X-Efficiency of Commercial Banks in Kenya

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Abstract
This study sought to determine the X-efficiency of commercial banks in Kenya and to establish whether the X-efficiency of these banks is affected by economies of scale. The data set consisted of annual operation costs of banks including interest expense. Deposits and borrowed funds were the inputs, and the loans to customers and investment and other incomes were the outputs. The data was collected from 33 banks for the period 2000 to 2005. To measure the X-efficiency level of commercial banks in Kenya, the study applied the Stochastic Econometric Cost Frontier approach which involves the estimation of the cost function and the derivation of the X-efficiency estimate based on the deviation from the efficient cost frontier. The empirical results obtained showed that X-efficiency exists in the commercial banks in Kenya and that X-efficiency of the banks is affected by economies of scale. The results showed that the average level of X-efficiency in Kenya's commercial banks industry is 18%. After controlling for scale differences, the average small bank is found to be relatively less efficient than the average large bank. The persistency of X-efficiency in relation to bank size was measured to determine if inefficient banks tend to remain inefficient over time. The results indicate that the average large bank inefficiency was more persistent than the average small bank inefficiency at the level of 23%. The results also show that bank size affects X-efficiency for large banks. These findings were consistent with the results found in other related studies in US Kwan and Eisenbeis, 1996), Hong Kong (Kwan, 2001) and Namibia (Ikhide, 2000).

1. Introduction

The pursuit of efficiency is a fundamental concern for all businesses including commercial banks and other financial institutions. Generally, the concept of efficiency can be regarded as the relationship between outputs of a system and the corresponding inputs used in their production. Within the financial efficiency literature, efficiency is treated as a relative measure, which reflects the deviations from the maximum attainable output for a given level of input (Kwan and Eisenbeis, 1996).

X-efficiency stems from technical efficiency. Nyhan (1998) defines technical efficiency as a way of using minimum inputs to produce a given level of output. If a financial institution is technically inefficient then it is using too many inputs to produce the given level of output. X-efficiency attempts to measure the degree of waste and friction in the production process. Allocative efficiency measures whether the right levels of various inputs have been used to produce a given level of output.

In this study we have used X-efficiency as a measure of cost efficiency i.e. the extent to which commercial banks usually incur minimum costs in their operations to produce a given level of output. The difference between the actual operating costs of commercial banks and the minimum costs they should use is the X-efficiency. There are two concepts related to X-efficiency these are scale and scope efficiency. Scale efficiency in a banking context refers to the economies brought about by joint operations. That is, the cost of providing joint banking services is less than the sum of banks stand-alone operations (Kwan and Eisenbeis, 1996). Scope efficiency in a banking context refers to the number of different types of services offered by banks and their effect on cost of operation and ability to raise revenue (Berger et al, 2001). This study analyzed the operating X-efficiency of commercial banks in Kenya with a view to highlight the status of cost efficiency so that managers and regulators can improve their own efficiency scores. This is important to managers, stockowners, depositors and investors.

Commercial banks in Kenya as elsewhere need to be efficient as they are accountable to their stockowners, depositors, investors and to the government for the resources entrusted to them. Cost efficiency in commercial banking helps to reduce the cost of transacting thereby increasing financial intermediation. A low cost of financial intermediation has a positive impact on economic growth and development (Levine & Zingales, 1998). Banks also play a major role in ensuring a smoothly functioning payment system, which allows financial and real resources to flow freely to their highest-return uses.

A basic benefit of enhanced efficiency is a reduction in spreads between lending and deposit rates. This is likely to stimulate both greater loan demands for industrial investments (and thus contribute to higher economic growth) and greater mobilization of savings through the banking system. Banks in most developing countries operate with relatively wide interest rate spreads. Operating inefficiencies of banks has been pointed out as one of the reasons to be investigated (Ikhide, 2000).

Policy makers, economists, and monetary authorities recognize the ability of banks to achieve the desired results and continue to play their role in contributing to the development of the economy. This depends not only on the existence of an enabling (regulatory) environment and the number of operating banks but also more importantly on their performance from one financial year to another. A commercial bank ought to improve on its X-efficiency in order to improve its performance from one year to another.

The Stochastic Econometric Cost Frontier Analysis (SFA) approach is applied to study the X-efficiency of commercial banks in Kenya. The cost function gives the minimum level of cost at which it is possible to produce some level of output, given input prices (Dwivedi, 2002) The cost frontier means that the observed production cost must lie anywhere above the cost frontier curve but no points can lie below it (Kwan, 2001). Thus, the amount by which a firm lies above its cost frontier is regarded as a measure of inefficiency.

The study is divided into four sections. Section one is the introduction. Section two is the literature review. Section three is the research methodology. Section four focuses on the data analysis, results, and discussion. Section five is the conclusion.

1.1 The Commercial Banking Industry in Kenya

Since independence commercial banks in Kenya have grown both in number, branches and the variety of services they offer like loans, credit and debit card services, introduction of Automatic Teller Machines (ATMs), electronic banking and other services. These developments are meant to improve scale and scope efficiency of operations in the banking industry. As commercial banks grow, they introduce new technology which increases scale and scope efficiency.

Kenya has 44 commercial banks, which includes both large and small-scale banks. The entrance of new banks both local and foreign into the Kenyan banking sector has increased competition in the industry. Whether and how a bank survives in this competitive environment depends in part on how efficient it operates both in terms of scale and scope. Some commercial banks in Kenya like Equity, Kenya Commercial Bank (KCB) and Cooperative bank play a special role in funding of small businesses that often have very limited access to other sources of external finance.

1.2 Statement of the Problem

The efficiency of commercial banks has reemerged as a critical issue to the public and private investors, whose confidence in financial institutions has been shaken by recent failures of banks in the banking sector in Kenya. The first cycle of bank failures began in 1984-1986 with the collapse of Rural Urban Credit Finance, Continental and Union Bank groups. These banks were liquidated after they were unable to repay the deposits obtained from government parastatals (Brownbridge, 1998). Some of the commercial banks were closed e.g. Euro Bank and Trade Bank. Central Bank of Kenya placed others under statutory management e.g. Daima Bank. Other banks experiencing liquidity problems such as the Home Savings and Mortgages Company Ltd and Nationwide Finance Company Ltd were merged to form part of the present Consolidated Bank (Njihia, 2005).

Bank failures damage the credibility of financial institutions raising the costs of deposits and forcing financial institutions to maintain high level of liquidity as a precaution against bank runs that could lead to insolvency. The need for efficiency in day-to-day operations of commercial banks is thus evident as this will reduce chances of a bank failing and also efficiency of intermediation translates into good performance in the whole economy (Musyoki, 2003).

An efficient and a smoothly operating payment system is a necessary precondition for business development in Kenya and other countries. Business development can be enhanced by efficient banking system through low cost of credit, which in turn affects the level and rate of economic growth.

Many countries in sub-Saharan Africa liberalized their financial sectors in the late 1980's or 1990's to encourage greater financial efficiency (Brownbridge, March 2002). Kenya liberalized her financial system in the 1990's with interest rate liberalization in 1991 and conversion of Non Banking Financial Institutions (NBFIs) to banks in 1994. Some state-owned banks like Kenya Commercial Bank and National Bank of Kenya were also privatized and banking rules and regulations strengthened. These changes have had an impact on the cost structure of commercial banks in Kenya due to the reduction in their levels of non-performing loans and political influence. Therefore, there is need to study X-efficiency of Kenya's commercial banks. The fragility within the financial system has exposed deficiencies in the banking sector more so in regulatory and supervisory framework. These deficiencies have an impact on costs incurred by banks to facilitate their operations. Also, though other studies of efficiency of commercial banks in Kenya have been done, the literature in this area is still scarce.

Similar studies of X-efficiency of commercial banks has been done elsewhere in some African countries like Namibia by Ikhide (2000), European countries like Germany, Italy, Netherlands, Switzerland and UK by Berger et al (2001), in United States (US) by Barr (1999), and Asian countries like Hong Kong by Kwan (2001). Ikhide (2000) using the efficient cost frontier approach and performance ratios studied the efficiency of the five commercial banks in Namibia from 1996 to 1998. He found out that the commercial banks are not producing at minimum costs and that profitability measures are not highly correlated with operating cost (lkhide, 2000). Kwan (2001) used the Stochastic Econometric Cost Frontier approach to study X-efficiency of commercial banks in

Hong Kong from 1992 to 1999. He found out that the average large banks tend to be more efficient than the average small banks and those efficient banks tend to grow faster than inefficient banks (Kwan, 2001). Barr (1999) used the ratio analysis and examiner ratings to evaluate efficiency and performance of US banks from 1984 to 1998. He found out that there exists a strong and consistent relationship between efficiency and inputs and outputs used. He also showed that a close relationship exists between efficiency and soundness of a banking system (Barr, 1999). Berger et al., (2001) studied efficiency barriers to the consolidation of European financial services industry. Using data of merger and acquisitions of large, publicly traded financial institutions in Europe for the period 1985 to 1997, they found out that barriers offset most of the potential efficiency gains from cross-border consolidation.

Mutanu (2002) used a sample of eight quoted commercial banks in Kenya to compare efficiency scores of highly capitalized banks with those of low capitalized banks for the period 1999 to 2001. Using the efficient cost frontier approach she found out that the low capitalized banks were more efficient than the highly capitalized banks and that capital ratio cannot be used to discriminate efficient banks from inefficient banks (Mutanu, 2002). Musyoki (2003) used a sample of 46 commercial banks in Kenya for the period 1998 to 2002 to establish if there is any link between quality and bank profitability. Through the use of a questionnaire he analyzed performance of banks using a set of indicators that included: liquidity, leverage, profitability and efficiency on productivity. The findings showed that quality improvement has a short-term effect on financial performance (Musyoki, 2003). Njihia (2005) used a sample of 36 commercial banks in Kenya from 1998 to 2004 to find out the determinants of profitability of commercial banks in Kenya. Using multiple regression analysis to analyze secondary data of financial statements of commercial banks, Njihia (2005) found out that the critical variables affecting profitability of commercial banks in Kenya are: non-performing loans and advances, interest expense on customers' deposits, operating expenses, provision for doubtful debts and total assets.

Despite few studies on commercial banks having been done in Kenya on issues such as performance by Musyoki (2003), profitability by Njihia (2005) and efficiency by Mutanu (2002), none of them has examined the X-efficiency of commercial banks in Kenya. Yet X-efficiency is an important element of a sound banking systems. Also as an improvement of the study done by Mutanu (2002) this study uses a larger sample of 33 commercial banks and will study the small and the large banks separately. To improve on the study done by Njihia (2005) and Musyoki (2003) this study uses Stochastic Econometric Cost Frontier Analysis, which is an improved technique to measure efficiency. This answered the following questions: What is the level of X-efficiency of commercial banks in Kenya? Does economy of scale affect the X-efficiency of commercial banks in Kenya?

2. Literature Review

The study of efficiency dates back to the path-breaking work of Farrell (1957) in his study on productive efficiency of the firm. He proposed specific measures of technical and allocative efficiency. Based on the concept of technical and allocative efficiency, Leibenstein (1966) coined the term X-inefficiency and noted that, for a variety of reasons, people and organizations normally work neither as hard nor as effectively as they could. The choice of focusing on X-efficiency in this study is partly because banking research to date suggests that X-efficiency appears to be large and tends to dominate scale and scope efficiencies (Kwan, 2001).

Profit maximization is one of the objectives of operation of commercial firms, and hence managers have to decide what level of output to produce (Dwivedi, 2002). This decision determines the firm's purchases of factor inputs and also influences the price at which output can be sold (Hardwick, Khan and Langmead, 1994). To maximize profit, firms can use the optimizing output technique specifically by minimizing average cost of production (Dwivedi, 2002).

Most firms operate in a competitive market and are often faced with a given market price. Their profit is dependent on their ability to reduce their unit cost of production. Given the technology and input prices, the prospect of reducing unit cost of production depends invariably on the size of a firm or output produced (Dwivedi, 2002). Faced with an increasingly competitive operating environment, high overhead costs, reduced interest rate margins and high levels of non-performing loans; banks have reacted by restructuring their operations. This involves rightsizing of establishment, greater focus on customer service through tailored products/service provisions and restructuring of non-performing loans with the aim of turning them to performing status (KCB Annual Report 2004).

Production involves transformation of resources into final goods or services. The relationship between inputs and outputs is a technological relationship, which economists summarize in a production function i.e. output is a function of various inputs used to produce that output (Nyhan, 1998). Technological efficiency is achieved for a given level of factor inputs if it is impossible to obtain a higher level of output given the existing technology. Cost efficiency of commercial banks will be achieved if the products produced are the ones that will give the bank maximum revenue using the given inputs (Dwivedi, 2002). If this is achieved then profits made by the banks too will be maximized as well as shareholders wealth.

It is plausible that some productively efficient firms are economically inefficient, and vice versa. Such efficiency

mismatches depends on the relationship between managers' abilities to utilize the best technologies and their abilities to respond to market signals. Productive efficiency requires only input and output data, whereas economic efficiency also requires market price data. Allocative efficiency is about doing things right, and economic efficiency is about doing the right things right (Kwan and Eisenbeis, 1996). The study of X-efficiency, therefore, includes both allocative efficiency and economic efficiency.

Productive efficiency examines levels of inputs relative to levels of outputs. To be productively efficient, a firm must either minimize its inputs given its output quantities, or maximize its outputs given inputs quantity (Barr, 1999). Economic efficiency is somewhat broader in that it involves optimally choosing the level and mixes of inputs and or outputs based on reactions to market prices. To be economically efficient, a firm seeks to optimize some economic goal, such as cost minimization or profit maximization. In this sense, economic efficiency requires both productive efficiency and allocative efficiency.

Various inputs and outputs have been used in the study of X-efficiency of commercial banks. For example, customer deposits and borrowed funds (loans) (Kwan, 2001) for inputs. Outputs on the other hand includes loans and advances to customers and other incomes like income from investments in intangible and other assets like treasury bonds and bills, buildings, shares, service charges and commissions, and income on foreign exchange dealings (Kwan, 2001). The cost is composed of operating expenses such as administrative expenses, directors' emoluments, depreciation of property and equipment, amortization of intangible assets and leasehold land, and auditor's remuneration (Kwan, 2001).

2.1 X-Efficiency of Commercial Banks

Kwan and Eisenbeis (1996) used Stochastic Efficient Frontier analysis in their study of inefficiencies in banking in the US, from 1986 to 1991. After controlling for scale differences, they found out that small banking firms on average are relatively less efficient than large banking firms. Moreover, small banking firms tend to exhibit larger variations in X-inefficiencies than large banking firms. Their findings suggest that the average large banking firm operates closer to its respective efficient frontier than the average small banking firm.

Barr (1999) used ratio analysis and examiner ratings techniques to study the productive efficiency and performance of US commercial banks. The sample period was from 1984 to 1998. Barr (1999) found out that there is a strong and consistent relationship between efficiency and inputs and outputs used, as well as independent measures of bank performance. Further, the results found by Barr suggest that the impact of varying economic conditions is mediated to some extent by relative efficiencies of the banks that operate in these conditions. A close relationship exists between efficiency and soundness of the banking system as determined by bank examiner ratings (Barr, 1999).

Ikhide (2000) used Econometric Cost Frontier approach and operating ratios to study Namibia's bank efficiency. The sample period was from 1996 to 1998. He found out that commercial banks are not producing at the point of minimum average costs and suggests that banks can further lower their operating costs as they expand output. He also observed that profitability measures by gross margins, return on assets and return on equity ratios are not highly correlated with operating costs (lkhide, 2000).

(Kwan, 2001) studied the X-efficiency of commercial banks in Hong Kong for the period starting from 1992 to 1999. He found that cost inefficiency of Hong Kong commercial banks was quite large averaging between 16 to 30 percent of the observed total costs. His analysis also found out that the level of inefficiency in Hong Kong banks was declining over time. This indicated that commercial banks in Hong Kong are now operating closer to the cost efficient frontier than before. These results are consistent with existence of technological innovation in banking during the sample period. Cross-sectional X-efficiency was skewed to the left indicating that there are more banks that are relatively efficient than inefficient, (Kwan, 2001). As a whole, the average large bank in Hong Kong was found to be less efficient than the average small bank, but the gap seemed to be narrowing over time (Kwan, 2001).

Further, Kwan (2001) established that X-efficiency is related with certain bank characteristics. Ceteris paribus, X-efficiency was found to decline with bank size, deposit to asset ratio, loan to asset ratios, provision for loan loss, and loan growth. X-efficiency was found to increase with off-balance sheet activities (Kwan, 2001). After controlling for on and off-balance sheet ratios and growth, bigger banks tend to be more efficient than smaller banks. Banks that make more loans and banks that gather more deposits tend to be more efficient (Kwan, 2001). Banks with higher loan loss provisions were more cost efficient, perhaps at the expense of lower profits. Efficient banks tend to grow faster than inefficient banks (Kwan, 2001). More off-balance sheet activities are associated with higher level of inefficiencies, in part because off-balance sheet products were not included in the output definition and therefore biased the output measure downward (Kwan, 2001).

Tefula (2002) used both stochastic and distribution free approaches to study the implications of X-inefficiency of the banking industry in Africa. Using data from 1992 to 1999 he found out that in Africa, profit inefficiencies are higher than cost inefficiencies. This is not surprising since profit inefficiency is a composite of cost and revenue inefficiencies. However, when profit inefficiencies are decomposed, he found out that the cost side was twice as large as the revenue side (Tefula, 2002). This suggested that more efficiency improvement would be achieved

through better management and control of the cost side compared to the revenue side. Furthermore since managers have greater control of the costs than the revenues; the higher cost efficiency reflects their cost preference behavior. This tends to subjugate the shareholders' best interests, thus increasing agency costs (Tefula, 2002). This has necessitated the study of X-efficiency rather than efficiency in general.

There is unequivocal link between efficiency and financial performance, which means that efficient banks usually experience high financial performance (Hughes, 2004). The evidence from the analysis of data collected in the study of efficiency of commercial banks in Gambia indicated that Gambia's banking system has not performed the functions as efficiently as it ought to (Agu, 2004). The causes of inefficiencies in the performance of the various functions include the heavy regulatory framework, the oligopolistic market structure and the small banking market (Agu, 2004).

A study of banking and process efficiency of Taiwan commercial banks by Taipei (1997) showed that banks in Taiwan usually act as a bridge to provide a major source of financial intermediation. They have tried to improve their efficiency by gaining strength in assets management and providing new services to attract spare funds (Taipei, 1997). In the early 1990's, Taiwan embarked on bank deregulation to increase operating efficiency and to attract funds into the loanable fund supply market. The results from the study of process efficiency of Taiwan commercial banks using Data Envelopment Analysis showed that there is rather high level of overall efficiency. The study suggested that the inefficient banks could effectively promote efficient resource utilization by better handling their labor and capital operating efficiency and by enlarging bank investment function (Taipei, 1997).

Many countries in Sub-Sahara Africa liberalized their financial sectors in the late 1980's or 1990's to encourage greater financial efficiency (Brownbridge, 2002). Policy reforms included: removing interest rate controls, removing requirements on banks to lend to specific sectors, privatizing state owned banks and allowing easier entry by private sector banks and Non Bank Financial Institutions (NBFIs) including foreign banks (Brownbridge, 2002). At the same time to promote sounder banking and help protect bank deposits, reforms were introduced to strengthen the prudential regulation and supervision of banks by improving bank laws and expanding supervisory capacities (Brownbridge, 2002).

2.2 X-efficiency of Commercial Banks in Kenya

Research by Ngugi (2001) indicates that Kenya experienced a widening spread in interest rates in post liberalization period i.e. after July 1991. Ngugi (2001) in her study found out that the interest rate spread increased because of the yet-to-be gained efficiency and high intermediation costs. Variations in interest rate spread are attributed to bank efforts to maintain threatened profit margins (Ngugi, 2001). Banks that faced increasing credit risk, as the proportion of Non-Performing Loans (NPLs) went up, responded by charging a high- risk premium on the lending rate. Fiscal policy actions saw an increase in Treasury Bills rates and high inflationary pressure that called for tightening of the monetary policy. As a result, the banks increased their lending rates but they were reluctant to reduce the lending rate when the Treasury Bills rate came down because of the declining income from loans (Ngugi, 2001). The banks responded by reducing deposit rate, thus maintaining a wider margin as they left the lending rate at a higher level. Thus there was an asymmetric response of lending rates to Treasury Bills rates. High implicit costs were realized with the tight monetary policy, which was pursued with increased liquidity and cash ratio requirements. Consequently, banks kept a wide interest rate spread even when inflationary pressure came down (Ngugi, 2001).

The wide interest rate spread hampers stimulation of both greater loan demands for industrial investment (which would thus contribute to higher economic growth) and greater mobilization of savings through the banking system (Ngugi, 2001).

Interest rates in Kenya were liberalized in 1991 while state owned banks like Kenya Commercial Bank (KCB) and National Bank of Kenya (NBK) were privatized in the 1990's, (centralbank.go.ke). Private sector banks were allowed easier entry by allowing Non Bank Financial Institutions to convert into banks in 1992 (www.centralbank.go.ke). Financial liberation has changed the nature of the risks facing the banking system (Brownbridge, 2002). Reforms have reduced the risk of bank distress caused by governments directing banks (government owned banks in particular) to lend to unviable and un-creditworthy borrowers (Brownbridge, 2002). New challenges emerged such as greater competition that is squeezing profits of weaker banks, the entry of new banks that lack the expertise to manage risks in liberalized markets, greater opportunities for fraud and abuse of depositors' funds by banks and NBFIs, and risks arising from foreign exchange (Brownbridge, 2002). Overall, although banks complied with regulator's requirements on capital matters, the regulator's urgings for small poorly capitalized banks to merge, recapitalize or wind up altogether in order to boost capital levels were almost entirely ignored. A good case is the failed merger of Daima bank (now in receivership) and the collapsed Euro Bank, which were both seriously undercapitalized (Thuita, 2003). This implies that undercapitalization may lead to X-inefficiency.

Low capitalized banks are more efficient than highly capitalized banks (Mutanu, 2002). The low capitalized banks by taking more risks increase their efficiency while the highly capitalized banks feel that taking more risks would be too much risk for their capital and this increases their inefficiency (Mutanu, 2002). Mutanu found out

that in the Kenyan context, capital cannot be used to discriminate efficient banks from inefficient banks because the highly capitalized banks can increase their capital through reevaluation of the assets and not through the injection of fresh capital or retained earnings (Mutanu, 2002). Further when Mutanu compared the size of banks and efficiency, the results showed that some of the largest banks were the most inefficient while the small banks maintained consistently moderate efficiency. This was evident in our local banks such as Kenya Commercial Bank and National Bank of Kenya which had the lowest efficiency clearly indicated in the market value (Mutanu, 2002). Small banks are more efficient than large banks, and therefore utilizing their resources efficiently unlike the large banks which do not want to take extra risk by injecting more capital. The large banks are not therefore utilizing their resources well (Mutanu, 2002). However, the study used a limited sample (only quoted banks). Mutanu recommended another study to be done using a different technique and a larger sample allowing small and large banks to be studied separately.

Commercial banks in Kenya have been introducing new banking services like Short text Message Service (SMS) banking by KCB where bank customers use the mobile phone to send instructions to the bank; introduction of different types of loans like education loan, car loan, house loan; and being involved in Initial Public Offers (1POs) floatation like for Kenya Electricity Generating company (KENGEN) shares. The KCB 2004 Annual Report and the Kenyan Banker (2004) have indicated that there is competition in the banking industry in Kenya. The Kenyan Banker (2004) stated that Kenya's banks are currently faced with increasingly competitive operating environment, high overhead costs, reduced interest rate margins and high levels of NPLs. The increased competition should leave little room for inefficiency. However, not much is known about the level of cost inefficiency of commercial banks in Kenya. High levels of non-performing loans and advances and reduced interest rate margins may contribute to the cost inefficiency of commercial banks as they may increase the costs incurred by banks. The increasingly competitive environment in the banking industry leads to an increase in overhead costs incurred by banks as a result of increased cost of advertising (Kenyan Banker, 2004). The three banking systems i.e. Kenya, Uganda and Tanzania, however, remain inefficient and perform only a limited intermediation role despite recent reform efforts and even with the presence of international banks (Cihak and Podpiera, 2005). This is due to the impediments to banking sector lending, competition and development in general (Cihak and Podpiera, 2005).

External environment is very turbulent due to both local and global competition, the increasingly demanding customer and changes in information technology. However, factor analysis reveal that the key factors that most impacted on the banks were increased competition and threat of substitute products (Gathoga, 2001). The banks are also differentiating their products/services given the homogeneous nature of products in the local market (Gathoga, 2001). Differentiating products may have an impact to increase cost, and for banks to be cost efficient the additional costs incurred on such output should also lead to a proportionate or more income from such services. Competitor analysis by Cooperative Bank as at September 2005 shows that commercial banks in Kenya are experiencing a challenge in credit risk management as shown by the high levels of non-performing loans and advances. The industry average of non-performing loans and advances was at 23% in comparison to the total loans (Competitor Analysis as at September, 2005). This may have increased the operation costs of commercial banks thus increasing the cost inefficiency of commercial banks in Kenya. Technological development in the banking industry in Kenya has enabled the banks to reduce their production costs and at the same time maximize their profits (KCB 2004 Annual Report). This may contribute to improved efficiency of commercial banks in Kenya. This study sought to determine the X-efficiency of commercial banks in Kenya and whether economies of scale affect X-efficiency.

Njihia (2005) in his study sought to find out the determinants of profitability of commercial banks in Kenya. Using multiple regression analysis technique, he studied 36 commercial banks from 1998 to 2004. He found out that the main variables affecting profitability of commercial banks in Kenya are: non performing loans and advances, interest expense on customers' deposits, operating expenses, provision for doubtful debts and total assets (Njihia, 2005). Efficiency in expense management was one of the most significant determinants of commercial bank profitability (Shanmugan, 1999 as quoted in Njihia, 2005). Musyoki (2003) compared quality improvement with financial performance in an attempt to establish if there is any link between quality and bank profitability. Using a sample of 46 commercial banks for the period 1998 to 2002, he found out that quality improvement has a short term effect on financial performance and that there are undoubtedly other benefits gained from improved quality, but they may be difficult to measure (Musyoki, 2003).

In summary, the literature suggests that the level of X-efficiency in Kenya is high. This is attributed to both internal and external factors to the commercial banks.

2.3 Estimation Techniques of Efficiency
2.3.1. Examiner Ratings
In the early 1970s regulators of federal financial institutions, realized the advantages of a standardized framework for the examination process of financial institutions. They developed a rating system whereby the most critical components of a financial institution's overall safety and soundness could be identified, measured

and quantified. In 1979, the uniform financial institution rating system was adopted commonly referred to by the acronym CAMEL. The evaluation factors that comprise the CAMEL ratings are: Capital adequacy, Asset quality, Management quality, Earning ability, and Liquidity. The outcome of an on-site examination of a financial institution has become a concise and indispensable tool for examiners and regulators (Barr, 1999).

Each of the factors is scored from 1 to 5 with 1 being the strongest rating. Additionally a single composite CAMEL rating is determined from these components, and represents the findings of the examination for the institution as a whole. The Commercial Bank Examination Manual produced by the Board of Governors of the Federal Reserve System describes the five composite ratings as follows:

CAMEL 1: An institution that is basically sound in every respect

CAMEL 2: An institution that is fundamentally sound but has moderate weaknesses.

CAMEL 3: An institution with financial, operational, or compliance weaknesses that give cause for supervisory concern.

CAMEL 4: An institution with serious financial weaknesses that could impair future viability.

CAMEL 5: An institution with critical financial weaknesses that render the probability of failure extremely high in the near term.

Research involving efficiency and CAMEL ratings is somewhat limited, due in large part to the restricted nature of the ratings (Barr, 1999). A firm's efficiency may fall in more than one of the five categories mentioned above or into none at all.

2.3.2. Operating Ratios

This method of measuring efficiency uses accounting data on bank margins, costs and profits as measures of bank efficiency (lkhide, 2000). The three types of operating ratios used include: asset ratios like Return on Asset (ROA) ratio, operating income ratios like Return on Investments (ROI) and operating equity ratios like Return on Equity (ROE).

However, a setback in using this method as a measure of inefficiency is that differences in capital structure, business mix and accounting standards across banks may affect these ratios and render comparability inadequate (Ikhide, 2000). These differences are present in the Kenya's commercial banks industry, thus if used alone it may not be a good measure of commercial banks X-efficiency.

2.3.3. Data Envelopment Analysis (DEA).

This is a non-parametric approach to measure efficiency. It compares the amounts of inputs used to produce a given level of output so as to establish efficiency in the production process (Barr, 1999). However this technique generally does not take account of prices and can therefore account only for technical inefficiency i.e. using too many inputs or producing too few outputs (Weill, 2003). It does not also account for allocative inefficiency and is not suitable for comparing firms that specialize in different inputs and outputs since it does not take account of relative prices (Weill, 2003).

DEA uses linear programming technique to compute efficiency scores. Its weakness is that it does not allow for error in the data; thus includes exogenous events in the inefficiency term (Weill, 2003).

2.3.4. Stochastic Efficient Cost Frontier Approach (SFA).

SFA was developed by Aigner, Lovell and Schmidt (1977). In this method a banking firm's observed total cost is modeled to deviate from the cost efficient frontier due to random noise and possibly X-inefficiency. A bank is labeled inefficient if its costs or profits are lower than the best practice bank after removing random errors. This technique assumes that inefficiencies follow an asymmetric normal distribution, and that both are orthogonal to the cost function exogenous variables.

Its advantages are that it allows for separation of random error from the inefficiency term; thus avoid consideration of exogenous events as inefficiency and that it allows easier control of the influence of variables on the structure of the cost frontier than the DEA (Weill, 2003). Its disadvantage is that it imposes more structure on the shape of the frontier by specifying a functional form of cost function (Weill, 2003). The advantages of SFA outweigh its disadvantage, so it was considered a better approach to use in this study of commercial banks X-efficiency.

3. Research Methodology

This study used the Stochastic Econometric Cost Frontier approach to measure X-efficiency of commercial banks in Kenya. The aim was to establish the level of X-efficiency of commercial and whether economies of scale affect X-efficiency of commercial banks. The study also analyzed the persistency of X-efficiency of commercial banks and how bank-size influences the level of X-efficiency. The Spearman Rank correlation coefficient was used to measure the persistency of X-efficiency. Pearson correlation coefficient was used to compare the relationship between X-efficiency and bank size.

3.2. The Population.

Kenya had 44 commercial banks in operation at the time the study was conducted in 2006. All these banks constituted the population of the study.

3.3. Data and the Sample

The data set consists of secondary data of the audited financial statements of commercial banks included in the sample. Specific data used are: deposits; borrowed funds; operating expenses (administrative expenses, director's emoluments, depreciation of property and equipment, amortization of intangible assets and leasehold land and auditor's remuneration), loans and advances to customers; investments in intangible and other assets, service charges and fees, bank commissions, and income on foreign exchange dealings. These were obtained from the audited financial statements from the Bank Supervision Department of Central Bank of Kenya (CBK). The number of banks studied in this paper constitutes 75% of commercial banks currently operating in Kenya. This comprises of 33 banks that have been operating in Kenya in the period of study, which is from the year 2000 to 2005. This sample size excludes banks that have been closed down. These have been selected through random sampling. According to central limit theorem in statistical theory, any sample equal to or greater than 30 is representative enough irrespective of the population size. The sample is further divided into small and large banks sub samples by using total assets as a proxy for size.

3.5. Research Model

3.5.1. Conceptual Model

The stochastic cost frontier model has the following general (log) form:

$$\ln C_n = f(\ln y_{i,n}, \ln w_{j,n}) + \varepsilon_n , \qquad (1)$$

Where C_n is the total cost for bank n; $y_{i,n}$ measures the ith output of bank n; and $w_{j,n}$ is the price of jth input of bank n. The error term e has two components:

$$\varepsilon_n = \mu_n + v_n \qquad (2)$$

The first component, μ_n captures the effect of the uncontrollable (random) factors while the second, v_n, represents controllable factors (Aigner et al, 1977). It is assumed that μ is distributed as asymmetric normal N (0,O μ^2)and that v is independently distributed as a half-normal, $\left| N\left(0, O v^2\right) \right|$ Where N is the number of banks studied, 0 implies the mean is zero, 0, μ^2 is variance of the uncontrollable random factors and v^2 is the variance of the controllable random factors. Following Jondrow, Lovell, Materov and Schmidt (1982), an estimate of the nth bank's X-efficiency can be derived from the composite error term.

$$XE_n = {}_{E[Vn \,|\varepsilon N]} = \frac{O\lambda}{1 + \lambda^2}\left(\frac{\phi(\varepsilon n\lambda/O)}{\phi(\varepsilon n\lambda/O)} - \frac{\varepsilon n\lambda}{O}\right) \qquad (3)$$

Where XE_n is the X-efficiency of batik n, E is the expectation operator, O is the standard deviation, λ is the ratio of the standard deviation of v to the standard deviation of $\mu (i.e., O_v / O_\mu), O^2 = O_v 2 + O_\mu{}^2$ and ϕ and ϕ are the standard and cumulative normal density functions respectively. The X-efficiency estimate has the interpretation of the percentage of the total costs that could have been reduced were the bank to operate at the efficient cost frontier.

Assuming the cost function to be stationary over time, pooled time-series cross-section observations were used to estimate the efficient cost frontier. For robustness, in addition to estimating the efficient cost frontier using the full sample of banks, the efficient cost frontier is also estimated separately for the subsamples of large banks and small banks.

3.5.2. Analytical Model

To specify the functional form of the cost frontier in equation (1) above, the standard multi-product translog cost function is used:

$$\ln C = \alpha_o + \sum_i \beta_i \ln y_i + \sum_i \beta_i \ln w_i + 1/2\sum_i \sum_k \gamma_{ik} \ln y_k + 1/2\sum_j \sum_h \varsigma_{jh} \ln w_j \ln w_h + \sum_i \sum_j \ln y_i \ln w_j + \varepsilon_n \qquad (4)$$

Where C is the operating cost (including interest expense), y_i and y_k are outputs i.e. loans and advances to customers and investments and other incomes respectively. W_j, and W_h are inputs i.e. deposits and borrowed funds respectively. α_0 is a constant, coefficients $\beta, \gamma, \varsigma,$ and their subscripts are used to differentiate the first and second inputs while y and their subscripts used to differentiate the first and second output.

The homogeneity restrictions,

$$\sum_j \beta_j = 1, \quad \sum_h \varsigma_h = 0, \quad \sum_{k,k} = 0 ,$$

are imposed by normalizing total costs and input prices by one of the input prices. These restrictions are imposed so as to obtain a normal distribution of X-efficiency estimates. Therefore, the difference between the mean and the median should be zero or almost zero for the mean X-efficiency to be distributed as asymmetric normal. Equation (4) was simplified as follows:

$$LnC = \alpha_o + \beta_1 lny_1 + \beta_2 lny_2 + \beta_1 lnw_1 + \beta_2 lnw_2 + 1/2\gamma_{11} lny_1 lny_2 +$$
$$1/2\varsigma_{11} lnw_1 lnw_2 + w_{11} lnyw_1 + w_{12} lny_1 lnw_2 + w_{21} lny_2 lnw_1 + 1$$
$$\omega_{22} lny_2 lnw_2 + \varepsilon_n \qquad (5)$$

Equation (5) was used to estimate the efficient total cost C that lies on the efficient cost frontier. Therefore, the X-efficiency level is the difference between the estimated total cost and the actual total cost estimated cost. If C is greater than estimated cost, then the commercial banks are inefficient but if they are equal then the commercial banks are efficient as they are operating at the efficient cost frontier. C cannot be less than estimated cost as it cannot be less than the efficient cost unless there is an error.

Further, the mean and standard deviation of the X-efficiency estimate were calculated. These gave the average level of X-efficiency and the variation of X-efficiency over time. The median was also calculated because if compared to the mean and they are almost equal it shows that the mean is distributed as asymmetric normal due to the restriction imposed by the model in equation (4). The Spearman Rank correlation of the X-efficiency estimate was also calculated so as to be able to determine the persistence of the inefficiency of the banks. The Pearson correlation coefficient was also calculated to show the relationship between the banks' X-efficiency estimates and their size. It was assumed that all banks have the same access to the underlying production technology and hence face the same cost frontier.

4. Data Analysis, Results and Discussion
This section presents the results of the data analysis, and discussion.
4.1 Descriptive Statistics
There were 33 banks in the sample. These banks were divided into two sub samples of small and large banks by using the median asset size of the sampled banks (Kwan, 2001). The aim of the division was to estimate X-efficiency separately for the large and small banks. The rationale is that the small and the large banks have different scales of operation and through these sub-samples the study sought to establish whether economies of scale affect X-efficiency. Banks that recorded an asset value above the median in the year 2005 are classified as large banks while those that recorded asset values below the median are classified as small banks. Out of the 33 banks sampled 16 were classified as large and the remaining 17 were classified as small.

Table 1. Summary Statistics for the Sample of Banks (All figures are in Billions of Ksh)

	Mean	Median	Standard Deviation	Min	Max
Loans and advances	8.435	3.35	11.6	0.133	56.737
investments and other incomes	5.057	1.787	7.8	0.116	47.526
Deposits	11.578	3.066	18.6	0.098	82.546
Borrowed Funds	3.929	0.816	8.6	0.026	52.549
Operating Cost	2.725	0.449	5.3	0.005	41.572
Total Assets	13.335	3.951	21.1	1.047	106.195

Table 1 above shows the mean of output for the full sample is at Kshs 8.435 billion and Kshs 5.057 billion for loans and advances and investments and other incomes respectively. While for the inputs are Kshs.11.578 billion and Kshs.3.929 billion for deposits and borrowed funds respectively. The mean of the operating cost is at Kshs.2.725 billion and Kshs 13.335 billion for total assets.

Pooled time-series cross-sectional analysis was applied to estimate the efficient cost frontier. Then the X-efficiency estimates for each bank and each sampling period was computed by subtracting the efficient cost from the actual cost. The time series measure of X-efficiency was obtained by aggregating data across banks. The distributions of X-efficiency for each sampling period are displayed in Table 2.

Table 2 shows the mean and median X-efficiency estimates for the years 2000 to 2005. For the full sample the mean X-efficiency was 18% in the year 2000 but by the year 2005 it had increased to 20%. For the large banks, X-efficiency increased from 17% in the year 2000 to 19% as at the end of the year 2005. For the small banks the mean X-efficiency estimate increased from 19% in the year 2000 to 21% by the end of the year 2005. The median calculated above if compared to the mean, the difference is almost zero. Therefore, the assumption that the mean of X-efficiency is distributed as a symmetric normal holds. A number of observations can be made from Table 2. First the estimated mean X-efficiency was increasing over time, suggesting that commercial banks in Kenya are now operating further from the cost frontier than before. This is with the exception of the years 2001 and 2003 which showed a slight decline in the mean and median X-efficiency.

Secondly, when X-efficiency is estimated separately for the large and the small banks, it was observed that the small banks are more inefficient than the large banks. Again, by pooling large and small banks together in the full sample we are imposing the restriction that large banks and small banks employ the same technology in their production process. This common technology assumption may be too restrictive and separating the large banks from the small banks allows a tighter fit of data. This finding is consistent with the findings documented in the study by Kwan and Eisenbeis (1996).

Table 2. Time- Series Properties of X- efficiency Estimates

Year		All banks	Large banks	Small banks
2000	Mean	0.1792	0.1718	0.1862
	Median	0.1875	0.1709	0.1898
2001	Mean	0.1743	0.1667	0.1814
	Median	0.1867	0.1816	0.1867
2002	Mean	0.1776	0.1736	0.1814
	Median	0.1901	0.1960	0.1867
2003	Mean	0.1699	0.1574	0.1815
	Median	0.1744	0.1743	0.1780
2004	Mean	0.1812	0.1697	0.1921
	Median	0.1867	0.1709	0.1875
2005	Mean	0.1966	0.1874	0.2053
	Median	0.1919	0.1836	0.2114

Source: Calculated from data collected from CBK

Finally, the range of the average X-efficiency estimate is between 18% and 20% and is almost similar to the range of X-efficiency estimates documented in the X-efficiency study of Hong Kong commercial banks by Kwan (2001).

Table 3 displays the cross sectional distribution of X-efficiency as at the beginning and at the end of the sampling period. Panel A shows that mean and median X-efficiency for the period 2000 to 2005 for full sample of banks was 18% and 19% respectively and X-efficiency was 17% for the large banks and 19% for small banks. This implies that all the commercial banks could reduce their costs by an average of 18% if they were to use their inputs efficiently so as to operate at the efficient cost frontier. However, when analyzed separately the small and large banks could reduce their costs by 19% and 17% respectively in order to operate at the efficient cost frontier.

Table 3. Panel A: Cross – Sectional properties of X- Efficiency Estimates Based on Averages from 2000 to 2005

Sample	Mean	Median	Standard Deviation
All banks	0.1798	0.1867	0.0600
Large banks	0.1711	0.1743	0.0715
Small banks	0.1880	0.1880	0.0454

Source: Calculated from data collected from CBK

The standard deviation shows variation of the X-efficiency estimates. The standard deviation during the study period was at 6% for the full sample of banks, 7% for the large banks and 5% for small banks. This implies that the inefficiency for the large banks varies more over time than the inefficiency for the small banks. This may be because of the effect of scale of operation whereby for large banks a small change in cost affects a large number of transactions whereas for small banks a small change in price affects few transactions as compared to large banks.

Table 3b. Panel B: Cross – Sectional properties of X- Efficiency Estimates Based on Average for 2000

Sample	Mean	Median	Standard Deviation
All banks	0.1792	0.1875	0.5922
Large banks	0.1718	0.1709	0.0666
Small banks	0.1862	0.1898	0.0524

Source: Calculated from data collected from CBK.

Table 3c. Panel C: Cross – Sectional properties of X- Efficiency Estimates Based on Averages for 2005

Sample	Mean	Median	Standard Deviation
All banks	0.1966	0.1874	0.6234
Large banks	0.1874	0.1835	0.0766
Small banks	0.2053	0.2114	0.0458

Source: Calculated from data collected from CBK.

Panels B and C compare the banks' cross-sectional properties of X-efficiency estimates at the beginning and at the end of the sampling period. We observed that the mean, median and standard deviation X-efficiencies for the banks increased from 2000 to 2005. This implies that the banks are operating further from the efficient cost

frontier in 2005 than in 2000. This may be because of the investment costs incurred by banks to upgrade their technology of production and to train their staff too.

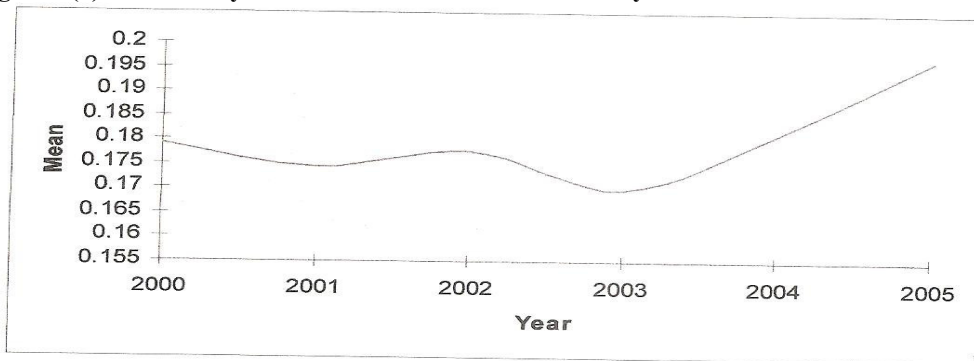**Figure 1(a) X-efficiency for All Commercial Banks in Kenya**

Figure 1 (a) depicts the cross-sectional mean of X-efficiency for each year between 2000 and 2005 for the full sample of banks. In the year 2000, the banking industry experienced increased costs due to the power shortage in the country. Banks had to look for alternative sources of power e.g. generators which are more expensive. Also the effects of last minute investment in technology to curb the millennium bug pushed up the costs of operation. There was a slight decline in 2001 as the power shortage had been resolved. However, the increase in 2002 is because of the effects of political uncertainty in the country at that time, which negatively affected the economy as a whole making it expensive to do business. The decline of cost inefficiency in the year 2003 was as a result of improvement of the economic performance in Kenya after the general elections. The interest rates were comparatively low hence reducing the costs of banks' operation. The increased cost inefficiency from 2004 to 2005 could be attributed to investments in technology and introduction of new ways of providing their services like SMS banking and electronic banking. These increased the costs incurred by the banks especially in terms of training and recruitment of new specialized staff.

Figure 1 (b) displays a similar pattern as Figure 1 (a) based. The median declines and increases with the decline and increase of X-efficiency, respectively. On average, the median X-efficiency lies between 17% and 19%.

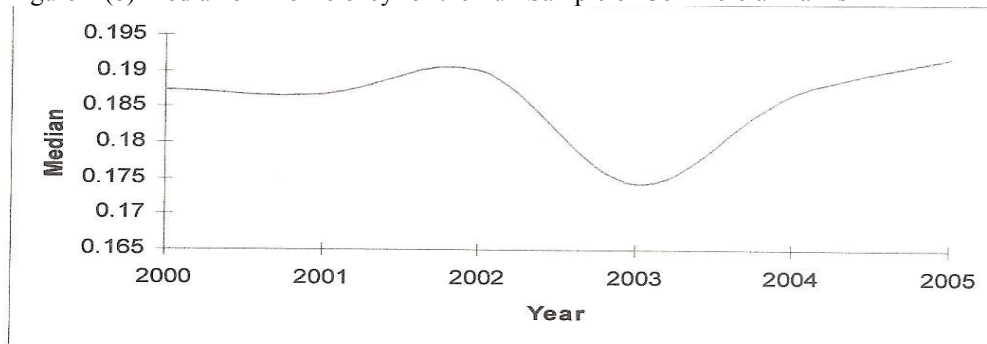Figure 1 (b) Median of X-efficiency for the Full Sample of Commercial Banks

Figure 1 (c) shows the standard deviation estimates of X-efficiency of commercial banks in Kenya. The standard deviation measures the variation of X-efficiency over time. The standard deviation also declined and increased with the decline and increase of the X-efficiency respectively. The range of the standard deviation was 5% to 7%.

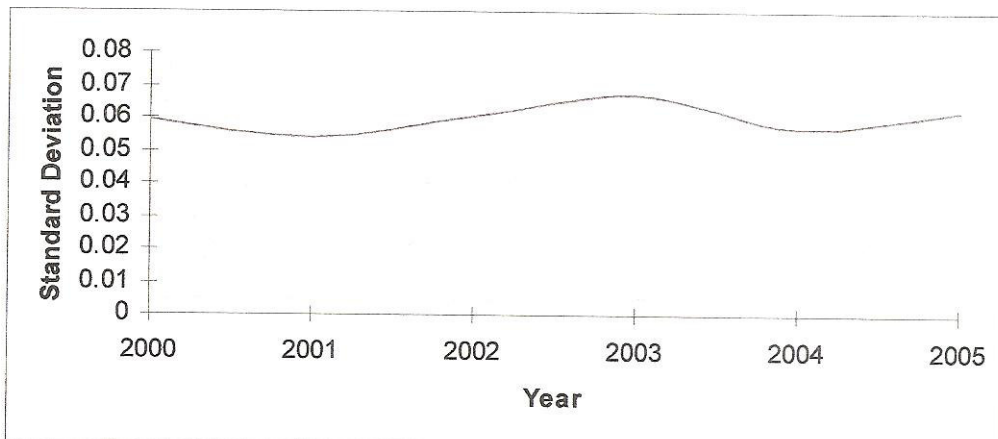Figure 1 (c) Standard Deviation of X-efficiency for the Full Sample of Commercial Banks

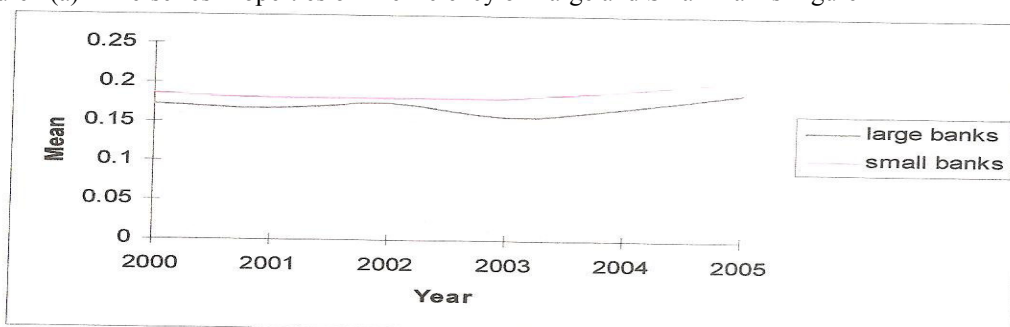Figure 2(a) Time-series Properties of X-efficiency of Large and Small Banks Figure

Figure 2 (a) shows the cross-sectional X-efficiency for the large banks and small banks. The following can be observed. First, the mean X-efficiency for the small banks is higher than the mean X-efficiency for the large banks. This implies that the small banks are more inefficient than the large banks. The large banks have a lower inefficiency level as compared to the small banks because they enjoy reduced costs due to large scale production. This shows that economies of scale affect X-efficiency of commercial banks in Kenya by reducing their costs. Secondly, after the year 2003, the X-efficiency gap between the two banks is increasing compared to the earlier time periods. This may be due to the fact that as the large banks continued to grow in size they enjoyed reduced costs of operation as compared to the small banks. This could be because of scale efficiency enjoyed by the large banks.

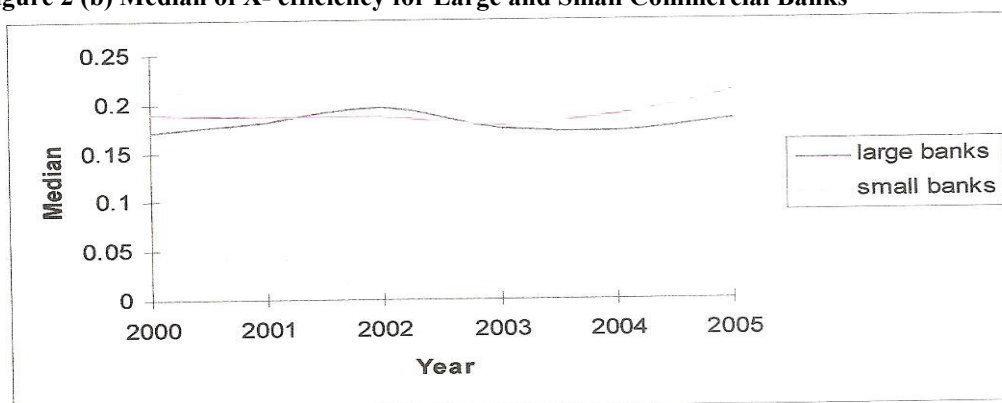**Figure 2 (b) Median of X- efficiency for Large and Small Commercial Banks**

Figure 2 (b) above depicts the same pattern as in figure 2 (a) above but using the median as a measure of X-efficiency. The median X-efficiency for the small banks generally was higher than the median X-efficiency for the large banks except for the year 2002. This implies that on average the small banks are more inefficient than the large banks.

Figure 2 (c) Standard Deviation of X- efficiency for Large and Small Commercial Banks
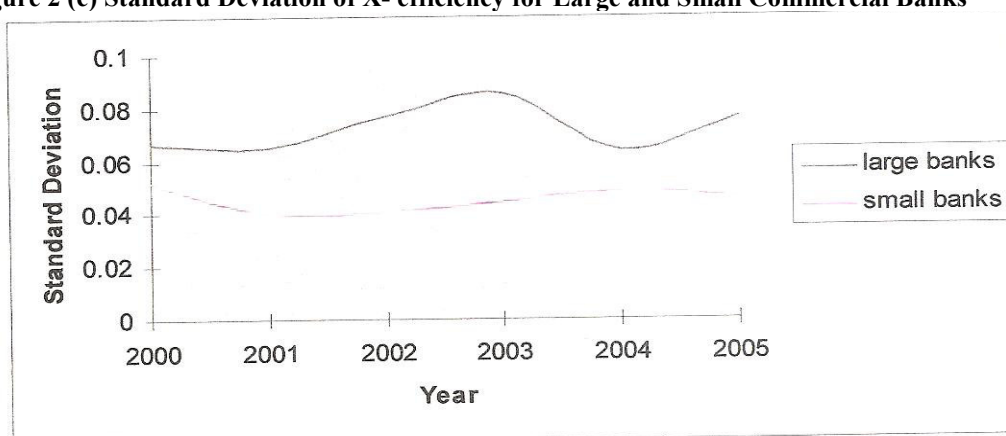

Figure 2 (c) above depicts the cross-sectional standard deviation for large and small banks. The standard deviation of the small banks is lower than the standard deviation of the large banks, which implies that the inefficiency for large banks varies more than the inefficiency for small banks.

The next property of X-efficiency to be measured was the persistency of X-efficiency in relation to size, which is measured by the Spearman Rank correlation. Table 4 below shows the correlation between size and X-efficiency among the commercial banks in Kenya.

Table 4: Spearman Rank Correlation of X-efficiency

Year	All Banks	Large Banks	Small Banks
2000-2005	0.112	0.232*	-0.13

Source: Calculated from data collected from CBK. * Correlation significant at 0.05 level of significance (2-tailed).

Spearman Rank correlation coefficients results show that the X-efficiency for all banks in general is persistent at 11% but is not significant. Further, it was observed that Spearman Rank correlation of X-efficiency is significant for large banks at 23% and at negative 13% for small banks. This implies that large banks will always tend to be less inefficient than small banks.

Finally, this study examined the relationship between X-efficiency and the characteristic of bank size by using Pearson correlation coefficients. Table 5 shows the results of the relationship between the characteristic of bank size and X-efficiency.

Table 5 Correlations between X-efficiency and Bank Size

Year	All banks	Large banks	Small bank
2000-2005	0.099	0.235*	-0.129

Source: Calculated from data collected from CBK. * correlation significant at 0.05 level (2 tailed).

The correlation between X-efficiency and the bank size is only significant at 5% level of significance for the large banks at 23.5%. The results for the full sample of banks show a positive correlation at 10%. However, the small banks have a negative relationship with bank size at 13%. This implies that for the large banks as the size of the bank increases the operation cost also increases. This implies that economies of scale affect X-efficiency.

4.4. Conclusion

This study examined the issue of X-efficiency among the commercial banks in Kenya by using the Stochastic Econometric Cost Frontier approach. The main reason for adopting this approach is because it enables us to make definitive statements about the level of X-efficiency and whether economies of scale affect X-efficiency. The results show that the level of X-efficiency in the Kenya's commercial banks industry is 18%. This implies that the commercial banks in Kenya should reduce their costs by 18% in order to operate at the efficient cost frontier. This finding is important to the bank managers and policy makers since it will enable them to improve the cost efficiency of banks. The level of X-efficiency is increasing with time which means the banks are operating further from the efficient cost frontier than before. This is a worrying trend.

After controlling for scale differences, it was found that large banks are less inefficient than the small banks. X-efficiency for large banks was at 17% and while X-efficiency for small banks was at 19% for the small banks. This gap ig X-efficiency for small banks and large banks is widening over time. This means that X-efficiency is affected by economies of scale. The persistency measure of X-efficiency showed that the large banks will always tend to be less inefficient than the small banks. The results also show that it is only the X-efficiency for the large banks which was significant in relation to bank size. This indicates that economies of scale affect X-efficiency.

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