

Cost Efficiency and Ownership Structure of Commercial Banks in Ethiopia: An application of non-parametric approach

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Abstract

The study was carried out to examine the relationship between cost efficiency and ownership structure of commercial banks in Ethiopia using data envelopment analysis (DEA). Moreover, the study made an attempt to explore the key factors that affect the cost efficiency of the commercial banks using the Tobit model. In measuring the cost efficiency of the commercial banks the study used the input-oriented BCC model. The study found that the average cost efficiency of state-owned commercial banks over the period 2000-2009 is 0.69 while that of the private commercial banks is 0.74. The aggregate cost efficiency of Ethiopian commercial banks is found to be 0.73. The Kruskal-Wallis (K-W) non-parametric test indicates that the difference between the cost efficiency of the state-owned and private commercial banks is statistically insignificant. The study found little statistical evidence to conclude that the state-owned commercial banks are less cost efficient than the private commercial banks. Thus, ownership structure has no significance influence on the cost efficiency of commercial banks in Ethiopia. In addition, the study has identified bank size, loan loss reserve to total assets, market share, market concentration, capital adequacy, and return on average assets as the key factors that influence the cost efficiency of the commercial banks.

Key words: DEA, Input -oriented BCC model, cost efficiency, and K-W non-parametric test

1. Introduction

Though history tells that Ethiopia used to make its own coins to transact since time immemorial, modern banking in the country began in 1905 during the era of Minelik II. Since then the banking sector of Ethiopia has undergone a number of changes. In early 1900s in general and during the reign of the emperor (1950s through early 1970s) in particular, both state and private commercial banks used to operate in the country. During the same period, foreign¹ banks were also allowed to invest in the banking market. However, the military regime that came to power in 1974 issued a new proclamation that resulted in nationalization of all private commercial banks and insurance companies that were operating in the country. In the period 1974 to 1991, thus, it was only the government that was legally allowed to take part in the country's financial sector. Nonetheless, following the downfall of the military regime in 1991, the current government issued a new banking proclamation to reform the country's financial sector so as to suit its free market policy. The momentous proclamation, most frequently noted as proclamation no. 183/1994, allows only domestic investors to take part in the financial sector of the country. Even the amended proclamation that is issued in 2008 (proclamation No. 592/2008) reinforces the stand of proclamation No.183/1994 and prohibits foreign national to take any part in the financial sector of the country. In any case, since the issuance of proclamation No. 183/1994, state-owned commercial banks and private commercial banks owned by domestic investors have been operating side by side in the country. Notwithstanding the longstanding customer

¹The new banking law that was issued in 1963 allowed foreign banks to operate in the country provided that they were 51 percent owned by Ethiopian nationals

relationship that the state-owned commercial banks have built over time, the private commercial banks are increasing their outreach and growing in terms of their assets, deposits and loans. Figures 1, 2 and 3 show the average assets, deposits and loans of state-owned and private commercial banks over the period 2000-2009. As the figures indicate, the share of private commercial banks in deposits, assets and loans has increased over the study period. The total deposits of state owned commercial banks ranges between Birr16, 218 million (which counts 88 percent of the total deposits of the commercial banks) in 2000 and Birr45, 323 million (60 percent of the total deposits of the commercial banks) in 2009 while that of the private commercial banks ranges between Birr2, 204.9 million (12 percent of the total deposits of the commercial banks) in 2000 and Birr29, 976.2 million (40 percent of the total deposits of the commercial banks) in 2009. In the same fashion the shares of the state owned commercial banks in terms of total assets and total loans and advances are declining while the share of the private commercial banks is increasing year after year over the period 2000-2009.

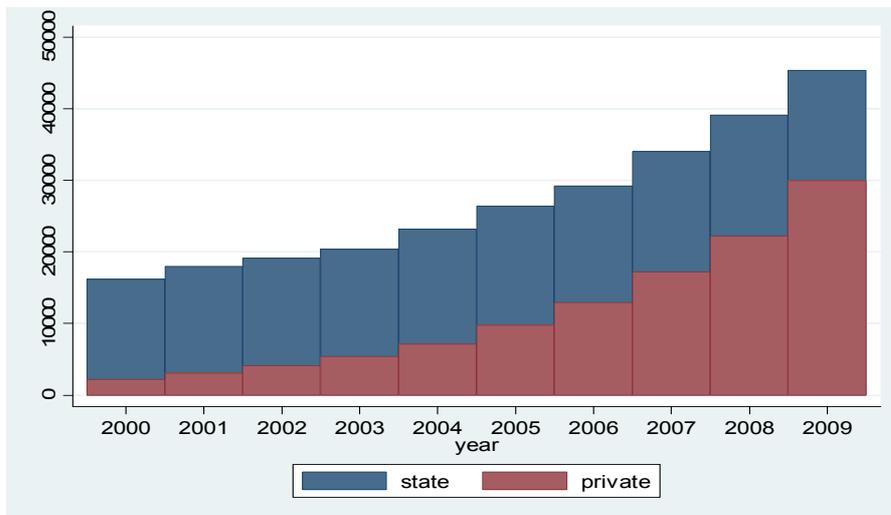


Figure 1 Deposits of state and private commercial banks

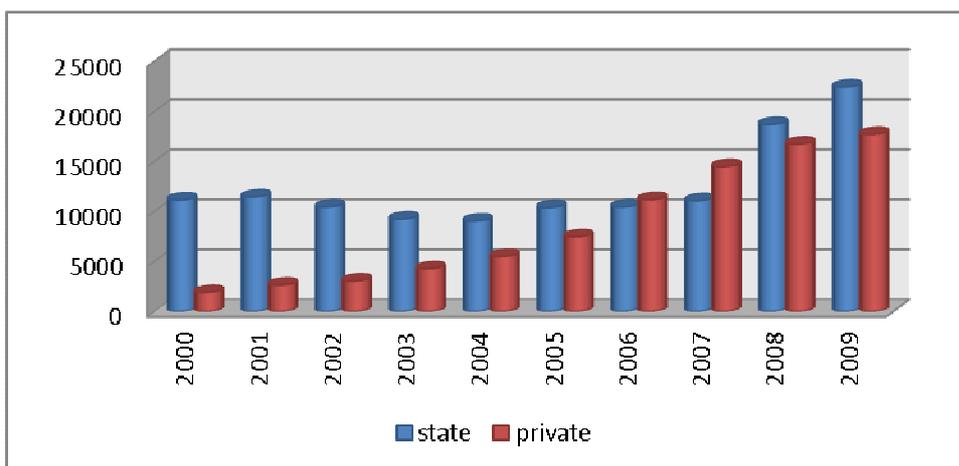


Figure 2 total loans and advances of state and private commercial banks

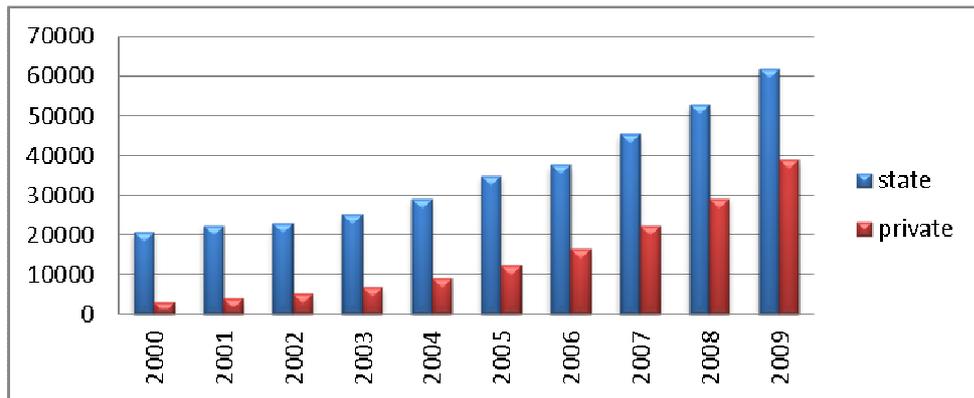


Figure 3 total assets of state and private commercial banks

The aim of this paper is to examine the relationship between cost efficiency and ownership structure and explore the key factors that affect the efficiency of commercial banks in Ethiopia. The relationship between cost efficiency and ownership structure of banks has been examined by a number of researchers. However, there is no consensus as far as the relationship between cost efficiency and ownership structure is concerned in the banking literature. For instance, researchers such as Unal et al. (2007) and Nigmonov (2010) found that state-owned commercial banks are as cost efficient as private commercial banks. Their study indicates that ownership structure has insignificant influence on banks' level of efficiency. On the other hand, researchers such as Isik and Hassan (2002), Frimpong (2010), and Tochkov and Nenousky (2009) contend that state owned commercial banks are less cost efficient than private commercial banks. Yet a study made by Gardener et al (2011) and Ray and Das (2010) reveal that state owned commercial banks are more efficient than their private counterparts. The same argument has led a number of researchers and scholars to look into the association between efficiency and ownership structure of banks in various countries for long. However, studies that examine this relationship in Ethiopia are rare. The only study that attempted to examine the efficiency of state and private commercial banks in Ethiopia is the one that was carried out by Kiyota et.al (2007). They used financial ratios in measuring the efficiency of the commercial banks and concluded that the state owned commercial banks were less efficient than the private commercial banks. However, financial ratios by their very nature are crude measures of performance as they fail to capture the multi-input and multi-output variables of banks. Consequently, researchers and academicians, such as Tahir et.al (2010), have suggested that results obtained using financial ratios to be interpreted with cautiousness. Though financial ratios are often used to measure the performance of banks, methods, such as the data envelopment analysis (DEA), that takes into account banks' multiple input and output variables reflect the true affairs of banks than the ordinary financial ratios, and thus have attracted the attention of researchers and academicians. Thus, the present study uses the data envelopment analysis (DEA) model to measure the cost efficiency of state-owned and private commercial banks. Needless to say, the present study is unique in its kind as it uses the DEA model to measure the cost efficiency of state and private commercial banks in Ethiopia for the first time. The fact that both state owned and private commercial banks are operating in the country makes the present study so vital to empirically examine the relationship between cost efficiency and ownership structure of commercial banks in Ethiopia.

The remainder of the paper is organized as follows: section two presents a brief account of the models used in analysis; section three presents the findings of the study, and; section four concludes.

2. Methodology

The audited annual financial reports of each commercial bank over the period 2000-2009 are obtained from the country's central bank, National Bank of Ethiopia. The total number of commercial banks

considered in the study ranges between 8 and 12 in 2000 and 2009, respectively. For the purpose of measuring the cost efficiency of the commercial banks, the data envelopment analysis (DEA) model is used. The Tobit regression model has been employed to explore the key factors that affect the cost efficiency of the commercial banks.

2.1. The DEA model: - Data envelopment analysis² has been frequently used to measure the relative efficiency of firms. Initially, data envelopment analysis was used to measure the relative efficiency of service rendering public organizations such as schools and hospital. Most recently, its application has been extended to analyze the relative efficiency of banks (Assaf et.al, 2011; AlKhathlan and Malik, 2010; Delis and Papanikolaou, 2009). The study carried out by Fethi and Pasiouras (2010) indicates that out of 196 studies that they have reviewed about 77 percent of them used the DEA model in measuring the efficiency and productivity growth of banks. Their study reinforces the fact that DEA has become one of the most widely used techniques of measuring efficiency of firms. The DEA measures the relative efficiency of firms. Unlike the parametric approach, DEA does not require a particular functional form for the technology to estimate the efficiency of a decision making unit (Hassan and Sanchez, 2007; Maudos and Pastor, 2003). That is, unlike the parametric approach, DEA makes no assumption as far as the form of the production function is concerned. DEA makes use of the observed input and output values of individual decision making units (DMUs) to empirically estimate the “best practice production frontier”. Thus, a DMU that falls on the efficient frontier that is enveloped by the DEA model is said to be efficient relative to its peers. A DMU that does not fall on the frontier is considered as inefficient in relative terms.

The two most commonly used DEA models include the CCR model, and the BCC model. The CCR model works best under the constant return to scale (CRS) hypothesis which presumes that all decision making units (DMUs) are operating at an optimal scale (see Charnes et al, 1978). However, factors such as imperfect competition and constraints in finance among others may not allow a bank to operate at an optimal scale. The BCC model, on the other hand, works best under the variable return to scale hypothesis which assumes that not all decision making units (banks) are operating at an optimal scale (see Banker et al, 1984). More profoundly, the BCC model essentially begins with the CCR model, and presumes that the DMUs that are being evaluated may be operating under variable return to scale. This denotes that in applying the BCC model the relative efficiency of each DMU is found by comparing it with those efficient DMUs that are operating at a similar capacity. Since the BCC model accounts for the variability in scope of operation that may exist among the banks, we prefer the BCC model to the CCR model in our analysis. The application of DEA model provides two alternatives in measuring the efficiency of banks. These two alternative models include the input-oriented DEA model and the output-oriented DEA model. One uses the input-oriented DEA model if the center of attention is to examine a firm’s ability to minimize the quantity of inputs used for a given level of output (without changing output level). The output-oriented DEA model is used if one is to examine the ability of a firm to maximize its output using a given level of input (without changing input level). The choice of the input-oriented DEA model or the output-oriented DEA model depends on the level of discretion the managers of a firm have either on the input side (cost) or the output side (revenue). If managers have more control on the input side (cost), the input-oriented DEA model is appropriate in measuring the efficiency of a firm. Otherwise, one has to go for the output-oriented DEA model. In the Ethiopian context, basically bank managers have more control on the input side than the output side. Thus, we choose the input-oriented DEA model in measuring the cost efficiency of Ethiopian commercial banks.

2.1.1. Model specification: - Considering DEA as providing a price on each of the inputs and a value for each of the outputs, the cost efficiency of a decision making unit can be defined as the ratio of the minimum cost at which it is possible to produce a given vector of outputs as determined by the

² *Data envelopment analysis is a non-parametric technique that was initially proposed by Charnes et.al (1978).*

frontier to the actual cost incurred to obtain the same quantity of outputs. This is mathematically given by:

$$CE_i = \frac{w_i x_{io}^*}{w_i x_{io}} \quad (1)$$

Where; w_i is a vector of input prices for the i -th bank, x_{io}^* is the cost minimizing vector of input quantities for the i -th bank, provided the input prices and the output levels y_i , and CE_i is the cost efficiency of the i -th bank. Supposing k inputs, m outputs, n DMUs (number of banks), w_i input prices, x_{io} is a vector of inputs for DMU $_i$, y_i is a vector of outputs for DMU $_i$, X is $K \times N$ input matrix, and Y is an $M \times N$ output matrix, the following linear programming model can be run to determine the cost efficiency of DMU $_0$ (Zhu, 2003-2011):

$$\text{Min } \sum_{i=1}^k w_i x_{io}^*$$

Subject to

$$\sum \lambda_j x_{ij} - x_{io}^* \leq 0, \quad i = 1, 2, 3 \dots k \quad (2)$$

$$\sum \lambda_j y_{mj} - y_{mo} \geq 0, \quad j = 1, 2, 3 \dots k$$

$$\lambda_j, x_{io}^* \geq 0$$

Where, λ is an $N \times 1$ vector of constants. The model in equation 2 works best under the constant return to scale assumption which assumes that all banks are operating at an optimal scale. Since the study has chosen to make use of the BCC model which works best under the VRS, the constant return to scale linear programming (equation 2) has to be modified to account for the variability in scope of operation that may exist among the commercial banks. This is done by adding the convexity constant $\sum \lambda_{j=1}$ (Banker et.al, 1984). Adding $\sum \lambda_{j=1}$ to equation 2 above results in:

$$\text{Min } \sum_{i=1}^k w_i x_{io}^*$$

Subject to

$$\sum \lambda_j x_{ij} - x_{io}^* \leq 0, \quad i = 1, 2, 3 \dots k \quad (3)$$

$$\sum \lambda_j y_{mj} - y_{mo} \geq 0, \quad j = 1, 2, 3 \dots k$$

$$\lambda_j, x_{io}^* \geq 0, \quad \sum \lambda_j = 1$$

2.1.2. Selection of inputs and outputs: The use of DEA model in measuring bank efficiency requires selection of appropriate input and output variables. However, there is no consensus as to the selection of the inputs and outputs in the banking literature. Aly et al. (1990:214) have rightly reflected the problem related to the output selection saying that "...the lack of a consensus in the literature on the theory of banking leaves the definition of output an unsettled issue. Hence, it is obvious that a precise definition of bank output is not possible at the present." Moreover, Grigorian and Manole (2002:10) recommend mandates of banks to be taken into account while defining the inputs and outputs for banks. More specifically, they state that "...the precise definition of a bank's "mandates" is important inasmuch as the definition of inputs and outputs stems from the functions that banks perform".

Though the production³ approach and the intermediation⁴ approach are the two main approaches that most previous researchers have depended in their selection of input and output variables, even those who follow the same approach have chosen different input and output variables in their analysis. For instance, Frimpong (2010), Wozniowska (2008), and Haslem et.al (1996) all used the intermediation approach but Frimpong treated deposits as input while the later two treated deposits as output. Berger and Humphrey⁵ (1997) contend that neither of the two approaches provides perfect figure since they both fail to fully capture the dual role of financial institutions. Though the study uses the intermediation approach since it examines the efficiency of all commercial banks in Ethiopia, it at the same takes into account the mandates of the commercial banks as Grigorian and Manole (2002) suggested in defining the inputs and outputs for the model. Thus, since deposit mobilization is one of the major performance indicators of commercial banks in Ethiopia and since Ethiopian commercial banks incur costs to mobilize deposits and have the mandate to inculcate the saving habits of the society, deposits are considered as output in the DEA model. Generally the study considers two inputs and two outputs. The inputs include labor and fixed assets and the outputs include net loans and deposits. The prices of the inputs are computed as follows: price of labor, employee salary and benefits to total assets; and the price of fixed assets, general expense to book value of physical assets. The operational definition of the inputs and outputs that are used in the model is indicated in Table1.

Table 1 Operational definition of inputs and outputs of the DEA model

Inputs	Definition	Input prices
1. Labor (X_1)	Total expenditures on employees (i.e. employees' salary and benefits)	Total personnel expenses to total assets ⁶
2. Fixed assets (X_2)	Book value of physical capital and premises	General expense to book value of fixed assets
Outputs		
1. Net loans (Y_1)	Total customer loans less provision for doubtful loans	
2. Deposits (Y_2)	Total customer deposits	

2.2. The Tobit Model

³ The production approach assumes that banks produce deposits and loans using labor and physical capital

⁴ The intermediation approach assumes banks as intermediaries between savers and borrowers

⁵ They generally suggest the production approach for measuring the efficiency of bank branches and that of the intermediation approach for measuring the efficiency of the financial institutions as a whole

⁶ Since obtaining data about the number of employees of each bank over the entire period under study is extremely difficult, the total asset figure has been used as a proxy for the number of employees. (See for example, Gardener et al ,2011; Vennet, 2002; Amidu, 2011

In situations in which the value of the dependent variable, such as efficiency scores, is constrained between one and zero, the Tobit regression model is believed to generate consistent estimates of regression coefficients than the ordinary least square (OLS) models. Thus, following the footprints of those who tried to assess the factors that affect the efficiency of banks such as Delis and Papanikolaou (2009), the present study used the Tobit regression model to look into the major variables that affect the cost efficiency of the commercial banks in Ethiopia. The study considered bank size, ownership, ROAA, market concentration, capital adequacy, credit risk, operation costs, liquidity, market share, and GDP growth rate as factors that may influence the efficiency of the commercial banks.

The equation can be specified as:

$$Eff_{cp} = \beta_0 + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + \dots + \beta_n x_{nit} + \epsilon_{it} \quad (4)$$

Where: Eff_{cp} are the cost efficiency scores estimated using DEA, the subscripts i and t denote bank i at time t , β_0 is the constant, $\beta_1, \beta_2, \dots, \beta_n$ are the coefficients, ϵ is the error term, and x_1, x_2, \dots, x_n represent the explanatory variables.

3. Result and discussion

3.1. Aggregate cost efficiency of Ethiopian Commercial Banks

2. Often it is necessary to look into the aggregate measures of firms' performance as it provides an overall figure of what is going on in the industry to which the firms belong. On top of measuring the cost efficiency of state and private commercial banks, the study has attempted to examine the overall cost efficiency of Ethiopian commercial banks over the period 2000-2009. The study reveals that the aggregate cost efficiency of Ethiopian commercial banks is 0.73 over the period 2000-2009. This implies that an average commercial bank has incurred 27 percent more costs than required to produce the given level of outputs over the period under study. This in other words means that an average commercial bank could have cut its costs down by 27 percent without making any change in its level of outputs over the study period.

3. It may be important to look at the aggregate cost efficiency of Ethiopian commercial banks on a year to year basis. As it is shown in Table2, the cost efficiency of Ethiopian commercial banks was found to be 0.66 in FY 2000 which slightly went up to 0.71 in FYs 2001 and 2002. The cost efficiency of Ethiopian commercial banks declined from 0.71 in FY 2002 to 0.70 in FY 2003 and went further down to 0.66 in FYs 2004 and 2005. Though the cost efficiency of Ethiopian commercial banks increased from 0.66 in FY 2005 to 0.83 in FY 2006, it slightly declined to 0.80 in FY 2007. The cost efficiency of Ethiopian commercial banks was found to be 0.83 in FY 2008 which went down to 0.75 in FY 2009. Generally, the study reveals that an average commercial bank could have reduced its cost by 34 percent in FY 2000, 29 percent in FYs 2001 and 2002, 30 percent in FY 2003, 34 percent in FYs 2004 and 2005, 17 percent in FY 2006, 20 percent in FY 2007, 17 percent in FY 2008 and 25 percent in FY 2009.

Table 2 aggregate cost efficiency of Ethiopian Commercial Banks over 2000-2009

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-9
N*	8	8	8	8	8	9	9	10	10	12	
CE**	3	3	4	5	5	5	6	7	6	4	
%***	37.5	50	50	62.5	62.5	55.6	66.7	70	60	33.3	
Mean	0.66	0.71	0.71	0.70	0.66	0.66	0.83	0.80	0.83	0.75	0.73
Minimum	0.35	0.38	0.32	0.24	0.19	0.13	0.37	0.45	0.38	0.37	
Maximum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Std.deviation	0.29	0.28	0.30	0.34	0.34	0.36	0.25	0.21	0.20	0.22	

*Source: Own calculation using DEA Frontier-2011, ** number of cost efficient banks, % number of cost efficient bank in percentage, N is the total number of commercial banks*

3.2. Cost efficiency of state and private commercial banks

Table 3 presents the cost efficiency of state and private commercial banks over the period 2000-2009. The cost efficiency of the state-owned commercial banks over the period 2000-2009 is 0.69. This implies that a state-owned commercial bank on average could have incurred only 69 percent of what it actually outlaid to produce the same level of output over the study period. On the other hand, the cost efficiency of the private commercial banks over the study period is found to be 0.74. This reflects that an average private commercial bank could have incurred only 74 percent of the cost it actually incurred to yield the same level of output over the study period. Stated in other words, the study indicates that an average state-owned commercial bank could have cut its cost, without making any reduction in its output level, by 31 percent over the study period while an average private commercial bank could have reduced its cost by 26 percent over the same period. Moreover, the study shows that the average cost of efficiency of the private banks (0.74) is a bit higher than the aggregate cost efficiency of Ethiopian commercial banks (0.73) while that of the state-owned commercial banks (0.69) is far lower than the aggregate cost efficiency (0.73).

So as to examine whether or not there is statistically significance difference between the cost efficiency of state and private commercial banks, the study used the Kruskal-Wallis⁷ (K-W) non-parametric test. Since the number of observations from each group is small on a yearly basis, the study performed the test on the scores of the pooled data comprising of 90 observations. The result of the Kruskal-Wallis (K-W) non-parametric test shows that there is no statistically significance difference between the cost efficiency of state-owned commercial banks and private commercial banks in Ethiopia. The result of the study suggests that the state-owned commercial banks are operating as efficiently as that of the private commercial banks. Against the findings of Kiyota et al (2007), Isik and Hassan (2002), and Frimpong (2010) who argue that state owned commercial banks are less cost efficient than private commercial banks, the result of the study is consistent with the finding of Unal et al. (2007) and Nigmonov (2010) who contend that state owned commercial banks are as cost efficient as private commercial banks. The study indicates that state-owned commercial

⁷ The Kruskal Wallis test is often considered as the non-parametric equivalent of the parametric One Way Analysis of Variance (ANOVA) in which both serve the same purpose of comparing differences that may exist between different groups.

banks are as cost efficient as private commercial banks in Ethiopia. This could be explained in a number of ways. First, the state owned commercial banks have been operating since long time and might have learnt a lot in carrying out banking activities in the most efficient ways. Second, following the liberalization of the country's financial sector in 1994, the state owned commercial banks are required to perform their activities as business organizations and equally compete with the private commercial banks in mobilizing savings, extending loans and rendering other banking services. This has forced the state owned banks to make use of resources in the most efficient ways in their endeavor to remain competitive in the banking market.

Table 3 Cost efficiency of state and private commercial banks in Ethiopia over 2000-2009

Bank	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	average
State											
Mean	0.68	0.70	0.67	0.62	0.60	0.57	0.73	0.76	0.81	0.82	0.69
Min	0.35	0.40	0.34	0.24	0.20	0.13	0.46	0.52	0.62	0.63	
Max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Std.dev	0.46	0.42	0.47	0.54	0.57	0.62	0.38	0.34	0.27	0.26	
N*	2	2	2	2	2	2	2	2	2	2	2
Private											
Mean	0.66	0.71	0.72	0.73	0.68	0.68	0.86	0.81	0.83	0.74	0.74
Min	0.36	0.38	0.32	0.24	0.19	0.22	0.37	0.45	0.38	0.37	
Max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Std.dev	0.28	0.27	0.28	0.32	0.32	0.33	0.24	0.20	0.21	0.22	
N**	6	6	6	6	7	7	8	8	8	10	

* The number of state-owned commercial banks, **the number of private commercial banks

3.3. Determinants of cost efficiency

An attempt has been made to explore the key factors that influence the cost efficiency of the commercial banks. To that end, thirteen explanatory variables have been regressed in the Tobit model against the cost efficiency of the commercial banks. The result of the Tobit regression analysis is presented in Table 4. The study found six of the explanatory variables to have significant influence on the cost efficiency of the banks.

Bank size is statistically significant and is also positively correlated with cost efficiency. A positive correlation between bank size and cost efficiency suggests that bank size has a positive impact on

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