# The Role of Price and Consumption Bundle Aggregation in Poverty Measurement: A Reassessment of Poverty in Uganda

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## Introduction

During the past few decades, Uganda has experienced substantial reduction in head-count poverty estimates from 38.8% during 2002/03 Uganda National Household Survey (UNHS), to 31.1% during 2005/06 UNHS and 24.5% during the latest survey conducted during the 2009/10 period, (UBOS, 2010). While part of this poverty reduction is a peace dividend that the government policies have ensured, Uganda has also hit the millennium Development Goal (MDG) of halving poverty head-count estimates from 56.4% in 1992 (MFPED, 2012; World Bank, cited by Fact fish, 2013). However, much of the several development programs that have liberated Ugandans to such a positive trend head-count poverty reduction, have been hugely supported by donor funds and these have a direct interest in clearly reviewing and understanding the progress made by their aid support to Uganda.

Recently, the tide has been turning. Museveni's Uganda is quickly losing her status as a donor darling due to corruption and inappropriate donor aid allocations. For instance for the financial year 2012/13, the Uganda government budget descended by approximately 260 million U.S dollars, contributing 6.2% of the national budget because donors including the republic of Ireland sighted graft and cut aid, (Independent, 2012). However, sometimes inappropriate allocation of donor funds due to perhaps mistaken policy guidance by the experts has made donors over and again to review their aid considerations to Uganda. For instance one of the most popular government programs in the recent past, the National Agricultural Advisory Services (NAADS) meant to enable government fight household poverty under the Prosperity For All (PFA) initiative has been recently suspended by President Museveni. The president realized that the NAADS program that was supposed to run for seven years at a minimum of 108 million U.S dollars per year was misguided by experts. The targeted people in some districts were still in camps thus support never reached them, selection of beneficiary farmers was biased and agricultural materials for use like animals were at hugely inflated prices. None of the disbursed NAADS monies were ever reimbursed to government, (Uganda Media Centre, 2013). In the wake of these political and social events (corruption, embezzlement and misallocation of national funds etc.), more and more people start questioning the continuing reduction in the

official poverty estimates or even develop doubt in its value that may either be underestimated or overestimated nationally or regionally as monies targeted for specific regions are embezzled by government officials and distributed to other regions where they come from in terms of private investments, politically initiated development projects and employment to their kin. For instance in early 2013, it was discovered that over 35 billion Uganda shillings (about 14 million U.S dollars) received as aid from donors towards the Peace Recovery and Development Plan for Northern Uganda (PRDP) had been embezzled by officials of the office of the prime minister, which was at the time headed by a Prime Minister from the Western region, Mr. Amama Mbabazi and a Permanent Secretary, Mr. Pius Bigirimana, also from the western region, both of whom are appointed by the president, who also hails from the west, (Bagala, 2013). Such mishaps have clear region specific implications on the cost of basic needs for households and also impact on Uganda's credibility and ability to access to donor aid and consequently of her national budget which then directly impacts on the poverty status of all Ugandans at a national level through basics and services' provisions that the government can be able to provide or enable her population produce and improve their poverty status. However representative poverty estimates enable both national and regional (local) governments to appropriately decide on how to allocate own revenues from nationally or regionally produced goods and services.

Uganda has been using the same food basket for the poor for all regions for over two decades to calculate poverty estimates (MFPED, 2012). In addition this consumption food basket used to estimate poverty rates has been the same for the entire Ugandan population despite clear problems that influence poverty and have been specific to particular regions of Uganda. For instance the northern region has suffered Lord's Resistance Army (LRA) rebel group insurgency since 1980's to an extent that the United States has recently committed 100 armed military advisers towards efforts to eliminate the group (Shanker & Gladstone, 2011). In addition the northern region people have been living in camps for a good time and not involved in household agriculture which also led to the misfiring of the NAADS Programme. Furthermore Ugandan regions that are greatly dispersed on ethnic grounds have clearly different staple foods that form most composition of these regions' specific food baskets. For instance bananas, the most produced crop in Uganda are a very important staple food in the Central and Western regions of the country as is perhaps for sweet potatoes in the East. Therefore in more realistic terms these regions are bound to have different consumption food baskets reflecting area based food differences and characteristics thus also attract different prices. While price heterogeneity has been incorporated in the Uganda poverty measurements from the start, consensus is building that specificity of poverty estimates also requires different food bundles for different spatial or temporal domains, since food is a central element of household welfare and poverty status (Heltberg & Tarp, 2002; Mukherjee & Benson, 2003). Different methodologies of estimating poverty yield different estimates, for instance using the same UNHS-2005/06 and 2009/2010 data, UBOS estimated Uganda head-count poverty rates respectively at 31.1% and 24.5%

whereas Daniels, (2011) estimated it at 33.0% and 30.6 %. All these authors were using slightly different approaches and parameters relying on their importance towards ensuring minimal better day to day households' standards of living. However these studies did not have their poverty lines tested for revealed preference conditions and since Daniels used non-monetary indicators, it is clear that both studies did not explicitly consider region specific food bundles and prices thus region specific food poverty lines, which usually contribute the largest proportion of the total poverty line in most developing countries, where Uganda has been a persistent member for decades.

In the current trend of estimating poverty more accurately and explicitly to appropriately guide national policy in both developed and developing world; and the donor community, the Cost of Basic Needs (CBN) approach has been found to be more feasible since it takes care of national regions' specific flexible food bundles and prices (Arndt & Simler, 2010). To estimate national poverty for Uganda more precisely, representatively and critically while considering food as a key element of household welfare and taking into account the households' specific spatial domain's environment, this paper has followed a CBN approach, using region specific utility-consistent food bundles and prices, derived under the entropy adjustments procedure. This has been the key addition to UBOS (2010), Daniels, (2011) and other similar methodologies. The entropy estimated utility-consistent poverty lines reflect better the effect region specific differences in food bundles and prices on household, regional and national poverty status. These region specific differences and characteristics have specifically contributed to region specific poverty head-count estimates that in turn have been used to project national poverty estimates for Uganda, grounded on the specificity and consistency properties of poverty lines.

**Poverty in Uganda:-Recent Trends and Controversies**

Basing on the official figures of poverty estimates for Uganda based on the National Poverty line, as displayed in Figure 1, Poverty in Uganda has been generally declining despite various economic, political and social challenges that have been facing Ugandans including; civil wars, drought, floods, land-slides, corruption and others that have at some times posed serious threats to key poverty status parameters like food and shelter for particular regions in Uganda.

Figure 1: Poverty head-count estimates for Uganda at National
Poverty line (% of Population)
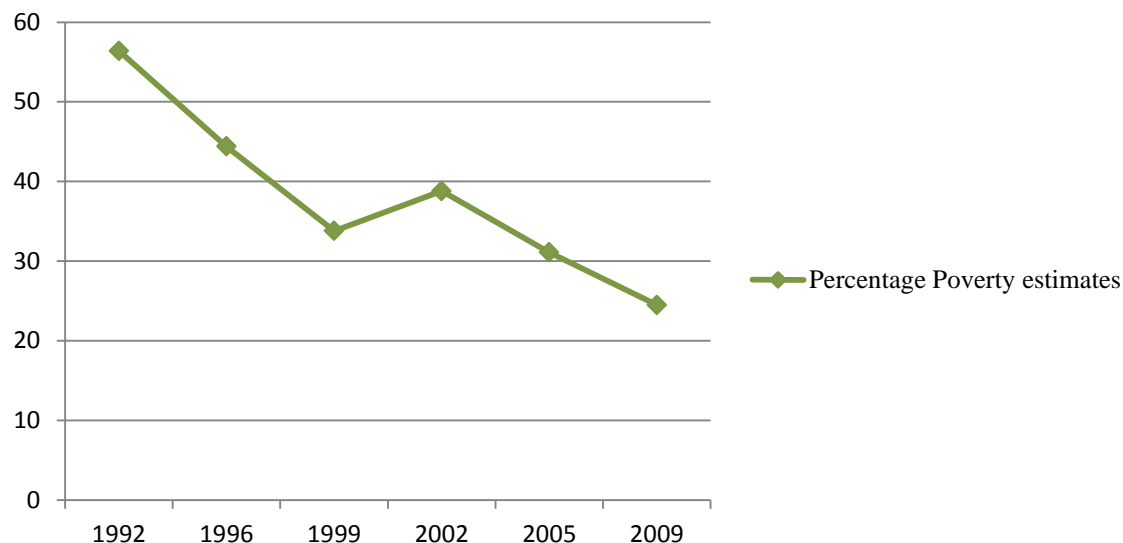
According to MFPED, (2012) over the decades poverty estimates in Uganda have been based on a common food basket for all Uganda; leading to a common food poverty line (21, 258 UGX per month per capita) for all regions and this has been used to define the household poverty status of all Ugandans irrespective of their regions of stay. It is common knowledge that what is considered an important food in Washington D.C, may not necessarily be that important in Kampala. The importance of a food product to a consumer is significant in determining the food product price. The price in turn is important in determining accessibility of the household to this food product. Accessibility to food and other basics for life whose availability, importance and price are much determined by the regions where households are located, finally determines the poverty status of that household. Therefore when estimating absolute poverty it is very crucial to construct specific standards of living for specific populations separated by time or areas of living, (Ravallion, 1994). For practical purposes, bananas that are an outstandingly important food in Kampala are perhaps not equally important or equally priced in Lira or Mbale, the regional towns in the northern and eastern regions of Uganda respectively. Therefore using a common food poverty line that is also utility-inconsistent may perhaps lead to unrepresentative regional and national poverty estimates. Table 1, displays original poverty lines used by UBOS for the Uganda national absolute poverty head-count estimates of 2009.

Table 1: Original Poverty lines for Uganda by UBOS (UNHS data 2009/10)

| Region | | Poverty Lines | | |
|---|---|---|---|---|
| | | Food | Non-Food | Total |
| Central | Rural | 21,258 | 10,848 | 32,106 |
| | Urban | 21,258 | 8,314 | 29,572 |
| Eastern | Rural | 21,258 | 9,427 | 30,685 |
| | Urban | 21,258 | 7,384 | 28,642 |
| Northern | Rural | 21,258 | 8,976 | 30,234 |
| | Urban | 21,258 | 7,689 | 28,947 |
| Western | Rural | 21,258 | 8,735 | 29,993 |
| | Urban | 21,258 | 6,907 | 28,165 |

Source: UBOS final UNHS data 2009/10

Note: Data are monthly per capita figures in Uganda Shillings (UGX)


**Data**

The data used for this paper was collected by the Uganda Bureau of Statistics (UBOS), the statutory national statistic body of Uganda, under the Uganda National Household Survey (UNHS) of the year 2009/2010 and here referred to as UNHS-2009/10. The data was collected from the four major regions of Uganda; Central, Eastern, Northern and Western starting May, 2009 to April, 2010, on several social and economic household variables including foods, incomes and expenditure. A total 6,775 households across Uganda was sampled basing on their rural-urban status, comprising of; 809 from Central urban, 1,177 from Central rural, 132 from Eastern urban, 1,274 from Eastern rural, 172 from Northern urban, 1,784 from  Northern rural, 107 from Western urban and 1,320 from  Western rural.  All food items on which data were collected by UBOS have been considered as food in this paper except beer, alcoholic drinks, cigarettes and tobacco that were treated as non-basics and non-food products. For the non-food items, only household assets have been considered and approximated to a 10% value usable by the household per year. Non-durables that are frequently used by households including water, electricity, firewood, charcoal, paraffin, rent and imputed rent, matches and soaps have been considered whereas other non-durables like handbags, batteries, newspapers, tires and others treated non basic. Semi-durables including clothing, beddings, stoves, plastic plates/tumblers and mattresses have been considered and estimated at 10% of use value per year, whereas other semi-durables like furniture, motor vehicles, bicycles, computers, phone handsets, TVs, glass ware, jewelry and household functions' expenses have been treated as non-basics and some of them had already been considered under the assets. All non-consumption expenditure like income, property and other taxes, remittances, service fees and gifts have all been treated non basic.


**Analytical Tools**

The data has been exclusively analyzed using a utility consistent poverty lines estimating pre-programmed toolkit developed by the World Institute for Development Economics Research of the United Nations University (UNU-WIDER), under the Growth and Poverty Project (GAPP). The institute embarked on estimating poverty for several developing countries in the Sub Saharan Africa (SSA) using utility consistent poverty lines, aimed to more realistically and reliably estimate poverty ratios and locate the poor by region in SSA countries including Mozambique, Egypt, Malawi, Kenya, Tanzania, South Africa and Uganda

Particular parameters within the original toolkit previously used in Mozambique have been changed to suite the Uganda situation; including among others the number of regions to be considered in calculating poverty estimates where in the Ugandan case we had the Central, Eastern, Northern and Western regions. The empirical methods of analysis embedded in the toolkit are STATA software do file codes based on the analytical methodology explained in details by Arndt and Simler, (2010), which has been exclusively followed and briefly described below. At the end of all the analytical process for this paper, a new programmed toolkit of do files with specifications for Uganda that can replicate exactly all results presented in this paper has been developed. The toolkit bears full details of all analytical procedure and reasons for such procedure.

**Analytical Methods**

The empirical methods of analysis used here are similar and explained in details by Arndt & Simler, (2010) and only illustrated necessarily in this paper. . However during the analysis, the rural/urban variable has been treated as collected by UBOS for the sub-regions, but at a region level, given the few numbers of the urban composition for the western, northern and eastern regions, their urban households have been collapsed back to the region hence having five spatial domains (regions) for the analysis at region level including eastern, northern, western, central urban and rural. This was because the toolkit estimation procedure at region level involved a preferred and pre-programmed five (5) iterations requirement, which needed relatively larger numbers than those collected in the urban sections of the east, north and west. Although the aggregation might have hampered the rural/urban poverty comparisons at the region level for the eastern, northern and western regions, the maintenance of the rural/urban specification at sub-region level maintained credibility of the national rural/urban poverty estimates.

**Utility Consistency and estimating Poverty lines**

Poverty lines are a good policy guidance tool on estimating and planning against absolute household poverty (Arndt & Simler, 2010). This paper focused on estimating absolute household poverty in Uganda implying that a household that failed to meet the minimum financial requirements of living standards given a particular regions' poverty line where that household is located, was considered poor and non-poor otherwise. That consideration fulfills the consistency property of credible poverty lines (households of similar welfare given their region of stay are equally poor), (Ravallion & Bidani 1994). The other important property of poverty lines is specificity; implying that poverty lines must communicate native opinions of the composition of poverty, (Ravallion & Bidani 1994). The specificity property takes care of the importance and value attached to particular food products and basics as per the particular regions' environment and characteristics.

The theory explaining absolute poverty lines is rooted in welfare economics and constrained utility maximization, implying that a model living standard that the poverty line signifies is the utility level that corresponds to the minimum allowable living standards. We track a methodology earlier used by Ravallion & Lokshin (2006) to estimate poverty in Russia, and recently by Arndt & Simler, (2010) in Egypt and Mozambique. The approach looks at household $n$ in population subgroup $m$. Household characteristics are embedded in vector $x_{nm}$, and preferences signified by a utility function $u_m$ $(q_{nm}, x_{nm})$. A household chooses a vector for consumption $q_{nm}$ which by that household's preferences and characteristics maximizes household utility. Therefore, the expenditure for a given household is expressed as: $e_m$ $(p_{nm}, x_{nm}, u)$ demarcating the lowest cost required to attain utility $u$ in population subgroup $m$ at prices $p_{nm}$ and characteristics $x_{nm}$. Hence a group of poverty lines that are utility consistent, related to the lowest allowable living standards, symbolized by utility $u_k$ are presented as;

$$k_{nm}^u = e_m(p_{nm}, x_{nm}, u_k) \qquad \forall \ n, m. \qquad (1)$$

Arndt & Simler, (2010) state that ideally a poverty line that is utility consistent is formulated as;

$$k_{nm}^u = p_{nm}q_{nm}(p_{nm}, x_{nm}, u_k). \qquad (2)$$

They add that CBN poverty lines to be utility consistent must be grounded on goods' bundles that are on a Hicksian utility compensated demand functions, so that equal levels of utility $u_k$ is realized. Revealed preferences (assuming that consumers prefer consuming more than less, (Varian 1992)) ensure that multiple bundles of goods produce equal utility levels.

Assuming indistinguishable consumers preferring more than less with preferences demarcated on $N(n \in N)$ commodities where each consumer lives in a specific spatial domain or region, $r$, within a set of spatial regions $R(r \in R)$. These consumers are forced to expend the lowest

required to achieve similar utility level that is random. With these restrictions, that also adds to the fact that hypothetically prices are dissimilar through these spatial regions, the revealed preference conditions below stand;

$$\sum_n p_{nr}q_{nr'} \geq \sum_n p_{nr}q_{nr} \qquad \forall \, r, r', \qquad\qquad (3)$$

Where $r'$ denotes a designated index for a set of spatial regions $R(r, r' \in R)$ as $p$ and $q$ respectively denote the prices and quantities. Logically, for each spatial region $r$, the characteristic consumer living in $r$ has a chance of selecting that bundle which provides the necessary level of utility. While preferring more to less rationally, the consumer selects a cost-minimizing bundle, $q_r$. Therefore, the cost of any other package providing a similar utility level, appraised at prices $p_r$, essentially is at least as much as the cost-minimizing bundle. Since, by supposition, a chosen bundle in every spatial region is providing an equal level of utility, equation (3) has to hold for the entire probable twosomes of spatial regions. Execution of circumstances expressed in (3), on a collection of bundles considered representative of the living standard portrayed by a region or time specific poverty line is candidly realistic.

However despite usage and consideration of all information available, bundles across regions substantially usually fail the revealed preference tests (Arndt & Simler, 2010). Therefore in such a case we have resorted to uncertainty or entropy estimations to better ensure that these bundles obey the revealed preference conditions, such that the results are in respect of the basic macroeconomic individualities, hence yielding entropy-adjusted utility-consistent poverty lines.

**Entropy/Uncertainty Estimation**

According to Arndt & Simler, (2010), broadly information within an estimation problem using an entropy principle arises in two forms: (1) hypothetical or practical information concerning the system imposing constraints on the standards that the numerous parameters for estimation can take and (2) previous knowledge of possible parameter standards. Considering the first one, information is used by stipulating constraint equations in the estimation methods. In the second case, information is used by stipulating a distinct previous distribution and estimating parameters by minimizing the entropy expanse stuck between the estimated and previous distributions. For entropy estimation considerations in this study, revealed preference conditions denote main hypothetical information which is inflicting constraints on the structure of poverty line bundles. Surveys household data studied by means of the CBN approach, offers the previous information on the structure of poverty line bundles. Additional information, like the minimum caloric requirements, can also be imposed. An instance illustrating a basic approach to achieving utility-consistent bundles while we follow a constrained minimization problem is as below;

$$\underset{q_{nr'}, s_{nr}^{ent}}{Min} \sum_{r} \sum_{n} s_{nr}^{ent} \ln\left(\frac{s_{nr}^{ent}}{s_{nr}^{org}}\right) \qquad\qquad (4)$$

Subject to:

$$\sum_{n} p_{nr} q_{nr'} \geq \sum_{n} p_{nr} q_{nr} \qquad \forall \ r, r' \qquad r \neq r' \qquad (5)$$

$$s_{nr}^{ent} \sum_{n'} p_{n'r} q_{n'r} = p_{nr} q_{nr} \qquad \forall \ n, r \qquad\qquad (6)$$

$$\sum_{n} calpg_{n} q_{n1} = cal \qquad\qquad (7)$$

$$s_{nr}^{ent} \geq 0, \quad s_{nr}^{ent} \leq 1, \quad q_{nr} \geq 0, \qquad \forall \ n, r, \qquad (8)$$

Where the representation is passed frontward from equation (3) and turned into constraint (5). The new representation is written as; $s_{nr}^{ent}$ representing the share of the budget for an entropy-adjusted bundle, $s_{nr}^{org}$ representing the share of budget for the original bundle, $calpg_{i}$ representing the calories in each unit quantity per commodity $n$, $cal$ representing the calorie requirement for bundles altogether, $r, r'$ stands for a location index in time or space and the $n'$ is a codenamed $n$ index. Depending on the specification design, that is temporal or spatial, observation of the conditions expressed in the equations above, yields entropy adjusted utility-consistent poverty lines.

For this study, we use the UBOS-UNHS-data 2009/2010 on a spatial dimension since the data was a one season survey and secondly we use the UNHS-data 2005/2006 bundles at 2009/2010 prices which explores both the spatial and temporal dimension on comparing poverty lines that are utility-consistent.

**Results**

**The CBN Food Poverty Lines**

In estimating poverty, two components of the poverty line are indispensable; the food poverty line and the non-food poverty line. Generally when we are assessing the cost of basic needs using the CBN approach, food is of prime priority and usually food products and prices are different across regions and by time. Therefore in an effort to recognize the key role of food in sustaining basic life and its importance as a master component in assessing the poverty status of households and policy formulation that may sometimes require being region-specific for efficient eradication of poverty, we divert from the methodology used by the Uganda National Bureau of Statistics (UBOS), the statutory body responsible for official national accounts. UBOS used a uniform food poverty line across all Uganda but varied the non-food poverty line (table 1). This methodology has been updated by using region-specific food poverty lines and original utility-inconsistent poverty line under the CBN approach presented in table 2.

Table 2: Original Utility Inconsistent Food Poverty lines for Uganda

| Region | Food Poverty lines | |
| --- | --- | --- |
| | By UBOS (Uniform) | By Authors (Region Specific) |
| Central Rural | 21,258 | 23,389 |
| Central Urban | 21,258 | 21,449 |
| Eastern | 21,258 | 17,862 |
| Northern | 21,258 | 11,247 |
| Western | 21,258 | 37,384 |

Source: UBOS and Authors' calculations (Authors using region specific flexible food bundles and prices from the UBOS-UNHS dataset, 2009/2010)
Note: Data are monthly per capita figures in Uganda Shillings (UGX)

From table 2, column 3, we clearly note that there are differences in the price of the food basket across all regions in Uganda if we consider regional differences. The western region has an incredibly very high food poverty line which is almost double that of the following region, central, and almost four times that of the northern region. Although, the central region is more urbanized than all these other regions and thus anybody would expect the central region to have the highest food basket survival price, the characteristics specific to the western region outweigh the urbanization element of the central region. For instance, much of the important foods consumed in the urban centers of the central region including Matooke (bananas), potatoes, sweet potatoes and others are hugely fetched from the western region. For instance 67% of Uganda's banana production is from the western region and 66% of Uganda's urban population depends on bananas for daily consumption (Pro Musa, 2013). Since bananas are a major important food staple in Uganda, and also inhabit the biggest cultivated space among staple foods in Uganda, (Edmeades, Smale & Karamura, 2006), they are that important a food basket component in Uganda. Therefore for instance the availability of important staples in the relatively more urbanized central region increases food supply in the central and relatively

lowers the price rates at a rate higher than the urbanization factor would do. At the same time, the heavy food exporting characteristic of other regions to the central where there are relatively better markets, in turn create a food supply shortage in this case more in the west, thus relatively increasing the prices of food in the western region hence increasing the basic cost of living which in turn also generally increases the food poverty line of the region.

Furthermore, much of the official key government employment including the presidency, premiership, several positions of ministership, senior army officers and others have been for decades since Museveni's ascendency to power in 1986 been occupied mostly by westerners. This has perhaps exposed people in this region to relatively better incomes and hence inflated the food prices for the CBN food bundle in the region's food markets hence also perhaps contributing importantly to the higher level food poverty line in the west.

**Tests for Revealed Preferences**

We present the revealed preferences for the index matrix for original region-specific food poverty lines across Uganda, in table 3. The rows represent the region specific bundles (quantities) whereas the columns represent the region-specific prices (standards). Remember that the food poverty lines presented in this paper as an output of the authors, possess clear information on prices, food products and quantities, other than the non-food poverty line that are only implicitly generated as a share of the total poverty line, since the specific information on the variables of quantity, prices and products constituting the non-food poverty line was not clearly accessible. Therefore the consistency tests in this study are restricted to food poverty lines.

Table 3: Tests for Revealed Preferences for Food Poverty lines in Uganda

| Region Specific Bundles | Region Specific Prices | | | | |
|---|---|---|---|---|---|
| | Central Rural | Central Urban | Eastern | Northern | western |
| Central Rural | 1 | 1.042 | 1.257 | 1.282 | 0.706 |
| Central Urban | 1.024 | 1 | 1.274 | 1.496 | 0.747 |
| Eastern | 0.793 | 0.955 | 1 | 0.991 | 0.520 |
| Northern | 0.875 | 1.189 | 1.019 | 1 | 0.519 |
| Western | 1.514 | 1.645 | 1.959 | 2.071 | 1 |

Source: Authors' calculations from the UBOS-Uganda National Household Survey 2009/10
Note: Values less than one (1) show letdown of a revealed preference condition

Assessing the matrix in table 3, diagonal elements are equivalent to one by meaning but for row *n* and column *m,* off diagonal elements represent the charge of getting region *n*'s food poverty line bundle in region *m,* compared to the charge of getting region *m*'s own food bundle. Off diagonal elements that are less than one (1), violate conditions for revealed preferences. For instance given the price values in the central rural region, consumers would be able to buy the food poverty line bundle of the eastern region at 79.3% of the price of their region's food poverty line bundle. The circumstance that consumers in central rural instead consume their own bundle signifies that they prefer their own bundle to that of the eastern region and that there is utility-inconsistence of these food poverty lines. Considering a possible 20 contrasts for revealed preferences from the 5 considered regions of Uganda, 13 of them consistently satisfy the revealed preferences. Generally the matrix indicates that the food poverty line bundle of the eastern region seems inferior to all regions' bundles as that of the western region seems superior to all others partially because of the reasons elaborated earlier.

Therefore, these CBN poverty lines are not consistent with the revealed preference's principle and hence are utility inconsistent, and if relied on for conclusions, such conclusions would perhaps be misleading. For the regions where the food poverty line bundle seems superior or inferior, poverty lines for that region signify better or poorer living standards compared to other regions. Therefore comparing poverty estimates based on such poverty lines either overestimate or underestimate poverty for regions bearing inferior or superior food bundles.

**Using the Entropy Estimator to attain utility-Consistent Food Poverty line Bundles and Poverty Evaluations**

We present a matrix of food poverty line bundles in table 4 for the revealed preference assessments upon whom a new set of poverty evaluations is presented in table 5 for comparisons with the CBN non-consistent original food poverty lines of both UBOS and the authors.

Table 4: Entropy adjusted (utility consistent) food poverty lines for Uganda, 2009: Revealed Preference tests and percentage changes

| Region Specific Bundles | Region Specific Prices | | | | |
|---|---|---|---|---|---|
| | Central Rural | Central Urban | Eastern | Northern | western |
| Central Rural | 1 | 1.059 | 1 | 1.055 | 1.082 |
| Central Urban | 1.010 | 1 | 1 | 1.213 | 1.129 |
| Eastern | 1.001 | 1.207 | 1 | 1.010 | 1 |
| Northern | 1.099 | 1.459 | 1.017 | 1 | 1 |
| Western | 1 | 1.151 | 1.034 | 1.120 | 1 |
| %change in food poverty line* | 9.63 | 3.78 | 4.63 | -56.11 | 13.70 |
| %change in food poverty line** | 0.57 | 2.92 | 19.86 | 17.40 | -51.76 |

Clearly assessing all elements in table 4, they are currently bigger or equal to one (1), implying that elements now meet the revealed preference principles, as needed by the assessment method. It is clear that now a number of the off-diagonal elements perfectly equal to one (1), implying that consumers from region *n* can obtain a food poverty line bundle from region *m* at exactly the same expense as that spent on a bundle from region *n*. Such a scenario however only happens if one or more of the imposed restrictions or constraints are observed. Such a scenario also signals equal living standards across regions and thus better informative comparisons can be easily made across regions. Table 4 also presents percentage changes in the original value of the food poverty line of both UBOS and authors caused by entropy adjustments. At least there is a change in every region and this change is positive in most of the regions. We note that regions that heavily failed the revealed preference tests suffer a heavier adjustments degree most notably the western that failed all column-wise tests signifying a high quality bundle and the eastern region that failed all the row-wise tests, signifying a low-quality poverty line food bundle. This comparison is in consideration with the authors' procedure that was subjected to revealed preference tests. Generally the food poverty line is upwardly adjusted in four of the five regions.

Considering the UBOS calculation procedures in comparison with the entropy adjusted values, the northern region experiences over 50% value decline. This is because in using the uniform food poverty line, UBOS up-scaled and down-scaled values from various regions to come up with a common value. However, while using the authors' calculations, the northern region is found to have the lowest CBN utility inconsistent food poverty line (table 2) of 11, 247 UGX per month per capita. Therefore up-scaling it to the Uganda uniform value of 21,258 UGX per month per capita was a very huge increment that almost doubled the original value, hence considerably leading to overestimation of the poor head-count estimates for the northern region by UBOS. When the UBOS value was compared to the entropy adjusted utility consistent value of 13,617 UGX per month per capita (table 6), the northern region thus found its original UBOS food poverty value reducing by 56.1 %, the highest of all. This implied that perhaps the poverty estimates for the northern region had been hugely overestimated by the national accounts' traditional methods of estimating poverty.

On considering the authors' CBN approach calculated original food poverty values that were utility inconsistent (table 2) and those that were entropy adjusted (utility-consistent) presented in table 6, the value of the western region dropped by 51.8%. This was because, the non-adjusted food poverty value of the western region was too high (37,384 UGX per month per capita, table

2) and had to be adjusted downwards (33,531 UGX per month per capita) to satisfy the imposed revealed preferences' principle across regions. However, still the food poverty line for the western region remained the highest amongst all regions even after entropy adjustment procedures, further reflecting a higher quality poverty line food bundle in the region thus perhaps exposing the higher living standards prevailing in the western region.

**Poverty Evaluations**

Changes in the region specific poverty lines impact on the region specific household poverty status and consequently poverty profiles at regional and national levels. We present new poverty evaluations in table 5 after entropy-adjustments on the food poverty line, whose computed share of the budget on the total poverty line was used to compute the non-food poverty lines. It should be noted that both the reviewed food and non-food poverty lines are different from the original poverty lines thus a clear indication of change in the regional and national poverty evaluations, profiles and head-count estimates.

Table 5: Poverty Head-count Percentage Estimates for Uganda

| Head-count Poverty estimates for Uganda 2009/10 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Estimation Methodology | UBOS (Using Non Region Specific utility inconsistent bundles) | | | Authors (Using Region Specific Utility-Inconsistent bundles) | | | Authors (Using Region Specific Entropy-Adjusted Utility-Consistent bundles) | | |
| **Region** | **P0** | **P1** | **P2** | **P0** | **P1** | **P2** | **P0** | **P1** | **P2** |
| National | 24.5 | 6.8 | 2.8 | 23.3 | 6.5 | 2.6 | 23.6 | 6.3 | 2.4 |
| Rural | 27.2 | 7.6 | 3.1 | 26.2 | 7.3 | 2.9 | 26.4 | 6.9 | 2.7 |
| Urban | 9.1 | 1.8 | 0.6 | 4.8 | 1.3 | 0.6 | 5.2 | 1.5 | 0.7 |
| Central Rural | 13.5 | 3.2 | 1.1 | 20.6 | 5.4 | 1.9 | 19.0 | 5.1 | 1.9 |
| Central Urban | 5.4 | 1.0 | 0.3 | 2.9 | 1.3 | 0.7 | 4.1 | 1.7 | 1.0 |
| Central | 10.7 | 2.4 | 0.8 | 14.8 | 4.0 | 1.6 | 14.2 | 3.9 | 1.6 |
| Eastern | 24.3 | 5.8 | 2.1 | 17.8 | 3.9 | 1.3 | 30.3 | 7.7 | 2.8 |
| Northern | 46.2 | 15.5 | 7.3 | 17.0 | 4.9 | 1.9 | 21.6 | 6.6 | 2.8 |
| Western | 21.8 | 5.4 | 2.0 | 45.2 | 14.1 | 6.0 | 25.4 | 6.2 | 2.3 |
| **Sub-regions** | **P0** | **P1** | **P2** | **P0** | **P1** | **P2** | **P0** | **P1** | **P2** |
| Kampala | 4.0 | 0.6 | 0.2 | 1.2 | 0.2 | 0.0 | 2.0 | 0.5 | 0.1 |
| Central 1 | 11.2 | 2.3 | 0.7 | 13.2 | 4.1 | 1.2 | 12.9 | 4.1 | 1.8 |
| Central 2 | 13.6 | 3.4 | 1.2 | 22.3 | 5.6 | 2.1 | 20.5 | 5.3 | 1.9 |
| East central | 21.4 | 4.8 | 1.7 | 16.6 | 3.5 | 1.1 | 27.4 | 6.9 | 2.5 |
| Eastern | 26.5 | 6.5 | 2.3 | 18.9 | 4.3 | 1.4 | 32.6 | 8.4 | 3.1 |
| Mid-Northern | 40.4 | 12.2 | 5.4 | 10.2 | 3.0 | 1.3 | 13.9 | 4.1 | 1.8 |
| North-east | 75.8 | 35.0 | 19.1 | 54.8 | 16.3 | 6.7 | 60.4 | 21.0 | 9.2 |
| West-Nile | 39.7 | 10.7 | 4.2 | 9.0 | 2.4 | 0.8 | 14.2 | 3.5 | 1.2 |
| Mid-Western | 25.3 | 6.6 | 2.7 | 47.8 | 15.9 | 7.1 | 29.5 | 7.5 | 3.0 |
| South-Western | 18.4 | 4.3 | 1.4 | 42.4 | 12.2 | 4.8 | 21.2 | 4.8 | 1.6 |

Notes: P0 refers to the head-count poverty estimate, P1 the Poverty gap and P2 the squared poverty gap. According to UBOS (2010), North East covers districts of Kotido, Abim, Moroto, Kaabong, Nakapiripiriti, Katwaki, Amuria, Bukedea, Soroti, Kumi and Kaberamaido; Mid-Northern: Gulu, Amuru, Kitgum, Pader, Apac, Oyam, Lira, Amolatar and Dokolo; West Nile: Moyo, Adjumani, Yumbe, Arua, Koboko, Nyadri, and Nebbi; Mid-Western: Masindi, Bullisa, Hoima, Kibaale, Bundibugyo, Kabarole, Kasese, Kyenjojo and Kamwenge; South Western: Bushenyi, Rukungiri, Kanungu, Kabale, Kisoro, Mbarara, Ibanda, Isingiro, Kiruhura and Ntungamo; Mid-Eastern: Kapchorwa, Bukwa, Mbale, Bududa, Manafwa, Tororo, Butaleja, Sironko, Paliisa, Budaka and Busia; Central 1: Kalangala, Masaka, Mpigi, Rakai, Lyantonde, Sembabule and Wakiso; Central 2: Kayunga, Kiboga, Luwero, Nakaseke, Mubende, Mityana, Mukono and Nakasongola; East Central: Jinja, Iganga, Namutumba, Kamuli, Kaliro, Bugiri and Mayuge; and Kampala: Kampala district

Head-count poverty estimates have been computed by evaluating the region-specific new poverty lines and the total household consumption per capita, and these geographical poverty profiles for Uganda are presented in table 5. Estimates are presented from the use of utility inconsistent bundles by the national accounts, UBOS, in column 2, and the authors in column 5, and finally those attained after imposing conditions for revealed preferences in column 8.

Because the authors' estimates from the utility-inconsistent bundles are generated using a well-known and monitored CBN approach by the authors, which then yields the utility consistent estimates, we shall now focus on comparing the two for the changes brought about after imposition of revealed preferences. In terms of regions the biggest difference is experienced in the western region, whose head count poverty estimate falls from 45.2% to 25.4% after entropy adjustments that ensure consistence of food bundles in terms utility gained across regions. The next incredible difference that is also over 10% is witnessed in the eastern region, whose head count poverty estimates increase from 17.8% to 30.3% after imposing consistency in utility. The magnitude of these adjustments in these two regions is not that surprising because from table 3, the two regions, eastern and western, each failed all the row-wise and column-wise revealed preference tests respectively, hence needed upward and downward adjustments to achieve utility consistency, a matter that in turn respectively increased and decreased their poverty estimates.

Though after entropy adjustments poverty estimates terribly decreased in the western and central rural regions by a sum of a magnitude of 41.6%, whereas the increases in poverty estimates that were experienced in the eastern, northern and central urban regions summed to a magnitude of only 39.8%, the national head-count poverty estimate also increased by 0.2% (23.3% Vs. 23.5%) and did not decrease. This was because the head-count composition in the regions that experienced poverty increase (table 7) was more than that in the regions that experienced a reduction. However, the increase in urban poverty head-count estimates (0.4%) was more than the increase in the rural poverty (0.1%), because the central urban region that contributed 66.3% of Uganda's urban population (table 7), had experienced an increase in poverty of 1.2% (table 5) and this represented a large head count for the urban population whereas the rural areas where poverty increased (eastern and northern) represented only 55% of Uganda's rural population. The increase in both rural and urban poverty head-count estimates consequently resulted in a positive increment of 0.2% in the national poverty head count estimates.

Table 6: Entropy adjusted Region-Specific Poverty lines for Uganda

| Spatial Domain | Poverty Lines | | | Percentage Share of food on Basic Needs Consumption Total |
|---|---|---|---|---|
| | Food | Non-food | Total | |
| Central rural | 23,522 | 9,169 | 32,691 | 72 |
| Central urban | 22,094 | 10,862 | 32,956 | 67 |
| Eastern | 22,290 | 9,199 | 31,488 | 71 |
| Northern | 13,617 | 5,461 | 19,078 | 71 |
| Western | 24,634 | 8,897 | 33,531 | 73 |

Source: Authors' Calculations from UNHS 2009/2010

Notes: Data are monthly per capita figures in Uganda Shillings (UGX)

To briefly compare the original figures of UBOS and those generated after entropy adjustments, the figures were generally following the same trend and quite comparable though UBOS estimates were generally slightly of higher values leading to UBOS's national poverty line head-count difference of 1%. However, the most notable difference is on a regional basis, where the northern region head-count's estimates drop by 24.6%. This was because UBOS used a common food basket priced uniformly (common food poverty line) across regions, which heavily overestimated the poverty in northern Uganda and heavily underestimated the poverty in the western region. Clearly, the original utility inconsistent region-specific food poverty lines (table 2) and the utility consistent region-specific food poverty lines (table 6) show that of all Uganda, the western region has the highest food poverty line and the northern region has the lowest, and in both instances that of the northern region is nearly half that of the western. Therefore, using a common food poverty line across Uganda was perhaps misleading especially on region specific head-count poverty estimates. Since the northern region contributed 29% of the survey population (table 7) and its regional poverty had been heavily overestimated, compared to the 21% contribution from the western region whose estimates had been heavily underestimated, it perhaps explains the reduction of 1% in the national poverty head-count estimates, when we compare both UBOS and the entropy adjusted estimates.

The other key issue to note from table 5 however is the consistence and large poverty estimates under all procedures, of the North-East sub region, clearly indicating that it is the region where access to basic life needs is most impossible all over Uganda. This region covers mostly the originally ethnic Karamoja region, currently composed of districts of Kotido, Abim, Moroto, Kaabong, Nakapiripiriti, Katwaki, Amuria, Bukedea, Soroti, Kumi and Kaberamaido. This is the region which was mostly affected by the 23 year civil war between Uganda and the LRA, and where corruption and public institutions heavily undermine principles of good governance, (ICCO, 2013). Furthermore this is the part of Uganda covered by Karamoja surfaces, where households' main life supporting activities are cattle keeping, trading and mining other than

farming, (FAO, 2006; Wikipedia, 2013). These activities present a real traditional challenge to permanent household settlements that would foster food production, feasibility to access aid and community systems that would support each other easily on household basic needs as is in other regions of Uganda. The region is very arid and remote with limited basic life support infrastructure (UNICEF, 2010) which makes even access of any willing potential support difficult. The regions still harbors Uganda's basically and absolutely poorest populations that need urgent poverty alleviation programs, better infrastructure and governance.

Table 7: Rural-Urban Composition of the Study dataset

| Region | | Frequency in data | Urban % at Region's total Frequency |
|---|---|---|---|
| Central | Urban | 809 | 40.7 |
| | Rural | 1,177 | |
| Eastern | Urban | 132 | 9.4 |
| | Rural | 1,274 | |
| Northern | Urban | 172 | 8.8 |
| | Rural | 1,784 | |
| Western | Urban | 107 | 7.5 |
| | Rural | 1,320 | |
| Total | | 6,775 | |

Source: Authors' calculations from the UBOS-UNHS 2009-2010

Another point of important notice just to add explanation towards perhaps explaining why really the western region was excavated as having the highest poverty line is clearly visible from table 7. Generally, by all poverty calculation methodologies (table 5); respective urban sub-regions possess lower poverty head-count estimates compared to the rural sub-regions. However, when we assess the contribution of the urban composition on the region specific total of participants in the data available, the western region has the least urban contribution (7.5%) of all regions. This implies that the data from the western region, largely was dominated by the rural section of the region and based on the poverty trends (being higher in rural), the western region bears the highest poverty lines. However, merely having a lower urban representation does not outweigh the fact that the western region still has the highest food poverty line bundle, since (1) its largest population is indeed practically rural and (2) the interaction effect of both rural and urban sub-regions always ensures spill-over effects at the regional level. Therefore, the results still credibly represent the practical picture of living standards in the western region as is for the others.

Focusing on other measures of poverty, further reference based to table 5 indicates that, measures for the poverty depth (P1), which is the poverty gap showing how much poor the poor

are, and the poverty severity (P2) which is the squared poverty gap showing how severe poverty is, qualitatively similarly follow the same trend as the poverty head-count estimate (P0), which is generally showing how broad poverty is in Uganda regionally and nationally.

**Conclusions and Future Research**

With the increasing populations of the world and decreasing resources available to support these populations, more representative successful planning and policy direly needs reliable and realistic estimates on poverty, since the poor are the more vulnerable of these populations. Such reliable estimates especially in the developing world countries like Uganda are of even a more important significance both in allocating resources in the ever insufficient national budget and or gaining credibility to access donor funding that is always required to meet the national budget.

We avail a poverty estimation CBN approach that provides poverty lines which are utility consistent, hence availing results that are very comparable and realistic. The method is grounded on earlier works of Ravallion & Lokshine, (2006) and more recently practically enhanced and used by Arndt & Simler, (2010), to generate and study utility-consistent poverty lines for other African countries including Egypt and Mozambique.

From our results while using the methodology on the Uganda data to estimate poverty and upon the findings of Arndt and Simler, (2010) in Egypt and Mozambique, tests for revealed preferences clearly indicate that poverty lines generated through other usual methodologies, do not satisfy the elementary principle of consistency. On the other hand utility consistent poverty lines generated under this new approach fully satisfy the consistency property.

Generally, in the Ugandan case, original UBOS or Authors' poverty lines that were estimated following the usual CBN bundles that were not utility consistent either overestimated poverty for the Northern region and underestimated that for the western region or overestimated poverty for the western region and underestimated poverty for the northern region respectively.

Through allowing for region-specific food bundles that satisfy revealed preference principles, this approach heightens specific and consistent CBN bundles. Therefore, the approach avails a resourceful improvement to the analysis of poverty lines presented in the national accounts and is empirically more convincing for use is poverty assessments especially that based on regions, which enhances appropriate national planning for these regions.

However, we need further assessment that is well able to disaggregate the non-food bundles more explicitly by their units, prices, quantities and per capita usage at specific places and time periods, for clearer and more perfect poverty estimates. This is based on the fact that current estimates are all done based only on full information of the food bundles, whereas a percentage share of the total household budget is used to estimate the non-food bundles.

Clearly, different regions are surrounded by different environments and all these impact on the type, quality and quantity of basic needs available to her people more specifically on the households' consumption bundles and the prices at which households can buy these bundles. Therefore, estimating poverty using utility-consistent region specific food bundles and prices provides the best representation and information on the absolute poverty status of these regions in relation to accessing life supporting basic needs while living in those particular regions and hence finally give a better representative, realistic and reliable national poverty estimates. A similar establishment has been realized by Ravallion & Lokshin (2006), in Russia, and Arndt & Simler, (2010) in Mozambique and Egypt. Therefore all national accounts need to employ this methodology in estimating poverty for more accurate and reliable planning and policy.

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