ESTIMATING TECHNICAL EFFICIENCY OF SELECTED COMMERCIAL BANKS IN ETHIOPIA USING DATA ENVELOPMENT ANALYSIS

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Abstract

The main objective of this study is to estimate the technical efficiency of 13 selected commercial banks in Ethiopia for the period 2010 to 2017 using Data Envelopment Analysis. Both the constant return to scale and variable return to scale efficiency indicate that the state owned bank has better technical efficiency than private banks. Moreover, Dashen Bank Share Company, Awash international bank, United bank Share Company, Nib international bank and Birhan international bank were efficient banks under constant return to scale. Besides, all banks are technically efficient under variable return to scale input oriented except Cooperative bank of Oromia. Finally, Commercial Bank of Ethiopia, Dashen Bank Share Company, United Bank Share Company, Nib International Bank and Birhan international Bank were efficient banks under output oriented constant returns to scale DEA and cooperative bank of Oromia is the only bank that has increasing return to scale in the study period.

Key words: *Data envelopment analysis, returns to scale, input oriented, output oriented*

Introduction

The development of an economy is relied on the performance of financial sector. Banking sector is the vital part of Ethiopian financial system, and thus for sound economic development, banks efficiency has become crucial (Sathye, 2001: Gishkori and Ullah, 2013). Efficiencies measurement of banks gets attention into banking system and potential for the economic development of a country. Moreover, efficiency of banking system is directly contributing to the productivity of the economy at large (Kumar and Gulati, 2008).

The interest of shareholders needs to be ensured that bank value is maximized and rewarded with reasonable returns and obviously only efficient banks ensure reasonable returns. From customers' point of view, as per their experience, only efficient banks can offer better quality services at reasonable costs. In a dynamic and competitive market environment, only efficient banks will survive and maintain high market share, and products positioning, and inefficient ones will eventually not compete and survive in the market. The efficient banks are able to compete because of their lower operational costs.

Thus to improve the banks performance, evaluating its efficiency and identifying the sources of inefficiency is a matter of serious interest in the finance literature (Yang, 2011).

The bank is said to be efficient when it generates a maximum potential amount of output possible with the given level of inputs available. The position held by the production frontier denotes a combination of technically efficient input and output. Also, when a bank generates an amount of output under the production frontier, the bank is said to be inefficient. It indicates a production of output less than the maximum achievable amount of output.

Thus, the aim of this paper is to estimate the efficiency of commercial banks using Data Envelopment Analysis during the period 2010 to 2017 inclusive.

Review of Emperical Research studies

Battese & Coelli (1988) applied the stochastic production frontier and in their study technical efficiency is defined in a broader sense. They considered the technical efficiency as the proportionate of a firm's average perceived production, its recognized effect, to the way of interrelated average production, assuming that the effect of the firm was null.

There are three approaches regarding the efficiency of banks. Firstly, intermediation approach states that financial institutions are considered as institutions transferring resources from savers to investors. In this approach, inputs are measured by the volume of deposits collected and funds borrowed from market participants whereas outputs are the loans and returns from investments. Secondly, the production approach assumed that financial institutions are producers of deposits and loans. In this approach, the number of accounts opened or transactions processed is the best measure of output, while the number of employees, physical capital and other operating costs used to perform those transactions are considered as inputs. Thirdly, under the assets approach it is assumed that the basic function of any financial institution is the creation of credit (loan), therefore, the value of assets of financial institutions acts as output in this approach (Zimkov, 2014).

According to Sathye M. (2003) interest expenses, non-interest expenses (inputs) and net interest income and non-interest income (outputs) have been used. A second DEA analysis was run with deposits and staff numbers as inputs and net loans and non-interest income as outputs on efficiency score of Indian banks for the year 1997-98. The scores were calculated using the non-parametric technique of Data Envelopment Analysis. The study shows that, the public sector banks have a higher mean efficiency score as compared to the private sector and foreign commercial banks in India.

Rao and Lakew (2012), measured the cost efficiency of the commercial banks in Ethiopia by using input-oriented BCC model. They found that the average cost efficiency of state-owned commercial banks over the period 2000-2009 is 0.69 while the private commercial banks are 0.74. The aggregate cost efficiency of Ethiopian commercial banks is found to be 0.73.

Methods and Materials

The population of this study was 18 commercial banks operating in Ethiopia. Of these banks 13 sample banks have been selected purposively on the basis of audited financial statements from the year 2010 to 2017. The financial statements of sample banks are gathered from NBE and their websites. Macro level data were obtained from World Bank data base.

Loan and advances, interest income and services and commission income are the output variables and interest expense, total deposits, net fixed assets, employee salary and benefits are the input variables considered to estimate the efficiency level with the help of DEAP 2.1 software package.

The DEA is a linear programming techniques to measure efficiency of production units or decision making units (banks) that produce multiple outputs. Several studies use this approach to measure efficiency of banks (Bhattacharyya, Lovell & Sahay (1997).

DEA is the non-parametric method, employed to estimate level of efficiency frontier and to evaluate the efficiency level of each decision making unit (each bank). Its 'conventional model is designed to maximize the relative efficiency of each decision making unit, provided that the relative efficiency scores obtained in this way for each decision making units are feasible for all the other decision making units in the data set. Therefore, the relatively efficiency can be estimated using DEA (Zimkov, 2014).

Fethi and Pasiouras (2010) noted most of efficiency measurement researches are done using DEA and they support that DEA has become one of the most widely used techniques of measuring efficiency of firms and it measures the relative efficiency of firms.

Results and discussion

According to the following table, six banks that are commercial bank of Ethiopia (CBE), Dashen bank Share Company (DBS), Awash international bank (AIB), United bank Share Company (UBS), Nib international bank (NIB), and Birhan international bank (BIB) are best practicing banks, therefore, these banks are relatively efficient banks over others. However, Cooperative Bank of Oromia (CBO) is the least efficient bank from all banks (11% technical efficiency).

Table 1; the overall technical efficiency of banks based on constant rate of return

Firm	CBE	DBS	AIB	BOA	WBS	UBS	LIB	CBO	NIB	ZBS	OIB	BIB	BRB	Mean
TE	1.00	1.00	1.00	0.89	0.78	1.00	0.95	0.11	1.00	0.98	0.97	0.88	1.00	0.89

Source: *Own calculation using DEA 2.1 software package.*

In the above table depicts, on average the mean value of overall technical efficiency of commercial banks is 89%. This indicates the banks have 11% inefficiency. Only three viz. banks Cooperative Bank of Oromia, Wogagn Bank Share

Company and Buna International Bank are observed to be inefficient banks as compared to the overall mean technical efficiency of all banks.

Variable return to scale helps to estimate efficiency whether an increase or decreases in inputs does result in a proportional change in outputs. This method includes both decreasing and increasing return to scale efficiency (Cooper, Seiford, & Zhu 2011).

Variable return to scale technical efficiency (input oriented) differs from constant return to scale technical efficiency that the earlier assumes the output variables changes in a non-constant proportion when the inputs variables changes in a constant rate. As such the changes in the output variables may be decreasing (DRS), increasing (IRS) or constant return in scale efficiency.

Table 2.VRS input oriented over all technical efficiency

Firm	CBE	DBS	AIB	BOA	WBS	UBS	LIB	CBO	NIB	ZBS	OIB	BIB	BRB	Mean
CRSTE	1.00	1.00	1.00	0.90	0.79	1.00	0.95	0.11	1.00	0.99	0.97	0.88	1.00	0.89
VRSTE	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.17	1.00	1.00	1.00	1.00	1.00	0.94
Scale	1.00	1.00	1.00	0.89	0.79	1.00	0.95	0.64	1.00	0.98	0.97	1.00	1.00	0.93
Scale Type	-	-	-	DRS	DRS	-	DRS	IRS	-	DRS	DRS	-	-	

Source: *Own calculation using DEA 2.1 software package.*

Table 2 indicates that, 11 banks are efficient based on VRS which were six only under CRS. Only two banks viz. Cooperative Bank of Oromia and Wogagen Bank Share Company are found to be inefficient.

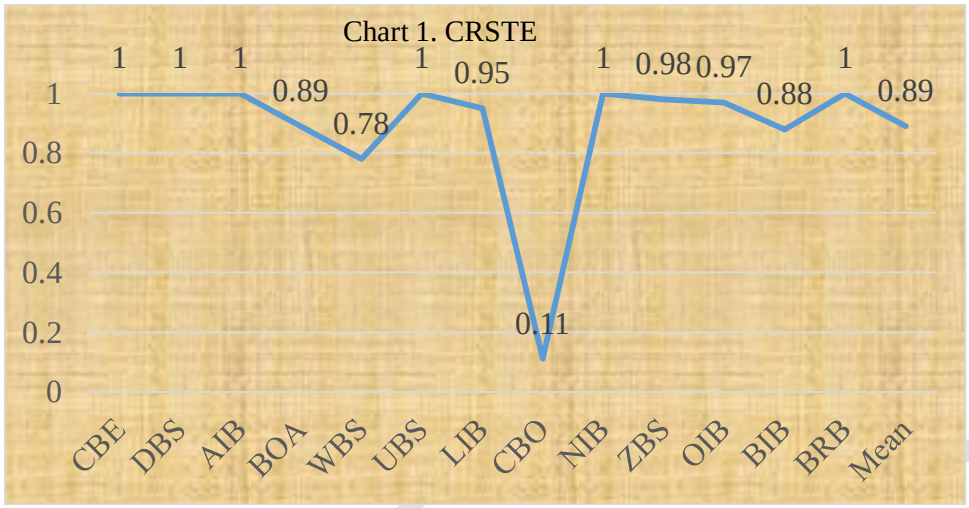
Scale efficiency indicates whether the returns on the output are increasing or decreasing when the input change for the given banks. It is determined by dividing technical efficiency based on constant return to scale by technical efficiency based on variable return to scale (Banker, Lopes & Almeida, 2012). The VRS DEA indicates that only Cooperative Bank of Oromia has increasing return to scale which means the bank outputs (total loans and advance, interest income, service charges and commission income) are increasing in greater proportion than that of increasing the inputs (interest expense, deposits, net fixed assets and employees salary and benefits) in a given proportion.

The increase in returns to scale occurs when the outputs increase by a larger proportion than the increase in the inputs during the production process (Banker *et al*, 2004).

Over all technical efficiency output oriented under CRS

The efficiency based on output oriented DEA is based on the assumption that inefficient unit is made efficient through the proportional increases of its outputs while the inputs proportion remains constant (Coelli, Hajargasht & Lovell 2008).

As noted in the chart table, the CRS technical efficiency indicates that CBE, DBS, AIB, UBS NIB, and BRN are efficient banks and other banks are not efficient according to the best practicing banks. CBO, WBS and BIB are the least efficient banks because their efficiency level is below the mean efficiency. The inefficiency level of CBO is 89%.



Source; Own calculation using DEA 2.1 software package

Output oriented over all technical efficiency VRS

According to the following table, all banks are efficient except WBS and CBO. Only CBO is below the mean efficiency level because as it needs to minimize the costs of inputs or increase the outputs to rise its efficiency by 0.39 (1-0.61). Seven banks have decreasing return to scale (BOA, WBS, LIB, CBO, ZBS, OIB, and BIB). This is indicative of the fact that, the loans and advances interest income and service and commission income of these banks are increasing in lower proportion that interest expense, deposits, fixed assets, employee salaries are increasing. However, all other banks have constant returns to scale efficiency.

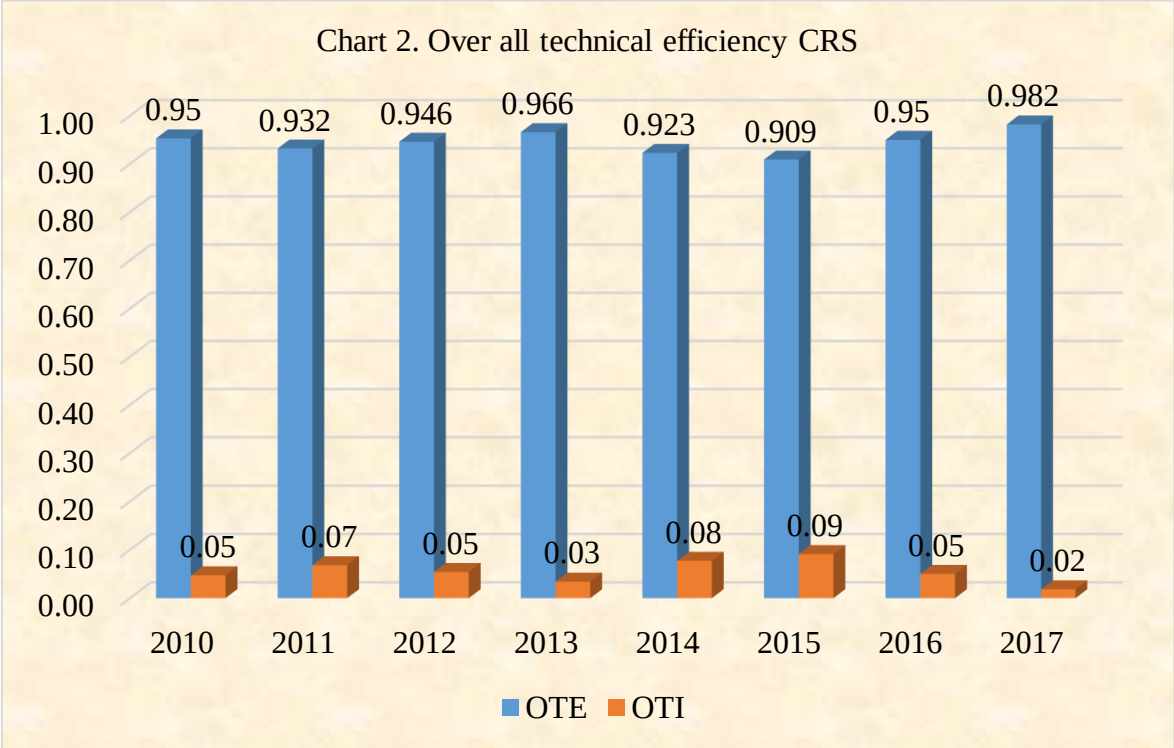
Table 3; VRS output oriented over all technical efficiency

Firm	CBE	DBS	AIB	BOA	WBS	UBS	LIB	CBO	NIB	ZBS	OIB	BIB	BRB	Mean
CRSTE	1	1	1	0.89	0.78	1	0.95	0.11	1	0.98	0.97	0.88	1	0.89
VRSTE	1	1	1	1	0.99	1	1	0.61	1	1	1	1	1	0.97
Scale	1	1	1	0.89	0.79	1	0.95	0.18	1	0.98	0.97	0.88	1	0.9
Type of scale	-			drs	drs		drs	drs		drs	drs	drs		

Source; Own calculation using DEA 2.1 software package

Over all technical efficiency based on CRS – Year wise

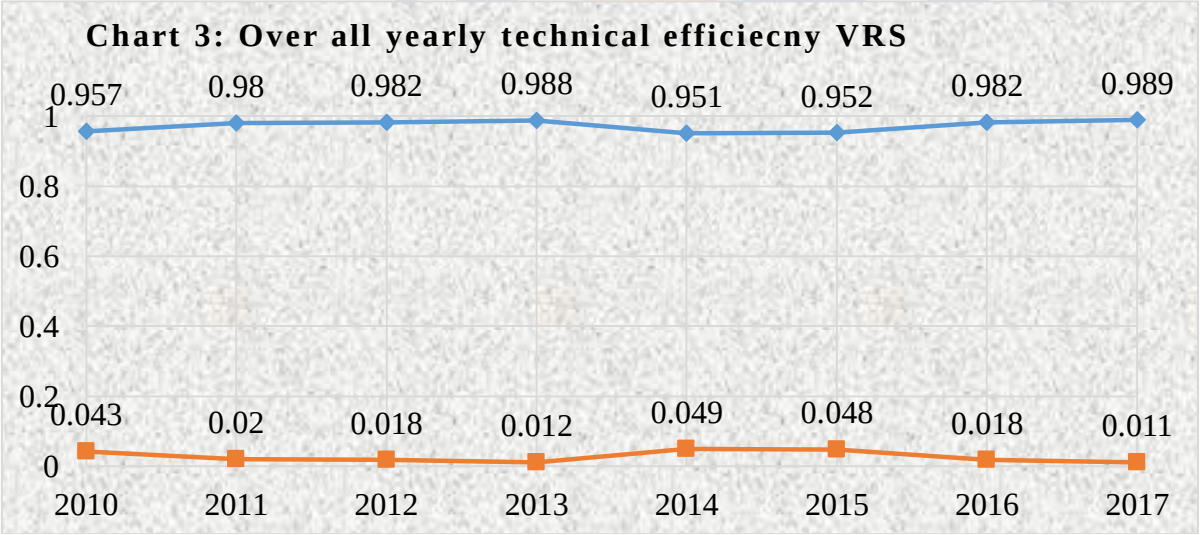
Chart 2 indicates, all the banks had highest technically efficient in the year 2017 and lowest technical efficiency in 2015 (90.9%). The overall mean was 0.945 and banks were efficient in all years except in 2011, 2014 and 2015.



Source; Own calculation using DEA 2.1 software package

Over all technical efficiency based on VRS- Year wise

As it can be seen in Chart 3, the highest over technical efficiency of all banks was in 2017 and the banks were inefficient in 2014 comparably. The technical inefficiency is 1.1% in 2017 and in 2014 it was 4.9% as well.



Source; Own calculation using DEA 2.1 software package

Conclusion

The efficiency of commercial banks of Ethiopia is estimated on the output and input basis. In addition it is also estimated assuming the constant return to scale and variable return to scale. It is found that CBE, DBS, AIB, UBS, NIB, and BIB are efficient banks under constant return to scale. Furthermore, all banks are technically efficient under variable return to scale input oriented except Cooperative bank of Oromia. CBE, DBS, UBS, NIB and BRB are efficient banks under output oriented constant returns to scale DEA. Except Wogagn bank Share Company and Cooperative Bank Oromia, all banks are efficient under variable return to scale output oriented DEA.

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