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**Article**

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Cogent Economics & Finance

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*Suggested Citation:* Lotto, Josephat (2019) : Evaluation of factors influencing bank operating efficiency in Tanzanian banking sector, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 7, Iss. 1, pp. 1-14,  
<https://doi.org/10.1080/23322039.2019.1664192>

This Version is available at:

<https://hdl.handle.net/10419/270681>

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**To cite this article:** Josephat Lotto | (2019) Evaluation of factors influencing bank operating efficiency in Tanzanian banking sector, Cogent Economics & Finance, 7:1, 1664192, DOI: [10.1080/23322039.2019.1664192](https://doi.org/10.1080/23322039.2019.1664192)

**To link to this article:** <https://doi.org/10.1080/23322039.2019.1664192>



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Received: 03 July 2019  
Accepted: 30 August 2019  
First Published: 05 September 2019

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Reviewing editor:  
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## GENERAL & APPLIED ECONOMICS | REVIEW ARTICLE

# Evaluation of factors influencing bank operating efficiency in Tanzanian banking sector

Josephat Lotto<sup>1\*</sup>

**Abstract:** This paper examines factors affecting operating efficiency of 36 commercial banks in Tanzania for the period between 2000 and 2017. The paper employs robust random-effect regression model to estimate the relationship between bank operating efficiency and its determinants. The results show that bank liquidity and capital adequacy have a positive relationship with bank operating efficiency. This suggests that capital adequacy and liquidity, not only strengthen financial stability by providing a larger capital cushion and bank required liquidity level, but also improve bank operating efficiency by lowering moral hazard between shareholders and debt-holders. Furthermore, the study shows that bank profitability and operating efficiency are directly related—implying that banks should put emphasis on improving their earning generating power to increase their operational efficiency. This paper suggests banks to increase their profitability by investing more on financial innovations and branch networks, and expand their market shares to boost their operational efficiency. Further, the paper argues that banks should optimally use their asset capacity to enhance their earnings profiles. At the same time, banks should avoid reckless lending that would increase the level of uncured credits in banks' portfolio. Finally, the results encourage banks in Tanzania to



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### ABOUT THE AUTHOR

Josephat Lotto is a Senior Lecturer in Finance and Corporate Governance at the Institute of Finance Management in Tanzania. He graduated with a PhD in Corporate Governance and Financial Strategies from the UK in 2012. He also holds MSc in Finance, MBA and CPA(T). Josephat's research interest lies at the heart of Corporate Governance and Financial strategies where the current paper forms a part of the research agendas around the broad theme. He has published over 25 research papers in various academic journals and he is a reviewer of several academic journals published by some reputable publishing houses such as **Wiley & Sons, Inc, Taylor & Francis Group** which publishes quality peer-reviewed journals under the **Routledge**; Multidisciplinary Digital Publishing Institute (MDPI), **Elsevier**, IEEE Access and **Springer Nature**. Such Journals include; *International Journal of Finance and Economics*, *African Journal of Economics and Management Studies*, *Development Policy Review*, *The European Journal of Finance*, *Sustainability Journal* and *International Advances in Economics*.

### PUBLIC INTEREST STATEMENT

Financial Sector is important for the economic development and prosperity of the country. Financial sector works as the backbone of the economy that controls the money supply. The Banks accept funding from surplus monetary units as deposits and give it to Business and Industries as advances. Banking is a very important sector because of the development of the finance, and particularly the banking system, promote economic growth. Banks are important for the economy and organizations in particular at the time of declines and money-related crisis. Industrial, agricultural and commercial development of a country is not imaginable without an efficient banking system. Therefore, the operational efficiency of the bank is of paramount importance for financial sector development and consequently, the economic growth at large.

monitor and evaluate these factors for improvement to enable the sustainability of banks and industry for economic growth.

**Subjects:** Corporate Finance; Banking; Credit & Credit Institutions

**Keywords:** Commercial banks; operating efficiency; evaluation; profitability; liquidity; capital adequacy

## 1. Introduction

Commercial banks are very important in socioeconomic development in any country, from developed to developing countries. Commercial banks have a crucial role in the economy as they enhance economic growth through efficient allocation of financial resources. This role is well established with financial system sustainability within the economy. Improvement of the financial system and sustainable economic growth in Tanzania has been achieved through several fundamental reforms in the banking industry since financial liberalization in the early 1990s (Mutaitina, 1994). The reforms have been associated with mobilization of financial resources as well as competition in financial markets. The increase in competition has resulted in quality and efficiency credit lending in the economy (BOT Report, 2017).

Efficiency of commercial banks has been cited as one of the key factors contributing to banks success or failure (Barr, Seiford, & Siems, 1994). In the current situation whereby the banking sector is integrated globally, it is imperative for commercial banks to build suitable business operation to avoid the possibility of collapse.

Operating efficiency is viewed as the ability of the company to reduce operating costs in attaining its objective through combination of right people, process and technology. With right combination of resources, business operation of any company will enhance productivity of services or goods offered, Shawk (2008).

The costs saved from resources of previous operations as a result of operating efficiency can be redirected to new opportunities that add value to the organization. The companies that operate efficiently tend to improve and maintain level of stability of output/services and operating performance compared to companies which are less efficient within the industry, Mills and Schumann (1985).

Banks operate efficiently by channeling savings from deposits mobilized toward those companies with high expected social and economic returns. After lending them, banks monitor these resources to ensure effective and efficient utilization. On the other hand, commercial banks which are wasteful and inefficient in channeling savings tend to slowdown economic growth and community welfare, Athanasoglou, Brissimis, and Delis (2008).

Banking system which is efficient enables financial resources to be channeled in the highest productive areas within the economy. This idea is proposed by Beck et al. (2010) who argued that economic growth and high productivity are associated with efficiency of the financial system in allocating financial resources in the economy.

There are number of studies that were undertaken on the factors which affect bank efficiency in developing countries. These studies include (Nakane & Weintraub, 2005, Bandarayake & Probhath, 2013, Ayadi & Arbak, 2013). Despite the importance of bank operation on economic and financial system, few studies have been conducted in Tanzania focusing on the bank operations, including determinants of bank efficiency. Those who attempted to tackle bank efficiency in Tanzania, using parametric methods, include Aikaali (2008), Xuezhi and Pastory (2012), Srinivas and Rwechungura (2013), Zawadi (2013) and Gwahula (2013). However, few studies have analyzed the determinants of bank operating efficiency. Raphael, G. (2013) also used parametric method to analyze the determinants of bank efficiency in

Tanzania utilizing a shorter and old dataset for period up to 2013. The current paper uses random-effect model, and a longer time period of 17 years, including the most recent data available to examine the determinants of bank operating efficiency. This increases the chances of having more robust empirical results. Apart from that, banks in Tanzania are currently experiencing a big transformation in business models, adaptation to new technology and introduction of IT systems. These are believed to be enablers of improving bank efficiency. Analyzing efficiency of banks, using the most recent dataset is imperative and interesting as it captures changes in banks' operations. The study joins the available studies to throw more light in this very crucial issue in the banking sector.

## 2. Related literature and hypothesis development

There are several empirical studies on banks efficiency that used panel data analysis. These studies include (Berger, Hancock, & Humphrey, 1993; Berger & Humphrey, 1997; Mitchell & Onvural, 1996), which concluded that the US banks average cost curve is relatively flat when compared to European banks. Most of empirical studies in Europe focus on cost functions using data from single bank or country. They found U-shape average cost curve and to some extent, the existence of scope economies (Parisio, 1992; Berger et al., 1993; Drake & Hall, 2003). It can be noted that choice of the approach to efficiency study as well as definitions of inputs and output in multi-product financial firm model will in most cases affect the estimates. This study uses panel data of large and small banks in Tanzania in the analysis of the factors affecting operating efficiency of banks. Operating efficiency ratio (%) (Which relate to non-interest expenses + interest expenses/loan advances + probable losses) will be used as a key measure of operating efficiency of banks.

Study by Hsiao, Chang, Huang, and Cianci (2010) revealed that bank efficiency in Taiwan improved after financial restructuring. The finding might be attributed to improvement in the risk management process in bank operation. Financial restructuring in the banking system is said to enhance competition which in turn improve efficiency (William & Cabro, 2012). This is contrary to idea which suggests that increase in market share increases bank efficiency as suggested by efficiency market hypothesis.

Efficiency market hypothesis states that achieving lower production costs enable banks to provide loans/credits at reasonable and affordable costs. This results in the increases in Market shares as the bank builds competitive advantages over other banks. Privatization in the banking industry increases competition which in turn decreases operating costs (Murillo, 2002). This is due to the fact that market share decreases with the increase in competition within the industry.

Banks concentration attracts low deposit which in turn increases lending rate to borrowers. This is also the signal of operating inefficiency of banks. Delis and Papanikolaou (2009) found that bank concentration is negatively related to bank efficiency.

Bank concentration is viewed in terms of competition in the banking Industry. In theory, it is argued that bank concentration is negatively related to bank competition. Studies carried out by Weill (2004) and Bikker and Haaf (2002), suggest that competition imperfection of bank is attributed by information failure between borrowers and banks.

Many studies carried out to establish the impact of bank concentration in bank efficiency suggested that bank concentration is positively related to bank efficiency (Berger & Mester, 1997, Casu & Girardone, 2006, Goddaran, 2001; Weill, 2004). The fact behind this finding is that large market share with well-differentiated products increase profitability which in turn increases efficiency. Similarly, bank concentration is caused by the increase in market share as a result of bank efficiency.

Okuda and Aiba, (2014) in their study on determinants of operational efficiency and total productivity factor using Cambodian financial institutions sample found that, as quoted" *the efficiency of large institutions is higher and more stable than that of small institutions; the*

*institutions whose foreign capital comprises more than half of total capital are significantly inferior to local institutions with respect to overall operation; institutions that are more resilient and operationally stable can generate profits more efficiently; institutions that are more diversified are more efficient; sound and diversified institutions tend to increase their total factor productivity; and some exogenous factors, such as increased household reserves of financial assets and improved economic infrastructure, contributed to the improvement of productivity change. These observations suggest that further improvement of Cambodian financial institutions requires an increase in operational capacity, appropriate selection of foreign ownership, enhanced soundness of management, greater diversification” pg 3.*

Using the value-added approach and the operating approach, Okuda and Aiba, (2014) found a positive and statically significant relationship between bank's Z-score and operating efficiency. This result is similar to Grigorian and Manole (2002), who examined bank efficiency in developing countries and found bank conducive operating environment is an enabling factor for efficient generation of bank earnings.

### **2.1. Hypothesis development**

In several previous studies, the results of the effects of bank size on bank efficiency are not consistent and the causality has been indistinguishable. Large banks are expected to be more efficient relative to small banks due to the fact that, large banks are capable to mobilize resources such as human resources, material and technology to improve operating efficiency (Hughes et al, 2001). Although Berger, Hasan, and Zhou (2009), Athanasoglou, Panayiotis & Brissimis et al. (2008), Feng and Serlists (2010), Wheelock and Wilson (2009) and Hassan and Marton (2003) report a positive relationship between bank efficiency and bank size, some studies such as Bonin, Hassan, and Watchet (2005), Berger, Hanweck & Humphrey (1987), Noulas, Ray & Miller (1990), and Mester (1992) show that larger banks are less efficient in transition economies. The common argument is that operating costs decrease as size of the bank increases up to a certain level and thereafter operating costs increase as the bank size increases beyond this level). This implies that operating efficiency improves as size of the bank increases but banks become less efficiency after a certain level. It is generally believed that the size of the bank matters a lot in market share distribution. Therefore, one may propose the following Hypothesis;

*H1: Bank size is expected to have a positive relationship with bank operating efficiency*

Literature also identifies capital adequacy as the determinant of bank operating efficiency. The study of European banks by Yener, Carbo, Gardener, and Molyneux (2007) shows a negative relationship between capital adequacy and operating efficiency. This is due to the fact that European banks preferred to hold more capital and take on less risk. Another study by Kwan and Eisenbeis (1997) found that companies with more capital operate more efficiently relative to companies with less capital which. Some studies such as Grigorian and Manole (2002), Pasiouras, Tanna, and Zopounidis (2007), Hassan and Sandez (2007), Delis and Papanikolaou (2009), Naceur, Ben-Khedhiri, and Casu (2009), and Tecles and Tabak (2010) which examined the determinants of bank efficiency found a positive relationship between capitalization and efficiency of banks. These findings suggest that capital adequacy allows the banks to take advantages of opportunities available at lesser costs to reduce risks associated with operations of the banks. It is from this argument that the following hypothesis is proposed;

*H2: Bank Capital Adequacy positively relates with bank operating efficiency*

The role played by banks in the economy is to impose liquidity by channeling loans to organization with high productivity from funds obtained through demand deposit (Diamond, 1984; Ramakrishnan & Thakor, 1984). Bank liquidity enables the bank to advance loans which in

turn generate income for banks. Liquid banks are said to be more efficient if they are capable to generate more outputs which include other assets and minimize risk associated with operations (Gorton & Huang, 2002). The study by Odunga, Nyangweso, Carter, and Mwarumba (2013), found that bank liquidity increases with operating efficiency of banks. This implies that, banks strive by increasing liquid assets which in turn improve operating efficiency. Therefore, it is prudent to propose the following hypothesis

*H3: Bank liquidity is expected to have a positive relationship with operating efficiency*

Asset quality is an important factor in bank performance as a significant increase in non-performing loan is an indicator of liquidation of banks (Demirguc-Kunt, 1989; Whalen, 1991). The level of risk exposure of the banks mainly is contributed by asset quality of the bank. Facts that contribute to this risk exposure in banks operations include trends of non-performing loans, risks which are specific to the banks and level of profitability of borrowing companies (Baral, 2005). Asset quality has been considered as one of the factors contributing to bank efficiency as an omission of this factor can results in misleading findings (Mester, 1996). Banking Industry inefficiency is said to be attributed to poor loan portfolio (Altunbas, 2002, Fan & Shasfer, 2004; Giradone, Molyneux, & Gardener, 2004). This is due to the fact that proper management of credit risk tends to enhance the efficiency of the bank (Berger and DeYoung (1997). The study by Tsai and Huang (1999) suggested that quality of assets of the banks and cost efficiency are positively related which implies that managing non-performing loans reduces costs associated with loans portfolio. Following these arguments, the paper put forward the following hypothesis:

*H4: Asset quality is positively related to bank operating efficiency*

The results of studies carried out to examine the impact of profitability on bank efficiency are controversial. Study by Dimitris (2008), suggests that there is positive relationship between profitability and efficiency of the bank. This implies that higher profitable banks have larger operating efficiency relative to less profitable banks. There is no compelling evidence that high profitable banks are characterized by greater operating efficiency than low-profit banks (Myron & Black, 1983). Also, studies by Casu, Girardone, and Molyneux (2004), Sanchez, Hassan, and Barkus (2013), Delis and Papanikolaou (2009), and Kalluru and Bhat (2009), on the determinants of the efficiency of banks, found that there is a positive relationship between profitability and banks efficiency. The preceding discussions give the room to suggest the following hypothesis:

*H5: There is a positive relationship between profitability and operating efficiency*

### **3. Data and methodology**

#### **3.1. Data collection**

We use the secondary data collected manually from annual-audited accounts for all 36 commercial banks operating in the Tanzanian banking industry between 2000 and 2017. The sample included only 36 commercial banks among the total of 56 banks. Commercial banks are chosen because their information disclosure and reporting are reliable, and most required information were able to be extracted easily. Because some of the observations in the sample are missing due to the emergence of new banks, our empirical work used unbalanced panel data.



### 3.2. Empirical design and model specification

In this paper, we use random-effect regressions model to identify various independent variables influencing the bank operating efficiency. When using multiple regression analysis, there is a possibility of endogeneity occurring whereby when certain variables are omitted, it leads to measurement errors (Gill & Biger 2012). Therefore, to minimize endogeneity issues, the most important variables that affect the banks operating efficiency (bank liquidity, capital adequacy, Size of the bank, assets quality and bank profitability) are used as depicted in the model presented below.

The relationship equation is shown below;

$$\text{OEFF}_{it} = b_0 + b_1 * \text{LIQUIDITY}_{it} + b_2 * \text{CAR}_{it} + b_3 * \text{BSZ}_{it} + b_4 * \text{ASSETS QUALITY}_{it} + b_5 * \text{NIM}_{it} + e_{1it}$$

where;

**OEFF**= Bank Operating expense over total operating income: It refers to what occurs when the right combination of inputs such as staff, technology and process are used in production, while ensuring that costs are maintained at the desired level so as to improve productivity (Shawk, 2008)

**CAR**= Capital Adequacy Ratio; measured as the ratio of quotient of total bank capital with total assets.

**BSZ**- = It is the size of the bank measured by natural logarithm of Bank Total Assets

**NIM**= Profitability; = It is the Net Interest Margin of the bank measured the difference between bank's interest earned and that paid by the bank for its loan portfolio.

**LIQUIDITY**= A ratio of Loans to deposits. The loan-to-deposit ratio is a measure of liquidity. Higher figures denote lower liquidity.

**ASSETS QUALITY**= A ratio of liquid assets to bank deposits

**e1it**= The Error Term

### 3.3. Regression diagnostics

Before running regression, we perform regression diagnostic tests such as multicollinearity and heteroscedasticity. Multicollinearity, according to Sdenmund, (2011), is a condition where the explanatory variables are virtually linear dependent. In Table 2, we can observe that the highest correlation among all the variables is +0.75 which is the correlation between CAR and LIQUIDITY. However, an absolute value larger than 0.8 is preferred to be sufficient to cause multicollinearity as recommended by Studenmund (2011). Considering that +0.75 is not above 0.8, we conclude that no very serious problem of multicollinearity among our variables is expected.

Alternatively, to test whether there is a potential multicollinearity we employ Variance Inflation Factor (VIF) where a value of VIF exceeding 10 implies a potential problem as advocated by Belsley, Kuh, and Welsch (1980). VIF test shows that there is no problem related to multicollinearity because the VIF value is just 2.64 as shown in Table 3.

After the test for multicollinearity, we also performed a Breusch-Pagan test for heteroscedasticity. The concern of heteroscedasticity is the homogeneity of variance of the residuals. This is one of the conditions to be met before OLS regression is run. The results of Breusch-Pagan test are presented in Table 4. The results demonstrate a Chi value that is greater than the critical value, meaning that we could reject the hypothesis for homoscedasticity.



According to White (1980), the homoskedasticity assumption is needed to show the efficiency of OLS. The heteroskedasticity test shows that the variances of the OLS estimators are biased. Thus, the usual OLS t-statistics and confidence intervals are no longer valid for inference problem. Using OLS estimator without adjustment will render estimations biased.

According to Lotto (2018), since this study uses panel data, to solve the potential problem of heterogeneity either a fixed effect or random-effect regression model should be employed. To decide between fixed or random effects a Hausman test, where the null hypothesis is that the preferred model is random affects vs. the alternative the fixed effects (Greene, 2008.) is used. To do this, the Hausman test was conducted. The Hausman test shows whether the unique errors are correlated with the regressors; the null hypothesis is that they are not correlated. If the probability of chi-squared in the Hausman test output is less than 0.05 fixed effect is preferred otherwise random effect is preferable. When this test was run the Chi-squared is found to be 0.0876 which is greater than 0.05; hence, the study chose to apply random-effect regression model. Random effects model considers the differences between individual firm effects. The rationale behind random effects model is that, unlike the fixed effects model, the variation across firms is assumed to be random and uncorrelated with the predictor or independent variables included in the model.

## 4. Empirical results

### 4.1. Descriptive statistics

In this section, the descriptive statistics of the variables used in the study are summarized. Table 1 depicts that, on average, the operating efficiency of all sampled banks is about 18.2%. This is measured as the ratio of bank expenses to bank revenues. Table 1, also, shows that the minimum operating efficiency for the sample banks is 3.8% while the maximum is about 125%. The operating efficiency exceeding 100% is just for two smaller banks, namely, United Bank of Africa and FNB. When these two banks are ignored the average operating efficiency of the remained sampled banks is just about 13.6%. Basically, the mean value of bank operating efficiency of 18.2% tells us that on average the operating expenses of any bank in the sample of this study are just about 18.2% of the bank's total income. The operating efficiency is the measure of the banks' output in relation to the inputs, and the size of this ratio directly relates to the banks' profitability. The higher the operating efficiency ratio, the higher is the bank profitability and vice versa.

Table 1 also shows an average capital requirement of about 16% for all banks sampled in this paper. This level is slightly above a statutory capital requirement stipulated in the BOT (2014). It is also shown, in Table 1, that the maximum and minimum capital ratios for the sample are 77% and -0.0025%, respectively. This shows that even though the Tanzanian banks, on average, have the capital ratio above the requirement, most of them are financed generally by 16% equity implying that they rely more on the long-term liabilities to finance their assets. Furthermore, Table 1 shows that bank' size had a minimum of 12 and picks up to a maximum of about 25% with average (mean) of about 14%. It is also reported that the banks' profitability measured as Net Interest Margin has a mean value of about 45% with maximum of 94% and minimum of 6% as shown in descriptive statistics Table 1. Likewise, the descriptive statistic Table 1 shows that the ratio between loans to total assets of the banks which measures the bank asset quality averages 49% while the ratio between Liquid Assets to bank deposits which measures bank liquidity is around 75%

### 4.2. Regression results

The fixed effect robust regression results presented in Table 5 show that bank operating efficiency is impacted positively by bank capital adequacy, liquidity, bank size, profitability and asset quality. Starting with bank capital adequacy the results show that the relationship between bank capital ratio and operating efficiency is positive and statistically significant at 5% significant level. That means for every increase in one unit of bank capital ratio, the banks operating efficiency increases

**Table 1. Descriptive statistics**

	Obs.	Mean	Std. dev.	Min	Max
OPEFF	383	0.1637	0.1821	0.0380	1.2547
CAR	383	0.1560	0.8654	0.00025	0.7658
LQ	383	0.7574	2.3724	0.13273	0.3998
AQ	383	0.4922	0.1386	0.0045	0.8720
NIM	383	0.3784	0.2487	0.0570	0.9363
BSZ	383	13.5085	0.6163	12.1305	25.2325

**Table 2. Correlation Matrix for the OPEFF regression**

OPEFF	CAR	LQ	AQ	BSZ	NIM	
OPEFF	1.0000					
CAR	0.6958	1.0000				
LQ	0.6514	0.7486	1.0000			
AQ	-0.2656	-0.4398	-0.6448	1.0000		
BSZ	0.0799	-0.0149	0.0869	-0.2270	1.0000	
NIM	0.2541	0.2728	0.1299	0.0176	-0.2287	1.0000

**Table 3. A test of multicollinearity using VIF Test**

Variable	VIF	1/VIF
LQ	5.06	0.1977
CAR	3.73	0.2680
AQ	1.11	0.9010
NIM	1.15	0.8696
BSZ	2.15	0.4651
Mean VIF	2.64	

**Table 4. Test for heteroscedasticity for OEFF**

**Breusch–Pagan/Cook–Weisberg test for heteroskedasticity**

HO: Constant variance

Variables: fitted values of bank operating efficiency

Chi<sup>2</sup>(1) = 251.58

Prob >chi<sup>2</sup> = 0.000

by about 53%. From basic finance understanding, equity capital to total assets ratio represents the bank's capital structure and shows the ability of a bank to survive losses. The decline in the ratio signals increases risk exposure and the possibility of capital adequacy problem. Banks are, therefore, encouraged to have more of equity in their capital structure in order to minimize risk exposure and to improve their operational efficiency. Banks need to concentrate on capital adequacy and particularly on equity capital to total assets ratio as a way of improving their operating efficiency. Such a positive relationship may as well show that the improved regulations on capital requirements persuade the bank's decision to re-examine their operating strategies by possibly putting more emphasis on bank governance, bank risk management procedures, credit management, employing more qualified bank staff and improving banks internal controls as

previously advocated by Ramakrishnan and Thakor (1984). We should also understand banks with large capital base are in better position to explore more profitable avenues and expand their operations compared to undercapitalized banks which avoid investing in risky projects instead they prefer investing in less risky government securities. This finding is consistent with that of Das and Ghosh (2006) who find a positive relationship between capital regulation and bank efficiency. They argue that sufficiently capitalized banks are financially healthier. This ultimately improves the bank operating efficiency.

The results in Table 5 also show that bank liquidity has a positive significant relationship with bank operating efficiency. The relationship is reported to be significant at 10% significant level. The results of the liquidity-efficiency nexus were expected and not a surprise because bank efficiency is commonly improved for banks that hold liquid assets. The result is consistent with the arguments by Kashyap, Rajan, and Stein (2002), Gorton and Huang (2002), that banks that are liquid are more efficient in producing more output.

The results of this paper, presented in Table 5, relating the relationship between bank profitability on operating efficiency, show that bank profitability is statistically significant at 1% significant level. Like in the study by Dimitris (2008), this relationship implies that highly efficient and profitable banks have larger operating efficiency relative to less profitable and efficient banks. This finding is similar to Myron and Black (1983), Casu et al. (2004), Sanchez et al. (2013), Delis and Papanikolaou (2009) and Kalluru and Bhat (2009)

Table 5, further, shows that asset quality has a statistically significant relationship with bank operating efficiency at 10% significant level. Asset quality is an important factor in bank efficiency and the level of risk exposure of the banks is contributed mainly by asset quality of the bank. The study by Tsai and Hang (1999) suggested that quality of assets of the banks and cost efficiency are positively related which implies that managing non-performing loans reduce costs associated with loans portfolio.

Generally, this paper confirmed most of the previous results in Tanzanian context using a different methodological approach (Random-effect estimator). In contrast, previous similar work in Tanzania such as Raphael (2013) and Zawadi (2013) used a different Data Enveloping Analysis.

**Table 5. Random effect regression results on OPEFF model**

Regressor	Random effect (Robust Model)	
	Coeff.	t-stat
CAR	0.529	2.76**
LQ	0.089	1.95*
AQ	0.034	1.94*
BSZ	0.048	2.98**
NIM	0.379	3.13***
Constant	0.239	3.67***
Adj.R <sup>2</sup>	0.63	
F-stats	287.98(0.000)	
Durbin-Watson	1.87	

### 4.3. Robustness check

To test the robustness of the results, a different measure of bank efficiency was used. In the first regression, a ratio of bank operating expense over total operating income was used. This ratio refers to what occurs when the right combination of inputs such as staff, technology and process are used in production, while ensuring that costs are maintained at the desired level so as to improve productivity (Shaw, 2008). An alternative ratio (Operating Performance of the bank) which captures both efficiency and effectiveness of use of banks resources is used as a dependent variable. The operating performance of the bank (OP) is a function of both efficiency and effectiveness; this is to say efficiency and effectiveness are mutually exclusive. Performance is the product of efficiency and effectiveness, i.e.  $OP_{xy} = EESx * EEy$  where  $OP_{xy}$ , represents overall bank operating performance;  $EESx$  represents efficiency estimates;  $EEy$  represents effectiveness estimates. This has been used by Raphael (2013).

Mathematically; Efficiency (Asset Turnover) \* Effectiveness (Profit Margin) = Operating Performance (ROI). When the model with the new dependent variable was employed the general results were similar to the previous results, in the direction of the relationship, except that the significance of the variables changed. Some variables gained more significance while others lost their original strong significance. For instance, in Table 6, Capital Adequacy was originally statistically significant at 5% significant level, but it has now lost its statistical significance to 10%. On the other hand, liquidity, which was statistically significant at only 10% has now gained the statistical significance to 1% significant level. However, both Bank Size and Profitability have maintained their original status. In general, the results are robust regardless of the efficiency measure used.

### 5. Concluding remarks and recommendations

This paper aimed at examining the determinants of operating efficiency of commercial banks in Tanzania for the period between 2000 and 2017. The findings of the paper reveal that the liquidity of banks and capital adequacy is directly related to bank operating efficiency. This indicates that capital adequacy and liquidity do not only improve banks' financial stability by giving a larger capital cushion and rising bank liquidity level, but also increase bank operating efficiency by lowering moral hazard between bank shareholders and debt-holders.

Additionally, the study reports a statistically significant relationship between bank profitability and operating efficiency showing that banks should put more emphasis on improving their capacity to generate earnings to escalate their operational efficiency. The paper, further, shows that asset quality has a statistically significant relationship with bank operating efficiency. This

**Table 6. Random-effect regression results on new OPEFF model**

Regressor	Random effect (robust model)	
	Coeff.	t-stat
CAR	0.640	1.86*
LQ	0.077	3.95***
AQ	0.043	2.74**
BSZ	0.061	2.98**
NIM	0.358	3.13***
BANCONC	0.876	1.345
Constant	0.332	2.67**
Adj. $R^2$	0.56	
F-stats	146.79(0.000)	
Durbin-Watson	1.67	

implies that managing non-performing loans reduces costs associated with loans portfolio and that banks' optimal use of their asset capacity enhances their earnings ability.

Moreover, the positive relationship between bank operating efficiency and bank size reported in this paper commends banks to work hard to expand their market share through increasing their customer base to boost the operational efficiency.

Following the conclusions presented, this paper advises banks to avoid irresponsible lending that would increase the level of unsecured credits in banks' portfolio. The results of the paper encourage banks in Tanzania to monitor and evaluate these factors for improvement to enable the sustainability of banks and industry for economic growth. Furthermore, in order to keep the sound financial development of Tanzania, banks operating in the Tanzanian banking sector must consider all the potential technologies which could improve their profit efficiency levels, since the main motive of banks is to maximize shareholders' value or wealth through profit maximization.

Like any other studies, this paper has two limitations which, of course, do not affect the results presented. Such limitations include lack of data for some banks in some years and lack of some qualitative information which would complement the reported empirical results. To improve this study further, as a further research agenda, one may collect the qualitative information and complement the quantitative results, and also future studies one may use a complete set of all banks in Tanzania instead of focusing on only commercial banks.

#### Funding

The author received no direct funding for this research.

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#### Citation information

Cite this article as: Evaluation of factors influencing bank operating efficiency in Tanzanian banking sector, Josephat Lotto, *Cogent Economics & Finance* (2019), 7: 1664192.

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