PRIVATE COMMERCIAL BANKS IN ETHIOPIA: EFFICIENCY ANALYSIS

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Abstract

In this paper the market structure of commercial banks in the economy is examined using the Herfindahl Index. The market is found highly concentrated especially in total assets and deposits towards public banks, especially the Commercial Bank of Ethiopia. The article has also tried to analyze cost efficiency of six private commercial banks operating in Ethiopia. The efficiency analysis is made using quarterly panel data from the first quarter of fiscal year 1997/98 to the second quarter of 2005/06 and employing the Stochastic Frontier Analysis. The cost efficiency result of the banks under review shows an improvement from time to time during the period. During the first two quarters of 2005/06 on average the banks were found producing for Birr 1.101 an output that can efficiently be produced for Birr 1.0. From the firm specific determinants of efficiency, size of banks (measured by total assets and branch network) and age are found negatively related while capital is found to positively affect efficiency of the banks.

1. Introduction

It is widely believed that efficiency in the banking sector is crucial for economic growth as it has a direct impact on the productivity of all the other sectors in the economy.

Stable growth, in the context of developing economies, requires that the economy be put on a path of higher savings and further ensuring that these savings are channeled into productive investment. In this scheme of growth, the banking system has a dual

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role to play. It is a mobilizer of savings as well as an allocator of credit for production and investment. Effectiveness of the banking sector's contribution to the economic growth and development is broadly determined by its efficiency in the allocation of the mobilized savings amongst competing projects (Misra 2003).

Inclusion of inefficiencies into economic analysis is attractive for several reasons. First, it helps to identify which producers are inefficient and to what extent. Once the inefficient firms are identified policies will be designed to promote efficiency and can be made more effective by directing the necessary help to those who are in the greatest need of assistance. Second, after recognizing the presence of inefficiency; it is natural to examine factors responsible for inefficiency, i.e., identification of determinants of inefficiency. When some explanatory factors are found, programs can be designed and support can be directed to the needy producers to achieve maximum effectiveness (Kumbhakar and Sarkar 2004).

In this paper we explore the extent of concentration of the commercial banking market in Ethiopia using the Herfindahl Index (HI) and the cost efficiency of private commercial banks operating in Ethiopia using stochastic frontier analysis (SFA). By employing the SFA method we will see the impacts of branch expansion, asset size, age, and capital size on the cost efficiency of private commercial banks operating in Ethiopia.

It is hypothesized that concentration in the commercial banking industry in Ethiopia is very high but declining from time to time. The concentration is uniquely significant in total assets and demand deposits and is comparatively lower in loan disbursement and collection.

It is also hypothesized that branch expansion and asset size have a negative impact on the cost efficiency of the banks while age and capital size have a positive impact. As the asset size and number of branches of banks expands attention of the management may divert from cost minimization and focuses on other routine administrative activities. As the age of the bank increases it accumulates management expertise and would increase efficiency. Banks with higher level of capital have the legal right to let single borrower use a higher amount of money and then they reduce their transaction costs[2]. In addition, higher capital connotes more fund is available to lend to borrowers without borrowing from other sources that require incurrence of additional costs.

The Herfindahl Index is calculated on some major indicators of the commercial banking market in Ethiopia. The stochastic frontier analysis focuses on cost efficiency of private commercial banks operating in Ethiopia only. All the data used here is obtained from Supervision, and Economic Research and Monetary Policy Directorates of National Bank of Ethiopia.

2. Literature Review

2.1. Background

Though the importance of efficient use of resources has long been recognized, mainstream neoclassical paradigm in economics assumes that decision-making units in an economy always operate efficiently. Nevertheless, these decision makers are not always efficient. Two firms that are identical in all aspects never produce the same output, and costs and profit are not the same. This output, cost and profit variation can be clarified in terms of technical and allocative inefficiencies, and some other unforseen exogenous shocks. A firm is said to be technically inefficient if it fails to produce the maximum possible output from a given set of inputs. And on the other hand, a cost minimizing or profit-maximizing firm is allocatively inefficient if it fails to allocate the inputs optimally, given the prices of the inputs and outputs. Both inefficiencies are costly in the sense that increase (decrease) cost (profit) arises due to these inefficiencies. Costs of these inefficiencies are also reflected in lower productivity of inputs. That means productivity growth will be lower in the presence of any one, or both, of these inefficiencies (Kumbhakar and Sarkar 2004).

2.2. Efficiency Concepts

Many economists have exerted their efforts in searching for optimal decisions resulting in efficient allocation of resources. But the problem is how to measure the efficiency. Practically it is impossible to know the frontier of a fully efficient firm;

[2] National Bank of Ethiopia directive number SBB/29/2002 limits the aggregate loan or extension of credit by any commercial bank to any single borrower at a maximum of 25 percent of the total capital of the bank.

however, it is estimated from observations on a sample of firms in that industry (Coelli, Rao and Battese 1998). For many years, substantial research effort has gone into measuring the efficiency of financial institutions, particularly commercial banks. The research focused mainly on estimating an efficient frontier and measuring the average differences between observed banks and banks on the frontier (Berger and Mester 1997a).

Many studies have discovered large inefficiencies, on the order of 20 percent or more of total banking industry costs, and about half of the industry's potential profits. Results of the efficiency estimates often vary substantially across studies according to the data source, as well as the efficiency concepts and measurement methods used. Berger and Humphrey (1997) documented 130 studies of financial institutions' efficiency, using data from 21 countries, from multiple time periods, and from various types of institutions including banks, bank branches, savings and loans, credit unions, and insurance companies. These variations in the data sets from which efficiencies are measured make it virtually impossible to determine how important the various efficiency concepts, measurement techniques and correlates used are to the outcomes of these studies (Berger and Mester 1997a).

Berger and Mester (1997a) employed three distinct efficiency concepts, using a number of different measurement methods, and applying comprehensive set of potential efficiency correlates to a single data set. The efficiency concepts employed were - standard profit efficiency, alternative profit efficiency and cost efficiency to estimate the efficiency of 6,000 U.S. commercial banks over six year period of 1990-95.

Cost efficiency gives a measure of how close a bank's cost is to what a best practice bank's cost would be for producing the same output bundle under same conditions. It is derived from a cost function in which variable costs depend on the prices of variable inputs, the quantities of variable outputs and any fixed inputs or outputs, environmental factors, and random error, as well as efficiency (Berger and Mester 1997a). Such a standard cost function can be modeled as:

$$C = C(y, w, z, \Delta, \psi_c, \phi_c), \qquad \textbf{(1)}$$

where c measures variable costs, w is the vector of prices of variable inputs, y is the vector of quantities of variable outputs, z indicates the quantities of any fixed netputs (inputs or outputs), which are included to account for the effects of these netputs on variable costs owing to substitutability or complementarily with variable netputs, Δ is a set of environmental or market variables that may affect performance, ψ_c denotes an inefficiency factor that may raise costs above the best-practice level, and ϕ_c denotes the random error that incorporates measurement error and chances that may temporarily give banks high or low costs. The inefficiency factor ψ_c incorporates both allocative inefficiencies from failing to react optimally to relative prices of inputs, w, and technical inefficiencies from employing too much of the inputs to produce y (Berger and Mester 1997a).

Technically it is also possible to formulate an alternative cost function by replacing the input price variable, w, with input quantity variable, X. Such an alternative cost function can be specified as:

$$C = C(y, X, z, \Delta, \psi_c, \phi_c) \tag{2}$$

Standard profit efficiency measures how close a bank is to producing the maximum possible profit given a particular level of input prices and output prices (and other related variables). Unlike the cost function, the standard profit function specifies variable profits in place of variable costs and takes variable output prices as given, rather than holding all output quantities statistically fixed at their observed, possibly inefficient, levels. That is, the profit dependent variable allows for consideration of revenues that can be earned by varying outputs as well as inputs. Output prices are taken as exogenous, allowing for inefficiencies in the choice of outputs when responding to these prices or to any other arguments of the profit function (Berger and Mester 1997a).

Berger and Mester (1997a) specified the standard profit function, in log form, as:

$$\ln(\pi + \theta) = f(w, p, z, \Delta) + \ln u_\pi + \ln \in_\pi \tag{3}$$

Where π is the variable profit of the firm, which includes all the interest and non-interest income of earned on the variable outputs minus variable costs, C, used in the cost function; θ is a constant added to every firm's profit so that the natural log is taken of a positive number; p is the vector of prices of the variable outputs; $\ln \in_{\pi}$ represents the random error; and $\ln u_{\pi}$ represents the inefficiency that reduces profits

The other interesting recent development in efficiency analysis is the concept of alternative profit efficiency, which may be helpful when some of the assumptions underlying cost and standard profit efficiency are not met. Efficiency here is measured by how close a bank comes to earning maximum profits given its output levels rather than its output prices. The alternative profit function employs the same dependent variable as the standard profit function and the same exogenous variables as the cost function. Thus, in lieu of counting deviations from optimal output as inefficiency, as in the standard profit function, variable output is held constant as in the cost function while output prices are free to vary and affect profits (Berger and Mester 1997).

Berger and Mester (1997) specified the alternative profit function, in log form, as:

$$\ln(\pi + \theta) = f(w, y, z, \Delta) + \ln u_{a\pi} + \ln \in_{a\pi} \quad \textbf{(4)}$$

Which is identical to the standard profit function in (3) except that y replaces p in the function f, yielding different values for the inefficiency and random error terms, $\ln u_{a\pi}$ and $\ln \in_{a\pi}$, respectively.

Cost efficiency is widely defined as the ratio of the total cost to be incurred if the bank was to operate at the most optimal point (i.e., the ideal cost of production) to the actual cost of the bank. The cost efficiency ratio may be thought of as the proportion of costs or resources that are used efficiently. For example, a bank with cost efficiency of 0.80 is 80 percent efficient or equivalently wastes 20 percent of its costs relative to a best-practice firm facing the same conditions. That means the bank is incurring a cost of 1.0 Birr to produce a unit of output that can be produced by 0.80

cents by efficient banks. Cost efficiency ranges over (O, 1], and equals one for a best-practice firm. Most researches conducted follow this procedure. See Berger and Mester (1997a); Altunbas, Evans and Molyneux (2001); Kumbhakar and Sarkar (2004); and Bos *et-al* (2005).

It is also possible to interchange the numerators and denominators and define cost efficiency as the ratio of actual cost of production to the ideal cost. In this case cost efficiency will be the reciprocal of the former coefficient and is equal to or greater than one, i.e., $[1,\infty)$. For example, a bank with cost efficiency of 1.2 means the bank is incurring a cost of 1.2 Birr to produce a unit of output that can be produced by 1.0 Birr by efficient banks. Bedari (2003) used this approach to estimate the cost efficiency of commercial banks in Botswana, Namibia and South Africa. In the same way, Kraft, Hofler and Payne (2002) followed this method to analyze bank efficiency in Croatia. In this paper we shall follow this method.

2.3. Efficiency Measurement Methods

Empirical measurement of productive efficiency was first made by Farrell in 1957. Farrell proposed that the overall efficiency of a firm consists of two components. He termed these two components as technical efficiency (which reflects the ability of a firm to obtain maximal output from a given set of inputs) and allocative (or price) efficiency (which reflects the ability of a firm to use the inputs in optimal proportions, given their respective prices and the production technology). Farrell used the term overall efficiency to mean economic efficiency (Coelli, Rao and Battese 1998). Farrell showed how to define cost efficiency and decompose it into its technical and allocative components. He also provided an empirical application to U.S. agriculture, though he didn’t use econometric techniques (Kumbhakar and Sarkar 2004).

The most common efficiency estimation techniques are Data Envelopment Analysis (DEA), Free Disposable Hull Analysis (FDH), the Stochastic Frontier Analysis (SFA), the Thick Frontier Approach, and the Distribution-Free Approach. The first two techniques are nonparametric while the latter three are parametric methods (Berger and Mester 1997a).

In this research we focus on the parametric techniques primarily because they correspond well with the cost efficiency concepts. The nonparametric methods generally ignore prices and can, hence, account only for technical inefficiency in using too many inputs or producing too few outputs. They cannot account for allocative inefficiency in misresponding to relative prices in choosing inputs, nor can they compare firms that tend to specialize in different inputs, because there is no way to compare one input with another without the benefit of relative prices (Berger and Mester 1997a).

Among the parametric methods we focus on Stochastic Frontier Analysis (SFA). SFA had its origin in two papers, one by Meeusen and van den Broeck (June 1977) and the other by Aigner, Lovell and Schmidt (July 1977) (Kumbhakar and Sarkar 2004). The SFA technique starts with a production technology that is specified as:

$$y = f(x_1,...,x_k;\beta) \times \exp\{v+u\} \qquad \textbf{(5)}$$

Where y denotes output, $x_1,...,x_k$ are k inputs used to produce y, f is the production technology (black box) which converts inputs to output, and β is a technology parameter vector to be estimated. v is a random noise component, an exogenous shock unknown to the producer. It can be either positive (good luck, for example) or negative. If a producer is unable to produce the maximum possible output, given its input levels and the technology, it is said to be technically inefficient. Such inefficiency might arise due to factors such as, managerial errors arising from inertia and ignorance, poor quality of inputs, etc. Since a technically inefficient firm's output is always less than the maximum possible level determined by the stochastic production frontier (i.e., $f(x_1,...,x_k;\beta)\exp(v))$, given a specific input bundle, a one sided term u $(u \le 0)$ is appended to (5) to capture technical inefficiency (Kumbhakar and Sarkar 2004).

In this case inputs are assumed to be given and the objective is to maximize output. Thus, the only inefficiency, if any, is technical. Since data are available only on output and input quantities, estimation of the unobserved inefficiency, u, for each producer from a sample of producers requires some special econometric techniques (Kumbhakar and Sarkar 2004).

The question of resource allocation is not addressed in the above framework because inputs are assumed to be given. In reality, however, input allocation decisions also need to be made. Assuming that the objective of the producer is to minimize cost (of inputs), one can express the technology in terms of the dual cost function viz.,

$$E = c(w_1,..., w_k, y; \gamma)/CE \quad \textbf{(6)}$$

Where E is actual cost, c(.) is minimum cost function without any inefficiency, $w = (w_1,..., w_k)$ are prices of inputs $x_1,..., x_k$, y is output, and γ is the technology parameter vector (related to β in (5)). CE is the overall cost efficiency. Since actual cost is increased due to technical and allocative inefficiencies, CE ≤ 1 (Kumbhakar and Sarkar 2004).

Allocative inefficiency arises when the producer fails to use inputs in such a way that the cost is minimized. That means, some inputs are overused and some are underused. Such misallocation leads to an increase in costs. Similarly, compared to another producer who is technically efficient, the presence of technical inefficiency means that an inefficient producer has to use more of every input (which is going to increase cost) to produce a given level of output. This increase in cost due to technical and allocative inefficiencies is captured by the CE term. The reciprocal of CE can be used to measure the percent by which actual cost exceeds the minimum possible cost (see Kumbhakar (1997)).

Even if the cost-function approach is the dual of the production-function approach of modeling inefficiency, there are some advantages of using the cost-function approach. One advantage is that while the cost-function approach can easily handle cases where producers produce multiple outputs, the production function approach to stochastic frontier analysis is done on the assumption of a single output. It would be rather restrictive to assume a single output in modern day settings where a large number of firms produce multiple outputs. In addition, while the cost function approach, being an input oriented measure of efficiency, can make a distinction between variable inputs and quasi-fixed inputs (inputs fixed in the short-term), the production-function approach, being an output-oriented measure of efficiency, treats all inputs equally (Kumbhakar and Sarkar 2004).

On the other hand, the cost-function approach imposes a behavioral assumption on producers, i.e., producers minimize cost, while the production-function approach does not impose any such behavioral assumption explicitly (although implicitly one assumes output maximization, at least in a single output framework). However, in competitive environments in which input prices (rather than input quantities) are exogenous, and in which output is also demand driven and so can also be considered as exogenous, the cost-function approach may be more appropriate. In addition, the data requirements for the cost-function approach are higher compared to that for the production function approach. While the latter requires data only on output and inputs, the former requires data on total expenditure, outputs, and input prices. In addition, where a multiple-equation framework is used data on inputs or input-cost share are also required (Kumbhakar and Lovell 2000, Kumbhakar and Sarkar 2004). In this paper we use the cost-function approach towards estimating and modeling inefficiency. Accordingly, we now provide the basic economic framework for estimating these models.

As outlined above, the estimation of a simple equation stochastic cost frontier assumes the existence of data on the prices of the inputs employed, the quantities of outputs produced, and the total expenditure made by each of the I producers. In this case, the estimable cost frontier can be expressed as:

$$\ln E_i = \ln(c(y_i, w_i; \beta)\exp\{u_i\}) \qquad i = 1,2,...,I \tag{7}$$

Where $E_i = \sum_n w_{ni} x_{ni}$ is the actual cost incurred by producer i, $y_i = (y_{1i},..., y_{Mi}) \geq 0$ is the vector of outputs produced by producer i, $w_i = (w_{1i},..., w_{Ni}) > 0$ is the vector of input prices faced by the producer, $c(y_i, w_i; \beta)$ is the cost frontier common to all producers, β is the vector of technology parameters to be estimated, and $u_i = \ln CI$ captures the percentage increase in cost due to inefficiency. Since actual cost is bounded below by the minimum cost $c(y_i, w_i; \beta)$, the random variable u_i is non-negative. The higher the value of u_i the higher is the cost inefficiency of the producer. Note that in this formulation the input vector x_i used by the producer i need not be observed. If this is indeed the case, then cost inefficiency cannot be decomposed into cost of technical inefficiency and cost of allocative inefficiency (Kumbhakar and Sarkar 2004).

Given the above formulation, the cost efficiency (CE) of a producer *i* can be expressed as:

$$CE_i = \frac{c(y_i, w_i; \beta)}{E_i} = \exp\{-u_i\} \quad \textbf{(8)}$$

Equation (7) defines cost efficiency as the ratio of minimum possible cost to actual or observed cost. Since actual cost is greater than or equal to the minimum cost, it follows that the CE_i is always less than or equal to one and equals one only when the producer is efficient, that is, its actual cost equals the attainable minimum cost with that output (Kumbhakar and Sarkar 2004).

In equation (6) the cost frontier $c(y_i, w_i; \beta)$ is deterministic because the entire excess of observed expenditure over minimum possible expenditure is assigned to cost inefficiency. However, sometimes costs may deviate from the minimum possible due to some other factors than inefficiency, i.e., due to random exogenous shocks like weather, strikes, quality of inputs, etc., which are beyond the control of producers. In order to control for such exogenous factors, another random term is added to the cost function, and the model becomes:

$$E_i = c(y_i, w_i; \beta)\exp\{v_i + u_i\}, \text{ where} \quad \textbf{(9)}$$

$c(y_i, w_i; \beta)\exp\{v_i\}$ is the stochastic frontier. The stochastic frontier consists of two components: a deterministic part $c(y_i, w_i; \beta)$ that is common to all producers, and firm-specific random part, $\exp\{v_i\}$.

Under this formulation,

$$\ln E_i = \ln c(y_i, w_i; \beta) + u_i + v_i \qquad i = 1,2,..., I \quad \textbf{(10)}$$

We can thus calculate the producer specific efficiency as:

$$CE_i = \frac{c(y_i, w_i; \beta)\exp\{v_i\}}{E_i} = \exp\{-u_i\} \quad \textbf{(11)}$$

2.4. Empirical Literature

A number of studies have used stochastic frontier analysis in evaluating banking efficiency. For example, Berger and Mester (1997a) with respect to U.S. banking; Kraft, Hofler and Payne (2002) with respect to Croatian banking; Bedari (2003) with respect to Botswanan, Namibian and South African banking; Kumbhakar and Sarkar (2004) with respect to Indian banking; and Styrin (2005) with respect to Russian banking, to name a few.

Empirical evidence shows that X-efficiency of the banking system is significant throughout the world. By employing stochastic cost frontier analysis using panel data on Indian banking system, Kumbhakar and Sarkar (2004) found that cost efficiency of Indian banks ranged from 69 percent in 1986 to 75 percent in 2000. By using a Fourier-flexible trigonometric cost frontier function, Kraft, Hofler and Payne (2002) estimated a mean cost inefficiency of 1.37 (which is equal to 73.0 percent). Bedari (2003) found a cost inefficiency ranging from 1.09 to 1.3 for Botswanan banks and from 1.04 to 1.13 for Namibian banks and from 1.03 to 1.36 for South African banks.

Many studies have also tried to examine determinants of inefficiency and have included asset size, organizational form, market environment, capital size and other firm specific characteristics. By using data on Russian commercial banks on quarterly basis from the first quarter of 1999 to the fourth quarter of 2002, Styrin (2005) examined the major determinants of inefficiency in Russian banks. Styrin found that banks based in Moscow are less efficient than the others (outside the capital). Kraft, Hofler and Payne (2002) found a negative relationship between inefficiency and asset size in Croatian banks. That means banks with larger asset size are more efficient than those with lower asset size.

Berger and Mester (1997a) found that the cost efficiency estimates do not vary much across [asset] size. Holding all else equal, the cost efficiency is about 2.5 percent higher at the largest banks (with assets over $10 billion) than the smallest banks (with assets under $100 million). But in terms of profit efficiency (both standard and alternative), small banks show the greatest level of efficiency. The cost and profit efficiency results found together seem to imply that as banks grow larger, they are equally able to control costs, but it becomes harder to efficiently create revenues. This is consistent with conventional wisdom and the historical fact that small banks typically have higher profitability ratios. It also helps explain the lack of a positive correlation between cost efficiency and profit efficiency (Berger and Mester 1997a).

Berger and Mester (1997a) explored the relationship between age of the bank and efficiency to investigate the theory that says bank production might involve “learning by doing” (Mester 1996). Their result, however, showed a very small coefficient on the contribution of age to efficiency.

3. Banking System in Ethiopia at a Glance

“…ያበዳሪዎቹ ባህሪ እየተሻለ የሚሄድ፣ ወለድም ዝቅ የሚል፣ ተበዳሪም የሚበዛ አበዳሪዎች ሲበዙ ነው።… በሌላውም የህዝብን ትዳር የሚነካ ነገር ሁሉ እንደዚሁ ነው። ሞኖፖል ለመንግስትም ለህዝብም ጉዳት ነው።… ስለዚህም ሞኖፖል የበዛበት ሀገር ቀጣፊና ሌባ ወንበዴም ይበዛበታል። ሞኖፖልም ሁሉ የሚጎዳ ከሆነ ዘንድ ይልቁንም የባንክ ስራ ሞኖፖል ሲሆን እጅግ ክፉ ነው።”

መንግስትና የህዝብ አስተዳደር (in Amharic) Gebre-Hiwot Bayikedagn, 1924, page 143

3.1. Background

In 1905 the first modern bank in the history of the country, Bank of Abyssinia, was established. The bank was owned and managed by the British-owned National Bank of Egypt and was given a banking monopoly for fifty years, including the right to issue notes and coins (Gebre-Hiwot 1924, Belai 1987 and Brownbridge and Harvey 1998). However, three other banks were established during the next decade. The first 100 percent African owned bank on the continent, Bank of Ethiopia replaced Bank of Abyssinia in 1931. Bank of Ethiopia was also authorized to issue notes and coins and act as the government’s bank. Unfortunately after few years of operation the bank was closed following the Italian invasion. Several Italian banks opened branches in Ethiopia during the occupation period. The State Bank of Ethiopia was established in

1942 and became operational in 1943 (Belai 1987 and Brownbridge and Harvey 1998).

A new banking law split the functions of State Bank of Ethiopia in 1963 into central and commercial banking, respectively, as National Bank of Ethiopia and Commercial Bank of Ethiopia. Both were owned by government. The 1963 law allowed for other commercial banks to operate, including foreign owned ones provided that they were at least 51 percent owned by Ethiopians (Belai 1987 and Brownbridge and Harvey 1998). Following the law many other banks were established.

In 1975, following the fall of the imperial government, there was a major change of economic strategy in the banking sector as it was seen in all other economic sectors. The new government aimed to create a socialist and centrally planned economy on the Soviet model. All privately owned banks were nationalized and concentrated into Commercial Bank of Ethiopia. Then the main financial sector reform was to direct the government banks to finance greatly increased public sector (Brownbridge and Harvey 1998).

Even though economic liberalization began during the last years of the previous government, neither then nor in the statements of the successor government, did financial sector reform appear as a priority. The succeeding government was also very determined not to allow foreign banks into Ethiopia, even as minority partners with Ethiopian banks. The commitment for continued ownership of existing financial institutions was extremely strong (Brown bridge and Harvey 1998). However, in recent years measures are being taken to privatize the Construction and Business Bank.

The main institutional changes proposed were very much less radical compared to elsewhere in Africa (Brown bridge and Harvey 1998). Among such changes were:

- Allowing private sector banks to operate, but only if owned 100 percent by Ethiopians;
- Restructuring the Agricultural and Industrial Development Bank (now Development Bank of Ethiopia) and Housing and Savings Bank (now Construction and Business Bank); and
- Giving greater autonomy in lending decisions to Commercial Bank of Ethiopia.

Privatization of banks in developing countries improves bank governance, competition, efficiency, and performance and fosters stability. In most developing countries, the government (politicians and bureaucrats) is not a benevolent social guardian. Thus state-owned banks can be used for political and personal gains. Hence, privatizing of banks (though not sufficient) would be good measure to prevent this to happen. Nevertheless, privatization has some potential costs. Such costs may include private banks turn away from underserved markets (e.g., rural sectors), engage in excessive risk lending and hence engender banking crisis and instability, and borrowers with informational and contractual difficulties may be rationed out by private banks (Lemma 2005).

3.2. The Financial System in Ethiopia

In Ethiopia the banking system dominates the financial system. At the close of November 2005 the financial system comprises of one central bank (National Bank of Ethiopia), nine commercial banks (of which two are owned by government), one development bank (Development Bank of Ethiopia), 27 micro-finance institutions (MFIs), nine insurance companies (of which one is government owned), one pension fund (Social Security Authority) and numerous savings and credit associations (SCAs) (IMF 2005, NBE 2006).

At the close of June 2005 total assets of the banking sector (central bank, commercial banks and the development bank) reached Birr 116.5 billion (which is more than 120 percent of GDP of the year). Commercial banks in Ethiopia comprise the publicly owned Commercial Bank of Ethiopia – CBE (1963) and Construction and Business Bank – CBB (1975); and seven other privately owned banks viz., Awash International Bank – AIB (1994), Dashen Bank – DB (1995), Bank of Abyssinia – BOA (1996), Wegagen Bank –WB (1997), United Bank – UB (1998), NIB International Bank – NIB (1999) and Cooperative Bank of Oromia - CBO[3] (2004), listed in order of their age.
Excess reserve and excess liquidity are among the major problems facing the banking system in Ethiopia today. At the close of June 2005, total reserve deposit of commercial banks with National Bank of Ethiopia reached Birr 12.9 billion. This is equivalent to 35.2 percent of total net deposits[4] mobilized by the commercial banks.

[3] In this paper, however, when we say private commercial banks we mean all but CBO.
[4] Net deposits equal demand, savings, and time deposits, less uncleared checks paid, and less uncleared effects (foreign).

Note that NBE directive number SBB/14/96 obliges banks to maintain only 5 percent of their net deposits with their reserve account at NBE. In other words, reserve balance of commercial banks has reached more than seven times their reserve requirement. In absolute amount excess reserve has gone beyond Birr 11.0 billion at the close of fiscal year 2004/05. Excess liquidity is also following the same development. At the end of June 2005 total liquid assets[5] of commercial banks reached Birr 22.4 billion. This equals 64.1 percent of total net current deposits[6] mobilized by commercial banks. Here also note that NBE directive number SBB/15/96 requires banks to maintain only 15 percent of their net current liabilities as liquid assets. In other words, liquid asset of banks has more than quadrupled the requirement set by NBE. In absolute amount excess liquid asset of commercial banks has reached Birr 17.2 billion.

One interesting fact to note is that these problems are not equally distributed among banks though we discussed the aggregate data for all commercial banks. Commercial Bank of Ethiopia, respectively, takes 90.7 and 79.4 percent of excess reserves and excess liquid assets in the Ethiopian commercial banking sector at the close of June 2005. The persistence of these excess reserve and excess liquidity problems is also implied in the interest rate structure of the banks as both the lending and deposit rates are almost constant and show very limited or no change unless NBE revises the minimum deposit rates for saving and time deposits.

Unlike their number, the privately owned commercial banks have a very small size compared to the public banks, especially the CBE. In addition, all the private banks are 100 percent domestically owned. There is admittedly a gradual but encouraging entry of private banks into the system. The lion's share of the banking market still goes to CBE (Lemma 2005). Encouraging measures were taken to enhance the role of the private sector in the financial sector like liberalizing lending interest rates and exchange rates (Addison and Alemayehu 2001). But the outcome leaves much to be desired as yet.

[5] Total liquid assets of the banks equal the sum of foreign and local currency cash on hand, reserve balance with National Bank of Ethiopia, deposits with other banks and their holdings of treasury bills.
[6] Net current deposits equal net deposits, less time deposits.

3.3. Competition in the Banking System

Competition takes place where two or more providers of services/ goods put forward their products, as substitutes, to buyers in the same market. It would be difficult to enforce collusion (anti-competitive behavior) in a market where there are several suppliers. In addition, when the firms in the market are of similar size competition increases as no one firm could dictate the market (Korsah, Nyarko and Tagoe 2001).

The presence of an uncompetitive market structure leads to low and inefficient financial intermediation. Interestingly, there is no one-to-one relationship between concentration and competition. On the one hand, monopolistic or oligopolistic behavior tends to result in higher intermediation costs and diseconomies of management than under a competitive structure; thus, noncompetitive behavior is consistent with the presence of wide interest rate margins and spreads, which tend to deter potential depositors, as well as potential borrowers, and result in low lending ratios. On the other hand, market size may offer the possibility of exploiting economies of scale (from overhead in administrative operations and information gathering), as well as economies of scope (in combining different product lines for instance). What really matters for the net effect on competition is the level of contestability[7] in the market: the threat of potential competition— or lack thereof—can substantially affect competitiveness conditions, regardless of market concentration (Buchs and Mathisen 2005).

Hence, the incidence of competition is one major factor affecting the efficiency of firms in the market. Higher level of concentration[8] in the market enhances the level of profit but reduces competition (Alzaidanin 2003). Hence, it would be wise to see in detail the structure of the market before saying anything about the efficiency or profitability of the newly emerged private commercial banks in Ethiopia. In the Ethiopian commercial banking sector, Commercial Bank of Ethiopia seems as having a quasi-monopoly power. In this section it is tried to examine the monopoly power of the CBE using Herfindhal Index (HI). The Herfindahl Index is a concentration

[7] Buchs and Mathisen (2005) classify the basic idea of market contestability into two: on the one hand, there are several sets of conditions that can yield competitive outcomes, with a competitive outcome possible even in concentrated systems. On the other hand, collusive actions can be sustained even in the presence of many firms.

[8] The conventional definition of concentration is the number and size distribution of firms in the market.

measure that can be used as a tool to examine the incidence of competition in a given market. It is given by the formula:

$$HI = 10{,}000\sum S_i^{\,2} \qquad \textbf{(12)}$$

Where S_i is the market share of the i^{th} bank

The value of the HI varies from 0 (where there is a perfectly competitive industry and the square of the share of one firm is very insignificant and close to zero) to 10,000 (where there is a pure monopoly and one firm totally controls the market and the share (and its square) of that firm is one. A market with an HI in excess of 1,800 is generally regarded as highly concentrated and adverse market power effects can be presumed (Korsah, Nyarko and Tagoe 2001 and IMF 2002).

Competition leads to efficiency and then to cost reduction. Once cost is minimized in the banking sector, cost of borrowing would be lower for other sectors and investment would be enhanced. The Herfindahl Index is of our interest because it is simple to calculate and is used widely to measure concentration in the financial sector.

In applying the Herfindahl Index to the Ethiopian banking industry the problem arises in selecting the indicator of the market. Taking only the balance sheet items may result in biased outcome as most of the balance sheet items like total assets, outstanding loans or total deposits of the commercial banks are functions of time. It is obvious that CBE outweighs all commercial banks with a significant difference in all these items. That is because CBE has advantages over the private banks. These advantages can be classified into two: one is the government (both central and regional) almost entirely banks with CBE and the other is CBE's much older age compared to others. For years CBE was opening branches throughout the country and establishing good relationship with major sections of the society. Therefore, if we take indicators from the balance sheet only CBE's monopoly power would obviously be higher.

So it would be wise to look beyond the balance sheet and incorporate variables that have a lesser correlation with time than the former ones. In searching for such variables the writer tried to look at collection and disbursement of loans over time on quarterly basis and annual profits of the commercial banks. In addition, it would be sensible to consider the deposit market in two ways, first taking total deposits and second taking only savings and time deposits. The rationale behind is that CBE as a major banker to government mobilizes almost all deposits of both the central and regional governments. It is known that more than 99 percent of government deposits are put in current account (demand deposits). Hence, it wouldn't surprise if CBE's share in demand deposits is higher than its share in savings and time deposits. To examine this situation the writer preferred to calculate the Herfindhal Index based on the markets for the following variables:

1. Total assets of commercial banks;
2. Total deposits (demand, savings and time) of commercial banks;
3. Total savings and time deposits of commercial banks;
4. Total outstanding lending of commercial banks;
5. Loan disbursement of commercial banks;
6. Loan collection of commercial banks; and
7. Total income of commercial banks.

Taking into consideration all these indicators the result supports our expectation. The HI of all indicators of the market demonstrate the quasi-monopoly power of CBE in that all the indicators taken have on average an index of well above 1800. Nevertheless, the extent of power differs across indicators. The average share of CBE from the total HI of the market during 2004/05 ranged from 98.4 percent in total assets to 73.4 percent in total loan disbursement **(Table 1 and Fig. 1-7** in the **Appendix)**.

4. Cost Efficiency Analysis of Private Commercial Banks in Ethiopia

4.1. Methodology

The methodology used here is the econometric technique that involves the estimation of the cost function and the derivation of X-inefficiency estimates from the residuals employed. This method, called Stochastic Frontier Analysis, is developed independently by Aigner Lovell, and Schmidt (1977) and Meeusen and van den Broeck (1977) (Coelli, Rao and Battese 1998). The method has the virtue of allowing for “noise” in the measurement of efficiency, and has been shown to be more robust than the other alternative method of data envelopment. In this method a bank’s observed total cost is modeled to deviate from the cost efficient frontier due to random noise and X-inefficiency. The stochastic cost frontier has the following form:

$$E_{it} = c(y_{it}, w_{it}, z_{it}, \Delta_{it}, \in_{it}) \qquad i = 1,2,...,I \qquad t = 1,2,...,T \tag{13}$$

where the subscripts i and t respectively refer to the i^{th} bank in period t; and E measures total actual costs, c is some functional form, y is the vector of quantities of variable outputs, w is the vector of prices of variable inputs, z indicates the quantities of any fixed netputs (inputs or outputs), which are included to account for the effects of these netputs on variable costs owing to substitutability or complementarity with variable netputs, Δ is a set of environmental or market variables that may affect performance. The error term $\in_i$ has two components and can be broken down as:

$$\in_{it} = v_{it} + u_{it} \tag{14}$$

The u_i accounts for inefficiency factor that may raise costs above the best practice level. It is what we call X-inefficiency. This includes both allocative inefficiencies from failing to react optimally to relative prices of inputs, w, and technical inefficiencies from employing too much of the inputs to produce y. Where as v_i captures measurement error and chances that may temporarily give banks high or low costs

To simplify the measurement of efficiency, the error term $\in_{it}$ (which comprises of the inefficiency and random terms u_{it} and v_{it}) is assumed to be multiplicatively separable from the rest of the cost function, and taking both sides of (13) by

substituting $\in_{it}$ with the right side of (14) can be represented as:

$$E_{it} = c(y_{it}, w_{it}, z_{it}, \Delta_{it}) \exp\{v_{it} + u_{it}\}, \qquad i = 1,2,...,I \;\; t = 1,2,...,T \tag{15}$$

Equation (15) can be designated in natural logs as:

$$\ln E_{it} = \ln c(y_{it}, w_{it}, z_{it}, \Delta_{it}) + v_{it} + u_{it}, \qquad i = 1,2,...,I \qquad t = 1,2,...,T \qquad \textbf{(16)}$$

The stochastic frontier (as discussed earlier) consists of two components: a deterministic part $\ln c(y, w, z, \Delta)$ that is common to all producers, and producer specific random part. The producer specific X-efficiency is calculated using the method proposed by Battese and Coelli (1995). The model specifies X-inefficiency effects in the stochastic frontier model that are assumed to be independently (but not identically) distributed non-negative random variables. For the i^{th} bank in the t^{th} period, the X-inefficiency effect, u_{it}, is obtained by truncation of the $N(\mu_{it}, \sigma^2)$-distribution where

$$\mu_{it} = \psi_{it}\delta \qquad \textbf{(17)}$$

Here ψ_{it} is a (1 X M) vector of observable explanatory variables, whose values are fixed constants; and δ is an (M X 1) vector of unknown scalar parameters to be estimated (which would generally be expected to include an intercept parameter). Equation (17) specifies that the means of the normal distributions, which are truncated at zero to obtain the distributions of the X-efficiency effects, are not the same, but are functions of values of observable variables used and a common vector of parameters (Coelli, Rao and Battese 1998).

The parameters of the stochastic cost frontier function can be estimated using either the maximum-likelihood (ML) method or using a variant of the corrected ordinary least-squares (COLS). The COLS method uses the ordinary least-squares (OLS) estimators, which are unbiased for the slope parameters, but the (negatively sloped) OLS estimator of the intercept parameter, β_0, is adjusted upwards, using the sample moments of the error distribution, obtained from the OLS residuals. The ML estimator is asymptotically more efficient than the COLS estimator, but the properties of the two estimators in finite samples cannot be analytically determined. Coelli (1995) investigated the finite-sample properties of the half normal frontier model in a Monte Carlo experiment and found that the ML estimator to be significantly better than the

COLS estimator. Given this result and the availability of automated ML routines, it is preferable to use the ML estimator to the COLS estimator whenever possible (Coelli, Rao and Battese 1998). Here too we use the ML method.

Estimating equation (16) requires:

i) Specification of a functional form for the deterministic kernel, $\ln c(y, w, z, \Delta)$

ii) An assumption about the distribution of the random variable, v_i and

iii) An assumption about the distribution of the random variable, u_i.

Assumption relating to the random variable v_i is standard and is assumed that it is distributed as a normal variable with zero mean and finite variance. Empirical models tend to differ primarily in their assumption relating to the random variable u_i and in their specification of the deterministic kernel. The initial models specified either a half normal or an exponential distribution for u_i, while latter models assumed a more general truncated normal distribution for u_i, with the truncation point occurring at zero to ensure non-negativity of u_i (Kumbhakar and Sarkar 2004).

Given a particular specification for the random variables v_i and u_i, the maximum likelihood (ML) technique is used to estimate the unknown parameters. To illustrate the procedure, let us suppose that we make the following assumptions with respect to v_i and u_i (the analytics of the ML technique doesn't depend on the particular specification of the deterministic kernel) based on Kumbhakar and Sarkar (2004):

i) $v_{it} \sim \ iidN(0, \sigma_v^2)$ - identically and independently and normally distributed

ii) $u_{it} \sim \ idN^+(0, \sigma_u^2)$ - independently (but not identically) half normally distributed

iii) v_{it} and u_{it} are distributed independently of each other and of the regressors.

4.2 Data

The basic question in constructing models for efficiency analysis arises in the definition of inputs and outputs. The role of deposits is particularly difficult to decide. Should we consider them as inputs or outputs of a bank? The answer depends on our view about the nature of banking business. In the literature there are two major positions. One is taking banks as financial "intermediaries" transforming deposits to loans and in this case deposits are to be considered as input. The second alternative is to view banks as financial institutions using capital and labor to produce financial products like loans and deposit account services, and then deposits are to be considered as output (Chakrabarti and Chawla 2003).

In our model labor, fixed assets and deposits are considered as inputs (and payments for them, input prices), while loans, other investments and foreign assets[9] are considered as outputs. Provision to bad loans is taken as a proxy to non-performing loans as data on the latter is strictly confidential and we are not able to get. Cost of banks is calculated by adding total interest and non-interest expenses of the banks.

Input prices are calculated differently for different inputs. Wages (prices for the input labor) are calculated by dividing total employee salary and benefit expenses of the bank to number of staff and prices for the input deposit are calculated by dividing total interest expenses by the sum of saving and time deposits and domestic borrowing. Here we excluded demand deposits from being a denominator for the calculation of prices for deposits. This is done because interest is paid on demand deposits only by two banks and these banks pay a very small rate compared to what they pay on savings and time deposits. In addition, for an account to bear interest there is a floor minimum balance to be met during a month. That means current account (demand deposit) with a balance below an amount set by the bank during any one day of a month cannot get interest. In reality for depositors with millions of Birr balance in most days of the month it is possible to have a balance with hundreds of Birr at least one day within a month. The price for fixed assets is calculated just by taking depreciation of the bank.

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[9] In taking into account foreign assets as outputs of banks it was difficult to get literature. Researches conducted on many other countries didn't consider foreign assets as output. But in the case of our country we found them good indicators of output of commercial banks as they are investments like other outputs and more importantly they are less risky than the other types of outputs.

Regarding the outputs we got the data on total outstanding loans of each bank (net of provision), the data for other investments is calculated by adding investments of the banks on shares and investments (in other domestic economic sectors) and other securities (like government treasury bills and bonds) and foreign assets is calculated based on the Monetary and Financial Statistics Manual of IMF (2000). Capital is taken as the sum of equity capital and legal reserve. Number of branches in each quarter is calculated based on the assumption that each branch begins operation one month after the license is issued by National Bank of Ethiopia (NBE) and in this case a branch licensed during the last month of a quarter is assumed to begin operation during the coming quarter. This happened because it was impossible to get data on the date the branch began to operate rather what we got from NBE is the date it was licensed. A total asset is taken from provisional balance sheets of commercial banks submitted to NBE on monthly basis (in millions of Birr). Age is calculated by giving 1.0 for a year and 0.25 for a quarter. That means a bank at its age of first quarter is given a figure of 0.25 and during the second quarter is given 0.50 balance and so on.

Nevertheless, there are some problems with the data worth mentioning. Provision to bad loans may not be the best substitute for non-performing loans. Both are not changing proportionally, at least strictly. The provision is more of a function of the provisioning directive of National Bank of Ethiopia than that of total non-performing loans of that bank. In fact it has some relations. That is why we took it. Next it was impossible to get the number of staff of each bank on quarterly basis. We got the data on annual basis and considered total staff at the close of the year to be the same for each of the four quarters. In addition, there is no significant difference in age among the banks under review.

4.3. Model Specification

Based on the methodology mentioned above in this section we specify the model we used to measure cost efficiency of private individual commercial banks operating in Ethiopia. The translog[10] cost function is specified as follows:

[10] It is also customary to use the Fourier-flexible functional form instead of the translog form. The Fourier-flexible functional form includes a standard translog plus Fourier trigonometric terms. These additional variables can make the approximating function closer to the true path of the data wherever it is most needed. It is also believed that a good fit of the data for the estimated efficient frontier is important in estimating efficiency, because inefficiencies are measured as deviations from this frontier. Nevertheless, Berger and Mester (1997b) found that both the translog and the Fourier-flexible functional forms yielded

$$
\begin{aligned}
\ln E_{it} &= \alpha + \sum_{j=1}^{3} \beta_j \ln(y_{jit}/z_{it}) + \tfrac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3} \beta_{jk} \ln(y_{jit}/z_{it})\ln(y_{kit}/z_{it}) \\
&+ \sum_{m=1}^{2} \gamma_m \ln(w_{mit}/w_{3it}) + \tfrac{1}{2}\sum_{m=1}^{2}\sum_{n=1}^{2} \gamma_{mn} \ln(w_{mit}/w_{3it})\ln(w_{nit}/w_{3it}) \\
&+ \sum_{j=1}^{3}\sum_{m=1}^{2} \chi_{jm} \ln(y_{jit}/z_{it})\ln(w_{mit}/w_{3it}) + \phi_1 \ln \Pr ov_{it} \\
&+ \tfrac{1}{2}\phi_{11}[\ln \Pr ov_{it}]^2 + v_{cit} + u_{cit}
\end{aligned}
\quad , \quad \textbf{(18)}
$$

Where E_{it} equals $C_{it}/w_{3it}z_{it}$ and the subscripts i and t represent that of the i^{th} bank during the t^{th} time period, C_{it} represents total expenditure of the bank (interest plus non-interest expenses), w_{mit} denotes input prices (w_{3it} price labor for the i^{th} bank during the t^{th} time period, w_{2it} price for the fixed assets and w_{1it} price for deposits and borrowing[11]), z_{it} is capital for the i^{th} bank during the t^{th} time period, y_{jit} denotes outputs (y_{1it} total outstanding loans net of provision, y_{2it} gross foreign assets and y_{3it} local investment shares) and $\Pr ov_{it}$ represents provisions for bad debts of the i^{th} bank during the t^{th} time period.

Following Kumbhakar and Sarkar (2004), we impose the usual symmetry restrictions on the above cost function and: $\beta_{jk} = \beta_{kj}$ and $\gamma_{mn} = \gamma_{nm}$. Moreover, to ensure linear homogenity of the cost function in w, the following restrictions are imposed:

$$\sum_m \gamma_m = 1, \sum_m \gamma_{mn} = 0 \forall n, \sum_m \beta_{jm} = 0 \forall j$$

Once we have discussed the efficiency concepts and measurement methods and specified our model then another question arises. What explains the differences in

essentially same average level and dispersion of measured efficiency, and both ranked the individual banks in almost the same order. Following this result we preferred to use the translog functional form.

[11] The borrowing is wholly from domestic sources.

efficiency across banks? The answer to this question has important implications for public policy, research, and bank management. A useful first step is to explore the effects of a number of potential correlates of bank efficiency - various bank characteristics that are at least partially exogenous to efficiency and so may help explain the differences in efficiency across banks. Several papers have undertaken analyses along these lines[12]. A two-step procedure is typically used; whereby firm efficiency is estimated using one of the techniques described in this paper and is then regressed on a set of variables describing the characteristics being investigated (Berger and Mester 1997a).

Some econometric issues make such analyses suggestive but not conclusive. First, the dependent variable in the regressions, efficiency, is an estimate, but the standard error of this estimate is not accounted for in the subsequent regression or correlation analysis. Second, none of the variables used in the regressions is completely exogenous, and the endogeneity of any regressor can bias the coefficient estimates on all the regressors. The banks can change the regressor variables whenever they want to. Endogeneity makes conclusions about causation difficult. As an alternative to regression analysis, simple correlations are provided in some articles to underscore the fact that causation may run in both directions (Berger and Mester 1997a).

Given these shortcomings of the variables, the equation for the X-inefficiency variable, u_{it}, is constructed as follows:

$$u_{it} = f(BN_{it}, Age_{it}, Assets_{it}, Capital_{it}; \delta) \tag{19}$$

Where f represents some functional relationship, BN_{it} is Branch Network (number of branches for the i^{th} bank during the t^{th} time period), Age_{it} is the age of the bank, $Assets_{it}$ represents total assets of the bank, $Capital_{it}$ denotes the total paid up capital plus legal reserve of the bank and δ represents parameters to be estimated.

[12] Among thses studies on banks include Aly *et al* (1990), Berger, Hancock, and Humphrey (1993), Pi and Timme (1993), Kaparakis, Miller, and Noulas (1994), Berger and Hannan (1996), Kwan and Eisenbeis (1995), Spong, Sullivan, and DeYoung (1995), Hughes *et al* (1996a,b), Mester (1996), and Styrin (2005).

4.4. Estimation Results

We estimated the above stochastic frontier models using FRONTIER (4.1c) program developed by Coelli (1996). We estimated two alternative versions of the above model, namely the Battese and Coelli 1992 model for determining the time behavior of efficiency, referred to as "Error Components Frontier Model - ECFM" in the FRONTIER program, and the Battese and Coelli 1995 model for explaining inefficiency as a function of exogenous factors, referred to as "Technical Efficiency Effects Frontier Model - TEEFM" in the FRONTIER program. In this section we discuss the results of these models.

Table 3, column 2, presents the estimated parameters of the translog cost function, and estimated parameters of the inefficiency function of Battese and Coelli TEEFM, estimated using the quarterly data on private commercial banks for the period from fiscal year 1997/98 first quarter to fiscal year 2005/06 second quarter. Since the main focus of our analysis is on efficiency, we do not present a detailed discussion of the estimated cost function parameters. We only note that the estimated coefficients are theoretically consistent and twelve out of the twenty-two parameters of the translog cost function are significant at 5 percent level.

The bottom part of **Table 3** presents the parameters that can be used to judge the suitability of using the stochastic frontier model. Under our formulation, testing for the presence of bank-specific inefficiency, and hence the necessity of using the frontier model, translates into testing the hypothesis $H_0 : \gamma = \mu = \eta = 0$[13]. The test is done using the Log-likelihood ratio (LR) test of the TEEFM estimation result. Note that the test statistics has a mixed chi-squared distribution and the critical value for a given level of significance, is lower than that reported in the usual chi-squared tables (Kumbhakar and Sarkar 2004 and Coelli, Rao and Battese 1998).

The generalized likelihood-ratio test requires the estimation of the model under both the null and alternate hypotheses. Under the null hypothesis, $H_0 : \gamma = \mu = \eta = 0$, the model is equivalent to the traditional average response function, without the X-

[13] Note that in this model testing only the null hypothesis of $H_0 : \gamma = 0$ doesn't imply the absence of inefficiency as $\gamma = 0$ is consistent with the presence of bank-invariant inefficiency.

inefficiency, u_i. The test is done using the usual likelihood ratio (LR) test, but the test statistic has a mixed chi-squared distribution and the critical value for a given level of significance, is lower than that reported in the usual chi-squared tables (Coelli, Rao and Battese 1998). The test statistics is calculated as:

$$LR = -2\{\ln[L(H_0)/L(H_1)]\} = -2\{\ln[L(H_0)] - \ln[L(H_1)]\} \quad \textbf{(20)}$$

Where $L(H_0)$ and $L(H_1)$ are the values of the likelihood function under the null and alternate hypotheses, H_0 and H_1, respectively.

As can be seen from **Table 3**, the log-likelihood function for the full stochastic frontier model is calculated to be 19.856 and the value for the OLS fit of the cost function is 4.681, which is much less than that for the full frontier model. This implies that the generalized LR-ratio statistic for testing the absence of the X-inefficiency effects from the frontier is calculated to be:

$$LR = -2\{4.681 - 19.856\} = 30.351$$

This value is calculated by FRONTIER and reported as “The LR test of the one-sided error”. This value is significant because it exceeds 21.666, which is the critical value obtained from **Table 1** of Kodde and Palm (1986) at 0.1 percent level of significance with degrees of freedom of 6. Hence, our analysis overwhelmingly rejects the null hypothesis of no X-inefficiency effects in private commercial banks in Ethiopia. Thus the standard average response function is not adequate for analyzing the cost behavior of banks and a frontier model is required. This implies that the stochastic frontier specification fits the data better than a deterministic frontier. Thus, the model implies that the performance of the banks is better analyzed within a stochastic frontier framework.

The estimated value of the parameter η (estimated using the ECFM) has positive sign (a value of 0.0477) but insignificant as the t-ratio is 0.271 (even insignificant at 25 percent level of significance). Here we accept the $H_0 : \eta = 0$ (which says efficiency is time invariant) and reject the alternate hypothesis. The positiveness of the parameter η might imply that the X-inefficiency of the private commercial banks has decreased and their efficiency has improved during the estimation period. While the insignificance and the smallness of the magnitude of the parameter shows the amount by which the efficiency changed over time is not that much significant. This is true for every bank since the parameter η in the Battese and Coelli (1992) model is bank invariant. **Fig. 8** and **9** show the trend in X-inefficiency of the banks. Looking at these figures in detail one might ask why X-inefficiency has risen during 2003/04? However, the situation is consistent with the implementation of NBE directive number SBB/32/2002[14]. This directive has increased expenses and therefore has shifted the operating point of the banks away from the minimum cost frontier.

According to these estimates, private commercial banks operating in Ethiopia exhibit a mean inefficiency (efficiency) score varying from 1.49 (0.67 or 67 percent) during the first four quarters of the estimation period to 1.12 (0.89 or 89 percent) during the last four quarters of the period of estimation. That means, the banks under review have begun to operate to a point closer to the cost frontier during the last four quarters compared to the first four quarters of the period discussed. The results obtained are comparable to the results obtained by different researchers as discussed previously under the literature review. Fiscal year average of the X-inefficiency status of the banks under review is presented under **Table 5.**

A common criticism of the stochastic frontier method is that there is no a priori justification for the selection of any particular distributional form for the X-efficiency effects, u_i. The half normal and the exponential distributions are arbitrary selections. Since both of these distributions have a mode at zero, it implies that there is the highest probability that the inefficiency effects are in the neighborhood of zero. This in turn, implies relatively higher efficiency. In practice, it may be possible to have a few very efficient firms, but a lot of quite inefficient firms. As μ is pre-assigned to be zero (that is, the null hypothesis) the distribution is assumed to be half normal. As can be seen from **Table 4**, μ has a non-zero value of 0.03224, though insignificant t-

[14] Directive number SBB/32/2002 was prepared to increase provisions of commercial banks for "Pass", "Special mention" and "Sub-standard" loans and was proposed to be implemented in four phases. The first phase ended at the close of December 2002, the second at the close of June 2003, the third at end December 2003 and the fourth phase during January 2004. The rate of provisions for "Pass" and "Special Mention" loans was scheduled to rise when one phase ends and the second comes.

statistics, and hence we accept the null hypothesis and reject our alternate hypothesis of the distribution is truncated.

Coming to the bank-specific determinants of inefficiency, **Table 3** shows that only capital is found to be negatively related with X-inefficiency, though the t-statistics is significant only at 25 percent. That means banks with higher capital are more efficient than those with low capital. This is consistent with our hypothesis. Most studies have found that well-capitalized banks are more efficient. This is consistent with moral hazard theory that suggests managers of institutions closer to bankruptcy might be inclined to pursue their own interests. But causation could run the other way, i.e., less efficient institutions have lower profits, leading to lower capital ratios (Berger and Mester 1997a). In the case of our country, be reminded that banks with higher level of capital have the legal right to lend a higher amount of money to a single borrower and can reduce their transaction costs. In addition, higher capital implies more fund is available to lend to borrowers without borrowing from other sources that require incurrence of additional costs.

Number of branches and asset size are found to be positively related with X-inefficiency. This is consistent with our hypothesis. As the asset size and number of branches of banks expands attention of the management may divert from cost minimization and focus on other routine administrative activities. That means banks with more branches and higher size of total assets are less efficient than those with lower number of branches and lesser size of total assets. This might be due to the expansion of banks outside Addis Ababa and it is as expected branches in the capital are more efficient than those in rural areas. It is obvious that banks with lower number of branches have a less number of branches outside Addis Ababa. In addition, branch expansion outside Addis Ababa results with more deposits mobilized (than with more outputs) and so branch network and asset size are on the same direction with their relation with inefficiency. The increase in deposits would not mainly go to outputs (loans, or foreign assets or other investments) rather it would go to excess reserve deposits with National Bank of Ethiopia and would raise their asset size. This is also consistent with conventional wisdom and the historical fact that small banks typically have higher profitability ratios (Berger and Mester 1997a, Styrin 2005). In contrast to our hypothesis, age is found to be positively related with X-inefficiency (though with insignificant t-ratio). That means banks with longer ages are less efficient than those with shorter ages. This is contrary to the theory that bank production involves "learning by doing" (Mester 1996). This might have resulted from the insignificant difference in age among the private banks.

5. Conclusions and Recommendations

5.1. Conclusions

The paper has tried to examine cost efficiency of private commercial banks operating in Ethiopia by using panel data from the first quarter of fiscal year 1997/98 to the second quarter of 2005/06. Before analyzing the cost efficiency it is tried to see the market structure for commercial banks in the economy. The market is found highly concentrated especially in total assets and deposits towards public banks, especially the Commercial Bank of Ethiopia.

The cost efficiency result of the banks under review is found comparable to the result obtained by different researchers employing the same methodology to the same institutions in other countries. Size of banks (measured by total assets and branch network) and age are found negatively related with efficiency while capital is found to be positively affecting efficiency of banks.

5.2. Recommendations

As it can be seen from this paper, the financial system (especially the banking sector) is highly concentrated. Concentration in the market is a barrier for the presence of a well-built competition and the prevalence of excessive unutilized financial potential in the form of excess reserves and liquidity impedes efficiency of banks. This initiates the need for an immediate attention of policy makers. Since analysis of concentration and excess reserve and liquidity is not the major subject matter of the paper we just recommend that the measures to be taken need a careful research and examination of the experience of other countries.

Based on the findings of the paper we would like to put forward the following recommendations for bank managers. First, as branch expansion is found positively related with X-inefficiency, rigorous study of the socio-economic environment under which the branch operates needs to be made before opening any branch (especially for those outside the capital). In this case, a detailed examination of the opportunities and threats of the branch both currently and in the future should be carried out. A branch, which is currently inefficient cost-wise, might be a potential source of efficiency for the bank in the future.

Second, asset size is also found positively related with inefficiency. This is mainly a result of the increase in deposits with branch expansion. Increases in deposits need to be utilized in the most efficient way. For this to happen banks should expand their market base and bank with anyone having the potential to invest in lucrative areas. In our country banks have a tradition of focusing on collaterals rather than on the potential of the borrower. On one side lenders may be right. But in this country, where land is forbidden by law from being used as collateral and with a society of mainly agrarian socio-economic setting, it would be difficult for borrowers to come with enough collateral that today's banks expect. Hence, banks should look at ways of minimizing the risk of uncollectibility of their loans and focus on the business too rather than focusing only on collaterals.

Third, size of capital is found negatively related with X-inefficiency. Banks should therefore mobilize their capital. Capital might be mobilized by issuing shares or by reducing the dividends to be distributed to shareholders.

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Appendix

Table 1: Herfindhal Index of Some Major Indicators of the Ethiopian Commercial Banking Market

	1999/00				2000/01				2001/02			
Particulars	**QI**	**QII**	**QIII**	**QIV**	**QI**	**QII**	**QIII**	**QIV**	**QI**	**QII**	**QIII**	**QIV**
HI of Total Assets	7560.5	7555.4	7466.4	7351.9	7087.0	7019.2	7088.5	7204.8	7047.6	6961.6	6958.0	6802.5
O/w % Share of CBE	99.5	99.6	99.5	99.5	99.4	99.3	99.4	99.4	99.4	99.3	99.3	99.2
HI of Total Deposits	7704.6	7627.5	7530.1	7444.5	7293.5	7187.4	7007.3	7094.7	6921.0	6780.3	6601.0	6542.7
O/w % Share of CBE	99.6	99.6	99.5	99.5	99.4	99.4	99.3	99.4	99.3	99.2	99.0	99.0
HI of Saving and Time Dep.	6418.7	6350.9	6149.1	6062.3	5859.2	5805.6	5596.1	5583.5	5442.7	5357.7	5233.1	5091.3
O/w % Share of CBE	98.7	98.6	98.4	98.4	98.1	98.1	97.8	97.8	97.6	97.4	97.2	96.9
HI of Loans Outstanding	6751.7	6717.6	6559.5	6302.5	6102.7	5941.8	5783.1	5759.2	5592.8	5420.2	5367.1	5308.5
O/w % Share of CBE	98.8	98.8	98.8	98.6	98.4	98.3	98.1	98.1	97.9	97.7	97.6	97.5
HI of Loan Disbursement	5936.5	5399.5	3862.6	3506.0	4922.8	3680.5	3861.3	3369.2	4488.9	2894.3	2491.1	3112.0
O/w % Share of CBE	97.6	96.6	90.7	88.1	96.3	90.0	89.9	86.7	95.1	78.6	74.6	86.4
HI of Loan Collection	5543.2	4540.5	6076.9	4542.8	5354.1	4629.9	5796.4	3866.9	4157.9	4031.3	4495.3	3867.0
O/w % Share of CBE	96.9	94.1	98.3	94.7	97.0	95.9	98.1	91.9	94.2	92.7	95.4	93.0
HI of Gross Income	7012.9	6109.0	6699.0	6049.9	5824.9	6052.9	5465.0	5362.1	5895.7	5169.6	5350.5	4649.5
O/w % Share of CBE	99.2	98.4	99.0	98.4	98.2	98.6	97.5	97.6	98.3	97.4	97.5	96.1

Table 1: Herfindhal Index of Some Major Indicators of the Ethiopian Commercial Banking Market (Cont'd)

	2002/03				2003/04				2004/05			
Particulars	QI	QII	QIII	QIV	QI	QII	QIII	QIV	QI	QII	QIII	QIV
HI of Total Assets	6508.2	6461.9	6411.8	6597.1	6351.6	6125.6	6308.1	6180.3	5969.8	5885.6	5747.2	5717.5
O/w % Share of CBE	99.0	99.0	99.0	99.1	98.9	98.7	98.9	98.7	98.6	98.5	98.3	98.3
HI of Total Deposits	6361.3	6293.8	6212.2	6109.3	5881.3	5881.9	5832.9	5768.4	5704.0	5572.8	5358.8	5234.0
O/w % Share of CBE	98.8	98.8	98.7	98.6	98.3	98.3	98.2	98.1	98.1	97.9	97.6	97.4
HI of Saving and Time Dep.	4912.3	4843.4	4720.2	4604.6	4456.7	4383.7	4171.5	4116.8	4053.6	3921.2	3720.5	3700.0
O/w % Share of CBE	96.6	96.4	96.1	95.7	95.2	95.0	94.2	93.9	93.6	93.0	92.2	92.1
HI of Loans Outstanding	5058.2	4669.1	4473.1	4171.9	4022.6	3947.6	3826.5	3538.8	3588.1	3502.4	3347.6	3282.3
O/w % Share of CBE	97.0	96.1	95.6	94.6	93.9	93.5	93.0	91.1	91.3	90.7	89.7	89.1
HI of Loan Disbursement	3542.5	2460.5	1748.4	2238.5	2929.7	2003.0	2021.8	3013.0	4081.9	2512.7	2183.9	2111.2
O/w % Share of CBE	89.7	60.2	43.6	65.5	81.2	45.4	37.6	81.9	93.2	74.0	66.0	60.4
HI of Loan Collection	3838.2	3980.6	3107.2	2676.3	2866.2	2508.7	4553.3	2477.0	3177.9	2707.5	2880.3	2362.7
O/w % Share of CBE	92.3	93.3	85.4	79.5	83.1	70.9	95.2	77.2	87.4	81.2	81.1	66.7
HI of Gross Income	5278.1	5073.4	4641.5	5472.5	4482.5	4284.9	3506.6	4619.7	4158.8	3832.2	3969.2	2895.2
O/w % Share of CBE	97.5	97.1	96.0	97.9	95.6	94.7	90.9	96.0	94.9	92.7	94.2	86.1

Table 2: The OLS Estimates of the Model Calculated by TEEF

	Coefficient	Standard-error	t-ratio
beta 0	0.047549484	0.063569798	0.74798859
beta 1	0.28852586	0.12822299	2.2501882
beta 2	0.26736341	0.064279656	4.1593784
beta 3	-0.27168066	0.065271420	-4.1623218
beta 4	0.099458513	0.017052243	5.8325766
beta 5	0.84051025	0.43587106	1.9283461
beta 6	-0.44569207	0.32013904	-1.3921828
beta 7	2.08068920	0.29584441	7.0330524
beta 8	0.16571223	0.37565144	0.44113297
beta 9	1.07373500	0.16768184	6.4034063
beta10	-0.27622010	0.075862992	-3.6410388
beta11	0.096487077	0.057760284	1.6704744
beta12	-0.18636803	0.080245551	-2.3224718
beta13	-0.006862116	0.028222387	-0.24314443
beta14	-0.42640861	0.20120397	-2.1192853
beta15	-0.24368844	0.10975812	-2.2202316
beta16	-0.14609388	0.10055852	-1.4528245
beta17	0.045667842	0.024392470	1.8722107
beta18	-0.090462562	0.086837439	-1.0417461
beta19	-0.073643205	0.10704807	-0.68794518
beta20	-0.079549450	0.036184538	-2.1984376
beta21	0.049828963	0.063515886	0.78451180
beta22	-0.064760548	0.028726163	-2.2544100
log likelihood function =	4.6805485		

Table 3: Final Maximum Likelihood Estimates of the Model Calculated by TEEF

	Coefficient	Standard-error	t-ratio
beta 0	-0.15163627	0.076012280	-1.9948918
beta 1	0.10156230	0.13084573	0.77619877
beta 2	0.26096832	0.056851639	4.5903394
beta 3	-0.26295454	0.056622674	-4.6439796
beta 4	0.097845407	0.014895946	6.5685930
beta 5	0.53789501	0.39635698	1.3570974
beta 6	-0.45125351	0.28301833	-1.5944321
beta 7	2.2369725	0.25655534	8.7192593
beta 8	-0.10859608	0.33923453	-0.32012094
beta 9	1.0435382	0.16569111	6.2980942
beta10	-0.16279086	0.067513906	-2.4112197
beta11	0.055957985	0.054609702	1.0246894
beta12	-0.16015821	0.072437763	-2.2109767
beta13	-0.0062035194	0.027311615	-0.22713851
beta14	-0.17548910	0.19881506	-0.88267509
beta15	-0.21665777	0.10647287	-2.0348636
beta16	-0.27437772	0.099807121	-2.7490796
beta17	0.035331761	0.022890982	1.5434795
beta18	-0.059863679	0.080535282	-0.74332240
beta19	0.053014460	0.11047350	0.47988394
beta20	-0.066340905	0.034960167	-1.8976141
beta21	0.080553065	0.058140665	1.3854858
beta22	-0.062816490	0.025560510	-2.4575601
delta 0	-0.19866539	0.30018987	-0.66179912
delta 1 (BN)	0.034871944	0.029607569	1.1778050
delta 2 (Age)	0.066092097	0.11871950	0.55670803
delta 3 (Assets)	0.00036552297	0.00027869649	1.3115449
delta 4 (Capital)	-0.022002964	0.0087359165	-2.5186784

Log likelihood function = 19.855969

LR test of the one-sided error = 30.350841

Number of restrictions = 6

[Note that this statistic has a mixed chi-square distribution]

Table 4: Final Maximum Likelihood Estimates of the Model Calculated by ECF

	Coefficient	Standard-error	t-ratio
sigma-squared	0.052418180	0.022660438	2.3132024
gamma (γ)	0.0058520301	0.41684257	0.014038946
mu (μ)	0.032236983	0.69132884	0.046630463
eta (η)	0.047664555	0.17571094	0.27126686

Table 5: Fiscal Year Average Cost Efficiency Result of Private Commercial Banks[1]

Code of the Bank	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
Bank I	2.229	1.669	1.253	1.414	1.273	1.376	1.331	1.384	1.092
Bank II	1.299	1.559	1.216	1.070	1.079	1.101	1.252	1.111	1.041
Bank III	1.204	1.267	1.160	1.154	1.148	1.130	1.383	1.089	1.171
Bank IV	1.233	1.263	1.216	1.297	1.320	1.323	1.557	1.113	1.122
Bank V		2.290	1.427	1.184	1.131	1.125	1.271	1.229	1.133
Bank VI			1.245	1.103	1.107	1.082	1.118	1.066	1.048
Average	**1.491**	**1.610**	**1.253**	**1.204**	**1.177**	**1.190**	**1.319**	**1.165**	**1.101**

[1] For fiscal year 2005/06 the average of only the two quarters is taken.

Fig. 1: Trend in HI Value of Total Assets of Commercial Banks

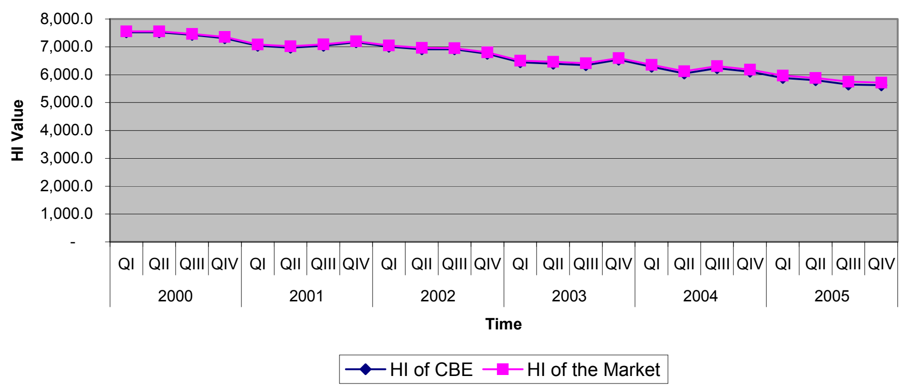
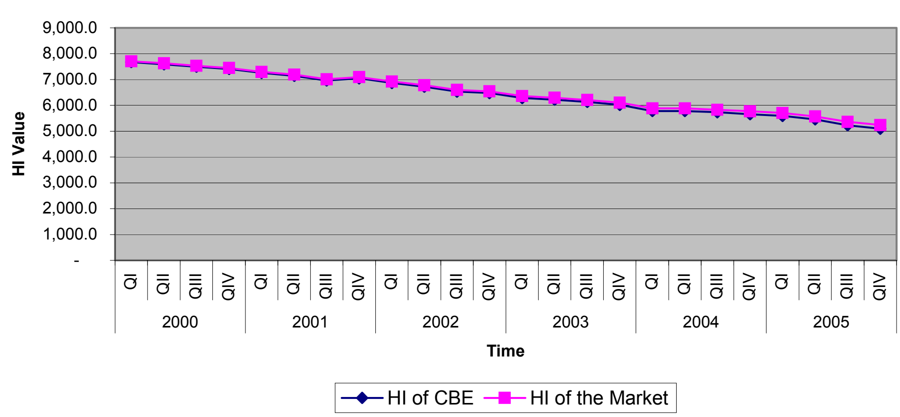


Fig. 2: Trend in HI Value of Total Deposits Mobilized by Commercial Banks



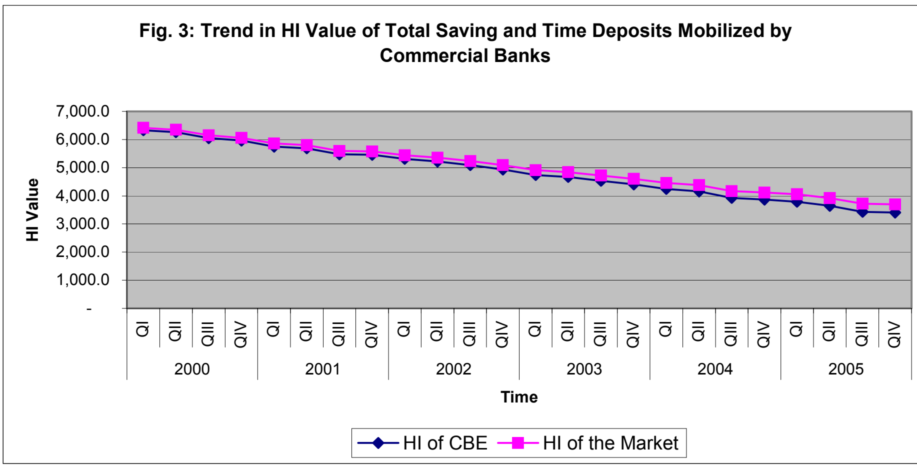


Fig. 3: Trend in HI Value of Total Saving and Time Deposits Mobilized by Commercial Banks
HI Value
7,000.0
6,000.0
5,000.0
4,000.0
3,000.0
2,000.0
1,000.0
-
QI
QII
QIII
QIV
2000
2001
2002
2003
2004
2005
Time
HI of CBE
HI of the Market

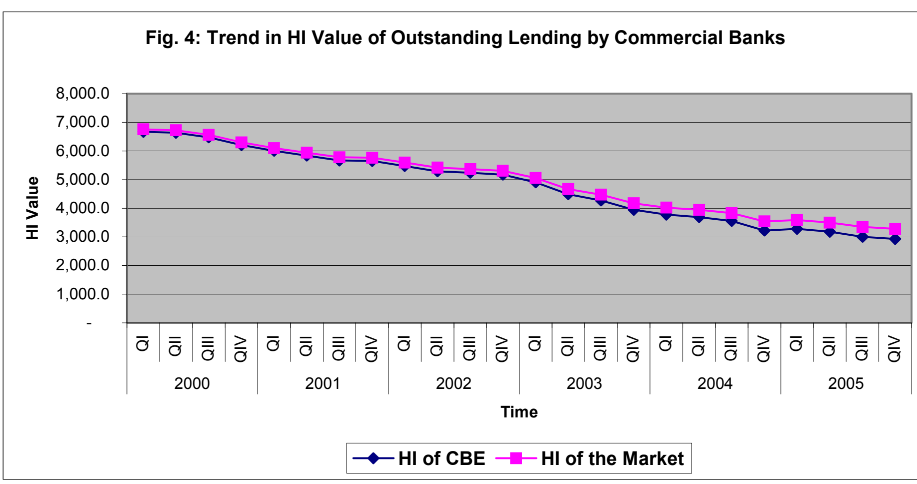


Fig. 4: Trend in HI Value of Outstanding Lending by Commercial Banks
HI Value
8,000.0
7,000.0
6,000.0
5,000.0
4,000.0
3,000.0
2,000.0
1,000.0
-
QI
QII
QIII
QIV
2000
2001
2002
2003
2004
2005
Time
HI of CBE
HI of the Market

Fig. 5: Trend in HI Value of Loan Disbursement by Commercial Banks

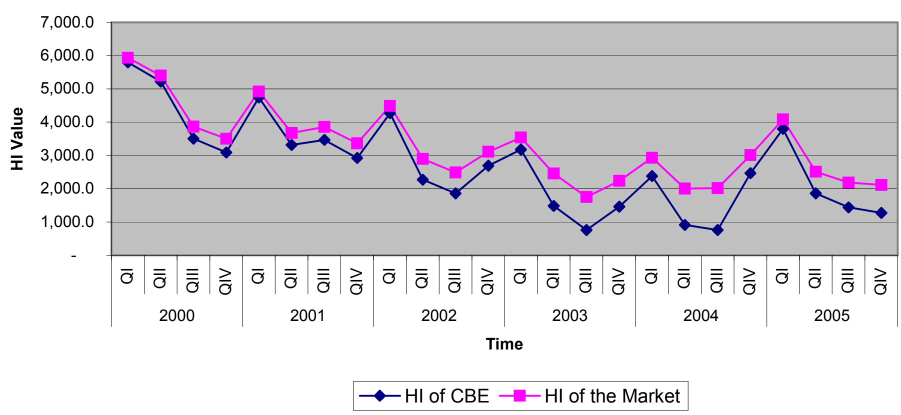


Fig. 6: Trend in HI Value of Loan Collection by Commercial Banks

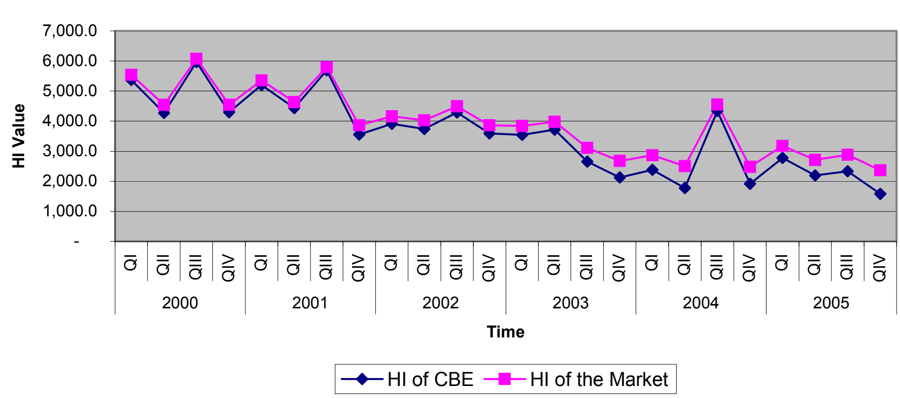


Fig. 7: Trend in HI Value of Gross Income of Commercial Banks

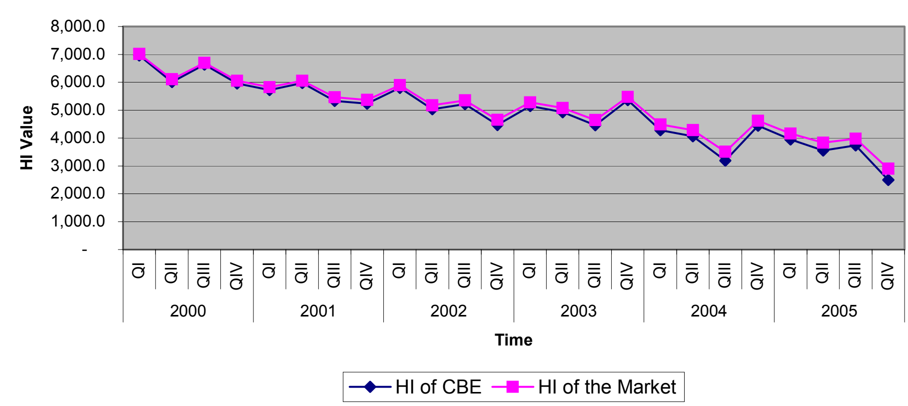


Fig. 8: Trends in X-inefficiency of Private Commercial Banks

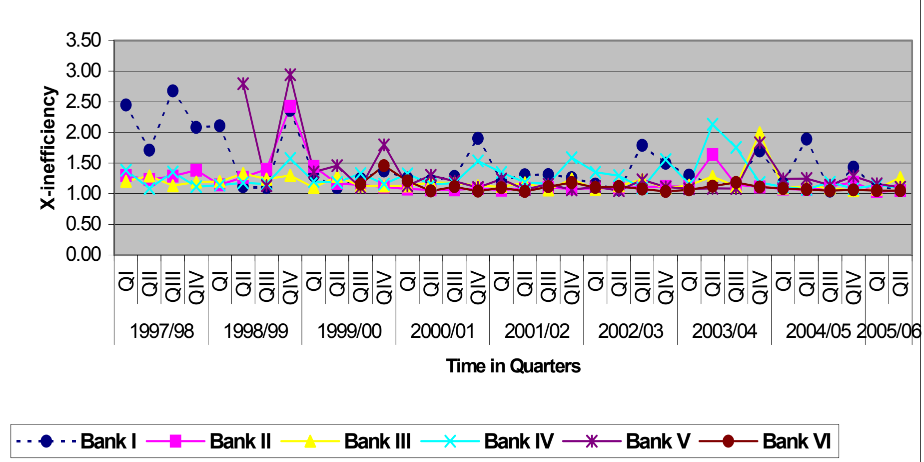


Fig. 9: Trends in X-inefficiency of Private Commercial Banks (Fiscal Year Average)