International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979
www.allsubjectjournal.com
Volume 3; Issue 2; February 2016; Page No. 320-327

Evaluating poverty determinants in Zambia with principle component analysis and logistic regression

Lincoln Daka, Humphrey Fandamu

Lecturer, Copperbelt University, School of Business, Department of Economics, Kitwe, Zambia

Abstract
Poverty is multi-dimensional in nature and depends on interactions of various socio-economic factors. Several demographic and health factors can shape up the economic status of a household, and theory suggests that the ability of a household to earn a given level of income can depend on the characteristics internal to the household. While most of the studies done on poverty determinants rely on the income, expenditure and consumption data, the data used in this study comes from the Demographic and Health Surveys, (DHS). The principal component analysis is used to create an asset index which gives the social economic status (SES) of each household. A Logistic regression is estimated based on this data with the SES (that is poor and non-poor) as the dependent variable and a set of demographic variables as the explanatory variables. The results presented in this paper suggest that the DHS data can be used to determine the correlates of poverty.

Keywords: poverty, principle component, socioeconomic status

1. Introduction

According to World Bank (2001) poverty is the result of economic, political and social processes that interact with each other and frequently reinforce each other in ways that exacerbate the deprivation in which poor people live. UNDP (1996) defines poverty from an array of human deprivations in terms of health, education and income. Like many countries in Sub-Saharan Africa, the Zambian government is faced with a challenge of addressing widespread poverty. Measuring poverty in Africa and understanding its determinants and dynamics have become increasingly important with the targets set by the Millennium Development Goals (MDGs) and the post-MDG agenda. The measurement and analysis of poverty have traditionally relied on reported income or consumption and expenditure as the preferred indicators of poverty and living standards (Achia, *et al*; 2010) [1]. Income is generally the measure of choice in developed countries while the preferred metric in developing countries is an aggregate of a household's consumption expenditures, Sahn and Stifel (2003) [8]. However both these money metric measures of poverty or welfare are too narrow to measure welfare of households, poverty being multi-dimensional in nature (Filmer & Pritchett, 1998). Development economists such as Filmer and Pritchett (1999) [5] argue that an asset index which is a composite function of different types of households assets (durable and non-durable assets) constructed by principle component analysis using demographic health survey data, gives a good picture of households welfare. For this reason this paper is aimed at evaluating poverty determinants in Zambia with principle component analysis (PCA) and logistics regression.

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Research Objective

In view of the challenges faced by many households in Zambia, the main objectives of the study is to:

- Analyze the determinants of household poverty in Zambia.

2. Literature Review

What determines poverty has been empirically explored by many researchers. A study by Lohano (2009) in Kenya focused on poverty dynamics and their determinants using panel survey found that the main cause of sharp rises in poverty was shocks in agriculture. A study on determinants of poverty using data from DHS in Kenya found that, along with other demographic factors, age of the household head increases the probability of being poor (Achia *et al* 2010) [1].

Another study carried out in Mozambique found low levels of human capital, including low educational levels and the poor health of most of the population; low productivity in the

agricultural sectors, high rates of fertility and corresponding high dependency ratios were major contributing factors of poverty (Datt, Simler, Mukherjee & Dava, 2000).

A study on Household Determinants of Poverty in Punjab province of Pakistan using logistic regression model summarizes the household determinants of poverty as the age, gender and education of the household head, as well as remittance, agricultural land holding, dependency ratio, family size and employment situation (Sikandar, 2008).

The use of demographic and health survey data to measure the determinants of poverty is not unique. Filmer and Pritchett (2001) used Demographic and Healthy Survey data to show that the relationship between wealth and enrollment in school can be estimated without income or expenditure data, by using household asset variables. Principle Component Analysis (PCA) provided acceptable and reliable weights for an index of asset to serve as a measure for wealth.

In the four countries examined – India, Indonesia, Nepal and Pakistan- this approach produced reasonable results. Filmer and Pritchett (1998, 1999) [5] and Filmer (2000) [4] explored how education attainment profile differed by wealth and gender in more than 35 countries using the DHS data. Sahn and Stifel (2000) [9] employed demographic and healthy survey data in an analysis of poverty in nine African countries; they used principal component analysis to construct an asset index.

Booysen (2002) used demographic and healthy surveys to measure differences in socioeconomic status of South Africa households. The asset index used represented a comparable indicator of poverty in South Africa.

In their study, Geda *et al*. (2001) used binomial and ordered logit analysis and identified the following variables as the key determinants of poverty: size of household, places of residence (urban or rural), level of schooling and engagement in agricultural activity, both in rural and urban areas.

The other study on the determinants of poverty in Kenya was done by Oyugi *et al* (2000) [7]. In their study they used the Probit Model to analyze the Welfare Monitoring survey (1994) data. The predictors (household characteristics) used in the study included holding area, livestock unit, the proportion of household members able to read and write, household size, sector of economic activity (agriculture, manufacturing/industrial sector or wholesale/retail trade), source of water for household use, and off – farm employment. The result showed that almost all the variables used were important determinants of poverty.

Rodriguez and Smith (1994) [6] used a logistic regression model to estimate the effect of different economic and demographic variables on the probability of a household being in poverty in Costa Rica. The source of the data was from the National Household – Income (1986). Their results showed that poverty was higher for the household whose heads had a lower level of education.

Rahman (2013), examined how household characteristics affect the probability of a household being poor via labor market interactions. The central premise was that the ability of a household to exploit available income-earning opportunities is shaped by characteristics inherent to the household. He concluded that poverty is high in households with young household heads, low-level education of the household heads, female heads, disability of household members, larger size, predominance of female members, excessive dependency burden or a high proportion of female workers. However, no study to the best knowledge of the authors has been undertaken to see the impact of demographic characteristics on poverty particularly referring to Zambia.

3. The Data and Methodology

3.1 Data

The data used to analyze the determinants of poverty is taken from the 2013-2014 Demographic and Health Surveys (DHS) for Zambia. The survey covered both rural and urban populations. The sample for the 2014 Zambia DHS was designed to provide estimates at national and provincial levels, as well as rural and urban. This is the first time that the ZDHS has been designed to provide estimates at such low levels. The updated list of enumeration areas (EAs) for the 2010 Census provided the sampling frame for the survey. For each EA, information is available on its location, type of residence (rural or urban), number of households and total population. Each EA has a cartographical map with delimited boundaries and main landmarks of the area. The survey used a two-stage stratified cluster sample design with EAs (or clusters) selected during the first stage and households selected during the second stage.

In the first stage, 722 EAs were selected with probability proportional to size, 305 in urban areas and 417 in rural areas. Prior to selection, EAs were stratified by province and then into urban and rural. A complete listing of households in each selected cluster, along with a mapping exercise, was conducted from November 2012 to January 2013 by listers and mappers from the central statistical office (CSO) Geographic Information Branch. Geographic coordinates were recorded for each sampled cluster by the listing teams using global positioning system (GPS) receivers.

In the second stage, a complete list of households served as the sampling frame for the selection of households for enumeration. An average of 25 households was selected in every EA. During the second stage of selection, a representative sample of 18,052 households was selected. All women age 15-49 and men age 15-59 who were either permanent residents of the households or visitors present in the households on the night before the survey were eligible to be interviewed using the individual questionnaire. In addition, a sub-sample of one eligible woman in each household was randomly selected to be asked additional questions on domestic violence.

This study used DHS data sets as opposed to the traditional income or consumption expenditure approach. 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.

Table 1 shows a brief description of the variable definitions used in the in this study.

Table 1: Variable Definitions

Variable	Description
Social Economic Status (SES)	An asset index computed using principle component analysis (PCA). A dichotomous variable with 1= poor, 0 otherwise. – **Dependent variable**
Age	Age of the household head
Age squared	Age squared of household head.
Education	The educational attainment of the female
	0=No education (reference)
	1=Incomplete primary
	2=Complete primary
	3=Incomplete secondary
	4=Complete secondary
	5=Higher
Rural	Type of place of residence. Dummy variable. 1 = rural, 0 otherwise.
Region	Provinces of the country
	0=Central (reference)
	1=Copperbelt
	2=Eastern
	3=Luapula
	4=Lusaka
	5=Muchinga
	6=Northern
	7=Northwestern
	8=Southern
	9=Western
Religion	Religions
	0=Catholic (reference)
	1=Protestant
	2=Muslim
	3=Other religion
Sex of household head	Sex of the household head. Dummy variable. 1 = male, 0 otherwise.

3.2 Methodology Computation of an Asset Index using Principal Components Analysis

Principal Component Analysis (PCA) was used to create an asset index based on data from the Zambia Demographic and Health Survey (2013-2014). The ZDHS includes information regarding the ownership of durable goods, housing characteristic, access to services, along with basic demographic information concerning household size and composition. Using PCA, the household variables will be recoded into dichotomous variables, distinguishing between a household that owns the particular asset with the household that does not own that particular asset, or for which a particular statement about access to services is true with one that does not own the asset or for which the statement is not true. Hence, all variables take on a value of zero or one. The

PCA is a multivariate statistical technique used to reduce the number of variables without losing too much information in the process. The PCA technique achieves this by creating a fewer number of variables, which explains most of the variation in the original variables. The new variables that are created are linear combinations of the original variables. The first new variables will account for as much of the variation in the original data as possible.

Given *p* variables $X_1 ... X_p$ measured in *n* households, the (*p)* principal components $Z_1 .... Z_p$ are uncorrelated linear combinations of the original variable, $X_1 ... X_p$ given as:

$$Z_1 = a_{11}X_1 + a_{12}X_2 + ... + a_{1p}X_p$$

$$Z_2 = a_{21}X_1 + a_{22}X_2 + ... + a_{2p}X_p$$

.....

$$Z_p = a_{p1}X_1 + a_{p2}X_2 + ... + a_{pp}X_p$$

This system of equations can be expressed as $Z = Ax$, where Z = ($Z_1 .... Z_p$), x= ($X_1 ... X_p$) and A is the matrix of

coefficients. The coefficient of the first principal component, $a_{11},....,a_{1p}$ are chosen in such a way that the variance of Z_1 is maximized subject to the constraint that $a_{11}^2+....+a_{1p}^2=1$. The variance of this component is equal to λ_1, the largest eigenvalue of A. The second principal component is completely uncorrelated with the first component and has variance equal to λ_2, the largest eigenvalue of A. This component explains additional but less variation in the original variable than the first component subject to the same constraint. Further, principal components (up to the maximum of *p*) are defined in a similar way. Each principal component is uncorrelated with all the others and the squares of its coefficients sum to one. The principal component analysis involves finding the eigenvalues and eigenvectors of the correlation matrix.

Logistic Regression Model

To identify key determinants of poverty, a dichotomous variable indicating whether the household is poor or not will be calculated. That is

$$SES=\begin{cases}1, if-the-household-is-poor\\0, otherwise\end{cases}$$

That variable will be named as Social Economic Status (SES). That is, SES is equal to 1 if the household is poor and 0 otherwise. It will then be determined whether the predictor variables – age of household head, size of household, educational level of the household head, type of residence(rural or urban), ethnicity, religion, sex of household head and proportions of female members in the household are associated with the poverty index, SES. This helps to identify the important predictor variables associated with social status before setting up the final logit model. The main focus is to identify the determinants of poverty using the logit model from the available data.

A logistic regression model is used, given by

$$Logit(p)=ln\frac{P}{1-P}=\beta_0+\beta_1X_1+\beta_2X_2+.....+\beta_{10}X_{10}$$

Where $X_1,....,X_{10}$ are the predictor variables – type of residence (rural or urban), educational level of the household head, region, size of household, age of household head, sex of household head, and *p* denotes the probability that the household is poor.

4. Results

4.1 Descriptive statistics

Table 2 shows the descriptive statistics for the sample population which is representative of the Zambian household population. The table shows that the social economic status (SES), which is the dependent variable has a mean of 0.4 and a standard deviation of 0.49. Results in table in tab2 also indicate that about 8.29 percent of the heads of households have no formal schooling, while about 31.32 percent have incomplete primary and about 15.33 percent having completed primary. In addition, about 8.7 percent have completed secondary education with 5 percent having completed tertiary education. The table also shows that 52 percent of the people live in the rural area while 48 percent live in the urban areas. The table equally shows that in about 74 percent of the households, the head of the household is male while in about 26 percent of the households the head is female. The region and religion variables have a mean of 5.4 and 2.4 respectively.

Table 2: Descriptive statistics

Variable	Statistic	
Social Economic Status (SES); mean (standard deviation)	.3987569	.4896575
Age in years; mean (standard deviation)	41.76132	12.24081
Level of education (%)		
no education	8.29	
incomplete primary	31.32	
complete primary	15.33	
incomplete secondary	31.24	
complete secondary	8.65	
Tertiary	5.16	
Total	**100**	
Rural (%)	52.04	
Sex of household head (% male)	73.95	
Region (standard deviation)	5.398148	2.807413
Religion (standard deviation)	2.390715	7.275266

Table 3 below shows all the variables used in the construction of the poverty index which was used as a measure of the socioeconomic status of the households (SES).

Table 3: The Poverty Index

Variable	Mean	SD	Component score	N
Source of Drinking water				
piped into dwelling	.090959	.2875596	0.1866	16411
piped to yard/plot	.1032821	.3043362	0.1476	16411
public tap/standpipe	.1422645	.3493319	0.0698	16411
tube well or borehole	.2086384	.4063477	-0.0834	16411
protected well	.090959	.2875596	-0.0245	16411
unprotected well	.1944851	.3958159	-0.1157	16411
protected spring	.0053685	.0730752	-0.0108	16411
unprotected spring	.0327599	.1780129	-0.0493	16411
river/dam/lake	.0959004	.2944636	-0.0900	16411
Rainwater	.0006101	.0246925	-0.0010	16411
tanker truck	.000061	.0078106	0.0030	16411
cart with small tank	.0012811	.0357708	-0.0063	16411

bottled water	.0026842	.0517416	0.0202	16411
Other water sources	.0075647	.0866481	0.0167	16411
Type of toilet facility				
flush to piped sewer system	.0958453	.2943879	0.1911	16411
flush to septic tank	.0519187	.2218697	0.1320	16411
flush to pit latrine	.0055518	.0743057	0.0291	16411
flush to somewhere else	.0009761	.031229	0.0154	16411
flush, don't know where	.000183	.0135279	0.0064	16411
ventilated improved pit latrine	.1180526	.3226802	-0.0150	16411
pit latrine with slab	.1711305	.3766344	0.0601	16411
pit latrine without slab	.4069916	.4912883	-0.1292	16411
no facility/bush/field	.1245196	.3301834	-0.1207	16411
composting toilet	.000061	.0078108	-0.0006	16411
hanging toilet/latrine	.0015252	.0390256	-0.0068	16411
Other	.000061	.0078108	-0.0014	16411
Main floor material used				
earth, sand	.4829878	.4997257	-0.2722	16411
Dung	.0327439	.177971	-0.0462	16411
wood planks	.0006098	.0246865	0.0080	16411
palm, bamboo, leeds	.0003049	.0174586	0.0026	16411
parquet, polished wood	.0071341	.0841646	0.0401	16411
vinyl, asphalt strips	.0026829	.051729	0.0296	16411
ceramic/terrazzo tiles	.0218902	.1463297	0.0950	16411
Cement	.4239634	.4941997	0.2541	16411
Carpet	.0043293	.0656566	0.0304	16411
Other	.0001829	.0135242	0.0006	16411
Main wall material used				
no walls	.0107311		-0.0268	16411
cane / palm / trunks	.0132309		-0.0345	16411
Mud	.1946833		-0.1438	16411
bamboo / pole with mud	.0352418		-0.0599	16411
stone with mud	.0100604		-0.0229	16411
Plywood	.0001829		-0.0007	16411
Cardboard	.0001219		0.0077	16411
Cement	.1567587		0.1888	16411
stone with lime / cement	.010792		0.0293	16411
Bricks	.4068654		-0.0971	16411
cement blocks	.1326139		0.1640	16411
wood planks	.0009146		-0.0050	16411
Other	.0046339		-0.0029	16411
Main roof material used				
no roof	.0106059	.1024404	0.0034	16411
thatch / palm leaf	.3906498	.4879109	-0.0268	16411
rustic mat	.0001829	.0135217	0.0123	16411
palm / bamboo	.0002438	.0156131	0.0063	16411
wood planks	.0003657	.0191209	0.0619	16411
Cardboard	.0003657	.0191209	-0.0518	16411
metal / iron sheets	.4413629	.4965649	0.0137	16411
Wood	.0014629	.0382208	0.0350	16411
calamine/cement fiber (asbestos)	.1241009	.3297067	-0.0108	16411
ceramic tiles / harvey tiles	.0023162	.0480729	-0.0008	16411
Cement	.0030477	.0551232	-0.0183	16411
roofing shingles	.0007924	.0281392	0.0305	16411
mud tiles	.0002438	.0156131	0.3986	16411
Other	.0010972	.0331062	0.0124	16411
Type of cooking fuel				
Electricity	.1141516	.318005	0.2148	16411
natural gas	.0002438	.0156121	0.0077	16411
Biogas	.0001828	.0135209	0.0021	16411
Kerosene	.0000609	.0078068	0.0014	16411
coal, lignite	.0004876	.0220762	0.0017	16411
Charcoal	.3993784	.4897856	0.1208	16411
Wood	.4600195	.4984142	-0.2503	16411
straw/shrubs/grass	.0018284	.0427217	-0.0106	16411

animal dung	.0004266	.020651	-0.0056	16411
Solar	.0000609	.0078068	0.0001	16411
Other durable goods				
Has electricity	.279142	.4485912	0.3003	16411
Has radio	.5957589	.4907595	0.1351	16411
Has television	.4038754	.490688	0.2680	16411
Has refrigerator	.2233868	.4165281	0.2787	16411
Has bicycle	.4828469	.4997209	-0.0413	16411
Has motorcycle/scooter	.0230943	.1502075	0.0298	16411
Has car/truck	.0837853	.2770739	0.1584	16411
Has telephone	.71708	.4504316	0.0712	16411
Has Mobile phone	.2246664	.4173751	0.1773	16411
Has animal drawn cart	.0524039	.2228469	-0.0262	16411
Has boat with motor	.0034123	.0583173	0.0089	16411

The scree plot in Figure 1 shows the proportion of variance explained by each principal component and indicates that the first four components would sufficiently explain the original variables.

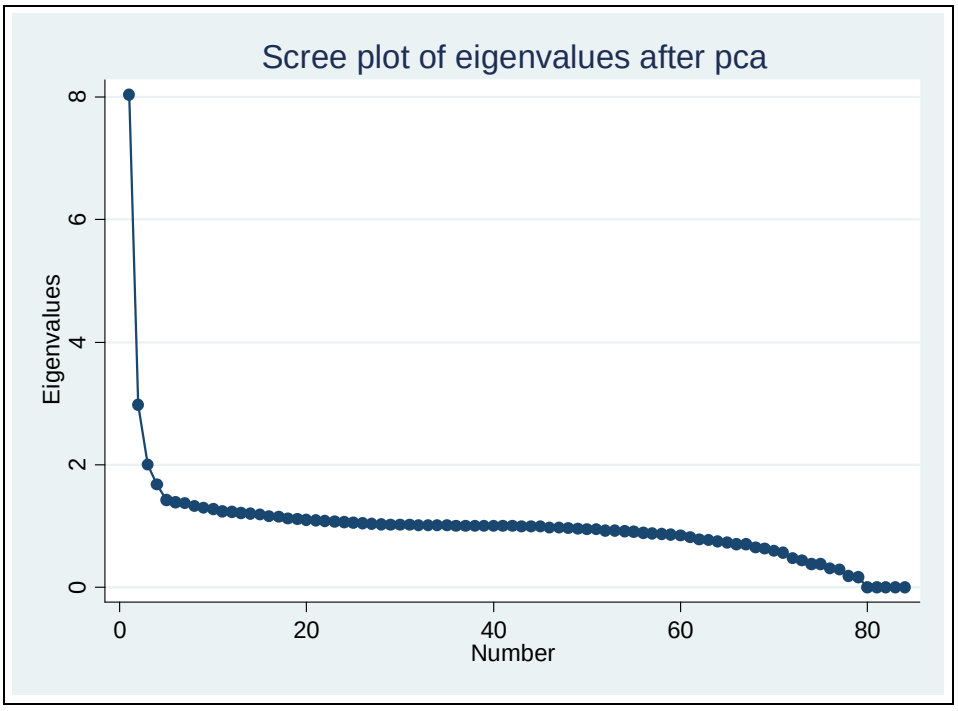

Fig 1.

Note also that the asset index derived from the DHS data was employed to calculate estimate of the headcount poverty index for Zambia. The asset index at the *40*-th percentile was employed as the poverty line and used as the dependent variable in the logistic regression. Below in table 4 are results from the logistic regression.

Table 4: Logistic Regression Output

Variable	**Coefficient**	**Linearized standard error**
Age	-.0628283***	.014167
Age squared	.0005768***	.0001496
Schooling		
No education (reference)		
Incomplete primary	-.3349078***	.1039927
Complete primary	-.7305329***	.1121184
Incomplete secondary	-1.400889***	.1117333
Complete secondary	-2.827078***	.1846611
Higher	-5.051606***	.4881087
Rural (rural=1; urban =0)	3.224314***	.1357737
Region		
Central (reference)		
Copperbelt	-.6251305**	.2349199

Eastern	.0831525	.1866828
Luapula	.342383	.2323361
Lusaka	-2.056756***	.3219389
Muchinga	.7997966***	.2216333
Northern	.7754372***	.2322336
Northwestern	.5721653**	.2758928
Southern	-.1664464	.1925059
Western	1.508382***	.2203111
Religion		
Catholic (reference)		
Protestant	-.1944448**	.0906034
Muslim	-.9657114	.6679517
Other religions	.3216802	.3736808
Sex of household head	-.365823***	.0883065
Constant	.1961584	.3956739

Dependent variable – Socioeconomic Status (SES)
* p<0.1, ** p<0.05, *** p<0.01

Number of strata	= 20
Number of PSUs	= 721
Number of observations	= 16360
Design df	= 701
F(21, 681)	= 71.22
Prob > F	= 0.0000

The Logistic table of results is presented in Table 4 above. Individual-level controls in the logistic regression include the age of the household respondent measured in years and an age squared variable accounting for the non-linearity associated with age-related variables.

Education
Compared to household respondents with no education, (reference variable) having incomplete primary education decreases the odds of being poor by 28.5% ($e^{-.3349078}$=0.715) holding all other variables in the model constant. Having complete primary education compared to having no education decreases the odds of being poor by 51.8% ($e^{-.7305329}$ = 0.482) holding all other variables in the model constant. Having incomplete secondary education compared to having no education at all decreases the odds of being poor by 75.4% ($e^{-1.400889}$ =0.246) holding all other variables in the model constant. Compared to having no education, having complete secondary education decreases the odds of being poor by 94.1% ($e^{-2.827078}$ =.0592) holding all other variables in the model constant. Finally, having higher education compared to having no education decreases the odds of being poor furthest by99.4% ($e^{-5.051606}$ =.0064) holding all other variables in the model constant.

Rural
The findings indicate that poverty is much higher in the rural areas than in the urban areas. For households living in the rural areas compared to households living in the urban areas, households living in the rural areas have higher poverty by 25 times ($e^{3.224314}$ = 25.14) the poverty in the urban areas holding all other variables in the model constant. This variable is highly significant in explaining poverty differentials.

Region
Compared to Households living in Central province, household living in the Copperbelt Province have their poverty levels lower by 46.5% ($e^{-.6251305}$ =.5352) holding all other variables in the model constant. Living in eastern province compared to living in central province increases poverty by8.7% ($e^{.0831525}$ =1.087) holding all other variables constant. Compared to living in Central province, living in Luapula increases poverty by 40.83% ($e^{.342383}$ = 1.4083) all other factors held constant. Households living in Lusaka province are found to have lower poverty levels by 87.3% ($e^{-2.056756}$ = .127), holding all other factors constant. In Muchinga province compared to Central province poverty levels are higher by 2.23 times ($e^{.7997966}$ = 2.23) holding all variables constant. On the other hand, living in Northern Province compared to living in Central province increases poverty by 2.17 times ($e^{.7754372}$ =2.17) all other factors held constant. Compared to households living in Central Province, households living in Northwestern province have higher poverty levels by 77% ($e^{.5721653}$ = 1.77) holding all other factors constant. Households in southern province compared to central province are found to have lower poverty levels by15.3% ($e^{-.1664464}$ = .847). Households in Western province compared to households in central province have poverty levels higher by 4.52 times ($e^{1.508382}$ = 4.52) all other factors held constant.

Religion
The findings also indicate that religion explains the correlates of poverty. Compared to being catholic (reference variable) being a protestant lowers poverty levels by 17.7% ($e^{-.1944448}$ =.823), holding all other factors constant.

Sex of Household Head
Sex of household head was also found to be a significant variable in explaining the determinants of poverty in the Zambian context. Compared to a household headed by a female, households headed by male were found to have lower

poverty levels by 30.6% ($e^{-.365823}$ =.694), holding all other factors constant.

5. Discussion

Asset based measures of poverty are increasingly being used. There are however, some limitation on their use.

- The asset- based measures are more reflective of the long-run household wealth, failing to capture short-run wealth to the household (Filmer and Pritchett 2001). Therefore, if the outcome of interest is associated with current resources to the household, then an index based on assets may not be the best measure
- The second issue is that the ownership does not capture the quality of the asset, (Falkingham and Namazie (2002)).
- Some variables may have a different relationship with the asset index across sub-groups; for example ownership of farm land may be more reflective of wealth in rural areas than urban areas.

The multi-variate analysis shows that increases in educational attainment have an important impact on reducing the probability that a household is poor. The logistic model shows that a rural family has a high probability of being poor. The rural/urban variable is statistically significant and this variable increases the odds of a household being poor significantly. The other demographic factors that increase the probability of being poor are the age of the household head, religion, region and sex of the household head. The rural/urban variability can be argued that the assets included in the asset index are by their nature urban rather than rural and therefore are biased against rural areas. Indeed in most of African countries Zambia inclusive, the governments regard the provision of formal housing, water and sanitation services as naturally urban services, but as the countries develop it would not be amiss for the rural population to strive towards having piped water, flush toilets and good housing characteristics. It is possible that important changes may take place in the economic situation of many households, but the asset indices may remain unchanged. That being the case then we cannot use the asset index to measure short or medium term social welfare of a household.

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