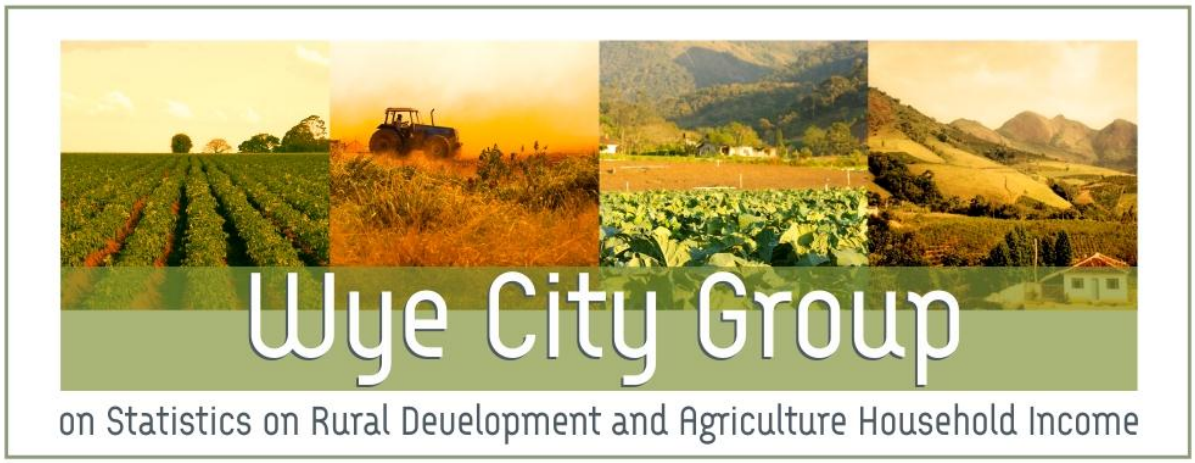

Measuring Poverty Trends in Uganda with Non-monetary Indicators

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ABSTRACT

Uganda has experienced high economic growth rates over the past decade, averaging 5.4 percent per year, while poverty rates have declined over 14 percent. However, conventional wisdom is that the benefits of poverty reduction have not been distributed equally. This paper seeks to examine poverty trends across Uganda from 1995 to 2010 by using non-monetary indicators based on household assets, housing characteristics, and household size and composition. In a variation on poverty mapping methods, we select household characteristics that are available in four national Demographic and Health Surveys (DHS) and the 2005 Uganda National Household Survey (UNHS). Using the UNHS data, regression analysis is used to estimate equations that predict household per capita expenditure based on these characteristics. Finally, these equations are applied to the same characteristics from the DHS data to generate estimates of per capita expenditure. This method offers the ability to examine poverty trends more frequently and at a lower cost since DHS surveys are implemented every three to four years in many countries whereas expenditure surveys are more costly and less frequent. Furthermore, this method avoids many of the difficulties associated with comparing household expenditure data over time including recall problems related to expenditure, adjustments for inflation and currency fluctuations, and changes in the poverty line. Finally, the DHS surveys use virtually identical wording, the same questionnaire format, and similar sampling methods, which ensure comparability of survey results.

The results confirm that the overall incidence of poverty has declined in Uganda over the past 15 years, but the rate varies across different regions and depending on the education of the head of the household. When compared to monetary measures of well-being, however, our measure of poverty based on non-monetary indicators has not declined as rapidly. We explore several alternative explanations for this discrepancy.

Keywords: Poverty trends, Uganda, Non-Monetary Indicators, Poverty Mapping, Asset Index

Paper presented at the Fourth Global Conference on Agricultural and Rural Household Statistics. Wye City Group. 9-11 November, 2011. Rio de Janeiro, Brazil.

*The author would like to thank Nicholas Minot for his assistance with the analysis and comments on earlier drafts of this paper. She would also like to thank Todd Benson for his help with information related to the data.

1. Introduction

Over the past decade, the Ugandan economy has grown at an average rate of 5.4 percent per year. This relatively high economic growth rate has been accompanied by a significant reduction in poverty. Over the past eight years alone, for example, poverty has decreased from 38.8 percent of the population to 24.5 percent according to the results of the Uganda National Household Survey (Uganda Bureau of Statistics, 2010).[1] This decrease in poverty, however, has not been uniform across the country. Urban areas experienced a 5.3 percentage point decrease in poverty whereas rural poverty fell by 15.5 percentage points. Examining regional poverty rates, eastern and northern Uganda have had the highest reduction in poverty rates (21.7 and 16.8 percentage points, respectively) compared to an 11.1 percentage point decline in Western Uganda.

Although information on poverty rates at the national and regional levels are available, very little is understood about the types of households that have gained and those that have seen their standard of living stagnate or decline. For example, are female-headed households better or worse off? Have households with less education shared in the economic growth? In addition to these questions, it is also important to ask if the reduction in poverty, as measured by per capita expenditure, is reflected in non-monetary measures of quality of living. In other words, has the reduction in expenditure-based poverty been reflected in an improvement in non-monetary indicators such as housing quality, access to water, sanitation facilities, and ownership of consumer assets such as radios and motorbikes?

This paper will attempt to address these questions by using a relatively new approach to measuring changes in poverty over time. Following Minot (2007), we use a variation on poverty mapping methods, also known as small-area estimation (Elbers, Lanjouw, and Lanjouw, 2003; Henninger and Snel, 2002; Hentschel, Lanjouw, Lanjouw, and Poggi, 2000), in combination with the asset index method (Filmer and Pritchet, 1998). In particular, the study will select household characteristics from four Demographic and Household Surveys (DHS) conducted in Uganda in 1995, 2000/2001, 2006, and 2009/2010.[2] These surveys do not collect data on household income or expenditure, but they do include a range of household characteristics which are likely to be related to standard of living. These characteristics include location (urban/rural), the size and age-gender composition of the household, the education of the head of household, the gender of the head of household, the type of floor, the source of water, the type of toilet, whether or not the house has electricity, and ownership of consumer durables such as bicycles and motorcycles. Previous experience suggests that these types of characteristics can "explain" 45-70 percent of the variation in welfare (as measured by per capita expenditure) across

[1] The poverty line is defined as "the cost of meeting caloric needs, given the food basket of the poorest half of the population and some allowance for non-food needs (Uganda Bureau of Statistics, 2010). "

[2] The Demographic and Health Surveys have been conducted in 84 countries over the past 25 years. They are funded primarily by the United States Agency for International Development with contributions from other donors and participating countries.

households (Alderman et al., 2001; Bangladesh Bureau of Statistics, 2004; Benson et al., 2005; Hentschel et al., 2000; Minot et al., 2006; Minot 2007).

The next step is to use data from the Uganda National Household Survey (UNHS) to estimate an equation that describes the relationship between per capita expenditure and the household characteristics identified in the DHS surveys. This information is then applied to the same characteristics from the DHS data to generate estimates of per capita expenditure for each household at four different time periods. Finally, the probability that a household is poor is estimated, and the results are averaged over groups of households indicating the percentage of the population living in a household whose per capita expenditure is below the poverty line.

Like Minot (2007), we use these results to examine poverty trends over time and to determine which types of households are gaining from economic growth. This type of information is useful in that it provides guidance to policymakers in the design and implementation of poverty-reduction strategies. We then extend the analysis in Minot's paper by comparing our poverty rates based on non-monetary indicators with poverty rates based on expenditure only. This is because Uganda, unlike many countries, collects household budget data relatively frequently. In particular, both the DHS and UNHS data sets were collected in 2006 and 2009/10, which will allow us to compare the two different poverty measures. This tests whether expenditure-based poverty reduction in Uganda is being accompanied by an improvement in non-monetary indicators of standard of living.

Overall, our results show that poverty has declined equally among male- and female-headed households over time Households with less education, however, have seen increases in poverty whereas more educated households have experienced a large decline in poverty. Comparing estimates of poverty rates, our results show that poverty rates based on non-monetary indicators have not declined as much as measures based on expenditure alone. Some possible explanations of this discrepancy are explored indicating that the most likely explanation of the difference is an insufficient adjustment of the poverty line.

This paper begins with background information on Uganda's economic growth and reduction in poverty in section II. The data and methods used for this paper are then described in more detail in section III. Finally, the results and conclusions are presented in sections IV and V, respectively.

2. Background

As stated earlier, Uganda has experienced high economic growth rates along with a significant drop in poverty rates. Not only in last decade, but Uganda has had sustained growth since 1986 when the National Resistance Movement (NRM) took over the government. Since that time, real gross domestic product (GDP) has grown at an annual rate of 6.8, which makes it one of fastest growing economies in Africa according to Kuteesa et al. (2010). This has been accompanied by a dramatic reduction in poverty rates from 56% in early 90s to 24% in 2010. Kakande (2010), in her analysis of the trends in poverty, writes that "this is one of the largest and fastest reductions in income poverty recorded anywhere in modern times (p. 237)." She notes, however, that the

improvement in the standard of living was not uniform across the country and that income inequality actually rose. According to the most recent statistics, the Gini coefficient for Uganda in 2009/10 is 0.426 (Uganda Bureau of Statistics, 2010) compared to .364 in 1992 (Appleton 2001).

Ssewanyana et al. (2011) also report that GDP gains of the 1990s were not evenly distributed with most gains going to the telecommunications and finance sectors. In an earlier report using the UNHS 2005/06 data, Ssewanyana (2009) examines household welfare and finds that "an increase in inequality hurts the "ultra" poor more than the poor." Mukwaya et al. (2011) examine inequality in a more recent period between 2005 and 2010 using the UNHS data. They attribute higher levels of inequality to the contrast between people working in manufacturing and service in urban areas with the large number of poor people also residing in urban areas.

Some researchers question the reduction in poverty. Byekwaso (2010) writes that "the reduction in poverty is a fiction." He critiques the consumption expenditure method to determine income and suggests that ownership of assets should be included in order to assess the true standard of living. Kakande (2010), after reporting the rapid decline in poverty rates, acknowledges qualitative findings on poverty trends which suggest that there was a decrease in well-being overall despite the drop in poverty rates. In particular, Kakande reports on "progress" towards the Millennium Development Goals, showing that there are mixed results.

Lawson et al. (2006) study movements in and out of poverty along with chronic poverty during the period from 1992 to 2002 using both qualitative and quantitative approaches. They find that education and assets were associated with welfare growth and that families that were chronically poor were larger and more likely to be subsistence farmers without any type of wage employment. Similarly, Okidi and McKay (2003) found that chronically poor families had a mean size of six members compared to four members for families that had never been poor when examining panel data between 1992 and 2000. They also identify the importance of education and the need for physical assets.

Overall, these studies on poverty show that there has been significant economic growth in Uganda, but that the gains from economic growth have not been equally distributed. Furthermore, there is some dispute about who has gained and how the standard of living should be measured. Both the need to examine asset ownership and the importance of qualitative data are evident. It is with these issues in mind that we examine poverty trends using household assets, household characteristics, and household size and composition.

3. Data and Methods

Over the past ten years, poverty mapping has become increasingly popular as a method to measure poverty in small areas or regions. This is done by combining information from household expenditure surveys and census data. In particular, the relationship between household expenditure and household characteristics is estimated from the expenditure surveys. This estimated relationship is then applied to household-level census data on the same characteristics which allows detailed maps to be generated showing poverty levels throughout a

country. Policy makers can then use this information to design poverty-reduction strategies by allocating funds to different regions and agencies based on need. The World Bank (2011) lists 21 examples of poverty mapping done between 1999 and 2005 along with extensions and policy applications of this type of analysis.

Although poverty mapping studies originally compared household expenditure to a poverty line, researchers began to use non-monetary indicators in their small-area estimation techniques. Hyman et al. (2005) examined some of these advances in poverty mapping including the use of food poverty lines, travel time to services and markets, inclusion of environmental information, and spatial relationships in poverty assessment. Our study is another extension of poverty mapping by applying budget data to DHS data sets rather than census data. Although we are unable to generate national poverty maps using the DHS data because of the relatively small sample size, we are able to examine poverty trends over time since the DHS surveys are conducted every three to five years compared to every ten years for a census.

In the first stage of the analysis, we estimate per capita expenditure (y_i) as a function of household characteristics (X_i) using UNHS data. These characteristics, which are available in both the UNHS data and the DHS data include the household size, the age-sex composition of the household, the age of the household head, the gender of the household head, the type of floor, the source of water, the type of toilet, and whether a household has electricity, a motorbike, a bicycle, and a television or radio. As illustrated in equation 1 below, we use the semi-log functional form to reduce heteroskedasticity and to produce residuals that approach a normal distribution.

$$(1) \quad \ln y_i = X_i'\beta + \varepsilon_i$$

Next, the regression coefficients from equation (1) are applied to the same household characteristics in four DHS surveys to generate estimates of per capita consumption. We then estimate the probability that a household is poor (Pi) with observable characteristics X_i using the equation (2) developed by Hentschel et al. (2000). .

$$(2) \quad E\left(P_i \middle| X_i', \beta, \sigma\right) = \Phi\left[\frac{\ln(z) - X_i'\beta}{\sigma}\right]$$

Where Φ is the cumulative standard normal distribution and $\boldsymbol{z}$ is the poverty line.

Finally, the poverty rate is determined by averaging the probabilities that a household is poor over a given region or geographic area and by household characteristics.

Table 1 shows the year of data collection, number of clusters, and number of households selected for each of the data sets used in this study. For both the UNHS and DHS data sets, a two-stage sampling design was used. In the case of the DHS surveys, as already mentioned, the sampling design and questionnaire format are almost identical, which ensures the comparability of survey results over time.

Table 1: *Data Sources*

Source	Year	Number of Clusters	Number of Households
Uganda National Household Survey	2005/06	783	7,400
Demographic and Health Survey	1995	296	7,550
Demographic and Health Survey	2000/01	298	7,885
Demographic and Health Survey	2006	321	8,531
Demographic and Health Survey	2009/10	170	4,421

The 2006 DHS survey, unlike the others which were independent, used the list of clusters from the 2005/06 UNHS survey to select its own sample. This was done in order to link health indicators from the DHS data with poverty data from the UNHS data. The fact that the DHS survey used a subset of clusters from the UNHS survey allows us to more accurately compare our poverty estimates based on household characteristics with those generated by the UNHS data.

There are several advantages to using this method that incorporates household assets rather than more traditional methods that rely only on household expenditure information to estimate poverty as illustrated in the list below.

- Using asset data instead of expenditures avoids problems associated with recall problems that require respondents to list all items purchased over some period in the past.
- Using asset data also avoids the use of household-maintained diaries for expenses, which are often inaccurate or not kept at all (Deaton and Grosh, 2000)
- Household expenditure surveys are expensive and often done infrequently, whereas DHS surveys been repeated three times on average in 57 countries approximately every 3.6 years. This makes it possible to examine changes in poverty over shorter periods of time.
- Combining asset data with one household expenditure survey avoids the problems associated with adjusting monetary values for inflation and currency depreciation when comparing two or more household expenditure surveys.
- There is no need to adjust the poverty line when using one expenditure survey and multiple DHS surveys.
- The DHS surveys avoid problems associated with changes in questionnaire format, sampling methods, and recall period that often make comparison between surveys difficult. This is because comparability is assured by the use of virtually identical wording for the relevant variables and similar sampling methods for the DHS surveys from one round to another.

One of the key assumptions behind the analysis in this paper is that the regression coefficients of expenditures as a function of household characteristics remain constant over the time period from 1995 to 2010. This implies that the relationship between expenditure and each non-

monetary indicator is stable over time. While this is a standard assumption in the asset index literature, it would be useful to test this assumption using UNHS data sets from different years. Although the 2009/2010 UNHS data are not yet available, Minot et al. (2006) compared results using two different household budget surveys. Their results showed that there were some differences including a lower overall poverty rate and a slightly lower predictive power of the model using the more recent household survey. As the authors note, one of the key factors that led to these differences is the difficulty of constructing comparable poverty lines for two surveys that are ten years apart. Despite these differences, the authors were able to show that the trends and patterns in poverty on a regional basis or based on household characteristics were similar. They concluded that the results based on a more recent budget survey supported the results using an expenditure survey done ten years earlier.

4. Results

In this section we first present the regression results that use household budget data to predict per capita expenditure based on household characteristics. This is followed a description of the estimated poverty trends over 1995-2010 that result from applying the regression results to the DHS data sets. Finally, we examine how these results differ from poverty estimates based on expenditure only.

4.1 Estimates of per capita expenditure

As described in Section III, we regress the natural logarithm of household expenditure as a function of household characteristics using the 2005/06 UNHS data. The sample of the UNHS data set is divided into eight strata that include urban and rural strata for each of the four administrative regions of Uganda: Central, Eastern, Northern, and Western. Because a Chow test indicated that the coefficients in the eight strata were significantly different from each other, separate regression models were estimated for each stratum.

In addition to the Chow test, several diagnostic tests were carried out using Ordinary Least Squares (OLS). The Breusch-Pagan test indicated that heteroskedasticity is present in four of the eight models. To correct this, we use the Huber/White/sandwich estimator of the standard errors. Omission of variables was indicated by the Ramsey RESET test in three of the eight models, but we were unable to correct this problem by adding additional variables and squared terms. We then tested for muticollinearity by looking for variance inflation factors (VIF) over 20. Only one of the eight models exhibited multicollinearity for three variables. These variables were left in the equation because they do not bias the coefficients and we were trying to maximize predictive power of the equation. Finally, we removed 75 cases that were identified as outliers using Cook's distance. Rather than using the traditional cut-off value of $D_i > 4/n$, we use a higher cut-off value of $D_i > 10*(4/n)$. Following the diagnostic tests, we used the *svyset* command in the statistical package Stata, which calculates the Huber/White/ sandwich estimators and takes into account the sample design of the UNHS data set.

Table 2
Regression Results of Per Capita Expenditure based on 2005/2006 UNHS data: Rural Areas

	Central Rural			Eastern Rural			Northern Rural			Western Rural		
	N=	1,569		N=	1,503		N=	1,263		N=	1,335	
	R2=	0.382		R2=	0.258		R2=	0.304		R2=	0.273	
	Coefficient	t-statistic		Coefficient	t-statistic		Coefficient	t-statistic		Coefficient	t-statistic	
Household size	-0.049	-2.26	**	-0.074	-5.73	***	-0.147	-4.78	***	-0.071	-2.73	***
Household size squared	0.001	1.00		0.002	3.98	***	0.006	2.94	***	0.002	1.39	
% males under 5 yrs	-0.006	-3.79	***	-0.004	-2.64	***	-0.001	-0.79		-0.002	-1.09	
% females under 5 yrs	-0.006	-3.88	***	-0.003	-1.64		-0.001	-0.31		0.000	-0.17	
% males 5-15 yrs	-0.005	-3.66	***	-0.002	-1.75	*	-0.003	-1.54		-0.001	-0.8	
% females 5-15 yrs	-0.004	-3.41	***	-0.001	-1.03		-0.002	-1.5		-0.002	-1.1	
% males 16-30 yrs	-0.001	-0.87		-0.002	-1.29		-0.001	-0.75		-0.001	-0.42	
% females 16-30 yrs	0.003	1.87	*	0.001	0.78		0.002	1.06		-0.001	-0.51	
% females 31-55 yrs	0.001	1.36		0.000	0.06		0.000	0.08		0.000	-0.09	
% males over 55 yrs	-0.002	-1.58		-0.002	-1.39		0.001	0.49		-0.002	-1.23	
% females over 55 yrs	-0.003	-1.37		0.000	0.13		0.000	-0.11		-0.001	-0.52	
Age of head	0.000	0.08		0.000	-0.03		-0.001	-0.69		0.003	1.87	*
Female head of house	-0.030	-0.78		0.022	0.49		0.039	0.94		-0.017	-0.37	
Tile, mosaic, stone, or cement floor	0.439	9.96	***	0.425	9.23	***	0.637	6.07	***	0.524	11.22	***
Water from bore hole	-0.293	-2.48	**	-0.028	-0.32		-0.250	-1.96	*	-0.102	-0.86	
Water from well/spring	-0.322	-2.79	***	-0.018	-0.2		-0.214	-1.68	*	-0.169	-1.65	
Other source of water	-0.191	-1.69	*	0.103	1.13		-0.218	-1.60		-0.120	-1.09	
No private flush toilet	-0.884	-3.73	***	0.476	3.29	***	0.359	6.62	***			
House has electricity	0.356	5.51	***	0.238	1.64					0.210	2.16	**
Motorbike ownership	0.146	2.12	**	0.048	0.33		0.326	1.57		0.364	5.06	***
Bicycle ownership	0.038	1.16		0.139	3.93	***	0.205	5.58	***	0.135	3.5	***
House has television or radio	0.161	4.42	***	0.245	7.39	***	0.240	7.15	***	0.235	6.27	***
Constant	11.816	49.69	***	9.944	50.88	***	10.191	53.09	***	10.536	58.3	***

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.
Omitted category for water dummies: water from private tap

Table 3
Regression Results of Per Capita Expenditure based on 2005/2006 UNHS data: Urban Areas

	Central Urban			Eastern Urban			Northern Urban			Western Urban		
	N=	508		N=	405		N=	342		N=	418	
	R2=	0.486		R2=	0.553		R2=	0.52		R2=	0.486	
	Coefficient	t-statistic		Coefficient	t-statistic		Coefficient	t-statistic		Coefficient	t-statistic	
Household size	-0.086	-2.73	***	-0.061	-1.07		-0.109	-3.56	***	-0.138	-3.35	***
Household size squared	0.002	1.69	*	-0.001	-0.15		0.003	1.65		0.005	2.18	**
% males under 5 yrs	-0.009	-3.42	***	0.001	0.28		0.000	-0.07		0.000	-0.01	
% females under 5 yrs	-0.007	-2.51	**	-0.003	-1.02		-0.005	-1.53		-0.003	-0.93	
% males 5-15 yrs	-0.005	-1.96	*	0.000	-0.17		0.000	0.12		0.001	0.47	
% females 5-15 yrs	-0.004	-1.64		0.002	0.79		0.003	0.93		0.006	3.25	***
% males 16-30 yrs	-0.004	-2.75	***	0.002	1.46		0.002	0.92		0.003	1.43	
% females 16-30 yrs	-0.001	-0.63		0.002	0.93		0.004	1.15		0.007	3.05	***
% females 31-55 yrs	-0.002	-1.47		-0.002	-1.01		-0.004	-1.46		-0.002	-0.83	
% males over 55 yrs	0.002	0.61		0.002	1.02		0.001	0.36		-0.008	-1.77	*
% females over 55 yrs	-0.006	-1.81	*	-0.004	-0.94		-0.008	-1.89	*	0.004	0.94	
Age of head	-0.001	-0.5		0.000	0.16		0.007	2.26	**	0.006	1.92	*
Female head of house	0.044	0.58		0.181	2.47	**	-0.063	-0.88		-0.207	-3.18	***
Tile, mosaic, stone, or cement floor	0.437	5.83	***	0.341	5.69	***	0.446	5.7	***	0.350	4.17	***
Water from bore hole	-0.635	-4.86	***	-0.281	-2.3	**	-0.240	-1.75	*	0.025	0.18	
Water from well/spring	-0.418	-4.41	***	-0.160	-1.2		-0.267	-2.06	**	-0.157	-1.65	
Other source of water	-0.497	-4.63	***	-0.232	-2.07	**	-0.175	-1.38		-0.126	-1.44	
No private flush toilet	-0.377	-3.53	***	-0.595	-3.47	***	0.381	1.82	*	-0.700	-5.4	***
House has electricity	0.288	4.2	***	0.551	5.96	***	0.380	4.13	***	0.342	4.02	***
Motorbike ownership	0.256	2.14	**	0.139	0.73		0.745	8.97	***	0.436	4.09	***
Bicycle ownership	-0.008	-0.12		0.241	3.38	***	0.166	2.89	***	0.056	1.08	
House has television or radio	0.221	2.76	***	0.264	4.49	***	0.177	2.17	**	0.463	6.12	***
Constant	11.975	53.26	***	11.087	50.44	***	9.983	32.65	***	11.071	44.3	***

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.
Omitted category for water dummies: water from private tap

Tables 2 and 3 illustrate the results of eight models. Household size, ownership of a television or radio, the type of floor and the type of toilet were statistically significant at the 5 percent level in at least six of the eight models. Variables that were significant in at least five of the eight models include ownership of a motorbike, ownership of a bicycle, and whether the house has electricity. The set of dummy variables representing the age-sex composition of the household was significant in five of the eight models using the F test of joint significance. On the other hand, the dummy variables representing the source of water were jointly significant in only three of the eight models. One surprising result from the regression analysis is that female-headed households do not appear to be any poorer than male-headed households. The coefficient of the female household head is significant in only two urban strata and in one of the two it is positive indicating a higher per capita expenditure than in male-headed households. Although female-headed households are often considered to be less well off than male-headed households, Quisumbing et al. (2001) find that female-headed households are poorer in only 22 percent of 180 comparisons consisting of ten countries and 18 alternative indicators in each country (three poverty lines, two adjustments for household size, and three poverty measures developed by Foster et al. (1984)).

4.2 Poverty estimates

In this section, we estimate the poverty rate for different types of households using the method described in Section III. The results in Table 4 show that the overall poverty rate in Uganda, calculated using non-monetary indicators, has decreased by five percentage points between 1995 and 2010. Considering urban and rural areas, the decline is slightly greater in rural areas with a five percentage-point drop compared to four percentage points in urban areas. Examining the four administrative regions, the greatest decline in poverty was in the eastern and western parts of Uganda with a ten percentage point decline in each area.

To examine the credibility of these results, Table 5 shows the standard errors of the poverty estimates using formulas developed by Hentschel et al. (2000). The 95 percent confidence intervals generated from these standard errors are within plus or minus 1.8 to 12 percentage points with an average of plus or minus five percentage points. In terms of the overall change in the poverty level between 1995 and 2010, the results are statistically significant at the one percent confidence level.

Another method to test the credibility as shown by Minot (2007) is to examine changes in household indicators over time. If the reduction in poverty over time is caused by a limited number of indicators, this would weaken the credibility of the results. If, however, the reduction in poverty is caused by a broad range of indicators, the results would be more plausible. Table 6 shows the trends in the indicators used to estimate poverty. Three indicators remain relatively stable (household size, age of household head, and the type of toilet). Although the percent of households with a female head increased, the regression analysis showed mixed results on the impact of this on poverty. The remaining indicators all showed signs of improvement suggesting that our poverty estimates are based on a broad range of indicators.

In addition to the geographic area, we also examined poverty trends based on the sex and the education of the household head. The results show that the poverty rates of both male- and female-headed households have declined by approximately the same amount, about five

Table 4: *Incidence of Poverty by Year and by Household Category*

	Year				
	1995	2000-01	2006	2009-10	Change from 1995/96 to 2010*
Uganda Total	.358	.323	.330	.306	-0.052
Urban					
Rural	.389	.355	.358	.337	-0.052
Urban	.131	.113	.139	.091	-0.040
Region					
Central	.196	.187	.172	.162	-0.034
Eastern	.405	.387	.368	.306	-0.099
Northern	.638	.611	.609	.575	-0.063
Western	.276	.240	.222	.170	-0.106
Stratum					
Central rural	.243	.238	.218	.200	-0.043
Central urban	.080	.061	.054	.053	-0.027
Eastern rural	.422	.402	.381	.342	-0.080
Eastern urban	.208	.222	.170	.117	-0.091
Northern rural	.659	.630	.639	.584	-0.075
Northern urban	.320	.336	.387	.285	-0.035
Western rural	.282	.245	.230	.178	-0.104
Western urban	.140	.099	.095	.073	-0.067
Sex of head of household					
Male	.359	.321	.323	.309	-0.050
Female	.355	.328	.347	.297	-0.058
Education of household head					
No schooling	.413	.397	.431		+0.018
Some primary school	.328	.335	.345		+0.017
Completed primary school	.302	.244	.253		-0.049
Some secondary school	.224	.190	.183		-0.041
Completed secondary	.128	.256	.020		-0.108
Higher than secondary	.007	.089	.099		-0.092

*Since education data for 2009/10 were not available, the reported change in poverty rates for education level of the head of household only cover the changes from 1995 to 2006.

percentage points. In addition to the same change in the poverty rate, the most recent poverty rate itself is almost identical for the two types of households at roughly 30 percent. Regarding education, the education of the household head was not available in the 2009/2010 DHS data set. We therefore examine changes in the poverty rate based on the education of the household head between 1995 and 2006. The results show that poverty rates of households with the least educated household heads (no schooling or some primary schooling) have increased by two percentage points between 1995 and 2006. At the highest levels (completion of secondary or

higher), poverty rates have declined by nine or ten percentage points. Although the absolute poverty rates confirm the negative relationship between poverty and education, the changes in

Table 5: *Standard Errors of the Poverty Estimates*

Year	Place	Sample size (N)	Headcount poverty ratio (Po)	Standard error of Po
1995	Uganda	7,527	0.358	0.008
2000/2001	Uganda	7,850	0.323	0.007
2006	Uganda	8,847	0.330	0.006
2009/2010	Uganda	4,402	0.306	0.009
1995	Central rural	1,280	0.243	0.017
1995	Central urban	1,152	0.080	0.011
1995	Eastern rural	1,428	.0422	0.016
1995	Eastern urban	546	0.208	0.034
1995	Northern rural	819	0.659	0.026
1995	Northern urban	278	0.320	0.062
1995	Western rural	1,598	0.282	0.014
1995	Western urban	426	0.140	0.030
2000/2001	Central rural	1,462	0.238	0.016
2000/2001	Central urban	1,294	0.061	0.009
2000/2001	Eastern rural	1,306	0.402	0.016
2000/2001	Eastern urban	564	0.222	0.028
2000/2001	Northern rural	810	0.630	0.021
2000/2001	Northern urban	244	0.336	0.056
2000/2001	Western rural	1.780	0.245	0.013
2000/2001	Western urban	390	0.099	0.024
2006	Central rural	1.611	0.218	0.016
2006	Central urban	962	0.054	0.011
2006	Eastern rural	1,792	0.381	0.015
2006	Eastern urban	130	0.170	0.050
2006	Northern rural	2.429	0.639	0.013
2006	Northern urban	158	0.387	0.048
2006	Western rural	1,690	0.230	0.014
2006	Western urban	138	0.095	0.032
2009/2010	Central rural	862	0.200	0.019
2009/2010	Central urban	460	0.053	0.015
2009/2010	Eastern rural	1,102	0.342	0.021
2009/2010	Eastern urban	76	0.117	0.033
2009/2010	Northern rural	942	0.584	0.019
2009/2010	Northern urban	73	0.285	0.055
2009/2010	Western rural	838	0.178	0.017
2009/2010	Western urban	49	0.073	0.045

poverty over time suggest that economic growth is not trickling down to the least educated. Not only are households with a less educated head much more likely to be poor, but economic

growth appears to be exacerbating the gap between those with less education and those with more.

Table 6: *Trends in the Household Characteristics Used to Predict Per Capita Expenditure*
(percent unless otherwise indicated)

Household characteristic	Year				Significance of change between 1995 and 2010	Implication for living standards
	1995	2000-01	2006	2009-10		
Household size (mean)	4.9	5.0	5.1	4.8		=
Age of household head (mean)	41.7	41.5	42.1	42.0		=
Female head of house	24.4	27.5	30.0	29.8	***	†
Floor of tile, mosaic, cement	15.1	19.6	23.1	27.6	***	+
Water from private tap	1.8	1.9	3.9	4.5	**	+
Water from bore hole	16.6	24.7	31.2	34.3	***	+
Water from well/spring	47.5	49.5	39.0	37.2	**	+
Water from public taps, rain water, stream, or other	34.1	23.7	25.8	24.1	***	+
Toilet – pit latrine, bush, other	98.9	98.0	98.5	98.4		=
House has electricity	6.8	8.6	10.7	12.3	***	+
House has motor bike	0.7	2.4	3.4	6.8	***	+
House has bicycle	34.2	38.8	37.9	39.3	*	+
House has radio or television	37.6	51.7	61.2	69.5	***	+

†Although the percentage of households with a female head has risen, the regression results showed only two of eight strata with a statistically significant coefficient for a feminine head of household. One of these was positive (indicating a higher income for female-headed households) and the other negative.
*Significant difference between 1995 and 2010 at the 10% level.
**Significant difference between 1995 and 2010at the 5% level.
***Significant difference between 1995 and 2010at the 1% level.

Because education information was not available for the 2009/2010 DHS data set, we excluded education from the regression analysis used to estimate per capita expenditure from the UNHS data. To determine if the results would be different if the education variable had been included, we ran a separate set of regressions using the 2005/2006 UNHS data that included education. Comparing the results showed that the model is robust to changes in specification. For example, the same variables (household size, television, radio, floor, and toilet) were significant in at least six of the eight models. Similarly, ownership of a bike or motorbike and the use of electricity were significant in five of the eight models. Regarding the fit of the models, the R-square values range from .31 to .60 for the eight strata with education compared to a range of .26 to .55 without education. Overall, it was clear that adding the education of the head of household improved the fit of the regression only slightly and had little effect on the poverty estimates.

4.3 Comparing poverty measures based on expenditure and non-monetary indicators

As described earlier, our poverty measures are based on a regression analysis of per capita expenditure as a function of household characteristics using a household expenditure survey. These results are then applied to household characteristics in four DHS surveys to estimate household expenditure. Finally, we estimate poverty rates based on the likelihood that a household is poor and then average these results over groups of households. The overall result is

the ability to estimate poverty trends over time, in this case over a 15-year period, with only one household expenditure survey. Again, one of the advantages of this is that household expenditure surveys are costly and done infrequently, whereas the DHS surveys have been done three times on average in over 50 countries.

One somewhat unusual aspect about Uganda is that household expenditure surveys have been done fairly frequently, which allows us to compare our results using non-monetary indicators with poverty rates based strictly on expenditure. Table 7 illustrates these two types of poverty measures in chronological order.

Table 7: *Comparing poverty rates using expenditure and non-monetary indicators*

Year	1995	2000/01	2002/03	2005/06	2006	2009	2009/10
Source	DHS	DHS	UNHS	UNHS	DHS	DHS	UNHS
National	0.358	0.323	0.388	0.311	0.330	0.306	0.245
Rural	0.389	0.355	0.427	0.342	0.358	0.337	0.272
Urban	0.131	0.113	0.144	0.137	0.139	0.091	0.091
Central	0.196	0.187	0.223	0.164	0.172	0.162	0.107
Eastern	0.405	0.387	0.460	0.359	0.368	0.306	0.243
Northern	0.638	0.611	0.630	0.607	0.609	0.575	0.462
Western	0.276	0.240	0.329	0.205	0.222	0.170	0.218
Central rural	0.243	0.238	0.276	0.209	0.218	0.200	0.135
Central urban	0.080	0.061	0.078	0.055	0.054	0.053	0.054
Eastern rural	0.422	0.402	0.483	0.375	0.381	0.342	0.247
Eastern urban	0.208	0.222	0.179	0.169	0.170	0.117	0.187
Northern rural	0.659	0.630	0.650	0.642	0.639	0.584	0.490
Northern urban	0.320	0.336	0.389	0.397	0.387	0.285	0.197
Western rural	0.282	0.245	0.343	0.214	0.230	0.178	0.231
Western urban	0.140	0.099	0.186	0.930	0.095	0.073	0.042

Source: DHS figures are our estimates of the poverty rate based on the method described in this paper that uses both the UNHS expenditure data and DHS asset data. The UNHS figures are those reported by the government and based on expenditure only.

Comparing the two surveys in 2005/2006 period first, the results are almost identical. The difference in the poverty rates calculated based on expenditure alone using the UNHS data and the rates calculated with the DHS data using non-monetary indicators is minimal with a range of negative one to 1.9 percentage points. These similarities in the rates are expected since both surveys were done in the same time period when household assets should be roughly the same for two surveys. Also, as mentioned earlier, the DHS survey in 2005/06 used a subset of clusters from the UNHS survey.

Comparing the results from the 2009/10 period, the results are similar for some regions, but there is definitely a larger disparity in the poverty rates overall. The range in the difference between the estimates for each region using DHS and UNHS data is negative seven to 11.3 percentage points. The poverty rates using the DHS data are higher in 11 of the 15 estimates shown.

The reason for the difference in the two measures of poverty in 2009/20120 may be explained by the fact that the two measures examine different dimensions of poverty. As stated by Alkire and Santos "...income poverty measures provide vitally important but incomplete guidance to redress multidimensional poverty (2010)." In their paper, which develops a multidimensional poverty index based on ten indicators related to health, education, and standard of living for 104 countries, they find that their index does not perfectly correspond to income poverty. In roughly two-thirds of the 89 countries with available income data, their multidimensional poverty index showed a higher rate of poverty than the $1.25 a day income measure. Alkire and Santos attribute this divergence to three key reasons: 1) income data are inaccurate; 2) a multidimensional poverty index captures services that are often not reflected in income surveys (water, electricity, education) and 3) not all households have the ability to translate income into improvements in health or education. In the case of Uganda, income poverty rates have dropped by 21 percent between 2006 and 2010 (or 6.6 percentage points), but the proportion of the population with access to a flush toilet has only increased by 0.1 percent percentage points during the same time period. Similarly, household electricity use, ownership of a bicycle, and access to water from a private tap have gone up by only 1.6, 1.4 and 0.6 percentage points respectively from 2006 to 2010, which is much less than the drop in poverty.

In addition to the different dimensions of poverty being measured, there are two other possible explanations that may help to explain the disparity between the two measures. First, the income-based poverty measures may exaggerate the reduction in poverty due to changes in the survey design or insufficient adjustment of the poverty line with the cost of living. A recent study, for example, showed that Uganda's poverty rate in 2010 should be closer to 45 percent (instead of 24.5 percent) based on a comparison of six welfare indicators in 23 countries (Tsimpo and Rasmussen, 2010). In other words, countries that are similar to Uganda in terms of gross domestic product per capita, access to piped water, access to electricity, literacy rates, share of food in the household budget, and the proportion of the population that is in rural areas should also have similar poverty rates. Tsimpo and Rasmussen also show that the poverty line is outdated. Updating the food basket from 1992 to 2010 and using only prices in Kampala, they show that the poverty rate in Kampala should be should be close to 19 percent (as opposed to the official rate of four percent) and that the poverty line should be doubled, which would lead to much higher poverty estimates. The results from their study suggest that our higher estimates of poverty based on assets may be a more accurate reflection of poverty.

A second factor that may lead to a disparity in the two measures of poverty is that there may be a lag between rising income and improved household assets which would lead to higher poverty estimates initially using DHS data. Given the results of the Tsimpo and Rasmussen study, however, this seems less likely as the primary cause of the disparity.

5. Conclusions

This paper uses a relatively new approach to measuring poverty trends. First we first estimate household expenditure as a function of household characteristics using the 2005/06 Uganda National Household Survey. We then apply these regression results to household characteristics in four DHS surveys to estimate household expenditure. Finally, we calculate poverty rates based on the likelihood that a household is poor and then average these results over groups of households. The overall result is the ability to estimate poverty trends over time with only one household expenditure survey.

Our results suggest that poverty, as measured by non-monetary indicators, has declined by five percentage points between 1995 and 2010. This decline is slightly greater in rural areas and much greater in the eastern and western parts of Uganda. An examination of changes in household indicators over time revealed that the reduction in poverty is based on the improvement in a broad range of indicators, which strengthens the plausibility of the results.

When examining male- versus female-headed households, the reduction in poverty is the same for both types of households. However, poverty rates for households with the least educated head of household have actually increased, whereas the poverty rate among households with more highly educated heads has dropped. This suggests that economic growth is not trickling down to less educated households.

Due to the frequency of household expenditure surveys in Uganda, we are able to compare our poverty rates based on non-monetary indicators with those generated based on income only in two time periods. For the first period, 2005/2006, the results are almost identical as expected since both surveys were done in the same time period and the DHS survey used a subset of clusters from the UNHS survey. In 2009/2010, however, the poverty rates using the DHS data are greater than those estimated directly from the UNHS in the majority of categories. This may be explained by the fact that the two measures examine different dimensions of poverty. Although income poverty has declined, there has not been a corresponding increase in ownership of assets. Other factors may also add to the disparity between the two measures including an exaggeration of poverty reduction in the expenditure survey due to survey design or insufficient adjustment of the poverty line with the cost of living. This possibility was supported by a recent study that showed that the poverty line is outdated and that the poverty rate should be much higher. Finally, there may be a lag between rising income and improved household assets. Further research is necessary to examine these hypotheses.

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