DETERMINANTS OF COMMERCIAL BANK PERFORMANCE IN SUB-SAHARAN AFRICA

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November, 2012
DECLARATION

I Munyambonera Ezra Francis, declare that this is my original work, and has never been presented for a degree award in this or any other University or institution of higher learning. I also declare that no part of this thesis is plagiarised work.

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<td>CSCS</td>
<td>Central Security Clearing System</td>
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<td>FE</td>
<td>Fixed Effects Estimation</td>
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<td>FGLS</td>
<td>Feasible Generalized Least Square Estimation</td>
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<td>GMM</td>
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ABSTRACT

The central theme of this research was to investigate the determinants of commercial bank performance in Sub-Saharan Africa (SSA). Specifically the focus was on profitability and total factor productivity growth as key measures of bank performance. The analysis used an unbalanced panel of 216 commercial banks drawn from 42 countries in SSA for the period 1999 to 2006.

Using the cost efficiency model, bank profitability was estimated using panel random effects method in static framework. The explanatory variables are growth in bank assets, growth in bank deposits, capital adequacy, operational efficiency (inefficiency), liquidity ratio as well as the macroeconomic variables of growth in GDP and inflation. The findings clearly show that both bank-specific as well as macroeconomic factors explained the variation in commercial bank profitability over the study period.

In estimating bank total factor productivity growth, the gross accounting procedure, through Estimation was also by the panel random effects method, in static framework. In this specification, new variables were introduced as explanatory. These are growth in other bank earning assets, asset quality, profitability and real exchange growth and maintaining some few variables used in bank profitability measurement. Results also show that both bank-specific as well as macroeconomic factors had an influence on bank total factor productivity growth over the study period.

These findings demonstrate the importance of both bank level as well as macroeconomic factors in explaining commercial bank performance in Sub-Saharan Africa. The policy implications drawn from this thesis are that if banks are to attain performance improvements, both bank level as well as macroeconomic factors are important.
CHAPTER I
INTRODUCTION

1.0 Background

During the last two decades, the global commercial banking sector has experienced major transformations in its environment, resulting in a significant impact on its performance. Both macro and micro economic factors have been affecting bank performance of the several measures. Identifying the key success factors of commercial banks’ performance allows designing informed policies that may improve the overall performance of the banking sector. Given the importance of commercial banks in Panayiotis et al. (2005), studying their determinants has attracted the interest of academic research as well as bank management, financial markets and bank supervisors. It is therefore of importance that studying of banks’ performance becomes of importance in view of the ongoing and emerging financial and economic crises, which could have a fundamental impact on the banking industry in many countries around the globe.

Bank level studies show that poor performance of government owned banks, especially in developing countries (La Porta et al., 2007; Dinc, 2005), has been largely due to lack of openness to foreign competition. Privatization which took place in 1980s and 90s was expected to improve and boost performance of the banking sector in Africa. Other findings on Africa and other developing economies’ financial sector performance have revealed mixed results (Cull, Clarke, and Shirley, 2005; Megginson, 2005). For example, in Mexico in the early and mid-1990s, privatization outcomes of the banking sector was so distortionary to the economy and required re-nationalization of the banks in the wake of the
Tequila crisis (Haber, 2005). It is, however, indicated that the second round of privatization of the sector, in government owned banks due to foreign competition, resulted into improved performance. In some other developing economies also, the initial attempts at bank privatization to improve performance was not successful, at least in part, because the state maintained relatively large shareholdings in the privatized banks and discouraged ownership by foreign investors (Bonin, Hasan and Whachtle, 2005; Sandrine, 2007 and IMF, 2007).

Despite the increased trend toward bank disintermediation in many countries, the role of banks has remained central in financing economic activities in general and different segments of the market. Empirical evidence show that a sound and profitable banking sector is in a better position to withstand negative shocks and contribute to the stability of the financial system. Otchere (2005) and others investigated the effects of privatization of banks in nine developing countries and found out that privatization across countries was made difficult by country-specific circumstances that were hard to control for. It was recommended that further studies should concentrate on using country-level studies that depend on natural experiments of data availability.

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

The study on formal and informal institutions and clients in Ghana, Malawi, Nigeria and Tanzania by Nissanke and Aryeetey (1998) revealed that continuous poor performance of financial systems could be partly explained by the high degree of markets fragmentation. Other possible causes identified by North (1990); Stiglitz (1989); Coase, (1992); and Williamson (1995) include operational costs, information asymmetry, and inappropriate governance mechanisms that are the major causes of moral hazard and adverse selection in banking operations.

Regardless of some improvements in economic growth in some African countries during the 80s and early 90s, financial sector performance has remained low with depressed savings rates. The low savings rates in the Sub-Saharan African countries suggest that investment and economic growth is still heavily dependent on foreign savings in form of external finance. The World Bank (2006) acknowledged that there are few signs of
sustainable progress arising from financial sector and public enterprise reform. The report
called for more wide reforms to achieve higher efficiency in the banking sector.
Panayiotis, et.al (2005) revealed that despite the increased trend toward disintermediation
observed in many countries, the role of banks was central in financing economic activity
in general and different segments of the markets in particular.

Panayiotis, et.al (2005) observed that the financial sector reforms in Western African
countries during the 80s and 90s, which created the West African Economic Monetary
Union (WAEMU), were aimed at improving banks’ performance to bring economic
growth. However, these reforms did not yield the expected outcomes. On the contrary, it
caused the banking crisis at the end of 80s and the beginning of 90s. What is blamed for
the failed reforms was the level of economic growth of most of the African countries that
could have affected banks’ performance (Sandrine, 2007).

This low level of performance of the banking system in SSA does not correspond to what is
depicted in many financial sectors in the sub-region. In relation to international standards,
Sub-Saharan African commercial banks have continued to exhibit very poor financial
intermediation as reflected in low levels of profitability, capitalization, liquidity risk, high
interest spread, among others, which in turn have a negative effect on the growth of savings,
investment, employment and, and consequently the economic growth of the region. In this
context, it would be of interest to empirically evaluate the determinants of SSA commercial
banks’ performance of the several measures.
In general, poor bank performance of the various indicators such as interest rate spread, high cost of financial intermediation, credit risk and inefficient and non-competitive financial systems are features of underdeveloped banking system. High and inflexible interest spreads are indicative of a lack of competition, limited financial sector deepening, the existence of perceived market risks, scale diseconomies and regulatory constraints (Mugume et al, 2009). Cross country, industry level and country case analysis confirm that that countries with higher levels of financial development experience better resource allocation, higher GDP per capita growth and low levels of poverty as reported by authors Levine (1997) and Martinez et al. (2004), among others.

Like in other developing countries, the commercial banking industry of Sub Saharan-Africa has 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.

Mugume (2006) observed that until early 1985, Sub-Saharan Africa had a highly repressed financial sector, whereby banks and other financial institutions were fully owned by the government. In the early part of 1980, many Sub-Saharan African countries entered into adjustment programs and the process of privatisation and liberalisation gained momentum
under the influence of the World Bank and the International Monetary Fund. Since then, the Sub Saharan African banking industry has become an attractive investment sector for both domestic and foreign investors to take part in the banking business.

This thesis therefore aimed at examining the determinants of commercial banks’ performance using the key measures of profitability and total factor productivity growth in Sub-Saharan Africa, considering 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.

Different from a few studies on SSA commercial banks that are limited in scope, coverage and estimation techniques, the focus of this thesis used an elaborate data drawn from 42 SSA countries and as well robust panel methods both in the estimation techniques and empirical tests. The thesis examined the determinants of commercial banks’ performance in SSA spanning the period 1999 to 2006 within a static panel data framework in contrast to a few and limiting previous empirical studies on commercial banks’ performance in Sub-Saharan Africa.

1.3 Problem Statement

Despite financial sector reforms in Africa since the 1980s and 1990s, commercial banks’ performance has remained poor and inefficient in the overall financial intermediation. Poor
performance of the banks have continued to manifest into high levels of credit risk to private agents, poor asset quality, limited and or inadequate capitalization, operational inefficiencies, and higher incidences of non-performing loans and higher levels of liquidity risk and high cost in overall financial intermediation. Poor performance of commercial banks is also blamed on low levels of economic growth as reflected 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 findings are corroborated in a number of studies Nissanke and Aryeetey (1998) and Aryeetey et al. (1997); Nissanke and Aryeetey (2006); Demerguc-Kunt and Huizinga (2001); Bikker and Hu (2002); Roland (1997); Eichengreen and Gibson (2001); Goddard et al. (2004); Gibson (2005); Bonaccorsi di Patti and Hardy (2005), Berger et al. (2005), and Nakane and Weitraub (2005); Gilbert and Wilson (1998), Leighner and Lovell (1998), and Hardy and Bonaccorsi di Patti and (2005, among others, who suggested more research into SSA banking system.

This study which focused on the determinants of commercial bank performance in SSA for the period 1999 to 2006 was therefore in response to what had been proposed in these empirical studies. All these studies observed that more understanding on African banking sector performance was important. World Bank (2006) also emphasized the need to undertake deeper analysis of financial sector performance in SSA, where performance has not been impressive, as this would provide more information on commercial banking system in the sub-region.
In understanding the factors that influence commercial bank performance in SSA, the study was guided by both the general objective and specific objectives as outlined below.

1.4 Objectives of the Study

The main objective of the study was to investigate the determinants of commercial bank performance in SSA over the period 1999 to 2006. The research should help to draw policy implications for industry improvement in the sub-region. The study utilized both bank level as well as macroeconomic factors to measure performance.

1.4.1 Specific objectives

Specific objectives of the study were:

i) To investigate the determinants of commercial bank profitability for the period 1999 to 2006.

ii) To examine the determinants of commercial bank total factor productivity growth for the period 1999 to 2006.

1.5 Significance of the Study

Empirical evidence clearly shows that studies focusing on Sub-Saharan Africa’s commercial banking sector are still scanty and limited. Even the few studies which have been undertaken point to a need for further investigation of the factors that have continued to cause poor performance of commercial banks in the sub-region, notwithstanding the reforms in the last two decades. Most of the evidence in regard to commercial banks’ performance is largely focused on the developed economies environments and the
conclusions may not be useful for African commercial banking improvements. Much of the empirical work on developed countries and a few on Africa and other developing countries on financial systems’ performance, have suggested a need to undertake further research on SSA banking system using sufficient data and robust methods to be able provide sufficient information for effective policy implementation of commercial banking. It is also apparent that the a few studies on SSA commercial banking are more of country specific and don’t provide comparative information across countries.

Williamson (1985; 1995); Nissanke and Aryeetey (2006); Dermenguc-Kunt and Huizingha (2001); and Bikker and Hu (2002) works, also suggested need for more empirical investigation of SSA financial systems. This would generate recommendations on how to improve efficiency of the industry in a liberalized environment. Egesa and Abuka (2007), on the other hand, suggested the use of more robust stochastic models for studying SSA using larger samples.

Dogan and Fausten (2007) stated that three factors that are important in measuring bank performance. First, it is vital to measure changes in efficiency and productivity of banks in developing countries using methodological and analytical approaches that address the specific issues of banking systems of small countries at various stages of development. Secondly, while there has been some attempt at studying aggregate financial sector performance, Hauner and Peiris, (2005) suggested that more effort is required in the direction of measuring productivity change at micro level. Thirdly, it is argued that liberalization policies aimed at increasing competition, boosting efficiency and
productivity by disciplining resources managers (Shyu, 1998). Because of the time trend of the data set, this study made use of a SSA panel data set for modeling bank performance in attempt to explore factors that influence profitability and factor productivity growth.

It is against this back ground that research was undertaken and its significance is that;

(a) It contributes to the frontier of knowledge on SSA commercial banking; and

(b) It uses elaborate econometric methods, using a panel of bank data from 42 SSA countries to explain factors that influence bank performance in terms of profitability and total factor productivity.

1.6 Hypotheses

The major hypothesis of this study is that bank level as well the macroeconomic factors have significant impact on commercial bank performance in SSA.

Specific hypotheses are:

(a) Bank specific and macroeconomic factors have significant impact on commercial banks’ profitability in SSA

(b) Bank specific and macroeconomic factors have significant impact on commercial banks’ factor productivity growth
1.7 Organization of the Thesis

The thesis is organized as follows. Chapter I presents the background and study motivation. In chapter II, the literature review on bank performance is explained. The conceptual framework and methodology are discussed in chapter III. In chapters IV and V, the regressions results on bank profitability and total factor productivity growth performance measures are discussed. Lastly, the conclusions and implications drawn from the study findings are given in chapter VI.
CHAPTER II
LITERATURE REVIEW

2.0 Determinants of Commercial Bank Performance

2.1 Understanding Bank Performance in Africa

In Sub-Saharan Africa (SSA), banks and other financial intermediaries have played a very limited role in the mobilization of resources to facilitate growth-enhancing private investments (Nissanke and Aryeetey, 2006). This is irrespective of the extensive reforms that have been implemented since 1980s and through 1990s.

Despite the dismal contribution to growth of private sector Hardy and Bonnaccorsi di Patti (2005) however revealed that the reforms have however impacted on the financial sectors in a number of ways. First, they have modified the environment under which banks operate. The reforms which have changed the operating environment include those deregulating interest rates, eliminating direct credits, liberalizing foreign currency holding, and introducing market-based systems of monetary policy management. Second, the reforms have affected the productivity of financial institutions. It is indicated that the reforms which have affected the productivity of banks include those that have led to changes in management and the ownership, those leading to more intense competition, and those underpinning new regulations on treatment of non-Performing loans and provision for loan recovery.
Kasekende and Atingi- Ego (2003) noted that governments in Africa have implemented significant financial sector reforms in recent years in an effort to improve efficiency of banks and enhance financial intermediation. In many countries most banks experienced weak financial positions and poor management capabilities in the 1980s and early 1990s as a result of economic mismanagement and civil unrest in some countries. The main problems identified include large numbers of non-performing loans, lack of capital, outdated banking methods, and decreased intermediation. The banking systems have been rebuilt with assistance from the international financial institutions. The main reforms have also involved liberalizing the sectors, creating new prudent frameworks, opening the systems to foreign banks, and restructuring and privatizing state owned banks. Despite all these changes however, there are indications of continued poor performance of commercial banks especially in the financial intermediation that would require redress.

Ddebbio (2004) studied the link between financial deepening, economic growth and development in a sample of 34 Sub-Saharan countries. Though the finding established that there could be a positive influence on output growth if the volume of investment is raised, no conclusive position has been reached. This discovery suggested further research to provide for better understanding of the linkage between financial development and economic growth. The research on the determinants of bank performance for SSA countries therefore was among the candidates for providing more information on SSA financial systems’ performance.
Mohamed (2007) ascertained that the impact of financial sector reforms on banking in SSA economies has not been all that impressive. While some countries have managed to proceed with more radical steps, others have barely made little progress towards financial sector reforms. Mehran et al. (1998) observed that many countries have made some improvement in the areas of domestic operations by establishing market-based monetary policy instruments and procedures, than in the area of the reform. The reform process has been generally based on the fundamental premises of liberalization and balance sheet restructuring, amounting to deregulation of interest rates and credit allocation.

De Grigorian and Guidotti (1998), Levine and Zervous (1998), Beck et al. (2005), and Levine (2003) among others, evidenced that a well-developed and sound financial system contribute significantly to economic growth by recognizing the important role financial intermediaries play in bridging the disequilibrium between savings and investment needs within an economy. Further, economic growth can be sustained only if scarce resources are mobilized efficiently and transformed into productive investments, a function performed by financial intermediaries. While the financial sector is a key catalyst for sustainable development of a country, much of the developing and under-developed countries have been grappling to keep up with the forces of globalization and liberalization that are transforming the global financial architecture.

2.2 Determinants of Bank Performance

While the successes of commercial banks in most countries depend largely on ability to operate efficiently, for some countries, empirical evidence reveals mixed results. For
example in India, liberalization of the financial sector yielded to higher efficiencies in the entire system (Bhattacharya et al., 1997). In Turkey, improvements in commercial bank productivity following liberalization were ascertained Isik and Hassan (2003). Khumbakar et al. (2005) uncovered efficiency decline in Spain just as Wheelock and Wilson (1999), on a decline in productivity in US banks. These results revealed that the short run impact of liberalization may be discouraging. Even in a liberalizing financial sector, bank profits could arise from market power or from other market or regulatory distortions (Isik and Hassan, 2002).

Egesa and Abuka (2007) ascertained that both internal and external pressures alter the way banks operate, mainly through encouraging input saving and waste minimization. External pressure could arise from liberalization of financial markets, while internal pressure from investment in new technology. It was noted that key aspects of commercial bank restructuring in the recent past in Uganda, aimed at increasing productivity. Whether this has been achieved remains an area for further research. While competition could force banks to raise productivity, lack of competitive pressures and weak regulation induces deviations from profit maximization goal as managers discover they don’t require operating efficiency to stay in business only, but also need to maximize their own wealth (Evanoff and Israilevich; Buer et.al., 2005).

Wheelock and Wilson (1999) recommended that in order to survive, banks must run efficiently. Improved bank profitability results from better resource allocation, and greater amounts of funds intermediated at better prices and improvements on service delivery to
consumers Isik and Hassan (2003) on the other hand, pointed out that financial liberalization affects the environment with which banks have to operate through increased competition from non-bank rivals, removal of interest rate ceilings on deposits and revisions to capital requirements. It was observed that to improve productivity, banks have to introduce innovations in financial engineering and apply new information-processing technologies to cut costs and reduce input waste.

Berger et al. (1993) and Berger and Hamprey (1997) confirmed that efficiency and productivity studies of banks have not kept pace with significant financial changes that have taken place especially in SSA. This could be because most studies seem to have concentrated on developed and industrial countries, paying lesser attention to the underdeveloping countries. Reforms undertaken in SSA were expected to create greater competition and efficiency in the banking systems and financial stability, product innovation and access to households and firms to financial services. Despite the anticipated results, Hauner and Peiris (2005) surprisingly established that the banking sector in SSA remain dominated by monopolistic, inefficient and fragile banking systems.

Allen and Rai, (1996); Leighton and Lovell (1998); and Grigirian and Manole (2002) on bank efficiency, showed that research on banking has, of recent, been of interest to researchers and policy makers in the developing world, than in the past years. These studies have followed important changes of restructuring measures in the banking systems. Efficiency measurement determines how banks provide an optimal combination of financial services with a set of inputs. The question, however, remains on how efficient the
delivery of financial services would be for economic agents. Since the main objective of banks is profit maximization, they could be constrained from achieving maximum profit due to regulation.

The available empirical evidence tend to show that studies on banking have extensively been concentrated more on developed and a few developing countries but less of SSA. There is thus insufficient information on the determinants of bank performance in SSA that would require further investigation (Short, 1979; Bourke, 1989; Molyneux and Thornton, 1992; Demerguc-Kunt and Huizinga, 2001). This would generate more information for policy guidance of the sector. The study in this direction would therefore be important.

Studies on bank profitability in Nissanke and Aryeetey (1998, 2006) also questioned why in some Africa countries like Ghana and Malawi, where reforms have been relatively orderly, the banking institutions have remained inefficient and not developed the capacities for risk management. Instead were still operating in an extremely constrained environment with underdeveloped institutional infrastructure and poor information base. The persistent poor performance of African banking sector, despite the reforms over the years, has suggested for more sector-wide studies that would guide policy for improving the sector.

The portfolios of banking institutions in Africa have been dominated by two characteristics: a) an extremely high incidence of non-performing loans and b) excess liquidity. Persistence of poor performance of banks, despite radical changes in the policy environment, could be explained by the institutional environment that restricted banks’ use of risk management tools and prevented improvement in their operational efficiency. The lack of changes in
institutional environments explains the paucity of savings mobilization efforts, the low lending trap in the presence of latent excess demand for credit and loans, and de-facto-crowding out of private finance and public financial requirements. These factors are combined to form a general post-liberalization credit crunch in many countries, encouraged by high-yielding government paper or bank bills\(^1\). The above observations seem to agree with (Kamau, 2009) that most of SSA countries have undergone many regulatory and financial reforms, but with limited success in financial intermediation.

While several studies such as Flamini, *et al.* (2009) and others confirmed that commercial banks’ performance is influenced by bank-specific, industry specific and macroeconomic factors, there are a few studies on SSA to evaluate to what extent these factors have contributed to the relatively poor performance of the banks in the sub-region. This would inform policy for growth and improvement of the industry. With ample is evidence of information gap, there are requirements for empirical studies on SSA commercial banks to critically examine the magnitude to which the above factors have contributed to the low performance of the banks in the various key measures.

### 2.2.1 Determinants of bank profitability

Bank profitability determinants are categorized into three indicators: bank-specific, industry-specific and macroeconomic. Bank specific indicators include: growth in bank assets, capital adequacy, operational efficiency, and liquidity. The common measure for industry-specific determinant is bank-concentration. While on the other hand, the key

\(^1\) A similar condition is observed across many countries as indicated by: Kasekende and Atingi-Ego (2003) and Ngugi (2001) for Uganda and Kenya respectively.
macroeconomic variables include: growth in GDP, GDP-per-capita inflation expectation, interest rate and its spread. The empirical evidence provides the various methods employed in studying bank profitability using these determinants. Much of the empirical literature agrees that bank level as well and macroeconomic factors largely influence bank profitability. There is however limited evidence that industry-specific factors have any significant influence on bank performance. It is against this background that the study utilized only bank level and macroeconomic factors to estimate bank profitability in SSA.

2.2.2 Bank-specific determinants

In trying to understand commercial bank performance in global context, studies on profitability have largely focused on returns on average bank assets (ROAA), net interest margin (NIM) and return on average equity (ROAE), as common measures. As such traditionally, the impact on bank performance has been measured by bank-specific factors such as capital adequacy, credit risk, liquidity risk, market power and regulatory costs. More recently, research has also attempted to focus on the impact of macroeconomic factors on banks’ performance.

In investigating bank profitability, Short (1979), Bourke (1989), Molyneux and Thornton (1992), Demerguc-Kunt and Huizinga (1999) and Goddard et al (2004), among others, applied linear models to explain performance. Linear models have however been criticized for employing inconsistent variables and generating inefficient results. Though focused more on developed countries, these studies pointed out the need to extend research to developing countries, SSA inclusive to understand about the factors that could be
influencing the low performance of commercial banks despite recent financial sector reforms.

Mercia, *et al.* (2002), Toddard, *et al.* (2004), and Panayiotis *et al.* (2005) showed that bank profitability is a function of internal and external factors. Internal factors include bank-specific; while external factors include both industry-specific and macroeconomic factors. According to this literature, there are six standard key bank-specific indicators that are widely used to study banks. These include profitability, capital adequacy, asset quality, operational efficiency, and growth in bank assets. Industry–specific factors include ownership, bank concentration index; while macroeconomic factors include interest rate, interest rate spread, inflation and levels of economic growth represented either GDP or GDP per-capita. Most of these factors are included in this study to estimate bank profitability for SSA banks.

Applying the General Method of Moments (GMM) technique to a panel of Greek banks for the period 1985 to 2001, Panayiotis *et al.* (2005) established that bank profitability persist to a moderate extent. Persistence suggests that departures from perfectly competitive market structures may not be large. All bank-specific determinants, with the exception of size, influence bank performance in the anticipated way. The study on Malaysian banks by Guru *et al.* (2004) also showed that efficient management is among the most important factors that explain high bank profitability. Extending a similar study to SSA, therefore, would generate comparative results.
Al-Hashimi (2007) investigated the determinants of bank net interest margin in 10 SSA countries, and applied an accounting decomposition model as well as panel regressions. The study indicated that credit risk and operational inefficiencies explain most of the variation in net interest margins across the region, with macroeconomic factors, having less influence on performance.

Smirlock (1985) found a positive and significant relationship between size and bank profitability. Short (1979) discovered that size is closely related to capital adequacy of a bank since relatively large banks tend to raise less expensive capital and, hence, appear more profitable. Using similar arguments, Bikker and Hu (2002) and Goddard et al. (2004), among others; linked bank size for small to medium size banks to capital and profitability. Molyneux and Thornton (1992), among others; found a negative and significant relationship between the level of liquidity and profitability. In contrast, Bourke (1989) reported an opposite result.

There is also an extensive literature based on the idea that an expense-related variable should be included in a profit function. For example, Bourke (1989) and Molyneux and Thornton (1992) found a positive relationship between better-quality management and profitability. Anthanasoglou, et al. (2006) study on the South Eastern European banking industry over the period 1998 to 2002, proposed new approaches in understanding bank profitability.
2.2.3 Industry-specific determinants

Another strand of literature emphasizes the importance of market structure and bank specific variables in explaining performance heterogeneities across banks. This literature is based on the structure-conduct-performance (SCP) paradigm and is also applicable to contestable markets, firm-level efficiency, and the roles of ownership and governance in explaining banks’ performance (Berger, 1995; Berger and Humphrey, 1997; Bikker and Hu, 2002; Goddard et al., 2004). Extensive empirical evidence does not provide conclusive proof that bank performance is influenced either by concentrated market structures and collusive price setting behavior or superior management and production techniques. Bank efficiency levels vary widely across banking sectors (Altunbaş et al., 2007; Schure et al., 2004).

Smirlock (1985) and Berger (1995) investigated the profit structure relationship in banking, providing tests of the aforementioned hypotheses. To some extent, the relative market power hypothesis was verified; since there was evidence that superior management and increased market share (especially in the case of small to medium sized banks) raise profits. In contrast, weak evidence was found for the efficient structure hypothesis. Efficiency not only raises profits, but may lead to market share gains and, hence, increased concentration, so that the finding of a positive relationship between concentration and profits could be a spurious result due to correlations with other variables. Bourke (1989), Molyneux and Thornton (1992) argued, instead that increased concentration is not the result of managerial efficiency, but rather reflects increasing deviations from competitive market structures,
which leads to monopolistic profits. Consequently, concentration should be related to bank profitability.

While some studies have questioned the relationship between bank ownership status and market power to profitability or not, there is little evidence to support the theory that privately-owned institutions will return relatively higher economic profits (Short, 1979). In contrast, Bourke (1989) and Molyneux and Thornton (1992) enlightened that ownership status could be irrelevant for explaining profitability. Eichengreen and Gibson (2001) on Greek banks using panel data for the period 1993 to 1998 however confirmed that industry-specific variables such as concentration ratio and market share could positively influence bank profitability. Recent literature also emphasizes the importance of changes in macroeconomic conditions on bank profitability.

2.2.4 Macroeconomic determinants

The last group of profitability determinants deals with macroeconomic control variables. The common variables include inflation rate, the long-term interest rate and rate of economic growth (Panayiotis et al., 2005). More recently, a number of studies emphasize the relationship between macroeconomic variables and bank risk. Allen and Saunders (2004) provided evidence of the importance of macroeconomic factors in determining the profitability of banks in the sampled.

Lovell (1996) introduced the issue of the relationship between bank profitability and inflation. The finding indicated that the effect of inflation on bank profitability depends on
whether bank wages and other operating expenses increase at a faster rate than inflation. The question is how mature an economy is so that future inflation is accurately forecasted to enable banks manage their operating costs. Perry (1992) observed that the extent to which inflation affects bank profitability depends on whether inflation expectations are fully anticipated. An inflation rate fully anticipated by the bank management implies that banks can appropriately adjust interest rates in order to increase their revenues faster than their costs and thus acquire higher economic profits. Bourke (1989) and Molyneux and Thornton (1992) found a positive relationship between inflation and bank profitability.

Saunders and Schumacher (2000) applied a model of Ho and Saunders (1981) to study the determinants of interest margin in six European Union and US banks during the period 1988 to 1995. They established that macroeconomic volatility and regulations have a significant impact on bank interest margin. The result pointed out an important trade-off between ensuring bank solvency, as defined by high capital to asset ratio, and lowering cost of financial services to consumers, as measured by lower interest rate margin.

Bourke (1989), Molyneux and Thornton (1992), Demerguc-Kunt and Huizinga (1999) and Bikker and Hu (2002) identified possible cyclical movements in bank profitability. Bikker and Hu (2002) established that bank profits are positively correlated with movements in the business cycle. Afanasieff et al. (2002); and Naceur, Steiner and Goaied (2003), studies on emerging countries (Brazil, Colombia, Malaysia and Tunisia) documented significant effects of financial liberalization on banks’ performance.
Afanasieff et al. (2002) also made use of panel data techniques to uncover the main determinants of bank performance in Brazil and found out that macroeconomic variables such as GDP growth rate, inflation expectations are important in determining bank profitability over time. Neeley and Wheelock (1997) also explored the profitability of sampled US commercial banks and found a positive impact of per-capita income on profitability.

2.3 Determinants of Bank Factor Productivity Growth

The banking sector has attracted considerable studies in the past two decades. This has involved a number of issues including the role of banks in financial development, bank efficiency, pricing behavior and regulation. Previous studies on banks using cost functions assumed that banks operate efficiently. Many researchers who have claimed the importance of investigating inefficiency in the banking units have questioned this assumption. As a result, this has resulted into further research with a view of generating better results.

The literature distinguishes two main types of bank efficiency. The first is operational efficiency by Farell (1957) that looks at market efficiency and the second is X-efficiency by Leibenstein (1966) that looks at allocative efficiency within banks. The concept of operational efficiency is purely technical and is defined as the product of technical efficiency and allocative efficiency (Coelli, 1996). Technical efficiency shows how far the bank yield is from its optimal production frontier, given input-output combination and prices.
A number of factors have motivated research on bank efficiency (Berger et al., 1997; Hardy et al., 2005). First, there is the mainstream economic thinking that improving the efficiency of financial systems is better implemented through deregulatory measures aiming at increasing bank competition on price, product, services and territorial rivalry. However, empirical evidence on the impact of financial deregulation on bank efficiency is mixed. Berger and Humphrey (1997) stated that the consequences of deregulation could essentially depend on industry conditions prior to the deregulation process as well as on the type of measures implemented. It is observed that restructuring and liberalization of the volume and the interest rates of bank lending could result into improvement 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).

Das et al. (2004) explored the effects of financial deregulation on risk and productivity growth of public sector banks in India for the period 1995 to 2001. They found evidence that capital, non-performing loans and productivity are related and do reinforce and complement each other in measuring bank efficiency. Also, that higher capital increases productivity, whilst higher loan growth reduces productivity. Leightner and Lovell (1998), using the best practice production frontiers, constructed the Malmquist growth indexes and productivity indexes for each Thai banks, for the years; 1989 to 1994. The study incorporated two different specifications of the services that the bank provides, one derived from the objectives of the bank itself and the other derived from the objectives of the banks of Thailand. The finding established that there was productivity growth when the bank
objective was profit-maximization, than achieving the objective of the Bank of Thailand. Laeven (1999) used Data Envelopment Analysis (DEA) to estimate the efficiencies of the commercial banks in Indonesia, Korea, Malaysia, Philippines and Thailand for the year’s; 1992 to1996. The research included risk when analyzing the performance of banks and found that foreign banks take relatively lower risk as compared with family-owned banks.

Bhattacharya et al. (1997) examined the productive efficiency of 70 Indian commercial banks during the early stages of liberalizing the sector. Technical efficiency scores were derived using a non-parametric data envelope analysis as well as parametric stochastic frontier models. Results showed that variation in efficiency scores among banks is due to temporal component, ownership component and random noise component. Public owned banks were most efficient followed by foreign banks and privately owned banks. Hardy et al. (2005) estimated the effects of banking reform on the profitability and efficiency of the Pakistani banking system. Cost and revenue frontiers were applied to estimate bank efficiency relative to the best available practice. Results indicated that financial market reform had increased both revenues and costs but did not increase overall factor productivity and profitability.

Berger and Humphrey (1997) showed that both parametric and non-parametric approaches have been applied to study bank efficiency in a number of countries in Europe and North America. In these studies, a number of issues were raised and tested relating to bank efficiency and financial deregulation. These issues mainly included the alternative methodologies used to estimate different types of efficiencies, namely technical efficiency,
allocative efficiency, scale efficiency, pure technical efficiency, cost efficiency and change in factor productivity (Coelli, 1996). This body of research also tested empirically the extent to which factors such as market share, total assets, credit risk, technology and scale of production, bank branches, ownership and location, quality of bank services and diversity of banking products, financial deregulation and managerial objectives determine bank efficiency.

Jagtiani (1996) investigated the impact of risk-based capital requirements on bank cost efficiencies in the US banking industry. The study established that the introduction of risk-based capital requirements could lead to a significant structural change in the banking industry, both in terms of efficient size and optimal product mixes. On the other hand, Sathye (2001) empirically investigated the X-efficiency in Australia, employing data envelope analysis technique (DEA). Results showed that banks in Australia have low levels of efficiency scores compared with banks in the European countries and in US. It is argued that inefficiency in Australian banks come mainly from the waste of inputs (technical efficiency) rather than choosing the correct input combinations (allocative efficiency). The finding further revealed that domestic banks in Australia were more efficient than foreign owned banks.

Mishkin (1991) showed that productivity of banks is likely to be affected by factors in the economic environment such as GDP growth, volatility of interest rate, and unexpected domestic currency depreciation, price level volatility and uncertainty, high share of non performing credit to private sector and adverse terms of trade. Further, Demirguc-Kunt and
Detragiache (1997) showed that unfavorable developments in the macroeconomic aggregates could worsen adverse selection and moral hazard problem. Also, that total factor productivity for banks in countries with weak macroeconomic environment could be related to bank specific factors such as bank size, bank expenses structure, income structure, asset quality, and capital adequacy, earning ratios, liquidity ratios and corporate governance structure.

De Young et al. (1998) revealed that quality management of regulatory bodies could be associated with higher productivity, just as asset quality. Total factor productivity differs across banks depending on adverse selection and moral hazard problems that affect channeling of funds to productive activities in the economy (Isik and Hassan, 2003). Naceur and Goeied (2003) analyzed the determinants of performance of Tunisian banks over the period 1980 to 1995. The best performing banks were those which struggled to improve labour and capital productivity and those which maintained a high level of deposit accounts relative to their assets.

Berg, Forsund and Jansen (1992) introduced the Malmquist index as a measure of the factor productivity growth in the banking industry. They focus was on the Norwegian banking system during the deregulation period 1980-1989. Results indicated that deregulation improves bank factor productivity. The increase in productivity is faster for larger banks, due to the increased antagonism they face. Favero and Papi (1995) used the non-parametric data envelope analysis on a cross section of 174 Italian banks in 1991 to measure the technical and the scale efficiencies of the banks. Results showed that efficiency in Italian
banking system was best explained by productivity, specialization by bank size and to a lesser extent by location.

Allen and Rai (1996) estimated a global cost function using an international database of financial institutions for fifteen countries. The sample was divided into two groups according to the country’s regulatory environment. Universal banking countries (Australia, Austria, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, Italy, United Kingdom and Sweden) permitted the functional integration of commercial and investment banking, while separated banking countries (Belgium, Japan and US) did not. Large banks in separate banking countries exhibited the largest measure of input inefficiency and had anti-economies of scale. All other banks had significantly lower inefficiency measures. The finding showed that smaller banks in all countries had significant levels of economies of scale. On the other hand, Italian banks, along with French, UK and US ones were found less efficient from the Japanese, Austrian, German, Danish, Swedish and Canadians ones.

Pastor, Perez and Quesada (1997) analyzed the productivity, efficiency and 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 compared the efficiency and 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 measurements of banking 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
Similarly, personnel expenses, non-interest expenses, other than personnel expenses were employed as a measurement of banking input. The research established that France had the banking system with the highest efficiency level followed by Spain, while UK presented the lowest level of efficiency. Altunbas and Molyneux (2007), among others, in their study on the banking systems in France, Germany, Italy and Spain found that there was a difference among the markets in Europe depending economies of scale.

Bikker (2001) investigated the determinants of bank productivity using a sample of European banks in various countries including Italy during the period 1989 to 1997. Results revealed that the most inefficient banks were first the Spanish ones, followed by the French and the Italian banks. The most productive banks were the ones in Luxemburg, Belgium and Switzerland. Hasan, Lozano-Vivas and Pastor (2000) analyzed the banking industries of Belgium, Denmark, France, Germany, Italy, Luxemburg, Netherlands, Portugal, Spain and the United Kingdom. First, the authors attempted to evaluate the efficiency scores of banking industries operating in their own respective countries. Later, they used 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.
Fernandez, Gascon and Gonzalez (2002) measured the economic efficiency of 142 financial intermediaries in eighteen countries for period 1989-1998. The aim of the study was to establish the relationship between efficiency, productivity change and shareholders’ wealth maximization. The research applied data envelope analysis to estimate the relative efficiency of commercial banks of different geographical areas (North America, Japan and Europe). The European banks included those from Austria, Belgium, Denmark, Finland, Germany, Ireland, Italy, Luxemburg, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. The three preferred outputs were: total investments, total loans, and non-interest income plus other operating income. In parallel, the four input variables were property, salaries, other operating expenses and total deposits. Results showed that commercial banks’ productivity across the world has grown significantly from 1989 to 1998.

Maudos et. Al. (2002) analyzed the cost and profit efficiency of European banks in ten countries, including those from Italy, for the period 1993 to 1996. They used multiple regression analysis along with data envelope analysis techniques. The sample was split into large, medium and small banks. Results suggested that only medium sized banks were profit efficient. Other studies by Lozano-Vivas, and Pastor (2002) examined banking efficiency in ten European countries in 1993. The value added method was adopted and the macroeconomic factors were components of explanatory variables. The finding showed that banking efficiency was low in Europe during this time period. Furthermore, the banks in Italy and Netherlands were the only ones which were not able to operate in a unified European banking system compared to the most efficient banks of the other sample
Casu and Molyneux (2003) applied DEA to investigate whether the productivity efficiency of European banking systems has improved and converge towards a common European frontier between 1993 and 1997. The geographical coverage of the study was France, Germany, Italy, Spain and the United Kingdom. All data was reported in ECU as the reference currency. Results indicated relatively low average efficiency levels. Nevertheless, it was possible to detect a slight improvement in the average efficiency scores over the period of analysis for almost all banking systems in the sample, with the exception of Italy.

Schure, Wagenvoort and O’Brien (2004) also estimated the productivity of the European banking sector for the same period and found that larger commercial banks were more productive on average than smaller banks. However, the Italian and the Spanish banks were found to be the least efficient. On the other hand, Casu, Girardone and Molyneux (2004) studied the efficiency analysis of European banks for the period 1994 to 2000. Found that Italian banks had 8.9 percent productivity growth, Spanish 9.5 percent, while German, French and English banks had 1.8 percent, 0.6 percent and 0.1 percent, respectively. The main reason for such improvements in efficiency for the Italian and Spanish banks was attributed to a cost reduction that these institutions achieved.

Rime and Stiroh (2003) examined the performance of Swiss banks for the period 1996-1999 using Malmquist index of total factor productivity (TFP) and found evidence of economies of scale for small and medium size banks, but little evidence for the large banks. Akhter
(2002) estimated the efficiency of 40 commercial banks in Pakistan for the year 1998 through DEA technique and confirmed that overall average efficiency of commercial banks in Pakistan is less than the World Mean Efficiency (Berger and Hamphery, 1997). The private banks were discovered to be more efficient than the public and foreign banks.

Using DEA, Rizvi (2001) investigated the productivity of banking sector in Pakistan for the period 1993 to 1998 by decomposing total factor productivity into its constituent components. The author discovered that productivity growth as well as efficiency improvement was sluggish during the period of reforms covered by this study. However, the domestic banks performed slightly better than foreign banks. On the other hand, Rogers and Sinkey (1999) examined common features of US commercial banks for the year 1993 by Malmquist index and found that banks that were large, had smaller net interest margins, had relatively fewer cost deposits, and exhibited less risk.

Bhattacharya et al. (1997) examined productivity efficiency of 70 Indian commercial banks during the early stages of the liberalization process. They estimated the technical efficiency scores using DEA and then used stochastic frontier analysis and attributed variation in the calculated efficiency scores to three component sources namely; temporal, ownership and random noise components. Public owned banks were found to be the most efficient followed by foreign banks and privately owned banks. Qayyum and Ahmed (2006) estimate the technical and pure technical efficiency of 22 commercial banks of Pakistan for the period 1991 to 2000 and find that the Government of Pakistan is successful in improving the efficiency of the domestic commercial banking system through the implementation of
Recent studies on China have shown that research on bank efficiency and productivity growth could be non-conclusive and result into mixed findings. This would 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 revealed that foreign banks were more profit efficient followed by private domestic banks. The cost efficiency measures, on the other hand, yielded different results. The study, however, did not provide information on the efficiency changes of Chinese banks through time, and the impact of WTO accession in 2001 on the efficiency of Chinese banks. Shujie et al. (2007) also used a stochastic frontier approach on a different sample of different of category of commercial banks for the period 1995 to 2001. Results showed that, on average, non-state-owned banks outperformed state-owned banks and could have been influenced by the type of input and outputs that were included in model estimation.

Studies on Chinese banking system (Fu and Heffernan, 2005; Chen et al.; 2005; Kumbhakar and Wang, 2001) have confirmed these findings. While many recent studies on banking efficiency have been undertaken in a number of countries in Europe and US, empirical evidence confirms that information on bank productivity determinants in most of the developing world including Africa remain limited (Casu et al. 2004). This is further confirmed in the studies (Wheelock and Wilson, 1999; Daniels et al., 2005; Isik and Hassan (2003); and Reizitis (2006); among others. These observations tend to suggest the need for
further research on SSA banking systems.

2.2.1 Approaches to studying bank factor productivity growth

Pasiouras and Sifadaskalakis (2007) examined the determinants of total factor productivity growth of Greek Cooperative banks 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 which 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 Humprey (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, considered 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. A financial 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.

2.3 Summary of the Literature and Research Gaps

Overall, empirical review for this research provides background information of commercial banks’ performance in general and concentrates specifically on profitability and total factor productivity measures. There is ample evidence of comprehensive account of commercial banks’ performance in developed countries and a few of the emerging ones, but less of Africa, signifying the requirement for further research on the sub-region. There is extensive literature on bank profitability and total factor productivity growth measurements which
provides support that these measures are influenced by both internal, sector specific as well as macroeconomic factors. Whereas extensive research has been done in developed countries using larger scope and robust econometric methods, such studies in African financial systems are lacking. Information on African banking systems seems to be scanty and limiting in terms of scope and type econometric techniques to adequately inform policy for the banking systems’ improvement in the sub-region. In light of these knowledge gaps and methodological requirements, the thesis sought to provide additional empirical evidence using a larger scope of sample commercial banks drawn from 42 SSA countries and applying robust panel econometric methods.

2.4 Linkage between bank profitability and total factor productivity growth

The linkage between bank profitability and total factor productivity growth is that they are alternate measures of bank performance. Independently each measure can be used to predict bank performance using bank level as well as macroeconomic variables that are identified in theory. Key bank level variables commonly used in estimating bank performance include bank growth, profitability, capital adequacy, credit risk, operational efficiency and liquidity risk, loan quality, asset quality; and key macroeconomic factors include; GDP, GDP-per-capita, inflation, exchange rare, interest rate and interest rate spread. In estimating these two measures stochastic and non- stochastic frontier methods can also be applied.
CHAPTER III
CONCEPTUAL FRAMEWORK AND ECONOMETRIC ISSUES

3.0 Conceptual Framework

In this section, the theoretical basis for generating bank profitability and total factor productivity growth functions are explained. The basis for variables identification that was considered in the model specifications is also illustrated. Adopting the theoretical models with some extensions generated the two models that were used to estimate the determinants of commercial banks’ performance in Sub-Saharan Africa (SSA) using a panel data set drawn from 42 countries.

3.1 Theoretical Framework for Commercial Bank Profitability Measurement

3.1.1 Theoretical basis for the model

A cost efficiency profit model was employed to measure bank profitability. This approach was adopted from the work done by Joaquin Maudos et al. (1999); Mercia, et al. (2002); Marco (2006), Goddard, et al. (2004); and Panayiotis et al. (2005), among others on bank efficiency in developed and a few developing economies. In measuring bank profitability using this framework, bank as well as macroeconomic indicators are utilised as inputs and outputs in the estimation process.

3.1.2 Cost efficiency model

The cost efficiency frontier is a technical efficiency concept based on a production function that is used to measure bank cost efficiency. Cost efficiency is derived from the cost
function and is a modified form of Cobb-Douglas production function. This provides information on how close (or far) bank costs are from the best practice, producing the same output under similar conditions.

Cost and profit efficiency definitions correspond, respectively to two important economic objectives: cost minimisation and profit maximisation. Cost efficiency is the ratio between the minimum cost at which it is possible to attain a given volume of production and the cost actually incurred. Thus, efficiency volume \((E_c)\) implies that it would be possible to produce the same vector of production \((1 - E_c)\). 100 percent of the costs. Efficiency ranges between \((0,1)\) interval, and equals one for the best-practice bank in the sample.

The costs of the bank depend on the output vector \((y)\), the price of inputs \((w)\), the level of cost inefficiency \((u)\) and a set of random factors \((v)\) which incorporate the effect of errors in the measurement of variables. Thus the cost function is simply expressed as:

\[
C = C(y, w, u v) .................................................................................................................. (3.1)
\]

In logarithmic terms, assuming that the efficiency and random error terms are multiplicatively separable from the remaining arguments of the cost function;

\[
lnC_i = f(y_i,w_i, \beta) + lnv_i +lnu_i ............................................................................ (3.2)
\]

Where \(C_i\) is the observed cost of production; \(y_i\) is the logarithm of output quantity of bank
variables; \( w_i \) is the vector of logarithms of input prices, \( \beta \) is a vector of unknown parameters to be established; \( v_i \) is the random error term and \( u_i \) is the non-negative inefficiency effect.

The expanded equation of cost efficiency function becomes;

\[
\ln C_i = \alpha + \alpha_i \ln \sum w_i + \alpha_{ij} \ln \sum \sum w_i + \sum \beta_k \ln y_k \ldots \ln v_i + \ln u_i \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3.3)
\]

where; \( C \) is total bank cost; \( y_k \) is the \( k \)-th bank variable output; \( w_i \) is the \( i \)-th bank input price; \( z \) is the bank equity capital; \( v \) is measurement error term; and \( u \) is the inefficiency term. The function could further reduce to a simple form;

\[
\ln (y_{it}) = x_{it} \beta + v_{it} - u_{it} \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3.4)
\]

where; \( i = 1, 2 \ldots N; t = 1.2 \ldots T \)

where; \( y_{it} \) is the cost per output of \( i \)-th firm in the \( t \)-th time period, \( x_{it} \) is a \( K \)-vector of value of bank variables used as explanatory associated with functional specification, \( \beta \) is \( K \)-vector unknown parameter to be estimated, \( v_{it} \) are random errors assumed to be independently normally distributed, with \( u_{it} \) being technical inefficiency effect. Equation 3.4 is the reduced form of the cost function that generates that profit efficiency function that estimated bank profitability. Different distributions of \( u_{it} \)'s are assumed for different panels.

On the basis of estimation of a particular functional form \( f \), cost efficiency \((E_c)\) is measured as the ratio between minimum costs \((C_{min})\) necessary to produce the output vector and costs
actually incurred (C).

Cost efficiency function is further decomposed to:

\[
E_c^{\min} = \frac{\exp[f(y,w)]\exp[\ln v]}{C \exp[f(y,w)]\exp[\ln u] \exp[\ln v]}
\]  

(3.5)

On the other hand, profit efficiency is a broader concept than cost efficiency since it takes into account the effects of choice of a certain vector of production both on cost and on revenues. Two profit functions can be distinguished, depending on whether or not there is market power: the standard profit function and the alternative profit function.

The standard profit function assumes that markets for outputs and inputs are perfectly competitive. Given the input and output price vectors \((p)\) and \((w)\), the bank maximizes profits by adjusting the amounts of inputs and outputs. Thus the profit function can be expressed as:

\[
\Pi = \Pi(w, p, v, u) \tag{3.6}
\]

In logarithmic terms it is expressed as:

\[
\ln(\Pi + \Theta) = f(w, p) + \ln v + \ln u \tag{3.7}
\]

where \(\Theta\) is a constant added to profits of each firm in order to attain positive values,
thus able to take logarithms. Profit efficiency is defined as the ratio between the actual profit of a bank and the maximum level that could achieved by the most efficient bank.

\[
\frac{E_{II}}{\Pi^{\text{max}}_{\text{II}}} = \frac{[\exp(\Pi (w,p)) \exp(\ln v) \exp(-\ln u) - \phi]}{[\exp(\Pi (w,p)) \exp(\ln v) - \phi]}
\]

(3.8)

The exogenous nature of prices in the above concept of profit efficiency assumes the existence of market power on the bank side. If instead of taking prices given, we assume the possibility of imperfect competition, we would take as given the output vector, and not that of prices. In this way, we define the alternative profit efficiency:

\[
\Pi_a = \Pi_a (y, w,u)
\]

(3.9)

This expression is equivalent to that of the cost function only if costs are substituted by profits as dependent variable. Notice that, in the alternative profit function, banks take a given the quantity of output (y) and the price of input (w) and maximise profits by adjusting price of output (p) and the quantity of inputs. As indicated by Berger and Mester (1997), alternative profit efficiency function is a representative closer to reality whenever the assumption of perfect competition in pricing is questionable or when there are differences of production quality among the banks in the sample.

To the extent that the sample on SSA includes a diverse group of countries with different levels of competition, the use for international comparisons of alternative profit efficiency seems more appropriate than that of standard profit. Also the standard definition of
efficiency requires information on output prices which may not be available according to the necessary degree of disaggregation. For these reasons, only alternative profit efficiency is estimated in this study.

Adopting the reduced form of the cost efficiency function equation (3.4), a profit efficiency function is generated by replacing the cost variable with a profit variable as;

\[ \Pi_{it} = x_i \beta + v_{it} - u_{it} \]  
\[ .................. \]  
\[ ............. \]  
\[ \text{(3.10)} \]

where \( \Pi \) is the profit variable and \( X_i = \) other bank variable indicators \( v_{it} \) are random errors assumed to be independently normally distributed, \( u_{it} \) is group specific variation that is time invariant.

The model permits estimations of unbalanced panels and \( u_{it} \)s are assumed to be exponential function of time, involving only one unknown parameter. Estimating bank profitability, this study also adopts a similar framework as applied by Naceur et.al. (2003) on Tunisian banks and Panayiotis et al. (2005) on Greece banks.

Based on economic theory, the general functional form of profit efficiency is expressed as;

\[ \Pi_{it} = \alpha + \alpha_i \sum \Pi_{t-i} + \beta_i X_{it} + \gamma \text{Macro} + u_{it} \]  
\[ .................. \]  
\[ ............. \]  
\[ \text{(3.11)} \]

45
where \( \Pi_i \) is the profitability variable and \( X_i \) are other bank variable indicators, and Macro are macroeconomic variables. Empirical theory identifies average asset ROAA, net interest margin NIM and return on average equity ROAE as common possible choices for measuring bank profitability. Macro refers to macroeconomic factors which influence bank behavior.

### 3.1.3 Model specification and variables

Model specification and variable identification is implemented in line with Naceur et al. (2003) and Panayiotis et al. (2005) classification of bank indicators. Bank indicators are classified into six categories: profitability that measures the overall performance of the bank; capital adequacy that measures the bank ability to meet regulated capital standards; credit risk that measures changes in the bank loan quality and risk; operational efficiency that measures the bank ability to generate revenue, pay, expenses and measure of employment expense; liquidity ratio that measures the changes in the bank cash position; and growth indicator that measures the bank change in assets. It is on the basis of this classification that the regression analysis of estimating bank profitability is implemented.

Bank profitability is the dependent variable in this study. Empirical studies show that bank profitability can be represented by three alternative measures: return on average asset ROAA, net interest margin NIM and return on average equity (ROAE) Yigremachew, 2008; and Weaver, 2001). Thus, depending on data availability and consistency, these measures are applicable to study bank profitability. Return to average assets reflects the bank ability to generate profits from bank assets although it may be biased due to off-balance sheet activities (Panayiotis et al., 2005). Return on assets is often referred to as the bank equity multiplier and measures financial leverage of the bank. Depending on data availability and
consistency these variables have been extensively applied in measuring bank profitability. In this study, these variables were adopted for estimation and their efficiency compared in the analysis. Other bank variables are also explained as follows. Capital adequacy expressed as equity to total asset ratio \( ETA \), growth in bank deposits \( lnTD \), operational efficiency as cost to income ratio \( CTIR \), liquidity as net loan to total asset ratio \( NLTA \), and growth indicator as growth in bank asset \( lnTA \).

To isolate the effects of bank characteristics, it is necessary to control for other factors that are used as determinants of bank profitability. In addition, the macroeconomic variables that influence bank profitability; GDP growth and inflation expectation were also included in the specification. Industry-specific variables such as bank concentration were not included due to data limitation and lack of a clear formula to estimate the variable. Even then, there is evidence that these variable representatives may have less significance to bank profitability. Their impact depends on other factors. The study therefore concentrated more on bank-specific and macroeconomic factors.

Using the profitability function equation and considering actual variable notations, the specification was given by;

\[
\Pi_{it} = c + \beta_1 lnTA_{it} + \beta_2 ETA_{it} + \beta_3 lnTD_{it} + \beta_4 CTIR_{it} + \beta_5 NLTA_{it} + \beta_6 lnGDPA_{it} + \beta_7 INFL_{it} + \varepsilon_{it} \\
\]  

\( \Pi_{it} \) is profitability variable represented by either return to average assets ROAA or net
interest margin \textit{NIM} or return on average \textit{equity ROAE}, LnTA is growth in bank assets, \textit{ETA} is bank equity to total assets, \textit{lnTD} growth in bank deposits, CTIR is cost to income ratio, liquidity ratio \textit{NLTA} is net loans to total assets, \textit{lnGDPA}, is \textit{GDP}-growth and \textit{INFL} is inflation expectation given by current inflation.

3.1.4 Variables and expected impact on bank profitability

In estimating bank profitability for SSA commercial banks, the profitability variable was considered as dependent variable. Empirical literature suggests return on average assets \textit{ROAA} and net interest margin \textit{NIM}, as appropriate choices for measuring bank profitability. These have been adopted in this study to provide comparative results. Table 3.1 presents the variables and expected impact on bank profitability.

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>Expected impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth in total assets - \textit{lnT}\textit{A}</td>
<td>Positive</td>
</tr>
<tr>
<td>Capital adequacy - \textit{eta}</td>
<td>Positive</td>
</tr>
<tr>
<td>Growth in total deposits - \textit{lnTD}</td>
<td>Positive</td>
</tr>
<tr>
<td>Cost income ratio - \textit{ctir}</td>
<td>negative</td>
</tr>
<tr>
<td>Liquidity ratio - \textit{nlta}</td>
<td>negative</td>
</tr>
<tr>
<td>Growth in GDP - \textit{lnGDPa}</td>
<td>Positive</td>
</tr>
<tr>
<td>Inflation - \textit{infl}</td>
<td>negative</td>
</tr>
</tbody>
</table>

Source: Empirical literature

**Bank-specific variables and expected impact on profitability**

Bank growth indicator is given by natural logarithm of total bank assets. Boyd and Runkle (1993) established a significant inverse relationship between size and return on assets in U.S banks from 1971 to 1990 and positive relationship between financial leverage and size of banks. Berger, et al. (1987) showed that banks experience some diseconomies of scale to
negatively affect performance. Goddard, et al. (2004), on five European countries, observed that the growth in bank size could positively influence bank performance. These observations suggest that the expected impact of bank size on bank profitability could be positive.

Capital adequacy indicator measured by bank equity to total assets, refers to the amount of own funds available to support a bank business and acts as a safety net in the case of adverse selection. It could also measure the bank ability to withstand losses. Banks with substantial capital adequacy ratio may be over cautious, passing up profitable investments opportunities. Alternatively, a declining ratio may signal capital adequacy problems. Capital is an important variable in determining bank profitability, although in the presence of capital requirements, it may proxy risk and also regulatory costs. In imperfect capital markets, well-capitalized banks may need to borrow less in order to support a given level of assets, and tend to face lower cost of funding due to lower prospective bankruptcy costs. The expected impact of this variable on bank profitability could therefore positive.

Anthanasoglou et al. (2005) and Berger (1995) noted that in the presence of asymmetric information, a well-capitalized bank could provide a signal to the market that a better-than-average performance should be expected. Well-capitalized banks are, in this regard, less risky and profits should be lower because they are perceived to be safer. In this case, we would expect to observe a negative association between capital and profits. However, if regulatory capital represents a binding restriction on banks, and is perceived as a cost, we would expect a positive relationship to the extent that banks try to pass some of the
regulatory cost to their customers. Profits may also lead to higher capital, if the profits earned are fully or partially reinvested. In this case, we would expect a positive causation from profits to capital. On the other hand, Berger et.al. (2005) established a positive causation in both direction between capital and profitability.

Growth in bank deposit can also measure the level of bank risk. This can also be represented by different measures including loans loss provision to total asset ratio as well as growth in bank deposit. Total deposit-to- loan ratio could also measure different levels of credit risk across countries if the respective practices on income verification and collaterals are different. Al-Hashimi (2007) found a positive effect of credit risk on Sub-Saharan Africa’s net interest margins. With perfect capital markets and no bankruptcy costs, the capital structure (how assets are financed) does not matter and value can only be generated by the assets. However, with asymmetric information and bankruptcy costs, the specific way in which assets are funded could create value. So the expected impact of this variable to bank profitability is positive.

Operational efficiency indicator which is also referred to as expenses by management is given as cost to income ratio. The higher this ratio, the less efficient and bank could adversely be affected in return on assets, depending on the degree of competition in the market. Al-Hashimi (2007) showed that operating inefficiencies appear to be the main determinants of high bank spreads in SSA economies. Brock and Rojas Suarez (2000) also established that administrative and other operating costs contribute to the prevalence of high spreads in Latin American countries. Some other studies Bourke (1989) and Molyneux and
Thornton (1992) revealed a positive relationship between better quality management and profitability in European banks. This variable could therefore have a positive impact on bank profitability.

Liquidity risk indicator is measured by bank net loans to total assets or a percentage of assets that comprise the loan portfolio. High ratios may be an indicative of better bank performance because of possible increases in interest income. However, very high ratios could also reduce liquidity and increase the number of marginal borrowers that default. This is also considered as bank activity mix and also an important proxy for the overall level of risk undertaken by banks to the extent that different sources of income are characterized by different credit risk and volatility. Demirguc-Kunt and Huizinga (1999) study of banks in 80 countries found that those with relatively high non-interest earning assets are, in general, less profitable. Banks that rely on deposits for their funding are also less profitable, possibly due to the required extensive branch network, and other expenses that are incurred in administering deposit accounts. Thus Again, the effect to bank profitability of factor productivity growth could be positive.

**Macroeconomic variables and expected impact on bank profitability**

Bank performance is expected to be sensitive to macroeconomic control variables. The impact of macroeconomic variables on bank risk has recently been highlighted in the literature. GDP growth is adopted as a control for cyclical output effects, and expected to have a positive influence on bank profitability. As GDP growth slows down, and, in particular, during recessions, credit quality decreases, and defaults increase, thus resulting
into reduced bank returns.

Demirgüç-Kunt and Huizinga (2001), and Bikker and Hu (2002) found a positive correlation between bank profitability and the business cycle. Anthonasoglou, et al. (2006) found a positive, notwithstanding asymmetric, effect on bank profitability in the Greek banking industry, with the cyclical output being significant only in the upper phase of the cycle. Al-Hashimi (2007) further established that the macroeconomic environment has only limited effect on net interest margins in SSA countries. This evidence is consistent with the results of other country-specific studies (Chirwa and Mlachila (2004) for Malawi, and Beck and Hesse (2006) for Uganda). GDP growth is therefore expected to have a positive impact could be positive and sometimes negative depending on trend growth of the economy.

The account for macroeconomic risk can be explained by inflation. It is envisaged that the extent to which inflation affects bank profitability depends on whether future movements in inflation are fully anticipated, which, in turn, depend on the ability of firms to accurately forecast future movements in the relevant control variables (Pasiouras and Kosmidou, 2007). An inflation rate that is fully anticipated increases profits as banks can appropriately adjust interest rates in order to increase revenues, while an unexpected change could raise costs due to imperfect interest rate adjustment.

Other studies, for example, Bourke (1989), Molyneux and Thornton (1992), Demirgüç-Kunt and Huizinga (1997), have found a positive relation between inflation and long term interest rates with bank performance. Inflation rate is approximated by the previous period’s
actual inflation and could positively or negatively influence bank profitability, positive due
to the ability of bank management to satisfactorily, though not fully forecast the future
inflation, which in turn could be incorporated into interest rate margins to achieve higher
profits. The expected impact of this macro variable is therefore negative depending on the
level of forecast by bank managers.

3.2 Theoretical Framework for Commercial Bank Factor Productivity Growth

3.2.1 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) showed that Cobb-Douglas production function is used as a basis for derivation of the determinants of total factor productivity growth ($tfpch$) of firms and banks in this case are treated as firms.

3.2.2 Generating bank total factor productivity growth 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.
\[ Y_{it} = A_{it}L_{it}^{\beta}K_{it}^{\gamma} \] \hspace{1cm} (3.13)

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

\(Y_{it}\) is a measure of output like 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 above production function into a log-linear function yields;

\[ y_{it} = \beta.l_{it} + \gamma.k_{it} + u_{it} \] \hspace{1cm} (3.14)

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 \(u_{it}\) can be split into two elements

\((\omega + e_{it});\)

\[ y_{it} = \beta.l_{it} + \gamma.k_{it} + \omega + e_{it} \] \hspace{1cm} (3.15)

where lower case denote the natural logarithm. \(\omega\) 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 Gross Accounting process, a firm’s productivity function is generated from Solow’s growth function residual error $\Omega$ (equation 3.15) as;

$$\Omega = f(k, l, t) = \{aA_t = \Phi_t = qt \cdot (l_t/Q_t) \cdot (\varphi Q_t/l_t) x l_t \} \cdot \{(k_t/Q_t) x (\varphi Q_t/x k_t)\} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldOTS

where $(q_t, l_t \text{ and } k_t)$ denote the growth rates of bank variable output, banks labour, and capital respectively and $\Phi$ 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_t l_t - (1-a_t) k_t \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldOTS

Where $A_t$ is factor productivity; $a_t l_t \text{ and } (1-a_t)$ are labour and capital shares in output respectively. This is also referred to as “Division Index Weighing System). Taking log either side, the equation further decomposes to:

$$\log A_t = \log (l_t + k_t) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldOTS

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:

$$\log A_t = \log (e_l + e_k)$$ ................................................................. (3.19)

where $\log A_t = \text{total factor productivity}$; $e_l = \text{proportion of operating on labour in total operating income}$; and $e_k = \text{share of operating expenditure in total operating income}$. The total factor productivity growth value was computed as $\log \left( \frac{\text{total operating expenses}}{\text{total operating income}} \right)$ 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.

### 3.2.4 Determinants of bank factor productivity growth

Using the nomenclature of equation (3.19), the determinants of bank total factor productivity growth is based on a basic specification of the form;

$$\text{tfpch}_{it} = c + \Omega_i \ln x_{it} + \gamma \text{Macro} + \varepsilon_{it}$$ ................................................................. (3.20)

The model is further applied as a two way error correction component, where $\varepsilon_{it}$ is given as;

$$\varepsilon_{it} = \eta_i + \lambda_t + \nu_{it}$$ ................................................................. (3.21)
\( \lambda_t \) 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, \( \eta_i \) is the unobservable bank specific effects, \( \text{macro} \) consists macro variables, \( \lambda_t \) is time-specific effects and \( \nu_{it} \) is the remainder error term assumed to be white noise stochastic error term, \( \alpha \) is a constant and \( \Omega \) is a (Kx1) vector of the coefficients of \( K \) explanatory variable.

### 3.2.5 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 as, 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 $TFPCH$ was 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. Using the identified variables a regression specification of the below was constructed;

$$TFPCH_{it} = c + \Omega_1 lnTD_{it} + \Omega_2 lnOEA_{it} + \Omega_3 NLTA_{it} + \Omega_4 NLTDS_{it}$$
$$+ \Omega_5 ROAA_{it} + \Omega_6 lnGDPA_{it} + \Omega_7 lnEXE_{it} + \varepsilon_{it}$$

Where $TFPCH = \text{total factor productivity growth}, lnTD = \text{growth in bank deposits}, lnOEA = \text{growth in other earning assets}; NLTA = \text{liquidity ratio}; NLTDS = \text{asset quality indicator represented net loans over depreciation plus short term financing};$ and $ROAA = \text{profitability ratio which shows the level of bank earnings.}$ The macroeconomic variables include GDP growth and growth in real exchange rate that have an influence on bank efficiency; and $\Omega_1........\Omega_7$ 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.

### 3.2.7 Variables and expected impact on bank total factor productivity growth

In estimating the bank function, total factor productivity growth $TFPCH$ was 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 Table 3.2 and further explained in the section that follows.

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>Expected impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth in bank deposits -(Intd)</td>
<td>Positive</td>
</tr>
<tr>
<td>Growth in other earning assets-(lnoea)</td>
<td>Positive</td>
</tr>
<tr>
<td>Liquidity ratio -(lnlta)</td>
<td>negative</td>
</tr>
<tr>
<td>Asset quality (lnltds)</td>
<td>Positive</td>
</tr>
<tr>
<td>Bank profitability - (lnroaa)</td>
<td>Positive</td>
</tr>
<tr>
<td>Growth in GDP (lngdpa)</td>
<td>Positive</td>
</tr>
<tr>
<td>Growth in real exchange rate - (lnexe)</td>
<td>Positive</td>
</tr>
</tbody>
</table>

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. (2004) showed that the composition of bank deposit is an important variable that could influence banking system performance. Naceur e t.al (2003) also indicated that bank deposit accounts relative to assets have a positive impact on 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) noted that diversification into bank activity could lead to increased efficiency of a bank through economies of scale of scope 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 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. Katrozo and Choi (2006) noted that bank activity diversification could make it more difficult for bank managers to monitor the behavior of the other branches. 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 indicated 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 (Baral, 2005). Aburime (2008) established 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) showed that productivity of banks is likely be affected by the level of economic performance such as a slow GDP growth, volatility of interest rates, un 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) showed 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) established that factor productivity of banks could be negatively affected by currency depreciation and price level volatility.

3.3 Methodology, Empirical Data and Analysis

To construct the sample, data was drawn from financial statements of individual banks provided in the Bank-Scope-Database. The Bank-Scope Database is a collection of data of balance sheets, income statements and other relevant financial accounts of several banks in the World. The data base 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 data for estimating the two models were drawn from this data set.
Mathieson and Roldos (2001) indicated three important characteristics of the Bank-Scope-database. First, its comprehensive coverage as Bank Scope data on banks accounts for around 90 percent of total bank assets in each country. Second, comparability, the data-collection process is based on separate data templates for each country to accommodate different reporting and accounting standards. Bank-Scope adjusts the collected data for country variation and presents them in a so-called global format. It is a globally standardised form for presenting bank data. Thus, Bank-Scope Databases are comparable across banks and across countries and allows cross-country comparisons (Claessens, Demirguc-Kunt and Huizinga, 2001). Third, Bank-Scope Databases provides information for individual banks, which are usually not available from other sources. Other data sources included International Monetary Fund- Financial Statistics.

Data was generated from 42 countries and 216 commercial banks with at least two years of operation between 1999 to 2006. In total, there were 1316 observations. The specification took a static framework as there was no verified time trend effect in the specification. Both Bank levels as well as macroeconomic variables that influence total factor productivity growth were included in line with theory and empirical evidence. Bank level variables include bank asset growth in assets, capital adequacy, credit risk, operating efficiency, liquidity ratio; while macroeconomic variables include growth in GDP and inflation. Data was downloaded in Microsoft Office, arranged in panel sets, and analyzed using STATA-11. The same data set, but using different variables was used in estimating the two models.
In order to understand the variability in bank performance across SSA sub-region, the countries were further categorized in low income and medium based on GDP-per-capita. Category one was low income of GDP per-capita of less or equal to 750 USD and medium of GDP per-capita of greater than or equal 750 USD. By disaggregation the first category was 164 group banks and second category was 62 group banks.

For the two measures of bank performance of profitability and total factor productivity growth, estimations utilized panel methods of fixed effects (FE), random effects (RE) and feasible generalized Least Squares (FGLS) in static framework. Both bank-specific and macroeconomic variables were used in the estimation methods. Bank specific variables included growth in deposits, growth in other earning assets, asset quality, liquidity ratio, loan quality, credit risk, operating efficiency, and profitability. The macroeconomic variables which according to theory have an influence on bank performance were included in the estimation. In estimating the models, bank profitability was represented by return on average assets (ROAA), net interest margin (NIM) and return on average equity (ROAE), but the discussion used the ROAA regression results. For bank total factor productivity growth model, the log of \{total operating expenses (toe) to total operating income (toi)\} was used as a proxy value for total factor productivity growth value. Total operating expenses in the sum total of operating expenses and operating expenses on capital ($e_t + e_k$)

### 3.4 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 was applied. To check for the significance of the models, F-test and Modified Wald Statistic were applied. The effect of time in the trend data was also tested by including time dummy variable.

Panel stationary test was conducted by the Augmented Dickey-Fuller (DF) and 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 at a maximum limit of p value =1.00. Baltagi (1998) concluded that when panels are stationary, it so happens that they are integrated and could generate at least one co-integrating equation. The specification checks also included some interaction analysis of at least two to three paired of variables to check their combined effect to bank profitability.
CHAPTER IV
DETERMINANTS OF BANK PROFITABILITY IN SUB-SAHARAN AFRICA

4.0 Introduction

In this chapter the determinants of bank profitability in Sub-Saharan Africa (SSA) were estimated. The analysis was based on unbalanced panel of a sample 216 banks commercial drawn from 42 countries for the period 1999 to 2006. Two categories of banks: low GDP per-capita country banks of less or equal to 750 USD and medium country income banks of per-capita GDP of greater or equal to 750 USD were generated to further compare the impact of the income country banks. This was by use of dummies in the panel regression analyses adopted for this thesis.

The three panel estimators of fixed effects (FE), random effects (RE) and feasible generalized least square were utilized to estimate bank profitability in this thesis. Due to lower time period of 7 years and larger observations, regression results for GMM-IV were not plausible and could not apply in this analysis. The analysis was implemented in static panel framework and the estimating equation was of the form;

\[
\Pi_{it} = c + \beta_1 \ln TA_{it} + \beta_2 \text{ETA}_{it} + \beta_3 \ln TD_{it} + \beta_4 \text{CTIR}_{it} + \beta_5 \text{NLTA}_{it} \\
+ \beta_6 \ln GDP_{Ait} + \beta_7 \text{INFL}_{it} + \epsilon_{it} \]

Where: \( \Pi_{it} \) is profitability variable represented by either return to average assets ROAA or net interest margin NIM or return on average equity ROAE, \( \ln TA \) is growth in bank assets,
ETA is bank equity to total assets, $ln TD$ growth in bank deposits, CTIR is cost to income ratio, liquidity ratio NLTA is net loans to total assets, $ln GDPA$ is GDP-growth and $INFL$ is inflation expectation given by current inflation.

4.1 Data Characteristics

Table 4.1 presents the descriptive statistics of the variables utilized in this study. The variables were computed in percentage points and millions of US dollars at constant 2000 prices in USD. The results confirm the adequacy of the data used in estimating the commercial bank profitability, ranging above 1000 observations. Looking at profitability as a key measure of bank performance, a mean of 2.28 percent, mean and maximum of minus 56.7 percent to 49.64 percent would indicate that most of the SSA commercial banks had lower levels profitability which could be arising from the low levels of capitalization, low levels of liquidity, high operational inefficiency, low levels of demand deposits, low levels of growth in assets and poor macroeconomic environment characterized by low growth in GDP and high inflation pressures in the economies.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs.</th>
<th>Mean</th>
<th>Std.dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on average asset (roaa)</td>
<td>1297</td>
<td>2.28</td>
<td>4.31</td>
<td>-56.70</td>
<td>49.64</td>
</tr>
<tr>
<td>Growth in banks assets (ltA)</td>
<td>1285</td>
<td>5.73</td>
<td>2.71</td>
<td>0.072</td>
<td>762805</td>
</tr>
<tr>
<td>Growth in bank deposits (ltd)</td>
<td>1261</td>
<td>5.51</td>
<td>2.81</td>
<td>0.194</td>
<td>5874527</td>
</tr>
<tr>
<td>Operational efficiency (ctir)</td>
<td>1207</td>
<td>62.98</td>
<td>44.00</td>
<td>1.66</td>
<td>974</td>
</tr>
<tr>
<td>Capital adequacy (eta)</td>
<td>1294</td>
<td>13.18</td>
<td>9.90</td>
<td>1.60</td>
<td>80.27</td>
</tr>
<tr>
<td>Liquidity (nlta)</td>
<td>1315</td>
<td>43.93</td>
<td>19.78</td>
<td>0.21</td>
<td>96.64</td>
</tr>
<tr>
<td>Growth in GDP (lgpda)</td>
<td>1138</td>
<td>22.36</td>
<td>1.200</td>
<td>19.81</td>
<td>25.80</td>
</tr>
<tr>
<td>Inflation rate (infL)</td>
<td>1091</td>
<td>13.87</td>
<td>41.57</td>
<td>-10.00</td>
<td>550</td>
</tr>
</tbody>
</table>

Looking at the minimum, mean and maximum values and standard deviations, results indicate that there was highest variability in operational efficiency and inflation indicator. Modest variability was exhibited in capital adequacy, levels of bank liquidity. Lower levels of variability were experienced in profitability, growth in bank assets, growth in bank deposits, and in GDP growth. This is a reflection of what was happening in the countries over the study period. Higher level of variability in operational efficiency of banks across SSA is an indication of poor performing banks in the sub-region. On the other hand higher variability in inflation is a reflection of a deteriorating macro environment which most of the countries went through over the study period.

In Annex II, the correlation relationship between the explanatory variables for measuring commercial bank profitability is illustrated. The results confirm some level of correlation between the dependent variable (return on average asset) and independent variables (bank assets, bank deposits, operational efficiency, capital adequacy, GDP and inflation). However, the overall correlation relationships between the explanatory variables range below 0.5, implying a lower degree of collinearity between the variables.

4.2 Robustness and Specification Test

4.2.1 Panel unit-root and co-integration

To test for stationarity of the variables in the model, unit-root test by the Augmented Dickey-Fuller and Fisher-type tests was applied. This test is recommended by Baltagi (1998 and 2005) and in other econometric literature, as appropriate for unbalanced panels for an advantage of accommodating any number of lags. The fisher test uses four types of other
tests: inverse-chi-squared (P), inverse normal (Z) inverse logit (L*). Table 4.2 shows the results of the Fisher-test for stationarity. The tests were implemented in levels (zero differenced and lag length (2)).

Table 4.2: Unbalance Panel Unit-Root Test Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fisher-type panel tests</th>
<th></th>
<th></th>
<th>Lag length</th>
<th>Deduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>P</td>
<td>PM</td>
<td>P ≤ α ;</td>
<td>p ≥ α</td>
</tr>
<tr>
<td></td>
<td>Statistic</td>
<td>P.Value</td>
<td>Statistic</td>
<td>P.Value</td>
<td></td>
</tr>
<tr>
<td>Bank profitability - (roaa)</td>
<td>0.000</td>
<td>1.000</td>
<td>-12.000</td>
<td>1.000</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I(0)</td>
</tr>
<tr>
<td>Growth in bank asset - (lta)</td>
<td>0.000</td>
<td>1.000</td>
<td>-12.1244</td>
<td>1.000</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I(0)</td>
</tr>
<tr>
<td>Bank capitalization ratio - (eta)</td>
<td>0.000</td>
<td>1.000</td>
<td>-12.1655</td>
<td>1.000</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I(0)</td>
</tr>
<tr>
<td>Growth in bank deposits - (ldt)</td>
<td>0.000</td>
<td>1.000</td>
<td>-12.083</td>
<td>1.000</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I(0)</td>
</tr>
<tr>
<td>Operational efficiency - (ctir)</td>
<td>0.000</td>
<td>1.000</td>
<td>-11.5758</td>
<td>1.000</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I(0)</td>
</tr>
<tr>
<td>Growth in GDP (lgdpa)</td>
<td>0.000</td>
<td>1.000</td>
<td>-11.8322</td>
<td>1.000</td>
<td>2</td>
</tr>
<tr>
<td>Growth in real exchange rate - (luxe)</td>
<td>0.000</td>
<td>1.000</td>
<td>-11.5326</td>
<td>1.000</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I(0)</td>
</tr>
</tbody>
</table>

Notes:
- Ho: All the panels contain unit roots
- HA: At least one panel is stationary
- Panel mean included
- Time trend included
- Drift term excluded


The t-statistic of less or equal to p-value shows a rejection of the null hypothesis that at least one panel has non-stationary variables. The findings show that all the variables are stationary at zero difference level and lag length (2) for the both P and PM-fisher type tests.

When panel variables are stationary, they as well integrated and could at least generate one co-integrating relationship (Baltagi, et.al, 2005).

When panel variables have no unit root, they are stationary and therefore integrated. Econometric literature shows that when variables are integrated, they generate at least one co-integrating equation for efficiency analysis. This is confirmed by a rejection of the null hypotheses of stationarity. The results prove that the key bank variables: growth in bank assets, capital adequacy, credit risk, operational efficiency and bank liquidity; as well as the
macro economic variables; of growth in GDP and inflation expectation were efficient and appropriate in measuring bank profitability in SSA over the study period 1999 to 2006 and

4.2.2 Hausman specification test
This tests the efficiency and consistency between the FE and RE estimators. Although the econometric theory recommends RE estimation for unbalanced panels, a confirmatory test by use of the Hausman specification test is usually carried out to evaluate the efficiency between FE and RE estimation methods. A rejection of the null hypothesis is when \( \text{Prob} > \chi^2 = \alpha \), confirmed the efficiency and consistency of the RE in estimating the model. Table 4.4 presents the results based on the test.

| Variable                      | \( (b) \) Fixed | \( (B) \) Random | \( (b-B) \) Difference | \( \text{Sqrt} | \text{diag}(V_b - V_B) \) |
|-------------------------------|-----------------|-----------------|------------------------|---------------------------|
| Growth in bank assets - \( \ln(\text{ta}) \) | -0.3952         | -0.4792         | 0.7890                 | 0.3621                    |
| Bank capitalization - \( \text{eta} \)          | 0.2076          | 0.1188          | 0.8883                 | 0.0220                    |
| Growth in bank deposits - \( \ln(\text{td}) \)  | 1.4975          | 0.6201          | 0.8755                 | 0.3775                    |
| Liquidity ratio – \( \ln(\text{nta}) \)       | -0.0269         | -0.0432         | 0.0163                 | 0.0128                    |
| Operational efficiency - \( \text{ctir} \)    | -0.0335         | -0.4041         | 0.0069                 | 0.0032                    |
| GDP growth- \( \ln(\text{gdp}) \)              | -2.5560         | -0.3872         | -2.1684                | 1.0992                    |
| Growth in exchange rate - \( \ln(\text{exe}) \)| -0.0033         | 0.0070          | 0.0036                 | 0.0030                    |

Notes:
1. \( b \) = consistent under \( H_0 \) and \( HA \); obtained from \textit{xtreg}
2. \( B \) = inconsistent under \( HA \), efficient under \( H_0 \); obtained from \textit{xtreg}
3. Test: \( H_0 \): difference in coefficient is systematic
4. \( \chi^2(7) = (b-B)'[V_b - V_B] (\chi^2) -1] [V_B] = 56.61; \text{Prob} > \chi^2 = 0.0000 


The findings are consistent with theory that the random effects estimator is expected to generate more efficient results where there is a high variability in the data set. Efficiency is
achieved in controlling for a possible endogeneity and auto-correlation effects associated with dynamic lag models (Arrellano and Bover (1995) and Blundell and Bond (2000). The evaluation also confirmed that there was no time effect in the regression results hence focusing the analysis on static specification as shown in Annex V.

4.3 Discussion of Results

Table 4.3 shows the regression results for all the sampled banks. Estimation is by applying the random effects (RE) technique. Econometrics recommends the random effects (RE) method as an efficient estimator for unbalanced panel models (Baltagi 1999). This was confirmed by the Hausman specification test which evaluates the efficiency between the random effects (RE) and fixed effects (FE) estimators for the panel regressions.

This is consistent with theory that random effects estimator is expected to generate more efficient results after controlling for possible endogeneity and autocorrelation effects associated fixed effects models (Arrellano and Bover 1995) and Blundell and Bond (2000). The efficiency of the RE results was confirmed by FGLS results which generated the similar results.
Table 4.3: Random Effects Regression Results for all Sample Banks

<table>
<thead>
<tr>
<th>Variable</th>
<th>FE Model</th>
<th></th>
<th>RE Model</th>
<th></th>
<th>FGLS Model</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>P.Value</td>
<td>Coeff.</td>
<td>P.Value</td>
<td>Coeff.</td>
<td>P.Value</td>
</tr>
<tr>
<td>Dependent variable = Bank profitability -(roaa)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth in banks assets - (lnata)</td>
<td>-0.0340</td>
<td>0.378</td>
<td>-0.667</td>
<td>0.076*</td>
<td>-0.4666</td>
<td>0.075*</td>
</tr>
<tr>
<td>Bank capitalization ratio - (eta)</td>
<td>0.2077</td>
<td>0.000***</td>
<td>0.1146</td>
<td>0.088*</td>
<td>0.1146</td>
<td>0.000***</td>
</tr>
<tr>
<td>Growth in bank deposit - (lnld)</td>
<td>1.4975</td>
<td>0.001*</td>
<td>0.6195</td>
<td>0.018***</td>
<td>0.6196</td>
<td>0.018***</td>
</tr>
<tr>
<td>Bank liquidity - (lnlt)</td>
<td>-0.02692</td>
<td>0.060*</td>
<td>-0.0419</td>
<td>0.000***</td>
<td>0.0419</td>
<td>0.000***</td>
</tr>
<tr>
<td>Operational efficiency - (ctir)</td>
<td>-0.0335</td>
<td>0.000**</td>
<td>-0.0404</td>
<td>0.000***</td>
<td>0.0404</td>
<td>0.000***</td>
</tr>
<tr>
<td>Growth in GDP - (lngdp)</td>
<td>-2.5556</td>
<td>0.021</td>
<td>-0.3872</td>
<td>0.000***</td>
<td>-0.3872</td>
<td>0.000***</td>
</tr>
<tr>
<td>Inflation - (inf)</td>
<td>-0.0033</td>
<td>-0.1170</td>
<td>-0.0060</td>
<td>0.063*</td>
<td>-0.0060</td>
<td>0.062*</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.1973</td>
<td>0.118</td>
<td>13.3571</td>
<td>0.000***</td>
<td>13.3571</td>
<td>0.000***</td>
</tr>
<tr>
<td>No. of Obs.</td>
<td>967</td>
<td></td>
<td>967</td>
<td></td>
<td>967</td>
<td></td>
</tr>
<tr>
<td>Group Banks</td>
<td>184</td>
<td></td>
<td>184</td>
<td></td>
<td>184</td>
<td></td>
</tr>
<tr>
<td>R.sq:</td>
<td>0.14</td>
<td></td>
<td>0.27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-Statistics- F(7,776)= 32.86</td>
<td>P&gt;0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wald-Statistics</td>
<td></td>
<td></td>
<td>Prob&gt;chi2</td>
<td>= 0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Wald chi2(7) = 359.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wald-Statistics</td>
<td></td>
<td></td>
<td>Prob&gt;chi2</td>
<td>=0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Wald chi2(7) = 362.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-4974.537</td>
<td></td>
</tr>
</tbody>
</table>

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

Using return to average asset (ROAA) as measure of bank profitability, the findings reveal that the RE and FGLs gave consistent and efficient results. The Wald statistic confirms that the models used as well as the variables was significant and correctly specified. Detailed discussed of the results follows.

The coefficient of the variable representing growth in bank assets is negative and significant at 10 percent significance level. A negative relationship of bank size suggests that the smaller the bank the, the more efficient the bank will be. Thus the case of Sub-Saharan commercial banks does not support the economies of scales the argument that the larger the bank, the bank will be more efficient. As observed by Hiroyuki (2009), among others, on SSA commercial banks, negative coefficient supports diseconomies of scale argument on bank on the relationship between growth in bank size and profitability.
The coefficient of the variable representing bank risk (growth in bank deposits) is positive and significant at 1 percent, 5 percent and 10 percent levels. This is consistent with Naceur et.al. (2003) finding that, other things constant, more deposits are transformed into loans. The higher the interest rate margins, the higher the profits and banks are able to shield themselves against hazards of credit risk resulting from adverse selection and moral hazard.

The coefficient of the variable representing capital adequacy (equity to total assets) is positive and significant with expected signs at 1 percent, 5 percent and 10 percent levels, respectively. This would imply that well capitalized banks experience higher returns and the finding is consistent with Anthanasoglou et al.(2006). Berger et.al. (1995), further showed that relaxation of one period assumption allows an increase in earnings to raise capital, provided the earnings are not fully distributed as dividends. Relaxation of perfect capital markets could allow capital to raise expected earnings by reducing the expected costs of bankruptcy financial distress in general. Positive effect on bank profitability could arise from relative growth in bank profitability as result of the financial sector reforms (IMF, 2007). The positive impact of the variable to bank profitability in most SSA countries reveals some levels of increased capitalization of the banks following the recent reforms in the financial sectors. This variable also measures the bank ability to withstand losses.

The coefficient of the variable representing liquidity risk (net loans to total assets) is negative and significant with expected signs at 1 percent, 5 percent and 10 percent levels, respectively. This is consistent with theory that the higher liquidity ratio could influence bank profitability. Higher ratios may be an indicative of improved bank profitability.
because of increased interest incomes from borrowed funds (Berger et.al. (2008). On the other hand, the same study pointed out that this variable could also have a negative effect on bank profitability. However theory has is that this variable can have a negative effect on bank profitability. This is when high ratios could result in reduced liquidity due increase in loan defaults

The coefficient of the variable representing operational efficiency (cost/income) is negative and significant with expected signs. This is consistent with theory that the higher costs of operation negatively affect bank profitability. Operational efficiency indicator is the expense variable and explains how banks could be efficient in resource allocation and utilization including human resource and technological improvements in banking. The negative growth in banks’ profitability that could have occurred during the period of study in a cross section of SSA countries, could be probably be explained by high costs of operation.

The macroeconomic variables chosen for this study were growth rate in GDP and inflation. The coefficient of growth in GDP variable, measured at constant 2000 prices in US dollars, is negative and significant at 1, 5 and 10 percent levels. This finding agrees with theory and empirical evidence that; the relationship between GDP trend growth and bank profitability could be pro-cyclical. This would imply that when GDP trend growth is positive, the effect to bank profitability is positive and when GDP trend growth in negative, the effect on profitability is negative. An important finding from this study is that most of the economies in SSA have of recent experienced very low and negative economic growth that could have
impacted negatively on bank profitability (Naceur *et al.*, 2003 and Panayiotis *et al.*, 2005). There are several reasons why the effect of growth in GDP to bank profitability 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.

For inflation variable, the coefficient is negative and significant with expected signs according to theory. This is consistent with the finding by Panayiotis et *al.* (2005) on Greek banks that that the effect of inflation on bank profitability depends on the ability of inflation forecast by the bank management. If predictions become correct, such adjustments in interest rates could be incorporated inflation expectation, to achieve higher profits. In this case, the relationship between bank and inflation becomes positive suggesting that banks are able to project the effect of inflation expectations in their operational costs to increase profits. From this conclusion, if the forecast is incorrect, the effect of inflation on bank profitability could be negative. Economic theory also argues that if the bank managers are able to predict inflation and incorporate in their cost structure the effect could be positive.

The regression results for net interest margin (*NIM*) and returns on average equity (*ROAE*) as other two key measures of bank profitability chosen in this thesis are also shown in Annex IV. They results are similar to those generated by return to average asset (ROAA) measure indicating that these have the same impact on measuring bank profitability.
4.4.1 Low and medium income country commercial banks

In Table 4.4, the regression results including dummies for low and medium income category commercial banks. In the specification, low income category banks were denoted as \((gdpcdummy)\) and medium income category banks were denoted as \((gdpcdummy2)\) and are based on 953 observations and 180 group banks. Compared to the overall sample bank regression results, using the dummy for low income country commercial bank category had have similar results like total sample in both RE and FGLS estimations. There is however a slight variation in coefficient values, p values as well as F and Wald Statistic due to data consistency and adequacy. The significance of the F-statistic and the Wald statistic confirm that the models significantly predict bank profitability behaviour.

Table 4.4: Random Effects Regression Results for Low and Medium Income Category Banks

<table>
<thead>
<tr>
<th>Variable</th>
<th>FE Model</th>
<th>FE Model</th>
<th>FE Model</th>
<th>FE Model</th>
<th>FE Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>P.Value</td>
<td>Coeff.</td>
<td>P.Value</td>
<td>Coeff.</td>
</tr>
<tr>
<td>Growth in banks assets- (Inta)</td>
<td>-0.1510</td>
<td>0.074**</td>
<td>-0.1858</td>
<td>0.200***</td>
<td>-0.2420</td>
</tr>
<tr>
<td>Bank capitalization ratio - (eta)</td>
<td>-0.0086</td>
<td>0.000***</td>
<td>-0.0045</td>
<td>0.000***</td>
<td>-0.0034</td>
</tr>
<tr>
<td>Growth in bank deposit - (Intd)</td>
<td>0.1533</td>
<td>0.001***</td>
<td>0.1808</td>
<td>0.000**</td>
<td>0.2422</td>
</tr>
<tr>
<td>Bank liquidity- (nlta)</td>
<td>0.0021</td>
<td>0.031**</td>
<td>0.0064</td>
<td>0.000***</td>
<td>0.0017</td>
</tr>
<tr>
<td>Operational efficiency - (ctir)</td>
<td>0.0023</td>
<td>0.000***</td>
<td>-0.0422</td>
<td>0.000***</td>
<td>0.0077</td>
</tr>
<tr>
<td>Growth in GDP - (lngdpa)</td>
<td>-0.1121</td>
<td>0.130</td>
<td>0.0372</td>
<td>0.008***</td>
<td>0.0374</td>
</tr>
<tr>
<td>Inflation- (inf)</td>
<td>-0.0024</td>
<td>0.431</td>
<td>0.0061</td>
<td>0.023**</td>
<td>0.0012</td>
</tr>
<tr>
<td>gdpcdummy</td>
<td>omitted</td>
<td>.......</td>
<td>-0.0830</td>
<td>0.000***</td>
<td>-0.0630</td>
</tr>
<tr>
<td>gdpcdummy2</td>
<td>0.2411</td>
<td>0.007***</td>
<td>omitted</td>
<td>...........</td>
<td>omitted</td>
</tr>
<tr>
<td>Constant</td>
<td>1.6451</td>
<td>0.011***</td>
<td>-1.5500</td>
<td>0.000***</td>
<td>-1.7215</td>
</tr>
</tbody>
</table>

| No. of Obs. | 953 | 953 | 953 |
| Group Banks | 180 | 180 | 180 |
| R.sq: | 0.28 | 0.49 | 0.49 |
| F-Statistics- F(8,765)= 70.31 | F> 0.00 | Prob>chi2 = 0.000 | Prob>chi2 = 0.000 |
| Wald-Statistics | -Wald chi2(8) = 738.25 | Prob>chi2 = 0.000 | Prob>chi2 = 0.000 |
| Wald-Statistics | -Wald chi2(8) = 995.68 | Prob>chi2 = 0.000 | Prob>chi2 = 0.000 |
| Log likelihood | 76.250 | 76.250 | 76.250 |


Note: 1. (Ln) = natural logs(log); 2. (***, **, *) = Significant at 0.01, 0.05 and 0.10, respectively; gdpcdummy=low income country category of GDP-per-capita of less or equal to USD 750 and gdpcdummy2=medium income country category of GDP-per-capita of equal or greater than USD 750.
The results clearly indicate that low income country commercial banks group were similar and comparable with the total bank sample and the medium income group was slight different.

The major conclusion drawn from these comparisons is that the total sample and low country income commercial bank category results were comparable. The medium income category commercial banks’ were omitted in regressions in both RE and FGLS. Rejection of the dummy for medium income country banks would indicate multicollinearity problems, data inconsistency and insufficiency in this category which had about 62 group banks compared to a total of 216 group banks drawn from 42 SSA countries. The fact that the results of the low country income commercial bank category had comparable results with the overall sample confirm the larger influence of these bank category in the results.
CHAPTER V

DETERMINANTS OF BANK TOTAL FACTOR PRODUCTIVITY GROWTH IN SSA

5.0 Introduction

In this chapter the determinants of commercial bank total factor productivity growth in Sub-Saharan Africa (SSA) were analysed in answering the second objective. In this analysis, the influence of bank specific as well as macroeconomic variables to commercial banks’ total factor productivity growth is explained. The analysis in this chapter included additional sets of variables in addition a few that were included in estimating banks’ profitability. Bank-specific variables considered in this analysis include growth in bank deposits, liquidity ratio, and other earning assets, asset quality, and profitability; while macroeconomic variables are GDP real exchange. The study also utilised unbalanced panel of 216 commercial banks from 42 countries. As in the previous chapter IV, the three panel estimators: fixed effects (FE), random effects (RE) and feasible generalised least squares (FGLS) were applied to estimate the regression equations.

The estimating equation was of the form;

\[
\text{TFPCH}_{it} = c + \Omega_1 \ln TD_{it} + \Omega_2 \ln OEA_{it} + \Omega_3 \text{NLTA}_{it} + \Omega_4 \text{NLTDS}_{it} \\
+ \Omega_5 \text{ROAA}_{it} + \Omega_6 \ln GDP_{it} + \Omega_7 \ln EXE_{it} + \varepsilon_{it} \]

Where \( TFPCH \) = total factor productivity growth, \( \ln TD \) = growth in bank deposits, \( \ln OEA \) = growth in other earning assets, \( \text{NLTA} \) = liquidity ratio, \( \text{NLTDS} \) = asset quality indicator;
and \( ROAA = \) Bank profitability which shows the level of bank earnings; macroeconomic variables including \( GDP \) growth and real exchange rate growth and \( \Omega_1 \ldots \Omega_7 \) are coefficients of explanatory variables.

The analysis utilized a panel data set of commercial spanning the period 1999 to 2006. The depended variable in this analysis was the computed total factor productivity growth variable generated through the Solow residual error through a decomposition process.

### 5.1 Data Characteristics

Table 5.1 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 most of SSA commercial banks in SSA as in Nissanke and Aryeetey (2006), among others.

Modest variability was 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 was a low variability in 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 was exhibited in total factor productivity growth, but at lower levels ranging between -3.59 percent to 4.14 percent. This level of factor productivity growth for commercial banks is far below the emerging and developed countries which in excess of 50 percent.

### Table 5.1: Descriptive Statistics of the Variables

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


Annex III gives the correlation between the explanatory variables for measuring bank total factor productivity growth. This analysis was also meant to demonstrate whether there was likely to be a problem of multi-co linearity in the regression results. When the correlation coefficient between any two variable combinations is analyzed, results show that the correlation coefficient between most of the two variable combinations is in the range of below 0.5. This implies that the effect of multi-collinearity in the regression estimates was less significant.
5.2 Specification and Robustness Tests

5.2.1 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 5.2.

<table>
<thead>
<tr>
<th>Table 5.2: Unbalance Panel Unit-Root Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Total factor productivity growth (tpch)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Growth in bank deposits (ltd)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Liquidity ratio (nlta)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Asset quality (nllds)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Growth in other earning assets (oea)</td>
</tr>
<tr>
<td>Bank profitability</td>
</tr>
<tr>
<td>GDP (gdpa)</td>
</tr>
<tr>
<td>Real exchange rate (exe)</td>
</tr>
</tbody>
</table>

Notes:
- Ho: All the panels contain unit roots
- HA: At least one panel is stationary
- Panel mean included
- Time trend included
- Drift term excluded


Results indicate that at least one of the panel is stationary with P ≤ α; p ≥ α 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.

### 5.2.2 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 \( \text{Prob} > \text{chi}^2 = a \), confirms the efficiency and consistency of the RE is estimating the model. Table 5.4 presents the results based on the test.

**Table 5.4: Hausman Specification Test between FE and RE Estimators**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficients</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(b)</td>
<td>(B)</td>
<td>(b-B)</td>
<td>Sqrt(diag(V_b-V_B))</td>
</tr>
<tr>
<td></td>
<td>Fixed</td>
<td>Random</td>
<td>Difference</td>
<td></td>
</tr>
<tr>
<td>Growth in bank - (ltd)</td>
<td>0.0246</td>
<td>0.8756</td>
<td>-0.0630</td>
<td>0.2022</td>
</tr>
<tr>
<td>Liquidity ratio (nlta)</td>
<td>-0.0037</td>
<td>-0.00612</td>
<td>0.0024</td>
<td>0.0009</td>
</tr>
<tr>
<td>Asset quality - (nltds)</td>
<td>0.0090</td>
<td>0.0014</td>
<td>-0.0063</td>
<td>0.0003</td>
</tr>
<tr>
<td>Other earning assets - (loea)</td>
<td>-0.08423</td>
<td>-0.1046</td>
<td>0.0241</td>
<td>0.1643</td>
</tr>
<tr>
<td>Bank profitability</td>
<td>-0.0628</td>
<td>-0.0670</td>
<td>0.0041</td>
<td>0.0013</td>
</tr>
<tr>
<td>Growth in GDP (lgdpa)</td>
<td>-0.0043</td>
<td>0.0338</td>
<td>-0.3802</td>
<td>0.0865</td>
</tr>
<tr>
<td>Growth in exchange rate - (lexe)</td>
<td>0.0348</td>
<td>0.0348</td>
<td>-0.0178</td>
<td>0.0187</td>
</tr>
</tbody>
</table>

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
- \( \text{Chi}^2(7) = (b-B)'[V_b-V_B]^{-1}(b-V) = 30.29; \text{Prob} > \text{chi}^2 = 0.0001 \)


Other diagnostic tests included F-statistic and Wald tests for the model significance, autocorrelation and multi-collinearity. 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 panel with lower time periods and larger observations tend to be efficiency in static models for they have limited autocorrelation and endogeneity specification effects.

5.3 Discussion of Results

This covered all the sampled commercial banks considered for the study. The type of estimation was static as the time trend effect was proven to be less significant in the panel specification. All the three type of estimations recommended to static panel models were applied. These are the fixed effects (FE), random effects (RE) and feasible generalized least square (FGLS) estimators. Due to the efficiency and consistency tested by Hausman test between FE and RE, RE estimation results are used in the interpretation of the results. The efficient of the RE regression results are further confirmed by FGLS estimation procedure. The results confirm that both RE and FGLS are efficient in estimating this model. The regression results are then explained in Table 5.3.
Table 5.3: Panel Regression Results for all Sample Banks

<table>
<thead>
<tr>
<th>Variable</th>
<th>FE Model</th>
<th>RE Models</th>
<th>FGLS Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable = total factor productivity growth (tfpch)</td>
<td>Coeff.</td>
<td>P.Value</td>
<td>Coeff.</td>
</tr>
<tr>
<td>Growth in bank deposits - (lntd)</td>
<td>0.0246</td>
<td>0.456</td>
<td>0.0875</td>
</tr>
<tr>
<td>Liquidity ratio (nlta)</td>
<td>-0.0037</td>
<td>0.020**</td>
<td>-0.0061</td>
</tr>
<tr>
<td>Asset quality - (nltds)</td>
<td>0.0008</td>
<td>0.064*</td>
<td>0.0015</td>
</tr>
<tr>
<td>Growth in other earning assets - (lnoea)</td>
<td>-0.0842</td>
<td>0.005***</td>
<td>-0.1046</td>
</tr>
<tr>
<td>Bank profitability</td>
<td>-0.0628</td>
<td>0.000***</td>
<td>-0.0700</td>
</tr>
<tr>
<td>Growth in GDP (lngdpa)</td>
<td>-0.0042</td>
<td>0.962</td>
<td>0.0340</td>
</tr>
<tr>
<td>Real exchange rate growth - (lnexe)</td>
<td>0.0169</td>
<td>0.427</td>
<td>0.0348</td>
</tr>
<tr>
<td>Constant</td>
<td>0.1131</td>
<td>0.953</td>
<td>-1.001</td>
</tr>
<tr>
<td>No. of Obs.</td>
<td>999</td>
<td></td>
<td>999</td>
</tr>
<tr>
<td>Group Banks</td>
<td>183</td>
<td></td>
<td>183</td>
</tr>
<tr>
<td>R.sq:</td>
<td>0.23</td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>F-Statistics- F(7,809)= 61.84</td>
<td>F&gt; 0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wald-Statistics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Wald chi2(7) = 534.59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wald-Statistics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Wald chi2(7) = 597.78</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

The coefficient of the variable representing growth in bank deposits is positive with expected sign at 5 percent and 10 percent levels in both RE and FGLS models. This is consistent with Naceur e t.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 banks loans and have implications to profitability and factor productivity growth 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 under RE and GLS regression models and significant at 1 percent, 5 percent and 10 percent levels, in both RE and FGLS models. The finding clearly shows negative relationship between bank total factor productivity growth and level of liquid assets held by the bank. As higher figures of the ratio denote lower
liquidity, the results imply that the more productive (inefficient) banks tend to be more (less) liquid.

A plausible reason relates to the increased cost for screening and monitoring required by a higher proportion of loans in the banks’ assets portfolio because loans are the type of assets with the highest operational cost in a bank portfolio (Ben Naceur and Omran, 2008). This is also observed in the study by Berger et al. (2008) that too little liquidity might force the bank to borrow at penal rates from the inter-bank market or from the central bank, depending on its reputation. In the same way, Nannyonjo (2002) observed that a high ratio could result in lost profitable investments activities in the banking industry in Uganda through reduced bank efficiency.

The relationship between asset quality represented by net loans to total deposits plus short term financing is negative and significant 1 percent, 5 percent and 10 percent levels, in both RE and FGLS models. This shows that total factor productivity growth of SSA commercial banks was 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 in normally associated with higher bank productivity indicated in (Kosmidoi (2008) and flamini et al (2009) studies on Sub-Saharan African commercial banks.
The coefficient of bank profitability (return on average asset) is negative with expected sign and significant at 1 percent, 5 percent and 10 percent levels, in both RE and FGL models. This reveals the low levels of banks’ profitability averaged at 11 percent across SSA over the study period negatively influenced banks’ total productivity growth. This finding would indicate that the less profitable banks, the more they become relatively less productive in their intermediation function. This corroborates similar findings of some previous studies by Isik and Hassan (2002), Hasan and Marton (2003), and Miller and Noulas (1996). 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 nets surplus revenues. In any progressive banking system, net incomes could have a bearing on factor productivity growth and portfolio investments.

Looking at macroeconomic variables chosen for this study. There is a positive and statistically significant relationship between growth in GDP and total factor productivity growth at 5 percent and 10 percent levels. This suggest 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 (Hiroyuki KIYOTA, 2009). This is consistent with theory and empirical evidence that prudent economic performance may result into some improvements in banks, 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 is positive with expected signs at 1 percent, 5 percent and 10 percent levels. This would suggest that cases where there is a positive change in the value of exchange rate, there are likely to 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 growth in real exchange 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.

Regression results based on NIM and ROAE are presented in annex IV. Results are almost similar with those of ROAA with slight variation in coefficient values and standard deviations arising from data variability.
5.3.2 Low and medium country income commercial banks

A comparative analysis of banks by country category in terms of GDP per-capita was applied. This was by introducing the dummies for the two categories as presented in Table 5.4. Results for low income country category banks were comparable with the total sample. All the variables; growth in bank deposits, liquidity ratio, asset quality, growth in other bank assets, bank profitability, GDP growth and real exchange rate growth had the expected signs although a slight variation coefficient values, but significant at 1, 5 and 10 percent levels. The dummy variable for medium income category commercial banks was consistently dropped out the regression equation consistently in the RE and FGLS models, other than in the FE model.

Using the RE and FGLS estimation methods, the dummy for medium income is consistently dropped and a dummy for low income retained. This is because after correcting for collinearity in the RE and FGGLS, the adequacy and consistency in the data, the regression becomes efficient and consistent. On the other hand, the problem with the dummy for medium income could be due to high variability within and across banks and insufficiency and consistency in the data set. Though results for RE and FGLS are similar, the latter are more efficient when the Wald statistics are compared.
Table 5.5: Panel Regression Results for Low and Medium Country Income Banks

<table>
<thead>
<tr>
<th>Variable</th>
<th>FE Model</th>
<th>RE Model</th>
<th>FGLS Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable = total factor productivity growth -(tfpch)</td>
<td>Coeff. P.Value</td>
<td>Coeff. P.Value</td>
<td>Coeff. P.Value</td>
</tr>
<tr>
<td>Growth in bank deposits- (lntd)</td>
<td>0.0268 0.485</td>
<td>0.0869 0.001***</td>
<td>0.1301 0.000***</td>
</tr>
<tr>
<td>Liquidity ratio (nltas)</td>
<td>-0.0037 0.342</td>
<td>-0.0061 0.000***</td>
<td>-0.0883 0.000***</td>
</tr>
<tr>
<td>Asset quality- (nltds)</td>
<td>-0.0010 0.518</td>
<td>0.0015 0.000**</td>
<td>0.0020 0.000***</td>
</tr>
<tr>
<td>Growth in other assets- (lnoea)</td>
<td>-0.0868 0.233</td>
<td>-0.1040 0.000***</td>
<td>-0.1387 0.000**</td>
</tr>
<tr>
<td>Bank profitability-(roaa)</td>
<td>-0.0660 0.000***</td>
<td>-0.0669 0.000***</td>
<td>-0.0744 0.000***</td>
</tr>
<tr>
<td>Growth in GDP (lngdpa)</td>
<td>0.1500 0.838</td>
<td>0.0341 0.054*</td>
<td>0.0330 0.002***</td>
</tr>
<tr>
<td>Real exchange rate growth-(lnexe)</td>
<td>0.0170 0.321</td>
<td>0.0136 0.004**</td>
<td>0.0389 0.000***</td>
</tr>
<tr>
<td>Gdpdummy</td>
<td>Omitted</td>
<td>-0.264 0.639</td>
<td>0.0212 0.574</td>
</tr>
<tr>
<td>Gdpdummy2</td>
<td>0.1276 0.237</td>
<td>omitted</td>
<td>omitted</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.4245 0.831</td>
<td>-0.4245 0.015***</td>
<td>-0.9799 0.000***</td>
</tr>
<tr>
<td>No. of Obs.</td>
<td>999</td>
<td>999</td>
<td>999</td>
</tr>
<tr>
<td>Group Banks</td>
<td>183</td>
<td>183</td>
<td>183</td>
</tr>
<tr>
<td>R.sq:</td>
<td>0.24</td>
<td>0.24</td>
<td>0.24</td>
</tr>
<tr>
<td>F-Statistics- F(8,808)= 54.31</td>
<td>F&gt; 0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wald-Statistics</td>
<td></td>
<td>Prob&gt;chi2</td>
<td></td>
</tr>
<tr>
<td>-Wald chi2(8) = 534.31</td>
<td></td>
<td>= 0.000</td>
<td></td>
</tr>
<tr>
<td>Wald-Statistics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Wald chi2(8) = 598.28</td>
<td></td>
<td>Prob&gt;chi2</td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td></td>
<td>= 0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-452.31</td>
<td></td>
</tr>
</tbody>
</table>

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

In summary, what the results show is that bank specific as well as macroeconomic variables have an influence on bank total factor productivity growth in SSA. Looking at the variation between total sample, low income and medium income category results, it can be concluded that the total sample and low income category banks had similar results confirming that the majority of the commercial banks were drawn from low income countries.
CHAPTER VI
CONCLUSION AND SOME IMPLICATIONS FOR POLICY

6.0 Summary

The research was conducted to investigate the determinants of commercial bank performance in Sub-Saharan Africa with a focus on profitability and total factor productivity growth measures. Both bank level and macroeconomic factors were used as explanatory variables of the two measures of bank performance as dependent variables. The lack of empirical information on commercial banking in Sub-Saharan Africa was the motivation behind this study. The study utilized a sample of 216 banks from 42 countries over the period 1999 to 2006. The random effects panel method was employed in estimating the two measures of bank performance.

The findings provide evidence that bank level as well as macroeconomic factors had a significant impact on SSA commercial bank profitability and total factor productivity growth over the study period 1999 to 2006. The findings call for a number of policy measures for improved competitiveness of SSA commercial banks in the financial intermediation services to the public.

Profitability and factor productivity growth for SSA banks can only be achieved if bank managers and policy makers continue to pay particular attention to bank-specific as well macroeconomic factors that have influence on their performance. Given the lower performance of the bank variable indicators and their marginal effects to bank performance
measures, it would be important to implement second generation reforms of the industry to bring about the desired growth of the industry.

6.1 Conclusions

The key conclusions on the determinants of bank profitability and total factor productivity growth are derived from the findings and discussions of this research. Discussions of the determinants of bank profitability as a dependent variable were based on the marginal effects of growth in bank deposits, capital adequacy, bank liquidity, operational efficiency, GDP growth and inflation; as explanatory variables. In estimating the determinants of bank total factor productivity growth as dependent variable discussions were based on the marginal effects of growth in bank deposits, bank liquidity, and growth in other earning assets, loan quality, asset quality growth in GDP and real exchange rate growth as explanatory variables. Key conclusions and policy implications drawn from the discussions are highlighted in the subsections that follow.

6.1.1 Determinants of bank profitability in SSA

The findings show that capital adequacy had positive influence on bank profitability. This could explain the relative growth in bank profitability achieved in most of the SSA countries following financial sector reforms during 1980s and 1990s. Positive growth of in capital adequacy in most of the SSA commercial banks could have merged from the opening up of most domestic banks to foreign competition during the reform period. Growth in bank deposits had a positive influence on bank profitability. This could reflect growing levels of deposit mobilization and increasing growth levels of banking population as the countries went through extensive economic and structural reforms. Positive influence of growth in
bank deposits could be a result of having deposits being transformed into loans.

Operational efficiency indicator had a negative effect on bank probability. The negative effect to growth in bank profitability could be explained by high costs in bank operations. Bank liquidity had negative influence on profitability. Excess liquidity is a sign that bank lending is low and banks are holding more money than statutory required for precautionary purposes. While, low liquidity is a reflection that banks are holding less money in their accounts, an indication of increased lending to the public, and thus implied growth in business and profitability.

The macroeconomic variables used in estimating bank profitability are mainly GDP growth and inflation. The findings show that, growth in GDP had a negative impact on bank profitability. This is consistent with theory that low GDP growth is an indication of low economic activity which negatively affects demand for private credit. Negative effect to bank profitability shows some levels of negative pro-cyclical GDP trends that happened in most of the SSA countries during the research period.

Most of the countries in SSA experienced very low and negative economic growth (Naceur et.al. 2003 and Panayiotis et al., 2005), which could have contributed to the reduction in bank profitability. For inflation variable, the effect to bank profitability was negative. The negative effect reflects the inability of bank managers to forecast inflation in their cost structure to realize profits (Panayiotis et al., 2005).
6.1.2 Determinants of bank total factor productivity growth in SSA

In measuring bank factor productivity growth for SSA, both bank level and macroeconomic factors had significant effect over the research period. The findings show that growth in bank deposits had a positive effect on total factor productivity growth. This would suggest that bank managers should take keen interest in deposit mobilization as these are cheaper sources of private sector credit. Bank liquidity and profitability were found to have negative influence on bank factor productivity growth.

The negative impact could arise from trading in bonds and other foreign assets without necessarily re-investing the profit in improving bank operations. This is typical of SSA banking system which has continued to operate in fragile financial markets. The negative effect of liquidity to factor productivity growth could arise from reduced private credit demand as result of high interest rates and poor performance of other macroeconomic aggregates such as inflation, exchange rate and GDP growth.

Asset quality, a measure of credit risk, had a positive impact on bank total factor productivity growth. The higher the quality of loans to assets (lower ratios), the higher the total factor productivity. Better performance of these variables means that banks have access to more funds for lending to private sector and more interest profit made. The higher the ratios, the low levels of bank total factor productivity growth.

Growth in other bank assets had significant influence on bank total factor productivity growth. This would imply that investment in other bank assets in SSA commercial could
improve bank factor productivity growth. Empirical evidence suggests that investment in other bank earning assets improves bank net earnings. Bank liquidity ratio positively influenced factor productivity growth. This would suggest that bank managers have to strike a balance given the risk/return trade-off of holding a relatively high proportion of liquid assets.

Too little liquidity could force the bank to borrow at penal rates from the inter-bank market or from the central bank, depending on its reputation, thus affecting total factor productivity growth. Higher ratios could also be result in lost profitable investments activities.

The macroeconomic variables of growth in GDP and growth in real exchange rate had also significant effect on bank total factor productivity growth in Sub-Saharan Africa. This is consistent empirical evidence that prudent economic performance may result into some improvements in bank factor productivity to some extent. Growth in real exchange rate had positive impact on banks total factor productivity. This could be a result of increased borrowing by private sector for investments in the importation of capital goods into the economy to enhance domestic production

6.2 Policy Implications for the Study

The main thrust of this research was to investigate the key determinants of bank performance in SSA with a focus on profitability and total factor productivity measures. This thesis is therefore paramount for guiding banking sector policy improvements in SSA. The governments and other concerned financial management institutions need to take into
account the main outcomes and other policy repercussions towards bank performance that has gained considerable importance in SSA banking industry in a liberalized financial market.

These findings therefore call for a number of policy interventions in SSA commercial banking industry for improved performance in profitability and factor productivity growth which are among the key measures of bank performance in the sub-region.

For bank profitability determinants, the thesis points out to the need for bank managers to gear towards optimum utilization of resources, observe prudent risk management procedures for sound and competitive services for better returns. There is also need for commercial banks in SSA to be responsive to risks associated with changing macroeconomic factors in a liberalised environment.

Results also confirm the importance of bank level as well as macroeconomic factors to the bank total factor productivity growth. This would suggest that banks should ensure efficient and effective supervisory and related service for optimum utilization of resources. This 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 bank 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, this study opens up areas for further research. One would be to investigate on how SSA commercial bank performance in terms of profitability and total factor productivity measures, compares with other regions and continents. Two would be to explore other measures of bank performance for SSA to add on the existing literature for improving the sector. Three would be to explore other appropriate methods that would be applied in the analysis of the available commercial bank data for generating comparative results, for effective policy and decision making for the sector. Given the changing environment of SSA banking system where there are increased mergers and acquisitions
within and across countries, there is need to implement long term studies to inform second generation reforms in the industry.
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Annexes

Annex I: List of Countries Selected for the Study

1. Angola
2. Benin
3. Botswana
4. Burkina Faso
5. Burundi
6. Cameroon
7. Ghana
8. Democratic Republic of Congo
9. Ethiopia
10. Gabon
11. Gambia
12. Ivory Coast
13. Kenya
14. Lesotho
15. Madagascar
16. Mali
17. Mauritania
18. Mauritius
19. Mozambique
20. Namibia
21. Nigeria
22. Rwanda
23. Senegal
24. Tanzania
25. Uganda
26. Zambia
27. Cape Verde
28. Central African Republic
29. Chad
30. Congo Brazzaville
31. Equatorial Guinea
32. Eritrea
33. Guinea
34. Liberia
35. Niger
36. SAO.Tome
37. Zimbabwe
38. Togo
39. Swaziland
40. Sierraloen
41. Seychelles
42. South Africa
### Annex II: Correlation Matrix for Bank Profitability Model

<table>
<thead>
<tr>
<th></th>
<th>roaa</th>
<th>ta</th>
<th>e_ta</th>
<th>td</th>
<th>nl_ta</th>
<th>ctir</th>
<th>gdpa</th>
<th>inf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank profitability</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total bank assets</td>
<td>0.0717</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bank capitalization</td>
<td>0.1518</td>
<td>-0.0429</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total bank deposits</td>
<td>0.0727</td>
<td>0.9843</td>
<td>-0.0449</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bank liquidity</td>
<td>-0.1255</td>
<td>-0.0521</td>
<td>0.0067</td>
<td>-0.0534</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operational efficiency</td>
<td>-0.4073</td>
<td>-0.0423</td>
<td>0.1463</td>
<td>-0.0425</td>
<td>-0.1469</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gdp</td>
<td>-0.0600</td>
<td>-0.0396</td>
<td>0.1385</td>
<td>-0.0382</td>
<td>-0.0110</td>
<td>0.0367</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>-0.0109</td>
<td>0.0302</td>
<td>0.0316</td>
<td>0.0283</td>
<td>-0.2263</td>
<td>0.0255</td>
<td>-0.0356</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

### Annex III: Correlation Matrix for Bank Profitability Model

<table>
<thead>
<tr>
<th></th>
<th>tfpch</th>
<th>td</th>
<th>nl_ta</th>
<th>nl_tds</th>
<th>oea</th>
<th>roaa</th>
<th>gdpa</th>
<th>exe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total factor productivity growth</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total bank deposits</td>
<td>-0.0439</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bank liquidity</td>
<td>-0.0212</td>
<td>-0.0670</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asset quality</td>
<td>0.0333</td>
<td>-0.0318</td>
<td>0.5993</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other bank earning assets</td>
<td>-0.0396</td>
<td>0.9556</td>
<td>-0.0820</td>
<td>-0.0290</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bank profitability</td>
<td>-0.5534</td>
<td>0.0994</td>
<td>-0.1498</td>
<td>-0.0478</td>
<td>0.0967</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td>0.1128</td>
<td>-0.0431</td>
<td>-0.0189</td>
<td>0.1142</td>
<td>-0.0458</td>
<td>-0.0947</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Real exchange rate</td>
<td>0.0122</td>
<td>0.4504</td>
<td>-0.2858</td>
<td>-0.1069</td>
<td>0.4741</td>
<td>0.1769</td>
<td>-0.1555</td>
<td>1.0000</td>
</tr>
</tbody>
</table>
Annex IV: Regression Results for NIM and ROAE

```
xtreg nim lta e_ta ltd nl_ta cti gdpa inf,fe
Fixed-effects (within) regression               Number of obs      =       974
Group variable: bnk
Number of groups   =       185
R-sq:  within  = 0.1698
    between = 0.0538    avg = 5.3
    overall = 0.0802    max = 8
          F(7,782)           =     22.86
       corr(u_i, Xb)  = -0.2755                                Prob > F           =    0.0000

-------------------------------------------------------------------------------
     nim |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------------------------------------------------------------------
    lta |  -.5438867   .3760998   -1.45   0.149    -1.282171     .194398
   e_ta |   .1541301   .0215303    7.16   0.000     .1118661    .1963942
    ltd |   .3654258   .3863915    0.95   0.345    -.3930615    1.123913
   nl_ta |  -.0100089   .0119085   -0.84   0.401    -.0333852    .0133674
   cti  |  -.0203127   .0035669   -5.69   0.000    -.0273146    -.0133108
   gdpa |  -5.47e-11   4.93e-11   -1.11   0.267     .0151e-10    4.21e-11
    inf |   .0259874   .0035762    7.27   0.000     .0189673    .0330076
_cons |    9.34899  1.1736350    7.97   0.000     7.045141    11.65284
-------------------------------------------------------------------------------

 sigma_u |  4.3920367
 sigma_e |  2.9562953
     rho |  .6881989 (fraction of variance due to u_i)

F test that all u_i=0:  F(184, 782) =     7.93            Prob > F = 0.0000

.xtreg nim lta e_ta ltd nl_ta cti lgdpa inf,re
Random-effects GLS regression                   Number of obs      =       974
Group variable: bnk
Number of groups   =       185
R-sq:  within  = 0.1607
    between = 0.1242
    overall = 0.1501    max = 8
          Wald chi2(7)           =    176.78
       corr(u_i, X)   = 0 (assumed)                                Prob > chi2        =    0.0000

-------------------------------------------------------------------------------
     nim |      Coef.   Std. Err.     z    P>|z|     [95% Conf. Interval]
-------------------------------------------------------------------------------
    lta |  -.1022214   .3293638   -0.31   0.756    -.7477626    .5433197
   e_ta |   .135409    .018541    7.30   0.000     .0990693    .1717487
    ltd |   .1163839   .3301558    0.35   0.724    -.5307095    .7634774
   nl_ta |  -.0314549   .0095177   -3.30   0.001    -.0501092    -.0128007
   cti  |  -.019333    .0031672   -6.10   0.000    -.0255405    -.0131254
   lgdpa |  -4.147619   .2180819   -1.90   0.057    -.8421946    .0126708
    inf |   .0263934   .0034035    7.75   0.000     .0197226    .0330643
-------------------------------------------------------------------------------
```
xtgls nim lta e_ta ltd nl_ta ctir lgdpa inf
Cross-sectional time-series FGLS regression
Coefficients: generalized least squares
Panels: homoskedastic
Correlation: no autocorrelation

Estimated covariances = 1
Estimated autocorrelations = 0
Estimated coefficients = 8
Obs per group: min = 1
max = 8
Wald chi2(7) = 209.45

Log likelihood = -2843.961
Prob > chi2 = 0.0000

nim | Coef.  Std. Err.   z    P>|z|   [95% Conf. Interval]
----------------- ------------- ------ -------- ------------------ ---------------
lta |   .384994     .3208713   1.20   0.230 -0.2439022  1.01389
e_ta|   .1099278    .0164268   6.69   0.000   .0777319   .1421237
ltd |  -.2842628    .320472    -0.89   0.375 -.9123764  .3438508
nl_ta| -.0618099    .0077487  -7.98   0.000  -.0769971  -.0466228
cmp. | -.0154006   .003402      -4.53   0.000  -.0220685  -.0087328
lgdpa| -.4841922   .1200277   -4.03   0.000  -.719442   -.2489423
inf |   .0203533    .003876    5.25   0.000   .0127564   .0279502
_cons |  20.23014    2.70998     7.47   0.000  14.91868   25.5416

.xtreg roae lta e_ta ltd nl_ta ctir gdpa inf,fe

Fixed-effects (within) regression
Number of obs   =    966
Number of groups =    184
R-sq: within = 0.0762 Obs per group: min = 1
between = 0.0120 avg = 5.3
overall = 0.0047 max = 8

F(7,775) = 9.13
Prob > F    = 0.0000
xtreg roae lta e_ta ltd nl_ta ctir lgdpa inf,re
Random-effects GLS regression
Group variable: bnk
Number of obs = 966
Number of groups = 184
R-sq: within = 0.0414
table om: 0.2471
table over = 0.0915
Wald chi2(7) = 96.48
Corr(u_i, X) = 0 (assumed)
Prob > chi2 = 0.0000

---------------------
roae | Coef. Std. Err. t P>|t| [95% Conf. Interval]
---------------------
ltl | 19.38609 5.163593 3.75 0.000 9.2498 29.52237
e_ta | -.4802391 .2961164 -1.62 0.105 -1.061524 .1010461
ltd | -21.96305 5.305275 -4.14 0.000 -32.37746 -11.54864
nl_ta | .1012531 .1647233 0.61 0.539 -.2221037 .4246099
crir | -.3239363 .0489842 -6.61 0.000 -.4200937 -.2277788
lgdpa | 5.00e-10 6.77e-10 0.74 0.460 -.828e-10 1.83e-09
inf | .1755607 .0491144 3.57 0.000 .0791477 .2719736
_cons | 40.44832 16.17489 2.50 0.013 8.696533 72.20011

---------------------
sigma_u | 32.646901
sigma_e | 40.580298
rho | .39291739 (fraction of variance due to u_i)

F test that all u_i=0: F(183, 775) = 1.37 Prob > F = 0.0026

.xtgls roae lta e_ta ltd nl_ta ctir lgdpa inf
Random-effects GLS regression
Group variable: bnk
Number of obs = 966
Number of groups = 184
R-sq: within = 0.0414
table om: 0.2471
table over = 0.0915
Wald chi2(7) = 96.48
Corr(u_i, X) = 0 (assumed)
Prob > chi2 = 0.0000

---------------------
roae | Coef. Std. Err. t P>|t| [95% Conf. Interval]
---------------------
ltl | 6.702667 2.996041 2.24 0.025 .8305348 12.5748
e_ta | -.355021 .1535173 -2.31 0.021 -.6559095 -.0541326
ltd | -5.34917 2.992643 -1.79 0.074 -11.21464 .5163037
nl_ta | -.1930072 .0729187 -2.65 0.008 -.3359253 -.0500891
crir | -.2487259 .0317675 -7.83 0.000 -.310989 -.1864627
lgdpa | -3.069124 1.131541 -2.71 0.007 -.5286904 -.8513444
inf | -.005191 .0362079 -0.14 0.886 -.0761572 .0677752
_cons | 108.8063 25.52997 4.26 0.000 58.76846 158.8441

---------------------
sigma_u | 0
sigma_e | 40.569902
rho | 0 (fraction of variance due to u_i)

.xtgls roae lta e_ta ltd nl_ta ctir lgdpa inf
Cross-sectional time-series FGLS regression

Coefficients: generalized least squares
Panels: homoskedastic
Correlation: no autocorrelation

Estimated covariances = 1
Estimated autocorrelations = 0
Estimated coefficients = 8

Number of obs = 966
Number of groups = 184
Obs per group: min = 1
avg = 5.25
max = 8

Wald chi2(7) = 97.28
Log likelihood = -4974.537
Prob > chi2 = 0.0000

|      | Coef.     | Std. Err. | z     | P>|z|   | [95% Conf. Interval] |
|------|-----------|-----------|-------|-------|----------------------|
| roae | 6.702667  | 2.983609  | 2.25  | 0.025 | .8549006 12.55043    |
| lta  | -.355021  | .1528803  | -2.32 | 0.020 | -.654661 -.0553811  |
| e_ta | -5.34917  | 2.980226  | -1.79 | 0.073 | -11.1903 .4919655   |
| ltd  | -.1930072 | .0726162  | -2.66 | 0.008 | -.3353323 -.0506821 |
| nl_ta| -.2487259 | .0316357  | -7.86 | 0.000 | -.3107306 -.1867211 |
| ctir | -3.069124 | 1.126846  | -2.72 | 0.006 | -5.277702 -.8605469 |
| lgdpa| -.005191  | .0360577  | -0.14 | 0.866 | -.0758627 .0654807  |
| _cons| 108.8063  | 25.42404  | 4.28  | 0.000 | 58.97609 158.6365   |
Annex V: Effect of Time in the Specification

xtreg roaa i.year lta e_ta ltd nl_ta ctir lgdpa inf,fe
Fixed-effects (within) regression  Number of obs  =  967
Group variable: bnk  Number of groups  =  184
R-sq: within  = 0.2408  Obs per group: min  =  1
between  = 0.1793  avg  =  5.3
overall  = 0.1356  max  =  8
F(14,769)  = 17.42
corr(u_i, Xb)  = -0.7995  Prob > F  =  0.0000

| Year | Coef. | Std. Err. | t  | P>|t| | 95% Conf. Interval |
|------|-------|-----------|----|-----|------------------|
| 2000 | -0.0065944 | 0.4843446 | -0.01 | 0.989 | -0.9573888 | 0.9442 |
| 2001 | 0.8384916 | 0.4905845 | 1.71 | 0.088 | -1.245522 | 1.801535 |
| 2002 | 0.2406659 | 0.5099356 | 0.47 | 0.637 | -0.760365 | 1.241697 |
| 2003 | 0.1452518 | 0.5500294 | 0.26 | 0.792 | -0.9344855 | 1.224989 |
| 2004 | 0.4341565 | 0.6170022 | 0.70 | 0.482 | -0.7770519 | 1.645365 |
| 2005 | 0.9085865 | 2.066157 | 0.44 | 0.660 | -3.147391 | 4.964564 |
| 2006 | -0.389867 | 0.4478421 | -0.87 | 0.384 | -1.269005 | 0.4892712 |
| lta  | 0.2115486 | 0.256876 | 8.24 | 0.000 | 0.1611225 | 0.2619747 |
| ltd  | 1.655913 | 0.4668722 | 3.55 | 0.000 | 0.7394173 | 2.572408 |
| nl_ta | -0.0206485 | 0.144299 | -1.43 | 0.153 | -0.0489753 | 0.0076782 |
| ctir  | -0.032432 | 0.0142894 | -0.24 | 0.807 | -1.497242 | 1.165995 |
| lgdpa | -0.165238 | 0.6783405 | -0.24 | 0.807 | -1.269005 | 1.224989 |
| inf  | -0.0436555 | 0.042994 | -1.02 | 0.310 | -0.0489753 | 0.0076782 |
| _cons | 45.78007 | 36.81352 | 1.24 | 0.214 | -26.49037 | 118.0505 |

sigma_u  4.1174477
sigma_e  3.5118943
rho  0.5788747  (fraction of variance due to u_i)
F test that all u_i=0:  F(183, 769)  =  1.51  Prob > F  =  0.0001

_xtreg roaa i.year lta e_ta ltd nl_ta ctir lgdpa inf,fe
Random-effects GLS regression  Number of obs  =  967
Group variable: bnk  Number of groups  =  184
R-sq: within  = 0.1945  Obs per group: min  =  1
between  = 0.4594  avg  =  5.3
overall  = 0.2779  max  =  8
Wald chi2(14)  =  366.31
corr(u_i, X)  = 0 (assumed)  Prob > chi2  =  0.0000
| roaa | Coef.  | Std. Err. | z     | P>|z| | [95% Conf. Interval] |
|------|--------|-----------|-------|-----|------------------|
| year | 2000   | -1.294023 | .4963064 | -0.26 | 0.794 | -1.102145 .8433404 |
|      | 2001   | .8470485  | .4865234  | 1.74  | 0.082 | -1.065198 1.800617  |
|      | 2002   | .3331878  | .4825304  | 0.69  | 0.490 | -.6125543 1.27893  |
|      | 2003   | .2597395  | .4709332  | 0.55  | 0.581 | -1.663272 1.182752 |
|      | 2004   | .6642211  | .471133   | 1.41  | 0.159 | -.2591826 1.587625 |
|      | 2005   | .2330652  | .4749052  | 0.49  | 0.624 | -.6977319 1.163862 |
|      | 2006   | .4458325  | 1.880181  | 0.24  | 0.813 | -3.239254 4.130919 |
| lta  |       | -.4621637 | .263546   | -1.75 | 0.079 | -.9787043 .054377  |
| e_ta |       | .1149039  | .0134867  | 8.52  | 0.000 | .0884703 1.413374  |
| ltd  |       | .613038   | .2633619  | 2.33  | 0.020 | .0968582 1.129218  |
| nl_ta|       | -.041618  | .0064323  | -6.47 | 0.000 | -.0542251 -.0290109 |
| ctir |       | -.0403375 | .0027974  | -14.42| 0.000 | -.0458203-.0348548 |
| lgdpa|       | -.3950784 | .1001449  | -3.95 | 0.000 | -.5913588 -.1987981 |
| inf  |       | -.0056567 | .003205   | -1.76 | 0.078 | -.0119384 .000625  |
| _cons|       | 13.17707  | 2.276187  | 5.79  | 0.000 | 8.71583 17.63832 |

**xtgls roaa i.year lta e_ta ltd nl_ta ctir lgdpa inf**

Cross-sectional time-series FGLS regression

Coefficients: generalized least squares

Panels: homoskedastic

Correlation: no autocorrelation

Estimated covariances = 1  Number of obs = 967
Estimated autocorrelations = 0  Number of groups = 184
Estimated coefficients = 15  Obs per group: min = 1
                             avg = 5.255435
                             max = 8

Wald chi2(14) = 372.08

Log likelihood = -2624.49  Prob > chi2 = 0.0000
| roaa       | Coef.  | Std. Err. | z     | P>|z|  | [95% Conf. Interval] |
|------------|--------|-----------|-------|------|-----------------------|
| year       |        |           |       |      |                       |
| 2000       | -1.294023 | .492442   | -0.26 | 0.793| -0.8304571 .8357663  |
| 2001       | .8470485 | .4827352  | 1.75  | 0.079| -.0990951 1.793192   |
| 2002       | .3331878 | .4787733  | 0.70  | 0.486| -.6051905 1.271566   |
| 2003       | .2597395 | .4672664  | 0.56  | 0.578| -.6560859 1.175565   |
| 2004       | .6642211 | .4674646  | 1.42  | 0.155| -.2519928 1.580435   |
| 2005       | .3331878 | .4712075  | 0.70  | 0.486| -.6051905 1.271566   |
| 2006       | .4458325 | 1.865541  | 0.24  | 0.811| -.3210561 4.102226   |

| lta        | -.4621637 | .2614939 | -1.77 | 0.077| -.9746824 .0503551  |
| e_ta       | .1149039  | .0133817 | 8.59  | 0.000| .0886762 1.411136   |
| ltd        | .613038   | .2613113 | 2.35  | 0.019| .1008773 1.125199   |
| nl_ta      | -.041618  | .0063822 | -6.52 | 0.000| -.0541269 -.0291091 |
| cttir      | -.0403375 | .0027756 | 14.53 | 0.000| -.0457776 -.0348975 |
| lgdpa      | -.3950784 | .0993651 | -3.98 | 0.000| -.5898305 -.2003264 |
| inf        | -.0056567 | .0031801 | -1.78 | 0.075| -.0118895 .0005761  |
| _cons      | 13.17707  | 2.258464 | 5.83  | 0.000| 8.750566 17.60358   |

```
. xtreg tfpch i.year ltd nl_ta nl_tds loea roaa lgdpa exe, fe
Fixed-effects (within) regression
Number of obs      =       999
Group variable: bnk  Number of groups   =       183
R-sq:  within  = 0.3586
       between = 0.1071
       overall = 0.1627
F(14,802)          =     32.03
corr(u_i, Xb)  = -0.3439
Prob > F           =    0.0000

| tfpch      | Coef.  | Std. Err. | t     | P>|t|  | [95% Conf. Interval] |
|------------|--------|-----------|-------|------|-----------------------|
| year       |        |           |       |      |                       |
| 2000       | -.0297001 | .0356862 | -0.83 | 0.406| -.0997495 .0403492   |
| 2001       | .0207238  | .0369259 | 0.56  | 0.575| -.0517591 .0932066   |
| 2002       | .0483897  | .0390141 | 1.24  | 0.215| -.0281922 .1249715   |
| 2003       | .0188862  | .0416066 | 0.45  | 0.650| -.0627845 .1005659   |
| 2004       | .0512821  | .0461804 | 1.11  | 0.267| -.0393666 .1419309   |
| 2005       | .037631   | .0506776 | 0.74  | 0.458| -.0618454 .1371075   |
| 2006       | -.3413164 | .1540498 | -2.22 | 0.027| -.6437049 -.038928   |

| ltd        | .0231151  | .0330685 | 0.70  | 0.485| -.0417959 .088026    |
| nl_ta      | -.0040525 | .0015956 | -2.54 | 0.011| -.0071846 -.0009205 |
| nl_tds     | .0008529  | .0004567 | 1.87  | 0.062| -.0000436 .0017494  |
| loea       | -.0907276  | .0302892 | -3.00 | 0.003| -.1501831 -.031272   |
| roaa       | -.0621866 | .0033651 | -18.48| 0.000| -.068792 -.0555812   |
```
```
\begin{verbatim}
xtreg tfpch i.year ltd nl_ta nl_tds loea roaa lgdpa lexe, re
Random-effects GLS regression Number of obs = 999
Group variable: bnk Number of groups = 183
R-sq: within = 0.3482 Obs per group: min = 1
between = 0.4491 avg = 5.5
overall = 0.3809 max = 8
Wald chi2(14) = 556.49 Prob > chi2 = 0.0000

tfpch Coef. Std. Err. z P>|z| [95% Conf. Interval]
  year
  2000 -0.0419723 .0356923 -1.18 0.240 -.1119279 .0279832
  2001 -0.0080946 .0354942 -.02 0.820 -.0776619 .0614727
  2002 .0010348 .0356493 0.03 0.977 -.0688365 .0709061
  2003 -0.047402 .0349081 -1.36 0.174 -.1158207 .0210167
  2004 -0.0314221 .0356493 -0.89 0.375 -.1008634 .0380191
  2005 -0.06025 .0357801 -1.68 0.092 -.1303777 .0098777
  2006 -.4716978 .1467477 -3.21 0.001 -.759318 -.1840776
  ltd .094791 .0259536 3.65 0.000 .0439228 .1456592
  nl_ta -.0061848 .0013064 -4.73 0.000 -.0087452 -.0036244
  nl_tds .0014698 .0003797 3.87 0.000 .0007256 .002214
  loea -.1084348 .0252173 -4.30 0.000 -.1578597 -.0590998
  roaa -.0666781 .0031073 -21.46 0.000 -.0727684 -.0605878
  lgdpa .0392498 .0175358 2.24 0.025 .0048802 .0736194
  lexe .0323862 .0100712 3.22 0.001 .012647 .0521254
  _cons -1.09992 .4047406 -2.72 0.007 -1.893197 -.306643

sigma_u .25795812
sigma_e .26362951
rho .48912795 (fraction of variance due to u_i)
\end{verbatim}
```

```
. xtgls tfpch i.year ltd nl_ta nl_tds loea roaa lgdpa lexe, re
Cross-sectional time-series FGLS regression
Coefficients:  generalized least squares
Panels: homoskedastic
Correlation: no autocorrelation
```

Estimated covariances = 1       Number of obs = 999
Estimated autocorrelations = 0     Number of groups = 183
Estimated coefficients = 15       Obs per group: min = 1
                avg = 5.459016
                max = 8
Wald chi2(14) = 632.00       Prob > chi2 = 0.0000
Log likelihood = -441.8829

|        | Coef. | Std. Err. | z     | P>|z|  [95% Conf. Interval] |
|--------|-------|-----------|-------|------|-----------------------|
| tfpch  |       |           |       |      |                       |
| year   |       |           |       |      |                       |
| 2000   | -.0654439 | .0493302   | -1.33 | 0.185 | -.1621294 , .0312415 |
| 2001   | -.0243302 | .048705    | -0.50 | 0.617 | -.1197901 , .0711298 |
| 2002   | -.0202937 | .048623    | -0.42 | 0.676 | -.115593 , .075056   |
| 2003   | -.073291  | .0473027   | -1.55 | 0.121 | -.1660026 , .0194206 |
| 2004   | -.0571512 | .0473588   | -1.21 | 0.228 | -.1499727 , .0356703 |
| 2005   | -.0859031 | .0474164   | -1.81 | 0.070 | -.1788375 , .0070314 |
| 2006   | -.8048577 | .1933073   | -4.16 | 0.000 | -.1.183733 , -0.4259824 |
| ltd    | .1377098  | .0227051   | 6.07  | 0.000 | .0932086 , .1822111   |
| nl_ta  | -.0088622 | .0011159   | -7.94 | 0.000 | -.0110493 , -.0066751 |
| nl_tds | .0019085  | .0003339   | 5.72  | 0.000 | .001254 , .0025629   |
| loea   | -.1458899 | .0222523   | -6.56 | 0.000 | -.1.895037 , -.1022761 |
| roaa   | -.073907  | .0034387   | -21.49| 0.000 | -.0806467 , -.0671673 |
| lgdpa  | .0350995  | .0104659   | 3.35  | 0.001 | .0145867 , .0556124   |
| lexe   | .0353951  | .0063497   | 5.57  | 0.000 | .0229499 , .0478404   |
| _cons | -.9600165 | .2457893   | -3.91 | 0.000 | -.1.441755 , -.4782783 |