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

Fadzlan Sufian[1]
Fakarudin Kamarudin[2]

Received: 31 March 2014 / Accepted 1 June 2014

ABSTRACT

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 only eight banks have been profit efficient throughout the period under study. The empirical findings seem to suggest that most of the 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

1. 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 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[*]. 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

[1] Corresponding author: Professor, Taylor's University, Taylor's Business School, Taylor's Lakeside Campus, 1 Jalan Taylor's, 47500 Subang Jaya, Selangor Darul Ehsan · Email: fadzlan.sufian@taylors.edu.my; fadzlan.sufian@gmail.com · Tel: 603-5629-5125

[2] PhD student, Universiti Putra Malaysia

[*] 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).

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 (Akhavein *et al*. 1997; Akhigbe and McNulty, 2003; Ariff and Can, 2008). Thus, profit efficiency provides a complete description on the economic goal of a bank that requires that banks reduce their costs and increase their revenues. Furthermore, Berger and Mester (2003) among others suggest that the 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 rare (e.g. Ariff and Can, 2008) and is entirely missing within the context of the Bangladesh banking sector. In the 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 importance, 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 a 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.

2. 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 can achieve its goals and inefficient if it fails. In normal circumstances, the firm's goal is to minimize the cost 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 successfully to 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 has been used to investigate the spectrum of efficiency related issues in a wide range of environments. Koopmans (1951) was the first to provide a 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 and Weyman-Jones (1992) suggest that the 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 and Mester (2003) show that a separate evaluation of the cost and revenue efficiency may not capture the goal of a bank that 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 the 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 and 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 that 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 and Hassan, 2002; Sufian, 2009; Sufian and Habibulah, 2009). On the other hand, studies which investigate the cost, revenue, and profit efficiency are relatively scarce (e.g. Ariff and Can, 2008) and is completely missing within the context of the Bangladesh banking sector.

The earlier studies by among others Wadud and Yasmeen (2004), Dilruba and Khandoker (2005), Yasmeen (2011), Hoque and Rayhan (2012), and Hoque and Rayhan (2013) have employed the DEA method to examine the technical alongside its mutually exhaustive components of pure technical and scale efficiency of the Bangladesh banking sector. Similarly, Samad (2009) and Baten and Kamil (2013) investigate the efficiency of the Bangladesh banking sector by employing the Stochastic Frontier Analysis (SFA). Noticeably absent is empirical investigation on the cost, revenue, and profit efficiency of the Bangladesh banking sector. In the 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.

3. METHODOLOGY AND DATA

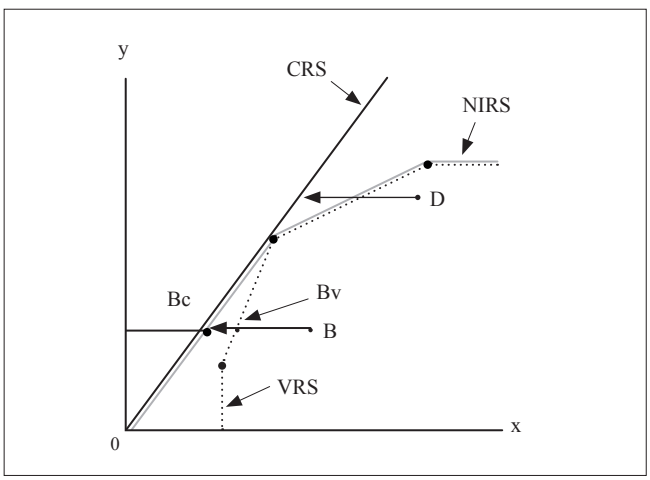
3.1. DATA ENVELOPMENT ANALYSIS (DEA)

The Data Envelopment Analysis (DEA) method is based on mathematical programming model developed by Charnes, Cooper and Rhodes (1978) (hereafter referred to as the CCR model). The method seeks to establish how then 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. 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, Charnes and Cooper (1984) (hereafter referred to as the BCC model) proposed the BCC model with a variable returns to scale (VRS) assumption which relaxes the CRS assume under the CCR model. Accordingly, to obtain robust results, the present study estimates the efficiency of Bangladesh banks under the VRS assumption.

The VRS assumption provides the measurement of pure technical efficiency (PTE). The PTE measures the efficiency of DMUs without being contaminated by scale. Therefore, efficiency results derived from the VRS assumption provide more reliable information on the efficiency of the DMUs (Coelli *et al*. 1998). The technical efficiency (TE) scores obtained from the CRS DEA can be divided into two components, one due to scale efficiency (SE) and the other is due to PTE. If there is a difference between the two TE scores (CRS TE vs. VRS TE), then, it indicates that the DMU suffers from scale inefficiency (Coelli *et al*. 1998).

Figure 1 provides a brief illustration. From Figure 1, under the CRS assumption, the input orientated technical inefficiency of point B is the distance BBc, meanwhile under the VRS assumption, the technical inefficiency would only be BBv. Therefore, scale inefficiency is the difference between BcBv. Although the SE measure provides information concerning the degree of inefficiency resulting from the failure of DMUs to operate with CRS, it does not provide information as to whether a DMU is operating in the area of increasing returns to scale (IRS) or decreasing returns to scale (DRS). This may be determined by running an additional DEA problem with non-increasing returns to scale (NIRS) imposed. Therefore, the nature of the scale inefficiencies, due to either IRS or DRS could be determined by

FIGURE 1: Calculation of Scale Economies in DEA



SOURCE: Coelli et al. (1998)

the difference between the NIRS TE and VRS TE scores. If the VRS TE @ PTE NIRS TE, then, the DMU is said to be operating at IRS (point B in Figure 1). On the other hand, if the VRS TE @ PTE = NIRS TE, then, the DMU is said to be operating at DRS (point D in Figure 1).

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 ith bank, these are represented by x_i

EQUATION MODEL 1:

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

i = 1,…,n banks

and y_i vectors respectively.

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

3.2 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

EQUATION MODEL 2:

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

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

subject to

$$\sum_{j=1}^{n} \lambda_j x_j + s_i^- = x_{io} \qquad i = 1,2,\ldots,m;$$

$$\sum_{j=1}^{n} \lambda_j y_j - s_r^+ = y_{ro} \qquad r = 1,2,\ldots,s;$$

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

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 DMU0, 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 θ* = 1 and the inefficient bank will exhibit θ* < 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 and 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 Model (1) is modified to a VRS slack-based model as follows:

EQUATION MODEL 3:

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

subject to

$$\sum_{j=1}^{n} \lambda_j x_j + s_i^- = x_{io} \qquad i = 1,2,\ldots,m;$$

$$\sum_{j=1}^{n} \lambda_j y_j - s_r^+ = y_{ro} \qquad r = 1,2,\ldots,s;$$

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

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

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 the production takes place with a disproportionate change in inputs and outputs. The scalar, ρ, captures the VRS based slack variables as follows:

EQUATION MODEL 4:

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

3.3 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	PCB
Bangladesh Commerce Bank	PCB
Bank Asia	PCB
BRAC Bank	PCB
City Bank	PCB
Dhaka Bank	PCB
Dutch-Bangla Bank	PCB
Eastern Bank	PCB
Export Import Bank of Bangladesh	PCB
First Security Bank	PCB
IFIC Bank	PCB
Islami Bank Bangladesh	PCB
Jamuna Bank	PCB
Janata Bank	SCB
Mercantile Bank	PCB
Mutual Trust Bank	PCB
National Bank	PCB
National Credit and Commerce Bank	PCB
One Bank	PCB
Premier Bank	PCB
Prime Bank	PCB
Pubali Bank	PCB
Rupali Bank	SCB
Shahjalal Bank	PCB
Sonali Bank	SCB
Southeast Bank	PCB
Standard Bank	PCB
Trust Bank	PCB
United Commercial Bank	PCB
Uttara Bank	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 and 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. 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 and Hassan, 2002). Third, Sealey and 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 and Mehdian, 1990; Berger and 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 and Can (2008) and other major studies on the efficiency of banking sectors in developing countries (e.g. Sufian *et al.* 2012a; Sufian *et al.* 2012b; Sufian and Habibulah, 2009; Bader *et al.* 2008; Isik and Hassan, 2002). The three input vector variables consist of *x1*: Deposits, *x2*: Labour, and *x3*: Capital. Meanwhile, the two output vector variables are *y1*: Loans and *y2*: Investments. The summary of data used to construct the efficiency frontiers is presented in Table 2.

4. EMPIRICAL RESULTS

4.1. 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 a 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%)).

TABLE 2: Summary Statistics of the Input and Output Variables in the DEA Model

Variable	Mean	Std. Dev.	Min	Max
Deposit (*x1*)	80,473.73	85,440.89	4,305	535,288.4
Labour (*x2*)	1,213.56	1,402.48	51.1	9,345.6
Capital (*x3*)	1,808.54	2,754.99	17.3	23,026.4
Loan (*y1*)	65,040.53	64,038.10	3,073	345,991.3
Investment (*y2*)	13,959.01	20,521.95	200	134,075.8

NOTES: *x1*: Deposits (deposits and short term funding), *x2*: Labour (personnel expenses), *x3*: Capital (fixed assets), *y1*: Loans (gross loan), *y2*: Investment (total security)

In other words, the Bangladesh banking sector is said to have lacked entirely to 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.

4.2 PROFIT EFFICIENCY OF THE BANGLADESH BANKING SECTOR: EVIDENCE FROM SPECIFIC BANK

The mean profit efficiency level for a 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 fully to maximize revenues while minimizing costs and subsequently lead to the perfect profit efficiency.

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.

4.3 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.

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

TABLE 3: 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**	

DRS, the findings that are similar to the earlier studies by among others Miller and Noulas (1996) and McAllister and McManus (1993). According to Noulas et al. (1990), small banks can be categorized as banks with assets in between $1 to $3 billion while banks with assets ranging from $3 to $6 billion are classified as large. Noulas (1990) points out that small banks in general tend to exhibit scale economies whereas diseconomies are more prevalent among large banks. Furthermore, Noulas et al. (1990) suggests that small banks should increase their size to reap the benefits of economies of scale while large banks should reduce their size become more cost efficient.

The earlier study by McAllister and McManus (1993) also suggest that the small banks have exhibit IRS, while

TABLE 4: Composition of Production Frontiers

Banks	Total Assets BDT (million)	2004	2005	2006	2007	2008	2009	2010	2011	Count Bank
Agrani Bank	1,628,286	CRS	CRS	CRS	DRS	DRS	DRS	DRS	CRS	**4**
Arab Bangladesh Bank	506,653	–	–	–	–	DRS	DRS	IRS	DRS	**0**
Bangladesh Commerce Bank	74,765	IRS	IRS	CRS	IRS	IRS	IRS	CRS	CRS	**3**
Bank Asia	453,733	CRS	CRS	CRS	CRS	CRS	CRS	IRS	IRS	**6**
BRAC Bank	368,901	–	–	–	–	–	DRS	CRS	IRS	**1**
City Bank	228,672	–	–	–	–	–	–	IRS	CRS	**1**
Dhaka Bank	504,897	IRS	CRS	DRS	DRS	DRS	DRS	IRS	IRS	**1**
Dutch-Bangla Bank	511,953	IRS	DRS	DRS	DRS	DRS	DRS	IRS	IRS	**0**
Eastern Bank	219,037	–	–	–	–	–	–	IRS	IRS	**0**
Export Import Bank of Bangladesh	420,871	–	–	–	–	DRS	CRS	CRS	CRS	**3**
First Security Bank	312,956	IRS	CRS	CRS	CRS	CRS	CRS	CRS	CRS	**7**
IFIC Bank	401,075	CRS	CRS	IRS	CRS	CRS	DRS	IRS	IRS	**4**
Islami Bank Bangladesh	1,787,277	DRS	DRS	DRS	DRS	DRS	DRS	DRS	DRS	**0**
Jamuna Bank	312,463	IRS	DRS	IRS	CRS	IRS	IRS	IRS	IRS	**1**
Janata Bank	1,221,546	–	–	–	–	–	CRS	DRS	DRS	**1**
Mercantile Bank	456,343	CRS	DRS	CRS	DRS	DRS	DRS	IRS	DRS	**2**
Mutual Trust Bank	199,734	–	–	–	–	–	CRS	CRS	CRS	**3**
National Bank	641,914	DRS	DRS	IRS	DRS	DRS	DRS	CRS	CRS	**2**
National Credit and Commerce Bank	427,432	CRS	CRS	DRS	CRS	CRS	CRS	IRS	CRS	**6**
One Bank	285,379	CRS	CRS	IRS	IRS	IRS	IRS	IRS	IRS	**2**
Premier Bank	209,518	–	–	–	–	–	IRS	CRS	I RS	**1**
Prime Bank	756,592	–	–	CRS	DRS	CRS	DRS	CRS	DRS	**3**
Pubali Bank	707,697	DRS	DRS	IRS	DRS	DRS	DRS	IRS	IRS	**0**
Rupali Bank	730,261	DRS	DRS	DRS	DRS	DRS	DRS	IRS	IRS	**0**
Shahjalal Bank	361,716	CRS	CRS	CRS	CRS	DRS	IRS	IRS	DRS	**4**
Sonali Bank	3,696,898	CRS	CRS	CRS	CRS	CRS	DRS	DRS	DRS	**5**
Southeast Bank	429,095	–	–	–	–	–	CRS	CRS	CRS	**3**
Standard Bank	286,619	CRS	CRS	CRS	CRS	CRS	CRS	CRS	CRS	**8**
Trust Bank	301,666	CRS	CRS	CRS	IRS	IRS	DRS	CRS	CRS	**5**
United Commercial Bank	409,085	–	–	–	–	–	DRS	IRS	DRS	**0**
Uttara Bank	486,389	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 correspond to the shaded regions have not been efficient in any year in the sample period compared to the other bank in the sample.

the large banks 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. It can be observed from Table 4 that Standard Bank has dominated the efficiency frontier (CRS) compared with other Bangladesh banks. Likewise, the results indicate that while the top 5 largest banks (based on total assets) namely Sonali Bank, Islami Bank Bangladesh, Agrani Bank, Janata Bank, and Prime Bank tend to operate at DRS or CRS at best. Meanwhile, the bottom 5 banks (smallest banks based on total assets) tend to operate at IRS or CRS at best.

One implication is that for the small Bangladesh banks, a proportionate increase in inputs would result in more than 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 underperforming banks by streamlining their operations and eliminating their redundancies and inefficiencies (Evanoff and Israelvich, 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 the 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.

5. CONCLUSIONS, POLICY IMPLICATIONS, AND DIRECTIONS FOR FUTURE RESEARCH

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 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 a 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 provided insights to policymakers about 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.

REFERENCES

ADONGO J, STROK C, HASHEELA E (2005) Measuring the Alternative Profit X-Efficiency of Namibia's Banking Sector. *Nepru Research Report* 36: 1-58.

AKHAVEIN JD, BERGER AN, HUMPHREY, DB (1997) The Effects of Megamergers on Efficiency and Prices: Evidence from a Bank Profit Function. *Review of Industrial Organization* 12 (1): 95-139.

AKHIGBE A, MCNULTY JE (2003) The Profit Efficiency of Small US Commercial Banks. *Journal of Banking and Finance* 27 (2): 307-325.

ARIFF M, CAN L (2008) Cost and Profit Efficiency of Chinese Banks: A Non-Parametric Analysis. *China Economic Review* 19: 260-273.

ASSAF AG, BARROS CP, MATOUSEK R (2011) Technical Efficiency in Saudi Banks. *Expert Systems with Applications* 38: 5781-5786.

AVKIRAN NK (1999) The Evidence on Efficiency Gains: The Role of Mergers and the Benefits to the Public. *Journal of Banking and Finance* 23 (7): 991-1013.

BADER KMI, MOHAMMED S, ARIFF M, HASSAN T (2008) Cost, Revenue and Profit Efficiency of Islamic Versus Conventional Banks: International Evidence Using Data Envelopment Analysis. *Islamic Economic Studies* 15: 24-76.

BANKER RD, CHARNES A, COOPER WW (1984) Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. *Management Science* 30 (9): 1078-1092

BERGER AN, HUMPHREY DB (1991) The Dominance of Inefficiencies Over Scale and Product Mix Economies in Banking. *Journal of Monetary Economics* 28: 117-148

BERGER AN, MESTER LJ (2003) Explaining the Dramatic Changes in Performance of US Banks: Technological Change, Deregulation, and Dynamic Changes in Competition. *Journal of Financial Intermediation* 12: 57–95.

BERGER AN (2007) International Comparisons of Banking Efficiency. *Financial Markets, Institutions and Instruments* 16 (3): 119–144.

BUTTON KJ, WEYMAN-JONES TG (1992) Ownership Structure, Institutional Organization and Measured X-Efficiency. *American Economic Review* 82 (2): 439-445.

CHAN SG, KARIM MZA, BURTON B, AKTAN B (2013) Efficiency and Risk in Commercial Banking: Empirical Evidence from East Asian Countries. Forthcoming in *European Journal of Finance.*

CHARNES A, COOPER WW, RHODES E (1978) Measuring the Efficiency of Decision Making Units. *European Journal of Operational Research* 2 (6): 429-444.

CHIU YH, CHEN YC (2009) The Analysis of Taiwanese Bank Efficiency: Incorporating Both External Environment Risk and Internal Risk. *Economic Modelling* 26 (2): 456–463.

COELLI T, PRASADA RAO DS, BATTESE GE (1998). *An Introduction to Efficiency and Productivity Analysis.* Kluwer Academic Publishers, Boston.

ELYASIANI E, MEHDIAN S (1990) Efficiency in the Commercial Banking Industry: A Production Frontier Approach. *Applied Economics* 22 (4): 539-551.

EVANOFF DD, ISRAELVICH PR (1991) Productive Efficiency in Banking. *Economic Perspectives,* Federal Reserve Bank of Chicago (July/August): 11-32.

FARE R, GROSSKOPF S, LOVELL KCA (1985). *The Measurement of Efficiency of Production.* Boston: Kluwer-Nijhoff Publishers.

FARE R, GROSSKOPF S, NORRIS M, ZHANG Z (1994) Productivity Growth, Technical Progress and Efficiency Change in Industrialized Countries. *American Economic Review* 84 (1): 66-83.

ISIK I, HASSAN MK (2002) Cost and Profit Efficiency of the Turkish Banking Industry: An Empirical Investigation. *Financial Review* 37 (2): 257-280.

KOOPMANS TC (1951) Analysis of Production As An Efficient Combination of Activities, in Koopmans TC (ed.), *Activity Analysis of Production and Allocation* (pp. 33-97). New York: John Wiley and Sons.

LEVINE R (1998) The Legal Environment, Banks, and Long Run Economic Growth. *Journal of Money, Credit and Banking* 30 (3): 596-613.

LIEBSTEIN H (1966) Allocative Efficiency vs. X-Efficiency. *American Economic Review* 56 (3): 392-415.

MAUDOS J, PASTOR JM, FRANCISCO PG, JAVIER QI (2002) Cost and Profit Efficiency in European Banks. *Journal of International Financial Markets, Institutions and Money* 12 (1): 33-58.

MCALLISTER PH, MCMANUS DA (1993) Resolving the Scale Efficiencies Puzzle in Banking. *Journal of Banking and Finance* 17 (2-3): 389-405.

MILLER SM, NOULAS AG (1996) The Technical Efficiency of Large Bank Production. *Journal of Banking and Finance* 20 (3): 495-509.

NOULAS AG, RAY SC, MILLER SM (1990) Returns to Scale and Input Substitution for Large U.S. Banks. *Journal of Money, Credit and Banking* 22 (1): 94-108.

SCHUMPETER JA (1934). *The Theory of Economic Development.* Cambridge, MA. Harvard University Press.

SEALEY CW, LINDLEY JT (1977) Inputs, Outputs and a Theory of Production and Cost at Depository Financial Institutions. *Journal of Finance* 32 (4): 1251-1266.

SHAMEEM AKM (1995) Impact of Flexible Interest Rate on Savings and Investment. *Bangladesh Journal of Political Economy* 13 (2): 62-78

SUFIAN F, HABIBULLAH MS (2009) Asian Financial Crisis and the Evolution of Korean Banks Efficiency: A DEA Approach. *Global Economic Review* 38 (4): 335-369

SUFIAN F, KAMARUDIN F, NOOR NHHM (2012A) Determinants of Revenue Efficiency in the Malaysian Islamic Banking Sector. *Journal of King Abdul Aziz: Islamic Economics* 25 (2): 195-224

SUFIAN F, MUHAMAD J, ARIFFIN ANB, YAHYA MH, KAMARUDIN F (2012B) Assessing the Effect of Mergers and Acquisitions on Revenue Efficiency: Evidence from Malaysian Banking Sector. *Vision: Journal of Business Perspectives* 16 (1): 1-11

SUFIAN F (2009) Determinants of Bank Efficiency During Unstable Macroeconomic Environment: Empirical Evidence from Malaysia. *Research in International Business and Finance* 23 (1): 54-77.

TONE K (2002) A Slack-Based Measure of Efficiency in Data Envelopment Analysis. *European Journal of Operational Research* 143 (1): 32–41.

WADUD IKM M, YASMEEN W. (2004) Competitiveness and Returns to Scale in Bangladeshi Banking Industry: A Closer Look into Profitability of Islamic Banking, in Islamic Banking: An International Perspective, Shanmugam B, Perumal V, Ridzwa A H (eds.) Universiti Putra Malaysia (UPM) Press.

DILRUBA K, KHANDOKER MSH (2005) X-Efficiency Analysis of Problem Banks of Bangladesh. *Pakistan Journal of Social Science,* 3 (3), 521-525.

YASMEEN W (2011) Technical Efficiency in the Bangladeshi Banking Industry: A Non Parametric Analysis. Paper Presented at the 2011 Barcelona European Academic Conference Barcelona, Spain.

HOQUE MR, RAYHAN MI (2012) Data Envelopment Analysis of Banking Sector in Bangladesh. *Russian Journal of Agricultural and Socio-Economic Sciences* 5 (5), 17 – 22.

HOQUE MR, RAYHAN MI (2013) Efficiency Measurement on Banking Sector in Bangladesh. *Dhaka University Journal of Science* 61 (1), 1-5.

SAMAD A (2009) Measurement of Inefficiencies in Bangladesh Industry Using Stochastic Frontier Production Function. *Global Journal of Business Research* 3 (1), 41-48.

BATEN A, KAMIL AA (2013) Evaluating Advance Efficiency of Bangladeshi Online Banks Using Stochastic Frontier Analysis. *African Journal of Business Management* 7 (32), 3177-3185.