

Determinants of Commercial Banks' Total Factor Productivity Growth in Sub-Saharan Africa (SSA)

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Abstract

The paper investigates the determinants of commercial banks' total factor productivity growth in Sub-Saharan Africa. The analysis uses an unbalanced panel of 216 commercial banks drawn from 42 countries, spanning the period 1999 to 2006. Using Solows' Gross Accounting and Decomposition procedure of the production function residual error, the model is estimated by robust panel methods. In the specification, the explanatory variables include growth in bank deposits, growth in other bank earning assets, liquidity ratio, and bank asset quality, as bank level factors; growth in GDP and real exchange rate, as macroeconomic factors. Results show that both bank-level and macroeconomic factors have an influence on banks' total factor productivity growth in Sub-Saharan Africa. These findings clearly show the importance of both bank level and macroeconomic factors in influencing banks' total factor productivity growth in Sub-Saharan Africa (SSA). The policy implications drawn from this paper is that if banks are to achieve total factor productivity improvements sustainably, both bank level as well as macroeconomic factors have to be equally taken care of in the planning processes.

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1 Introduction

The recent debate on economic performance of most of the Sub-Saharan Africa (SSA) economies reveal that the banking systems have played a very limited role in contributing to growth in terms of resource mobilization to facilitate private sector investments. The literature points potential causes of SSA's poor economic performance, ranging from

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external shocks to domestic policies including poor financial performance. Notwithstanding various efforts through financial sector reforms, financial markets have remained largely fragmented with substantial gaps in the financing of economic activities for private agencies. Since the 1980s, the importance of the banking sector motivated the liberalization and restructuring of state dominated monopolistic, inefficient and fragile banking systems in Sub-Saharan Africa (SSA) to contribute to economic development (Hauner and Peiris, 2005). Most of the banking sector were heavily regulated before the reforms and could have affected market entry and exit, capital adequacy levels, reserve and liquidity requirements, deposit insurance and determination of interest rates on deposits and loans.

Like in other developing countries, commercial banks in SSA have experienced a major transition in the last two decades. The banking industry is a mixed one, comprising of local private and foreign commercial banks. Many efforts have been made to explain the performance of these banks. Understanding the performance of banks requires knowledge about the relationships between the different bank performance measures of internal and external determinants (Yigremachew, 2008). It becomes imperative for banks to endure the pressure arising from both internal and external factors and to prove to be profitable. This study therefore is an attempt to investigate the determinants of commercial banks' total factor productivity growth. This considers the effect of the variables related to bank size, capital adequacy, liquidity risk, asset quality, credit risk, operational and intermediation costs and the prevailing economic environment. Based on the theoretical models by different scholars, banks have been modeled as dealers in the credit market acting as intermediaries between suppliers and demanders of financial funds. It is therefore important that more information is generated on this sector to know how efficiently it can supply credit to the market participants.

Different from a few studies on SSA commercial banks that have limited focus, coverage and estimation techniques, the focus of this paper uses an elaborate data drawn from 42 SSA countries and as well robust panel methods both in the estimation techniques and empirical tests. The paper examines the determinants of Sub-Saharan commercial banks' total factor productivity growth spanning the period 1999 to 2006 using static panel methods.

Despite financial sector reforms in Africa since the 1980s and 1990s, commercial banks' performance have remained poor and inefficient in the overall financial intermediation. Poor performance of the banks have continued to be reflected into the low levels of key indicator performance like poor asset quality, limited and or inadequate capitalization, operational inefficiencies, and higher incidences of non-performing loans, higher levels of liquidity risk and high cost in overall financial intermediation. Poor performance of commercial banks is also blamed to low levels of economic performance as mirrored in the high interest rate spreads, high inflation rates, high interest rates, lower deposit rates to capital investment, high volatility in exchange rate, and low growth in GDP and GDP per-capita. These observations are also emphasised by Bonaccorsi di Patti and Hardy (2005), Berger *et al.* (2005), among others.

This study which focuses on the determinants of commercial bank's total factor productivity growth in SSA for the period 1999 to 2006, is in response to what has been proposed in several empirical studies for SSA commercial banking system. In all these studies, it is recommended that more studies to understanding the African banking sector performance is important. World Bank (2006) also emphasises the need to undertake deeper analysis on commercial banking in SSA, where performance has not been

impressive, as this would provide more information on industry performance in the sub-region. In understanding the factors that influence commercial banks' total factor productivity growth in SSA, the paper is guided by a specific objective as stated below.

The objective of the paper is to investigate the determinants of commercial banks' total factor productivity growth in SSA for the period 1999 to 2006. The research helps to draw policy implications for improving financial intermediation in the sub-region, using bank level data. The main hypothesis of the study is therefore to understand whether both bank level and macroeconomic factors significantly influence commercial banks' total factor productivity growth in SSA.

The rest of the paper is organized as follows; section two, the literature review on banks' total factor productivity is explained. The conceptual framework and methodology are discussed in section three. In section four the regression results are discussed; while in sector five, the conclusions and policy implications for the study are given.

2 Literature Review

2.1 Determinants of Bank's Total Factor Productivity

A number of factors have inspired research on banks' productivity (Berger *et al.*, 1997; Hardy *et al.*, 2005). First, there is the mainstream economic thinking that improving the efficiency of the financial systems is better implemented through the sector liberalization and restructuring aiming at increasing bank competition on price, product, services and territorial rivalry. However, empirical evidence on the impact of financial liberalisation on bank efficiency is mixed. Berger and Humphrey (1997) stated that the consequences of opening up banks to competition could essentially depend on industry conditions prior to the reform process as well as on the type of measures implemented. Restructuring and liberalization of the volume and value of interest rates of bank lending could result into improvements in both efficiency and productivity of banks (Berg *et al.*, 1992; and Zaim, 1995). However, the impact of liberalization on banks' performance could result in varied productivity efficiency depending on the type of ownership (Bhattacharya *et al.*, 1997).

Pastor, Perez and Quesada (1997) analyse efficiency differences in technology in the banking systems of United States, Spain, Germany, Italy, Austria, United Kingdom, France and Belgium for the year 1992. Using the non-parametric data envelope analysis together with the Malmquist index compares the efficiency differences in technology of several banking systems. Their study used value added technique to measure bank efficiency. Deposits, productivity assets and loans nominal values were selected as measures of bank's output, under the assumption that these are proportional to the number of transactions and the flow of services to customers on both sides of the balance sheet.

Similarly Bikker (2001) examines the determinants of bank productivity using a sample of European banks in various countries including Italy during the period 1989 to 1997. Results reveal that the most inefficient banks were first the Spanish ones, followed by the French and the Italian banks. The most productive banks are the ones in Luxemburg, Belgium and Switzerland. Hasan, Lozano-Vivas and Pastor (2000) study the banking system of Belgium, Denmark, France, Germany, Italy, Luxemburg, Netherlands, Portugal, Spain and the United Kingdom. First, the authors attempt to evaluate the efficiency scores of banking businesses operating in their own respective countries. Later, they use a common frontier to control for the environmental conditions of each country.

Banks in Denmark, Spain and Portugal were found equally technically efficient and successful.

Recent studies on China show that research on bank efficiency and productivity are not conclusive and result into mixed findings. This suggests a call for further research to provide more information on the banking sectors in the world. Berger *et al.* (2006) applied the trans-log production functional form to estimate the profit efficiency of different banking ownership groups in China, for 1994 to 2003 period. The finding reveal that foreign banks are more efficient and profitable followed by private domestic banks.

2.2 Approaches to studying Bank's Total Factor Productivity

Pasiouras and Sifadaskalakis (2007) examined the determinants of total factor productivity growth of Greek Cooperative banks and found that there is a variation in the definition of bank inputs and outputs. These results tend to agree with other similar studies that there is no agreed common position for proper definition of bank inputs and output in measuring bank performance. Bregendal (1998) further explained that in studying banks, there could be as many assumptions and considerations for the various bank inputs and outputs as there as there could be applications in estimating banks' performance. On the other hand, Freixas and Rochet (1997) gave three common approaches in bank literature that could be used to discuss bank activities. These include; the production approach, the intermediation approach and the user cost approach with the modern approach that is combination of the production and intermediation approaches.

The production and intermediation approaches apply the traditional microeconomic theory of the firm to banking and differ only in the specification of banking activities. The third approach goes one step further and incorporates some specific activities of banking into the classical theory and hence modifies it. In the production approach, banking activities are described as the production of services to depositors and borrowers. Traditional production factors, land, labor and capital, are used as inputs to produce desired outputs. Although this approach recognizes the multi-product nature of banking activities, earlier studies ignore this aspect of banking products, partly because the techniques to deal with scale and scope issues are not well developed (Freixas and Rochet, 1997). This approach suffers from a basic problem in terms of measurement of outputs. Is it the number of accounts, the number of operations on these accounts, or the dollar amount that are important. The generally accepted approach is to use dollar amount because of availability of such data.

The intermediation approach is in fact complementary to the production approach and describes the banking activities as transforming the money borrowed from depositors into the money lent to borrowers. This transformation activity originates from the different characteristics of deposits and loans. Deposits are typically divisible, liquid and riskless, while on the other hand loans are indivisible illiquid and risky. In this approach, inputs are financial capital—the deposits collected and funds borrowed from financial markets, and outputs are measured by the volume of loans and investments Modern approach has the novelty of integrating risk management and information processing into the classical theory of the firm. In some instances it is referred to as the user cost approach (Egesa and Abuka (2007). One of the most innovative parts of this approach is the introduction of the quality of bank assets and the probability of bank failure in the estimation of costs. It is further revealed that this approach could be embedded in the previous approaches (Freixas and Rochet, 1997). It is suggested that dual models that are robust are more in

studying banks than applying individual methods.

Using the user-cost approach, banks are analyzed as production units (Ferrier and Lovell, 1990). In other studies: Berger and Humphrey (1997); Nannyonjo (2002); Egesa and Abuka (2007); Anthanassopoulos and Giokas (2000); Wheelock and Wilson (1999) and Dogan; and Fausten (2003), on the efficiency of banks in Uganda, Europe and Middle East countries, consider banks as intermediary institutions. Although it is obvious that banks carry both functionalities, for a quantitative study, the choice has to be made due to a conflict in variable definitions. As a result of a non-agreement among the various approaches, modern methods are recommended in studying bank efficiency. The modern approach assumes that banking is a simultaneously occurring two-stage process. During the production stage banks collect deposits by using their resources, labour and physical capital. Banks use their managerial and marketing skills in the intermediation stage to transform these deposits into loans and investments. This framework is employed to determine the application process as well as the selection of inputs and outputs for the analysis of efficiency. In the modern approach, the role of production, cost and behavior of a bank is analyzed within the context of a profit maximizing producer. Under this assumption, a bank is assumed to make its price and output decisions depending on the market value of its costs and revenues. Only those services that are associated with acquisition of earning assets are regarded as economic outputs of the bank.

3 Theoretical Framework for Bank's Total Factor Productivity

3.1 Theoretical Basis for the Model

The generic model adopted is the Solow's growth function, which also takes the Cobb-Douglas production framework. Using the Growth Accounting Decomposition process of the Solow' Growth Residual Error, total factor productivity growth (*tfpch*) of the bank is derived. This is then used to specify total factor productivity growth function using the identified key variables identified from theory and empirical literature as determinants of banks' performance. Miller and Upadhyay (2000) show that Cobb-Douglas production function is used as a basis for derivation of the determinants of total factor productivity growth (*tfpch*) of firms; where banks in this case are treated as firms.

3.1.2 Generating bank's total factor productivity function

Adopting the structure of the above studies, Solow's growth models use basic Cobb-Douglas production function to derive the firm's factor productivity variable. In implementation, a trans-log function which in theory is more flexible and attractive is applied. For the exposition here, the simplest conceivable two-factor productions function is adopted.

$$Y_{it} = A_{it} \cdot L_{it}^{\beta} K_{it}^{\gamma} \quad (1)$$

where $(\beta + \gamma) = 1$ implies constant returns to scale.

Y_{it} is a measure of output such as value added, while L and K represent labour and capital

respectively. (A) is the total factor productivity *tfpch* because it increases all factors' marginal product simultaneously.

Transforming the (1) above production function into a log-linear function yields (2);

$$y_{it} = \beta \cdot l_{it} + \gamma \cdot k_{it} + u_{it} \quad (2)$$

where the lower case denote the natural logarithm. The residual of this equation is the logarithm of the firm specific total factor productivity A_{it} . In this basic framework, the residual error term u_{it} in (2) can be split into two elements ($\omega + e_{it}$);

$$y_{it} = \beta \cdot l_{it} + \gamma \cdot k_{it} + \omega + e_{it} \quad (3)$$

where lower case denote the natural logarithm. ω is the part of the error term that is observed by the firm early enough to influence decisions and e_{it} is the true error term that may contain both the unobserved shock and measurement error.

Using the growth accounting process, a firm's productivity function is generated from Solow's growth function residual error ω equation (3) as;

$$\omega = f(k_t, l_t) = \{\partial A_t / t = \Phi_t = q_t - (l_t / Q_t) \cdot (\partial Q_t / l_t) \times l_t\} - \{(k_t / Q_t) \times (\partial Q_t / k_t \times k_t)\} \quad (4)$$

under competitive labour and capital markets, the marginal product of each of the factors equals their respective price and equals $(l_t + k_t) = 1$

where (q_t , l_t and k_t) denote the growth rates of bank variable output, banks labour, and capital respectively and Φ is the rate of total factor productivity growth.

By assuming perfect competition and profit maximization of a firm, under such conditions, the price elasticity of demand is infinite; factor elasticities equal the factor shares in output. This decomposes in the final equation given as:

$$\log A_t = q_t - a_l l_t - (1 - a_l) k_t \quad (5)$$

Where A_t is factor productivity; a_l , l_t and $(1 - a_l)$ are labour and capital shares in output respectively. This is also referred to as "Division Index Weighing System). Taking log either side, equation (5) further decomposes to (6):

$$\log A_t = \log (l_t + k_t) \quad (6)$$

Where A_t = total factor productivity growth and $\log (l_t + k_t)$ is also growth in the share of labour and capital in total output. When prices are attached, this can expressed as the total log (share of labour and capital expenses in total income). Using the same nomenclature the bank total factor productivity can be expressed as (7):

$$\log A_t = \log (e_l + e_k) \quad (7)$$

Where $\log A_t$ = total factor productivity; e_l = proportion of operating on labour in total operating income; and e_k = share of operating expenditure in total operating income. The

total factor productivity growth value was computed as log (total operating expenses to total operating income (*toe/toi*) from the bank data set drawn from BankScope data base. The generated *tfpch* values were then used as dependent variable in estimating total factor productivity growth function. This took a log linear panel structure to measure the marginal effects of the explanatory variable to bank total factor productivity growth.

3.1.3 Measurement of bank's total factor productivity growth

Using the nomenclature of equation (7), the determinants of bank total factor productivity growth is based on a basic specification of the form (8);

$$tfpch_{it} = c + \Omega_i \ln x_{it} + \gamma Macro + \varepsilon_{it} \quad (8)$$

The model is further applied as a two way error correction component, where is given as;

$$\varepsilon_{it} = \eta_i + \lambda_t + v_{it} \quad (9)$$

is the time effect across bank

Where *tfpch_{it}* is bank total factor productivity growth that measures performance; *i* denotes the individual bank classification, *t* is the time period, η_i is the unobservable bank specific effects, macro consists macro variables, λ_t is time-specific effects and v_{it} is the remainder error term assumed to be white noise stochastic error term, α is a constant and Ω is a (Kx1) vector of the coefficients of *K* explanatory variable.

3.1.4 Model specification

The variable selection for this study relied mainly on the user-cost approach in the classification of bank inputs and outputs. Using these criteria, the key bank input and output indicators for measuring performance included: total deposits, total other earning assets, capital adequacy, liquidity, loan quality and earnings. These indicators were used to construct the bank total factor productivity change function for the study. They are augmented with macroeconomic factors which were considered as input exogenous factors to the bank including level of economic performance and financial liberalization variables

Empirical literature provides a list of bank inputs and outputs as financial indicators that are used to measure total factor productivity growth for banks. These are contained in the bank balance sheet and financial accounts and categorized into bank level and macroeconomic variables. These include total bank deposits, total customer loans, other earning assets, capital adequacy, liquidity ratio, and total assets, profitability as bank level variables aggregated bank input and outputs. These are usually augmented by macroeconomic factors in the estimation of banks' total factor productivity growth.

In this study, total factor productivity growth *TFPCH* is considered as the dependent variable while; growth in bank deposits, growth in other earning assets, operational efficiency, capital adequacy, asset quality, liquidity ratio, growth in *GDP* and growth in exchange rate, variables considered as explanatory variables. Using the identified variables, a regression specification is constructed and presented as;

$$TFPCH_{it} = c + \Omega_1 \ln TD_{it} + \Omega_2 \ln OEA_{it} + \Omega_3 NLTA_{it} + \Omega_4 NLTDS_{it} + \Omega_5 ROAA_{it} + \Omega_6 \ln GDPA_{it} + \Omega_7 \ln EXE_{it} + \varepsilon_{it} \quad (10)$$

Where $TFPCH$ = total factor productivity growth, $\ln TD$ = growth in bank deposits, $\ln OEA$ = growth in other earning assets; $NLTA$ = liquidity ratio; $NLTDS$ = asset quality indicator represented net loans over depreciation plus short term financing; and $ROAA$ = profitability ratio which shows the level of bank earnings. The macroeconomic variables include GDP growth and growth in real exchange rate that have an influence on bank efficiency; and $\Omega_1, \dots, \Omega_7$ are coefficients of explanatory variables. The variables estimate the influence of bank as well as macroeconomic factors on total factor productivity change for SSA commercial banks.

3.1.5 Variables and expected impact on bank total factor productivity growth

In estimating the bank function, total factor productivity growth $TFPCH$ is regressed against the identified key bank-specific as well as macroeconomic variables used as explanatory variables. According to classical bank theory and other empirical studies, the expected impact of these explanatory variables to total factor productivity growth is illustrated in table 1 and further explained in the section that follows.

Table 1: Determinants of Bank Total Factor Productivity Growth and Expected Impact

Explanatory variable	Expected impact
Growth in bank deposits $-(\ln td)$	Positive
Growth in other earning assets $-(\ln oea)$	Positive
Liquidity ratio $-(\ln lta)$	negative
Asset quality $(\ln ltds)$	Positive
Bank profitability $-(\ln roaa)$	Positive
Growth in GDP $(\ln gdp)$	Positive
Growth in real exchange rate $-(\ln ex)$	Positive

Source: Empirical literature

Total bank deposit is the total sum of demand and savings deposits, by bank and non-bank depositors. This could also be a measure of bank risk. Increase in both saving and demand deposits are likely to increase the loan portfolio of banks and bring about increased returns to bank assets and factor inputs (labour and capital). Tabi Atemnkeng *et al.* (2006) show that the composition of bank deposit is an important variable that could influence banking system performance. Naceur *e t.al* (2003) also indicate that bank deposit accounts relative to assets have a positive impact on bank's efficiency and factor productivity growth.

Other bank earning assets could be represented by the sum of total securities, deposits with banks and equity investments. This variable reflects the bank level of diversification in asset portfolio choices and ensures stability and efficiency of banks in rendering services to the economy. Financial institutions in recent years have been generating income from "off-balance sheet" business and fee income, as a way of diversification into trading activities, other services and non-traditional financial operations (Uzhegova 2010). The concept on revenue diversification follows the concept of portfolio theory which states that individuals can reduce firm-specific risk by diversifying their portfolios.

Chiorazzo *et al.* (2008) note that diversification into bank activity could lead to increased efficiency of a bank through economies of scale through joint production of financial activities. Product mix reduces total risks and improved bank efficiency through earning from non interest activities. In this case growth in other bank assets as way of diversification could have a positive effect on bank efficiency and total factor productivity growth. The expected impact of this variable to total factor productivity growth could be positive. There is also an opposite argument that the bank activity diversification could lead to high risk to the bank through agency costs and organizational complexity. The benefit of diversification into other earning assets or activities may overshadow the benefits of diversification. In this case diversification into other earning assets has a negative effect on bank efficiency. This variable therefore could have negative effect in this case.

Bank liquidity ratio indicator is expressed as the ratio of net loans over deposits plus short-term funding. This would imply that to sustain bank liquidity, bank managers have to strike an optimal balance given the risk return trade off of holding a relatively high proportion of liquid assets. Too little liquidity could force the banks to borrow at penal rates from the inter-bank market and or central bank, depending on its reputation. On the other hand, a high ratio could result in a loss of profitable investments, making the sign of the variable unclear (positive or negative), depending probably on the underlying economic factors. Tabi Atemnkeng *et al.* (2004) also indicate the composition of bank liquidity ratio is significant in commercial banks' profitability and factor productivity growth.

Bank profitability, commonly represented by return on average assets (*ROAA*), net interest margin (*NIM*) and return average equity (*ROAE*), is considered one of the important standard measures of bank profitability (Panayiotis *et al.*, 2005). The measure reflects the ability of bank management to generate profits from bank assets. Increased profits to banks are expected to generate revenues from which operating expenses and provisions for loan losses are covered. The reverse is however true. It implies therefore that higher bank profitability ratios could result into improved bank efficiency and vice-versa. The expected sign of this variable is positive to bank factor productivity growth.

Asset quality expressed as net loans over depreciation plus short term financing could also indicate the level of credit risk banks do face. Credit risk is one of the factors that affect the health of banks. The quality of assets held by the bank depends on exposure to specific risks, trends in non-performing loans and the health and profitability of bank borrowers. Aburime (2008) establishes that bank profitability depends on the ability to foresee, avoid and monitor risks, possibly to cover losses brought about by risks. This would also imply that the expected impact of this variable could therefore be negative.

The type of macroeconomic and policy environment determines the level of total factor productivity of banks (Egesa and Abuka, 2007). The deregulation of the financial sector improves bank productivity through profitability changes. Mishkin (1991) shows that productivity of banks is likely be affected by the level of economic performance such as a slow GDP growth, volatility of interest rates, an expected domestic currency depreciation, price level volatility, uncertainty, high share of non performing credit to private sector and adverse terms of trade movement. Real growth in exchange rate could be a measure of financial liberalization. Total factor productivity of banks with weak macroeconomic conditions is likely to be low and negative. Bashir (2000) shows that growth in GDP is expected to impact bank performance by influencing numerous factors related to supply

and demand for loans and deposits. Growth in real exchange rate, an indicator for financial liberalization is very important factor in determining bank factor productivity growth. Chirwa *et.al.* (2004) establish that factor productivity of banks could be negatively affected by currency depreciation and price level volatility.

3.2 Methodology, Empirical Data and Analysis

To construct the sample, data was generated from financial statements of individual banks provided in the Bank-Scope-Database. The Bank-Scope Database is an assemblage of data of balance sheets, income statements and other relevant financial accounts of all financial institutions in the World. The SSA commercial banks' data was accessed through Bank of Uganda (BoU). To ensure consistency, only data for commercial banks in the unconsolidated format was used. The period of study is 1999 to 2006. The choice for this period is driven by data availability in the BankScope data base which has larger lags in updating from world's banking institutions. This period is also appropriate because it falls within the period where banking sector reforms have been implemented in SSA.

Data was drawn from 42 countries and 216 commercial banks, for 1999 to 2006 period. In total, there were 1316 observations. In the model specification both bank and macroeconomic variables that influence bank's total factor productivity growth as defined by theory and empirical evidence are included. Bank level variables include growth in bank deposits, growth in other bank earning assets, bank liquidity ratio, bank asset quality, and bank profitability while macroeconomic variables include growth in GDP and real exchange rate growth. Data was downloaded in Microsoft Office, arranged in panel sets, and analyzed using STATA- 11.

3.3 Robustness and Specification Tests

Panel estimation is commonly by three estimators of fixed effects (FE), random effects (RE) and generalised method of moments (GMM-IV). Depending on the type of data and time period, this is applied either in static or dynamic forms. Dynamic form especially when the data set have larger time periods and observations (Baltagi, 2005). To test for efficiency between the (FE) and random effects (RE) estimators, the Hausman Specification test is applied. To check for the significance of the models, F-test and Modified Wald Statistic are applied. The effect of time in the trend data is also tested by including time dummy variable.

Panel stationarity test is conducted using the Fisher type-tests that are recommended for unbalanced panels (Baltagi, 2005). In this test non-stationarity in the panel series is the rejection of null hypothesis that all the panels have unit root. This is where the $t(z)$ -statistic is less than $t(z)$ -critical. The fisher-test uses four other type tests including inverse-chi-squared test (P), inverse normal (Z), inverse logit (L*) and modified inv.chi-squared (PM). The inference is made using a maximum limit of p value =1.00. Baltagi (1998) conclude that when panels are stationary, it so happens that they are integrated and could generate at least one co-integrating equation.

4.0 Results and Discussion

In this section determinants of commercial bank total factor productivity growth in Sub-Saharan Africa (SSA) are analysed. The dependent variable is the total factor productivity growth (*tfpch*) and is generated through a gross decomposition process of the Solow' gross residual error. The explanatory variables include bank level; growth in bank deposits, liquidity ratio, and other earning assets, asset quality, and profitability; and macroeconomic factors include GDP growth, real exchange rate growth. The study also used unbalanced panel data of 216 commercial banks from 42 countries. Panel methods are used to estimate the regression equations. The analysis utilizes a panel data set of 216 SSA commercial banks spanning over the period 1999 to 2006.

4.1 Data Characteristics

Table 2 gives a descriptive statistics of the variables used in the thesis. This gives the number of observations, means, minimum and maximum values and standard deviation of the variables. The statistics confirm that there was adequate data for all the variables utilised in estimation, with observations ranging above 1100 for all of them. Descriptive statistics clearly show that there was higher variability in the quality of assets at about 79.72 percent across banks in SSA. This could be explained by higher levels of non-performing loans which is characteristic of most of SSA commercial banks as in indicated by Nissanke and Aryeetey (2006), among others.

Modest variability is recorded in bank liquidity at about 19.784 percent. This could also be explained by the different levels of capitalization banks receive in the different countries through different channels. In other bank specific variables of growth in bank deposits, growth in other earning assets, bank profitability, there is a low variability across commercial banks in the sub-region. This could be true given the liberalized nature the banking system in SSA is operating with heavy presence of multilateral firms and external financing exposure. For the macroeconomic variables of growth in GDP and growth in exchange rate across the sub-region, there is evidence of low variability in the variables across the sub-region and this could have contributed to the stability of the banks and attracted foreign investment in the sector in the last 2 decades. Lowest variability is exhibited in total factor productivity growth, but at lower levels ranging between -3.59 percent to 4.14 percent. This level of total factor productivity growth for commercial banks is far below the emerging and developed countries which in excess of 50 percent.

Table 2: Descriptive statistics of the variables

Variable	Obs.	Mean	Std.dev.	Min	Max
Total productivity	1258	-0.40	0.496	-3.593	4.140
Growth in deposits	1261	5.51	2.805	0.194	15.580
Growth in other assets	1220	4.83	2.984	0.005	15.270
Bank liquidity	1315	43.93	19.784	0.210	96.64
Asset quality	1296	65.56	79.712	0.630	80.270
Bank profitability	1297	2.30	4.326	-0.56	49.640
Growth in GDP	1138	22.36	1.201	19.81	25.800
Growth in RER	1136	5.45	2.141	1.100	10.015

Source: Panel estimates: 1999 - 2006.

4.2 Specification and Robustness Tests

4.2.1 Stationarity test

To check for the stationarity of the variables, panel unit nit-root using Fisher-type tests was applied. This was by the Augmented Dickey-Fuller test for unbalanced panels (Baltagi, 2005). All the four tests, inverse chi-squared (280) P, inverse normal (Z), inverse logit (L*) and modified inv. Chi-squared (PM) were run at zero difference level and lag length of (2). Only (280) P and (PM) type generated efficient results used in the analysis as given in table 3.

Table 3: Unbalanced panel Unit-Root test results

Variable	Fisher-type panel tests				Lag length	Deduction $P \leq \alpha ; p \geq \alpha$
	{(280) P}		PM			
	Statistic	P.Value	Statistic	P.Value		
Total factor productivity growth - (tfpch)	0.000	1.000	-11.8322	1.000	2	I(0)
Growth in bank deposits- (ltd)	0.000	1.000	-12.0830	1.000	2	I(0)
Liquidity ratio (nlta)	0.000	1.000	-12.1655	1.000	2	I(0)
Asset quality- (nltds)	0.000	1.000	-12.083	1.000	2	I(0)
Growth in other earning assets - (oea)	0.000	1.000	-11.9583	1.000	2	I(0)
Bank profitability	0.000	1.000	11.786	1.00	2	I(0)
GDP (gdpa)	0.000	1.000	-11.8322	1.000	2	I(0)
Real exchange rate- (exe)	0.000	1.000	-11.7473	1.000	2	I(0)

Notes:

Ho: All the panels contain unit roots

HA: At least one panel is stationary

Panel mean included

Time trend included

Drift term excluded

Source: Panel Computation, 1999 - 2006.

Results indicate that at least one of the panel is stationary with $P \leq \alpha$; $P \geq \alpha$ and integrated at zero difference level given by I (0). This is confirmed by a rejection of the null hypothesis of non-stationary. The results confirm that all the variables are integrated and can generate at least one co-integrating equation.

4.2.2 Hausman specification test

This tested the efficiency and consistent between the FE and RE estimators. Although the econometric theory recommends RE estimation for unbalanced balanced panels, a confirmatory test by use of the Hausman specification test. In this test a rejection of the null hypothesis is when $Prob > chi2 = \alpha$, confirms the efficiency and consistency of the RE is estimating the model. Table 4 presents the results based on the test.

Table 4: Hausman specification test between FE and RE estimators

Variable	Coefficients			
	(b) Fixed	(B) Random	(b-B) Difference	(Sqrt)diag(V_b-V_B)
growth in bank- (ltd)	0.0246	0.8756	-0.0630	0.2022
liquidity ratio (nlta)	-0.0037	-0.00612	0.0024	0.0009
asset quality- (nltds)	0.0090	0.0014	-0.0063	0.0003
other earning assets -(loea)	-0.0842	-0.1046	0.0241	0.1643
bank profitability	-0.0628	-0.0670	0.0041	0.0013
growth in gdp - -(lgdpa)	-0.0043	0.0338	-0.3802	0.0865
growth in exchange rate - (lexe)	0.0348	0.0348	-0.0178	0.0187

Notes:

B = consistent under h_0 and h_a ; obtained from xtreg

b = inconsistent under h_a , efficient under h_0 ; obtained from xtreg

test: h_0 : difference in coefficient is systematic

chi2(7) = (b-b)'[v_b-v_b] (-1) (b-v) = 30.29; prob > chi2 = 0.0001

Source: panel computation, 1999 - 2006.

Other diagnostic tests included F-statistic and Wald tests for the model significance, auto colleration and multi-collineraity. All these tests confirmed that the models were correctly specified and had no autocorrelation and multicollinearity in the robust models of RE and FGLS. The effect of time in the specification was also tested and confirmed that there was no time effect in the specification which is consistency with econometric theory (Baltagi et.al. 2005) that panels with lower time periods and larger observations tend to be efficient in static models for they have limited autocorrelation and endogeneity specification effects.

4.3 Discussion of Results

Table 5 presents the panel regression results based on three estimators: fixed effects (FE), random effects (RE) and feasible generalized least square (FGLS). The RE and FGL estimators have similar results and therefore used in the discussion. This confirms that both RE and FGLS are efficient in estimating this model.

Table 5: Total factor productivity growth (tfpch)*

Variable	FE Model		RE Models		FGLS Model	
	Coeff.	P.Value	Coeff.	P.Value	Coeff.	P.Value
Growth in bank deposits- (lntd)	0.0246	0.456	0.0875	0.001***	0.1284	0.000***
Liquidity ratio (nlta)	-0.0037	0.020**	-0.0061	0.000***	-0.0087	0.000***
Asset quality- (nltds)	0.001	0.064*	0.0015	0.000***	0.0020	0.000***
Growth in earning assets (lnoea)	-0.0842	0.005***	-0.1046	0.000***	-0.1370	0.000***
Bank profitability	-0.0628	0.000***	-0.0700	0.000***	-0.0744	0.000***
Growth in GDP (lngdpa)	-0.0042	0.962	0.0340	0.057*	0.0327	0.002***
Real exchange rate growth(lnexex)	0.017	0.427	0.035	0.001***	0.0370	0.000***
Constant	0.1131	0.953	-1.001	0.014**	-0.9645	0.000****
No. of Obs.	999		999		999	
Group Banks	183		183		183	
R.sq:	0.23		0.36			
F-Statistics	F(7,809)= 61.84		F> 0.00			
Wald-Statistics	-Waldchi2(7) = 534.59		Prob>chi2 = 0.000		Prob>chi2 = 0.000	
Wald-Statistics-Wald chi2(7)	= 597.78					
Log likelihood					-457.475	

Source: Panel estimation, 1999-2006.

Note: 1. Ln = Natural logs (log); 2. ***, **, * = Significant at 0.01, 0.05 and 0.10, respectively

*Panel regression results for all sample banks

The coefficient of the variable representing growth in bank deposits is positive and significant at 5 percent and 10 percent levels in both RE and FGLS models. This is consistent with Naceur *et al.* (2003) that bank deposit accounts relative to assets have a positive impact on efficiency and factor productivity growth. Banks deposits are a source of cheaper bank loans and have positive implications to profitability and factor productivity through increased demand for private credit and investment in other bank earning assets.

The proxy measure of bank liquidity risk (*net loans to total assets*) exhibits a negative relationship with bank productivity growth and significant at 5 percent and 10 percent levels, in both RE and FGLS models. The finding clearly shows negative relationship between bank's total factor productivity growth and the level of liquid assets held by the bank. As higher figures of the ratio denote lower liquidity, the results imply that the more efficient (inefficient) banks tend to be more (less) liquid.

The relationship between asset quality given by net loans to total deposits plus short term financing is positive and significant at 10 percent in FE model and 5 percent in both RE and FGLS models. This shows that total factor productivity growth for SSA commercial banks is positively affected by good asset quality. The positive relationship means that banks which are efficient in monitoring their credit loans tend to be more profitable and

therefore register higher factor productivity. This in line with theory that reduced exposure to credit risk is normally associated with higher bank productivity indicated in Flamini *et. al* (2009) studies on Sub-Saharan African commercial banks.

The coefficient of bank profitability (return on average asset) is negative as expected and significant at 1 percent at all regression levels. This reveals the low levels of bank's profitability averaged at 11 percent across all the sample banks negatively influence bank's total factor productivity growth. This finding would indicate that the less profitable banks, the more they become relatively less efficient in their intermediation function. This corroborates with similar findings of some previous studies by Isik and Hassan (2002). Banks reporting higher profitability ratios are usually preferred by clients and therefore attract the biggest share of deposits as well as the best potential creditworthy borrowers. Such conditions create a favourable environment for the profitable banks to be more efficient from the intermediation activities point of view. Positive and significant profitability would imply that the banks are able to generate positive revenues that could cover bank expenses and provision for bank loans, leaving net surplus revenues. In any progressive banking system, net incomes could have a bearing on factor productivity growth and portfolio investments.

Regarding macroeconomic variables, there is a positive and statistically significant relationship between growth in GDP and total factor productivity growth at 5 percent and 10 percent levels for FGLS and RE models, respectively. This suggests that the higher GDP growth in an economy the more efficient and productive banks become as they respond to rigorous economic activity through investment demand and private sector credit supply (Hiroiyuki KIYOTA, 2009). This is consistent with theory and empirical evidence that prudent economic performance may result into some improvements in a bank's factor productivity to some extent. The literature further explains that there are also reasons as to why the effect of growth rate in GDP to bank productivity could be negative or positive. Firstly, bank credit could decrease during economic down swings, since such periods are normally associated with increased risk and vice-versa. In absence of this variable however; it is also observed that this variable could be partly captured by bank-specific variables.

The coefficient of real exchange growth variable has the expected positive signs at 1 percent, 5 percent and 10 percent levels for RE and FGLS models. This would suggest that cases where there is a positive change in the value of exchange rate, there are likely to be better chances of increased borrowing by private sector for investment and importation of capital goods into the economy to enhance domestic production. The positive impact of in real exchange rate growth could be a result of stability in the exchange rate market resulting from central bank interventions (Atingi Ego and Kagwa Sebudde, 2003). This could be true for most of the countries in SSA during the liberalization period of 1980s and 1990s. Most of the countries have operated a free market exchange rate regime moderated by the central banks to stabilize their exchange prices to the levels that stimulate total factor productivity growth in the various sectors including the services sectors to realize factor productivity growth.

5 Conclusions and Policy Implications

Results do confirm the importance of bank and macroeconomic factors to banks' total factor productivity growth in SSA. This suggests that banks should ensure efficient and

effective supervisory and related service for optimum utilization of resources. Activities would include equitable investment of resource gains from different investments such as earning bonds and securities banks trade in, prudent resource management to avoid high levels of liquidity risk, increased supervision to avoid high levels of non-performing loan ratios, ensure sound competitive environment and excellence in services to maintain competitive bank total factor productivity growth.

On the macro economic effects to banks' factor productivity growth, there is also need for bank managers to be responsive to risks associated with changing macroeconomic factors such as GDP growth, exchange rate. This would suggest that policies aimed at stabilizing exchange rate and GDP growth should be given priority in fostering financial intermediation. Since the output cycle matters for bank performance, fiscal and monetary policies that are designed to promote output stability and sustainable growth are good for financial intermediation.

This research is a springboard for policy improvement in the diverse financial sectors in SSA. The governments and other concerned financial management institutions need to take into account the main fabrics and other policy repercussions towards commercial bank profitability that have gained considerable importance in SSA financial sector. This could probably be achieved through undertaking comprehensive and rigorous stress testing to avoid risks associated with market failures in the sector.

In the final analysis, study calls for a number of policy measures that are important for improving the efficiency of commercial banks in SSA; especially in the financial intermediation services to the public, where performance has not very comparable in other continents.

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