Bank Efficiency in Africa

Roseline Oluitan
Brunel University
United Kingdom
Roseline.Oluitan@brunel.ac.uk

Abstract

This paper examines the level of efficiency that exists in the financial sector in African countries. It is a follow up on previous studies that observed that export activities in these countries is not important in fostering their financial development despite the vast amount of trade taking place in these countries including exportation of crude oil. Therefore the critical question is "Is the financial system proxied in this study by commercial banks for these countries well positioned and actually distributing the economic resources efficiently to be able to harness the benefit and gains of intermediation. Empirical evidence supports a sound intermediation process and efficiency in the banking system (Vittas, 1991; Howard & Haynes, 2001).

There are basically two measures of efficiency available in literature, which are the cost function and the production function. This approach considers the banks sources of funding as inputs while the usage of funds proxied by loans etc are considered as outputs. This is seen more rational for the type of the operation of the banking sector. For the purpose of this paper, the cost function will be estimated as this is deemed more appropriate for the reason adduced for this study above. Due to the nature of the banking service sector, a single-output and multi-input approach is adopted. The output consists of loans, other earning assets and non-interest revenue which are used individually for the estimation. The input is deemed to be made up of capital, deposits and labour (overhead). The analysis is further extended by calculating the x-inefficiency

Several methods have been used in literature, but one of the most widely used is SFA which is being proposed for this study. Commercial banks from about forty seven African countries are expected to be covered in the study for a period of ten years. The study is further estimated by dividing the countries into income classification with a view to ascertain whether income level and possibly level of financial development is important in the efficiency of the sector. The study affirms this postulation after observing the x-inefficiency of the banking sector for the middle and low income countries in Africa.

Introduction

The banking sector is a viable tool for the development of the economy where it operates. Evidences abounds in the literature that the financial

institution through their intermediation activities are able to enhance the productive base of the economy. However, studies have found that the financial sector notably the banking industry in Africa are under-developed and not well positioned to assist their respective economies to grow. Several firms within the continent will rather seek for funding outside the region (if opportune) for so many reasons. This situation is having an effect on the spate of growth within the continent and also the level of development by the banking sector.

African continent is largely under-developed with most of the countries dependent on natural resources such as oil, gold or agriculture. These products are mostly exported to other parts of the world and they are dependent on the proceeds of the trade to finance their economic activities. A recent study conducted observed that trade proxied by exports even though large is potent in supporting the economic growth of the respective economies, but not very significant in enhancing the development of the financial sector. At best, one could guess that possibly the financial system are not doing enough to support the firms in their bid to finance their business transactions. This assumption led to examining the importance of banks in living up to their role as financial intermediary and providing necessary tools needed for the businesses.

There are basically two techniques that are commonly used in literature to determine the efficiency of institutions. These are the Data Enveloping Analysis method (DEA) and the Stochastic Frontier Analysis method (SFA).

These two methods have been used widely in the literature and it is somehow difficult to say which is better although they have differing abilities. According to Berger & Humphrey (1997), SFA is a better too for benchmarking relative performances. This according to them is because "it permits individuals with very little institutional knowledge or experience to select best practice firms within the industry, assign numerical efficiency values, broadly identifies areas of input overuse. Secondly, in the hands of individuals with sufficient institutional background, frontier analysis permits management to objectively identify areas of best practise within complex service operations". In essence, it is a useful tool to understand the numerical efficiency value and the X-efficiency of firms. Apart from the above reasons in favour of SFA, the DEA is a tool that is not efficient with unbalanced panel, whereas SFA is able to cope with it.

In view of these reasons, the SFA methodology will be used to analyse the efficiency of the deposit money banks in Africa. There are basically two measures of efficiency available in literature, which are the cost function and the production function. This approach considers the banks sources of funding as inputs while the usage of funds proxied by loans etc are considered as outputs. This is seen more rational for the type of the operation of the banking sector. For the purpose of this paper, the cost function is therefore deemed more appropriate hence proposed for the study. Due to the nature of the banking service sector, a multi-output/input approach is proposed such that the output consists of loans, other earning assets and non-interest revenue. The input is deemed to be made up of capital, deposits and labour (overhead). The analysis is further extended by calculating the x-inefficiency. The continent is further divided based on the income categorisation of the countries, currency unions and regions as a robustness check.

Data for the study is obtained from datascope – a renowned source for financial information. The study will cover ten years from 1998 to 2007 for forty seven African countries. The research will make postulations about the relevance of macroeconomic factors and possible controls that may minimise the level of inefficiency within the financial system within the continent. The theoretical background is discussed in the second section while methodology, model formulation and definition of variables are covered in the third section. The interpretation of the result is discussed in the fourth section and the conclusion in section five.

Objective of the Study

The main thrust of this paper is to examine the intermediation activities of the deposit money banks in Africa whether they have been discharging this activities efficiently. This is borne out of the fact that banks in the continent seems not to be positively significant in intermediating for exports. Meanwhile, most countries within the continent are highly dependent on natural resources and/or agricultural products which are exported to other parts of the world. The process should ideally facilitate a robust relationship with the financial sector in form of financing these products hence the expected positive and significant relationship between financial development and exports. This assumption is found not to hold for African countries. The main question we then ask in this study is whether banks in Africa are discharging their intermediating function efficiently

or better still is the variations in the error component in the relationship largely due to X-ineffiency.
It is anticipated that this paper will aim to find out the main cause of the inverse relationship between financial development and exports and also make postulations that will change the scenario positively.

Motivation for the Study

There are many problems associated with the African continent; one of which is the high degree of poverty ravaging the continent. Most of the countries are classified as low income countries with some having a per capita income extremely poor. However this same continent is blessed with so many resources. Despite these resources, the wealth of these nations is largely poor.

Previous empirical work has established that the role of banks in the course of intermediation is very significant in promoting growth within the economies. This they attributed to financial support for the firms which results in enhanced productivity base for the country. This scenario therefore supports a robust and positive relationship between financial intermediation and trade. However, for the developing countries in Africa, this postulation does not hold. This is because a previous study observed a significant inverse relationship. This implies that trade proxied by exports is not having a positive relationship with financial development. One argument that could be proffered is that the financial sector is not providing enough support for the firms to ensure a positive relationship in the activities of these industries and the financial sector. This could possibly mean that the financial sector is not discharging their duties efficiently to harness the gains of such activities.

This study will examine the level of efficiency of the banking sector in Africa and determine the extent of their in-efficiency. So far the, we are not aware of any study on the efficiency of banks that covers the entire continent. Most of the studies are country specific study, hence this work is first known study that covers the entire continent. Efforts are also made to check whether regions, currency zones etc are relevant in the determination of x-inefficiency for countries. It is anticipated that this study will aim to provide an answer to this ugly trend in the relationship that currently exists between financial development and trade.

Literature Review

Banking system in Africa has often been described as under-developed. The depth of financial intermediation is relatively low for these countries and seems to follow the level of income for the respective countries. To analyse the situation, we have used some measures of financial depth and development such as ratio of liquid liabilities to GDP; ratio of money outside the coffers of the banking sector to GDP and the ratio of Private Sector Credit by the Deposit Money Banks to GDP. These charts in the appendix section show that the various proxies for financial development are very low comparatively. A perusal of the chart reveals that the bulk of liquid liabilities are in form of money outside the coffers of the deposit money banks; a common feature associated with underdevelopment. Similarly, most of the countries had their private sector credit as a percentage of GDP far below 0.5. This is a very low figure, even much lower than the currency outside the coffers of the banking sector. Whichever way this is viewed, it portends a gap within the system which could possibly be attributable to inefficiency of the system.

The charts 1, 2 and 3 shown in Appendix suggest some sort of relationship between the level of income classification for the countries and the volume of financial activities within the economy. These countries are now arranged based on their income category and presented in a scatter plot so as to ascertain the type of relationship that exists amongst them. These plots are presented in the Appendix as plots 1 and 2. Basically, the plots were limited to private sector as a percentage of GDP and liquid liabilities as a percentage of GDP. This is because ratio of money outside the deposit money banks is almost similar for the economies as revealed by the chart discussed above.

There are numerous studies on bank efficiency, but most of them are based on the developed and transition economies. These papers focused on different aspects of the banking industry. Berger & Humphrey (1997) conducted a study based on survey of 130 previous studies that covered 21 countries. They found that the various methodologies do not produce consistent result. The concept of inefficiency is not a phenomenon associated with the under-developed, but cuts across levels of development. Berger et al (1996) study on 760 branches of a large US commercial bank observed that there are twice as many branches that would minimise cost

with the X-inefficiencies more than 20% of operating costs. This view was supported by Casu & Molyneux in their study of the European banking system using Tobit regression model approach. They observed that following the EU legislative harmonisation, there has been a small improvement in bank efficiency levels.

A concept being discussed is the inclusion of firm/country specific variables that could account for some of the variations in the inefficiency term. This approach was tried by Battese & Coelli (1995) in their panel study on 14 paddy farmers from an Indian village. They observed that the model for the technical inefficiency effects, which included a constant term, age, schooling of farmers and year of observation were significant component in the stochastic frontier production function. This view was further discussed by Hollo & Nagy (2006) in their study on bank efficiency in the enlarged European Union considered the impact of controlling for factors that are country specific and originates from the banks operational environment. They found that controls for such factors reduce the size of the actual gap between the old and new member states (and vice versa). They also observed the existence of an X-efficiency gap.

Some studies on efficiency have focused at examining the concept in relation to the ownership of the banks. Hauner (2005) in his study of the large German and Austrian banks observed that state owned banks are more cost efficient (possibly due to availability of cheaper funds) while cooperative banks are as cost-efficient as private banks. The premise of this study is similar to that of Chen (2009) who examined the efficiency of banks in Sub-Saharan African middle-income countries. They found that banks on average could save between 20-30% of their total costs if they operate on the efficient frontier. Similarly, they opined that foreign banks are more efficient than public banks and domestic banks. The study by Ikhide (2009) on commercial banks in Namibia follows the same line of argument as those discussed above. To him, commercial banks in the country can increase their efficiency by increasing their current scale of operation while the current level of input combination does not make for maximum efficiency.

The efficiency of the banking sector is an important point that aids the actual realisation of the purpose of this sector. One of the major reasons for the establishment of banks is to facilitate the concept of intermediation through re-directing funds from the surplus sector to the

deficit sector of the economy. This issue transcends the soundness of banks, but rather sounds banks that are efficiently positioned to provide the much needed credit for growth. According to Ikhide (2009), the solvency, strength and soundness of the banking system are germane to the performance of the entire economy. Without a sound and efficiently functioning banking system, the economy cannot function. Due to this reasons amongst others, banking supervisors place a lot of emphasis on banks operational efficiency.

When a country opens up to international trade, it allows such a country to grow faster than would otherwise have been. This presumes that export led growth facilitates industrial and financial development (Stiglitz; 2002) and this fete is being viewed to have account ted for the rapid growth in Asia which improved the standard of living of the populace. This position sharply contrasts the situation in Africa hence the need to examine the level of efficiency of the banking sector in discharging their duties.

A study of efficiency usually involves estimating the efficient frontier and also determining the extent of deviations from the efficient frontier by each cross section included in the study. In order to do this, two methods are popular for the estimation. These are the Data Enveloping Analysis (non-parametric) and the Stochastic Frontier Analysis (parametric). According to Berger & Humphrey (1997), these methods differ based on the assumptions imposed on the data, but there is no consensus on the preferred method for determining the efficient frontier. In essence, these approaches differ in how much shape is imposed on the frontier along with the distributional assumptions imposed on the random error and inefficiency.

The Data Enveloping Analysis (DEA) is a non-parametric methodology that uses the linear programming approach. This procedure was initially proposed by Farrell in 1957 but later used for analysis by Charnes et al in 1978. This method assumes economic optimalisation of the efficiency frontier. It is formed as the piecewise linear combination which connects the set of observation in the series being analysed, thus yielding a convex production possibility set. Therefore, the DEA efficiency score is defined relative to other Decision-Making Unit, different from the usual absolute standard. The DEA thus not require a full specification of the underlying functional form for the relationship; a requirement that is essential for the parametric

methodology. This procedure however assumes that there is no random error in the estimated relationship and also suites best a balanced panel.

The Stochastic Frontier Analysis (SFA) is a parametric tool for the measurement of efficiency which was developed independently by Aigner et al (1977) and Meeusen & Van den Broeck (1977). This methodology allows the specification of the functional form for the relationship to be estimated and provides random error which is decomposed to allow for estimation of the technical efficiency. The procedure assumes that part of the error component (composed) captures the inefficiencies of the system and these errors are assumed to be asymmetrically distributed. The random error component is assumed to be symmetrically distributed. Due to this reason, the SFA is widely used though no confirmed opinion on which of the two approaches is better. However, this study intends to use the SFA, not because it is a better tool (as that cannot be asserted), but rather because it suits the study being proposed and more suitable for unbalanced panel which characterises the data that we intend to use.

The Stochastic Frontier Analysis

The SFA is a tool useful in estimating the technical inefficiency for both the production and cost estimation. The process involved are essentially the same, but the underlying assumption differs for the two forms of estimation. In this study we shall be focusing on the cost function which is being used to further the explanation below. The SFA as earlier mentioned allows a decomposition of the error term to obtain the level of efficiency and the random error (white noise). Now, let us consider a model in the panel form:

$$Y_{it} = \beta X_{it} + \varepsilon_{it} \quad \text{---------- (1)}$$

Where Y_{it} is the cost (or log) of the i-th firm at time t

X_{it} is a kx1 vector of input and output prices of the i-th firm at time t

β is the vector of unknown parameters

ε_{it} is the error component of the i-th firm at time t which the frontier decomposes further

When the error term is decomposed, the model with the SFA becomes

$$Y_{it} = \beta X_{it} + (V_{it} + U_{it}) \quad \text{---------- (2)}$$

Where V_{it} is the symmetric random variable representing errors of approximation and other sources of statistical noise of the i-th firm at

time t which is assumed to be iid $[N(0,\sigma_v^2)]$and U_{it} is the non-negative random variables which are assumed to account for technical inefficiency in production and are often assumed to be iid $[N(0,\sigma_u^2)]$. Using the Battese & Coelli specification (1995), the random variables could be assumed to be iid with a normal or half normal distribution as truncations at zero of the $[N(m_{it},\sigma_u^2)$ and m_{it} represents $Z_{it}\delta + W_{it}$. Z_{it} is a vector of px1 variables which are capable of influencing the efficiency of a sector specific firm/country while δ is the unknown coefficient for the estimation. W_{it} represents the truncation of the distribution with zero mean and variance σ^2. Therefore the point of truncation is $Z_{it}\delta$; implying that $W_{it} \geq Z_{it}\delta$

Technical efficiency is a term used to depict the current level of output over possible maximum output given the level of input. It is the ratio of observed output to the corresponding stochastic frontier output:

$$TE_{it} = \frac{Y_{it}}{\exp(X_{it}\beta + V_{it})} = \frac{\exp(X_{it}\beta + V_{it} + U_{it})}{\exp(X_{it}\beta + V_{it})} = \exp(U_{it}) \leq 1 \quad \text{--------(4)}$$

Therefore $TE_{it} = \exp(U_{it}) = \exp(Z_{it}\delta + W_{it})$

There are basically two forms of estimation with the cost function. The first is the log-linear Cobb-Douglas while the second is the log-linear translog function. The model for both are as stated in equation 4 and 5 below.

Cobb-Douglas: $$\ln Y_{it} = \beta_0 + \Sigma\, \beta_n \ln X_{nt} + (V_{nt} + U_{nt}) \quad \text{----------} \quad (5)$$

Translog: $$\ln Y_{it} = \beta_1 + \Sigma\, \beta_n \ln X_{nt} + \frac{1}{2}\Sigma\, \Sigma\, \beta_{nm} \ln X_{nt} \ln X_{mt} + (V_{nt} + U_{nt}) \quad (6)$$

The U_{nt} is ≥ 0; thus implying that the cost efficiency is a function of the cost that was efficiently utilised by the firm. Where the cost efficiency estimate is 0.6; this implies that 40% of the firm's cost can be reduced if it operates along the frontier line.

The debate on the efficacy of either of the above two functions seems not fully settled. However most of the literature supports the use of the translog function as it is deemed to be capable of explaining the model better than the Cobb-Douglas function (Duffy and Papageorgiou (2000)). Nonetheless, we shall estimate the two functions and also examine which of them explains the variability occasioned by inefficiency better.

Methodology

In this paper, we use the SFA methodology to estimate the efficiency frontier. We shall be estimating the cost function and assume that the errors exhibit half normal distribution. Both the Cobb-Douglas and the Translog methodologies will be estimated and a decision made about which of the methods best explains the model.

Following Sealey and Lindley (1977), we use the intermediation approach that assumes bank deposits are inputs in the operational cycle. The model to be estimated involves a three output and three input variables. The variables used for the estimation follow the definition of Hollo & Nagy (2006). The input variables are labour, capital and cost of borrowed funds while the output variables are loans, other earning assets and non interest income. Unlike the approach of Hollo & Nagy, we separate the output variables and estimate the model with each of the output variables. The model is also varied with the inclusion of some variables that are country specific and may likely affect the level of the efficiency as postulated by Battese & Coelli (1995) and Hollo & Nagy (2006). The Cobb-Douglas and Translog models to be estimated are stated in equations 7 and 8 below:

$$Y_{it} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + V_{it} + U_{it} \quad \text{----------} \quad (7)$$

$$Y_{it} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + 0.5\beta_5 X_1^2 + 0.5\beta_6 X_2^2 + 0.5\beta_7 X_3^2 + 0.5\beta_8 X_4^2 + \beta_9 X_1 X_2 + \beta_{10} X_1 X_3 + \beta_{11} X_1 X_4 + \beta_{12} X_2 X_3 + \beta_{13} X_2 X_4 + \beta_{14} X_3 X_4 + V_{it} + U_{it} \quad \text{-----} \quad (8)$$

Where:

Y_{it} is the logarithm of Total Cost for the firms (banks); X_1 is the logarithm of output (total loans; other earning assets; other operating income); X_2 is the cost of labour (wages); X_3 is the firm's capital and X_4 represents the cost of borrowed funds.

To examine the level of inefficiency, the U_{it} is modelled as a half normally distributed random variable that can be influenced by some macro-economic variables. Similar to the input and output variables, these macro-economic variables follow the definition of Hollo & Nagy (2006) and they are inflation (INF), private sector credit as a percentage of GDP (PSCRGDP), liquid liabilities as a percentage of GDP (LLY) and domestic bank assets as a percentage of GDP (DBAGDP). All the macro-economic

variables are obtained from Beck et al (2000) database. Thus the technical efficiency equation is:

$$U_{it} = \delta_0 + \delta_1 PSCRGDP_{it} + \delta_2 DBAGDP_{it} + \delta_3 LLY_{it} + \delta_4 INF_{it} + W_{it}$$

Where: -

PSCRGDP is Private Sector Credit by the Deposit Money Banks as a percentage of GDP

DBAGDP is Domestic Bank Assets as a percentage of GDP

LLY is Liquid Liabilities as a percentage of GDP and

INF is Inflation Rate

These variables are not logged in the regression because they are being expressed as a ratio by definition.

Data – Definition and Summary Result

The bank specific data used for this study are obtained from BankScope. The data covers forty-seven African countries. Data obtained are in respect of banks classified as commercial bank by the database. This data are all transformed to dollar value using the exchange rate obtained from the IFS. Data for the macro-economic variables were obtained from Beck et al database. In the study, and following the intermediation approach which assumes that bank deposits are output, similar to Sealey and Lindley, we adopt a multi output model, but introduced the outputs into the model one after the other. This implies that each model contains one output used for the estimation.

The three outputs employed in the analysis are: - Loans, Other Earning Assets and Other Operating Income. These variables are used as defined by datascope. The input and netput variables are Labour, Physical Capital and Cost of Funds. Labour data is obtained by expressing personnel expenses as a ratio of total assets. The Physical Capital is obtained by expressing the difference between non-interest expenses and personnel expenses as a ratio of total assets. Lastly, cost of funds is obtained by expressing interest expenses as a ratio of total deposit. The dependent variable is total cost which is obtained from the addition of interest expenses and non-interest expenses (including personnel expenses). All the variables are transformed to their logarithmic level for the estimation.

In total about three hundred and twenty nine banks are involved in the analysis from forty-seven African countries (comprising of medium and low income). From the summary statistics (Appendix Table 2), it shows that the

variables are widely dispersed from each other. This for all the variables average about 6.0 as shown by the minimum and maximum values. This feature is not unexpected because of the wide disparity in the income level of the countries included in this study. Nonetheless, the variables exhibit normality with the Jarque-Bera result.

Analysis and Interpretation

As earlier mentioned, three outputs and three input/netput variables were employed in this analysis along with four macro-economic variables. It has also been stated earlier that the output variables will be used one after the other for the estimation, thus implying three different estimations for the three outputs. The SFA methodology is applied. In agreement with the previous studies, the Cobb-Douglas approach was found not to be able to define the model as the translog approach, thus the approach was dropped in favour of the translog approach. The main result for the estimation is presented below.

Table: - 1 Estimation Output for Cost Efficiency for African Countries 1998 – 2007

Bank Specific Variables	Regression 1	Regression 2	Regression 3
Constant	-0.11*** (0.01)	-0.15*** (0.01)	-0.11*** (0.01)
Loans	0.44*** (0.02)		
Other Earnings		0.47*** (0.02)	
Other Operating Income			0.41*** (0.02)
Labour	-0.08*** (0.02)	-0.05** (0.02)	-0.10*** (0.02)
Physical Capital	0.24*** (0.03)	0.04 (0.03)	0.05 (0.03)
Cost of Funds	-0.07*** (0.03)	-0.12*** (0.03)	0.15*** (0.02)
Half Square of Loans	0.15*** (0.01)		
Half Square of Other Earnings		0.07*** (0.01)	
Half Square of Other Operating Income			0.11*** (0.01)
Half Square of Labour	-0.04*** (0.01)	-0.04*** (0.01)	-0.05*** (0.01)
Half Square of Physical Capital	-0.03 (0.02)	-0.03 (0.02)	-0.07*** (0.02)
Half Square of Cost of Funds	-0.05*** (0.01)	-0.09*** (0.01)	-0.02*** (0.01)
Loans *Labour	-0.00 (0.01)		
Other Earnings*Labour		-0.02*** (0.01)	
Other Operating Income*Labour			-0.02** (0.01)
Loans *Physical Capital	0.00 (0.01)		
Other Earnings* Physical Capital		0.05*** (0.01)	
Other Operating Income* Physical Capital			0.05*** (0.01)
Loans * Cost of Funds	-0.01 (0.01)		
Other Earnings* Cost of Funds		-0.04*** (0.01)	
Other Operating Income* Cost of Funds			-0.07*** (0.01)
Labour* Physical Capital	0.04*** (0.01)	0.03*** (0.01)	0.04*** (0.01)
Labour* Cost of Funds	-0.02*** (0.01)	-0.02*** (0.01)	-0.03*** (0.01)
Physical Capital * Cost of Funds	0.06*** (0.01)	0.05*** (0.01)	0.07*** (0.01)
EFFICIENCY RESULT			
Economy Specific Variables	Regression 1	Regression 2	Regression 3
Constant	-0.82*** (0.07)	-1.19*** (0.16)	-5.46*** (0.17)

Private Sector Credit as % of GDP	**-5.99*** (0.57)**	**-1.98*** (0.32)**	**-3.78*** (0.63)**
Domestic Bank Assets as a % of GDP	**2.43*** (0.28)**	**6.23*** (0.72)**	**8.82*** (0.82)**
Liquid Liabilities as a % of GDP	**-0.27 (0.28)**	**4.82*** (0.60)**	**4.28*** (0.28)**
Inflation	**0.00*** (0.00)**	**-0.00*** (0.00)**	**0.01*** (0.00)**
σ2	**0.25*** (0.01)**	**0.33*** (0.02)**	**0.60*** (0.02)**
γ	**0.74*** (0.01)**	**0.76*** (0.02)**	**0.92*** (0.00)**
Log likelihood	**-506.86**	**-912.22**	**-254.55**
Likelihood ratio test	**388.22**	**209.31**	**582.04**

A perusal of the result shows that the high level of the likelihood ratio test is high. It suggests that the model is properly specified. This is further buttressed by both σ2 (sum of variances) and γ (variance of inefficiency term over sum of variances) which are both jointly highly significant. This may thus be interpreted that the model is well formulated. It also implies that both σ2 and γ are important in the determination of cost efficiency for the banks in Africa. The gamma (γ) of 0.92 is highest for the model with other operating income as the output variable. This means that these banks are highly efficient with costs in determining their operating income. Next to that is the model with other earnings as the output variable which has 0.76 for gamma. This figure is very close to that of 0.74 for the model with loans as the output variable. What this implies is that inefficiency ranges between 24 to 26% of cost for the industry. This better expressed means that between 24-26% of cost expended by the banks could be avoided if the sector operates along the efficient frontier. This finding is consistent with the view of Chen (2009) who observed about 20-30% cost inefficiency for banks in the Sub-Saharan Middle-Income Countries. It is also consistent with the observation of Ikhide (2009) when he opined that banks in Namibia still have economies that can be exploited by an increase in the size of the larger banks. According to him, though these banks are operating at the declining portion of their of their average cost curve, they have not reached their optimum size where their operating costs are lowest. In essence, they are not yet operating along the frontier line.

All the macro-economic variables included in the study are deemed to be important in determining the efficiency of the banking sector. Except for liquid liabilities which is not significant when loans is used as the output variable, others are significant at 1%. This also affirms that the macro-economic variables are very germane to efficiency of the sector. The non-significance of liquid liabilities is not totally unexpected as it does

not enhance the sector when funds are basically outside the coffers of the bank. Though a common feature with the developing countries, it is proving not to aid efficiency hence the situation needs to be addressed from a cash carrying economies that are in developing countries to cash-less country typified by the developed/advanced economies.

The sign of the coefficient for private sector credit as a percentage of GDP is negative. This implies that increases in total cost reduce private sector credit expressed as a ratio of GDP. This is expected, but could be a major source of inefficiency, as banks in the developing economies charge higher costs which may put off credible investor from embarking on a good proposal. Another observation is labour which also has a negative coefficient. This runs contrary to expectation as one would expect a positive relationship between total cost and labour cost. This is not the case. A perusal of these countries reveals that the cost of labour is very cheap thus; it may suggest a reduction with increases in operational activities. This is a bane to banking services and may make it difficult to attract the right calibre of staff that will deliver the efficient services so much desired in these economies. All the other signs are as expected in the study.

One of the major arguments in literature is that the level of income of a country plays some role in the level of efficiency of the financial system. In view of this, we estimated the cost function based on the two main income levels within the continent i.e. medium or low. The result of this estimation is reported in the appendix tables 3, 4 and 5. The result presented in table 3 represents the output when loans is used as the output variable for all the countries included in the study (earlier presented above), the medium income countries and low income countries. This approach is adopted to facilitate comparison amongst the different types of combination included in the analysis. The same procedure is adopted for the other output variables used in this study with their result presented in tables 4 and 5 in the appendix.

When bank loan is the output variable, the likelihood ratio test affirms the joint significance of the sum of variance ($\sigma 2$) and gamma (γ). Both $\sigma 2$ and γ are significant for the three estimations. This posits that efficiency is important for these banks. The efficiency level for the medium income countries which is 0.94 is significantly higher than 0.74

obtained for all the countries. The efficiency level for the low income countries is very low at 0.11. This implies that banks in medium income countries are far more efficient than the low income countries. It also suggests that while inefficiency in the medium income economies is limited to below 10% that of low income countries is as high as possibly 90%. Domestic bank assets as a percentage of GDP has a negative coefficient for the low income countries, possibly suggesting poor asset base by the financial institutions in these countries.

A previous submission in this paper is that there seems to be a positive correlation between income level and the various proxies for financial development earlier discussed. This result therefore reinforces that assertion and suggests that the poor level of development of the financial sector in the low income economies is a major factor for inefficiency. This result therefore suggest that efficiency is important for banks in Africa (including medium and low income countries), but the current level of efficiency in the low income countries is extremely poor. The result did not make any appreciable difference when other earnings are used as the output variable. Rather, the coefficient for gamma (γ) for low income countries is not significant. Other variables follow similar line of discussion as enumerated above for all the countries result. The same observation is made when other operating income is introduced as the output variable.

From these result, it is possible to postulate that bank loans is a better output variable than the other two output variables. Despite the poor level of the development of the financial sector in the low income economies, use of bank loans still produced some level of significance for the measure of inefficiency (gamma - γ). It is able to explain efficiency in cost estimation function more than the other output variables. The study also suggests that the model is responsive to the definition of the output variable included in the study.

Conclusion

This study has examined the level of efficiency of banks in African continent over ten years. The SFA methodology was used while the countries were divided according to the level of income of the respective countries. The work involves use of three output variables and three input/netput

variables. The output variables were introduced individually into the model, thus a total of nine estimations were involved when the country income categorisation in included. The translog function estimated shows that the level of inefficiency of the financial sector ranges from about 10-26%. When the countries were divided according to the income classification of the countries, it was observed that much of the inefficiency within the continent is attributable to the low income countries. The efficiency of the medium income countries is even higher than the average within the continent.

Much of the inefficiency within the continent could be attributed to poor intermediation and possibly low skilled people. This is because the labour cost was small and has negative correlation with total cost. Similarly, the macro-economic variable proxied by private sector credit expressed as a percentage of GDP also carries a negative coefficient. This may be a pointer to possible under development of the sector. An assertion buttressed by the positive correlation between the various proxies for financial development and income classification.

An observation from this study is that the level of intermediation to the private sector by these banks is the main issue accounting for inefficiency. This is coupled with the seeming under development of the capital market; which places a lot of reliance on the money market. Where inefficiency exists, it is bound to have serious impact on the economies. Banks in Africa, mostly those in the low income countries should be poised to eliminate inefficiency through reduction in cost of banking transactions and by ensuring good level of intermediation mostly for the real sector of their economies.

References

BAKER, R. D., CHARNES, A. and COOPER, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. Management Science, 30: 1078-1092.

BATTESE, G. E. and COELLI, T. J. (1995). A model for technical inefficiency effects in a stochastic frontier production function for panel data. Empirical Economics, 30: 325-332

BAUER, P., BERGER, A. and HUMPHREY, D. (1992). Efficiency and productivity growth in US banking. In H. O. Fried, C. A. K Lovell and P. Schmidt (eds), The Measurement of Productivity Efficiency; Techniques and Applications. Oxford: Oxford University Press, 386-413.

BERGER, A. N. and DE YOUNG, R. (1997). Problem loans and cost efficiency in commercial bands. Journal of Banking and Finance, 21: 849-870.

BERGER, A. and HUMPHREY, D. (1997). Efficiency of Financial Institutions: International Survey and Directions for future Research. Journal of Operations Research, Special issue on New Approaches in Evaluating the Performance of Financial Institutions.

BERGER, A. N., LEUSNER, J. H. and MINGO, J. J. (1997). The Efficiency of Bank Branches. Journal of Monetary Economics, vol. 40, pp141-162.

BERGER, A. N., HASAN, I. and KLAPPER, L. F. (2004). Further Evidence on the link between Finance and Growth: An International Analysis of Community Banking and Economic Performance. Bank of Finland Discussion Papers.

CLAESSENS, S. and LAEVEN, I. (2004). What Drives Bank Competition? Some International Evidence. Journal of Money, Credit and Banking, 36: 563-583.

CHARNES, A., COOPER, W. W. and RHODES, E. (1978). Measuring the efficiency of decision making units. European Journal of Operational Research, 6: 429-444.

CHEN, C. (2009) Bank Efficiency in Sub-Saharan African Middle-Income Countries. IMF Working Paper No. 14

COELLI, T. J. (1996) A GUIDE TO Frontier Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation. CEPA Working Paper

DEMIRGUC-KUNT, A., LAEVEN, L. and LEVINE, R. (2003) Regulations, Market Structure, Institutions and the Cost of Financial Intermediation. National Bureau of Economic Research Working Paper 9890.

FERRIER, G. D. and LOVELL, C. A. K. (1990). Measuring cost efficiency in banking; econometric and linear programming evidence. Journal of Econometrics, 46: 229-245.

FIELDS, J. A., MURPHY, N. B. and TIRTIROGLU, D. (1993). An international comparison of scale economies in banking; evidence from Turkey. Journal of Financial Services Research, 7: 111-125.

HAUNER, D. (2005) Explaining Efficiency differences among large German and Austrian banks. Journal of Applied Economics, 37:9, pp 969-980.

HIRSHLEIFER, J. and GLAZER, A. (1993). Price Theory and Applications, 5th edn. New Delhi, Prentice-Hall of India.

HOLLO, D. and NAGY, M. (2006). Bank efficiency in the enlarged European Union. Bank for International Settlement, vol. 26, part 13: 217-235.

HOWARD, M. and HAYNES, H. (2001). Commercial banks efficiency in Barbados. Savings and Development, 25, No. 3

IKHIDE, S. (2009). Measuring the Operational Efficiency of Commercial Banks in Namibia. South African Journal of Economics, vol. 76, issue 4: 586-595.

IMF (2007). Namibia: Financial system Stability Assessment. IMF Country Report No. 07/83. IMF, Washington, DC.

JEMRIĆ, I. and VUJČIĆ, B. (2002). Efficiency of banks in Croatia: A DEA approach. Comparative Economic Studies, 44: 169-193.

KENNY, C. J. and MOSS, T. J. (1998). Stock market in Africa: Emerging lions or white elephant? World Development, 26: 829-843.

KNELLER, R. and STEVENS, P. A. (2003). The specifications of the aggregate production function in the presence of inefficiency. Economic Letters, 8: 223-226

LEIBENSTEIN, H. (1966). Allocative Efficiency versus 'X-efficiency'. American Economic Review, Dec., pp. 1252-1258.

MAGGI, B. and ROSSI, S. P. S. (2003). An Efficiency Analysis of banking systems: A Comparison of European and United States large Commercial Banks using different Functional Forms. Working Paper no 03-35, European Integration, Financial Systems and Corporate Performance (EIFC) Consortium, the United Nations University, Institute for New Technologies, Maastricht.

MCALLISTER, P. H. and MCMANUS, D. A. (1993). Resolving the scale efficiency puzzle in banking, Journal of Banking and Finance, 17: 389-405.

TIMME, S. G. and YANG, W. K. (1991). On the Use of a Direct Measure of Efficiency in Testing Structure-Performance Relationships, Working Paper. (Georgia State University).

SEALEY, C. W. and LINDLEY, J. T. (1977) Inputs, Outputs and a Theory of Production and Cost at Depository Financial Institutions. The Journal of Finance, vol. 32, No. 4, pp 1251-1266.

VITTAS, D. (1991). Measuring Commercial Bank Efficiency Policy Research Working Papers Series, Country Economic Development, The World Bank, Washington DC, November.

Appendix

Table 2: - SUMMARY STATISTICS FOR BANK RELATED VARIABLES IN AFRICA 1998-2007

	Cost of Funds	Labour Expenses	Loans	Other Earning Assets	Other Operating Income	Physical Capital	Total Cost
Mean	-2.069584	-1.923398	1.388486	1.320778	1.585620	-1.111629	0.852289
Median	-1.950000	-1.815000	1.540000	1.410000	1.810000	-0.550000	0.790000
Maximum	1.460000	0.240000	5.130000	4.560000	5.160000	1.940000	4.220000
Minimum	-5.870000	-5.730000	-1.270000	-2.340000	-1.090000	-4.950000	-2.190000
Std. Dev.	1.860275	1.922261	1.111192	1.092999	1.197881	1.364079	0.818200
Jarque-Bera	314.3834	383.9860	100.1855	77.38347	122.0155	264.9735	190.9857
Observations	3290	3290	3290	3290	3290	3290	3290

Table 3: - Estimation Output for Cost Efficiency with Loans as Output Variable for African Countries 1998 – 2007

Bank Specific Variables/Country Combination	All Countries	Medium Income	Low Income
Constant	-0.11*** (0.01)	-0.17*** (0.01)	-0.13*** (0.03)
Loans	0.44*** (0.02)	0.28*** (0.03)	0.24*** (0.03)
Labour	-0.08*** (0.02)	-0.05 (0.04)	-0.21*** (0.02)
Physical Capital	0.24*** (0.03)	0.19*** (0.08)	0.23*** (0.03)
Cost of Funds	-0.07*** (0.03)	-0.19*** (0.05)	-0.01 (0.03)
Half Square of Loans	0.15*** (0.01)	0.08*** (0.01)	0.28*** (0.02)
Half Square of Labour	-0.04*** (0.01)	-0.09*** (0.02)	-0.05*** (0.01)
Half Square of Physical Capital	-0.03 (0.02)	-0.14*** (0.03)	0.05*** (0.02)
Half Square of Cost of Funds	-0.05*** (0.01)	-0.05*** (0.02)	-0.05*** (0.01)
Loans *Labour	-0.00 (0.01)	-0.05*** (0.01)	0.02** (0.01)
Loans *Physical Capital	0.00 (0.01)	0.06*** (0.02)	0.01 (0.01)
Loans * Cost of Funds	-0.01 (0.01)	-0.13*** (0.01)	-0.04*** (0.01)
Labour* Physical Capital	0.04*** (0.01)	0.16*** (0.01)	-0.01 (0.01)
Labour* Cost of Funds	-0.02*** (0.01)	-0.08*** (0.01)	-0.01** (0.01)
Physical Capital * Cost of Funds	0.06*** (0.01)	0.00 (0.02)	0.07*** (0.01)
EFFICIENCY RESULT			
Economy Specific Variables	All Countries	Medium Income	Low Income
Constant	-0.82*** (0.07)	-2.31*** (0.29)	0.09** (0.04)
Private Sector Credit as % of GDP	-5.99*** (0.57)	-7.86*** (0.96)	-1.40*** (0.57)
Domestic Bank Assets as a % of GDP	2.43*** (0.28)	6.23*** (0.84)	0.45 (0.32)
Liquid Liabilities as a % of GDP	-0.27 (0.28)	-3.33*** (0.54)	0.08 (0.16)
Inflation	0.00*** (0.00)	0.00*** (0.00)	0.01*** (0.00)
$\sigma 2$	0.25*** (0.01)	0.77*** (0.07)	0.06*** (0.00)
γ	0.74*** (0.01)	0.94*** (0.01)	0.11** (0.05)
Log likelihood	-506.86	-282.07	76.44
Likelihood ratio test	388.22	355.44	126.67

Standard error in parenthesis while ***, ** and * denotes 1%, 5% and 10% level of significance

Table 4: - Estimation Output for Cost Efficiency with Other Earnings as Output Variable for African Countries 1998 – 2007

Bank Specific Variables/Country Combination	All Countries	Medium Income	Low Income
Constant	-0.15*** (0.01)	-0.20*** (0.02)	-0.13*** (0.02)
Other Earnings	0.47*** (0.02)	0.33*** (0.03)	0.26*** (0.03)
Labour	-0.05** (0.02)	-0.01 (0.05)	-0.16*** (0.03)
Physical Capital	0.04 (0.03)	-0.19*** (0.08)	0.11*** (0.03)
Cost of Funds	-0.12*** (0.03)	-0.27*** (0.06)	-0.07*** (0.03)
Half Square of Other Earnings	0.07*** (0.01)	0.05*** (0.02)	0.22*** (0.02)
Half Square of Labour	-0.04*** (0.01)	-0.07*** (0.02)	-0.04*** (0.01)
Half Square of Physical Capital	-0.03 (0.02)	-0.04 (0.04)	0.02 (0.02)
Half Square of Cost of Funds	-0.09*** (0.01)	-0.12*** (0.02)	-0.07*** (0.01)
Other Earnings*Labour	-0.02*** (0.01)	-0.03** (0.01)	-0.01* (0.01)
Other Earnings* Physical Capital	0.05*** (0.01)	0.07*** (0.02)	0.02 (0.02)
Other Earnings* Cost of Funds	-0.04*** (0.01)	-0.10*** (0.02)	-0.03*** (0.01)
Labour* Physical Capital	0.03*** (0.01)	0.07*** (0.02)	-0.00 (0.01)
Labour* Cost of Funds	-0.02*** (0.01)	-0.02 (0.01)	-0.02*** (0.01)
Physical Capital * Cost of Funds	0.05*** (0.01)	-0.06*** (0.02)	0.06*** (0.01)
EFFICIENCY RESULT			
Economy Specific Variables	All Countries	Medium Income	Low Income
Constant	-1.19*** (0.16)	-1.20*** (0.26)	0.09*** (0.01)
Private Sector Credit as % of GDP	-1.98*** (0.32)	-2.90*** (0.62)	2.54*** (0.27)
Domestic Bank Assets as a % of GDP	6.23*** (0.72)	7.70*** (1.28)	-1.46*** (0.28)
Liquid Liabilities as a % of GDP	4.82*** (0.60)	-6.21*** (1.02)	-0.21 (0.13)
Inflation	-0.00*** (0.00)	-0.01*** (0.00)	0.00*** (0.00)
$\sigma 2$	0.33*** (0.02)	0.53*** (0.07)	0.06*** (0.00)
γ	0.76*** (0.02)	0.83*** (0.03)	0.00 (0.00)
Log likelihood	-912.22	580.71	-52.09
Likelihood ratio test	209.31	164.18	111.46

Standard error in parenthesis while ***, ** and * denotes 1%, 5% and 10% level of significance

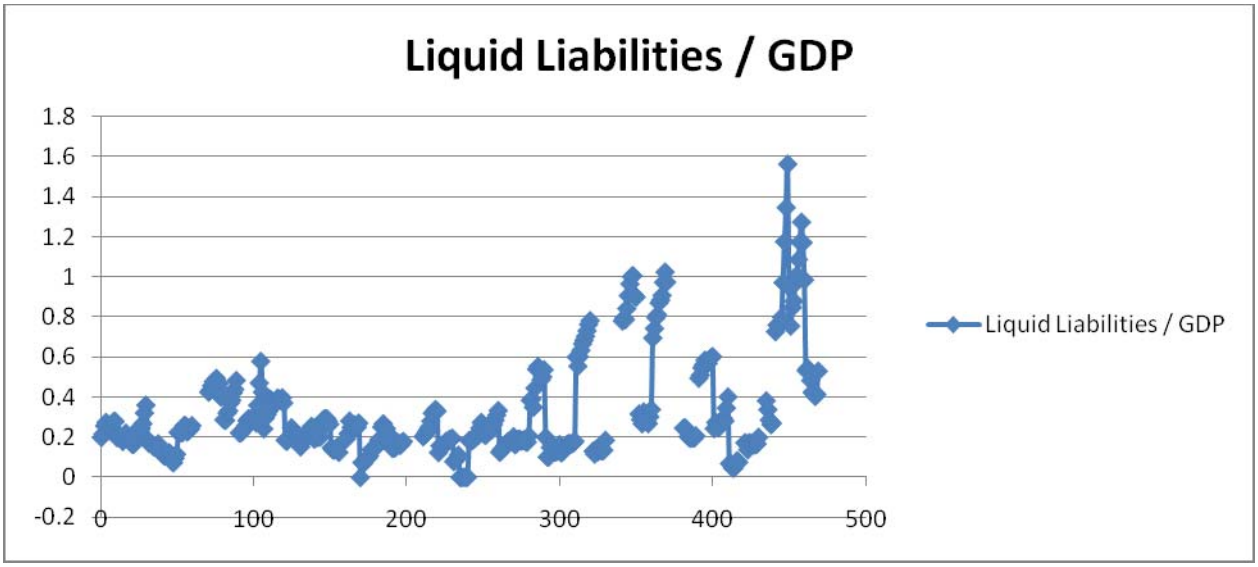
Table 5: - Estimation Output for Cost Efficiency with Other Operating Income as Output Variable for African Countries 1998 – 2007

Bank Specific Variables/Country Combination	All Countries	Medium Income	Low Income
Constant	-0.11*** (0.01)	-0.18*** (0.01)	-0.17*** (0.04)
Other Operating Income	0.41*** (0.02)	0.28*** (0.03)	0.11*** (0.03)
Labour	-0.10*** (0.02)	-0.04 (0.05)	-0.25*** (0.02)
Physical Capital	0.05 (0.03)	-0.12 (0.09)	0.21*** (0.03)
Cost of Funds	0.15*** (0.02)	-0.00*** (0.06)	0.07*** (0.02)
Half Square of Other Operating Income	0.11*** (0.01)	0.05*** (0.02)	0.28*** (0.02)
Half Square of Labour	-0.05*** (0.01)	-0.06*** (0.02)	-0.04*** (0.01)

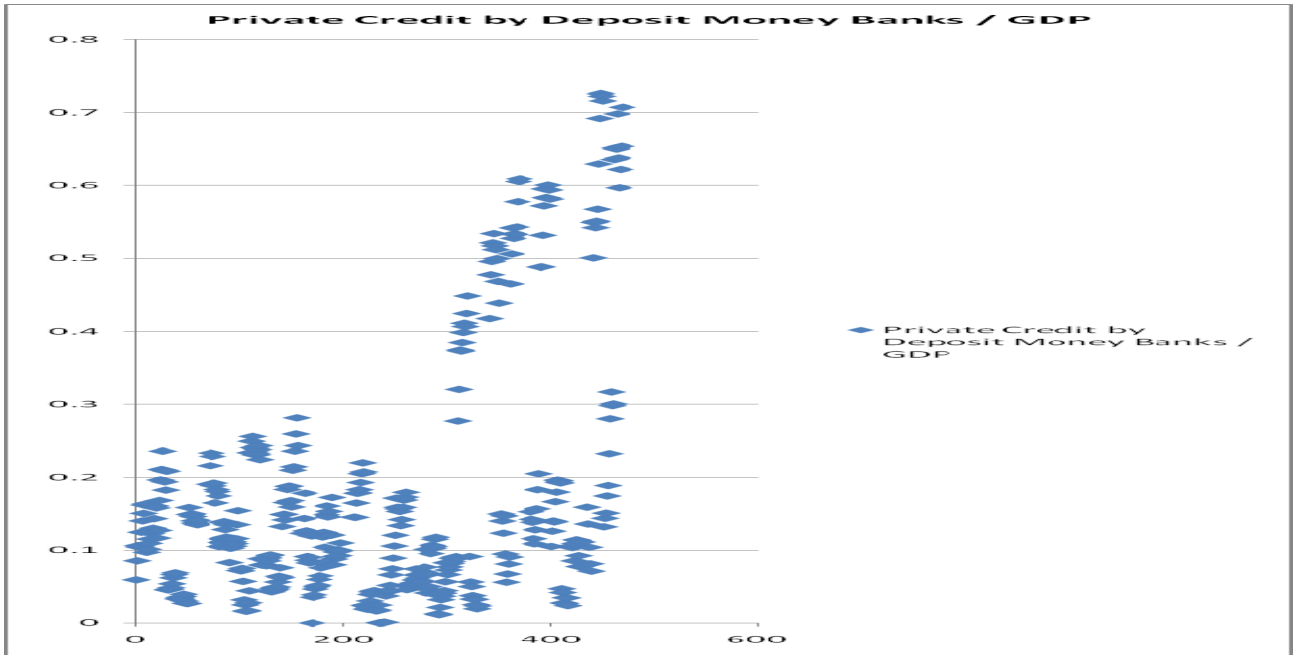
Half Square of Physical Capital	**-0.07*** (0.02)**	**-0.13*** (0.03)**	**0.03** (0.02)**
Half Square of Cost of Funds	**-0.02*** (0.01)**	**-0.09*** (0.02)**	**-0.05*** (0.01)**
Other Operating Income*Labour	**-0.02** (0.01)**	**-0.04*** (0.01)**	**0.01* (0.01)**
Other Operating Income* Physical Capital	**0.05*** (0.01)**	**0.11*** (0.03)**	**0.01 (0.01)**
Other Operating Income* Cost of Funds	**-0.07*** (0.01)**	**-0.18*** (0.02)**	**-0.07*** (0.01)**
Labour* Physical Capital	**0.04*** (0.01)**	**0.12*** (0.02)**	**-0.01 (0.01)**
Labour* Cost of Funds	**-0.03*** (0.01)**	**-0.06*** (0.01)**	**-0.02*** (0.00)**
Physical Capital * Cost of Funds	**0.07*** (0.01)**	**0.00*** (0.02)**	**0.07*** (0.01)**
EFFICIENCY RESULT			
Economy Specific Variables	**All Countries**	**Medium Income**	**Low Income**
Constant	**-5.46*** (0.17)**	**-1.52*** (0.20)**	**0.15*** (0.04)**
Private Sector Credit as % of GDP	**-3.78*** (0.63)**	**-3.85*** (0.53)**	**0.38* (0.22)**
Domestic Bank Assets as a % of GDP	**8.82*** (0.82)**	**7.65*** (0.95)**	**0.07 (0.21)**
Liquid Liabilities as a % of GDP	**4.28*** (0.28)**	**-5.74*** (0.73)**	**-0.36*** (0.10)**
Inflation	**0.01*** (0.00)**	**0.00 (0.00)**	**0.01*** (0.00)**
σ2	**0.60*** (0.02)**	**0.53*** (0.04)**	**0.04*** (0.00)**
γ	**0.92*** (0.00)**	**0.90*** (0.01)**	**0.00 (0.06)**
Log likelihood	**-254.55**	**-313.94**	**319.66**
Likelihood ratio test	**582.04**	**351.97**	**71.39**

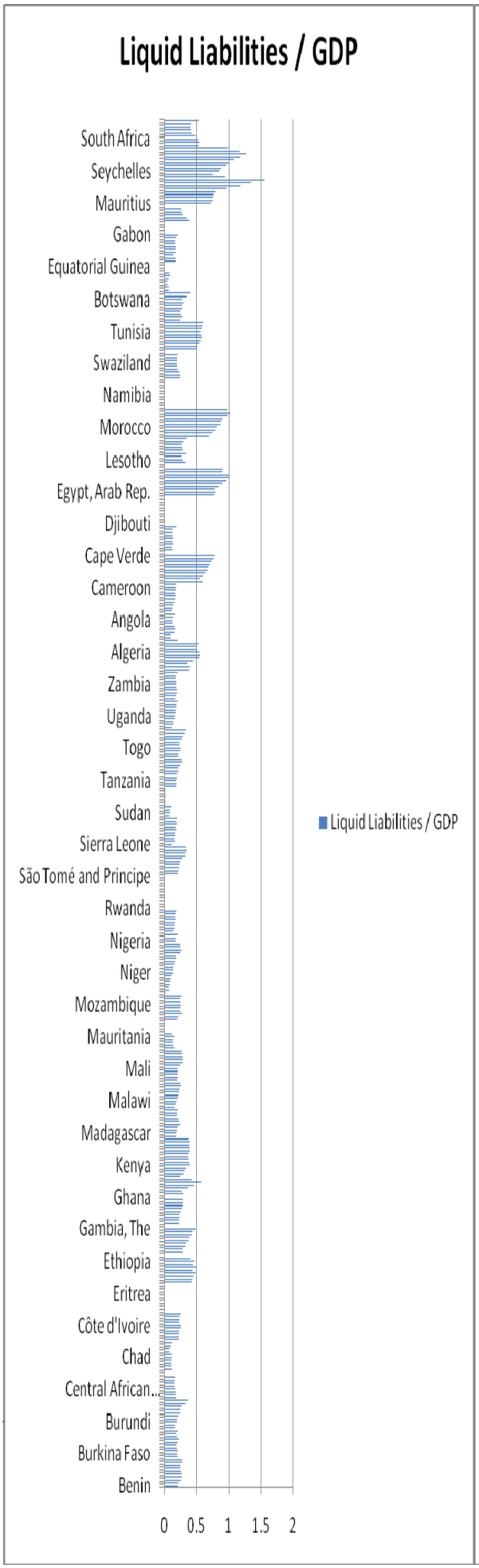
Standard error in parenthesis while ***, ** and * denotes 1%, 5% and 10% level of significance

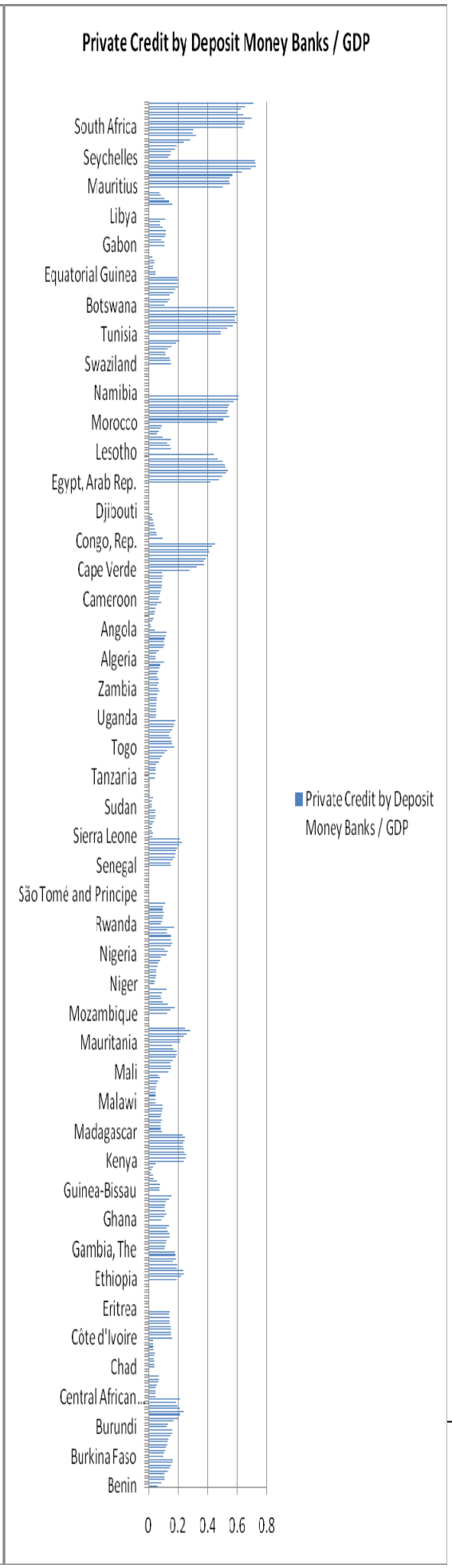
Plot 1

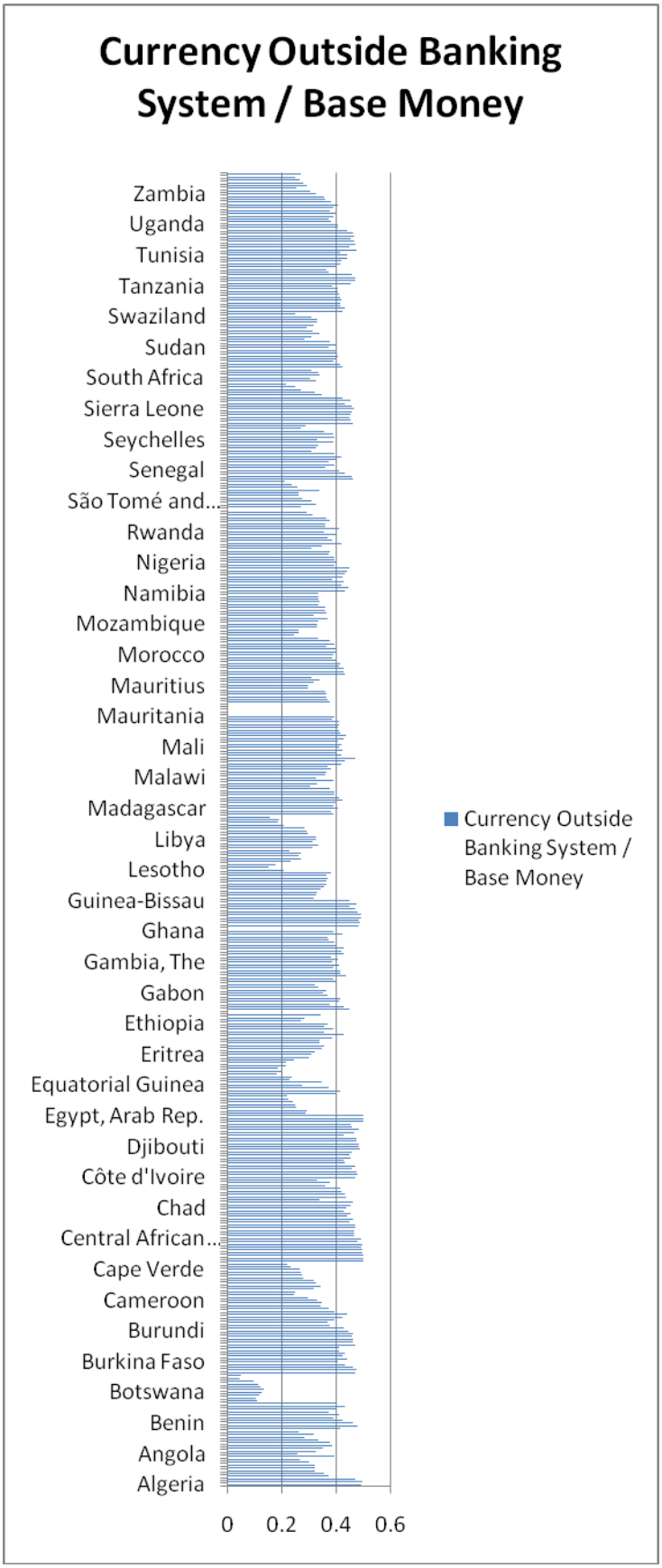


Plot 2


Private Credit by Deposit Money Banks / GDP
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
200
400
600
Private Credit by Deposit Money Banks / GDP


Liquid Liabilities / GDP
South Africa
Seychelles
Mauritius
Gabon
Equatorial Guinea
Botswana
Tunisia
Swaziland
Namibia
Morocco
Lesotho
Egypt, Arab Rep.
Djibouti
Cape Verde
Cameroon
Angola
Algeria
Zambia
Uganda
Togo
Tanzania
Sudan
Sierra Leone
São Tomé and Principe
Rwanda
Nigeria
Niger
Mozambique
Mauritania
Mali
Malawi
Madagascar
Kenya
Ghana
Gambia, The
Ethiopia
Eritrea
Côte d'Ivoire
Chad
Central African...
Burundi
Burkina Faso
Benin
0
0.5
1
1.5
2
Liquid Liabilities / GDP


Private Credit by Deposit Money Banks / GDP
South Africa
Seychelles
Mauritius
Libya
Gabon
Equatorial Guinea
Botswana
Tunisia
Swaziland
Namibia
Morocco
Lesotho
Egypt, Arab Rep.
Djibouti
Congo, Rep.
Cape Verde
Cameroon
Angola
Algeria
Zambia
Uganda
Togo
Tanzania
Sudan
Sierra Leone
Senegal
São Tomé and Principe
Rwanda
Nigeria
Niger
Mozambique
Mauritania
Mali
Malawi
Madagascar
Kenya
Guinea-Bissau
Ghana
Gambia, The
Ethiopia
Eritrea
Côte d'Ivoire
Chad
Central African...
Burundi
Burkina Faso
Benin
0
0.2
0.4
0.6
0.8
Private Credit by Deposit Money Banks / GDP


Currency Outside Banking System / Base Money
Zambia
Uganda
Tunisia
Tanzania
Swaziland
Sudan
South Africa
Sierra Leone
Seychelles
Senegal
São Tomé and...
Rwanda
Nigeria
Namibia
Mozambique
Morocco
Mauritius
Mauritania
Mali
Malawi
Madagascar
Libya
Lesotho
Guinea-Bissau
Ghana
Gambia, The
Gabon
Ethiopia
Eritrea
Equatorial Guinea
Egypt, Arab Rep.
Djibouti
Côte d'Ivoire
Chad
Central African...
Cape Verde
Cameroon
Burundi
Burkina Faso
Botswana
Benin
Angola
Algeria
0
0.2
0.4
0.6
Currency Outside Banking System / Base Money