

Efficiency and Returns to Scale in the Bangladesh Banking Sector: Empirical Evidence from the Slack-Based DEA Method

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The study provides new empirical evidence on the level of profit efficiency and returns to scale of the Bangladesh banking sector. We employ the Slack-Based Data Envelopment Analysis (SBM-DEA) method to assess the level of profit efficiency of individual banks over the years 2004 to 2011. The empirical findings indicate that the Bangladesh banking sector has exhibited the highest and lowest level of profit efficiency during years 2004 and 2011 respectively. We find that there are only eight banks have been profit efficient throughout the period under study. The empirical findings seem to suggest that most of Bangladesh banks have been experiencing economies of scale due to being at less than the optimum size, or diseconomies of scale due to being at more than the optimum size. Thus, decreasing or increasing the scale of production could result in cost savings or efficiencies.

Keywords: Banks, Profit Efficiency, Slack-Based Data Envelopment Analysis, Returns to Scale, Bangladesh.

Introduction

The banking sector is the main source of funds for long-term investments and the foundation of economic growth (Schumpeter, 1934). 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. (Levine, 1998) points out that 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.

The banking sector is one of the most important mechanisms of Bangladesh financial system since the early 1970s. During the early years, all financial institutions, including commercial banks, are required to fulfill economic objectives set by the government. Basically, there are four types of banks operating in the Bangladesh banking sector namely, Government Owned Specialized Banks or State Owned Development Financial Institution (DFIs), Nationalized Commercial Banks or State Owned Commercial Banks (SCBs), Domestic Private Commercial Banks (PCBs), and Foreign Commercial Banks (FCBs). However, the efficiency of the banking sector has become an imperative issue among policymakers in Bangladesh since the formation of the National Commission on Money, Banking and Credit in 1986 (Shameem, 1995). The purpose for the establishment of the commission among others is to find solutions for efficient operations and management of the banking system (Shameem, 1995).

In maintaining the stability of the banking system, the efficiency of the banking sector is important so as to ensure that banks remain profitable and healthy.

It would be reasonable to expect that improvements in profit efficiency could lead to higher bank profitability levels and help ensure the sustainability of the country's economic growth. Besides, profit efficiency is also in line with firms' main objective that is to maximize profit since it takes into account both the cost and revenue effects on changes in outputs scale and scope. Profit efficiency measures how close a bank is in producing the maximum level of profit, given the amount of inputs and outputs and their price levels (Akhavain *et al.*, 1997; Akhigbe & McNulty, 2003; Ariff & Can, 2008). Thus, profit efficiency provides a complete description on the economic goal of a bank which requires that banks reduce their costs and increase their revenues. Furthermore, (Berger & Mester, 2003) among others suggest that profit efficiency offers valuable information on the efficiency of bank managements.

The paper seeks to provide for the first time empirical evidence on the profit efficiency of the Bangladesh banking sector. Although studies on bank efficiency are voluminous, these studies have mainly concentrated on the banking sectors of the western and developed countries (see survey in Berger, 2007). On the other hand, empirical evidence on the developing countries is relatively scarce and the majority of these studies focuses on the technical, pure technical, and scale efficiency concepts. On the other hand, studies which investigate the cost, revenue, and profit efficiency are relatively scarce (e.g. Ariff & Can, 2008) and is completely missing within the context of the

Bangladesh banking sector. In light of the knowledge gap, the present paper seeks to contribute to the literature by providing for the first time empirical evidence on the profit efficiency of the Bangladesh banking sector.

To do so, we employ the non-parametric Slack-Based Data Envelopment Analysis (SBM-DEA) method. The period covered include a time of significant reform in the country's banking sector and encapsulates the recent global financial crisis in 2007 to 2008. Given that the issue of increasing the profitability of the Bangladesh banking sector is of utmost important, the findings from this study are expected to interest various parties such as the central bank, policy makers, investors, bank managers, etc. By analyzing the level of profit efficiency of banks operating in the Bangladesh banking sector, we would be able to identify the actual level of profit efficiency and subsequently the level of profit inefficiency, which is recognized as opportunity loss.

The paper is set out as follows: the next section provides review of the related literature, followed by Section 3 which outlines the data and methodology employed by the study. Section 4 reports the empirical findings. Finally, we conclude in Section 5 with some discussions on the policy issues and offers avenues for future research.

Review of the Literature

The basic concept of efficiency is that it measures how well firms transform their inputs into outputs according to their behavioral objectives (Fare *et al.*, 1994). A firm is said to be efficient if it is able to achieve its goals and inefficient if it fails. In normal circumstances, a firm's goal is assumed to be cost minimization of production. Thus, any waste of inputs is to be avoided so that there is no idleness in the use of resources. In the production theory, it is often assumed that firms are behaving efficiently in an economic sense. According to (Fare *et al.*, 1985), firms are able to successfully allocate all resources in an efficient manner relative to the constraints imposed by the structure of the production technology, by the structure of input and output markets, and relative to whatever behavioral goals attributed to the producers.

A wide range of models have been used to investigate a spectrum of efficiency related issues in a wide range of environments. (Koopmans, 1951) was the first to provide the definition of technical efficiency where the producer is technically efficient if an increase in any output requires a reduction in at least one output and if a reduction in any input requires an increase in at least one other input or a reduction in at least an output. (Liebenstein, 1966) on the other hand was the first to introduce the concept of X-efficiency. The X-efficiency concept defines cost inefficiencies that are due to wasteful use of inputs, or managerial weakness. The X-efficiency concept seeks to explain why all firms do not succeed in minimizing the cost of production and recognizes that the sources of X-efficiency may also be from outside of the firm. In this regard, (Button & Weyman-Jones, 1992) suggest that X-inefficiency is due partly to the firm's own actions as well as from exogenous factors surrounding the environment in which the firm operates.

(Berger & Mester, 2003) show that separate evaluation of the cost and revenue efficiency may not capture the goal of a bank which is to maximize profit. The profit efficiency concept may help overcome this shortfall since its main goal is to maximize revenues and profit by minimizing costs from various inputs and outputs. Technically, profit efficiency concept can be divided into two main types namely standard profit efficiency and alternative profit efficiency. (Maudos *et al.*, 2002) suggests that besides requiring that goods and services to be produced at a minimum cost, the measurement of profit efficiency require the maximization of revenues to match the profit maximization objective. In essence, the wrong choice or mispricing of outputs may result in revenue inefficiency.

(Adongo *et al.*, 2005) posits that profit efficiency occurs when the increase in revenues is higher than the increase in costs arising from producing the additional or higher quality services. (Ariff & Can, 2008) on the other hand suggest that the standard profit efficiency measure assumes the existence of perfect competition in both input and output factors. Their findings indicate that a bank is a price-taker implying that it has no market power to determine the output prices. On the other hand, the alternative profit efficiency assumes the existence of imperfect competition, where a bank is a price-setter indicating that it has market power in setting the output prices.

(Bader *et al.*, 2008) points out that there are a fair number of studies which have examined the efficiency of banking sectors in developing countries. However, previous studies have mainly concentrated on the technical, pure technical, and scale efficiency concepts (e.g. Isik & Hassan, 2002; Sufian, 2009; Sufian & Habibullah, 2009). On the other hand, studies which investigate the cost, revenue, and profit efficiency are relatively scarce (e.g. Ariff & Can, 2008) and is completely missing within the context of the Bangladesh banking sector. In light of the knowledge gap, the present paper seeks to contribute to the literature by providing for the first time empirical evidence on the profit efficiency of the Bangladesh banking sector.

Methodology and data

Data Envelopment Analysis (DEA)

The Data Envelopment Analysis (DEA) method is based on mathematical programming model developed by (Charnes *et al.*, 1978) (hereafter referred to as the CCR model). The method seeks to establish how the n decision making units (DMUs) determine the envelopment surface (the best practice efficiency frontier). The CCR model presupposes that there is no significant relationship between the scale of operations and efficiency by assuming constant returns to scale (CRS) and is only justifiable when all DMUs are operating at an optimal scale (Xu, 2013). However, technological advances and regulatory changes may have different impacts across banks of different sizes resulting in banks to face either economies or diseconomies of scale (Assaf *et al.*, 2011). To address this issue, (Banker *et al.*, 1984) extends the CCR model by relaxing the CRS assumption. The resulting BCC model is used to assess the efficiency of DMUs characterized by variable returns to scale (VRS).

To discuss the DEA method in more technical terms, let us assume that there is data on K inputs and M outputs for each N bank. For the i th bank, these are represented by x_i and y_i vectors respectively.

$$\hat{\delta}_i = \max_{\delta, \lambda} \left\{ \delta > 0 / \hat{\delta}_i y_i \leq \sum_{i=1}^n y_i \lambda; x_i \geq \sum_{i=1}^n x_i \lambda; \lambda \geq 0 \right\},$$

$i = 1, \dots, n$ banks (1)

Where y is a vector of bank outputs, x is a vector of bank inputs, λ is a $N \times 1$ vector of constants. The value of $\hat{\delta}_i$ is the profit efficiency score for the i th bank. A measure of $\hat{\delta}_i = 1$ indicates that the bank is profit efficient, while $\hat{\delta}_i > 1$ indicate that a bank is inefficient. The linear programming problem must be solved n times, once for each bank in the sample.

The Slack-Based Data Envelopment Analysis (SBM-DEA)

The present study employs the non-parametric Slack-Based Data Envelopment Analysis (SBM-DEA) method to compute the efficiency of individual banks operating in the Bangladesh banking sector. The method constructs the frontier of the observed input-output ratios by linear programming techniques. The method is a non-radial efficiency measure dealing directly with input excesses and output shortfalls (Tone, 2002). A DMU (a bank in our case) is said to be efficient with a value of unity if the DMU is on the frontier of the production possibility set with no input and output slack. The estimated model for profit efficiency can be illustrated by

$$\theta^* = \max \theta$$

$$\max \sum_{i=1}^n s_i^- + \sum_{r=1}^s s_r^+$$

subject to

$$\sum_{j=1}^n \lambda_j x_{ij} + s_i^- = x_{io} \quad i = 1, 2, \dots, m;$$

$$\sum_{j=1}^n \lambda_j y_{rj} - s_r^+ = y_{ro} \quad r = 1, 2, \dots, s;$$

$$\lambda_j, s_i^-, s_r^+ \geq 0$$

(2)

Where DMU_0 is one of the n DMUs under evaluation; x_{io} and y_{ro} are the i th input and r th output for DMU_0 , respectively; and λ_j represents the unknown weights, where j represents the number of DMUs. The optimal value of θ^* represents the distance from the efficient frontier. Therefore, the most efficient bank will have $\theta^* = 1$ and the inefficient bank will exhibit $\theta^* < 1$.

The SBM-DEA method is preferred to parametric estimation as the former deals with input excesses and output shortfalls simultaneously rather than holding the

input or output at a given level (Chan *et al.*, 2013). Furthermore (Chiu & Chen, 2009) suggest that the SBM-DEA method provides a well representation of banking operation in the real situation since banks are given a certain degree of control on both the input and output sides. For the purpose of this study, we adopt the SBM-DEA under the VRS assumption to solve the profit efficiency problem. Equation (1) is modified to a VRS slack-based model as follows:

$$\max \sum_{i=1}^n w_i^- s_i^- + \sum_{r=1}^s w_r^+ s_r^+$$

subject to

$$\sum_{j=1}^n \lambda_j x_{ij} + s_i^- = x_{io} \quad i = 1, 2, \dots, m;$$

$$\sum_{j=1}^n \lambda_j y_{rj} - s_r^+ = y_{ro} \quad r = 1, 2, \dots, s;$$

$$\lambda_j, s_i^-, s_r^+ \geq 0$$

$$\sum_{j=1}^n \lambda_j = 1$$

(3)

Where w_i^- and w_r^+ are user-specified weights obtained through value judgment. While, s_i^- is the i th input slack and s_r^+ is the r th output slack. The SBM-DEA method under the VRS model assumes that production takes place with a disproportionate change in inputs and outputs. The scalar, ρ , which captures the VRS based slack variables, is as follows:

$$\rho = \left(\frac{1}{a} \sum_{m=1}^m \frac{x_{j,m}^0 - s_{j,m}^-}{x_{j,m}^0} \right) \left(\frac{1}{b} \sum_{n=1}^n \frac{y_{j,n}^0 + s_{j,n}^+}{y_{j,n}^0} \right) \quad (4)$$

Data Collection and Input and Output Variables

The present study gathers data on all commercial banks operating in the Bangladesh banking sector during the years 2004 to 2011. The source of financial data is the Bureau van Dijk’s BankScope database which provides banks’ balance sheet and income statement information. Due to the entry and exit of banks during the years, the actual number of banks operating in the Bangladesh banking sector varies. The final sample comprised of 31 commercial banks of which complete data are available for the years 2004 to 2011. In order to maintain homogeneity, only state owned commercial banks (SCBs) and private commercial banks (PCBs) are included in the analysis. Foreign commercial banks (FCBs) and specialized development banks (SDBs) are excluded from the sample. The complete list of banks included in the study is given in Table 1.

Table 1
Commercial banks in Bangladesh 2004–2011

Bank	Status
Agrani Bank	SCB
Arab Bangladesh Bank Ltd. - A.B. Bank Ltd	PCB
Bangladesh Commerce Bank Ltd	PCB
Bank Asia Ltd.	PCB
BRAC Bank Ltd.	PCB
City Bank Ltd	PCB
Dhaka Bank Ltd.	PCB
Dutch-Bangla Bank Ltd.	PCB
Eastern Bank Ltd.	PCB
Export Import Bank of Bangladesh Ltd.	PCB
First Security Bank Ltd.	PCB
IFIC Bank Ltd.	PCB
Islami Bank Bangladesh Ltd.	PCB
Jamuna Bank Ltd	PCB
Janata Bank	SCB
Mercantile Bank Ltd.	PCB
Mutual Trust Bank	PCB
National Bank Ltd.	PCB
National Credit and Commerce Bank Ltd.	PCB
One Bank Ltd.	PCB
Premier Bank Ltd	PCB
Prime Bank Ltd.	PCB
Pubali Bank Ltd.	PCB
Rupali Bank Ltd.	SCB
Shahjalal Bank Ltd	PCB
Sonali Bank	SCB
Southeast Bank Ltd.	PCB
Standard Bank Ltd.	PCB
Trust Bank Ltd	PCB
United Commercial Bank Ltd	PCB
Uttara Bank Ltd.	PCB

Source: Bankscope Database

Note: SCB is State Owned Commercial Banks. PCB is Private Owned Commercial Banks

There are three main approaches that are widely used in the banking theory literature namely, production, intermediation, and value added approaches (Sealey & Lindley, 1977). The present study adopts the intermediation approach attributed to three main reasons. First, the study attempts to evaluate the efficiency of the whole banking sector and not branches of a particular bank (Andries *et al.*, 2013). Second, the intermediation approach is the most preferred approach among researchers investigating the efficiency of banking sectors in developing countries (e.g. Bader *et al.*, 2008; Isik & Hassan, 2002; Sufian & Habibullah, 2010). Third, (Sealey & Lindley, 1977) suggest that financial institutions normally employ labour, physical capital, and deposits as their inputs to produce earning assets.

Nevertheless, the intermediation approach is preferable since it normally includes a large proportion of any bank's total costs (Elyasiani & Mehdiyan, 1990; Berger & Humphrey, 1991; Avkiran, 1999).

For the purpose of this study, three inputs and two outputs variables are chosen. The selection of the input and output variables are based on (Ariff & Can, 2008) and other major studies on the efficiency of banking sectors in developing countries (e.g. Sufian *et al.* 2012a; Sufian *et al.*, 2013; Sufian & Habibullah, 2010; Bader *et al.*, 2008; Isik & Hassan, 2002). The three input vector variables consist of x_1 : Deposits, x_2 : Labour, and x_3 : Capital. Meanwhile, the two output vector variables are y_1 : Loans and y_2 : Investments. The summary of data used to construct the efficiency frontiers are presented in Table 2.

Table 2

Summary statistics of the input and output variables in the DEA model

Variable	Mean	Std. Deviation	Minimum	Maximum
Deposit (x_1)	80,473.73	85,440.89	4,305.00	535,288.40
Labour (x_2)	1,213.56	1,402.48	51.10	9,345.60
Capital (x_3)	1,808.54	2,754.99	17.30	23,026.40
Loan (y_1)	65,040.53	64,038.10	3,073.00	345,991.30
Investment (y_2)	13,959.01	20,521.95	200.00	134,075.80

Notes: x_1 : Deposits (deposits and short term funding), x_2 : Labour (personnel expenses), x_3 : Capital (fixed assets), y_1 : Loans (gross loan), y_2 : Investment (total security)

Empirical results

Profit Efficiency of the Bangladesh Banking Sector: Evidence from Specific Year

Table 3 shows the mean profit efficiency level of the Bangladesh banking sector for specific year from 2004 to 2011. The empirical findings given in Table 3 seem to indicate that the highest (lowest) level of profit efficiency (inefficiency) was attained during the year 2008 (84,6 % (15,4 %)), while the lowest (highest) level of profit efficiency (inefficiency) was recorded during the year 2011 (65,4 % (34,6 %)). In other words, the Bangladesh banking sector is said to have slacked to fully minimize costs and maximize revenues resulting in the existence of profit inefficiency.

In essence, the empirical findings from this study indicate that on average Bangladesh banks have earned 84,6 % during the year 2008, but only 65,4 % during the year 2011 and lost the opportunity to make 15,4 % and

34,6 % more profit from the same level of inputs during the years 2008 and 2011 respectively.

Profit Efficiency of The Bangladesh Banking Sector: Evidence from Specific Bank

The mean profit efficiency level for specific bank during the years 2004 to 2011 are given in Table 3. The empirical findings seem to suggest that eight banks namely Bangladesh Commerce Bank, Export Import Bank of Bangladesh, Janata Bank, Mutual Trust Bank, Prime Bank, Sonali Bank, Southeast Bank, and Standard Bank have exhibited maximum profit efficiency level. The results indicate that these banks have not slacked in their intermediation function and have been successful to fully maximize revenues while minimizing costs and subsequently lead to the perfect profit efficiency.

Summary on level of profit efficiency

Bank	2004	2005	2006	2007	2008	2009	2010	2011	Mean Bank
Agrani Bank	1,000	1,000	1,000	1,000	1,000	0,423	0,578	1,000	0,875
Arab Bangladesh Bank	–	–	–	–	0,334	0,347	0,033	0,747	0,365
Bangladesh Commerce Bank	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Bank Asia	1,000	1,000	1,000	1,000	1,000	1,000	0,686	0,188	0,859
BRAC Bank	–	–	–	–	–	0,003	1,000	0,095	0,366
City Bank	–	–	–	–	–	–	0,413	1,000	0,707
Dhaka Bank	0,027	1,000	0,670	1,000	1,000	0,182	0,352	0,062	0,536
Dutch-Bangla Bank	0,660	0,020	0,131	0,045	0,889	0,999	0,263	0,347	0,419
Eastern Bank	–	–	–	–	–	–	0,257	0,240	0,248
Export Import Bank of Bangladesh	–	–	–	–	1,000	1,000	1,000	1,000	1,000
First Security Bank	0,332	1,000	1,000	1,000	1,000	1,000	1,000	1,000	0,916
IFIC Bank	1,000	1,000	0,188	1,000	1,000	0,004	0,570	0,353	0,639
Islami Bank Bangladesh	1,000	1,000	0,392	1,000	1,000	1,000	1,000	1,000	0,924
Jamuna Bank	0,062	0,010	0,004	1,000	0,552	0,288	0,266	0,136	0,290
Janata Bank	–	–	–	–	–	1,000	1,000	1,000	1,000
Mercantile Bank	1,000	0,037	1,000	0,212	0,626	1,000	0,227	0,030	0,516
Mutual Trust Bank	–	–	–	–	–	1,000	1,000	1,000	1,000
National Bank	0,970	0,052	0,283	0,118	0,955	0,627	1,000	1,000	0,626
National Credit and Commerce Bank	1,000	1,000	0,007	1,000	1,000	1,000	1,000	1,000	0,876
One Bank	1,000	1,000	0,072	0,289	0,429	0,236	0,655	0,569	0,531
Premier Bank	–	–	–	–	–	0,316	1,000	0,315	0,544
Prime Bank	–	–	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Pubali Bank	0,945	0,189	0,341	0,199	0,932	0,398	0,111	0,785	0,488
Rupali Bank	0,563	1,000	1,000	1,000	0,928	0,038	0,191	0,487	0,651
Shahjalal Bank	1,000	1,000	1,000	1,000	1,000	0,471	0,799	0,227	0,812
Sonali Bank	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Southeast Bank	–	–	–	–	–	1,000	1,000	1,000	1,000
Standard Bank	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Trust Bank	1,000	1,000	1,000	0,127	0,218	0,012	1,000	1,000	0,670
United Commercial Bank	–	–	–	–	–	0,714	0,039	0,643	0,465
Uttara Bank	1,000	1,000	1,000	1,000	0,599	1,000	1,000	0,040	0,830
Mean Year	0,828	0,765	0,671	0,761	0,846	0,657	0,692	0,654	

From Table 3 it can be observed that Arab Bangladesh Bank 36,5 % (63,5 %), BRAC Bank 36,6 % (63,4 %), Dutch-Bangla Bank 41,9% (58,1 %), Eastern Bank 24,8 % (75,2 %), Jamuna Bank 29 % (71 %), Pubali Bank 48,8 % (51,2 %) and United Commercial Bank 46,5% (53,5 %) have exhibited the lowest (highest) profit efficiency (profit inefficiency). The results indicate that these seven banks have earned the lowest of what was available and therefore greater loss of opportunity to make higher profits despite utilizing the same level of inputs compared to their peers.

Composition of the Efficiency Frontiers

While the results above highlight the sources of profit inefficiency of the Bangladesh banking sector, we next turn our discussions on the sources of the scale inefficiency of banks in Bangladesh. Furthermore, it is worthwhile to examine the trend in the returns to scale of Bangladesh banks since the dominant source of profit inefficiency in the Bangladesh banking sector seems to be scale related. It is worth noting that a bank can operate at CRS or VRS where CRS signifies that an increase in inputs results in a proportionate increase in outputs and VRS means a rise in inputs results in a disproportionate rise in outputs. Furthermore, a bank operating at VRS can be at IRS or DRS. To recap, IRS means that an increase in inputs results in a higher increase in outputs, while DRS indicate that an increase in inputs results in lesser output increases.

To identify the nature of returns to scale, first the CRS scores (obtained with the CCR model) is compared with VRS (by using the BCC model) scores. For a given bank,

if the VRS score equals to its CRS score, the bank is said to be operating at constant returns to scale (CRS). On the other hand, if the scores are not equal, a further step is needed to establish whether the bank is operating at IRS or DRS. To do this, the DEA model is used under the non-increasing returns to scale (NIRS) assumptions. If the score under VRS equals the NIRS score, then the bank is said to be operating at DRS. Alternatively, if the score under VRS is different from the NIRS score, then the bank is said to be operating at IRS (Coelli *et al.*, 1998).

Table 4 shows the composition of Bangladesh banks that lie on the efficiency frontiers. The composition of the efficiency frontier suggests that the number of banks that span the efficiency frontier varies between seven to 12 banks. It can be observed from Table 4 that Standard Bank and First Security Bank have appeared to be the global leaders i.e. have appeared the most times on the efficiency frontier. On the other hand, the empirical findings seem to suggest that 7 (22,6 %) banks have never made it to the efficiency frontier throughout the period of study.

Composition of production frontiers

Banks	2004	2005	2006	2007	2008	2009	2010	2011	Count Bank
Agrani Bank	CRS	CRS	CRS	DRS	DRS	DRS	DRS	CRS	4
Arab Bangladesh Bank	–	–	–	–	DRS	DRS	IRS	DRS	0
Bangladesh Commerce Bank	IRS	IRS	CRS	IRS	IRS	IRS	CRS	CRS	3
Bank Asia	CRS	CRS	CRS	CRS	CRS	CRS	IRS	IRS	6
BRAC Bank	–	–	–	–	–	DRS	CRS	IRS	1
City Bank	–	–	–	–	–	–	IRS	CRS	1
Dhaka Bank	IRS	CRS	DRS	DRS	DRS	DRS	IRS	IRS	1
Dutch-Bangla Bank	IRS	DRS	DRS	DRS	DRS	DRS	IRS	IRS	0
Eastern Bank	–	–	–	–	–	–	IRS	IRS	0
Export Import Bank of Bangladesh	–	–	–	–	DRS	CRS	CRS	CRS	3
First Security Bank	IRS	CRS	CRS	CRS	CRS	CRS	CRS	CRS	7
IFIC Bank	CRS	CRS	IRS	CRS	CRS	DRS	IRS	IRS	4
Islami Bank Bangladesh	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	0
Jamuna Bank	IRS	DRS	IRS	CRS	IRS	IRS	IRS	IRS	1
Janata Bank	–	–	–	–	–	CRS	DRS	DRS	1
Mercantile Bank	CRS	DRS	CRS	DRS	DRS	DRS	IRS	DRS	2
Mutual Trust Bank	–	–	–	–	–	CRS	CRS	CRS	3
National Bank	DRS	DRS	IRS	DRS	DRS	DRS	CRS	CRS	2
National Credit and Commerce Bank	CRS	CRS	DRS	CRS	CRS	CRS	IRS	CRS	6
One Bank	CRS	CRS	IRS	IRS	IRS	IRS	IRS	IRS	2
Premier Bank	–	–	–	–	–	IRS	CRS	IRS	1
Prime Bank	–	–	CRS	DRS	CRS	DRS	CRS	DRS	3
Pubali Bank	DRS	DRS	IRS	DRS	DRS	DRS	IRS	IRS	0
Rupali Bank	DRS	DRS	DRS	DRS	DRS	DRS	IRS	IRS	0
Shahjalal Bank	CRS	CRS	CRS	CRS	DRS	IRS	IRS	DRS	4
Sonali Bank	CRS	CRS	CRS	CRS	CRS	DRS	DRS	DRS	5
Southeast Bank	–	–	–	–	–	CRS	CRS	CRS	3
Standard Bank	CRS	CRS	CRS	CRS	CRS	CRS	CRS	CRS	8
Trust Bank	CRS	CRS	CRS	IRS	IRS	DRS	CRS	CRS	5
United Commercial Bank	–	–	–	–	–	DRS	IRS	DRS	0
Uttara Bank	CRS	CRS	CRS	CRS	IRS	CRS	CRS	IRS	6
Count Year	11	12	11	9	7	9	12	11	82

Notes: The Table shows the evolution of returns to scale in the Bangladesh banking sector during the period 2004-2011 derived from the SBM-DEA method. CRS, DRS, and IRS denote Constant Returns to Scale, Decreasing Returns to Scale, and Increasing Returns to Scale respectively. Count Bank denotes number of times a bank appeared on the frontier during the period of study, count year. Count Year denotes the number of banks appeared on the efficiency frontier during the year. The banks corresponds to the shaded regions have not been efficient in any year in the sample period compared to the other bank in the sample.

In general, the empirical findings presented in Table 4 clearly indicate that the small banks tend to operate at CRS or IRS, while the large banks tend to operate at CRS or DRS, the findings that are similar to the earlier studies by among others (Miller & Noulas, 1996; McAllister & McManus, 1993; Noulas *et al.*, 1990). To recap, McAllister & McManus (1993) suggest that while the small banks have generally exhibited IRS, the large banks on the other hand tend to exhibit DRS and at best CRS. As it appears, the small Bangladesh banks have experienced IRS in their operations during the period of the study.

One implication is that for the small Bangladesh banks, a proportionate increase in inputs would result in more than a proportional increase in outputs. Hence, the small Bangladesh banks, which have been operating at IRS, could achieve significant cost savings and efficiency gains by increasing their scale of operations. In other words, substantial gains can be obtained by altering the scale via internal growth or further consolidation in the sector. In fact, in a perfectly competitive and contestable market, the efficient banks should absorb the scale inefficient banks in order to exploit cost advantages. Thus, banks which experience IRS should either eliminate their scale inefficiency or be ready to become a prime target for acquiring banks, which can create value from under-

performing banks by streamlining their operations and eliminating their redundancies and inefficiencies (Evanoff & Israelevich, 1991).

On the other hand, the results seem to suggest that further increase in size would only result in a smaller increase of outputs for every proportionate increase in inputs for the large banks, resulting from the fact that the large banks have been operating at declining returns to scale (DRS) and constant returns to scale (CRS). Hence, decision-makers ought to be more cautious in promoting mergers among the large banks as a means to enjoying efficiency gains.

Overall, the empirical findings from this study seem to suggest that in the case of the Bangladesh banking sector, profit inefficiency has much more to do with the scale of production rather than the inefficient utilization of resources. The dominant effect of the scale inefficiency indicates that most of Bangladesh banks have been operating at the 'incorrect' or non-optimal scale of operations. They either experience economies of scale (i.e. (IRS)) due to being at less than the optimum size, or diseconomies of scale (i.e. (DRS)) due to being at more than the optimum size. Thus, decreasing or increasing the scale of production could result in cost savings or efficiencies.

Conclusions and Policy Implications

To date, studies on bank efficiency are numerous. However, most of these studies have concentrated on the banking sectors of the western and developed countries. On the other hand, empirical evidence on the developing countries is relatively scarce and the majority of these studies focuses on the technical, pure technical, and scale efficiency concepts. The present study attempts to fill in this gap by providing new empirical evidence on the profit efficiency of the Bangladesh banking sector. By employing the Slack-Based Data Envelopment Analysis (SBM-DEA) method, we compute the profit efficiency of individual banks operating in the Bangladesh banking sector during the years 2004 to 2011. The period covered by this study encapsulates the recent global financial crisis in 2007 and 2008.

The empirical findings indicate that the Bangladesh banking sector has exhibited the highest profit efficiency level during the year 2004, while profit efficiency seems to be at the lowest level during the year 2011. We find that Bangladesh Commerce Bank, Export Import Bank of Bangladesh, Janata Bank, Mutual Trust Bank, Prime Bank, Sonali Bank, Southeast Bank, and Standard Bank have exhibited a perfect or 100% profit efficiency level. On the other hand, Arab Bangladesh Bank, BRAC Bank, Dutch-Bangla Bank, Eastern Bank, Jamuna Bank, Pubali Bank, and United Commercial Bank have been the least profit efficient banks during the period under study. The composition of the efficiency frontier suggests that the number of banks that span the efficiency frontier varies between seven to 12 banks. We find that Standard Bank and First Security Bank have appeared to be the global leaders i.e. appeared the most times on the efficiency frontier, while 7 (22,6 %) banks have never made it to the efficiency frontier throughout the period of study.

The empirical findings from this study present considerable policy relevance. Firstly, the empirical findings from this study clearly suggest that the decline in the efficiency of Bangladesh banks were mainly due to scale. The results imply that banks operating in the Bangladesh banking sector are either too small to benefit from the economies of scale or too large to be scale efficient. Thus, from the policy-making perspective, the results imply that the relatively smaller banks could raise their efficiency levels by expanding, while the larger banks would need to scale down their operations to be scale efficient.

Secondly, in terms of scale efficiency, larger banks are lagging behind its smaller counterparts. The optimal size for a firm would be at a point where it reaches a constant return to scale (CRS). To recap, a DMU operating under increasing returns to scale (IRS) needs to expand its operations, while a DMU operating at decreasing returns to scale (DRS) would on the contrary lead to downsizing. Perhaps the reason why larger banks are underperforming in comparison to their smaller peers could be that their size has become more of a burden than an advantage. There are also considerable costs associated with the management of

a large organization and making sure that these costs do not outweigh the size benefits is of great importance.

The empirical findings from this study clearly call for regulators and decision makers to review the profit efficiency of banks operating in the Bangladesh banking sector. This consideration is vital because profit efficiency is the most important concept which could lead to higher or lower profitability of the Bangladesh banking sector. To improve the performance of banks, regulators may need to employ and exercise the same information technologies, skills, and risk management techniques which are applied by the most efficient banks.

The results could also provide better information and guidance to bank managers, as they need to have clear understanding on the impact of profit efficiency on the performance of their banks. Thus, banks operating in the Bangladesh banking sector have to consider all the potential technologies which could improve their profit efficiency levels since the main motive of banks is to maximize shareholders' value or wealth through profit maximization.

The empirical findings from this study may also have implications for investors whose main desire is to reap higher profit from their investments. By doing so, they could concentrate on the potential profitability of banks before investing. Therefore, the findings of this study may help investors plan and strategize on the performance of their investment portfolios. It would be reasonable to suggest that wise decisions that investors make today would significantly influence the level of expected returns in the future.

Nevertheless, the study has also provide insights to policymakers with regard to attaining optimal utilization of capacities, improvement in managerial expertise, efficient allocation of scarce resources, and the most productive scale of operation of commercial banks operating in the Bangladesh banking sector. This may also facilitate directions for sustainable competitiveness of the Bangladesh banking sector operations in the future.

Due to its limitations the paper could be extended in a variety of ways. Firstly, future research could include more variables such as taxation and regulation indicators, exchange rates as well as indicators of the quality of the offered services. Secondly, in terms of methodology, the non-parametric Malmquist Productivity Index (MPI) method could be employed to investigate changes in productivity over time as a result of technical change or technological progress or regress could yet be another extension to the present paper. Finally, future research into the efficiency of the Bangladesh banking sector could also consider the production function along with the intermediation function.

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