Global Scientific JOURNALS

GSJ: Volume 8, Issue 6, June 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

Exploring the Operational Efficiency of Commercial Banks in Zambia

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ABSTRACT

Zambia's central bank – Bank of Zambia (BOZ) - has reported that the banking sector has been satisfactory in its performance and conduct, it has relied on financial ratio analysis, an approach which has been found to be inadequate in many aspects. Financial ratio analysis as a measure of efficiency can be considered problematic and rigid and may also fail to account for environmental and broad institutional factors as drivers of efficiency and performance. It also fails to differentiate between the different types of efficiency such as scale and x-efficiency. To circumvent these weaknesses, this study adopted a flexible and heuristic approach – the stochastic frontier approach – to unpack and define efficiency in terms of its operational meaning. A Tobit regression was undertaken to establish the determinants of efficiency as well as to investigate quantitatively the internal and external factors which underpin and drive efficiency in the banking sector.

The study found that commercial banks in Zambia for the study period were inefficient of order of 10.3%. This suggests that, for the Zambian banking industry as a whole, mismanagement of resources may be an impediment to desirable performance. The Tobit regression revealed that foreign owned banks were on average more efficient than domestic banks, it also revealed that bank inefficiency in the Zambian banking sector was underpinned by bank profitability, high Capital adequacy, greater bank liquidity and high percentage of non-performing loans. Inefficiency means that banks are using a costly combination of inputs to produce a feasible level of output.

Keywords: Operational efficiency, X-efficiency, Tobit model, Scale efficiency

INTRODUCTION

The study of the efficiency of commercial banks has gained a lot of popularity in recent times among African countries. First, the efficiency of banks is directly linked to the productivity of the economy. Banking system assets constitute a substantial proportion of total output. Banks provide liquidity, payments and safekeeping for depositors and channel these funds into investment and working capital requirements. Bonds and Stock markets are thin and banks are a major source of intermediation. A basic benefit accompanied by the efficiency of banks is a reduction in spreads between lending and deposit rates. Banks in most developing countries operate with relatively wide spreads.

In Zambia, the Post -independence financial reforms mostly were centred on three main areas: nationalization of foreign financial institutions, establishment of government owned banks , development of finance institutions, and administrative controls over interest rates (Fardi 1991; Jones 1994).The banking system is still dominated by foreign commercial banks as can been seen from the table below depicting the banks ownership operating in Zambia. The table distinguishes bank ownership by varying it between Foreign and Domestic depending on the majority of shareholders.

TABLE 1: CURRENT OWNERSHIP STRUCTURE OF ALL COMMERCIAL BANKS IN ZAMBIA

No.	BANK NAME	TYPE OF OWNERSHIP
1	Access Bank Zambia Limited	FOREIGN
2	Atlas Mara Bank Zambia Limited	DOMESTIC
3	Bank of China Zambia Limited	FOREIGN
4	Barclays Bank of Zambia	FOREIGN
5	Cavmont Bank Limited	FOREIGN
6	Citibank Zambia Limited	FOREIGN
7	Ecobank Zambia Limited	FOREIGN

8	First Alliance Bank Zambia Limited	DOMESTIC
9	First Capital Bank Zambia Limited	FOREIGN
10	First National Bank of Zambia Limited	FOREIGN
11	Indo-Zambia Bank Limited	FOREIGN
12	AB Bank	FOREIGN
13	Investrust Bank Zambia Limited	DOMESTIC
14	Stanbic Bank Zambia Limited	FOREIGN
15	Standard Chartered Bank Zambia Plc	FOREIGN
16	United Bank for Africa Zambia Limited	FOREIGN
17	Zambia Industrial Commercial Bank Limited	FOREIGN
18	Zambia National Commercial Bank Plc	DOMESTIC

Source: Bank of Zambia Official website

This study will establish empirically the operational efficiency of commercial banks in Zambia and identify the key drivers of this efficiency. By so doing the study will make a modest contribution to the stock of knowledge and raise the levels of enlightenment on the subject from the policy making perspective: for the Central Bank and the Management of the respective Banks used in the study.

LITERATURE REVIEW

Both the stochastic frontier and DEA models have received substantial application in the banking efficiency literature. Traditionally, technical efficiency in banking was measured using the production function capturing scale and scope efficiencies. However, technical efficiency is only a component of overall economic efficiency. The slow pace in growth of the bank efficiency literature for Sub-Sahara African Countries is partly due to lack of bank-level data during the control regimes. In the efficiency analysis of Namibian banks, Ikhide (2000; 2008) and Adongo, et al. (2005a; 2005b) reached contrasting conclusions. It is important to point out that the accounting ratios and narrow measures of efficiency such as spreads are only indicative of actual

bank performance and may not provide reliable estimates of banking efficiency (World Bank, 2006).

Foreign banks were found to be more efficient than public and domestic private banks. Chen (2009) also argues that besides macroeconomic stability, bank competition and financial development, institutional factors also explain the differences in bank efficiency for the sample countries. Efficiency indicators also showed wide variations across different bank categories. Finally, they find evidence suggesting that the securities market and nonbank financial institutions hinder bank efficiency.

Pasiouras *et al*. (2007) analyse the cost efficiency of Greek banks and its determinants. The main results indicate that Greek banks operate at an average efficiency of 82%. Furthermore, they found that the size of the bank is positively associated with greater bank efficiency; however, they found that GDP per capita and unemployment influences bank efficiency negatively. Hassan and Sanchez (2007) study the determinants of efficiency and its dynamics on the banking industry in Latin America. Delis and Papanikolaou (2009) study the determinants of bank efficiency in ten newly acceded European countries. They applied a semi-parametric two-stage model to examine the effects of bank-specific, industry specific and macroeconomic variables on bank efficiency. The main results indicate that foreign ownership, market interest rates and GDP growth are positively related to bank efficiency. Afterwards, they applied a Tobit regression to investigate the impact of institutional, financial and bank-specific determinants of bank efficiency. On the other hand they found that highly capitalized banks, greater liquidity, and stock market developments increase bank efficiency; whilst greater credit to the private sector and higher market concentration lowers bank efficiency.

Kalluru and Bhat (2009) examine the determinants of cost efficiency of commercial banks in India for the period 1992- 2006. Tecles and Tabak (2010) study the determinants of bank efficiency in Brazil for the period 2000-2007. They apply a Bayesian Stochastic Frontier in order to obtain the determinants of bank efficiency. The main results suggest that large banks are the most cost and profit efficient alongside foreign owned banks. Furthermore, they found a positive relationship between the degree of capitalization and bank efficiency. Wezel (2010) investigates the efficiency of domestic and foreign banks in Central America for the period 2002-2007. In Mexico, Guerrero and Negrin (2006) analyse the efficiency of the Mexican banking sector for the period 1997-2004. In order to estimate the efficiency scores they applied the Distribution Free Approach (DFA) and obtain measures of X-efficiency and two measures of scale efficiency. Foreign banks take the lead followed by large domestic banks (Aikaeli 2008).

According to Ines Ayadi (2013), studying the determinants of Tunisian Bank Efficiency using Data Envelopment Analysis, it was discovered that market share in Tunisian banks has inverse impact on their efficiency. In conjunction with other studies, Ahmad and Noor (2011) in their study of determinants of Efficiency and profitability of World Islamic banks using the non-parametric Data Envelopment Analysis denoted that bank size and capital adequacy has direct relationship with bank efficiency, while loan intensity gives an indirect relationship, which means banks with higher loan to total asset ratio tends to exhibit lower efficiency level. This research recognizes the work of Kiyota (2009) who studied the efficiency of commercial banks of sub-Saharan Africa: A Comparative analysis of Domestic and Foreign Banks, who used a fraction of Zambian banks in his Sample for his regional efficiency analysis using data obtained from Bank Scope Database.

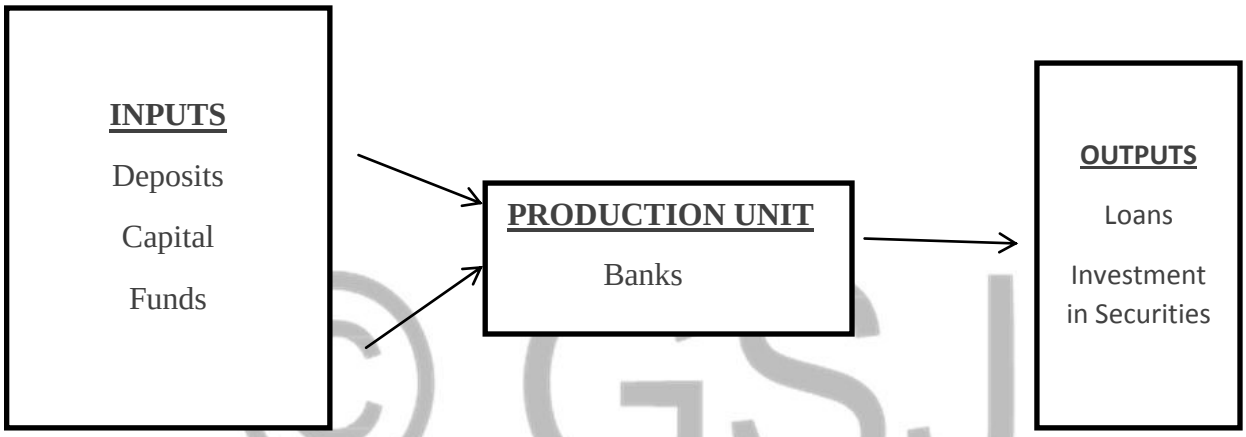
CONCEPTUAL FRAMEWORK

The definition and measurement of inputs and outputs in the banking function remains a contentious issue among researchers. Banks are typically multi-input and multi-output firms. As a result, defining what constitutes 'input' and 'output' is fraught with difficulties, since many of the financial services are jointly produced and prices are typically assigned to a bundle of financial services. Additionally, banks may not be homogeneous with respect to the types of outputs actually produced. To determine what constitutes inputs and outputs of banks, one should first decide on the nature of banking technology. In the banking theory literature, there are two main approaches competing with each other in this regard: the production and intermediation approaches (Sealey and Lindley, 1977).

Under the production approach, a financial institution is defined as a producer of services for account holders, that is, they perform transactions on deposit accounts and process documents such as loans. Hence, according to this approach, the number of accounts or its related transactions is the best measures for output, while the number of employees and physical capital is considered as inputs. Previous studies that adopted this approach are among others by Sherman and Gold (1985), Ferrier and Lovell (1990) and Fried *et al.* (1993). The intermediation approach on the other hand assumes that financial firms act as an intermediary between savers and borrowers and posits total loans and securities as outputs, whereas deposits along with labour and physical capital are defined as inputs. For the purpose of this study, a variation of the intermediation approach or asset approach originally developed by Sealey and Lindley (1977) will be adopted in the definition of inputs and outputs used in equation (2). According to Berger and Humphrey (1997), the production approach might be more suitable for branch efficiency studies, as at most times bank branches basically process customer documents and bank funding,

while investment decisions are mostly not under the control of branches. Furthermore, the intermediat0ion approach has more appeal to a developing country such as Zambia where banks continue to perform the basic function of financial intermediation. Figure 1 below depicts the selection of inputs and outputs that are under the intermediation Approach. As seen in figure 1, banks use the inputs such as deposits, Capital and Funds to produce Loans and Investments in securities.

Figure 1 - Intermediation Process Illustration



Source: Author's drawings adopted from literature

METHODOLOGY

Secondary cross sectional data was sourced from all the respective banks in Zambia through their published bank consolidated financial reports for the quantitative and qualitative study. STATA 13 is the statistical software package used in the analysis of data. It is a fast and multi-purpose data analysis and statistical software with a wide array of estimation and statistical features that apply to both standard and advanced statistical methods and techniques.

According to Greene (1980), the transcendental logarithmic (Trans-log) function is the most frequently selected model to measure bank efficiency because it is a flexible functional form. For

this reason this paper employs a basic multi-product trans-log stochastic cost function. A basic multi-product trans-log is specified and deviations from the cost frontier are estimated based on it. Let total cost for the *n*th banking firm be TC_n, with the measure of its outputs Q_i and input prices P_j. The two-component error term cost function for the firm is

$$\text{In } TC_n = f(Q_i, P_j) + \mathcal{E}_n \quad (1)$$

Where $\mathcal{E}_n = V_{it} + U_{it}$, of which V_{it} is uncontrollable component of error term ($\mathcal{E}_n$), while U_{it} is its controllable component, which accounts for inefficiency. Because of the fact that the probability of a bank in Zambia to be efficient at one period of time is almost the same as the probability for it to be inefficient at any other subsequent period, therefore exponential distribution assumption fits best the analysis at hand. Exponential conditional distribution of U_{it} given $\mathcal{E}_n$ is written as $N(-\sigma_v A, \sigma^2_v)$, where $A = \mathcal{E}_n / \sigma_v + \sigma_v / \sigma_u$. X-inefficiency of bank *n* denoted by C_n can be specified as the expected value of U_{it} conditional on $\mathcal{E}_n$

$$C_n = E(U_{it} / \mathcal{E}_n) = \sigma_v [\{\phi(A) / 1 - \Phi(A)\} - A] \quad (2)$$

ϕ represents a standard density function while Φ is a cumulative density function in this formulation. In the stochastic frontier model, the ratio of standard deviations of μ_n and δ_n is defined as $\lambda = \sigma_u / \sigma_v$, while $\sigma^2 = \sigma^2_u + \sigma^2_v$. Estimates of x-inefficiency (C_n) are obtained by evaluating equation (2) at estimates of σ^2_u and σ^2_v.

To estimate parameters for the prediction of x-inefficiency in (2), multi-product trans-log cost function (1) is now expressed as

$$lnTC_n = \beta_0 + \beta_1 lnP_L + \beta_2 lnP_K + \beta_3 lnP_F + \beta_4 lnQ_L + \beta_5 lnQ_I + \mathcal{E}. \quad (3)$$

Equation (1) and (3) is estimated in one step using Maximum Likelihood Method (MLM). In this study the variables included in equation (3) are measured as seen in Table 2 below.

TABLE 2: DESCRIPTION OF VARIABLES FOR STOCHASTIC FRONTIER ANALYSIS

VARIABLE	DESCRIPTION
Total Cost (TC)	Total interest Expenses + Total Non- Interest Expenses + loan loss provision
The two major Qutputs (Q_i)	Q_L and Q_I, Loans and investments in Securities respectively
Input Price of Capital(P_K)	Depreciation over Fixed Assets
Input Price of Labour (P_L)	All Personnel Expenses over Total Assets
Input Price of Funds (P_F)	Total interest expenses over (Deposits plus other borrowed funds)

Source: Author's own elaboration on the computations used

The model is therefore specified with x-inefficiency index as a function of regressors hypothesized as determinants of x-inefficiency of all Commercial banks in Zambia.

$$lneff = f(OWN, ROA, K, L, S, NPL, NIM, LOATA) \quad (6)$$

Where *Ineff* denotes x-inefficiency index estimated from the multi-output trans-log cost function. *OWN* is a proxy for ownership type constructed by using a Dummy where 1 means foreign and 0 Domestic. *ROA* is a proxy for profitability captured by the ratio Profit before Tax to Total Assets. *K* is a proxy for capital adequacy measure, of which we use the proportionate spending on the capital goods relative to other non-tax expenses as a proxy. *L* is a proxy for bank liquidity captured by the ratio of Total bank's liquid Assets to Total assets , while *S* is a bank size variable measured by natural logarithm of total assets in this case. *NPL* is a proxy for Credit Risk, captured in this case by the ratio of non-performing loans to total loans. *NIM* is a proxy for Net

Interest margin captured by Net interest rate income minus Net interest rate expense over Total Assets. *LOATA* is a proxy for Loan intensity which is captured by the ratio of Net Loans to Total Assets. X-inefficiency function is expressed mathematically as a two-limit Tobit estimation model,

$$Ineff = \alpha_0 + \alpha_1 OWN + \alpha_2 ROA + \alpha_3 K + \alpha_4 L + \alpha_5 S + \alpha_6 NPL + \alpha_7 NIM + \alpha_8 LOATA + \mathcal{E}_i$$

$$if\ LHS > 0 \qquad (7)$$

Ineff = 0, otherwise

Results

The findings comprised of descriptive statistics of data and detailed presentation and discussion of the results from the estimated models. The determinants and drivers of efficiency of commercial banks were established and the tobit model was explored to analyze the operational efficiency of commercial banks in Zambia using the parametric estimation framework, presented below.

TABLE 3: DESCRIPTIVE STATISTICS OF THE DATA (N=190)

VARIABLES	Mean	Std. Dev.	Min	Max
TRANSLOG COST FUNCTION:				
TC	61440.37	60036.19	3890	223194
Q_L	973976.4	1138052	12252	3806872
Q_I	457728.5	517988.7	226	2251838
P_L	.0241544	.0211901	.0014696	.1433305
P_K	.0574788	.0455571	.0023073	.5171052
P_F	.0173357	.0192672	.000126	.1300429
TOBIT MODEL:				
OWN	.6842105	.4660576	0	1
ROA	.0002519	.0216374	-.1056222	.0534359
CAM	1.285115	1.568903	.1762609	18.17242
EL	.3971712	.1615458	.1151585	.9359755
S	13.95677	1.328142	10.32885	15.82993

NPL	.0068029	.0149493	0	.1023875
NIM	.014442	.0072666	-.0037894	.0611051
LOATA	.411025	.1489098	.0396812	.6896687

Source: Author's computations based on Published Banks' Consolidated Annual Reports.
Note: INDO-ZAMBIA bank being a Joint Venture (Foreign Public) was captured as a Domestic bank.

Table 4.0 shows the descriptive statistics of all the variables used in the study. The descriptive statistics revealed insights about the operations of the Commercials Banks throughout the period of study. It revealed that the average total cost (TC) of Banks is K61440.37 with a Minimum cost of K3890 and a Maximum cost of K223194. The average amount of Net Loans, Advances and Overdrafts given out by Banks is K973976.4 with a Minimum and Maximum amount of K12252 and K3806872 respectively. The average amount of Investment in Securities is K457728.5 with the Minimum and Maximum amount of K226 and K2251838 respectively.

RESULTS FROM STOCHASTIC FRONTIER MODEL

Table 4 below gives the empirical results of the maximum likelihood parameter estimates obtained from the trans-log cost function. Overall the trans-log cost function is well behaved and passes a battery of diagnostic test.

TABLE 4: EMPIRICAL RESULTS FROM THE MULTI-OUTPUT TRANS-LOG COST FUNCTION

InTC	Coef.	Parameter	t-statistic	P-value
lnQ_L	β_5	.6051135	26.81	0.000*
lnQ_I	β_4	.2205848	9.58	0.000*
InP_L	β_3	.5928624	13.63	0.000*
lnP_K	β_2	.1868888	5.57	0.000*
lnP_F	**β_1**	**.0363454**	**1.22**	**0.223**
INTERCEPT	β_0	2.88026	15.36	0.000*
Diagnostics:				
Log likelihood function	1.6744167			
Wald test statistic	3783.63			
Wald chi square (p-value)	0.0000*			
σ^2_u (P-value)	0.000*			

σ^2_v (p-value)	0.000*
σ^2	0.0611
LR test of one-sided error	38.45*
Observations	190

Significance level: * p<0.01, ** p<0.05, *** p<0.10

Source: Author's computations from data obtained from the respective bank's annual report consolidated financial statements

As seen in Table 4 above, the variance of the inefficient component (σ^2_μ) in the composed error model is statistically significant at 1 percent level of significance. The significance of σ^2_μ reveals that banks experienced some x-inefficiency during the study period. From the Wald test statistic 3783.63 is significant at 1%. We therefore reject the null hypothesis that there is no relationship between the dependent and independent variables at 1 percent level of significance and it further reinforces that the overall model is significant at 1 percent level of significant. More importantly, the test for the one-sided inefficiency error as the dominant structure cannot be rejected at 1 percent. The likelihood ratio (*LR*) statistic was calculated as 38.45 and is significant at 1% level. This implies that there is a presence of the inefficient component and the errors are not normal errors as they have been separated into inefficiency component and idiosyncratic term. Thus, the specification of the model is correct.

Sample parameter estimates are plausible, consistent with a priori expectations. We observe a positive and significant coefficient on the unit price of labour at 1 percent. The estimated coefficient shows that a unit increase in the labour factor price directly translates into 0.59 percent increase in total costs. This means there is a near correspondence between labour costs and overall bank expenses. The estimated coefficient for the price of capital was found to be

statistically significant at 1 percent, carrying a positive sign. The estimated coefficient for capital implies that if the input price of capital rises by 1 unit the overall cost will rises by 0.19.

However, equipment and buildings are of a fixed nature, costs related to these assets tend to be of less significance over time. Despite the input price of funds being insignificant it carries a positive coefficient that shows that the input price of funds may have little to no significant impact on overall cost in the Zambian banking sector. Estimates for the trans - log frontier model also depict an important effect of bank outputs on costs. The point estimates for both output measures Loans (Q_L) and Investment in securities (Q_I) are statistically significant at 1 percent. This shows that bank costs increase with the scale of production. The model shows that if a bank increases output measure of Loans by 1 unit, the overall costs will rise by 0.61 percent. Alternatively, if a bank decides to increase its output measure of investments in securities by 1 unit, the overall costs rises by 0.22 percent.

RESULTS OF THE ESTIMATION OF INDIVIDUAL BANK MEAN INEFFICIENCY

The significance of σ^2_μ reveals that banks experienced some x-inefficiency during the period. X-inefficiency indices are predicted from the estimates of the stochastic frontier model using the distribution of inefficiency term u_i conditional on $\mathcal{E}_n$ (equation 2). Table 5 below depicts the mean inefficiency indices of all commercial banks for the period of 2018 annual report.

The table ranks them on average according to the least inefficient to the most inefficient Bank. It is imperative to note that the inefficiency scores generated for each Bank represents the deviation from the cost efficient frontier which can be expressed in terms of Percentages. That is to say a given inefficiency scores indicates by how much, in terms of percentage, a particular Bank is above the minimum cost represented by the cost efficient frontier.

TABLE 5: MEAN INEFFICIENCY SCORES FOR ALL COMMERCIAL BANKS (N = 10)

No.	Bank Name	Mean inefficiency Score	Std. Dev.	Min.	Max.
1	AB	0.0873783	.0025325	.0778879	.0938143
2	ICB	0.0916146	.0039329	.0861997	.0991238
3	BOC	0.0919737	.0040813	.0864031	.0968361
4	FAB	0.0919882	.0029827	.0865849	.096964
5	ACCESS	0.0924029	.0018868	.0887748	.0950324
6	INTERMARKET	0.0925697	.0021237	.0882594	.0948765
7	UBA	0.0927576	.0019255	.090207	.0969771
8	CAVMONT	0.1007414	.0013205	.0989576	.1028779
9	CITIBANK	0.1010772	.0012566	.0992137	.1033287
10	ECOBANK	0.1024824	.0030229	.0985616	.1075386
11	INDO-ZAMBIA	0.1060778	.006396	.0880987	.1092374
12	ATLAS MARA	0.1066672	.0022709	.1039867	.1094985
13	INVESTRUST	0.1079946	.0006415	.1069569	.1091881
14	FNB	0.1124362	.0021421	.109061	.1160254
15	STANCHART	0.1167482	.0010275	.1147514	.1179439
16	ZANACO	0.1185001	.0035475	.108646	.1204552
17	BBZ	0.1185805	.0004516	.1182238	.119447
18	STANBIC	0.1189109	.0013099	.1163629	.1206296

Source: Author's computations from data obtained from the respective bank's annual report consolidated financial statements

As seen in Table 5 above, on average AB Bank was found to be the least inefficient bank for the study period under consideration. It had an average inefficiency score of 8.7% with minimum inefficiency score of 7.7% and a Maximum inefficiency Score of 9.3%. This result implies that AB Bank had costs that are 8.7 percent above minimum defined by the frontier. It also means that 8.7 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

ICB on average was found to have an inefficiency score of 9.2% with a minimum inefficiency score of 8.6% and a Maximum inefficiency score of 9.9%. This result implies that ICB had costs that are 9.2 percent above minimum defined by the frontier. It also means that 9.2 percent of its

costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

BOC on average was found to have an inefficiency score of 9.2% with a minimum inefficiency score of 8.6% and a Maximum inefficiency score of 9.7%. This result implies BOC had costs that are 9.2 percent above minimum defined by the frontier. It also means that that 9.2 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

FAB on average was found to have an inefficiency score of 9.2% with a minimum inefficiency score of 8.7% and a Maximum inefficiency score of 9.7%. This result implies that FAB had costs that are 9.2 percent above minimum defined by the frontier. It also means that 9.2 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

ACCESS on average was found to have an inefficiency score of 9.2% with a minimum inefficiency score of 8.9% and a Maximum inefficiency score of 9.5%. This result implies that ACCESS had costs that are 9.2 percent above minimum defined by the frontier. It also means that 9.2 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

Intermarket on average was found to have an inefficiency score of 9.3% with a minimum inefficiency score of 8.8% and a Maximum inefficiency score of 9.5%. This result implies that Intermarket had costs that are 9.3 percent above minimum defined by the frontier. It also means that 9.3 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

UBA on average was found to have an inefficiency score of 9.3% with a minimum inefficiency score of 9.0% and a Maximum inefficiency score of 9.7%. This result implies that UBA had costs that are 9.3 percent above minimum defined by the frontier. It also means that 9.3 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

CAVMONT on average was found to have an inefficiency score of 10.0% with a minimum inefficiency score of 9.9% and a Maximum inefficiency score of 10.2%. This result implies that CAVMONT had costs that are 10.0 percent above minimum defined by the frontier. It also means that 10.0 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

CITIBANK on average was found to have an inefficiency score of 10.1% with a minimum inefficiency score of 9.9% and a Maximum inefficiency score of 10.8%. This result implies that CITIBANK had costs that are 10.1 percent above minimum defined by the frontier. It also means that 10.1 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

ECOBANK on average was found to have an inefficiency score of 10.2% with a minimum inefficiency score of 9.9% and a Maximum inefficiency score of 10.8%. This result implies that ECOBANK had costs that are 10.2 percent above minimum defined by the frontier. It also means that 10.2 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

INDO-ZAMBIA on average was found to have an inefficiency score of 10.6% with a minimum inefficiency score of 8.8% and a Maximum inefficiency score of 10.9%. This result implies that INDO-ZAMBIA had costs that are 10.6 percent above minimum defined by the frontier. It also

means that 10.6 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

ATLAS MARA on average was found to have an inefficiency score of 10.7% with a minimum inefficiency score of 10.4% and a Maximum inefficiency score of 10.9%. This result implies that ATLAS MARA had costs that are 10.7 percent above minimum defined by the frontier. It also means that 10.7 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

INVESTRUST on average was found to have an inefficiency score of 10.8% with a minimum inefficiency score of 10.7% and a Maximum inefficiency score of 10.9%. This result implies that INVESTRUST had costs that are 10.8 percent above minimum defined by the frontier. It also means that 10.8 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

FNB on average was found to have an inefficiency score of 11.2% with a minimum inefficiency score of 10.9% and a Maximum inefficiency score of 11.6%. This result implies that FNB had costs that are 11.2 percent above minimum defined by the frontier. It also means that 11.2 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

STANCHART on average was found to have an inefficiency score of 11.7% with a minimum inefficiency score of 11.5% and a Maximum inefficiency score of 11.8%. This result implies that STANCHART had costs that are 11.7 percent above minimum defined by the frontier. It also means that 11.7 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

ZANACO on average was found to have an inefficiency score of 11.9% with a minimum inefficiency score of 10.9% and a Maximum inefficiency score of 12.0%. This result implies that ZANACO had costs that are 10.9 percent above minimum defined by the frontier. It also means that 10.9 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

BBZ on average was found to have an inefficiency score of 11.9% with a minimum inefficiency score of 11.8% and a Maximum inefficiency score of 11.9%. This result implies that BBZ had costs that are 10.9 percent above minimum defined by the frontier. It also means that 10.9 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

STANBIC on average was found to have an inefficiency score of 11.9% with a minimum inefficiency score of 11.6% and a Maximum inefficiency score of 12.0%. This result implies that STANBIC had costs that are 11.9 percent above the minimum defined by the frontier. It also means that 11.9 percent of its costs were wasted relative to the "best-practice" commercial bank producing the same output and facing the same conditions.

It is crucial to note that the inefficiency scores generated by the trans-log cost function do not imply that the Commercial banks in Zambia are not efficient to any degree; they are efficient to some degree. The inefficiency scores basically indicate that there is room for improvement by all the commercial banks in the Zambian banking Sector; as the cost efficient frontier depicts attainable output. To compute their level of efficiency we convert the inefficiency scores into efficiency scores as seen in Table 6 - by finding the exponential of the reciprocal of the inefficiency score {EXP(-U); the value obtained is the efficiency score.

Table 6 below reveals the average efficiency scores of all commercial banks in Zambia. As before the banks are ranked accordingly - from the most efficient bank to the least efficient bank for the period of the study. As seen in Table 6, the higher the efficiency of a bank, the lower its inefficiency – in Table 5 AB Bank was the least inefficient, after the transformation AB Bank was found to be the most efficient bank (Table 6) for the study period. An efficiency score obtained for a bank, measures how efficient a bank is in using a combination of labour, physical capital and collected deposits to produce an output combination of Loans and Investment in securities under price constraints.

TABLE 6: MEAN EFFICIENCY OF ALL COMMERCIAL BANKS (N=10)

No.	Bank Name	Mean inefficiency Score	Mean Efficiency Score {EXP(-U)}
1	AB BANK	0.0873482	0.916357964
2	ICB	0.0916146	0.912456743
3	BOC	0.0919737	0.912129138
4	FAB	0.0919882	0.912115912
5	ACCESS	0.0924029	0.911737736
6	INTERMARKET	0.0925697	0.911585671
7	UBA	0.0927576	0.9114144
8	CAVMONT	0.1007414	0.90416682
9	CITIBANK	0.1010772	0.903863252
10	ECOBANK	0.1024824	0.902594035
11	INDO-ZAMBIA	0.1060778	0.899354676
12	ATLASMARA	0.1066672	0.898824752
13	INVESTRUST	0.1079946	0.897632444
14	FNB	0.1124362	0.89365436
15	STANCHART	0.1167482	0.889809219
16	ZANACO	0.1185001	0.888251727
17	BBZ	0.1185805	0.888180314
18	STANBIC	0.1189109	0.887886908

Source: Author's own calculations based on published bank consolidated annual report data

On average AB BANK was found to be Efficient by 91.6%. ICB, BOC, FAB, ACCESS, UBA, CAVMONT, CITIBANK, ECOBANK, INDO-ZAMBIA, ATLASMERA, INVESTRUST, FNB, STANCHART, ZANACO, BBZ and STANBIC are on average efficient by 91.2%, 91.2%, 91.2%, 91.2%, 91.2%, 91.1%, 90.4%, 90.4%, 90.3%, 89.9%, 89.9%, 89.8%, 89.6%, 89.4%, 88.9%, 88.8%, 88.8% and 88.8% respectively.

OVERALL ANNUAL REPORT X-INEFFICIENCY ESTIMATES

In view of all the inefficiency indexes of all commercial banks over the study period, the mean inefficiency index is 10.3%. This result implies that the Zambian banking sector for the period under this study was inefficient of degree 10.3%. This means that for the banking industry as a whole, mismanagement of resources remains an impediment to good performance .The annual report inefficiency index was changing ranging from 10.1 to 10.5. This implies the existence of certain static management approaches which deliver with some sustained inefficiency rates varying little from the period mean of 10.3 percent. The changes were up and down with the standard deviation of 0.01.

RESULTS FROM TOBIT REGRESSION

X-inefficiency indexes obtained from the Trans-log Cost function (equation 3) were regressed against eight explanatory variables comprising Ownership, Profitability, Capital adequacy, bank liquidity, bank size, Credit Risk, Net interest Margin and Loan Intensity (equation 7). Using consolidated data for all banks, the Tobit model is estimated and the results are presented on Table 7 below. The Log-Likihood ratio (LR) test statistic 505.97 is significant at 1 percent level of significance. This implies that we reject the null hypothesis that states that at least one variable is equal to Zero. Thus, the overall model is statistically significant – that is to say there is a relationship between all the independent variables and the dependent variable and that all the

independent variables are simultaneously not equal to zero. Furthermore, all variables were found to be statistically significant at varying levels of significance.

Table 7: Tobit Estimates of the Sources of X-inefficiency

INEFF	Coef.	Parameter	t-statistics	P-value
OWN	α_1	-.001063	-2.13	0.034**
ROA	α_2	-.0813193	-5.84	0.000*
K	α_3	-.0010316	-7.07	0.000*
L	α_4	-.0196109	-8.40	0.000*
S	α_5	.0081481	37.21	0.000*
NPL	α_6	.0308563	2.05	0.042**
NIM	α_7	.0630771	1.99	0.048**
LOATA	α_8	.0099464	4.04	0.000*
INTERCEPT	α_0	-.0059034	-1.86	0.065***
Diagnostics:				
Pseudo R2		-0.4279		
Wald test statistic		505.97		
p-value		(0.0000)*		
Log likelihood		844.23705		
Observations		190		

Significance level: * p<0.01, ** p<0.05, *** p<0.10
Source: Author's own calculations based on published bank consolidated annual report data

Starting with Ownership variable, *Own*, we see that it's significant at 5 percent level of significance and bears a negative sign. This suggests that ownership does have a bearing on bank efficiency in Zambia and that on average foreign owned banks are more efficient than domestic owned banks in the Zambian banking sector. This result is consistent with the findings of Delis and Papanikolaou (2009), Figueira, et al. (2006) and Chen (2009). Contrary to the findings of Wezel (2010) who found that foreign banks are not necessary efficient in North America.

At 1 percent level of significance, Profitability *ROA* is statistically significant and has a negative sign. This implies that the profitability of commercial banks reduces X-inefficiency in this sector thereby enhancing the banks efficiency. This result is consistent with the findings of Mester, 1996; Pastor *et al*., 1997; Carbo *et al*., 1999; Casu and Molyneux, 2003. However, contrary to

the finding of Ajloumi and Omari (2009) who found that profitability of Jordanian Islamic Banks was negatively related to bank efficiency.

With capital adequacy variable, *K*, we see that it is significant at 1 percent level of significance and bears a negative sign. This implies that high capital adequacy has a positive impact on Zambian banks efficiency. This result is consistent with findings of Alkeali (2008), Djahlilor and Piesse (2007) and Armer, Mustapha and Eldomiaty (2011): who suggested that capital inadequacy underpins banks efficiency.

In connection with banks liquidity, estimated parameter established a significant relationship between bank inefficiency and bank liquidity at 1 percent level of significance and has a negative sign. This implies that low bank liquidity lowers bank efficiency in Zambian banks. This result is in lie with the findings by Naceur et al. (2009) and Armer, Mustapha and Eldomiaty (2011): who found that greater bank liquidity enhances efficiency in banks.

Bank size, S, is statistically significant at 1 percent level of significance and has a positive sign. This implies that the bank size, S, is positively related to x-inefficiency. This result is in conformity with the findings of Ahmad and Noor (2011): who suggested that the bigger a bank size the lower the efficiency levels. Contrary to Hauner (2005) who explains that larger banks could pay less for their inputs than their counterparts and that there could be increasing returns to scale through the allocation of fixed costs thereby enhancing bank efficiency.

The same result can be found with *NPL*, which also has positive sign and is statistically significant at 5 percent level of significance. *NPL* represents credit risk, suggesting that greater credit risk reduces the degree of bank efficiency. This result is consistent with other studies (Demir *et al*., 2005; Kalluru and Bhat, 2009; Delis and Papanikolaou, 2009) arguing that reduced efficiency in banks can be a result of large amounts of non-performing loans relative to Net

loans. Similar findings have been reported in previous studies. For example, Carvallo and Kasman (2005) found that high risk undermined banks' ability to improve cost efficiency performance of Latin American and Caribbean banks.

With regards to net interest margin, *NIM*, we see it being statistically significant at 5 percent level of significant and have a positive sign. This result implies that net interest margin is positively related with X-inefficiency in the Zambian banking firms. This result is in line with the findings of Demirguc-Kunt and Huizinga (1999) and Mirna DUMIČIĆ and Tomislav RIDZAK (2002).

Finally, Loan intensity, *LOATA*, is statistically significant at 1 percent level of significance and has a positive sign. This result implies that Loan intensity is positively related to x-inefficiency in the Zambian banking sector. This result suggests that banks with a higher loan to total asset ratio tends to exhibit lower efficiency level. This result suggests that loan intensity increases the overall bank cost and reduces the quality of Loans provided. This result is consistent with findings of Ahmad and Noor (2011).

EFFICIENCY WITH REGARD TO TOTAL ASSETS

The researcher wanted to find out if there is any significant difference regarding the efficiency related to total assets among all the banking groups during the study period.

This was tested as under: Null Hypothesis

H0: There is no significant difference in total assets among all the 18 commercial banks during the study.

H1: At least one of the estimated parameters is not equal to zero. The test for overall significance is conducted using the F test (n=190).

TABLE 8: ANALYSIS OF VARIATION

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	7.2E+12	2.4E+12	5.085904	0.002094
Residual	187	8.69E+13	4.72E+11		
Total	190	9.41E+13			

Source: Author's own compilation from the data

The above ANOVA table indicates that the calculated value of F is 5.08, which is more than the table p-value at 5% level of significance. Hence, the null hypothesis is rejected. It means that there is a significant difference in total assets among all the three banking groups. The model is statistically significant and can be used for inference.

The total assets of banks have a huge impact on efficiency of bank operations. If a firm is cost efficient, then it should be profitable and negatively correlated with other cost performance like ratio of operating cost to total assets or the ratio of operating to income.

TABLE 9: MODEL SUMMARY

R	R Squared	Adjusted R^2	Level of Significance
0.71782	. 93197	. 918231	0.05

Source: Author's own compilation from the data

Using the model statistical analysis, the return to assets level obtained from the sample is statistically significant at 95% level of significance. The results obtained are statistically significantly.

The data obtained shows that, the 91.82% of the commercial bank total assets would enhance the efficiency levels of the commercial banks operations, holding other factors constant. The finding is statistically significant at 5% level of significance.

Therefore, because of the above conditions being met, the data is normally distributed and the t test can be used in the validation of the findings.

Limitations of the Research

Broader institutional factors, pertaining to, say, the conduct and frequency of monetary policy shocks, including how fiscal policy via deficit financing may impact the efficiency of the banking sector have not been considered.

RECOMMENDATIONS

Based on the findings and critical consideration of the literature, the following recommendations can be made:

1. Banks should enhance their management capacity as the bank expands by employing decentralization policies to break down the bureaucracy that is exhibited by commercial banks in Zambia.
2. The banks should carefully monitor the ratio of non- performing loans to total loans by them ensuring that their management and credit officers abide by the banks' credit guidelines in the consideration of loan proposals, not least align these to national, regional and international guidelines to minimize risk to exposure. The results indicate that the rising incidence non-performing loans have a consequent adverse on operational efficiency. This calls for banks to acquire the employment of a sound management team and credit officers with regular examination of banks asset book by the supervisory bodies as a way to curb this menace.
3. Banks should lower their net interest margins if they want to reduce on their x-inefficiency. If banks want to charge high lending rates, they also have to charge high deposit rates to reduce their net interest margin. This will make them more competitive and enhance their efficiency levels.
4. Capital inadequacy is among the critical impediments to x-efficiency. Banks should optimize productivity through rearrangement of their capital - labour balance.

5. Domestic banks should aim to address their efficiency issues by participating in international banking, with guidance from the central bank, to align with monetary policy shifts. This entails domestic owned banks setting up their stations/subsidiaries in foreign countries, if possible, to run competitively but to also spread their risk profile. This outreach to other economies by domestic banks will compensate for the capital flight from the economy through foreign banks.
6. Fiscal consolidation and management of macroeconomic risk is necessary: increasing public debt and increased debt servicing have been shown to be positively linked to higher interest rate margins; which may ultimately underpin bank efficiency.

RECOMMENDATIONS FOR FURTHER RESEARCH

This study only focuses on investigating the efficiency levels of the Zambian Commercial banks using Parametric Measure of efficiency (Stochastic methods), however further investigations can be made using a different methodology like non-parametric measures such as Data Envelopment Analysis, but should take into account the broader macroeconomic policies, such as monetary and fiscal policy shocks.

This study also focused on Bank specific factors to determine factors that affect bank efficiency in Zambian banks. This is one side of determinants of bank efficiency. There are other determinants that may influence bank efficiency such as macroeconomic variables. There is need to investigate further their influence on bank efficiency.

In addition, a different approach can be useful to determine whether introduction of certain technologies in banking such as mobile money banking services have had a positive effect on bank efficiency. This would require exploring efficiency within the context of a difference-in-

difference framework to establish the status with respect to efficiency before and after technological innovation.

Acknowledgements

The authors wish to acknowledge the valuable support of everyone who participated in this research.

REFERENCES

Adongo, J. S. (2005). Fcators influencing the alternative profit X-efficiency of Namibia's banking sector.

Ahmad, N. M. (2012). The Determinants of World Islamic Banks Efficiency: Does country income level have an impact? . *Journal of Islamic Economics, Banking and Finance. Vol.8. No 2.April-June.*

Aigner, D. L. (1977). Formulation and estimation of stochastic frontier production function models. . *Journal of Econometrics , 6, 21-37 .*

Akhavein, J. D. (1997). The Effects of Mega Mergers on Efficiency and Prices: Evidence from a Bank Profit Function. *Review of Industrial Organization 12.*

Amer H.M.H, W. T. (2011). Determinants of operating efficiency for lowly and highly competitive banks in Egypt. Journal of Cambridge Business and Economics Conference,UK.June 27-28.

Ayadi, I. (2013). Determinants of Tunisian Bank Efficiency: A DEA Analysis. International Journal of Financial Research.vol.4, No.4.

Bank., W. (2006). Review of World Bank Assistance for Financial Sector Reforms. *Washington D.C: Independent Evaluation Group, World Bank.*

Banker, R. C. (1984). some models for estimating technical and scale inefficiencies in Data Envelopment Analysis. *Management Science , 30, 1078-1092.*

Bauer, P. B. (1998). Consistency conditions for regulatoryanalysis of financial institutions: a comparison of frontier efficiency methods. f. *Journal of Business and Finance , 50, 85-114.*

Beccalli, E. C. (2006). Efficiency and stock performance in European banking. *Journal of Business Finance & Accounting , 33 (1-2), 245-262.*

Beck, T. &. (2009). Why are interest spreads so high in Uganda? . *Journal of Development Economics , 88, 198-204.*

Berger, A. N. (1997). Efficiency of financial institutions: international survey and directions for future research. *European Journal of Operational Research , 98, 175-212 .*

Berger, A. N. (1991). The dominance of inefficiencies over scale and product mix economies in banking. . *Journal of Monetary Economics , 28, 117-148 .*

Berger, A. N. (1993). The Efficiency of Financial Institutions: A Review and Preview of Research Past, Present, and Future". . *Journal of Banking and Finance, Vol. 17, pp. 221-249 .*

Bhattacharya, A. L. (1997). "The Impact of Liberalization on the Productive Efficiency of Indian Commercial Banks," . *European Journal of Operational Research, 98(2): 332-45.*

Bull, T. a. (1995). End of the road for Meridien', Profit, June, pp 15-20.

Casu, B. a. (2003). A comparative study of efficiency in European banking, Applied Economics, 35, 1865-1876.

Charnes, A. C. (1990). "Polyhedral Cone – Ratio DEA Models with an Illustrative Application to Large Commercial Banks," . *Journal of Econometrics, 46(1-2): 73-91.*

Charnes, A. C. (1978)). Measuring the efficiency of decision making units. *European Journal of Operational Research , 2, 429-444.*

Chen, C. (2009). Bank efficiency in Sub-Saharan African middle-income countries. . *IMF Working Paper, WP/09/14 . International Monetary Fund (IMF).*

Čihák, M. &. (2005). Bank behavior in developing countries: evidence from East Bank behavior in developing countries. *Working Paper No.WP/05/129 . International Monetary Fund.*

Daley, J. a. (2009). Efficiency and convergence in the Jamaican banking sector: 1997-2007, Cardiff Economics Working Papers, E2009/30.

Delis, M. a. (2009). Determinants of bank efficiency: evidence from a semi-parametric methodology, MPRA Working Paper No. 13893.

Demirgüç-Kurt, A. a. (1998). Determinants of Commercial Bank Interest Margins and Profitability: Some International Evidence.

Eisenbeis, R. F. (1999). The informativeness of stochastic frontier and programming frontier efficiency scores: cost efficiency and other measures of Bank Holding Company performance. *Working Paper, No.99-33 . Federal Reserve Bank of Atlanta .*

Fardi, M. A. (1991). Zambia: reform and reversal' in Thomas Vinod, Ajay Chhibber.

Farell, M. T. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society, 120, 253-290.*

Favero, C. &. (1995). Technical efficiency and scale efficiency in the Italian banking sector:a non-parametric approach. Applied Economics , 27, 385-395.