

Application of DEA Methodology in Measuring Efficiency of Some Selected Commercial Banks in Bangladesh

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Abstract

Banking sector is one of the most important mechanisms of Bangladesh financial system since the early 1970s. In most developing countries, the banking sector represents the backbone of the financial system. Performance of a bank is generally conceptualized as bank's ability to generate transaction by effectively utilizing its resources. Bank efficiency has been an important issue in transition. This paper focuses on measuring efficiency performance of 21 commercial banks in Bangladesh of the year 2014 with the help of Data Envelopment Analysis (DEA). The technical efficiency is estimated by using the input-oriented and output-oriented DEA methods under the variable return to scale (VRS). Results show that under the VRS assumptions, both input-oriented output-oriented methods out of twenty one banks only five banks namely ICB Islami bank, National bank, Basic Bank, EXIM bank and NRB bank are technically efficient because they have the technical efficiency scores equal to one. The Bangladesh banking sector is expected to be able to meet the increasing and more sophisticated demands from consumers and businesses, to adapt and adjust to the technological advances, to face the challenges of globalization and liberalization, and thereby contributing to the overall economic growth and stability.

Keywords: Efficiency, DEA, Private Banking, Bangladesh

1. Introduction

Banking sector of a country is one of the most vital sectors of the country's economy. It is one of the most important mechanisms of Bangladesh financial system since the early 1970s. In most developing countries, the banking sector represents the backbone of the financial system. Therefore, an efficient and profitable banking sector may help ensure an effective financial system which is conducive to economic growth and development. The efficiency of financial intermediation affects a country's economic growth and at the same time, bank (financial intermediation) insolvencies could result in systemic crises and consequently negative implications on the economy (Levine, 1998). Performance of a bank is generally conceptualized as bank's ability to generate transaction by effectively utilizing its resources. Economically the efficiency refers to the ratio of outputs to inputs. Bank efficiency has been an important issue in transition. To examine bank efficiency, DEA techniques have been employed in several developing countries, like Brazil (Tecles and Tabak, 2010) and China (Fadzlan, 2009),

and also for different regions, such as Central America (Wezel, 2010), Middle East and North Africa (MENA) (Naceur, et al., 2009), selected European countries that recently acceded the European Union (Delis and Papanikolaou, 2009), or in broader samples of countries from all around the world (Chen, Liu and Lu, 2010). Das (1997) studied technical, allocative and scale efficiency of different PSBs for the period 1990-1996 using DEA approach. Saha and Ravisankar (2000) analyzed the performance of Indian banks using DEA approach for a sample of 25 PSBs banks over a period 1992-1995. Sathye (2003) measured the productive efficiency of banks in India using DEA. Sufian (2007) has employed the DEA method to investigate the effects of mergers and acquisitions on the efficiency of Malaysian banks. Iveta Řepková (2014) examine the efficiency of the Czech banking sector during the period 2003–2012 by Data Envelopment Analysis (DEA) window analysis. Hoque and Rayhan (2012) used Data Envelopment Analysis technique to rank the banks in Bangladesh by efficiency scores. They used twenty four different banks in Bangladesh and found that out of them under Constant Return to Scale DEA gives 3 efficient banks whereas under Variable Return to Scale DEA gives 12 efficient Banks. Fethy and Pasiouras (2010) in their review of performance-related literature in banking identified 136 studies that apply DEA for measuring bank efficiency. The present study focuses on measuring efficiency performance of some selected private banks in Bangladesh of the year 2014 using Data Envelopment Analysis (DEA).

2. Methodology

2.1 Data

This study purposively considers 21 commercial banks in Bangladesh and the necessary data are collected through the annual reports of the year 2014. This study mainly emphasis on five variables, these are: operation profit, operation income, operation cost, total assets and deposits. For the purpose of efficiency analysis operation profit is considered as output variable that is to be maximized and the other four variables are considered as input variables.

2.2 Data Envelopment Analysis

DEA was first developed by Charnes *et al.*, (1978) as a mathematical programming procedure for evaluating the relative efficiencies of multiple decision-making units (DMUs). It was constructed on the theoretical framework presented by Farrell (1957). Banker et al. (1984) extended DEA to measure efficiency under the assumption of

variable returns to scale. This paper consider VRS model. According to Coelli, T. (1996) the input-oriented DEA model based on the variable returns to scale (VRS) is stated as follows:

$$\begin{aligned} & \min_{\theta, \lambda} \theta, \\ & \text{subject to } -y_i + Y\lambda \geq 0, \\ & \quad \theta x_i - X\lambda \geq 0, \\ & \quad N1'\lambda = 1 \\ & \quad \lambda \geq 0 \end{aligned}$$

where, $N1$ is an $N \times 1$ vector of ones.

According to Coelli, *et al.*, (2002) the output-oriented DEA model based on the VRS is stated as follows:

$$\begin{aligned} & \min_{\varphi, \lambda} \varphi, \\ & \text{subject to } -\varphi y_i + Y\lambda \geq 0, \\ & \quad x_i - X\lambda \geq 0, \\ & \quad N1'\lambda = 1 \\ & \quad \lambda \geq 0 \end{aligned}$$

where, $N1$ is an $N \times 1$ vector of ones and $1 \leq \varphi < \infty$ and $(\varphi - 1)$ is an increase in the ratio of output that can be achieved by i^{th} bank, with a given quantity of inputs which is constant.

3. Results and Discussion

The DEA efficiency score can be summarized to show how much supposedly the banks maximum output is without addition of input if it can be considered as the best technical efficiency. The technical efficiency is estimated by using the approach of maximizing the output subject to constant input and evaluated on the VRS (input-oriented and output-oriented). Efficiency scores for both input-oriented and output-oriented of each bank were estimated and presented in Table 1.

Table 1: Efficiency scores for both input-oriented and output-oriented of each bank

Name of Bank	Input-Oriented				Output-Oriented			
	CRSTE	VRSTE	SCALE	Return to Scale	CRSTE	VRSTE	SCALE	Return to Scale
AB bank	0.708879	0.819442	0.865076	irs	0.708879	0.78971	0.897645	crs
Al-Arafa Islami Bank	0.789719	0.844491	0.935143	irs	0.789719	0.823564	0.958904	irs
BIBL	0.546849	0.644007	0.849136	irs	0.546849	0.692236	0.789976	drs
Brac bank	0.931669	0.977392	0.95322	irs	0.931669	0.946644	0.984181	crs
City bank	0.809084	0.819442	0.987361	irs	0.809084	0.992778	0.81497	crs
DBBL	0.648118	0.986365	0.657077	irs	0.648118	0.722021	0.897645	crs
EBL	0.942431	0.956015	0.98579	irs	0.942431	0.964513	0.977105	irs
ICB Islami bank	0.364566	1	0.364566	irs	0.364566	1	0.364566	irs
Janata Bank	0.445581	0.493182	0.903481	irs	0.445581	0.584668	0.76211	drs
National bank	1	1	1	crs	1	1	1	crs
Trust bank	0.526596	0.85326	0.617157	irs	0.526596	0.609205	0.864398	irs
Basic Bank	1	1	1	crs	1	1	1	crs
One bank	0.789894	0.812567	0.972097	irs	0.789894	0.902526	0.875203	irs
EXIM bank	1	1	1	crs	1	1	1	crs
Meghna bank	0.38482	0.866346	0.444188	irs	0.38482	0.650703	0.591391	irs
Prime bank	0.607611	0.728392	0.83418	irs	0.607611	0.676894	0.897645	crs
Marcantile bank	0.627864	0.669764	0.937442	irs	0.627864	0.722021	0.869593	crs
Primier bank	0.405074	0.804589	0.503454	irs	0.405074	0.473826	0.8549	irs
NRB bank	0.600761	1	0.600761	irs	0.600761	1	0.600761	irs
Dhaka bank	0.607611	0.775274	0.783736	irs	0.607611	0.699457	0.868688	crs
IFIC bank	0.506342	0.849791	0.595843	irs	0.506342	0.564079	0.897645	crs

Note: CRSTE = technical efficiency from CRS DEA, VRSTE = technical efficiency from VRS DEA, SCALE = scale efficiency = CRSTE/VRSTE, irs = increasing return to scale; drs = decreasing return to scale; crs = constant return to scale

Table 1 shows the technical efficiency scores for all the banks considered in this study. Here, we see that under the VRS assumptions, input-oriented results only five banks namely ICB Islami bank, National bank, Basic Bank, EXIM bank and NRB bank are technically efficient because they have the technical efficiency scores equal to one. Also, under the VRS assumptions, output-oriented method gives similar results. We note that the technical efficiency (TE) of AB bank obtained by input-oriented method is about 0.8194. That is AB bank should be able to increase the operating profit by 18.06% without increasing inputs. On the other hand, the technical efficiency (TE) of

AB bank obtained by output-oriented method is about 0.7897 i.e., the bank should be able to increase the operating profit by 21.03% without increasing inputs. Similar interpretation holds for the other banks. On the basis of the return to scale we may conclude that the two methods give different results. Input-oriented method gives three banks were characterized by constant return to scale, eighteen banks operate under increasing return to scale and have no banks operate under decreasing return to scale whereas output-oriented method gives eleven banks were characterized by constant return to scale, eight banks operate under increasing return to scale and only two banks operate under decreasing return to scale.

Table 2: Frequency distributions of technical and scale efficiency scores obtained with the input-oriented and output-oriented DEA model

Efficiency Score	Input Oriented		Output Oriented	
	TE	SE	TE	SE
0.0-0.60	1 (4.76)	4 (19.05)	3 (14.29)	2 (9.52)
0.60-0.70	2 (9.52)	3 (14.29)	5 (23.81)	1 (4.76)
0.70-0.80	2 (9.52)	1 (4.76)	3 (14.29)	2 (9.52)
0.80-0.90	8 (38.10)	3 (14.29)	1 (4.76)	10 (47.62)
0.90-1.00	8 (38.10)	10 (47.62)	9 (42.86)	6 (28.57)

Note: TE = Technical efficiency; SE = Scale efficiency, Values in parenthesis indicates the percentage.

Table 2 shows the frequency distribution of technical, and scale efficiency of banks. Only one bank considered in this study operates below 60% TE levels for input-oriented and three banks operates below 60% TE levels for output-oriented VRS. About 38% of banks operate between 0.90-1.00 efficiency levels for input-oriented VRS whereas for output-oriented VRS it is 42%. In case of input-oriented and output-oriented VRS, about 48% banks have efficiency level between 0.70 and 0.90 whereas for output-oriented VRS, there are about 19% banks have efficiency level between 0.70 and 0.90.

Summary statistics for the measures of technical and scale efficiencies are presented in Table 3. Under input-oriented and output-oriented method, the estimated TE was found to be about 85%, which indicates that the output per bank can be increased on average 15%. On the other hand, under output-oriented method on an average 20% output per bank can be increased. SE measures the optimality of the firm's size, or when it

operates where average and marginal products are equal (Forsund and Hjalmarsson, 2004). The result reported in Table 3 is the average level of SE was around 80%, which indicate that the bank can reduce scale inefficiency by 20% in case of input-oriented DEA whereas for output-oriented DEA the bank can reduce scale inefficiency by around 15%. Graphical comparison of Technical efficiency of the banks obtained by Input and Output oriented method is given in Figure 1. It is observed that in almost cases both methods give similar results.

Table 3: Summary statistics of Technical efficiency (TE) and Scale efficiency (SE) of selected banks

Statistics	Input Oriented		Output Oriented	
	TE	SE	TE	SE
Mean	0.8524	0.7995	0.8007	0.8461
Standard Deviation	0.1390	0.2047	0.1751	0.1583
Minimum	0.4932	0.3646	0.4738	0.3646
Maximum	1.0000	1.0000	1.0000	1.0000

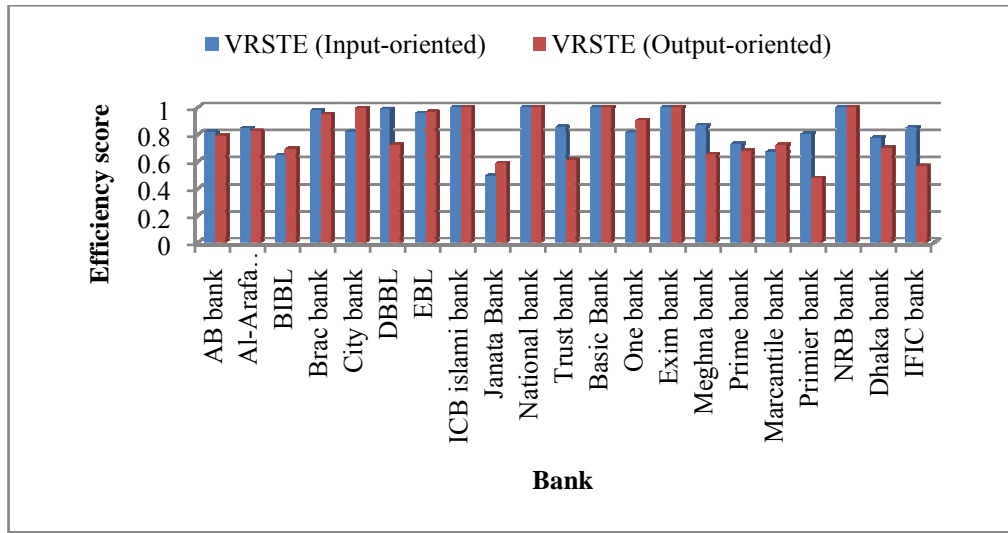


Figure 1: Graphical comparison of Technical efficiency of the banks obtained by Input and Output oriented method.

4. Conclusion

This paper employs data envelopment analysis (DEA) to estimate the relative efficiency of 21 commercial banks of Bangladesh. Results show that under the VRS

assumptions, both input-oriented output-oriented methods only five banks namely ICB Islami bank, National bank, Basic Bank, EXIM bank and NRB bank are technically efficient because they have the technical efficiency scores equal to one. Also, under input-oriented and output-oriented method, the estimated TE was found to be about 85%, which indicates that the output per bank can be increased on average 15%. On the other hand, under output-oriented method on an average 20% output per bank can be increased. By improved handling of operating expenses, capital and by boosting banking investment operations, the less efficient banks can successfully endorse resource utilization efficiency. The Bangladesh banking sector is expected to be able to meet the increasing and more sophisticated demands from consumers and businesses, to adapt and adjust to the technological advances, to face the challenges of globalization and liberalization, and thereby contributing to the overall economic growth and stability.

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