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How Efficient are Commercial Banks in Bangladesh? Evidence from the Stochastic Frontier Approach

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Abstract

The banking sector in Bangladesh includes various sorts of banks; there are state-owned and private commercial banks, conventional and Islamic commercial banks and different generation banks. All kinds of banks start the journey to contribute to the banking sector and hence economic growth in Bangladesh through, among others, mobilising deposits and providing loans. This paper aims to evaluate the technical efficiency of a sample of first-generation and second-generation commercial banks. The sample of first general banks includes Janata bank limited, Rupali Bank Limited and Islami Bank Bangladesh Limited, while the second-generation banks consist of Dutch Bangla Bank Limited and Jamuna Bank Limited.

We apply the stochastic frontier approach with the Cobb-Douglas frontier model specification. We use secondary data from 1996 to 2017 for the first-generation banks and 2002 to 2017 for the second-generation banks. We use operating income, net profit, deposit, and loans & advance as dependent variables and labour cost, occupancy cost, cost of material and other expenses as independent in the stochastic frontier model. We estimate four stochastic frontier models with four dependent variables separately, applying the maximum likelihood estimation technique. We also estimate these frontier models with both the specification of the half-normal as well as the truncated normal distributional assumptions for the inefficiency effects component and choose the specification to apply the generalised likelihood ratio test.

Efficiency results show that Dutch Bangla Bank Limited and Jamuna Bank Limited, as second-generation banks, are 73 and 55 per cent technically

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efficient, respectively, in terms of earning a profit. In contrast, Islami Bank Bangladesh Limited, Janata Bank Limited and Rupali Bank Limited, as first-generation banks, are, on average, 59, 33 and 46 per cent efficient in achieving profit targets. It implies that state-owned first-generation banks are less efficient than other banks. Results also indicate that first general banks are, on average, 96 and 89 per cent technical efficient in mobilising deposit and supply loans and advances, while second-generation banks are 83 and 84 per cent technical efficient, respectively, on an average. It predicts that first-generation banks are more efficient than second-generation banks in mobilising deposits and providing loans & advances. Results imply that given the technology, there are scopes for improving efficiencies, especially in realising more profit, and hence appropriate policy formulations are required.

Keywords *Efficiency · Commercial Banks · Stochastic Frontier Model · Bangladesh*

1. Introduction

The banking sector of Bangladesh consists of state-owned and private commercial banks and some specialised banks. The state-owned commercial banks fall into the category of first-generation banks, while the private commercial banks enter second and third-generation banks. The banking sector is known as the backbone of an economy. A sound and stable banking process are necessary for developing the banking sector and hence the economic growth of an emerging economy of a country like Bangladesh, which is experiencing a massive change due to the far-reaching reforms implemented in the aftermath of the financial crisis. Since 2016 the banking sector has been facing some crises in the increase of the non-performing loans due to the improper selection of the borrower, relatively high interest, increase in salary and other benefits of the employees, insufficient risk management practices, and improper management governance.

Some of the banks in Bangladesh were nationalised in 1972. The purpose of the nationalisation was to reach the common masses and bring the country's financial inclusion rather than to make a profit. After that, the government liberalises the banking sector, ultimately increasing the number of private commercial banks and their branches (Bangladesh Bank, 2017). The banking industry in Bangladesh today dominates the financial sector, contributing to 74% of the whole financial industry (Robin *et al.,* 2018). The function of the banking sector is to speed up the improvement of the financial sector and largely relies on the soundness and profitability of the industry. In the banking sector of Bangladesh, there exists, *among others*, supervision gaps and market distortions.

In recent times, the banking sector has been experiencing several ups and downs, and many changes have been adopted to enhance the structural positions of the sector. The major participants of the banking industry are the commercial banks that should be competent enough because it can create anarchy and mismatch in the expansion of the financial sector and the economy in general. To

maintain market shares and survive in the competitive situation, banks must adopt the new technological advancements and efficiently enhance technical innovation capability.

The state-owned commercial banks are sometimes reluctant to give loans because of non-performing loans and spending more funds on processing loans. This causes an increase in operating costs. On the other hand, private commercial banks are heading towards extending various loans. Thus, banks face default loans or non-performing loans. Commercial banks have recently faced liquidity and deposit crises in their day-to-day operations. This negatively affects profit earnings and investment capacity and further decreases the efficiency of the banks.

Moreover, the state-owned commercial banks are not entirely using new technologies to reduce operating costs, making these banks more cost-inefficient compared to other banks. In case of timely and proper selection of the employees, the state-owned commercial banks are lagging, and hence these banks are operating with fewer employees. This causes poor and low-quality service and ultimately decreases the banks' profit.

Banks with lower efficiency are likely to be insolvent in general (Podpiera and Podpiera, 2005); this may contribute to banking and financial failure affecting the economy adversely. Again, it is argued that the breakdown of a single bank can hamper other banks' operations. Moreover, commercial banks should be not only efficient but also profitable because these banks face vigorous competition domestically as well as internationally. These banks should be efficient and competent in mobilising and utilising financial resources from surplus to deficit units.

In times of crisis and collapse, it creates a burden to take over these banks to the government of a developing country like Bangladesh. Securing efficacy in these sectors would require rigorous the efficiency of programs and policies on a grander scale, inducing uninterrupted development and pecuniary growth. Thus, we need to measure the performance of the banks and identify the gap between the efficient and the inefficient banking institutions. Therefore, the efficiency of the banks requires to be calculated to offer policy suggestions concerning the capability of the incumbents and the degree of competition in the banking industry. This study tries to add to the literature by measuring technical efficiency in operating income, net profit, loans & advances, and deposits using a sample of state-owned and private commercial banks.

2. Review of Literature

Research on efficiency analysis in the banking industry is increasing. Yildirim (2016) estimates the cost efficiency of Turkish commercial banks employing the stochastic frontier model. Empirical results suggest that the cost efficiencies of Turkish banks are improved over time, with the effects of the 2008 and 2010 crises. Niaki and Shalmani (2016) examine the branch-level efficiency of Sarman

Bank in an Iranian banking context using the stochastic frontier model and report that changes in salaries have not significantly increased total costs. Increased operational costs have led to an increase in the costs of the branches, while an increased depreciation rate has led to cost reduction.

Ngan (2014) estimates profit and cost efficiency in the banking sector of Vietnam. The paper adopts the stochastic frontier analysis approach to measure the cost and profit efficiency of 45 Vietnamese commercial banks over the years from 2007 to 2012. Results show that mergers and acquisitions can increase potential cost inefficiency and foster competition for banks. Sarmiento and Galan (2015) analyse the influence of risk-taking on bank efficiency in the Colombian banking industry. The paper employs a stochastic frontier model with random inefficiency parameters for capturing the influence of risk-taking on bank efficiency. The paper finds that more capitalised banks are more cost and profit efficient, while banks are assuming more credit risk are less cost-efficient but more profit efficient.

Aiello and Bonanno (2013) evaluate profit and cost efficiency in the Italian banking industry by employing a translog stochastic frontier model. Results show that the average cost and profit efficiency levels are around 90% and stable over time. Afza and Asghar (2017) estimate the efficiency of commercial banks in Pakistan by applying the stochastic frontier approach. The efficiency trend analysis indicates that the efficiency remains similar over the examined period, especially the banks' cost efficiency. The results, however, show that the profit efficiency of the conventional banks has fallen, whereas it increases for the Islamic banks.

Azad *et al.* (2017) analyse the efficiency of banks in Malaysia by unveiling a dynamic network data envelopment analysis (DEA). This paper uses a three-step network DEA model with slack-based variable returns to scale approach. The empirical results imply that few banks in Malaysia are performing well in transforming deposits and equities into profit and making loan-loss provisions minimum.

Warraich *et al.* (2013) investigated the scale efficiency scores of Islamic banks of Pakistan from 2006 to 2009 within the framework of the DEA approach. Both constant returns to scale and variable returns to scale specification are applied for calculating scale efficiency under input orientation. The results depict that the Dawood Islamic bank is the most scale efficient Islamic bank and that the Islamic banks had the highest mean scale efficiency scores in 2007. Shahwan *et al.* (2013) measured the profitability, marketability and social disclosure efficiency of UAE banks using the non-parametric frontier method. Findings suggest that the UAE banks perform much better in profitability and social disclosure activities than in marketability. Result also depicts the positive relationship observed between social disclosure and profitability performance.

Samad (2009) explores Bangladesh's banking industry's inefficiencies by applying a stochastic frontier production function model and using the time-invariant cross-sectional data. The technical efficiency examination indicates that Bangladesh commercial banks' efficiency lies between 12.7% and 94.7%;

the industry average is 69.5%. This paper also shows that about 30% of the commercial banks in Bangladesh are below the industry average. Qamruzzaman et al. (2016) identify the level of financial efficiency of financial institutions from 2011 to 2015 in Bangladesh. The paper considers 24 private commercial banks. Technical efficiency is calculated by applying DEA, considering both input and output variables. Results reveal that 62% of banks are efficient under constant returns scale and are efficient under constant returns to scale 75% of banks are efficient at the firm level. We design, in this paper, to calculate the efficiency performance of a sample of first, second and third-generation commercial banks in terms of operating income, net profit, deposit and loan & advances and compare their efficiency performances. Further, we apply the stochastic frontier model to measure the level of efficiency. From this viewpoint, this research is different from others and the first of its kind.

3. Theoretical Framework

The stochastic frontier model, independently introduced by Aigner et al. (1977) and Meeusen and van den Broeck (1977), is applied to calculate the technical efficiency. The general stochastic frontier model we begin with is defined as:

$$y_i = f(x_i ; \beta) e^{u_i} \quad \text{i = 1, 2, 3, ..., n} \tag{1}$$

Where y_i denotes the output quantity of the *ith* banks, x_i is a vector of inputs, β identifies a vector of parameters. The composed error u_i is divided into two parts: a stochastic random error part and an inefficiency part, that is,

$$u_i = \xi_i - \zeta_i \tag{2}$$

Where $\xi_{i \text{ represents}}$ the symmetric error and ζ_i denotes the asymmetric non-negative error representing the technical inefficiency. While ξ_i is assumed to be distributed independently and identically $N(0, \sigma^2 \xi)$, ζ_i is independently and identically distributed non-negative truncations (at zero from below) of the $N(\mu, \sigma_\zeta^2)$ distribution. The model provides variance parameters which are expressed as follows:

$$\sigma_u^2 = \sigma_\xi^2 + \sigma_\zeta^2 ; \ \gamma = \sigma_\zeta^2 / \sigma_u^2 \ \textit{and} \ \ 0 \le \gamma \le 1 \tag{3}$$

Estimators for β of (1) and variance parameters of (3) can be calculated with the help of the maximum likelihood estimation method. With the utilisation of standard integrals, we can obtain the estimate of - ζ_i *from* the expected value of - $\zeta_{i,}$ given *u,* as well as the assumption of distributions of $\xi_{i \text{ and }} \zeta_i$ as:

$$E(-\zeta_i / u_i) = [\frac{1-\Phi\{\sigma_i^* - (\mu_i^* / \sigma_j^*)\}}{1-\Phi(-\mu_i^* / \sigma_i^*)}] e^{(-\mu_i^* + \frac{1}{2}\sigma_i^{*2})} \quad (4)$$

where $\mu_i^* \equiv \frac{\sigma^2\xi - \mu_i\sigma^2\varsigma}{\sigma^2\xi + \sigma^2\varsigma}, \sigma_i^{*2} \equiv \frac{\sigma^2\varsigma^2\xi}{\sigma^2\xi + \sigma^2\varsigma}$ and $\Phi(\cdot)$ represents cumulative distribution function (Battese and Coelli, 1988). This gives the estimates of the bank-specific efficiency.

4. Empirical Methodology and Data

4.1 Empirical Specification of the Model

Estimating the technical efficiency score requires the stochastic frontier model to be specified. We specify the widely-used Cobb-Douglas stochastic frontier model to predict banks' technical efficiency (TE), and the maximum likelihood method is employed to estimate the model. The specified model is expressed as follows:

$$\ln y_i = \beta_0 + \sum_{k=1}^{4} \beta_k \ln x_k + \xi_i - \zeta_i \quad (i \text{ indicates time and } k \text{ inputs}) \quad (5)$$

Where y_i represents the output variables, operating income, net profit, deposit, loans & advance, x_{i1} is the amount of labour cost, x_{i2} is the total occupancy cost, x_{i3} is the total cost on materials, x_{i4} is other expenses., and *ln* denotes natural logarithm. The term ξ_i is defined before, and the term ζ_i is distributed independently of ξ_i such that ζ_i has non-negative truncation (at zero from below) of the $N(\mu_i, \sigma_\zeta^2)$ where μ_i can be expressed as:

$$\mu_i = f(z_k) \quad (6)$$

Where z_{i1} denotes the number of branches and z_{i2} is the business per branch.

We estimate the stochastic frontier model and the technical inefficiency effects model with the assumptions of the truncated normal and the half-normal distributional assumption for the inefficiency term. To check the suitability of the half-normal or truncated normal distributional assumption, we use the generalised likelihood ratio test, which is $\lambda = -2In[L(H_0)/L(H_A)]$ where $L(H_0)$ and $L(H_A)$ are the values of the likelihood function under the null hypothesis of the half-normal distribution and the alternative hypothesis of the truncated normal distribution, respectively. The test statistic possesses an asymptotic χ^2 distribution degrees of freedom equals the number of constraints enforced under the null hypothesis (Coelli, 1995). We therefore use and discuss results from the stochastic frontier model given the assumption of truncated normal distribution for the technical inefficiency model.

4.2 Data

Data are collected from the five commercial banks in Bangladesh. These banks are chosen from the first, second and third-generation banks. Among these banks, Janata Bank Limited and Rupali Bank Limited are first-generation banks, Islami Bank Limited and Dutch Bangla Bank Limited are second-generation banks, and Jamuna Bank Limited is a third-generation bank. Janata Bank Limited and Rupali Bank Limited are the state-owned commercial banks, while Islami Bank Limited, Dutch Bangla Bank Limited and Jamuna Bank Limited are the private commercial banks. Data from the first-generation banks and Islamic Bank Bangladesh Limited were collected from 1996 to 2017. Those for Dutch Bangla Bank and Jamuna Bank Limited are collected from 2002 to 2017. Output variables include loans & advances, total operating income, net profit and total deposit of the banks. Input put variables include occupancy cost, labour cost, cost of material, and other expenses. The environmental variable consists of the number of branches and businesses per branch.

4.2.1 Summary Statistics of Variables

4.2.1.1 Janata Bank Limited

Table 1 shows the summary statistics of variables of Janata Bank Limited. The mean of deposit, operating income, loans & advance, net profit, labour cost, occupancy cost, cost of material, other expenses and business per branch are 12.27, 9.00, 181059.01, 11.89, 8.10, 5.91, 5.81, 5.90 and 12.97 million taka respectively with a respective standard deviation of 0.71, 0.89, 118885.90, 0.68, 0.64, 0.64, 0.73, 1.00 and 9.62. The maximum value of the deposit, operating income, loans & advance, net profit, labour cost, occupancy cost, cost of material, other expenses and business per branch are 13.43, 10.14, 418612.23, 12.94, 9.20, 6.91, 7.14, 7.52, and 27.71 million taka respectively.

Table 1: Statistics of the Janata Bank Limited

	Deposit	Operating Income	loans & advance	Net Profit	labour Cost	Occupancy Cost	Cost on Material	Other Expenses	Branches	Business per Branch
Mean	12.27	9.00	181059.01	11.89	8.10	5.91	5.81	5.90	879.05	12.97
Median	12.15	8.94	131479.98	11.79	8.01	5.76	5.59	5.68	890.50	9.04
Std. Dev	0.71	0.89	118885.90	0.68	0.64	0.64	0.73	1.00	24.69	9.62
Skewness	0.25	-0.05	0.77	0.06	0.31	0.29	0.64	0.06	-0.27	0.34
Kurtosis	-1.24	-1.70	-0.75	-1.18	-1.27	-1.23	-0.93	-0.77	-1.76	-1.74
Mon.	11.23	7.65	48754.64	10.79	7.23	4.96	4.83	3.85	847.00	2.35
Max.	13.43	10.14	418612.23	12.94	9.20	6.91	7.14	7.52	910.00	27.71

5. Results of Efficiency Performance

We employ the maximum likelihood method to calculate the Cobb-Douglas frontier model with the truncated and half-normal distribution assumption and the technical inefficient model. The generalised likelihood test indicates that the truncated normal distribution assumption fits the model. Results are given in Table 6-10.[1]

5.1 Efficiency Performance of Janata Bank Limited

Table 2 shows the efficiency level of different variables of Janata Bank Limited. during the study period. During the first five years the rates are not satisfactory and the efficiency rates are 52.20%, 53.05%, 44.09%, 52.39%, 51.96% and 47.26% respectively during the year 1996 to 2001 respectively. After that the efficiency level continues to show better position and the rates are 57.18%, 67.54%, 71.89%, 78.06%, 83.51%, 68.37%, 95.53%, 97.57%, 98.75%, 99.16%, 98.71%, 98.25%, 98.31%, 98.52% and 98.81% respectively. The net profit position occupies by the bank is not satisfactory. In case of deposit collection capacity by the bank the result is satisfactory. The efficiency levels are 98.53%, 97.53%, 97.55%, 97.79%, 97.66%, 97.46%, 97.64%, 97.47%, 97.71%, 97.56%, 97.46%, 98.39%, 97.52%, 97.33%, 97.63, 97.77, 97.78%, 97.71%, 97.68%, 97.73%, 97.77% and 97.64% respectively.

Table 2: Efficiency Values of Janata Bank Limited

Year	Operating Income	Net Profit	Deposit	loans & advance
1996	0.5220	0.5083	0.9753	0.9761
1997	0.5305	0.8516	0.9753	0.9751
1998	0.4409	0.9214	0.9755	0.9769
1999	0.5239	0.9207	0.9779	0.9795
2000	0.5196	0.1416	0.9766	0.9805
2001	0.4726	0.1157	0.9746	0.9780
2002	0.5718	0.0881	0.9764	0.9791
2003	0.6754	0.1022	0.9747	0.9783
2004	0.7189	0.0090	0.9771	0.9803
2005	0.7806	0.0019	0.9756	0.9787
2006	0.8351	0.0007	0.9746	0.9780
2007	0.6837	0.0737	0.9839	0.9843
2008	0.9553	0.9010	0.9752	0.9754
2009	0.9757	0.5834	0.9752	0.9760
2010	0.9875	0.2523	0.9733	0.9776
2011	0.9916	0.2972	0.9763	0.9795
2012	0.9902	0.0002	0.9777	0.9817
2013	0.9871	0.9952	0.9778	0.9786
2014	0.9825	0.2805	0.9771	0.9785
2015	0.9831	0.2052	0.9768	0.9780
2016	0.9852	0.0386	0.9773	0.9786
2017	0.9881	0.0366	0.9777	0.9789
Average	0.7773	0.3330	0.9764	0.9785

[1] We produce efficiency results only. Results of model parameters are not produced because of lack of space as our objective is to show efficiency performances and their comparisons.

5.2 Test Results of Efficiency Series

We use a non-parametric Wilcoxon Signed Rank and t-test to check whether there is any difference between efficiency series obtained in operating income, net profit, deposit and loans & advances. We compare the pairs' results: operating Income - net profit, operating income – deposit, and operating income - loans & advances. Table 3 represents the non-parametric test results. In the case of Dutch Bangla Bank Limited, all the three pairs are not significant. For the Islami Bank Bangladesh Limited operating income - net profit is not significant, but the rest of the two pairs are significant. In the case of Jamuna Bank Limited, operating income- deposit is not significant. For Janata Bank Limited, all three pairs are significant. In the case of Rupali Bank Limited, operating income- net profit is insignificant.

Table 3: Non-Parametric (Wilcoxon Signed Rank) Test Summary

Banks	Efficiency Series	Sig.	Null hypothesis
Janata Bank Limited	Operating Income - Net Profit	0.001	Reject
	Operating Income - Deposit	0.008	Reject
	Operating Income - Loans & advance	0.007	Reject

Table 4: t- Statistics of Sample Banks

Bank	Efficiency Series	t- Statistics	Sig. (2-tailed)
Janata Bank Limited	Operating Income - Net Profit	4.651	0.0000
	Operating Income - Deposit	-4.385	0.0000
	Operating Income - loans & advance	-4.430	0.0000

Table 4 represents the t- statistics of operating income- net profit, operating income- deposit and operating income loans & advances of the sample banks. In the case of Dutch Bangla Bank Limited, all the three pairs are not significant. For the Islami Bank Bangladesh Limited operating income- net profit is not significant, but the rest of the two pairs are significant. In the case of Jamuna Bank Limited, operating income- deposit is not significant. For Janata Bank Limited, all three pairs are insignificant. In the case of Rupali Bank Limited, operating income- net profit is insignificant.

6. Conclusion

This paper aims to evaluate the efficiency of a sample of first, second and third-generation commercial banks and make an efficiency comparison. The sample chooses Janata Bank Limited and Rupali Bank Limited as first-generation banks, Islami Bank Bangladesh Limited and Dutch Bangla Bank Limited as second-generation banks, and Jamuna Bank Limited as third-generation banks. We apply

the stochastic frontier approach with a specification of the Cobb-Douglas stochastic frontier model and the technical inefficiency effects model. We use secondary data from 1996 to 2017 for the first-generation banks and second-generation Islami Bank Bangladesh Limited. From 2002 to 2017, for second-generation Dutch Bangla Bank Limited and third-generation Jamuna Bank Limited, efficiency is assessed in operating income, net profit, deposit, and loans & advances.

Efficiency results of first-generation banks exhibit that, in terms of operating income, net profit, deposit, and loans & advances, the averages of efficiency performance of Janata Bank Limited are 77%, 33%, 97% and 97%, respectively, those for Rupali Bank Limited are 87%, 46%, 92% and 71% and for Islami Bank, Bangladesh Limited are 54%, 59%, 98% and 98%. Efficiency analysis for second-generation banks shows that Dutch Bangla Bank Limited is found to be, on an average, 89%, 73%, 79% and 83% efficient in terms of operating income, net profit, deposit and loans & advance, respectively and that for third-generation indicate that Jamuna Bank Limited are 90%, 54%, 87% and 84% efficiency in terms of operating income, net profit, deposit, and loans & advance respectively.

A comparison of efficiency analysis implies that the first-generation banks are less efficient in managing operating income and net profit than their second and third-generation counterparts. In contrast, these first-generation banks are more efficient in collecting deposits and providing loans & advances. Dutch Bangla Bank Limited shows the highest efficiency in earning a net profit, and Janata Bank Limited shows the lowest. Jamuna Bank Limited holds the highest efficiency in managing operating income, while Janata Bank has the lowest. The deposit collection efficiency of Islami Bank Bangladesh Limited is the highest, and that of Dutch Bangla Bank Limited is the lowest. In providing loans & advances, Islami Bank Bangladesh Limited earns the highest while Rupali Bank Limited has the lowest position. Results reveal that there is room for enhancing efficiencies, especially in managing more net profit; hence, appropriate policy suggestions are required.

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