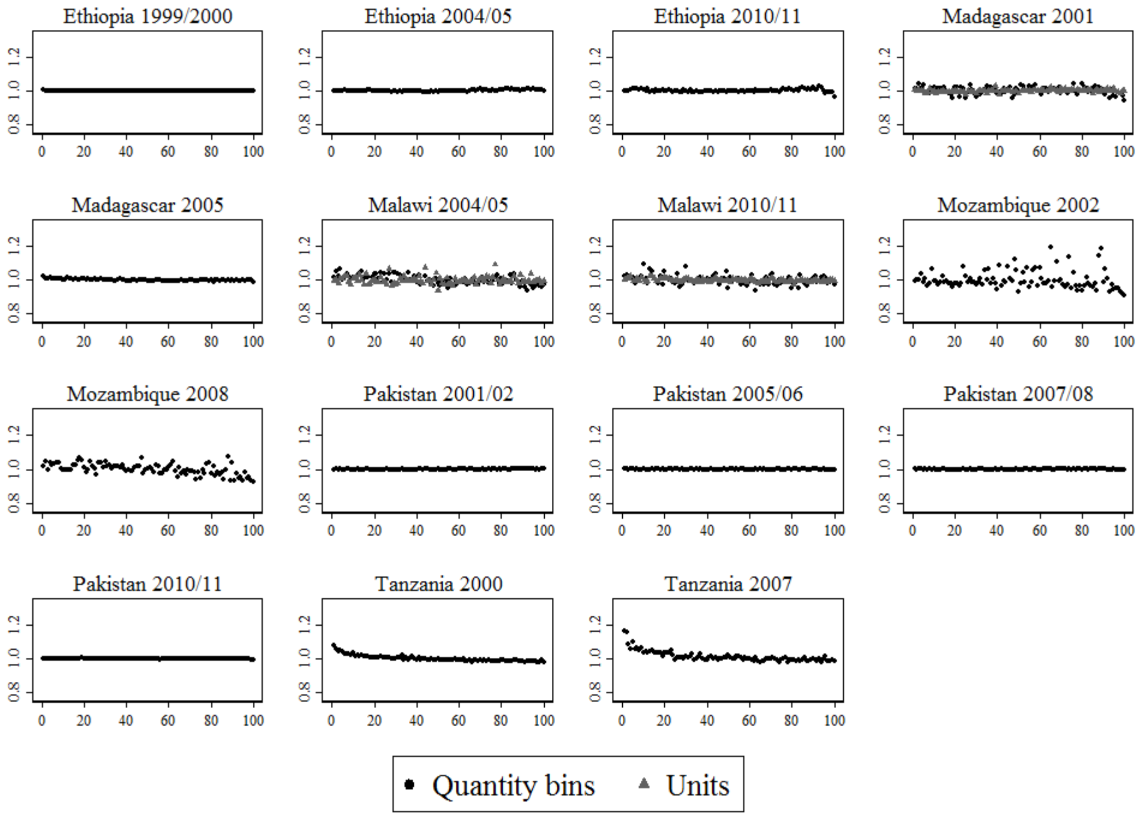
Figure 3: Expensiveness indices by country and survey using the bins-of-quantities formulation



Note: In each scatter plot, each point represents the average for a percentile of the consumption distribution. A few points at the extreme ends of the consumption distributions are outside the graph areas.

Source: Author's calculations.

Figure 4: Quantity CPI by country and survey



Note: In each scatter plot, each point represents the average for a percentile of the consumption distribution. A few points at the extreme ends of the consumption distributions are outside the graph areas. The black circles are CPIs based on quantity bins; the grey triangles are based on units of purchase.

Source: Author's calculations.

Tables

Table 1: A quality-adjusted index example

Good 1						Other expenditure	Total expenditure	p_{AH}^{i}	p_{AH-u}^{i}	CPI_{q}^{i}
Quality	Amount	$\bar{p}_m$	$\bar{p}_{m,u}$	q_m	p_1^i			(2)	(3)	(4)
High	Small	3.5	4	1	5	1	6	1.33	1.20	1.11
Low	Small	3.5	4	1	3	1	4	0.89	0.80	1.11
High	Big	3.5	3	2	4	1	5	1.13	1.29	0.88
Low	Big	3.5	3	2	2	1	3	0.63	0.71	0.88

Source: Author's calculations.

Table 2: Data sources and descriptive statistics

Country and survey years	Household survey reference	CPI reference	No. of households	No. of EAs	No. of strata	2005 PPP USD Survey mean (consumption)	2005 PPP USD GDP per capita (national accounts)	10th percentile/ mean consumption	90th percentile/ mean consumption	National poverty rate
Ethiopia	Stifel and	NBE (2014),								
HICES (1999/2000)	Woldehanna	CSA (Multiple	17,332	1264	20	1.40	1.44	0.48	1.60	46.8
HICES (2004/05)	(2016,	years, 2015)	21,595	1548	18	1.69	1.74	0.46	1.58	46
HICES (2010/11)	forthcoming)		27,830	1966	20	2.07	2.56	0.42	1.64	23.8
Madagascar	Stifel et al. (2016,	INSTAT								
EPM (2001)	forthcoming)	Madagascar	5080	303	12	0.91	2.54	0.27	2.06	57.8
EPM (2005)		(2015)	11,781	561	12	0.83	2.38	0.31	1.83	59.1
Malawi	Pauw et al.	NSO (2015)								
IHS2 (2004/05)	(2016,		11,280	564	30	1.33	1.77	0.35	1.72	47
IHS3 (2010/11)	forthcoming)		12,271	768	31	1.89	2.17	0.29	1.78	38.8
Mozambique	Arndt, Jones, and	INE (2015)								
IHS2 (2004/05)	Tarp (2016,		8700	857	11	1.29	1.60	0.31	1.78	54.1
IHS3 (2010/11)	forthcoming)		10,832	1060	11	1.51	2.12	0.31	1.75	54.7
Pakistan	Whitney (2015)	MoF (2012)								
HIES (2001/02)			14,649	1050	8	1.74	5.05	0.51	1.60	34.4
HIES (2005/06)			15,374	1109	8	2.21	5.87	0.51	1.61	22.3
HIES (2007/08)			15,441	1113	8	2.54	6.36	0.51	1.65	17.2
HIES (2010/11)			16,295	1180	8	2.52	6.60	0.53	1.57	12.4
Tanzania	Arndt et al.	CountrySTAT								
HBS (2000)	(2013)	(2015)	22,176	1158	20	0.83	2.37	0.38	1.79	35.7
HBS (2007)			10,407	447	20	1.13	3.15	0.37	1.79	33.6

Note: EAs are enumeration areas. HICES is the Ethiopia Household Income, Consumption and Expenditure Survey (HICES, multiple years). EPM is the Enquête Périodique auprès des Ménages (INSTAT 2002, 2006). IHS is the Integrated Household Survey (NSO 2005, 2012). IAF is the Inquérito aos Agregados Familiares (MPF et al. 2004). IOF is the Inquérito ao Orçamento Familiar (MPF and DNEAP 2010). HIES is the Household Integrated Economic Survey (FBS 2003, 2007, 2009, 2013). HBS is the Household Budget Survey (NBS 2002, 2011), and covers only mainland Tanzania (excludes Zanzibar). The poverty rates are from the sources listed above, except for Tanzania, where the estimates are from Arndt, Demery, McKay, and Tarp (2016, forthcoming), and for Pakistan, where the estimates are from Government of Pakistan (2008, 2014). PPP conversion factors and national account information are from World Bank (2012).

Source: Author's own compilation based on the sources listed in the table and in the note.

Table 3: Food and non-food CPI

Country and year	Core food	Non-core food	Non-food	Ratio (CF/NCF)	Ratio (CF/NF)
Ethiopia					
1999/2000	100.0	100.0	100.0	1.00	1.00
2004/05	98.9	145.7	112.8	0.68	0.88
2010/11	249.0	315.8	254.7	0.79	0.98
Madagascar					
2001	100.0	100.0	100.0	1.00	1.00
2005	152.4	176.3	149.9	0.86	1.02
Malawi					
2004/05	100.0	100.0	100.0	1.00	1.00
2010/11	248.5	177.6	188.2	1.40	1.32
Mozambique					
2002	100.0	100.0	100.0	1.00	1.00
2008	228.2	200.4	139.8	1.14	1.63
Pakistan					
2001/02	100.0	100.0	100.0	1.00	1.00
2005/06	132.0	131.1	124.4	1.01	1.06
2007/08	182.8	144.6	131.9	1.26	1.39
2010/11	290.3	279.2	207.1	1.04	1.40
Tanzania					
2000	100.0	100.0	100.0	1.00	1.00
2007	199.1	158.8	131.4	1.25	1.52

Note: Core CPIs are calculated based on survey data. Non-core and non-food inflation are calculated based on the sources listed in Table 1. All CPIs are normalized to 100 in the first survey year.

Source: Author's calculations.

Table 4: Gini coefficients using alternative deflators

	WIID	GAPP	Quantity	Composition	Both	Quantity minus nominal	Composition minus nominal	Both minus nominal
Ethiopia								
1999/2000	30.0	28.9	28.9			0.0		
2004/05	29.8	32.6	32.6	32.0	32.0	0.0	–0.6	–0.6
2010/11	29.8	32.1	32.3	32.0	32.2	0.1	–0.1	0.0
Madagascar								
2001	45.3	45.4	45.6			0.2		
2005	41.0	41.0	41.1	40.6	40.8	0.2	–0.4	–0.2
Malawi								
2004/05	41.0	41.9	42.7			0.8		
2010/11	39.3	44.5	45.3	45.4	46.2	0.8	1.0	1.7
Mozambique								
2002	47.1	41.5	42.1			0.6		
2008	41.4	41.4	42.7	44.3	45.4	1.3	2.8	4.0
Pakistan								
2001/02	30.4	26.8	26.8			0.0		
2005/06	32.7	28.5	28.5	28.7	28.7	0.0	0.2	0.3
2007/08	30.0	27.9	27.9	29.2	29.2	0.0	1.3	1.3
2010/11	30.6	26.0	26.1	27.2	27.2	0.1	1.1	1.2
Tanzania								
2000	34.6	34.2	34.8			0.6		
2007	35.0	35.3	36.2	36.7	37.6	0.9	1.4	2.3

Source: Author's calculations.

Table 5: Poverty rates and changes using different inequality measures

	WIID	'Pure' GAPP	Quantity	Compo-sition	GAPP + both deflators	Composition minus GAPP	Quantity minus GAPP	Both minus GAPP
Ethiopia								
1999/2000	50.3	49.5	49.5				0.0	
2004/05	36.6	39.8	39.8	39.1	39.1	-0.6	0.0	-0.7
2010/11	14.6	17.6	17.8	17.5	17.7	-0.1	0.2	0.1
Madagascar								
2001	34.2	34.3	34.5				0.2	
2005	32.2	32.1	32.3	31.7	31.9	-0.5	0.2	-0.3
Malawi								
2004/05	45.2	47.8	48.6				0.7	
2010/11	41.2	40.4	41.3	41.4	42.2	1.0	0.8	1.8
Mozambique								
2002	56.7	52.7	53.1				0.5	
2008	38.1	38.1	39.5	41.1	42.4	3.0	1.4	4.2
Pakistan								
2001/02	1.2	0.4	0.4				0.0	
2005/06	1.1	0.3	0.3	0.3	0.3	0.0	0.0	0.0
2007/08	0.3	0.1	0.1	0.3	0.3	0.1	0.0	0.1
2010/11	0.3	0.0	0.0	0.1	0.1	0.0	0.0	0.0
Tanzania								
2000	24.4	23.9	24.7				0.8	
2007	13.1	13.5	14.6	15.2	16.2	1.7	1.1	2.7

Note: Poverty rates are reported in per cent.

Source: Author's calculations.

Appendix

Table A1: Coefficient of variation of prices of the three most consumed food items

	Most consumed	2nd most consumed	3rd most consumed	Simple average
Ethiopia				
1999/2000	0.16	0.18	0.26	0.20
2004/05	0.25	0.29	0.22	0.25
2010/11	0.41	0.39	0.39	0.40
Madagascar				
2001	0.59	0.31	0.26	0.39
2005	0.19	0.17	0.19	0.18
Malawi				
2004/05	0.92	0.64	0.65	0.74
2010/11	0.79	0.54	0.40	0.58
Mozambique				
2002	0.56	0.21	0.66	0.48
2008	0.59	0.56	0.60	0.58
Pakistan				
2001/02	0.33	0.15	0.08	0.19
2005/06	0.23	0.13	0.22	0.19
2007/08	0.30	0.24	0.09	0.21
2010/11	0.48	0.31	0.12	0.30
Tanzania				
2000	0.64	0.64	0.16	0.48
2007	0.54	0.15	0.62	0.44

Note: Most consumed is defined in terms of frequency of consumption among households. In order to remove any effect of extreme outliers, prices below the 1st (and above the 99th) percentile are replaced by the value of the 1st (99th) percentile.

Source: Author's calculations.

Table A2: Gini coefficients deflated by quantity discounting index estimated using alternative numbers of bins

	Number of bins			
	2	4	8	16
Ethiopia				
1999/2000	28.9	28.9	28.9	28.9
2004/05	32.6	32.6	32.6	32.6
2010/11	32.2	32.3	32.3	32.4
Madagascar				
2001	45.7	45.6	45.2	45.1
2005	41.1	41.1	41.1	41.1
Malawi				
2004/05	42.6	42.7	43.0	42.9
2010/11	45.1	45.3	45.2	45.2
Mozambique				
2002	41.9	42.1	42.1	42.1
2008	42.2	42.7	42.9	42.9
Pakistan				
2001/02	26.8	26.8	26.8	26.8
2005/06	28.5	28.5	28.5	28.5
2007/08	27.9	27.9	27.9	27.9
2010/11	26.1	26.1	26.1	26.1
Tanzania				
2000	34.6	34.8	34.9	34.8
2007	36.0	36.2	36.3	36.2

Note: The default number of bins is '4'.

Source: Author's calculations.

Table A3: Gini coefficients deflated by quantity discounting index using alternative spatial domains

	Nominal (GAPP)	Alternative spatial domains		
		No spatial unit	Strata	Enumeration area
Ethiopia				
1999/2000	28.9	28.9	28.9	28.9
2004/05	32.6	32.6	32.6	32.6
2010/11	32.1	32.3	32.3	32.1
Madagascar				
2001	45.4	45.9	45.6	45.4
2005	41.0	41.3	41.1	41.0
Malawi				
2004/05	41.9	44.1	42.7	42.1
2010/11	44.5	47.1	45.3	44.5
Mozambique				
2002	41.5	43.1	42.1	41.5
2008	41.4	42.9	42.7	41.4
Pakistan				
2001/02	26.8	26.9	26.8	26.8
2005/06	28.5	28.5	28.5	28.5
2007/08	27.9	28.0	27.9	27.9
2010/11	26.0	26.2	26.1	26.0
Tanzania				
2000	34.2	34.9	34.8	34.3
2007	35.3	36.6	36.2	35.5

Note: The spatial unit used in the main text is Strata.

Source: Author's calculations.