METHODOLOGY FOR POVERTY MEASUREMENT IN MALAWI (2016/17)

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and

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1. Introduction

The fourth Integrated Household Survey (IHS4) is a multi-topic survey implemented by the National Statistical Office (NSO) of Malawi between April 2016 to April 2017. Like its predecessor, IHS3 (2010/11), this survey provides socioeconomic indicators that are representative at district level. IHS3 and IHS4 are comparable because similar questionnaires were implemented to collect the data, and the sample selection is based on a sampling frame using the 2008 population census. The sampling frame used in both surveys includes the three regions (North, Central, and South) and is stratified into rural and urban strata. The urban stratum includes the four major cities (Lilongwe, Blantyre, Mzuzu, and Zomba). In both surveys, a stratified two-stage sampling design is used. The IHS4 and IHS3 collected information from 12,271 and 12,447 households, respectively. About 88 percent of the sample in both surveys came from 28 districts in rural areas. A key difference between IHS4 and IHS3 is the data collection mechanism: IHS4 was conducted using the Computer-Assisted Personal Interviewing (CAPI), while IHS3 was implemented using a paper questionnaire. Despite this difference in the platform of data collection, IHS3 and IHS4 are comparable and hence can be used to monitor changes in welfare and the progress toward achieving some of the targets/goals in the Malawi Growth and Development Strategy (MGDS).

The purpose of this note is to describe the methodology used to measure monetary poverty using IHS4 data and steps taken to ensure comparability with the poverty estimates generated using IHS3. To conduct poverty analysis, we need two main sets of information: (a) a welfare indicator that ranks individuals and (b) a threshold welfare level (that is, poverty line) below which an individual is considered as poor. To rank the population from the person with the lowest to the highest welfare level, the total expenditure on food and nonfood items is used. Individuals with the welfare indicator below and above the poverty line are classified as poor and nonpoor, respectively. The welfare indicator is constructed using the same methodology as IHS3 to guarantee comparability over time.

The rest of the report is organized as follows. Section 2 outlines the steps in the construction of the nominal consumption aggregate and adjustments for living cost differences and household size. Section 3 describes the derivation of the poverty line, and finally Section 4 presents the poverty measures used in this report and the poverty estimates.

2. Welfare indicator

Previous poverty measurement studies have reached some consensus on the use of monetary values as an indicator of welfare/living standard, and this approach is regularly employed for poverty monitoring and analysis. Although the monetary indicator of welfare does not cover all aspects of human well-being, it captures a central component of any assessment of living standards. In developing countries such as Malawi, it is also a common practice to use consumption expenditure as the preferred welfare indicator because it is likely to be a more accurate measure of living standards than income. The following subsections describe the construction of aggregate consumption expenditure by component: food, nonfood, durables, and rent expenditures.

2.1. Consumption aggregate

2.1.1. Food component

Measurement of food consumption is critical for poverty analysis as food is basic for human survival and standard of living. The food module of IHS4 collects data on the food consumed in the household over the past one-week recall period. More specifically, consumption information was collected on 136 food items from the most knowledgeable member of the sampled household. To make the data collection and analysis easier, these food items were organized into 11 categories: cereals, grains, and cereals products; roots, tubers, and plantains; nuts and pulses; vegetables; meat, fish, and animal products; fruits; cooked food from vendors; milk and milk products; sugar, fats, and oil; beverages; and spices and miscellaneous.

During the construction of the food component of total consumption, several considerations and adjustments were made. First, all major sources of food consumption are accounted for. These include purchases, own-production, gifts, and other sources.

Second, the survey has focused on actual consumption of food items as opposed to total purchases or total own-production. This distinction is important as not all purchased and/or own-produced items get consumed over the same period by all households. Indeed, many farm households cultivate crops not just for own consumption but for the market as well.

Third, to get aggregate food consumption, monetary values of both purchased and non-purchased items were calculated. Because the survey collects information on both quantity and expenditure

on purchased food items, unit values were constructed by dividing expenditure with quantity consumed. These unit values are then used to calculate monetary values of non-purchased food items. However, adjustments must be made on unit values as they reflect not only price differences between different items but could also capture quality differences for the same item. This is particularly relevant if the item has many varieties and the IHS survey instrument did not capture these varieties separately. In this regard, IHS4 has some improvements over IHS3 in that consumption information on fish items are disaggregated not only on how they are made—that is, sundried, fresh, or smoked as in IHS3—but also on their size (small, medium, and large as in IHS4). In contrast to IHS3, consumption information on sweet potatoes and groundnuts were also further disaggregated by their types in IHS4. To deal with remaining quality differences in unit values in IHS4, median unit values were calculated for each item at several levels with both geographical and time dimensions. Geographical disaggregation includes district, urban and rural areas, and national. In these disaggregation, the survey month and year are taken into consideration. Thus, if a sampled household consumed a food item that was not purchased, the median unit value from its district and matching survey time would be used to value that consumption. If no other household consumed the same item in that district during the same survey month, or if there are not enough observations to obtain a reliable unit value, the median unit value from the immediate upper level (in this case urban or rural areas) during the same survey month and year would be used to estimate the value of that consumption.

Fourth, to reduce cognitive and informational burdens on surveyed households, respondents were allowed to report their quantity consumption in nonstandard and local units such as heaps and pails. These units were transformed into kilograms using conversion factors that were collected from a supplementary survey conducted alongside Malawi's 2013 Integrated Household Panel Survey (IHPS) and IHS3. This standardization of consumption information is necessary before unit values were calculated and expenditure on food was aggregated.

Finally, to deal with exceptionally low or high levels of quantity of consumption and/or unit values, both automated and subjective trimming methods were implemented. The automated method includes measuring how far the unit value or quantity consumed for each item is from the mean or median of its distribution. For some items, the extremely high unit values are replaced by the 95th percentile and the extremely low unit values are replaced by the 5th percentile, and this decision

is taken on an item-by-item basis after extensive consultation between experts at the NSO and the World Bank.[1]

2.1.2. Nonfood component

The nonfood consumption modules (Modules I–K) of IHS4 have detailed information on household expenditure on various nondurable nonfood goods and services. We include household expenditure on all nonfood items as described in the international standard for Classification of Individual Consumption by Purpose (COICOP). Appendix D shows the COICOP classification of items and the respective questions in the IHS4 questionnaire. Therefore, parts of the total nonfood expenditure is made up of the value of expenditure on nonfood nondurable item groups such as education; health services, including prescription and nonprescription drugs; housing utilities such as water, electricity, gas, firewood, charcoal, and others; clothing and footwear; transport service including operation cost of private vehicle/bicycle/motorbike, but not the actual purchase of these durable items, and public transportation; communication services such as mobile phone services; recreation and cultural services, except the purchase of durables such as televisions; hotel and lodging; and miscellaneous goods and services such as personal care like soap and personal effects such as umbrella. Expenditures on these goods and services are reported/collected in different reference periods (past 7 days, 1 month, 3 months, and 12 months). For those items with a reference period shorter than 12 months, the corresponding expenditure is annualized. The total annual household expenditure on these goods and services is compiled to calculate the total expense on nondurable nonfood items and matched with durable goods and rental/housing expense in the corresponding COICOP code.

Some expenditures that are sporadic in nature such as wedding, funerals, and births are excluded from consumption aggregate, which is intended to capture households' regular expenditure, to avoid overestimation of well-being. Remittance to others is excluded from consumption aggregate as it does not imply welfare improving consumption. Expenditure to repair or upgrade dwelling such as purchase materials and labor cost is also excluded from consumption as the housing/rental expenditure, discussed below, captures the value gains from this repair/upgrade.

[1] The list of items and their respective trimming threshold is available upon request.

Finally, it is important to note that we rely on total expenditure values and that there is no unit value data for nonfood goods and services. The diversity of nonfood items, both in quality and unit price, makes it difficult to compute a standard price for these nonfood items. For instance, the type, quality, and unit of measurement of prescription medicines are so diverse that it is not possible to calculate their unit values.

2.1.3. Durable goods

The ownership and utilization of durable goods is a crucial component of consumption aggregate as these goods improve the well-being of households. However, these goods are often purchased occasionally and used over extended periods. To properly account for the welfare of households, it is important to impute the use value of (or utility derived from) these goods in each year of service—not at the time of purchase. The utility derived from the use of these goods could be imputed using the purchase value and the expected lifetime of the goods.

Estimation of the use value derived from these durable goods is based on the information collected in the data and certain assumptions outlined below. The durable goods module (Module L) of IHS4 collects information on 22 home appliances and other durables used by households to improve their daily lives.[2] The information collected about these items include their age, estimated current value, and number of each item owned by the household. Using the information on current value, age, and number of goods and the following three important assumptions, we estimate the use value.[3] First, the purchase of these durables is assumed to be uniformly distributed over time. This assumption allows us to estimate the lifetime of each durable good, except car and motorcycle, as twice the current age of the item. For car and motorcycle, ownership of which are recent phenomenon in rural Malawi, the distribution is likely skewed and hence we calculate lifetime of these two durables as three time their current age.[4] Table 1 presents the average estimated lifetime of each durable good and the number of households that own at least one of these items. Second, the remaining service years left for each durable good is calculated as its current age minus the

[2] This module also collects information on durable assets used for productive purposes. However, these goods are not directly used to improve welfare and hence are not included in the consumption aggregate.
[3] Due to lack of data on purchase value, the estimated current value is used for approximating the total value of the durable goods.
[4] The decision to use a different approach for car and motorcycle gives a more reasonable estimated lifetime: 11.8 years and 9.0 years, respectively. However, if we decide to adopt uniform distribution assumption, the estimated lifetime for car and motorcycle becomes only 7.9 years and 6.0 years, respectively.

estimated lifetime of the good. For goods that are very old, the estimated remaining service left might be negative. In such cases, the remaining service year is replaced by two years. Finally, the ratio of the current value and the remaining lifetime of services is used to approximate the annual use value of each durable good.

Table 1: Estimated average lifetime of consumer durables

		2010		2016	
		Lifetime (years)	Households reporting	Lifetime (years)	Households reporting
1	Mortar/pestle (*mtondo*)	12.3	1,497	15.4	5,600
2	Bed	12.5	1,441	13.8	4,689
3	Table	12.4	1,282	13.3	3,605
4	Chair	10.2	1,389	11.2	4,577
5	Fan	6.6	173	7.7	586
6	Air conditioner	9.7	9	7.5	12
7	Radio ('wireless')	7.5	1,589	8.2	4,536
8	Tape or CD/DVD player	6.2	472	8.1	1,274
9	Television	7.3	424	9.3	1,583
10	VCR	8.5	46	10.5	106
11	Sewing machine	13.8	114	18.6	297
12	Kerosene/paraffin stove	10	34	15.4	42
13	Electric or gas stove	6.8	180	8.1	487
14	Refrigerator	9.6	193	9.7	750
15	Washing machine	6	8	10.1	18
16	Bicycle	11.4	1,224	12.4	4,551
17	Motorcycle/scooter	10.7	14	9.0	218
18	Car	7.7	79	11.8	259
19	Computer equipment	5.2	66	5.9	343
20	Satellite dish	6.2	136	8.2	606
21	Solar panel	4.4	43	5.5	905
22	Generator	4.6	36	8.8	91

Note: Households reporting refers to the total number of households that have reported owning these goods.

2.1.4. Rent for housing

Like durable goods, only the service derived from dwellings, not the construction or repair expenses, needs to be included in the consumption basket. The residence of a household could

either be owned by the household itself or rented from others. The rental expenditure on dwellings rented from other owners could be a good estimate of the service value of housing if the rental market is competitive. The IHS4 housing module (Module F) collects rental expense for households that rent their residences from others. However, most households, especially in rural areas, own their dwellings. For these households, self-reported rental values are collected. The self-reported rental data might, however, be inaccurate. To improve the accuracy of self-reported rent, information on actual rental expense is used.

To improve the accuracy of self-reported rental expenses (as well as actual rent), a hedonic regression is estimated using logarithm of rent (for those who are renting) and a hedonic rental value is imputed for both renter and non-renter households. The estimation takes into account types of dwelling (number of rooms and type of wall, roof, and floor), services available in the dwelling (source of drinking water, type of toilet, and availability of electricity in the home and in the village/town), and region and survey time fixed effects (urban, region, district, and survey year and month fixed effects). Based on the regression coefficients and the characteristics of the dwellings, the predicted rental value of the dwelling is estimated.[5] These estimates are used to replace outliers in the rent and self-reported rent data.

2.2. Adjustment for household size and composition

The next step in the construction of the welfare indicator requires adjusting consumption to account for household size and demographic composition of households to make welfare comparisons across individuals, not across households. This involves converting the standard of living defined at the household level to an indicator defined at the individual level. Adult equivalence scales are sometimes used to convert household consumption into individual consumption by correcting for differences in the demographic composition and household size. In this report, consumption expenditure per capita is used as indicator of individual welfare. A sensitivity analysis of poverty estimates to applying a different scale for children is presented in Appendix B.

[5] The predicted rent in logarithm is converted into normal scale.

2.3. Adjustments for cost of living differences

2.3.1. Between the Third and Fourth Integrated Household Surveys

To estimate poverty rates using IHS4, the poverty line from the previous round (IHS3) must be updated to the latest round. This is accomplished by inflating the national poverty line from March 2010 (the start of IHS3 fieldwork) to April 2016 (start of IHS4 fieldwork). To do this, price indexes need to be used to express the poverty lines from both rounds in the same constant real prices. The Consumer Price Index (CPI) is often used to adjust for cost-of-living differences between the two periods. However, the NSO has rebased its CPI in 2012. The CPI series before and after the rebasing are not directly comparable because they use different weights and price data between before and after the rebasing are not fully comparable. The quality of food price data in the CPI before the rebasing has been particularly weak and not directly comparable to price data after the rebasing in 2012.

In such cases where a continuous CPI series between two consecutive household surveys is not available, a food price index is often developed using the unit values (expenditure divided by quantity) of items in the two surveys (IHS4 and IHS3). This approach has several advantages under this circumstance, including the use of actual transactions the households conducted and price data coming from several locations, especially for items such as maize that is commonly consumed. Also, unit values are used to value consumption of own production. However, unit values are also known to include both price effects and quality effects (see Deaton and Tarozzi 2000).

Therefore, the price adjustment relies on a survey-based food price index by using unit values of food items in IHS3 and IHS4. To adjust for changes in prices of nonfood items, the official nonfood CPI is used. The food and nonfood indexes are then combined using their respective budget shares to calculate overall inflation rate between March/April 2010 and April/May 2016.

The unit values of 57 food items, which account for 88.2 percent of the total food consumption in IHS4, are used to construct the food price index. Relatively rare food items that are consumed by less than 20 households in IHS4 and/or IHS3 are excluded from the analysis. The resulting food inflation rate was found to be almost identical if food items consumed by fewer than 50 households

were excluded from the food price index calculation.[6] The food price index was calculated over the first two survey months of IHS3 and IHS4 (that is, between March/April 2010 and April/May 2016) as opposed to calculating the food price index between the first survey month of the two rounds. This is done to increase the number of common items between IHS3 and IHS4 and to reduce the impact of outlier unit values. The list of food items, their weight, median unit values, and number of sampled households that have reported their consumption are presented in Table A.1.

The food price index is, therefore, estimated based on the food module of IHS3 and IHS4. The median food unit values are used rather than mean values as the former is less likely to be affected by extreme values. The food index is calculated as follows:

$$\text{Food Index} = \sum_{j=1}^{N} w_j \times \frac{p_j^{April/May,2016}}{p_j^{March/April,2010}} \times 100,$$

where w_j is the national weight for item j. It is the average food budget share for item j in IHS4.

The national median unit value for item j in month and year t is represented by p_j^t. The averages of these median values over the first two survey months are taken to represent $p_j^{March/April,2010}$ and $p_j^{April/May,2016}$ for item j.

The nonfood index is calculated from the official nonfood CPI. The official nonfood CPI is used because it is less affected by revisions in data collection and handling before and after the 2012 rebase. In addition to this, IHS4 did not collect price data on nonfood items as in the price module of the community survey in IHS3.[7] This precluded the possibility of estimating nonfood index using the community surveys of IHS3 and IHS4.

The food and the nonfood price indexes are combined using the food and the nonfood consumption shares: 50.2 percent and 49.4 percent, respectively. The resulting overall inflation is 271.4 percent between March/April 2010 and April/May 2016. The corresponding food and nonfood inflations

[6] Note that rare food items have low weight in the food basket, and hence including/excluding them has minimal effect on the estimated food inflation.

[7] This approach was adopted to estimate the nonfood inflation rate between the 2010 and 2013 Integrated National Panel Surveys.

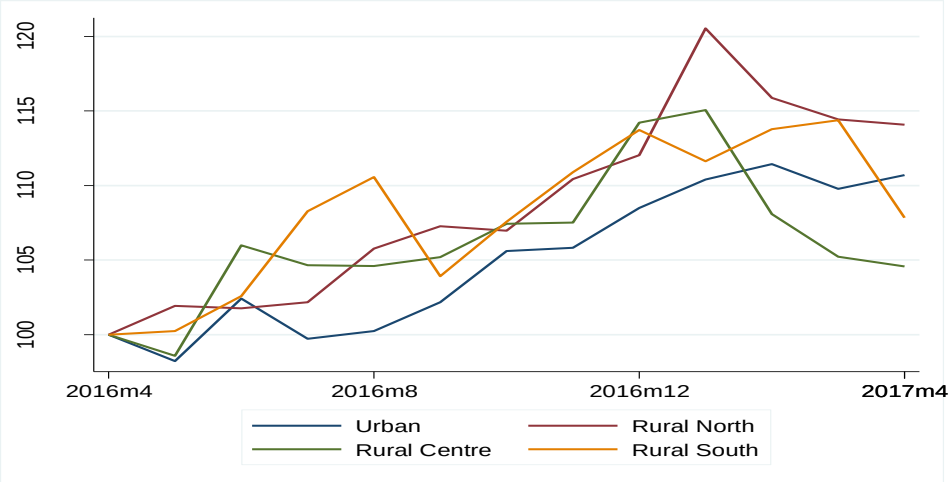
are 319.2 percent and 222.5 percent, respectively. Thus, an inflation of 271.4 percent is used to adjust the poverty line expressed in March 2010 prices to a poverty line expressed in April 2016.

2.3.2. Price adjustment within the Fourth Integrated Household Survey

For poverty analysis using household surveys, the nominal consumption must also be adjusted for temporal and spatial differences in cost of living observed within the survey period and across survey locations. The temporal adjustment deals with differences in cost of living over time (April 2016 to April 2017). For example, MWK 1,000 in April 2016, or at the start of the fieldwork for IHS4, may not be worth the same value in April 2017, or at the end of the fieldwork for the survey. The spatial adjustment deals with differences in cost of living over locations. For example, MWK 1,000 in a rural district may not be worth the same in a large city such as Blantyre.

Because temporal price variations can differ significantly across areas, a region-specific temporal adjustment is implemented by using a combination of the unit values of food items from IHS4 and the official nonfood CPI. These itemized unit values are combined with their respective average food budget shares in the household survey to calculate the regional monthly food price index. The food price index is then combined with the nonfood CPI to calculate the overall regional monthly price index. The food price index is calculated using unit values from the household survey—consistent with the price adjustment across surveys described earlier. At the end of this exercise, consumption in IHS4 is adjusted to regional prices of April/May 2016. Figure 1 shows these regional monthly price indexes by region.

Figure 1: Regional monthly price indexes by region and month of fieldwork (2016/17)



Source: Authors' calculation using IHS4.

In addition, adjustments were also made for spatial cost-of-living differences across regions. To do this, a spatial Paasche price index is estimated. Similar to the temporal price adjustments above, food prices come from unit values from IHS4, while the price data for nonfood items come from the price data used to calculate official nonfood CPI. Following the source of the prices, the weights of the items in the price index come from IHS4 for food items and the weights for nonfood items comes from the regional weight of the official nonfood CPI. Both correspond to average budget shares at the regional level. The food and nonfood price indexes are then combined using the average budget shares of the two consumption aggregates at the regional level.

The base for spatial price index is All-Malawi for April/May 2016, which are the beginning months of fieldwork for IHS4. Average national prices are compared with average regional prices for the same period. By having the same reference period at the national and regional levels, the difference in prices in this calculation is attributable only to spatial differences. Table 2 shows the spatial price indexes. As expected, urban areas are the most expensive followed at a distant second by Rural North. Rural Center and Rural South regions are similarly expensive.

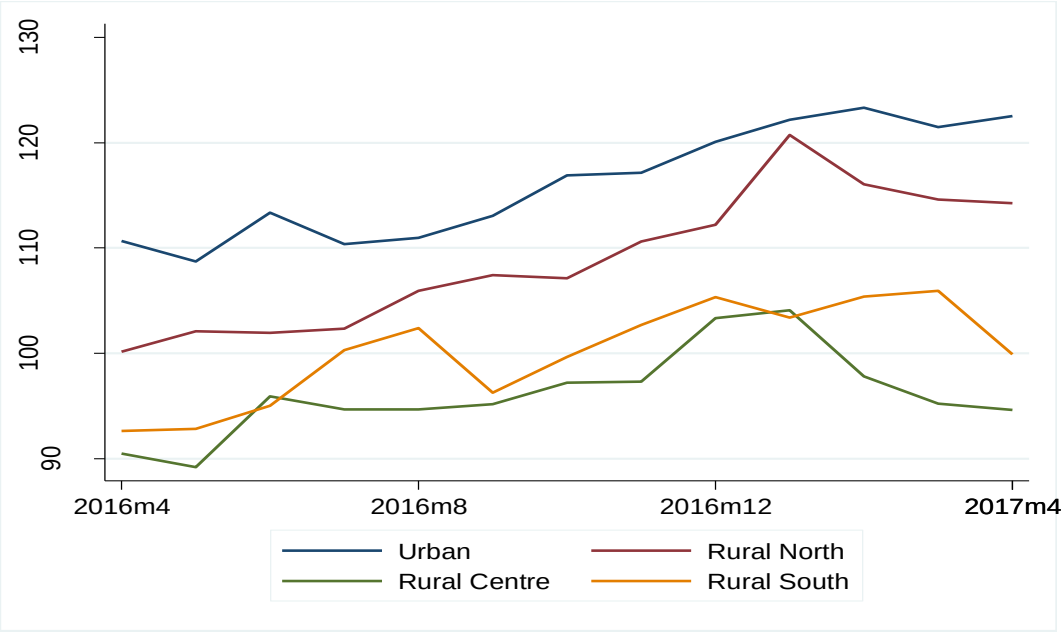
Table 2: Paasche spatial price indexes by region

Location	April/May 2016
All-Malawi	100.0
Urban	110.7
Rural North	100.2
Rural Central	90.5
Rural South	92.8

Source: Authors' calculation using IHS4.

After combining the spatial and temporal differences in prices, the trends in regional price indexes for the IHS4 survey period are presented in Figure 2. The basis here is national prices for April/May 2016.

Figure 2: Temporal and spatial indexes



Source: Authors' calculation using IHS4.

3. Poverty line

The cost-of-basic-needs approach is most commonly used to establish a poverty line. In this approach, the cost of acquiring enough food for adequate nutrition—in the case of Malawi 2,400 calories per person per day—is first estimated and then an allowance for the cost of other basic needs is added (Haughton and Khandker 2009; Ravallion 1998). The poverty line in Malawi was set in 2005 using the basic needs approach. Therefore, the total poverty line is the cost meeting basic nutritional needs (that is, food poverty line) and the allowance for other basic needs (that is, the nonfood poverty line). The nonfood allowance was estimated as the average nonfood consumption of the population whose food consumption is close to the food poverty line.[8] If a person's total expenditure is below the poverty line, the person is considered poor. An individual with consumption below the food poverty line is considered ultra-poor.

The poverty line is in essence absolute, and it also needs to be expressed in constant prices (that is, real poverty line). In other words, the poverty line is absolute because it fixes the same standard

[8] Further details on the construction of the poverty line is available in the 2005 NSO report (NSO 2005).

of living throughout Malawi—two persons with the same welfare level will be treated the same way regardless of the location of their residence. Similarly, to ensure proper comparison of well-being over time, the real poverty line is used. The 2004/05 (IHS2) poverty line has been adjusted to reflect 2010 prices (IHS3) in the previous poverty measurement. The inflation rate (271.4 percent) calculated in Section 2.2.1 is used to adjust the March 2010 poverty line to reflect April 2016 prices. Table 3 shows the poverty line expressed in March 2010 and April 2016 prices.

Table 3: Poverty lines per person per year (in 2010 and 2016 prices)

	2010 prices	2016 prices
Food	22,956	85,259
Nonfood	14,046	52,167
Total	37,002	137,425

Source: IHS3 poverty line and price index

4. Poverty

4.1. Poverty measures

To measure poverty, the class of poverty measures proposed by Foster, Greer, and Thorbecke (FGT) are used (Foster et al., 1984). In addition to the poverty headcount index, the FGT provides poverty gap and severity indexes. This family of poverty indexes can be summarized by the following equation:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{z - y_i}{z}\right)^\alpha * I(y_i < z),$$

where α is a nonnegative parameter that takes value 0, 1, or 2; z is the poverty line; y_i denotes consumption of individual i; and N is the total number of individuals in the population. $I(y_i < z)$ is an indicator function which is equal to 1 when individual i's consumption is below the poverty line and 0 when the consumption is above the poverty line.

The poverty headcount index ($\alpha = 0$) is the percentage of population whose consumption is below the poverty line. This simple and easy-to-interpret index is the most widely used poverty measure. However, it has some limitations in that it does not capture how close/far the poor are from the poverty line and the distribution of consumption among the poor. Two other poverty indexes address these limitations. The poverty gap ($\alpha = 1$), which is the average consumption shortfall of

the poor relative to the poverty line, addresses the first limitation by accounting for extent consumption shortfall. Finally, the poverty severity (α = 2), which is also called poverty gap squared, accounts for the inequality among the poor. For instance, redistribution of consumption among the poor will not be captured by both poverty headcount and poverty gap. However, such a transfer, for example, transfer from a poor person to somebody less poor, increases poverty severity but might not affect headcount or poverty gap. In the poverty severity index, larger poverty gaps carry higher weight (Haughton and Khandker 2009).

4.2. Poverty estimates

The poverty estimates for 2016/17 (IHS4) are presented, alongside the poverty estimates for 2010/11 (IHS3), in Table 4. The results show that the national poverty headcount has not changed much since 2010/11. By 2016/17, about 51.5 percent of Malawians had consumption level below the national poverty line, and this is after a 0.8 percentage point increase since 2010/11. This small increase in national poverty rate is not statistically significant. The results also show that the poverty headcount rate remains much higher in rural areas (59.5 percent) than urban centers (17.7 percent). The poverty headcount rate increased in rural areas by 2.8 percentage points between 2010/11 and 2016/17. Comparison of the poverty rate across rural regions shows that the poverty rate remains the highest in Rural South, followed by Rural North. However, poverty rate has increased in both Rural South and Rural Central, while it did not change in Rural North.

The poverty gap, which captures the average shortfall of consumption of the poor as a percentage of the poverty line, has decreased slightly between 2010/11 and 2016/17. Nationally, the poverty gap decreased from 18.9 percent to 16.8 percent. This decrease is observed both in urban and rural areas.

Table 4: Poverty indexes (2010/11 and 2016/17)

	2016/17				2010/11				
	Coef.	Std. Err.	[95% Conf. Interval]		Coef.	Std. Err.	Std. Err.	[95% Conf. Interval]	
Poverty headcount rate									
National	51.5	1.1	49.3	53.7	50.7	1.2	48.4	53.0	53.0
Urban	17.7	1.8	14.2	21.3	17.3	2.6	12.2	22.4	22.4
Rural	59.5	1.0	57.5	61.4	56.6	1.1	54.5	58.8	58.8
Rural North	59.9	2.1	55.7	64.1	59.9	2.4	55.3	64.6	64.6
Rural Center	53.6	1.5	50.5	56.6	48.7	1.7	45.3	52.0	52.0
Rural South	65.2	1.3	62.7	67.8	63.3	1.6	60.2	66.4	66.4
Poverty gap									
National	16.8	0.5	15.9	17.8	18.9	0.6	17.7	20.1	20.1
Urban	4.5	0.5	3.5	5.5	4.8	0.8	3.3	6.4	6.4
Rural	19.7	0.5	18.7	20.6	21.4	0.6	20.2	22.6	22.6
Rural North	18.9	0.9	17.1	20.7	22.2	1.2	19.8	24.6	24.6
Rural Center	16.4	0.7	15.0	17.7	17.3	0.9	15.6	19.0	19.0
Rural South	23.2	0.7	21.8	24.5	25.1	0.9	23.3	27.0	27.0
Poverty gap squared									
National	7.4	0.3	6.8	7.9	9.3	0.4	8.6	10.0	10.0
Urban	1.6	0.2	1.2	2.1	2.0	0.4	1.3	2.8	2.8
Rural	8.7	0.3	8.1	9.2	10.6	0.4	9.8	11.3	11.3
Rural North	7.9	0.5	7.0	8.9	10.7	0.7	9.2	12.1	12.1
Rural Center	6.8	0.4	6.0	7.5	8.3	0.5	7.2	9.3	9.3
Rural South	10.8	0.4	9.9	11.6	12.8	0.6	11.6	14.0	14.0

Source: Authors' calculation using IHS3 and IHS4.

The poverty rate at district level is presented in Table A.2. The results indicate that poverty rate is much higher in districts in South region.

4.3. Robustness of poverty results

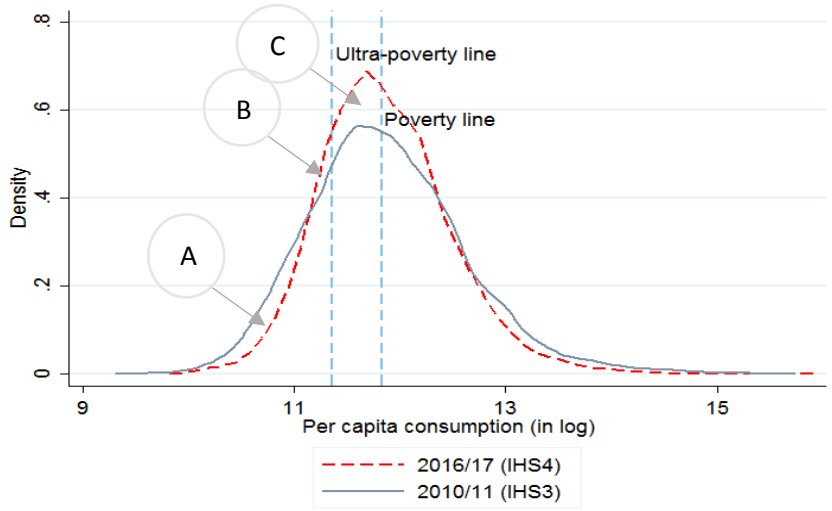
As a robustness check, two further analysis are conducted. First, a comparison of the kernel densities of per capita consumption in IHS3 and IHS4 is presented along with moderate and ultra-

poverty lines. Second, a survey-to-survey (S2S) imputation of consumption in IHS4 is conducted using IHS3.

4.3.1. Density of consumption

The kernel densities of per capita consumption in IHS3 and IHS4 are presented in Figure 3. The consumption per capita and poverty lines are expressed in April 2016 prices. The densities show that there is no change in the share of the population under the moderate poverty line. The area between IHS3 and IHS4 densities before their second intersection (area A) is almost equal to the area after their second intersection and the moderate poverty line (area B+C). This implies that moderate poverty did not change much. On the other hand, ultra-poverty has declined: the area before their second intersection (area A) is greater than the area between them after the second intersection and ultra-poverty line (area B).

Figure 3: Kernel density of consumption per capita (in April 2016 prices)



4.3.2. Survey to Survey (S2S)

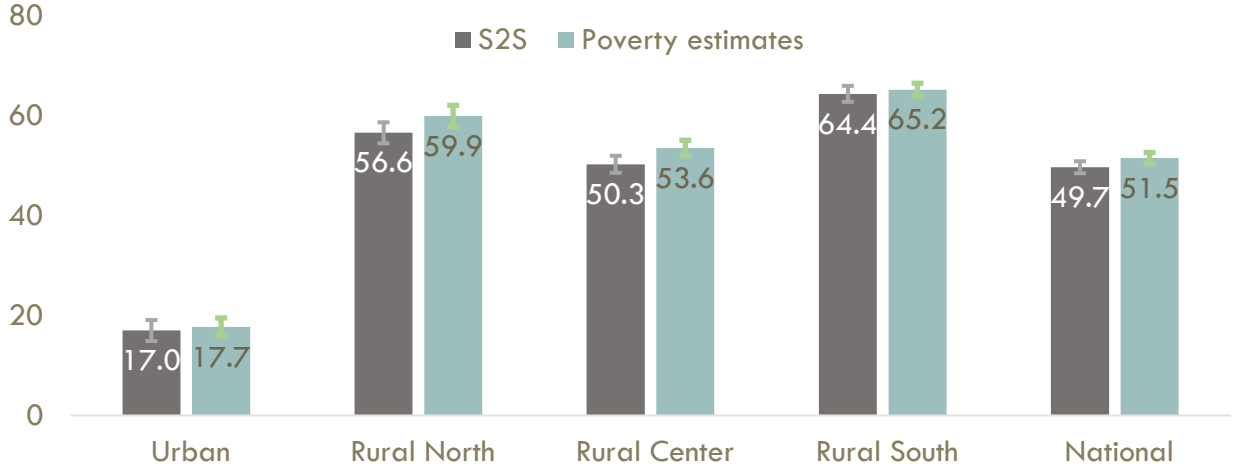
An S2S imputation approach is used to estimate a reliable poverty trend across surveys. An S2S imputation methodology estimates consumption models in one survey and applies the models to another survey to estimate household expenditures and poverty rates. This method is often used when there is a debate on comparability of CPIs and/or consumption data. Often, as in the case of Malawi, the CPI series might be discontinuous and/or it might deviate from price index imputed using unit value. In such cases, the S2S technique is used to adjudicate the choice the right price

adjustment (Christiaensen et al. 2012). This approach was used for Russia, Morocco, Lesotho, Gabon, and Malawi (2010/11–2013). This method, however, assumes that the estimated relation between consumption and its predictors is stable over time (Christiaensen et al. 2012).

There are several variants of S2S approach. For this analysis, we adopted a methodology developed by Yoshida et al. (2015). This methodology was developed on a small area estimation method proposed by Elbers, Lanjouw, and Lanjouw (2002, 2003) while incorporating multiple imputation technique developed by Rubin (1987) and Schafer (1999) and a machine learning technique developed by James et al. (2013).

For this analysis, to reflect regional specific consumption patterns, we estimated models separately for Urban, Rural North, Rural Central, and Rural South regions using IHS3 (2010/11). The final models are presented in Appendix C. Applying these models to IHS4 data, household expenditures and poverty rates are estimated. The comparison between the poverty estimates presented in Section 4.2 and the S2S implied poverty estimates is presented in Figure 4. The result shows that the two estimates are statistically identical.

Figure 4: Comparison between S2S imputation and IHS4 poverty estimations



Appendix

Appendix A: List of items included in the food index

Table A.1: Food items used in the food price index calculation

			IHS4		IHS3	
		Weight (%)	Median unit value in April/May 2016	Households reporting in April/May 2016	Median unit value in March/April 2010	Households reporting in March/April 2010
1	Maize *ufa mgaiwa* (normal flour)	26.2	218.8	395	48.6	374
2	Maize *ufa* refined (fine flour)	13.6	265.0	169	49.8	210
3	Maize *ufa madeya* (bran flour)	0.7	175.0	21	52.5	31
4	Green maize	2.4	166.3	52	36.8	44
5	Rice	2.4	806.5	264	150.0	254
6	Bread	1.5	600.0	308	232.7	275
7	Buns, scones	0.7	875.7	243	234.3	300
8	Biscuits	0.1	817.1	146	487.6	255
9	Cassava tubers	1.0	170.8	187	41.4	210
10	White sweet potato	1.4	116.9	443	38.3	171
11	Orange sweet potato	0.5	110.5	190	36.2	60
12	Irish potato	0.9	272.4	183	77.4	189
13	Plantain	0.1	192.8	41	13.1	28
14	Bean, white	0.8	725.0	142	165.0	123
15	Bean, brown	3.1	733.4	422	190.9	374
16	Pigeon pea (*nandolo*)	2.1	691.2	22	160.0	34
17	Groundnut flour	0.6	1452.9	279	390.8	130
18	Soybean flour	0.7	450.0	67	85.0	24
19	Cowpea (*khobwe*)	0.5	706.6	61	113.5	58
20	Onion	0.8	803.6	522	174.2	510
21	Cabbage	0.4	128.8	171	36.8	101
22	*Tanaposi*/rape	1.6	178.4	592	63.4	322
23	*Nkhwani*	3.3	367.8	225	90.8	219
24	Chinese cabbage	0.2	200.8	147	48.8	43
25	Tomato	4.3	493.8	989	105.7	791
26	Cucumber	0.3	246.3	77	56.4	92
27	Pumpkin	1.9	82.3	137	15.4	152
28	Okra/*Therere*	1.1	495.0	235	130.0	198
29	Eggs	1.7	1133.8	410	431.0	276
30	Beef	1.3	1500.0	135	500.0	127
31	Goat	2.0	1500.0	184	500.0	163
32	Pork	0.8	1275.0	131	375.0	81

			IHS4		IHS3	
		Weight (%)	Median unit value in April/May 2016	Households reporting in April/May 2016	Median unit value in March/April 2010	Households reporting in March/April 2010
33	Chicken	2.6	1897.9	94	535.3	97
34	Banana	0.6	274.7	266	73.5	406
35	Citrus - *naartje*, orange, and so on	0.1	187.6	123	46.9	91
36	Guava	0.2	143.6	77	45.0	98
37	Avocado	0.3	173.4	137	41.9	247
38	Fresh milk	0.5	463.6	144	90.5	151
39	Powdered milk	0.4	1930.0	150	1400.0	105
40	Margarine - blue band	0.2	1850.0	65	875.0	88
41	Sugar	3.7	650.0	842	145.0	832
42	Sugarcane	0.5	49.1	411	10.8	254
43	Cooking oil	5.2	1366.5	1025	469.6	804
44	Salt	2.2	462.3	1267	166.6	1295
45	Maize - boiled or roasted (vendor)	0.1	283.2	32	55.2	22
46	Chips (vendor)	0.2	687.1	171	245.3	128
47	Meat (vendor)	0.1	1317.2	45	488.7	32
48	Fish (vendor)	0.1	1159.9	56	241.6	48
49	Mandazi, doughnut (vendor)	1.2	947.2	497	247.0	369
50	Samosa (vendor)	0.1	638.5	75	229.1	43
51	Tea	0.2	1800.0	429	1000.0	481
52	Coffee	0.0	5000.0	27	2225.0	21
53	Squash (*Sobo* drink concentrate)	0.3	750.0	73	200.0	136
54	Fruit juice	0.3	750.0	78	400.0	28
55	Freezes (flavored ice)	0.1	275.0	134	100.0	58
56	Soft drinks (Coca-Cola, Fanta, Sprite, and so on)	0.2	833.3	99	185.7	183
57	*Thobwa*	1.4	130.0	65	40.0	35

Note. Households reporting refers to the total number of households that have reported consuming the food item. Food items that are consumed by less than 20 households are excluded from the analysis.

Table A.2.: Moderate Poverty and Ultra-Poverty by District

	District	Poverty	Std.Error	Ultra-poverty	Std.Error
	Chitipa	73.8	2.2	33.8	2.4
	Karonga	57.1	2.5	22.7	2.1
	Nkhatabay	57.7	2.5	16.3	1.9
	Rumphi	53.6	2.5	17.3	1.9
	Mzimba	42.9	2.5	16.8	1.9
	Likoma	31.4	3.4	4.4	1.5
North	Mzuzu City	9.7	1.5	2.0	0.7
	Kasungu	53.0	2.6	14.5	1.8
	Nkhotakota	53.4	2.6	25.1	2.2
	Ntchisi	53.5	2.6	22.8	2.1
	Dowa	48.8	2.6	15.6	1.9
	Salima	58.4	2.5	26.6	2.3
	Lilongwe	47.9	2.1	13.9	1.4
	Mchinji	50.5	2.6	17.4	1.9
	Dedza	63.1	2.5	25.6	2.2
	Ntcheu	54.1	2.5	19.2	2.0
Central	Lilongwe City	18.0	1.6	4.7	0.9
	Mangochi	59.5	2.5	22.8	2.1
	Machinga	72.4	2.3	28.5	2.3
	Zomba Non-City	55.9	2.5	19.3	2.0
	Chiradzulu	66.4	2.4	28.0	2.3
	Blantyre	38.9	2.5	11.5	1.6
	Mwanza	53.6	2.6	16.0	1.9
	Thyolo	67.3	2.4	29.3	2.3
	Mulanje	69.2	2.4	35.8	2.5
	Phalombe	83.2	1.9	50.6	2.6
	Chikwawa	63.2	2.5	34.6	2.4
	Nsanje	74.3	2.2	37.0	2.5
	Balaka	61.3	2.5	21.5	2.1
	Neno	46.9	2.6	16.6	1.9
	Zomba City	15.8	1.9	3.9	1.0
South	Blantyre City	8.0	1.4	1.0	0.5

Appendix B: Adjustment for household composition

As noted in Section 2.3, one of the key steps in the construction of the welfare indicator is moving from a measure of standard of living defined at the household level to a welfare indicator at the individual level as the ultimate objective is to make comparisons across individuals and not across households. Even if per capita consumption is frequently used, sometimes adult equivalence scales are used to convert household consumption into individual consumption by correcting for differences in the demographic composition as well as household size.

The use of an adult equivalence scale accounts for the demographic composition of households as it allows us to rescale to reflect the fact that members might have different needs based on their age and gender. It is commonly assumed that children need only a certain fraction of adult consumption needs. As a result, during a comparison of two households that have the same total consumption and household size, but different composition of children and adults, the one which is composed mainly of children is thought to have higher welfare as the weights assigned for children is lower. However, there is no consensus on the appropriate weight applicable to children. Some are based on nutritional grounds, a child may need only a fraction of the food requirements of an adult, but it is not clear why the same scale should be carried over to nonfood items. It may very well be the case that the same child requires more in education expenses or clothing. As a sensitivity analysis, this report presents poverty estimates using incremental scale for children under the age of 16 and a weight of one for adults (Table B.1).

Table B.1: Adult equivalent scale

Age (years)	Equivalence scale
0–1	0.33
1–2	0.47
2–3	0.55
3–5	0.63
5–7	0.73
7–10	0.79
10–12	0.84
12–14	0.91
14–16	0.97
>16	1.00

The comparison of welfare status based on adult equivalent and per capita consumption is conducted by investigating the correlation of these two welfare indicators and the implied poverty.

The correlation coefficient is 0.99 and hence the two welfare indicators are strongly correlated. These indicators also correctly classify the poor and the nonpoor individuals in the same way. For example, the comparison of 50 percent of the population ranked in terms of per adult equivalent consumption and another 50 percent of the population ranked in terms of per capita consumption shows that both indicators classify 95 percent of the individuals in the same way. In other words, these two welfare indicators correctly identify the same population as poor if a fixed poverty is chosen (Table B.2).

Table B.2: Poverty using alternative consumption aggregates

		Per capita consumption		
		Poor	**Nonpoor**	**Total**
Per adult equivalent consumption	Poor	47.4	2.6	50
	Nonpoor	2.6	47.4	50
	Total	50	50	100

Appendix C: Survey-to-survey imputation

This appendix is redacted. Readers who are interested in this section could access it by contacting the NSO.

Appendix D: Classification of individual consumption by purpose (COICOP)

Table D.1: Classification of items by COICOP and the repetitive modules in IHS4 questionnaire

COICOP code	Description	Module (M), question (Q) and label/code (L): in this sequence MQ-L
01	Food and nonalcoholic beverages	
01.1	Food	
	Cereals, tubers, nuts, vegetables, fruits, oil, sugar, and so on	G02-101 to G02-818
01.2	Nonalcoholic beverages	
	Tea; coffee; cocoa, Milo; squash; *thobwa*; fruit juice; freezes; soft drinks; bottled water; *maheu*; and other	G02-901 to G02-907, G02-909 to G02-G910, G02-912, G02-916
02	Alcoholic beverages and tobacco	
02.1	Alcoholic beverages	
	Bottled or canned beer, traditional beer (*masese*), wine or commercial liquor, locally brewed liquor (*kachasu*), and chibuku (commercial traditional-style beer)	G02-G908, G02-G911, G02-G913 to G02-G915
02.2	Tobacco	
	Cigarettes or other tobacco	I02-103
03	Clothing and footwear	
03.1	Clothing	
	Infant clothing	J02-301
	Baby nappies/diapers	J02-302
	Boy's trousers	J02-303
	Boy's shirts	J02-304
	Boy's jackets	J02-305
	Boy's undergarments	J02-306
	Boy's other clothing	J02-307
	Men's trousers	J02-308
	Men's shirts	J02-309
	Men's jackets	J02-310
	Men's undergarments	J02-311
	Men's other clothing	J02-312
	Girl's blouse/shirt	J02-313

COICOP code	Description	Module (M), question (Q) and label/code (L): in this sequence MQ-L
	Girl's dress/skirt	J02-314
	Girl's undergarments	J02-315
	Girl's other clothing	J02-316
	Lady's blouse/shirt	J02-317
	Chitenje cloth	J02-318
	Lady's dress/skirt	J02-319
	Lady's undergarments	J02-320
	Lady's other clothing	J02-321
	Cloth, thread, other sewing material	J02-326
	Laundry, dry cleaning, tailoring fees	J02-327
03.2	Footwear	
	Boy's shoes	J02-322
	Men's shoes	J02-323
	Girl's shoes	J02-324
	Lady's shoes	J02-325
04	Housing, water, electricity, gas and other fuels	
04.1	Actual rents for housing	
	Actual rent payment	F04
04.2	Imputed rents for housing	
	Estimated the rent for non-renters	F03
04.4	Water supply	
	Water for cooking, bathing, and so on	F37
04.5	Electricity, gas and other fuels	
	Value of the firewood used in the past week	F18
	Electricity	F25
	Charcoal	I02-101
	Paraffin or kerosene	I02-102
	Candles	I02-104
	Matches	I02-105
	Light bulbs	I02-209
	Solar panel	L02-531
	Generator	L02-532
05	Furnishings, household equipment, and routine home maintenance	
05.1	Furniture, furnishings, carpets, and other floor coverings	
	House decorations	J02-338
	Carpet, rugs, drapes, curtains	K02-401
	Mat - sleeping or for drying maize flour	K02-403
	Mosquito net	K02-404

COICOP code	Description	Module (M), question (Q) and label/code (L): in this sequence MQ-L
	Mattress	K02-405
	Bed	L02-502
	Table	L02-503
	Chair	L02-504
05.2	Household textiles	
	Linen - towels, sheets, blankets	K02-402
05.3	Household appliances	
	Repairs to household and personal items (radios, watches, and so on)	I02-218
	Fan	L02-505
	Air conditioner	L02-506
	Sewing machine	L02-511
	Kerosene/paraffin stove	L02-512
	Electric or gas stove; hot plate	L02-513
	Refrigerator	L02-514
	Washing machine	L02-515
05.4	Glassware, tableware, and household utensils	
	Bowls, glassware, plates, silverware, and so on	J02-328
	Cooking utensils (pots, stirring spoons, whisks, and so on)	J02-329
05.5	Tools and equipment for home	
	Batteries	I02-220
	Recharging batteries of cell phones	I02-221
	Torch/flashlight	J02-331
	Paraffin lamp (hurricane or pressure)	J02-333
	Mortar/pestle (*mtondo*)	L02-501
05.6	Goods and services for routine home maintenance	
	Milling fees, grain	I02-201
	Wages paid to servants	I02-215
	Cleaning utensils (brooms, brushes, and so on)	J02-330
06	Health	
06.1	Medical products, appliances, and equipment	
	Expenditure for nonprescription medicines (Panadol, Fansidar, cough syrup, and so on)	D12
06.2	Out-patient services	
	Expenditures for illnesses and injuries (medicine, tests, consultation, and in-patient fees)	D10
	Expenditure not related to an illness (preventative health care, pre-natal visits, check-ups)	D11
	Stay(s) at the traditional healer or faith healer	D19
	Stay(s) at the traditional healer or faith healer, transport costs	D20

COICOP code	Description	Module (M), question (Q) and label/code (L): in this sequence MQ-L
	Stay(s) at the traditional healer or faith healer, food costs	D21
06.3	Hospital services	
	Hospitalization(s) or overnight stay(s) in a medical facility	D14
	Hospitalization(s) or overnight stay(s) in a medical facility, transport costs	D15
	Hospitalization(s) or overnight stay(s) in a medical facility, food costs	D16
07	Transport	
07.1	Purchase of vehicles	
	Bicycle	L02-516
	Motorcycle/scooter	L02-517
	Car	L02-518
07.2	Operation of vehicles	
	Petrol or diesel	I02-212
	Motor vehicle service, repair, or parts	I02-213
	Bicycle service, repair, or parts	I02-214
07.3	Transport services	
	Public transport - bicycle, taxi	I02-107
	Public transport - bus, minibus	I02-108
	Public transport - other	I02-109
08	Communication	
08.1	Postal services	
	Postage stamps or other postal fees	I02-210
08.3	Telephone and fax services	
	Cell phone	F35
09	Recreation and culture	
09.1	Audio-visual, photographic and information processing equipment	
	Music or video cassette or CD	J02-336
	Film, film processing, camera	K02-407
	Radio (wireless)	L02-507
	Tape or CD player; HiFi	L02-508
	Television	L02-509
	VCR	L02-510
	Computer equipment and accessories	L02-529
	Satellite dish	L02-530
09.2	Durables for recreation and culture, including repairs	
	Sports and hobby equipment, musical instruments, toys	K02-406
09.3	Other recreational items and equipment, gardens and pets	

COICOP code	Description	Module (M), question (Q) and label/code (L): in this sequence MQ-L
	Expenditures on pets	I02-219
09.4	Recreational and cultural services	
	Tickets for sports / entertainment events	J02-337
09.5	Newspapers, books, stationery	
	Newspapers or magazines	I02-106
	Stationery items (not for school)	J02-334
	Books (not for school)	J02-335
10	Education	
10.1	Education, all levels	
	Tuition, including any extra tuition fees	C22A
	After school programs and tutoring	C22B
	School books and stationery	C22C
	School uniform and clothing	C22D
	Boarding school fees	C22E
	Contributions for school building or maintenance	C22F
	Transport	C22G
	Parent association and other school related fees	C22H
	Other school expenses	C22I
11	Restaurants and hotels	
11.1	Vendors, cafes, restaurants	
	Vendor consumption: maize (boiled or roasted), chips, cassava, eggs, chicken, meat, fish, *mandazi*, samosa, meals eaten at restaurants, other	G820-G830
11.2	Accommodation services	
	Night's lodging in rest house or hotel	J02-339
12	Miscellaneous goods and services	
12.1	Personal care	
	Bar soap (body soap or clothes soap)	I02-202
	Clothes soap (powder)	I02-203
	Toothpaste, toothbrush	I02-204
	Toilet paper	I02-205
	Glycerine, Vaseline, skin creams	I02-206
	Other personal products (shampoo, razor blades, cosmetics, hair products, and so on)	I02-207
12.3	Personal effects	
	Umbrella	J02-332

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