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A Comparative Analysis of Financial Inclusion Indices: Evidence from Malawi

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Abstract: Recently, Malawi, has taken initiatives aimed at increasing financial inclusion so as to achieve faster inclusive economic growth. In order to measure financial inclusion at the household level it is important to use an efficient tool or approach. In the study we measured the reliability of the three indices measuring financial inclusion namely, weighted average method, principle component analysis and multiple correspondence analysis. The Cronbach alpha value was used to test the reliability i.e. internal consistency of each of the three indices. The results were 0.453 for the weighted average method; 0.796 for the principal component method and 0.805 for the multiple correspondence analysis. According to the reliability criteria, the multiple correspondence analysis had good results, while the principle component analysis had acceptable reliability. The most widely used method of weighted average method produced unacceptable results. The implication of these results suggest that if one is interested in examining important factor affection financial inclusion at household level, they are advised to use the multiple correspondence analysis.

Keywords: Financial Inclusion;Weighted Average;Principal Component Analysis;Multiple Correspondence Analysis; Probit Analysis.

JEL Classification: G23

1. Introduction

This study set out to assess the efficacy of three approaches of analyzing the extent to which a household is financially included.Generally, as Lapukeni (2015) argues, financial inclusion goes further than mere access to finance such that usage and quality are crucial as well. Differences in financial inclusion at household level can be as a result of income, age and gender (Demirgüc-Kunt, Klapper & Singer, 2012). Additionally, Demirgüc-Kunt *et al.* (2012) mention high costs of the services, unavailability of services due to regulatory barriers, or a variety of other market and cultural factors may pose as challenges thereby increasing people's lack of access to financial services.

Essentially, financial inclusion is regarded as an important tool for economic development and poverty reduction by the Government of Malawi (Mandiwa, 2014). Demirgüc-Kunt *et al.* (2012) notes, other benefits from financial inclusion include improved household consumption and female empowerment. Globally, in both developing and developed economies, financial inclusion is being prioritized by policy makers, regulators and governments are putting in measures so as to increase access to and usage of

financial services (Jabir, 2015).

Notwithstanding the importance of financial inclusion, the prevalence of financial exclusion is still high universally. Recently, studies have established that there are still around two billion adults, across the globe, who are financially excluded (World Bank, 2014). Additionally, the report indicated that almost 80 percent of these adults live on less than $2 a day.

Kadale Consultant (2009) and Nkuna *et al.* (2018), noted that 55% of Malawians are financially excluded.

One of the crucial questions arising in the literature on financial inclusion (FI) pertains to how it should be measured (Sarma, 2008). The concept is broad and there is no consensus in its definition in the literature (Camara & Tuesta, 2014). As a result of no single definition, there is also no universally accepted standard measure of financial inclusion. Some financial inclusion measures are: fraction of the adult population in each economy with access to formal financial intermediaries (Honohan, 2008); quality and usage of the financial services (Diniz *et al.* 2011; Sarma & Pais, 2011);number of bank branches and ATMs per million people; volume of bank credit and deposit as ratios of GDP, among others (Kempson *et al.* 2004 and Global ICT, 2017).

In Malawi, some financial inclusion studies have focused on the role of commercial banks on financial inclusion (Nkuna *et al.* 2018); the financial inclusion-poverty nexus in Malawi (Kaluwa & Kunyenje, 2017); determinants of access to banking services in Malawi (Chipeta & Kanyumbu, 2018) as well as the impact of financial inclusion on monetary policy effectiveness (Lapukeni, 2015b).

The objective of this study is to examine the best way of measuring financial inclusion at the household level in Malawi.In order to achieve the main objective, the study pursued the following specific objectives:

1) To assess the reliability of financial inclusion indices measured differently, i.e. by use of a weighted average (WA) method, or using data reduction methods such as principal component analysis (PCA) and multiple correspondence analysis (MCA).
2) To examine which model fits better when the financial inclusion is measured using the different approaches.

Our interest was to assess the efficacy of financial inclusion measurements at household level.

2. Literature Review

This section present theoretical and empirical review. We discuss theoretical review of the methods used to measure factors affecting financial inclusion at household level. This is followed by empirical review of some studies that have been done in measuring the financial inclusion determinants at household level.

2.1. Theoretical review

In this section, we discuss the theoretical arguments for financial inclusion, definitions, importance and measurement of financial inclusion, approaches

to measurement of financial inclusion at household level.We discuss these in turn.

2.1.1. Theoretical arguments for financial inclusion measurements at household level

In order to assess whether a given household is likely to demand financial services.a weighted average index has been widely used. Kumar and Mishra (2011) argued that measures of household level inclusion, as a proxy of demand for financial services, provide a comparative picture across locations, and separately for rural and urban India. They used the following set of variables: formal saving, formal insurance, formal credit, informal saving and informal credit. Since the indicators were all in percentages, then it meant that they were already normalized with a minimum of zero and maximum of hundred.

Although the weighted average is widely used, other studies have used principal component analysis (PCA) and multiple correspondence analysis (MCA) as alternative approaches.These two are examples of data reduction approaches used to combine several indicators into one 'reduced' index containing information from households. For example, Camara and Tuesta (2014) used two-stage principal component analysis, whereby, in the first stage, they estimated three sub-indices namely, usage, access, and barriers; which defined their financial inclusion measure. However, with regard to measuring financial inclusion at the household level, Kumar and Mishra (2011) measured financial inclusion using an equal weighted average of the indicators to calculate composite financial inclusion index for the demand side, separately for formal and informal sources.

Multiple correspondence analysis (MCA) is an extension of correspondence analysis (CA) which allows one to analyze the pattern of relationships of several categorical dependent variables and in turn, reveal patterning in complex data sets (Salkind, 2007). In that regard, when the variables to be analyzed are categorical and not quantitative, MCA can also be seen as a generalization of the PCA (*Le Roux & Rouanet, 2004*). In the same vein, MCA is obtained by using a standard CA on an indicator matrix that is, a matrix whose entries are 0 or 1 (Greene, 2003).

2.2. Empirical Literature on Financial Inclusion

Using 2011 data from the World Bank's Global Findex database, Demirgüç-Kunt & Klapper (2012a) analyzed the use of financial services in 148 countries. They provided main statistics for three measures of financial inclusion as follows: ownership of a bank account, savings on a bank account and use of bank credit. The results showed that differences in income among countries and individuals within countries influence the level of financial inclusion.

Demirgüç-Kunt *et al.* (2012b) examined financial inclusion and legal discrimination against women in developing countries based on a probit model and ordinary least squares (OLS). The results suggested that apart from income

other individual characteristics such as education, employment status, rural residency, age and gender remain significantly related to usage of financial services.

In China, Fungáčová and Weill (2014) analyzed financial inclusion relative to other Brazil-Russia-India-China-South Africa (BRICS) countries using the World Bank's Global Findex Database for 2011. The study suggested that higher income, better education, being male and older are associated with greater use of formal accounts and credit in China.

3. Methodology

The analytical approach to the study followed the objectives.

3.1. Measurements of Financial Inclusion Indices

Thus, we first developed three indices of financial inclusion using the three approaches of weighted average, principalcomponents analysis and multiple correspondence analysis. We assessed the performance of the indices using the Cronbach alpha test which measures internal consistency, i.e., how closely related a set of items (individual financial inclusion variables) are as a group (financial inclusion as a single concept). It is considered to be a measure of scale reliability (Tavakol, Mohagheghi & Dennick, 2008). We use the following equation.

$$\alpha^{1} = \frac{N.\overline{c}}{\overline{v} + (N-1).\overline{c}} \tag{1}$$

Where N = number of items

$\overline{c}$ = average covariance between item pairs

$\overline{v}$ = average variance

We discuss the three indices in turns.

3.1.1. Weighted Average Index

Weighted average of the indicators was used to calculate composite financial inclusion index for the demand side, separately for formal and informal sources (Kumar & Mishra, 2011). In case of formal sources, the index was the average of these three components while in case of informal sources, the index was the average of two components that is saving and credit only which indicated the status of availed financial services.

$$FII_i^f = \frac{\Sigma_{q=1}^{2} x_{iq}}{3} \tag{2}$$

1. The reliability results (α) are interpreted as follows: α≥0.9=Excellent; 0.8≤α<0.9 = Good; 0.7<0.8 = Acceptable; 0.6<0.7 = Questionable; 0.5<0.6 = Poor; <0.5 = Unacceptable *(Source: https://www.statisticshowto.com/cronbachs-alpha-spss/).*

Where,

FII_i^f = Financial inclusion level of household i when they can access to formal financial services *f*.

x_{iq} represented the value of indicator *q* for the household i

q = 1–3 represented formal financial services namely saving, formal credit and formal insurance

For those who can access informal financial services, the index was built as

$$FII_i^{\inf} = \frac{\Sigma_{q=1}^{3} x_{iq}}{2} \tag{3}$$

Where,

$FII_i^{\inf}$ = Financial inclusion level of household i when they can access informal financial services inf.

x_{iq} represented the value of indicator *q* for the household i

q = 1 – 2 represented informal financial services namely informal saving and informal credit

3.1.2. Principal Component Analysis

The following equation was used. According to this procedure the jth factor, F_j can be expressed as:

$$F_j = WJ_1X_1 + WJ_2X_2 + WJ_3X_3 + \cdots + WJ_pX_p \tag{4}$$

Where:

F_j = estimate of j^{th} factor

W_j = weight on factor score coefficient

P = number of variables

3.1.3. Multiple Correspondence Analysis

Generally, MCA is defined as the application of weighted Principal Component Analysis (PCA) to the indicator matrix G (Salkind, 2007). Moreover, G is divided by its grand total np to obtain the correspondence matrix $F = \frac{1}{np}G$, that is, $1_n^r FI_q = 1$ where 1_i is an *i* x 1 vector of ones. The vectors $r = FI_q$ and $c = F^t$ 1*n* are the row and column marginal respectively. These marginal are vectors of row and column masses.

3.2. Household Financial Inclusion Model

We employed a probit model for the estimation because of the binary nature of the dependent variable (Heckman, 1979). The probit model specification is presentedin the equation below and the econometric specification follows that of Efobi *et al.* (2014), Fungáèová and Weill (2015), and Jabir (2015).

For each one of the three indices, i.e. one from the weighted average, another from the principal components analysis, and another from the multiple correspondence analysis, we run three probit models and compare them to test the model with the best fit using the Akaike Information Criteria.

The following equation was used.

$$\begin{aligned}\Pr(Fin\_inc_i) = {} & \beta_0 + \beta_1 sex_i + \beta_2 age_i + \beta_3 age_i^2 + \beta_4 loc_i + \beta_5 edu_i + \\ & \beta_6 income_i + \beta_7 informal\_borrowing_i + \beta_8 mobile\_money\_usage_i + \\ & \beta_9 social\_capital_i + \mu_i\end{aligned} \tag{5}$$

Table below decries the variables and the expected signs.Because we used cross sectional data for the estimation, we estimate the parameters using robust standard errors to mitigate for the potential heteroskedasticity.

Table 1: Definition of Variables and Expected Signs

Variables	*Description*	*Expected sign*
Fin_inc	Proxied by a composite measure of financial inclusion (financial inclusion index)	Not applicable
Mobile money usage	A dummy variable capturing whether a respondent used mobile money services (sending or receiving money)	Positive
Age	Age in years (Continuous)	Positive
Age squared	Age in years squared (Continuous)	Negative
Sex	A dummy variable that takes 1 for female and 0 for male.	Negative
Location	A dummy variable 0 and 1 for rural and urban respectively	Negative
Social capital	A dummy variable capturing group membership	Positive
Education	Number of schooling years	Positive
Income	A continuous variable representing the income of the household head.	Positive
Informal borrowing	A dummy variable indicating whether one informally borrowed or not.	Indeterminate

3.3. Description of Data

We used household level data from the Financial Literacy Baseline Survey (2013) dataset (Chirwa & Mvula, 2014). The baseline survey covered a randomly selected nationally representative sample of 4,999 households throughout Malawi across four strata including urban-cities, urban-district towns, peri-urban and rural areas.

4. Empirical Results and Discussions

We compared the reliability and goodness of fit of estimating financial inclusion using the three approaches of weighted average method, the principal component analysis and the multiple correspondence analysis.

4.1. Reliability test

The reliability tests were carried out using the Cronbach's alpha test and the results presented in Table 2 below.

Table 2: Model Reliability Results

	FII_{WA}	$FIIP_{CA}$	FII_{MCA}
Cronbach's alpha	0.453	0.796	0.805
Corrected item-total correlations	0.20 – 0.49	0.30 – 0.58	0.57 – 0.71
Item deleted	0.42 – 0.55	0.66 – 0.74	0.83 – 0.85
Inter-item correlations	0.06 – 0.38	0.09 – 0.49	0.42 – 0.60

To begin with, the internal consistency of the indices was assessed using inter-item and item-total correlations, Cronbach's alpha (a) coefficient and alphaif item deleted. Essentially, from the results, the Cronbach's alpha value is 0.805 for FII_{MCA} and 0.796 for FII_{PCA}, which indicates relatively higher levels of internal consistency as compared to the 0.453 for FII_{WA}. The criteria presented in the Cronbach test indicates that the multiple correspondence analysis gave the index for financial inclusion with a Cronbach's Alpha's coefficient of 0.805 (which is lying between 0.8 and 0.9).The principal component analysis index gave a somewhat acceptable index with an internal consistency alpha coefficient of 0.796 (which is lying between 0.7 and 0.8) while results from the weighted average method gave unacceptable index with a Cronbach's Alpha coefficient of 0.453. This means that assessing financial inclusion at household level, one would get more reliable results using the principal component method and the multiple correspondence method.

The FII_{MCA} and FII_{PCA} indices appeared to be more reliable as compared to the FII_{WA}. Their internal consistency was broad in keeping with existing data in other settings and the alphas were above the value of 0.70 recommended for group comparisons (Adulyanon & Sheiham, 1997; Kline, 1993; Hays et al., 1998; Slade, 1997). It should be noted that while the FII_{MCA} index had the highest Cronbach's alpha's coefficient, that of the FII_{PCA} is not placed very much far away. Additionally, the item-total correlations for both FII_{PCA} and FII_{MCA} were well above the minimum recommended threshold of 0.20 although they were higher for FII_{MCA} while those for the FII_{WA} were very low. Even more, for both indices (that is, FII_{PCA} and FII_{MCA}), the values for alpha when any one item was deleted were lower than the original alphas for the whole indices as opposed to the FII_{WA} (Streiner, 2003). Moreover, there was neither negative nor very high correlation among the items. Both indices had acceptable reliability even

though the reliability values for the FII_{PCA} showed moderate agreement but good agreement for FII_{MCA} implying that the FII_{WA} is not the most reliable measure (Bayer & Altman, 1991).

4.2. Testing for model quality

Before running probit regressions, diagnostic tests were carried out.A number of diagnostic tests were conducted to assert the appropriateness of the model. In order to assess the level of multicollinearity, so as to avoid indeterminate regression coefficients and infinite standard errors, the variance covariance matrix was used. It was observed that there was absence of multicollinearity in the estimated model. Additionally, to test the significance of a particular model, the Wald test was used and the results showed that the modelsare correctly specified and that the parameters are jointly significant at 5% significance level since the p-value was less than 0.05. Just as a precaution of having the problem of heteroscedasticity in the analysis, the estimates were regressed using robust standard errors.

The results in Table 3 below are based on the indices for weighted average, principal component analysis and multiple correspondence analysis.

Table 3: Marginal effects from the probit regression based on the financial inclusion index

Variables	FII_{WA}	FII_{PCA}	FII_{MCA}
Mobile_money_usage	0.131*	–0.024***	0.086***
	(0.061)	(0.006)	(0.022)
Age	0.002*	0.021***	0.045***
	(0.001)	(0.001)	(0.001)
Age squared	–0.011*	–0.000**	–0.000**
	(0.005)	(0.000)	(0.000)
Sex	–0.054***	–0.001	–0.019**
	(0.006)	(–0.005)	(0.005)
Location	–0.006	–0.008***	–0.060***
	(0.005)	(0.000)	(0.003)
Education	0.052***	0.030***	0.009**
	(0.014)	(0.006)	(0.060)
Informal borrowing	–0.008	0.011*	0.033***
	(0.014)	(0.005)	(0.029)
Income	0.006	–0.013*	0.107**
	(0.005)	(0.006)	(0.132)
Social_capital	–0.039*	0.002**	0.012**
	(0.015)	(0.001)	(0.009)
Predicted Pseudo R^2	0.43	0.34	0.278
Wald	804.82	130.05	61.72
N	4999	4999	4999
Akaike Information Criteria	112	66	127

Note: Robust Standard errors in parentheses, $^{*}p< 0.10$, $^{**}p< 0.05$, $^{***}p< 0.01$

We use the Akaike Information Criteria information to assess which model fits better.The model that uses the financial inclusion variable derived from the principal component analysis approach performs better than the other two, i.e. had the lowest value of the Akaike Information Criteria.Surprisingly, the multiple correspondence analysis which performed best on index in the Cronbach's Alpha's test, was the worst in the AIC test.All nine variables were significant in the model that uses financial inclusion variable derived from the MCA approach while the model using financial inclusion using PCA approach, sex was not significant. The model with financial inclusion derived from the weighted average approach had the following variables not significant: income, location and informal borrowing.Contrary to an observation that most analysts use the weighted average when assessing financial inclusion of households (), in our analysis, the weighted average analysis was never the best. The regression model of financial inclusion derived using PCA had the best model fit. Surprisingly, the model of financial inclusion derived from the MCA, an index which was most consistent using reliability Cronbach's alpha test, had the worst model fit of the probit model.

Based on the results, age of the household head is positively related to financial inclusion. On the contrary, age^2 has a non-linear relationship with financial inclusion in Malawi. Thus, while the effect of age on financial inclusion, is positive, the effect of age^2 is negative, implying that financial inclusion increases with age. However, this is merely up to a certain age after which the probability of being financially included is unlikely. Thereby, demonstrating the non-linear relationship between age^2 and financial inclusion. Mainly, this finding is in line with the conclusion of Allen *et al.* (2016) as well as Honohan and King (2012).

Our findings indicate that education is positively related to financial inclusion. This was expected because, other things being equal, the higher the levels of education achieved by an individual, the higher the likelihood of being financially included. This is also consistent with the findings of Honohan and King (2012), that education, particularly, being highly educated, contributes to the acceleration of the use of formal financial services among individuals in developing countries. With the exception of weighted average method, income plays a significant role in influencing financial inclusion. Essentially, the income variable was expected to be positively associated with financial inclusion. It should be noted that income can be endogenous, i.e. one can only be financially included if one has an income. There is a small chance of reverse causality in this case.

With the exception of the model using financial inclusion variable generated by PCA, sex of household head a significant factor influencing financial inclusion in Malawi. The results showed that men are more likely to be financially included as opposed to women. This is supported by the findings of Allen *et al.* (2016) who found that women are less likely to be financially included.

The results indicate a positive and significant relationship between urban dwelling and financial inclusion indicating that individuals living in an urban environments are more likely to use formal financial services than those in rural areas. Similarly, the likelihood of being financially included is unlikely among people living in rural areas. The explanation for this may be that there are more opportunities for increasing their income in urban areas than it is the case for rural areas whereby people have greater difficulties in accessing financial services.

Social capital is positively associated with financial inclusion such that individuals with group membership are shown to have more access to financial services than those with no membership. This finding is consistent with literature both in developing and developed countries since one's level of social capital is positively linked to financial inclusion, as expected (Taube & Joye, 2001).

With the exception of weighted average, for the other models informal borrowing was significant to financial inclusion. In other words, depending on informal sources of borrowing such as family and friends, and employers improved financial inclusion. This could be the case because an individuals' ability to manage his/her immediate sources of finance without necessarily seeking external debt enables him to be financially included as argued by Efobi *et al.* (2014).

5. Conclusions

This study set out to examine the household characteristics affecting financial inclusion of the households.This was done using data from the Financial Literacy Baseline Survey dataset by Chirwa and Mvula (2014). In order to, comprehensively, measure financial inclusion at the household level, the study assessed the reliability of the widely used weighted average method by comparing it with the principle component analysis and multiple correspondence analysis after constructing three indices of financial inclusion using the three different approaches.

Using Cronbach reliability test, the MCA approach gave more reliable index for measuring financial inclusion followed by the PCA approach.For the probit model, using the Akaike Information Criteria showed that the PCA model gave best model fit.These results are interesting in the sense that most researchers use the weighted average method when assessing factors affecting financial inclusion. In our study, the method never performed to the best in any one of the approaches.

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