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ABSTRACT:

We apply the transcendental logarithmic model on panel data to measure x-inefficiency of 89 banks drawn from nine Sub-Sahara African countries over a period of eight years. Both the stochastic and distribution free approaches indicate that profit inefficiencies are higher than cost inefficiencies, which is not surprising since the former is a composite of cost and revenue inefficiencies. However, when profit inefficiencies are decomposed, we find that the cost side is twice as large as the revenue side. The cost preference behaviour of managers is evidence to support the agency theory and corroborates bad management rather than bad luck hypothesis despite inconclusive granger causality results. This has implications on corporate governance, internal controls and accountability to shareholders. Further tests support the efficient structure hypothesis of x-inefficiency to suggest that the relatively smaller markets for financial services in most Sub Sahara Africa economies justify greater market concentrations for commercial banks to be viable.

1. INTRODUCTION

Notwithstanding the debate about the direction of causality, the relationship between long-term economic growth and financial sector growth is widely acknowledged by economists; for example, Popiel (1994), Fry (1995) and Stiglitz (1998). According to King and Levine (1993a, 1993b), the correlation between financial development and faster rates of economic growth suggests that finance leads to faster economic growth. Murinde (1996) observes that banks are the major providers of finance for firms in the developing countries, while Brownbridge and Kirkpatrick (1999b) note that banks are the dominant financial institutions in lower income countries. In the context of Sub-Sahara Africa, commercial banks dominate the intermediation process of linking investors to savers. The pivotal role of commercial banks in the intermediation process, and ultimately their contribution to economic performance is threatened by the spate of bank distress and failures (Brownbridge and Kirkpatrick, 1999c).

Inefficiency has been linked to problem banks and bank failures (De Young, 1998). Like elsewhere, bank failure is undoubtedly a topical issue in Sub-Saharan Africa. Scholarly research to provide diagnostic prescriptions to stabilise the banking sector is has therefore attracted a number of studies, for instance Maimbo (199..), Brownbridge (199.. and Tefula (2001). It has been postulated that inefficient banks survived in the past because of tight regulation and restrictions of entry (Berger and Mester, 1997). Financial sector reforms have engendered deregulation and paved the way for non-bank financial institutions to participate in markets and products hitherto exclusive to commercial banks. The impact of reforms has not only transformed the character (in terms of the range of products) supplied by domestically owned financial institutions, be they banks or other categories of financial institutions, but has also opened up markets to allow the participation of foreign owned institutions. The intensified competitiveness and contestability of financial services sector has put further pressure on profit margins, and therefore x-inefficiency is no longer a peripheral subject, but has become critical for the survival of commercial banks. Allen and Rai (1997) argue that "as regulatory policy and market realities bring banks into closer competition with international counterparts, the survival of the economically fittest should prevail". Regional economic blocs are gaining momentum in Sub-Saharan Africa. ECOWAS, COMESA, SADC, EAC and more recently the African Union, are some of the regional groupings intended to enhance cross-border institutions and trade. The implication of this trend is that other international banks previously located only in some member countries can now take advantage of the closer links to expand. If indigenous banks in Sub-Sahara Africa are to survive the liberalised environment, they ought to examine their working practices and improve efficiency levels to match international competitors. Furthermore, the Basle convention and other international protocols, require Sub-Sahara African Banks to observe international standards of prudence and efficient operations.

Cooper et al (1997) find that earlier studies largely concentrated on diseconomies of scale and scope, rather than x-inefficiency, to prescribe policy. However, studies by Berger, Hunter and Timme (1993) and Bauer, Berger and Humphrey (1993) reveal that scale and scope inefficiencies in US Banks were only 5%, compared to 20% x-inefficiencies. This was corroborated by Allen and Rai (1996), from an international perspective. In their study of commercial banks in 15 countries, they found that "operational inefficiencies far outweigh output inefficiencies as measured by economies of scale and scope."

The vast amount of research about the commercial banking sector has been attributed to the increasing number of problem banks and bank failures (Cooper et al, 1997. In 1988, for example, the US Comptroller of Currency reported that "external economic conditions, such as cyclical fluctuations, could not alone provide the traditionally assumed explanations of these failures and successes; the difference between the failed banks and those that remained healthy or recovered from problems was the calibre of management." This suggests that besides exogenous factors beyond the control of management, some causes are within the domain of management control. It is therefore imperative that important policy questions about mergers, liberalisation and deregulation also necessitate close scrutiny of the core factors that cause x-inefficiency.

The strong relationship between inefficiency and problem banks is the primary motivation of this paper. Problem banks in Sub-Saharan Africa and bank failures have been phenomenal in the last decade, and a threat to the stability of the financial sector in these countries. The secondary motivation is derived from the relatively fewer studies in this area with specific reference to Sub-Saharan Africa. In addition to recapping the theoretical aspects of x-inefficiency, this paper makes two contributions. First, in terms of empirical investigation, this is one of the few cross-country studies about x-efficiency in Sub-Sahara Africa by incorporating pool data from nine[1] countries. Two most notable earlier studies on this subject using data from Sub Sahara Africa by Okeahalam (1998, 1999) focused entirely on Botswana. Secondly, we test two sets of diametrical hypotheses; market-power *vis-à-vis*

[1] Botswana, Ghana, Kenya, Lesotho, Malawi, Namibia, Nigeria, Swaziland and Zambia

efficient-structure and bad luck *vis-à-vis* bad management. The conclusions drawn from the results are our support-tools to make policy suggestions.

The rest of the paper is organised as follows: Section 2 reviews some of the existing literature about x-inefficiency, its determinants, the theoretical concepts and hypotheses. The methodology is discussed in Section 3, while the econometric estimations and results are presented in Section 4. Section 5 concludes with the policy implications.

2 LITERATURE REVIEW

2.1 What is x-inefficiency and why is it important?

In simple terms, efficiency is about productivity as defined by the ratio of outputs to inputs, so that a higher ratio represents better efficiency. Grosskopf (1993) refers to the efficiency measure as *total factor productivity index* because of its composite nature since it is computed on the basis of outputs and inputs. Therefore augmentation of outputs and conservation of inputs, contemporaneously, is the cornerstone of efficiency (Lovell, 1993). Thus two distinct dimensions to efficiency emerge. While economies of scale and scope relate to output, x-inefficiency, the focus of this paper is about inputs. The terminology x-inefficiency was coined by Leibenstein (for details, see De Young, 1998) to describe costs arising from management deficiencies, but not from suboptimal economies of scale and scope. Okeahalam (1998) suggests that the terminology *x-inefficiency* reflects the difficulty of precisely identifying the determinants of this type of inefficiency. This is corroborated by De Young (1998) who points out that although x-inefficiency has been linked to management quality, empirical support is scanty. According to Goldberg and Rai (1993), x-inefficiency is a measure of how banks utilise their inputs to produce a given level of output, while Berger et al (1993) describe x-inefficiency as the variances or deviations from the efficient frontier set by the best practice or benchmark firm. X-inefficiency, incorporates two components, thus technical and allocative inefficiencies (Allen and Rai, 1996). Technical inefficiencies occur due to suboptimal usage of inputs leading to waste, while allocative inefficiencies arise from inappropriate mix or composition of inputs.

In spite of the different dimensions of x-inefficiency, it has been widely used by researchers as a proxy for management performance, for example, Berger and DeYoung (1997) whose study reveals that the relationship between problem loans and inefficiency is positive. They argue that problem loans are a manifestation of operational inefficiency and also suggest that management ratings in commercial banks are more strongly related to the asset quality (or the level of problem loans) than any other factor. Implicitly therefore, asset quality is a strong proxy of management efficiency. This tallies with findings by other researchers (Heffernan, 2000; Hardy, 1998; Dewatripont & Tirole, 1993; Brownbridge and Kirkpatrick, 1999) that deterioration of asset quality is the principal cause of problem banks and bank failure.

The ultimate objective of policy makers and regulatory authorities is to minimise inefficiency in the banking sector, in order to realise a number of benefits (Berger, Hunter, and Timme, 1993). First, more efficient banks will intermediate more funds, offer a wider range and better quality of services to clients at competitive prices. The second benefit is that banks become more profitable and therefore investors would expect higher dividends. Third, as a result of increased profitability, investor confidence is boosted, thereby attracting more capital in addition to an increase in internally generated retained reserves thus bolster capital accumulation.

This increases the safety and soundness of the banks, and hence the stability of the financial system which means a reduction in the risk of bank failures and the pertinent costs.

In their international survey on efficiency of financial institutions, Berger and Humphrey (1997), highlight the primary usefulness of inefficiency studies to policy makers from four perspectives; (a) deregulation, (b) mismanagement, problem loans and bank failures, (c) market structure and concentration, and (d) the effects of mergers and acquisitions. They also point out that qualitative measures of inefficiency are usually available, but what lacks are the precise numerical estimates of inefficiency. It is thus plausible to argue that qualitative measures are mere indicators of direction rather than incise pinpointers of position, and yet the relevance of objective numerical values is now more critical than before, if timely and appropriate remedial decisions are to be taken and implemented.

From the perspective of deregulation, policy makers need to establish to what extent the intended objectives are achieved and at what pace. Again, in the survey by Berger and Humphrey (1997), we find that inefficiency studies have been used to monitor the effects of deregulation in Japan, Norway, Spain, Turkey and United States. Similar studies have been carried out by Kraft and Tirtiroglu (1998) about Croatia, Hasan and Marton (2000) about Hungary, Drake (1992) about UK building societies, Worthington (1998) about Australian building societies. Although the list is by no means exhaustive, findings from those studies give mixed signals about the effects of deregulation on inefficiency. While for Norway and Turkey (Berger et al, 1992) deregulation appeared to reduce inefficiencies, the state of affairs in USA after the deregulation of the 1980s remained rather static, according to Bauer et al (1993). But Humphrey and Pulley (1997) found that productivity decreased in US banks, although other factors rather than deregulation possibly led to this phenomenon. Lozano (1997) also found that inefficiency did not decrease in Spain despite deregulation. The mixed results demonstrate that it is imperative to monitor the effects of deregulation. Berger and Humphrey (1997) succinctly conclude that “the implication for government policy is that the conventional wisdom which holds that deregulation always improves efficiency and productivity may be incorrect. Industry conditions prior to deregulation and other incentives may intervene.” Therefore econometric investigations ought to develop models whose specifications take into account any other relevant variables. In spite of the world-wide intense research activity about bank inefficiencies in the context of deregulation, Sub Saharan Africa is conspicuously missing from the list notwithstanding radical reforms undertaken through the structural adjustment programmes prescribed by the World Bank and IMF over the last two decades.

The issue of problem banks and the risk of bank failures is of great concern to regulators, therefore any variable that can help in the process of early detection of distress would greatly enhance prompt corrective action. By applying CAMEL assessment procedure, De Young (1997) finds that management quality is positively related to cost efficiency, which is in turn significantly responsive to asset quality. Berger and Humphrey (1992) and Cebenoyan et al (1993) find that the failure probability of inefficient financial institutions is higher compared to the more efficient counterparts, and that there is a discernible relationship between inefficiency and problem institutions well ahead of actual failure. Other studies by Hughes and Mester (1993), Mester (1996, 1997), Hermalin and Wallace (1994) all indicate that inefficiency is an indicator of potential problems. The relevance of inefficiency as a proven and objective measure for early detection of bank distress is well documented, and it is therefore an appropriate decision making tool to be adopted by financial regulators and policy makers in Sub Sahara Africa.

2.2 Determinants of x-inefficiency

Do agency costs matter? Brealey and Myers (2000) point out that in the past, economists assumed without question that key stakeholders such as managers, shareholders, creditors and employees, all acted for the common good of the firm in unison. Therefore goal congruency between each party was taken for granted. Although the stakeholder concept recognises various interest groups, the managers and shareholders still remain most dominant in driving the firms' activities, with the former acting as agents of the latter. As agents, managers are expected to run the organisation to achieve objectives that are in harmony with shareholders' best interests. However, this is not always the case, as managers' interests sometimes take precedence over shareholders' interests, which inevitably leads to conflict between the two parties. *Agency theory* is the term used to describe the phenomenon of potential conflicts of interest between managers and other stakeholders (particularly the shareholders) within an organisation and the various ways of attempting to resolve such conflicts in order to achieve goal congruency.

In North America, Western Europe and Japan, corporate governance has been subjected to greater scrutiny in order to mitigate agency-related problems and the pertinent costs. In United Kingdom, for example, the combined code of corporate governance reviews the dual model of 'chairman-chief executive' *vis-à-vis* the separated-role model. Proponents of the combined model argue that it integrates the processes of decision-making and implementation, which reduces bureaucracy and augments efficiency. Moreover, unlike the separated model, accountability is undivided for the combined model, since one office takes full responsibility thus mitigating potential conflicts between the decision-makers and implementers. In spite of these apparent merits, findings by Pi and Timme (1993) reveal a positive relationship between inefficiency and the combined role model of corporate governance, but the relationship is negative in the separated model. This suggests that concentration of authority tends to constrain prudent judgement and transparency.

Hannan and Mavinga (1980) also find that managers have higher expenditure preference in widely held companies, which leads to greater cost inefficiency than in closely held companies. Agency problems are less pronounced in closely held companies due to the substantial overlap between ownership and management. A number of public limited liability (widely-held) companies in United Kingdom have been accused of the "fat cat" syndrome and other excessive perquisite awards to top management. Berger, Hunter and Timme (1993), suggest that agency costs can be mitigated by separating decision-control from decision-management. It is therefore not surprising that the UK corporate governance code has, for example, strengthened the role of non-executive directors through remuneration and audit committees as part of the mitigation process intended to curtail management excesses which would otherwise exacerbate inefficiency.

In the context of Sub Sahara African banks, the agency problem can be analysed from two perspectives. First, in spite of the on-going reforms and privatisation process, a number of banks are still government owned. The public ownership of government banks does not only qualify them to be classified as widely-held, but it is plausible to place them at the extreme end of this category (super widely-held) particularly where no private individuals have direct shareholdings. Directors and top managers are normally government appointees whose professional ethos are likely to be subordinated by political allegiance. This is supported by Brownbridge and Harvey (1998) by pointing out that although the performance of government owned banks in Sub Sahara Africa varies due to several factors, management is critical because it is heavily influenced by political patronage. Therefore agency related costs will be expected to be higher in government controlled banks, and thus increase inefficiency. It would therefore be expected that privatisation of government banks will reduce inefficiencies. The second perspective relates to foreign ownership. Again, Brownbridge and Harvey (1998) argue that foreign links and relics of foreign ownership contributed to better management and performance of commercial banks. Although better performance has been attributed to absence of political interference, it appears better corporate governance mitigates agency costs and enhances performance to reduce inefficiency.

Regulation and corporate structure are also significant. Although the restrictions imposed by regulators on the scope and mode of operations by commercial banks are intended to ensure that the financial system is sound and safe, they constrain the maximum potential of performance. Berger and Mester (1997), for example, note that the minimum reserve requirement forces banks to keep liquidity at an opportunity cost, since such funds could earn higher returns if invested. In a nutshell, mandatory reserves increase cost and reduce potential profits, hence augmenting cost and profit inefficiency.

When regulators impose restrictions on commercial banks, the portfolio of investment options available is curtailed, and yet some of the excluded activities could generate higher returns. Banks will still seek those activities through other avenues such as setting up non-bank subsidiaries or some other suitable structures, to circumvent the restrictions. However, Berger, Hunter and Timme (1993), point out that "although the non-bank structures serve the same purpose as the organisations they attempt to emulate, they are likely to incur a higher cost". Grabowski et al (1993) and Newman and Shrieves (1993) find corroborative evidence in USA, to suggest that banks with subsidiary structures (multi-bank holding companies or MBHC) are less efficient than branch banks (BB) without other holding companies.

Scale and scope of operations are important too. Although size is typically associated with scale and scope inefficiencies, Berger et al (1993) find that x-inefficiency is negatively related to the scale of operations, which suggests that larger firms tend to be closer to the efficient frontier than smaller firms. Berger et al (1993) also suggest that the allocative component of x-inefficiency is more significant than its counterpart, technical inefficiency, implying that larger firms are more likely to achieve optimal mix of inputs than smaller firms. Therefore contrary to the belief that size only influences scale inefficiencies, it is also a determinant of x-inefficiency. Moreover, since x-inefficiency is a proxy of management quality (De Young, 1997), larger banks have the resources to attract high calibre of personnel, which partly explains their superior performance and the lower x-inefficiencies.

2.3 Market power hypothesis

The *market power hypothesis* (MPH), also referred to as *structure-conduct-performance* theory, postulates that when firms have greater market power, they offer less favourable terms to their customers and are therefore able to recoup abnormal profits. This is because they have substantial control in an imperfect market and can thus can maintain monopolistic rents by adjusting prices to the detriment of the customer, more or less at will, to cover their inefficient practices. In the case of banks, it means they will charge higher interest rates on loans, higher commissions on other products, but pay lower interest rates on deposits. This suggests that high market structure measures are indicative of higher inefficiencies.

Profitability as a key efficiency indicator can be used to investigate the relationship between market structure and performance or inefficiency. There are two measures of market structure. The first one is the measure of *market concentration* (MC) which is a determined by the number of participating firms and their respective market shares. It is a macro indicator of the market competitiveness. Higher concentration indices represent less competitive markets with fewer players who have power to drive market prices; the reverse is true for lower concentration indices. One of the most widely used measures of market concentration is the *Herfindahl-Hirschman Index* (HHI). It is computed by summing the squares of the market share of each firm in the industry within a specified market[2]. The second measure of market structure is *market share*. Unlike market concentration which universally applies to the whole market, market share is micro and specific to each individual firm. It can be computed by using the percentage of turnover or assets as deemed appropriate.

$$HHI = \sum_{i=1}^{n} (S_i)^2 \qquad (1)$$

Where S_i is the share of firm i, n is the number of firms.

We can specify the MPH model as follows:

[2] ***Computing HHI:***
(a) A market consisting of three firms with market shares of 40%, 38%, and 22%;
HHI = ($40^2 + 38^2 + 22^2$ = 3528).
(b) A market with one firm and 100% market share; HHI = 100^2 = 10,000
(c) Since the maximum concentration possible is 10,000, HHI could be expressed as a percentage

$$PINEFFS = f\,(SHHI, z_i) + e \qquad (2)$$

Where *PINEFFS* is profit x-inefficiency, *SHHI* is market concentration index, z_i represents other control variables, and e is the error term. Therefore *SHHI* granger causes *PINEFFS*.

Berger and Hannan (1989) introduced a modified version of MPH, referred to as the *relative market power* hypothesis (RMP). It posits that as the market share controlled by a firm increases, so does its market power to manipulate prices in its favour so as to increase profitability without necessarily improving efficiency. RMP is thus based on market share rather than market concentration, and therefore high concentration is not an essential prerequisite for RMP phenomenon to exist.

We can specify the RMP model as follows:

$$PINEFFS = f\,(BMKT, z_i) + e \qquad (3)$$

Where *PINEFFS* is profit x-inefficiency, *BMKT* is the bank's market share, z_i represents other control variables, and e is the error term. Therefore *BMKT* granger causes *PINEFFS*.

The major policy implication of the market power hypothesis is that anti-trust institutions such as the competition commission in UK, anti-trust organisations in USA, etc are socially desirable and should be strengthened to ensure that customers are not unfairly exploited because of imperfections in the market structure. Furthermore, incentives to increase competitiveness should be provided, while at the same time, a cautious approach to approving mergers should be pursued.

Berger and Humphrey (1997) observe that regulatory authorities, particularly in the United States, subscribe to the "market power paradigm" in policy formulation,

with 10,000 as the denominator. Therefore HHI of 3528 = 35.28%, HHI of 10,000 = 100%.

regarding mergers and acquisitions to ensure that the anti-trust laws are not breached. Moreover, in spite of the widely held view that mergers usually reduce cost and profit inefficiency, Berger and Humphrey (1997) note that no such improvement on the average has been consistent. In fact, they argue that some mergers have indeed aggravated inefficiencies. Therefore mergers which are bound to be detrimental to healthy competition should not be justified on the pretext of efficiency improvement. Two litmus tests have been suggested to identify those mergers that could enhance efficiency. The first is where sizeable portions of the markets of the merging institutions overlap, in which case merging will lead to elimination of duplicate functions. The second one is where the dominant or acquiring institution is more efficient and would be expected to transfer its superior practices to the partner. But Berger and Humphrey (1997) suggest despite these tests, there is no significant evidence to confirm that mergers improve efficiency.

From the perspective of individual institutions, mergers, market power and efficiency could be replicated in terms of branch network so that the efficiency of different sizes of branches is evaluated, to help decisions of consolidating or breaking up some, as deemed appropriate. For example, Okeahalam (1998) finds that the consolidation of branch banks in Botswana has not compromised efficiency, although it is not clear whether significant improvements are achieved. In USA, Berger, Leusner and Mingo (1997) find that about 66% of the branches of a large (anonymous) bank suffer from up 25% x-inefficiencies, but yet management still keep those inefficient branches. Ideally, closing x-inefficient branches would be expected to reduce costs, but may also lead to loss of customers and market share, unless there are x-efficient branches in the proximity to take-over the business of the closed branches. Berger et al (1997) find that banks do not close the x-inefficient branches because "overbranching raises revenues from providing extra customer convenience", and perhaps more importantly, it would be impractical to close 66% of the branches. The findings by Okeahalam (1998) and Berger et al (1997) lead to the conclusion that neither consolidation nor closure of branches will eradicate x-inefficiency altogether. Policy makers and regulators therefore ought to recognise that it is the degree of branch x-inefficiency that should be of concern, otherwise eliminating it totally may not be feasible. Consideration of compensatory effects from efficiencies derived from economies also plays an important role.

Okeahalam (1998) argues that the positive relationship between profitability and market power suggests that banks with large market share are more profitable. Berger (1995), Goldeberg and Rai (1996) also find that there is a positive relationship between profitability and market structure measures. Although there is no contention about the positive correlation between profit and market structure measures, there is some ambiguity in identifying the factors that lead to higher profits as market structure measures increase. The contention, however, is about the actual source of higher profitability. While market power hypothesis implies that market power precedes profitability, a diametrical school of thought (the efficient structure hypothesis) suggests that efficiency is a precursor of market power and profitability.

2.4 Efficient structure hypothesis

Like MPH, the *efficient-structure hypothesis* (ESH) is based on the positive relationship between profit and market structure. ESH, however, posits that some firms are inherently more efficient due to better management and technologies, and enjoy distinct competitive advantage in the market place because they can offer better terms to their customers. As they attract more customers, they grow and capture larger market shares. Thus in contrast to MPH, ESH implies that larger market shares and higher market concentration are effects of efficiency. If MPH holds, then anti-trust institutions are not necessary because high market concentration and large market shares are manifestations of efficiency, and the customers ultimately benefit from this phenomenon.

ESH models based on market concentration and market share respectively, can be specified as follows:

$$SHHI = f\,(PINEFFS, z_i) + e \qquad (4)$$

$$BMKT = f\,(PINEFFS, z_i) + e \qquad (5)$$

Where PINEFFS is profit x-inefficiency, SHHI is the market concentration, BMKT is the bank's market share, and z_i represents other control variables, and e is the error term. Therefore PINEFFS granger causes SHHI in (4), PINEFFS granger causes BMKT in (5).

2.5 Bad management or bad luck?

Berger and De Young (1997) discuss the bad management (including skimping) and bad luck hypotheses, from an inter-temporal point if view. They apply the granger causality techniques to investigate these hypotheses. They argue that problem loans and inefficiency are not dichotomous but one causes the other. Either of the two hypotheses will hold depending on what event precedes the other, and the preceding event is assumed to cause the subsequent event. If problem loans precede inefficiency, this suggests that exogenous factors beyond the control of management may have led to the deterioration of asset quality. Management will then try to rectify the situation by spending more on recovery procedures and possibly foreclosures. These extra costs increase the inefficiency levels. On the other hand, if high inefficiency level precedes problem loans, this suggests that the bad management hypothesis holds. Poor management leads to poor appraisal of loans and poor administrative procedures, which eventually create sticky loan portfolios. Bad management and bad luck hypotheses are represented by equations 6 and 7 respectively:

$$Aq = f(x\text{-}ineff, z_i) + e \quad (6)$$

Where Aq is Asset quality, and x-ineff is x-inefficiency, z_i represents other control variables. X-inefficiency granger causes asset quality (problem loans) = BAD MANAGEMENT

$$x\text{-}ineff = f(Aq, z_i) + e \quad (7)$$

Where Aq is Asset quality, and x-ineff is x-inefficiency, zi represents other control variables. If asset quality (problem loans) granger causes x-inefficiency = BAD LUCK

In both cases above, unidirectional approach is assumed, thus from problem loans to inefficiency in the case of bad luck hypothesis, and from inefficiency to problem loans, on the case of bad management. In reality, however, the movements are likely to be bi-directional and this makes it difficult to draw any firm inferences. Nevertheless, any indicative findings could be used in suggesting policy solutions. In case of bad luck, for example, it would be appropriate to strengthen prudential regulation e.g. reduce exposure limits of insider lending or industry concentration. As for bad management, the ultimate solution is to replace top management. Other measures would require strengthening internal control procedures, credit quality and cost efficiency.

3 METHODOLOGY

3.1 Selection of the economic concepts

According to Berger and Humphrey (1997), x-inefficiency is a performance indicator based on two main economic concepts, thus; *cost* and *profit*. Whereas the cost concept focuses on inputs, the profit concept incorporates both inputs and outputs.

Although most researchers, for example, Drake (1992), Berger (1995), De Young (1998) focus on one economic concept at a time, we adopt both the cost and profit concepts concurrently for comparison. Worthington (1998) argues that the cost concept is more relevant in the determination of bank x-inefficiency because banks are constrained from achieving maximum profits due to regulatory restrictions imposed such as the minimum reserve and capital adequacy requirements. Moreover, management has substantial control on the cost of inputs, not necessarily on pricing but on usage, yet the output side is beyond their control. If x-inefficiency were to be used as a proxy for management quality, it would not be an equitable performance measure because it incorporates variables beyond management control. Furthermore, econometric estimation of the output side becomes more complex and less accurate with multi-product functions. Therefore the most suitable primary objective in these circumstances is cost minimisation. A simple cost function may be presented as follows:

$$C = f\,(p,q,z,e) \tag{8}$$

Where: C represents the variable costs, p is the vector of prices of inputs, q is the vector of outputs in quantity, z represents any control variables and e is the error term.

The cost function may be represented in the log form as:

$$lnC = f(p,q,z) + ln\, e_c \qquad (9)$$

The essence is to identify benchmark bank with the lowest cost, from which inefficiency of other banks may be derived as:

$$Cost.Inefficiency = 1 - \frac{C^{\min}}{C^{b}} = 1 - \left[\frac{\exp[f(p^b, q^b, z^b)] \times \exp[\ln e_c^{\min}]}{\exp[f(p^b, q^b, z^b)] \times \exp[\ln e_c^{b}]}\right] = \left[1 - \frac{e_c^{\min}}{e_c^{b}}\right] \qquad (10)$$

Where the superscripts *min* and *b* represent the benchmark or lowest cost bank, and bank b whose x-inefficiency is derived respectively, exp is exponential of the natural logarithm.

Berger and Mester (1997) derive the efficiency ratio as C_{min}/C_b, which represents the portion of costs that are deployed efficiently compared to the benchmark bank, assuming similar conditions of production. Therefore the excess costs (1-eff) are inefficiencies.

On the other hand, it can be argued that the profit concept is more appropriate because management performance is a balancing phenomenon involving controllable and non-controllable variables, and a measure that excludes either of them does not fully capture management performance. The profit function, however, seeks to maximise profits at a given level of input and output prices. It therefore takes into account input prices as well as revenues generated from output. However, the output prices are taken as exogenous, which implies that maximising profit is determined by the input inefficiencies. There are two versions of profit function. The first is the *standard profit function*, whose elements are similar to those of the cost function, except for q, the vector of outputs (in quantity) which is replaced by s, the vector of output prices. The log form of the standard profit function is thus:

$$ln(? + ?) = f(p,s,z) + ln\ e_{?} \qquad (11)$$

Where a constant, ?, is added to avoid a negative profit, as it would be inappropriate for the logarithm form.

Efficiency is the ratio of realised profit of a given bank b to maximum profit of the benchmark bank, therefore inefficiency will be derived by subtracting the efficiency ratio from one.

$$?'ineff\ ?\ 1\ ?\ \frac{?^{b}}{?^{\max}}\ ?\ 1\ ?\ \frac{\exp[f(p^{b}, s^{b}, z^{b})]\ ?\ \exp[\ln e_{?}^{b}]\ ?\ ?}{\exp[f(p^{b}, s^{b}, z^{b})]\ ?\ \exp[\ln e_{?}^{\max}]\ ?\ ?}\ ?\ 1\ ?\ \frac{e_{?}^{b}}{e_{?}^{\max}} \qquad (12)$$

Where the right hand side of the equation is the standard profit inefficiency, the superscripts *max* and *b* represent the benchmark or most profitable bank, and bank b whose x-inefficiency is derived respectively, ? is the constant, exp is exponential of the natural logarithm.

In contrast to the cost function, profit efficiency can be negative because firms can throw away more than 100% of their potential profits (Berger and Mester, 1997). This implies that it is possible to have an inefficiency ratio which is greater than one, but this would not be logical. To avoid this problem, the largest negative (loss) amount in the sample is identified and then added to each observation as a constant ? which is subtracted later when computing inefficiency (See equation 12).

Berger and Mester (1997) present three arguments which make the profit function superior to the cost function in evaluating the performance of a firm. First, profit maximisation (or optimisation) is a more conventional economic goal in business. More importantly, it takes into account marginal revenue (MR) as it does for marginal cost (MC). Although maximisation is achieved where MR = MC, it is possible to have MC which is greater than that of the benchmark firm, which demonstrates that a firm seeking to be cost efficient could be constrained to exploit the maximum profit potential. In a nutshell, cost efficiency does not guarantee profit efficiency. Secondly, the profit function accounts for errors on both the input as well as the output side. Thirdly, the cost function assumes that output level is constant, but this ignores the fact that each firm has a different optimal level of output, since efficiency will vary at different output levels, both in terms of volume and mix.

The second version of profit function is referred to as the *alternative profit function*. This is a hybrid between cost and standard profit functions. The left-hand side of the identity is the same as that of the standard profit function. But the right-hand side is the same as that of the cost function, because *s*, the price of outputs, is replaced by q, the quantity of outputs, therefore output level is held constant but prices may vary. The alternative profit function can now be presented as:

$$ln(a? + ?) = f(p,q,z) + ln\ e_{a?} \qquad (13)$$

From (12), the alternative profit function to compute inefficient can be derived as shown in (14).

$$a?'ineff ? 1 ? \frac{a?^{b}}{a?^{\max}} ? 1 ? \frac{?\{\exp[f(p^{b}, q^{b}, z^{b})] ? \exp[\ln e^{b}_{a?}]\} ? ?}{?\{\exp[f(p^{b}, q^{b}, z^{b})] ? \exp[\ln e^{\max}_{a?}]\} ? ?} ? 1 ? \frac{e^{b}_{a?}}{e^{\max}_{a?}} \qquad (14)$$

Where the right hand side of the equation is the alternative profit inefficiency, the superscripts *max* and *b* represent the benchmark or most profitable bank, and bank b whose x-inefficiency is derived respectively, ? is the constant, exp is exponential of the natural logarithm.

Humphrey and Pulley (1997) find that quantities (outputs) are better predictors of profit than prices, which makes the alternative profit function superior to the standard profit function. Furthermore, Berger and Mester (1997) find that the alternative profit function is more applicable on panel data from different countries because of its distinct advantages. First, "the alternative profit inefficiency compares the ability of banks to generate profits for the same levels of output and therefore reduces the scale bias that might be present in the standard profit efficiency measure". This is because output is assumed to be constant while prices may vary. Secondly, the alternative profit function takes into account variations in quality of outputs, which implies that some banks may generate more revenue to reflect the quality of their output. This is an important attribute of the alternative profit function in the context of this empirical analysis where panel data is pooled from nine countries, because it would be expected that the quality of products is bound to vary widely across those countries. Thirdly, unlike the standard profit function which assumes perfect market conditions, the alternative profit function takes into account market imperfections which may lead to price differentials. This is an important element in the context of commercial banks in Sub Sahara Africa, because despite deregulation, the prudential requirements and licensing requirements could be viewed as restrictive barriers to entry, and thus contributing to market imperfections. The fourth attribute of the alternative profit function arises from the first one, in that since output quantities are used rather than output prices, then the weakness of imprecise price measurement is mitigated. Humphrey and Pulley (1997) find that quantities (outputs) are better predictors of profit than prices, which further justifies the use of alternative profit function. Our preferred choice between the *standard profit function* and the *alternative profit function* is the latter.

3.2 The parametric measurement techniques

Lovell (1993) and Greene (1993) discuss two broad categories of techniques for estimating efficiency, mathematical and econometric techniques. Lovell (1993) points out that "the econometric approach is stochastic, and so attempts to distinguish the effects of noise from the effects of inefficiency, while the programming (mathematical) approach is non-stochastic is curtailed by including noise in its estimation of inefficiency. The econometric approach is parametric while the mathematical approach is non-parametric.

Despite the intense debate about the choice between parametric and non-parametric techniques, there is no universal agreement among researchers as to which one of the two approaches is more robust, but much depends on the objective of investigation and the data set. Imposing the functional form, in the case of parametric approach, could lead to mis-specification errors, and yet the non-parametric approach is criticised for lack of a priori functional form thus making hypothesis testing difficult. Moreover, non-parametric techniques, do not isolate the random error term which arises due to measurement deficiencies, luck or data problems and will therefore lead to inaccurate estimates of inefficiency because of the inclusion of the random factor.

In parametric regressions, the functional relationship between the dependent and independent variables is specified priori. The unknown parameters are then estimated by 'fitting' the function so that the relationships between the independent and dependent variables can be interpreted meaningfully. In a nutshell, the primary objective of parametric regressions is to estimate parameter values for analysis and interpretation. We therefore opt for two parametric techniques, the stochastic frontier approach (SFA) and distribution free approach (DFA). The advantage of engaging two methods is the ability to cross-validate the findings, and in case significant discrepancies occur, it opens research questions for further enquiry.

The Stochastic Frontier Approach (SFA), also referred to as Economic Frontier Approach (SFA), assumes a composite error term with two elements. The first one is the random term, which is symmetrically and normally distributed. The second one is the systematic error term, which represents inefficiency. It is asymmetrical and truncated i.e. half-normal or one-sided distribution, since inefficiencies can not be negative from the best practice frontier. Both the random and systematic components of the error term are orthogonal to the variables specified in the identity. Inefficiency is the mean or mode of the distribution. The assumption of half normality poses one major difficulty in case the inefficiencies are not clustered in the half to full efficiency. This tends to distort the estimation values. It has been proposed that truncated or gamma distribution would be more appropriate, but again this would raise another problem since random term is assumed to be symmetrical, isolating it from the composite term would be difficult.

Unlike stochastic frontier approach, the Distribution Free Approach (DFA) does not assume specific distribution for inefficiencies. Instead, it assumes that inefficiencies tend to stabilise over time, while the random term will even out to zero in the long run, which implies that the residual term above zero is inefficiency. The firm with the lowest inefficiency is assumed to represent the most efficient frontier. Although some truncation may be necessary to exclude outliers, DFA is applicable regardless of the form of distribution. The main shortcoming is that the frontier may move due to different factors other than inefficiency.

3.3 The translog functional form

The transcendental logarithmic (translog) function is one of the most popular parametric functional forms of estimating inefficiency because of its general quadratic flexibility (Drake, 1992). Worthington (1998) notes that it has generally performed well in the previous studies due to its strong attributes, one of which is not to impose restrictions on the elasticity of substitution between inputs. Furthermore, it caters for multiple inputs and outputs, and also recognises joint costs in multi-product outputs. However, the translog form suffers from the large number of coefficients to estimate, which therefore necessitates a large number of observations to secure sufficient degrees of freedom, but the use of panel data mitigates this problem. Furthermore, Esho and Sharpe (1994) argue that this problem is more pronounced in estimating scale rather than x-inefficiencies, we therefore find it of little consequence to this analysis since the focus is x-inefficiency.

A number of researchers use the Fourier-flexible version of the translog function, for example Berger and De Young (1997), Berger, Leuser and Mingo (1997), Berger and Mester (1997), Hassan and Morton (2000). According to Berger and De Young (1997), this is because it combines the standard translog form with the non-parametric Fourier form where the trigonometric transformations of variables make it possible to globally approximate the underlying cost function over the entire range of data." Berger and De Young (1997) also established that inefficiencies derived using the translog function were almost twice as large as those from Fourrier-flexible form. This is partly because the translog form does not fit well for data which is widely dispersed from the mean, with large standard deviations. Nevertheless, we do not find it necessary to include the Fourier component since logarithm transformations reduce the dispersion measures substantially so that the problem of observations lying far from the sample mean is alleviated.

The cost and profit translog functions are presented as equations 15 and 16 respectively.

$$\ln TC ? ? ? \underset{i?1}{\overset{3}{?}} ?_i \ln Q_i ? \frac{1}{2} \underset{i?1}{\overset{3}{?}} \underset{j?1}{\overset{3}{?}} ?_{ij} \ln Q_i \ln Q_j ? \underset{k?1}{\overset{4}{?}} ?_k \ln P_k ? \frac{1}{2} \underset{k?1}{\overset{4}{?}} \underset{l?1}{\overset{4}{?}} ?_{kl} \ln P_k P_l ? \underset{i?1}{\overset{3}{?}} \underset{k?1}{\overset{4}{?}} ?_{kl} \ln Q_i \ln P_k ? ? \qquad (15)$$

$$\ln ?? ? ? ?? ? ? \underset{i?1}{\overset{3}{?}} ?_i \ln Q_i ? \frac{1}{2} \underset{i?1}{\overset{3}{?}} \underset{j?1}{\overset{3}{?}} ?_{ij} \ln Q_i \ln Q_j ? \underset{k?1}{\overset{4}{?}} ?_k \ln P_k ? \frac{1}{2} \underset{k?1}{\overset{4}{?}} \underset{l?1}{\overset{4}{?}} ?_{kl} \ln P_k P_l ? \underset{i?1}{\overset{3}{?}} \underset{k?1}{\overset{4}{?}} ?_{kl} \ln Q_i \ln P_k ? ? \qquad (16)$$

Where $\ln TC$ is the log of total cost; ln(? +?) is the log of profit plus a constant[3]; ? is the intercept; Q is the quantity of outputs; P represents the prices of inputs; $?_i$, $?_{ij}$, $?_k$, $?_{kl}$, and $?_{kl}$ are coefficients; while ? is the error term.

Following Drake (1992), we incorporate Shepherd's lemma share equations[4] to improve the efficiency of parameter estimations by reducing their variances. Although the share equations do not increase the number of parameters in the equation, they provide some additional information.

The share equations are derived as follows:

$$S_k ? \frac{P_k X_k}{C} ? ?\frac{?C}{?P_k}??\frac{P_k}{C}?? \frac{? \ln C}{? \ln P_k}$$

$$S_k ? ?_k ? \underset{k}{?} ?_{kl} \ln P_k ? \underset{i}{?} ?_{ij} \ln Q_i ? \ln v_k \qquad (17)$$

[3] The constant is based on the observation with the biggest loss plus 1, to avoid negative profit.
[4] Note that the number of share equations = n-1, where n is the number of inputs.

3.4 The intermediation versus production approach

The translog model is applied to derive the x-inefficiency measure which is then regressed against selected explanatory variables (the correlates) for hypotheses testing at the second stage. Berger, Leusner and Mingo (1997) examine two approaches to estimating cost inefficiency, the *intermediation* and *production* approaches. For the intermediation approach, total costs include both operating and interest expenses, but the production approach is based on operating costs only. The outputs are given in *monetary values* and according to *transactions completed*, for the intermediation and production approaches respectively. In terms of the inputs, the intermediation approach includes both prices of physical inputs as well as prices of financial inputs (interest paid), but the production approach excludes the latter. Berger, Leusner and Mingo (1997) suggest that the intermediation approach is superior because it is more inclusive, and captures the essence of a financial institution.

We basically follow the intermediation approach but expand the scope of total costs to include personnel and overhead expenses for two reasons. First, since we use panel data pooled from nine countries, incorporating 89 banks over a period of eight years, inconsistencies in classification and reporting of costs are likely to exist. For example, some banks could treat a portion of operating expenses as overheads and vice versa, hence the ability to capture total cost behaviour would be curtailed if we restricted the analysis to operating and interest expenses. Secondly, although technology in Sub Sahara African banks is generally less developed, there are differences in levels of development not only between countries, but also between foreign and domestically owned banks. The flexibility of substituting production factors between technology and labour partly depends on the level of technological development. For example, banks with auto-teller machines (ATMs) can reduce the personnel costs but increase operational costs to dispense cash, whereas those without ATMs will incur higher personnel costs to deliver a similar service. It is therefore plausible to argue that exclusion of personnel expenses might understate the actual cost of operations for the banks with less developed technology, and hence the justification to include them.

3.5 Decomposing the error term

The cost and profit functions are based on Cobb-Douglas logarithm form and can be rearranged as follows:

$$lnC = f(p,q,z) + ln\ e_c \quad ? \quad lnC = ? + ?_1 p + ?_2 q + ?_3 z + ln\ e_c \qquad (18)$$

$$ln(a? + ?) = f(p,q,z) + ln\ e_{a?} \quad ? \quad ln(a? + ?) = ? + ?_1 p + ?_2 q + ?_3 z + ln\ e_{a?} \qquad (19)$$

One important feature common to both functions, is the special empirical applications based on the error term, *ln e*. Unlike most specifications, where econometric investigations focus on the parameters $?_i$, Green (1993) notes that these parameters become subordinate in the process of computing the inefficiency measure. What is of primary concern, however, is the error term. The assumptions of extracting inefficiency from the error term will differ depending on the technique used, but it is generally accepted that the error term *e* is composed of two elements, the random term, *v*, and the inefficiency term, *u*. In order to extract the inefficiency term, the error term *e* must be decomposed to isolate the random element from the systematic inefficiency term. It is assumed that the random term, which accounts for luck and uncontrollable variables, is normally distributed with zero mean and unit variance.

Once the random term is isolated, the residual, u is the inefficiency term. In the context of x-inefficiency, it is further sub-divided into two components. The first one is the allocative component or mix inefficiency. This occurs when the combination of inputs is not optimised to derive the lowest total cost of inputs for a given price structure. The second element relates to actual usage (over-usage) of inputs. This is referred to as technical inefficiency, because it represents waste of inputs. Following Jondorow et al (1982), x-inefficiency can be calculated from the following model:

$$X \; ? \; INEFF \; ? \; \frac{??}{1 \; ? \; ?^2} \; ? \; \frac{?(?_i ?)}{?? \; (??_i ? / ?)} \; ? \; \frac{?_i ?}{?} \; ? \qquad (20)$$

Where $?(?)$ is the density of the standard normal distribution, and $?(?)$ is the truncated cumulative distribution.

We follow improvements suggested by Greene (1993) when using panel data, by applying the fixed effects approach, where the error terms are treated as bank-specific. Fecher and Pestieau (1993) propose the following function with parameters that vary across countries:

$$?_{it} = ?_0 + ?x_{it} + u_{it} \qquad (21)$$

Where $?_0$ are country fixed effects, x_{it} are country related variables, and u_{it} is the residual representing inefficiency, provided it is normalised to fulfil the non-negativity requirement.

We use one country related variable, HHI, in equation (21) based on the assumption that market concentration depicts the intensity of competition in the country, and that it is an approximate proxy of the banking sector characteristics in a given country.

4 ECONOMETRIC ESTIMATION AND RESULTS

4.1 The sample, sources of data and definitions of variables

The sample consists of 9 countries incorporating 89 banks (Table 1) for the period 1992 to 1999. The source of data for this section is *bankscope,* an international database covering over 10,000 banks. We use panel data because of the flexibility it offers in terms of increasing the degrees of freedom.

See Table 1 at end of document

The variables for the cost and profit functions are defined in Table 2.

See Table 2 at end of document

The descriptive statistics in Table 3 review the data characteristics before the translog regressions are estimated.

See Table 3 at end of document

From Table 3, we note that there are no significant outliers in the transformed data as this is particularly important if the translog function is to perform well without incorporating the Fourier-flexible component. The mild skewness reflects normal distribution character of the data. The relatively high Jarque-Bera is because of the large number of observations. The kurtosis measure is generally above 3 which suggests a high pitched distribution.

The correlation analysis (See Table 4) shows that the natural logarithms of deposits (Q1) and loans (Q2), and deposits (Q1) and other investments (Q3), have correlation coefficients of more than 0.8. This is not surprising because loans and other investments are normally driven by deposits. Under normal circumstances, this creates a problem of multicollinearity. Notwithstanding this inherent shortcoming of the translog model, other researchers have found that it still generates acceptable estimates of x-inefficiency.

See Table 4 at end of document

Panel data is susceptible to autocorrelation because it combines cross-section and time series. This leads to inefficient estimators as variances tend to be larger, thus rendering t and F tests unreliable. It is therefore recommended to carry out stationarity tests to assess the effect of data characteristics on the results generated. However, in the context of the translog model, this is not a critical issue since we are not estimating parameters. Nevertheless, we test for stationarity as a routine procedure and find that each of the explanatory variables is stationary in at least one of the two tests (Augmented Dickey-Fuller and Phillips-Perron tests: see Table 5)

See Table 5 at end of document

4.2 Estimating x-inefficiency

We follow a two step approach to estimating x-inefficiency. First, we run a system of seemingly unrelated regressions (SURE) to estimate the cost and profit translog functions as specified in equations (15) and (16) respectively, incorporating the share equation (17). Gujarati (1995) justifies the use of SURE (also known as Zellner after its pioneer) for estimating simultaneous equations because their error terms may be contemporaneously correlated. SURE improves efficiency of the estimators although the regressions may be seemingly unrelated, and the results are therefore better than if each of the regressions were estimated separately.

The second step is to derive the error term, and extract x-inefficiency. In the case of the distribution free approach (DFA), the average of the error term per bank over the period reported is the inefficiency measure. However, the stochastic frontier approach (SFA) is more involved. We follow the fixed effects model specified in (21), and regress the error term against HHI for each country using OLS technique. We then identify the bank with the lowest x-inefficiency which becomes the benchmark as the best practice bank. X-inefficiency for the other banks is computed using models (10) and (12) for the cost and profit functions respectively. The descriptive statistics of x-inefficiency measures are shown in Table 6 reveal that profit inefficiency is generally higher than cost inefficiency which is not surprising, since the former incorporates both costs and revenue. What is striking, however, is that cost side inefficiencies are almost twice as high as the revenue side

See Table 6 at end of document

The tests for equality (See Table 7) show that the F-statistics in both cases is insignificant at 1% and 5%, which means that the x-inefficiency derived using DFA and SFA are not significantly different, and that either method gives comparable results.

See Table 7 at end of document

4.3 Testing the hypotheses

Finally, the x-inefficiency scores obtained are used to test hypotheses against selected explanatory variables defined in Table 8.

See Table 8 at end of document

As for the previous section, we test for correlation (See Table 9) before running the regressions. We note that the most serious correlation is between size and market share at 0.95. We opt to drop size for two reasons. First, we need to retain market because it is one of the key variables in testing the market power hypothesis. Secondly, size can be captured by an alternative variable, total assets.

See Table 9 at end of document

Unlike in the case for the translog model where stationarity was of secondary importance, it is critical in hypotheses testing because we are estimating parameters, and therefore it is imperative to ensure the efficiency of estimators is not curtailed by large variances due to non-stationary variables. The results in Table 10 are based on

Augmented Dickey-Fuller procedure to test for stationarity. The results indicate that all the variables are stationary, most of them at 1% significance, with only three and one at 5% and 10% significance, respectively.

See Table 10 at end of document

The market power and efficient structure hypotheses: If market power causes inefficiency, then the market power hypothesis holds. On the other hand, if efficiency causes market power, the efficient structure hypothesis holds. Since the basis of these "twin" hypotheses is causality, we find it appropriate to run granger-causality tests between inefficiency and market concentration or market share, and vice versa. The results are given in Table 11.

See Table 11 at end of document

Although almost all results are insignificant, we find some significant causation between PINEFFS and SHHI based on 5 lags, which is barely significant at 10%, suggesting that profit inefficiency (or efficiency) causes market concentration. The interpretation of this result supports the efficient market hypothesis, and thus rejects the market power hypothesis. However, the Granger-causality test is inconclusive for two main reasons. First, although it indicates the direction of causation, the sign of relationship, whether positive or negative, is not provided. If the efficient structure hypothesis holds, then the assumed relationship between PINEFFS and SHHI would be negative. Secondly, the choice of the ideal number of lags is subjective. The greater the number of lags, the longer the term of relationship and causation. Due to these shortcomings, further investigations are therefore necessary, before any firm conclusions can be drawn from Granger-causality tests. We therefore regress SHHI as a dependent variable against a number of explanatory variables, including PINEFFS which we find significant at 1% with a negative sign as expected. (See Table 12).

See Table 12 at end of document

Bad Luck and Bad management hypotheses: Following DeYoung (1997), we carry out Granger causality tests between cost inefficiency (CINEFFS) and asset quality (BASQ), and do not find any significant causality relationship. However, when CINEFFS is regressed against selected explanatory variables, including BASQ, it is significant with a positive sign at 5%, which suggests that deterioration of asset quality causes cost inefficiency, hence supporting the bad luck hypothesis. The interpretation of results becomes more complicated when we switch asset quality to become the dependent variable in the regression so that cost inefficiency is one of the explanatory variables. Cost inefficiency is significant at 1% with a positive sign, which could be interpreted that cost inefficiency leads to deterioration of asset quality, thus supporting the bad management hypothesis. (See Table 11).

See Table 13 at end of document

But Gujarati (1999) warns that statistical relationships in regressions do not necessarily establish causation, however strong they may appear, but merely offer some predictive relationship. He argues that causation is derived from some established theoretical postulation. Furthermore, the interpretation of these results ought to be considered in the context of short and long-term relationships. The Granger causality, if applied with sufficient lags, is about long-term phenomenon, whereas the regression is more short to medium term.

The results do not reveal any discernible long-term pattern of causation between asset quality and cost inefficiency, to confirm or reject either the bad luck or bad management hypothesis. Following Gujarati (1995), the insignificant F-statistics in both directions suggest independent relationship between cost inefficiency and asset quality deterioration, which implies that bad luck and bad management hypotheses are not necessarily dichotomous, but could exist either singularly or simultaneously.

5 CONCLUSION

We find, as expected, that profit inefficiencies are higher than cost inefficiencies, since the former is a composite of cost and revenue inefficiencies. However, decomposition of the profit inefficiency reveals that the cost side is twice as large as the revenue side. This suggests 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 cost side rather than the revenue side, the higher cost inefficiency reflects their cost preference behaviour which tends to subjugate the shareholders' best interests, thus increasing agency costs. There are three policy perspectives to the cost-revenue fulcrum of inefficiency. The first one is that regulators should take greater interest in internal controls and budgetary performance reports, in addition to the traditional focus on the asset quality, capital adequacy and liquidity indicators. Although regulators receive performance reports on regular basis, and carry out on-site and off-site surveillance, this could be reinforced by strict corporate governance codes. Secondly, the cost preference behaviour could be a manifestation of information asymmetry. Policy makers should institute and enforce financial reporting standards, which are transparent to ameliorate the agency costs. But this is a long-term objective, which entails collaboration with other institutions such as the accounting profession. Therefore as an interim measure, policy makers should consider vetting accounting firms that perform the function of external auditing. Thirdly, it would be inappropriate to assume that all cost-side inefficiencies are "self-inflicted" by management, and therefore the contributory exogenous factors, including the role of regulation, should be analysed.

The Granger-causality tests suggest that a decrease in inefficiency (or increase in efficiency) causes higher market concentration, which thus support the efficient structure hypothesis. According to this hypothesis, policy makers should not curtail the emergence of concentrated markets because they are inherently more efficient, and transfer the benefits to society in general and to the customers in particular. Instead, inefficient banks should either be closed or taken over by the efficient ones. In the context of Sub Sahara Africa, it is plausible to argue that the generally small size of the commercial banking market compared to the industrialised countries makes smaller banks unviable because they find it difficult to break even, and hence the justification for higher market concentration. On the other hand, although the results do not directly lend credence to the diametrical market power hypothesis, there is no firm evidence to suggest that it can not co-exist with efficient structure hypothesis. From policy perspective, it would thus be inappropriate to assume that every anti-trust measure increases inefficiency. Therefore selective policy and careful balance between deregulation and market control should be adopted. While free competition should be encouraged, the size of the market has to be taken into account. Countries with small markets should strengthen few banks, which can remain viable according to the volume of business available, without necessarily protecting inefficient ones. The mixed approach is easier said than done, because striking the right balance is not easy, but policy makers should nevertheless strive to achieve an optimum position by avoiding extreme positions.

The causality tests neither confirm nor reject both the bad luck and bad management hypotheses. However, the cost preference behaviour of managers is evidence to support the agency theory and corroborates bad management rather than bad luck hypothesis despite inconclusive granger causality results. We conclude that although the two hypotheses are not mutually exclusive, they are independent of each other, but bad management seems to be more dominant. Policy should therefore be designed to tackle both of them simultaneously with greater emphasis on management.

Bad luck, for example, can be mitigated through controlling sector and borrower concentration exposures, and policy should specify appropriate limits. In particular, the experience from South East Asia suggests that sectoral concentrations tend to grow during boom times, regulators should particularly be vigilant even where certain sectors appear to be extremely profitable. The dot.com experience in Europe also confirms that such booms are short lived, and when the bubble busts, lenders face catastrophic losses.

Bad management can be mitigated through corporate governance, internal controls and accountability to shareholders. For instance, separating the roles of Board chairman and the chief executive, introducing audit and remuneration committees composed of non-executive directors, nurturing a strong and independent internal audit function, could enhance transparency and strengthen internal controls. The performance of directors and senior management should be evaluated regularly, and prompt corrective action, such as removal of incompetent or dishonest officials should be implemented without forbearance. In case of new banks, proposed management must be vetted as part of the licensing procedure.

Last but not least, legislation should provide for criminal and civil prosecution of directors and managers, proven to have acted incompetently or fraudulently. This will mitigate the adverse incentive effect. This could be extended to cover aspects of connected lending activities arising from the borrowing entities. This can be detrimental to financial sector stability because banks do not apply the required appraisal standards when lending to related companies. The policy dimension to mitigate connected activities, is to curtail cross board membership. The law should restrict companies to borrow from banks with which they share a specified number of directors or persons closely connected to them. Mechanisms should be designed to detect disguised connections, and deterrent punitive measures should be included in the legislation to prosecute with those who violet the restrictions.

Table 1: The sample countries

Country	Number of Banks
1. Botswana	5
2. Ghana	9
3. Kenya	22
4. Lesotho	2
5. Malawi	3
6. Namibia	5
7. Nigeria	35
8. Swaziland	4
9. Zambia	4
Total	*89*

Source: Computed by the author from *Bankscope*

Table 2

Dependent Variables		
TC	Total cost	Operating + interest + personnel + overheads
? +?	Profit	Net profit + constant
Independent Variables		
Q1	Output 1	Deposits in US dollars
Q2	Output 2	Total loans in US dollars
Q3	Output 3	Other investments in US dollars
P1	Input 1: price	Total operational expenses ? total assets
P2	Input 2: price	Total interest expenses ? total deposits
P3	Input 3: price	Total personnel expenses ? total assets
P4	Input 4: price	Total overheads ? total assets
S1	Input 1: Share	Total operating expenses ? total costs
S2	Input 2: Share	Total interest expenses ? total costs
S3	Input 3: Share	Total personnel expenses ? total costs
S4	Input 4: Share	Total overheads ? total costs

Table 3: Descriptive statistics

	LOG(P1)	LOG(P2)	LOG(P3)	LOG(P4)	LOG(Q1)	LOG(Q2)	LOG(Q3)
Mean	-1.55	-2.43	-3.80	-2.75	11.45	10.88	10.87
Median	-1.81	-2.44	-3.73	-2.76	11.56	10.90	10.97
Maximum	0.00	4.37	-1.80	-1.06	15.15	14.17	14.92
Minimum	-2.20	-6.61	-10.93	-5.19	3.71	1.10	5.41
Std. Dev.	0.65	0.76	0.95	0.48	1.39	1.49	1.45
Skewness	1.39	1.80	-3.22	-0.07	-0.71	-1.23	-0.34
Kurtosis	3.55	25.55	19.36	5.33	5.52	8.48	3.64
Jarque-Bera	102.98	6670.87	3953.19	69.58	106.75	461.71	10.97
Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	307	307	307	307	307	307	307

Table 4: Correlation matrix of the translog variables

	LOG(P1)	LOG(P2)	LOG(P3)	LOG(P4)	LOG(Q1)	LOG(Q2)	LOG(Q3)
LOG(P1)	1.00						
LOG(P2)	-0.12	1.00					
LOG(P3)	-0.13	0.00	1.00				
LOG(P4)	-0.16	-0.04	0.29	1.00			
LOG(Q1)	-0.11	-0.50	0.02	-0.09	1.00		
LOG(Q2)	-0.18	-0.20	0.06	-0.05	0.85	1.00	
LOG(Q3)	-0.03	-0.34	0.00	0.03	0.83	0.71	1.00

Table 5: Stationarity results

Variable	Test	Intercept + Trend t-statistic	Intercept t-statistic	None t-statistic
LOG(P1)	ADF	-4.099228 ***	-4.129149 ***	-0.609823
	PP	-14.616360 ***	-14.524800 ***	-3.967063 ***
LOG(P2)	ADF	-3.870997 **	-4.200769 ***	-0.730380
	PP	-11.444710 ***	-10.720760 ***	-1.357797
LOG(P3)	ADF	-1.028530	-1.313390	0.482325
	PP	-3.948159 **	-3.979140 ***	0.231380
LOG(P4)	ADF	-2.199497	-1.748951	2.364647 **
	PP	-1.889636	-1.403750	2.959200 ***
LOG(Q1)	ADF	-2.389576	-2.328587	-1.166032 *
	PP	-4.146960 ***	-4.095859 ***	-2.567877 **
LOG(Q2)	ADF	-1.279421	-1.197791	-0.993683
	PP	2.432302	2.361893	-4.712204 ***
LOG(Q3)	ADF	-2.808927	-2.895271 **	-0.768144
	PP	-3.863469 **	-3.861525 ***	-1.795849

Notes: ADF Augmented Dickey Fuller Test
PP Phillips-Perron Test

*** 1% Level of significance
** 5% Level of significance
* 10% Level of significance

Table 6: Descriptive Statistics of x-inefficiency

	DFACOST	SFACOST	DFAPROFIT	SFAPROFIT
Mean	20.25582	19.28643	33.46510	33.64627
Median	20.47019	19.22322	34.29631	34.43725
Maximum	42.39477	39.60966	60.45278	59.99389
Minimum	0.000000	0.000000	0.000000	0.000000
Std. Dev.	6.611879	6.508377	7.803044	7.701402
Skewness	0.213978	0.214675	-0.876920	-0.903132
Kurtosis	3.491629	3.633730	6.558330	6.695169
Jarque-Bera	5.133561	7.080299	190.1635	204.4120
Probability	0.076782	0.029009	0.000000	0.000000
Observations	290	290	290	290

Note:

DFACOST = Cost x-inefficiency based on the Distribution Free Approach
SFACOST = Cost x-inefficiency based on the Stochastic Frontier Approach
DFAPROFIT = Profit x-inefficiency based on the Distribution Free Approach
SFAPROFIT = Profit x-inefficiency based on the Stochastic Frontier Approach

Table 7: Tests of equality between means

Null Hypothesis	Statistic	Value	Probability
DFACOST=SFACOST	Anova F-statistic	3.736	0.0537
DFAPROFIT=SFAPROFIT	Anova F-statistic	0.072	0.7879

Table 8

Dependent Variables

PINEFFS Profit x-inefficiency based on SFA
CINEFFS Cost x-inefficiency based on SFA

Independent Variables

BASQ Problem loans to Total loans, % (Asset quality)
BCAP Equity to net loans, % (Capital ratio)
BEQA Equity to total assets, %
BLIQ Liquid assets to customer and short term funds, %
BMKT Market shares, %, by loans and deposits equally weighted
BPR Profit in US $
BROA Return on Assets, %
BSTA Ownership status, 0 for domestic and 1 for foreign
BSZE Bank assets to total assets in banking sector, % (Size)
BTTA Total assets in US $
SFPA Foreign penetration, %
SGDPC Per capita GDP
SGDPR GDP growth rate
SHHI Market concentration index, %
SINT Real interest rate, % (lending)

Note: Variables beginning with "B" are bank-specific
Variables beginning with "S" are systematic

Table 9: The correlation matrix

	BASQ	BCAP	BEQA	BLIQ	BMKT	BPR	BROA	BSTA	BSZE	BTTA	SFPA	SGDPC	SGDPR	SHHI	SINT
BASQ	1.00														
BCAP	-0.54	1.00													
BEQA	0.14	0.14	1.00												
BLIQ	0.25	0.18	0.11	1.00											
BMKT	-0.20	-0.09	-0.16	-0.39	1.00										
BPR	-0.12	0.07	-0.09	0.24	0.03	1.00									
BROA	-0.16	0.21	0.35	0.23	0.06	0.40	1.00								
BSTA	-0.10	-0.06	0.19	-0.41	0.51	-0.18	0.07	1.00							
BSZE	-0.18	-0.07	-0.19	-0.34	0.95	0.14	0.06	0.45	1.00						
BTTA	0.02	0.00	-0.23	0.09	0.07	0.66	-0.03	-0.24	0.24	1.00					
SFPA	-0.19	-0.14	0.07	-0.62	0.67	-0.25	-0.04	0.66	0.62	-0.20	1.00				
SGDPC	-0.27	-0.19	-0.18	-0.60	0.42	-0.10	-0.13	0.45	0.39	-0.04	0.74	1.00			
SGDPR	0.11	-0.14	-0.05	0.01	-0.04	0.14	-0.01	-0.04	0.05	0.11	-0.05	0.08	1.00		
SHHI	0.07	-0.13	0.05	-0.31	0.72	-0.26	0.10	0.65	0.63	-0.25	0.73	0.34	-0.13	1.00	
SINT	0.13	0.14	0.27	0.18	0.12	-0.09	0.24	0.16	0.11	-0.13	0.03	-0.42	-0.03	0.26	1.00

Table 10: Stationarity results

Variable	Test	t-stastic
BASQ	ADF	-6.499456 ***
BCAP	ADF	-7.850325 ***
BEQA	ADF	-6.286818 ***
BLIQ	ADF	-4.089157 ***
BMKT	ADF	-3.276629 **
BPR	ADF	-5.635645 ***
BROA	ADF	-6.297731 ***
BSTA	ADF	-3.797499 ***
BSZE	ADF	-4.511960 ***
BTTA	ADF	-5.555347 ***
SFPA	ADF	-2.613557 ***
SGDPC	ADF	-3.519601 ***
SGDPR	ADF	-2.667300 *
SHHI	ADF	-3.074730 **
SINT	ADF	-3.013545 **

Note: ADF Augmented Dickey Fuller Test

*** 1% Level of significance
** 5% Level of significance
* 10% Level of significance

Table 11: Granger Causality Tests

Pairwise Granger Causality Tests Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Probability
SHHI does not Granger Cause PINEFFS	263	0.25619	0.77419
PINEFFS does not Granger Cause SHHI		1.50402	0.22418

Pairwise Granger Causality Tests Lags: 5			
Null Hypothesis:	Obs	F-Statistic	Probability
SHHI does not Granger Cause PINEFFS	244	0.19523	0.96413
PINEFFS does not Granger Cause SHHI		1.87133	0.10015

Pairwise Granger Causality Tests Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Probability
BMKT does not Granger Cause PINEFFS	238	0.35543	0.70125
PINEFFS does not Granger Cause BMKT		1.24245	0.29058

Pairwise Granger Causality Tests Lags: 5			
Null Hypothesis:	Obs	F-Statistic	Probability
BMKT does not Granger Cause PINEFFS	203	1.04745	0.39112
PINEFFS does not Granger Cause BMKT		0.72547	0.60510
SHHI does not Granger Cause PINEFFS	244	0.19523	0.96413
PINEFFS does not Granger Cause SHHI		1.87133	0.10015

Table 12: Determinants of SHHI

Dependent Variable: SHHI
Method: Least Squares
Included observations: 141

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BASQ	0.213053	0.051135	4.166510	0.0001
BCAP	0.019992	0.019174	1.042679	0.2990
BEQA	-0.078061	0.134965	-0.578384	0.5640
BLIQ	0.000876	0.014797	0.059178	0.9529
BMKT	0.468571	0.041949	11.17006	0.0000
BPR	-0.000227	8.09E-05	-2.811206	0.0057
BSTA	7.092736	1.363248	5.202823	0.0000
BTTA	-1.66E-06	1.41E-06	-1.181321	0.2396
PINEFFS	-0.257408	0.093852	-2.742688	0.0070
SGDPR	-0.291306	0.169892	-1.714647	0.0888
SINT	0.051029	0.050398	1.012508	0.3132
C	20.36284	4.077417	4.994054	0.0000

R-squared	0.758268	Mean dependent var	20.23753
Adjusted R-squared	0.737655	S.D. dependent var	11.86305
S.E. of regression	6.076209	Akaike info criterion	6.527904
Log likelihood	-448.2172	F-statistic	36.78623
Durbin-Watson stat	0.446333	Prob(F-statistic)	0.000000

Table 13: Testing bad luck and bad management hypotheses

Dependent	CINEFFS	BASQ
CINEFFS	NA	2.100444** (0.138328)
BASQ	2.100444*** (0.052610)	NA
BCAP	-1.011520 (0.018331)	-9.138689*** (0.023386)
BEQA	-0.888617 (0.135143)	2.590422** (0.214444)
BLIQ	1.206677 (0.015739)	1.855686* (0.025335)
BMKT	-0.603950 (0.056473)	-3.146769*** (0.088464)
BPR	0.884409 (0.000057)	-2.824327*** (0.000096)
BSTA	1.065881 (1.468761)	-1.009444 (2.382671)
BTTA	-0.573964 (0.000024)	3.450891*** (0.000019)
BFPA	0.914308 (0.036263)	-1.171293 (0.058683)
SGDPC	0.078829 (0.001423)	-1.127057 (0.002296)
SGDPR	-0.632961 (0.163578)	1.608194 (0.293099)
SHHI	-0.700723 (0.090958)	4.359000*** (0.138219)
SINT	-0.483614 (0.046849)	0.409245 (0.075986)

Note: Significance: *** = 1%; ** = 5%; * = 10%
Standard errors in parenthesis below the estimated coefficients.

References:

Allen, L and A. Rai, 1996. Operational efficiency in banking: An international comparison. *Journal of Banking & Finance*, 20, 655 – 672.

Bauer, P., A. N. Berger and B. D. Humphrey, 1993. Efficiency and productivity growth in US banking. The measurement of productive efficiency: Techniques and applications, *Oxford University Press*, Oxford – Edited by: Fried, H. O., C. A. K. Lovell and S. S. Schemidt

Berger, A. N., 1995. The profit-structure relationship in banking – Tests of market power and efficient structure hypotheses. *Journal of Money, Credit and Banking*, 27, 404 – 431.

Berger, A. N and R. DeYoung, 1997. Problem loans and cost efficiency in commercial banks. *Journal of Banking & Finance*, 21, 849 – 870.

Berger, A. N and T. H. Hannan, 1989. The price concentration relationship in banking. *Review of Economics and Statistics*, 71, 291 – 299.

Berger, A. N and B. D. Humphrey, 1997. Efficiency in financial institutions: International survey and directions for future research. *European Journal of Operational Research*, 98, 175 – 212.

Berger, A. N and W. C. Hunter and S. G. Timme, 1993. Efficiency in financial institutions: A review and preview of research, past, present and the future. *Journal of Banking & Finance*, 17, 221 – 249.

Berger, A. N., J. H. Leusner and J. J. Mingo, 1997. The efficiency of bank branches. *Journal of Monetary Economics*, 40, 141 – 162.

Berger, A. N and L. J. Mester, 1997. Inside the black box: What explains differences in the efficiencies of financial institutions? *Journal of Banking and Finance*, 21, 895 – 947

Brownbridge, M., 1998. Financial distress in local distress in local banks in Kenya, Nigeria, Uganda and Zambia – Causes and implications for regulatory policy. *Development Policy Review*, Vol 16 No.2 June 1998, *Blackwell*, London.

Brownbridge, M. and C. Kirkpatrick, 1999a. Financial distress in local distress in local banks in Kenya, Nigeria, Uganda and Zambia – Causes and implications for regulatory policy. Presented to *Finance and Development Research Workshop* 9-10 July 1999, Manchester, UK.

Brownbridge, M. and C. Kirkpatrick, 1999b. Financial regulation in developing countries: A critical survey. Presented to *Finance and Development Research Workshop* 9-10 July 1999, Manchester, UK.

Brownbridge, M. and C. Kirkpatrick, 1999c. Commercial bank restructuring and reform in Sub Saharan Africa. Presented to *Finance and Development Research Workshop* 9-10 July 1999, Manchester, UK.

Brownbridge, M. and C. Kirkpatrick, 1999d. Financial sector regulation: The lessons of the Asian crisis. *Development Policy Review*, September.

Cebenoyan, A. S., E. S. Cooperman, C. Register, and S. Hudgins, 1993. The relative efficiency of stock versus mutual S & L: A stochastic frontier approach, Working Paper, *University of Baltimore*.

Chaffai, M. E., 1997. Estimating input-specific technical efficiency: The case for Tunisian banking industry. *European Journal of Operational Research*, 98, 175 – 212.

Cooper, W. W., A. N. Berger, P. L. Brocket and J. T. Pastor, 1997. New approaches to analysing and evaluating the performance of financial institutions. *European Journal of Operational Research*, 98, 170 – 174

DeYoung, R., 1998. Management quality and x-inefficiency in national banks. *Journal of Financial Services Research,* 13(1), 5 – 22.

DeYoung, R., 1997. A diagnostic test for the distribution-free efficiency estimator: An example using US commercial bank data. *European Journal of Operational Research,* 98, 243 - 249.

Dietsch, M., and A. Lozano-Vivas, 2000. How environment determines banking efficiency: A comparison between French and Spanish industries. Journal of Banking and Finance, 24, 985 – 1004.

Drake, L., 1992. Economies of scale and scope in UK building societies: An application of the translog multi-product cost function. *Applied Financial Economics,* 2, 211 – 219.

Esho, N and I. G. Sharpe, 1994. Scale and scope economies of Australian permanent building societies in dynamic framework. *Asia Pacific Journal of Management*, 11, 255 – 273.

Fetcher, F., 1993. Efficiency and competition in O.E.C.D. financial services. (Chapter 15). *The measurement of productive efficiency: Techniques and applications, Oxford University Press,* Oxford – Edited by: Fried, H. O., C. A. K. Lovell and S. S. Schemidt.

Fry, J. M., 1995. Money, interest, and banking in economic development, 2nd Edition. *The John Hopkins University Press,* Baltimore.

Goldberg, L. G and A. Rai, 1996. The structure – performance relationship for European banking. *Journal of Banking and Finance*, 20, 745 – 771.

Grabowski, R., N. Rangan, R. Rezvanian, 1993. Organisational forms in banking: An empirical investigation of cost inefficiency. *Journal of Banking and Finance,* 17, 531 – 538.

Green, W. H., 1993. The econometric approach to efficiency analysis. (Chapter 2). *The measurement of productive efficiency: Techniques and applications*, *Oxford University Press*, Oxford – Edited by: Fried, H. O., C. A. K. Lovell and S. S. Schemidt.

Grosskopf, S., 1993. Efficiency and productivity. (Chapter 4). *The measurement of productive efficiency: Techniques and applications*, *Oxford University Press*, Oxford – Edited by: Fried, H. O., C. A. K. Lovell and S. S. Schemidt.

Hasan, I. And K. Marton, 2000. Development and efficiency of the banking sector in a transitional economy: Hungarian experience. *Bank of Finland, Institute for Economies in Transition,* Discussion Paper.

Hermalin, B. E. and N. E. Wallace, 1994. The determinants of efficiency and solvency in savings and loans. *Rand Journal of Economics*, 25, 361 – 381.

Humphrey, D. B. and L. B. Pulley, 1997. Banks' responses to deregulation: Profits, technology and efficiency. *Journal of Money, Credit and Banking*, 73 – 93.

King, R. G. and R. Levine, 1993a. Finance and growth: Schumpter might be right. *Quarterly Journal of Economics*, Vol 108 pp 717-737.

King, R. G. and R. Levine, 1993b. Finance, enterprenuership and growth: Theory and evidence. *Journal of Monetary Economics*, Vol 32 pp 513-542.

Kraft, E. and D. Tirtiroglu, 1998. Bank efficiency in Croatia: A stochastic-frontier analysis. *Journal of Comparative Economics*, 26, 282 – 300.

Leibestein, H., 1966. Allocative efficiency vs x-inefficiency. *American Economic Review*, 56, June.

Lovell, C. A. K., 1993. Efficiency and productivity. *The measurement of productive efficiency: Techniques and applications*, pp 3 – 67, *Oxford University Press*, Oxford – Edited by: Fried, H. O., C. A. K. Lovell and S. S. Schemidt.

Lozano, A. 1997. Profit efficiency for Spanish savings banks. *European Journal of Operational Research*, 98, 382 – 395.

Maimbo, S. M., 1999. Bank failures in Tanzania, Uganda and Zambia. Presented to *Finance and Development Research Workshop*, 9-10 July, 1999 Manchester, UK.

Mester, L. J., 1997. Measuring efficiency at US banks: Accounting for heterogeneity is important. *European Journal of Operational Research*, 98, 230 – 242.

Mester, L. J., 1996. A study of bank efficiency taking into account risk preferences. *Journal of Banking and Finance*, 20, 1025 – 1045.

Murinde, V., 1996. Development Banking & Finance. *Ashgate Publishing,* Vermont.

Newman, J and R. Shrieves, 1993. Multibank holding effect on cost efficiency in banking. *Journal of Banking and Finance,* 17, 709 – 732.

Okeahalam, C. C., 1999. Costs and efficiency in Botswana commercial banking. *Journal of Econometrics*, 23, 53 – 72.

Okeahalam, C. C., 1998. An analysis of price-concentration relationship in the Botswana commercial banking industry. *Journal of African Finance and Economic Development*, 3, 65 – 84.

Pi, L. and S. G. Timme, 1993. Corporate control and bank efficiency. *Journal of Banking and Finance,* 17, 515 – 530.

Popiel, P. A., 1994. Financial systems in Sub-Sahara Africa: A comparative study. *World Bank Discussion Paper No. 260.*

Stiglitz, J. E., 1998. Knowledge for development: Economic science, economic policy and economic advice. *10th Annual World Bank Conference on Development Economics.*

Stiglitz, J. E., 1994. The role of the state in financial markets. In Proceedings of *World Bank Conference on Development Economics, 1993.* World Bank, Washington.

Stiglitz, J. E., 1989. Financial markets and development. *Oxford Review of Economic Policy*, 5(4): pp 55-68

Stiglitz, J. E. and A. Weiss, 1981. Credit rationing in markets with imperfect information. *American Economic Review of Economic*, 71: pp 393-410.

Tefula, M., 2001. Evaluating the performance of commercial banks in Sub-Sahara Africa, Unpublished PhD thesis, *The University of Birmingham.*

Worthington, A. C., 1998. Efficiency in Australian building societies: An econometric cost function approach using panel data. *Applied Financial Economics*, 8, 459 – 467.