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# EFFICIENCY ANALYSIS OF SCHEDULED BANKS IN BANGLADESH: DEA NON-PARAMETRIC APPROACH

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***Abstract***

*This study examines the performance of state-owned commercial banks, conventional private commercial banks, foreign commercial banks, and Islamic commercial banks operating in Bangladesh between 2014 and 2020 using data envelopment analysis (DEA). The 26 scheduled banks in the study included four state-owned, thirteen conventional commercial, three foreign, and six Islamic banks. According to the survey, state-owned commercial banks, traditional private commercial banks, foreign commercial banks, and Islamic commercial banks all had average technical efficiency scores of 0.9196, 0.8976, 0.9981, and 0.9115, respectively. State-owned commercial banks are the most efficient, at 8.04 percent, followed by foreign commercial banks at 0.18 percent and conventional private commercial banks at 10.24 percent, according to this data. The investigation also depict that in state-owned commercial banks and Islamic banks, scale inefficiency is the initial cause of technical inefficiency, whereas in ordinary private commercial banks, pure technical inefficiency is the predominant cause. To achieve technological efficiency, both state-owned and Islamic commercial banks must enhance scale efficiency. Private commercial banks can also improve their technological efficiency by improving management performance.*

***JEL Classification:*** *C8, D6, G21*

***Keywords:*** *Efficiency, Data Envelopment Analysis, Returns to Scale, Commercial Banks*

## 1.0 Introduction

The banking industry has contributed to Bangladesh's economy grow significantly. The banking

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system is critical for capital development in both the public and private sectors, supporting agricultural, industrial, and service sector expansion, and producing overseas remittances. The efficiency of scheduled banks has long-term impacts on economic growth and stability. In economics, efficiency is defined as the highest possible ratio between the output and input of a manufacturing system. This ratio depicts the best utilization of available resources to achieve the highest level of efficiency (Cvilikas & Jurkonyte, Dumbliauskiene, 2016).

There are four types of scheduled banks based on their ownership structure: (I) state-owned commercial banks (SCBs), (II) specialized banks (SBs), (III) private commercial banks, and (IV) foreign commercial banks (PCBs). Banks, on the other hand, are classified into three types based on their mode of operation: fully conventional banks, fully Islamic Shariah based banks, and banks with dual operations. There were 61 licensed banks in FY21, 8 PCBs operating as complete Islamic banks, and 22 conventional banks with Islamic banking branches. Total number of scheduled banks is 61, and the total number of scheduled bank branches is 10752, of which 6 are SCBs, 3 are SBs, 43 are PCBs, and 9 are FCBs. In 2020, SCBs will hold 25.1% of total assets, PCBs will have 67.3 percent, FCBs will hold 5.5 percent, and SBs will hold 2.1 percent. The banking industry as a whole had total assets of BDT 18,406.0 billion in 2020. The total deposits in the banking industry were BDT 13797.9 billion. SCBs account for 25.9%, PCBs for 67.3 percent, FCBs for 4.3 percent, and SBs for 2.5 percent of the total deposits held by the banking sector (Source: Bangladesh Bank's Annual Report 2020-2021). The banking sector has made significant progress, but it still faces many difficulties, including persistently high inflation, an increase in foreign exchange rates, an industry-wide liquidity crisis that is getting worse, an increase in the number of non-performing loans, a cap on lending interest rates, and downcast investment in socially enviable sectors like agriculture, health care, and education.

Our study's objective is to assess the efficiency performance of Bangladeshi commercial banks from 2014 to 2020 and propose policy recommendations for enhancing bank performance in Bangladesh. Additionally, it evaluates how various Bangladeshi commercial banks fare in terms of performance.

Following the preface, the second part of the paper is a review of the literature, and the third part is about methods. The findings are analyzed in the fourth part of the report. Finally, in the concluding part, recommendations and policy implications are presented.

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## 2.0 Review of Literature

Numerous studies have been done on the efficiency of commercial banks in both developed and developing countries. The Data Envelopment Analysis (DEA) frontier technique is only employed in a few researches focusing on commercial bank performance in Bangladesh.

Berger, A. N., and D. B. Humphrey (1997) examine the efficiency of financial institutions in 21 different countries. According to the study, Frontier models with and without parameters have comparable efficiency values, however non-parametric models have somewhat lower mean efficiencies and higher dispersion than parametric models. According to the findings, evaluating individual firms based on their efficiency values across models does not strongly represent the similarities in average efficiency values for firms across different frontier models.

Nabi, M. G., Islam, M. A., and Bakar, R. (2019) investigate the effectiveness of Bangladesh's state-owned, conventional private and Islamic commercial banks between 2009 and 2014. According to the findings, Bangladesh's state-owned and Islamic commercial banks must both increase scale efficiency in order to improve their technical efficiency. Traditional private commercial banks' technological efficacy can be improved by enhancing managerial performance.

Wozniewska, G. (2008), performed research for this paper at Poland's leading banks between 2000 and 2007. The empirical findings show that efficiency metrics provide a similar, albeit not identical, picture of Polish commercial bank performance. Both approaches' results complement one another, indicating that the non-parametric DEA method is highly helpful and deserves to be used in banking.

Singh, P. K., & Gupta, V. K. (2013) compare the technological efficiency of the Indian banking industry from 2007 to 2011. Due to fierce rivalry, shifting policies, and instability, the Indian banking sector is crucial. The findings indicate that such banks have enough room for improvement. This study also suggests using the DEA approach to gauge the relative effectiveness of the Indian banking industry.

Soteriou, A., and S. A. Zenios (1999) developed a paradigm for integrating efficiency benchmarking with strategic benchmarking of bank branch services. They use three DEA

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models: one for operational efficiency, another for quality, and yet another for profitability. According to empirical data, analyzing operations, service quality, and profitability all at once gives more insights than benchmarking studies of these three factors separately.

Katib, M. N., & Mathews, K. (2000) use the technological effectiveness and management structure traits of the Malaysian banking industry from 1989 to 1995. Technical inefficiency developed because of the banking sector's scale inefficiency in Malaysia. The banks with greater market power, however, also have greater technological efficiency.

Hassan, M. K., and Sanchez, B. (2007) found regulatory rather than technical inefficiencies in their study and comparison of banking productivity and efficiency in Latin American countries. According to this, bank managers do not choose the optimal input-output combinations since they are not required to do so by market conditions or government regulations.

P. A. Aghimien, F. Kamarudin, M. Hamid, and B. Noordin (2016) study 43 Gulf Cooperation Council (GCC) banks between 2007 and 2011. This research looks at the GCC's technical efficiency (TE), pure technical efficiency (PTE), and scale efficiency (SE). The data indicate that GCC banks operate at a high degree of efficiency. On the other hand, the results show inefficient resource management.

## 3.0 Methodology

To compare the efficiency of scheduled banks in Bangladesh, our research will empirically analyze the technical and scale efficiency of Bangladeshi commercial banks between 2014 and 2020. Due to its usefulness with small sample sizes and the constraints of other methodologies, the study employed data envelopment analysis (DEA) to analyze the efficacy of scheduled banks in Bangladesh.

### 3.1 Model Specification Using Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a non-parametric linear programming technique used to assess the effectiveness and productivity of homogeneous entities referred to as decision-making units (DMUs). Banker et al. created the Charnes-Cooper-Rhodes (CCR) model, which is based on a constant return to scale, as well as the Banker-Charnes-Cooper (BCC) model, which is

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based on variable returns to scale (VRS) (CRS). Both the Banker-Charnes-Cooper (BCC) and the input-oriented Charnes-Cooper-Rhodes (CCR) models are used in this research.

**CCR DEA Model**

The model includes DMUs. Each DMU has at least one positive input and at least one positive output value, and DMUj consumes xij of input I and produces yrj of output r, where xij and yrj are both zero. This ratio is known as the objective function in mathematical programming for the specific DMU being evaluated, therefore Max $h_o$ (u,v) = $\frac{\sum_r u_r y_{ro}}{\sum_i v_i x_{io}}$……..(i)

It should be noticed that the $_{ro}$'s and $x_{io}$'s are the observed output values, whereas the $u_r$'s and $v_i$'s are the observed input values of DMUo, the DMU to be evaluated.

A set of normalization constraints represents the requirement that each DMU's virtual output to virtual input ratio, including DMUj=DMUo, be less than or equal to unity (one for each DMU). As a result, one mathematical programming solution to the problem is

$$\text{Max } h_o(u,v) = \frac{\sum_r u_r y_{ro}}{\sum_i v_i x_{io}} \text{……..(ii)}$$

Subject to

$$\frac{\sum_r u_r y_{rj}}{\sum_i v_i x_{ij}} \leq 1 \text{for j=1, 2…..., n}$$

$$u_r, v_i \geq 0 \text{ for all i and r.}$$

There are several approaches to solve the above-mentioned ratio form. If (u*, v*) is the right solution, then (u*, v*) is the best answer for >0. The solutions (u, v) for which = 1 yield the corresponding linear programming problem, with the variables changing from (u, v) to (, v) due to the Charnes-Cooper transformation.

$$\text{Max } z = \sum_{r=1}^{s} \mu_r y_{ro}$$

Subject to

$$\sum_{r=1}^{s} \mu_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0$$

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$$\sum_{i=1}^{m} v_i x_{io} = 1$$

$$\mu_r v_i \geq 0$$

Due to the existence of the idea of duality in LP, the dual for DMU is as follows:

$$\theta^* = min\theta$$

Subject to

$$\sum_{j=1}^{n} x_{ij}\lambda_j \leq \theta x_{ij} \qquad \text{for i= 1, 2,…..,m;}$$

$$\sum_{j=1}^{n} y_{rj}\lambda_j \geq y_{ro} \text{ for r = 1, 2,…..,s;}$$

$$\lambda_j \geq 0 \text{ for j = 1,2, ……..,s}$$

The efficiency score for a certain DMU will be represented by the value of $\theta$ obtained where $0 \leq \theta \leq 1$. When it has a value $\theta$ equal to 1, the DMU is totally efficient and on the frontier. Since it was the model employed by Farrell, this last one is commonly referred to as the "Farrell model" (1957).

**BCC DEA Model**

The CCR model's continuous return to scale (CRS) assumption is included because it recognizes that imperfect market conditions and other constraints prevent all DMUs from operating at an optimal scale. By including the constraint N1$\lambda = 1$, the CCR issue can be made to produce the variable returns to scale (VRS) programming.

$$\theta^* = min\theta$$

Subject to

$$\sum_{j=1}^{n} x_{ij}\lambda_j \leq \theta x_{io}$$

$$\sum_{j=1}^{n} y_{rj}\lambda_j \geq y_{ro}$$

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$$N1'\lambda_j = 1$$

$$\lambda_j \geq 0$$

N*1 is a vector of ones, where N1 is a single number. As a result, the VRS model incorporates the data more completely and yields efficiency scores that are on level with or greater than the CRS.

### 3.2 Data and Variables

When selecting input and output variables to estimate various efficiency scores for specific institutions, the bulk of authors in the empirical literature have used the intermediation approach (Burger and Humphrey, 1997).

The model used in this study had three inputs and three outputs. The output vector is made up of the total amount of loans, other earning assets (money invested in corporate and governmental securities), and off-balance-sheet activities. Deposits, fixed assets, and operations expenses are the input vectors. The total of demand and time deposits is used here to represent deposits, the cost of the buildings is used to represent fixed assets, and operational costs are used to represent operating expenses. Four of Bangladesh's 62 commercial banks are state-owned, making up our sample of 26 commercial banks for our empirical study. There are thirteen domestic private conventional commercial banks, three overseas commercial banks, and six Islamic commercial banks. Each variable is measured in million BDT (Bangladesh currency unit, Taka).

The finding analyzes the TE and SE performance of commercial banks in Bangladesh using balanced data from elected banks acquired from their annual reports for 2014-2020. STATA version 14 is used to compute and apply the DEA.

## 4 Results and Findings

### 4.1 Efficiency comparison of state-owned commercial banks (SCBs)

#### 4.1.1 Technical Efficiency (TE), Pure Technical Efficiency (PTE), and Scale Efficiency (SE) of SCBs

Over the study period of 2014-2020, one state-owned commercial bank achieved a score of 1 for having 100 percent efficiency. Sonali Bank ranks first among all state-owned commercial banks

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in terms of technical efficiency (TE), pure technical efficiency (PTE), and scale efficiency (SE), as indicated in Table 1. Janata Bank has reached 100% efficiency in terms of pure technological efficiency (PTE). The mean technical efficiency (TE) and scale efficiency (SE) scores for Janata Bank are 0.9869, 1.00, and 0.9869, respectively. In terms of 1.31 percent TE and 1.31 percent SE, Janata Bank is inefficient. Agrani Bank ranks third in terms of scale efficiency (SE) and pure technological efficiency (PTE). Agrani Bank's average TE, PTE, and SE scores are 0.8548, 0.9243, and 0.9252, respectively. This suggests that Agrani Bank has 14.52 percent TE inefficiency, 7.48 percent PTE inefficiency, and 7.48 percent SE inefficiency.

**Table 1: Efficiency Scores of State-Owned Commercial Banks (SCBs)**

| SCB | Efficiency | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Mean Scores | Inefficiency (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| SONALI | TE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.00 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.00 |
| | SE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.00 |
| RUPALI | TE | 0.8443 | 0.9123 | 0.8334 | 0.7961 | 0.7958 | 0.8091 | 0.8654 | 0.8366 | 16.34 |
| | PTE | 0.8468 | 0.9209 | 0.8610 | 0.8048 | 0.8007 | 0.8177 | 0.8661 | 0.8454 | 15.46 |
| | SE | 0.9970 | 0.9209 | 0.9679 | 0.9892 | 0.9939 | 0.9894 | 0.9992 | 0.9796 | 2.04 |
| AGRANI | TE | 0.9044 | 0.8804 | 0.9614 | 0.9014 | 0.7555 | 0.7796 | 0.8011 | 0.8548 | 14.52 |
| | PTE | 0.9776 | 0.9653 | 1.0000 | 0.9666 | 0.7890 | 0.9143 | 0.8570 | 0.9243 | 7.57 |
| | SE | 0.9251 | 0.9120 | 0.9614 | 0.9326 | 0.9576 | 0.8527 | 0.9348 | 0.9252 | 7.48 |
| JANATA | TE | 1.0000 | 1.0000 | 1.0000 | 0.9429 | 0.9656 | 1.0000 | 1.0000 | 0.9869 | 1.31 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.00 |
| | SE | 1.0000 | 1.0000 | 1.0000 | 0.9429 | 0.9656 | 1.0000 | 1.0000 | 0.9869 | 1.31 |

Source: author's own calculation.

Rupali Bank gets the lowest TE and PTE efficiency scores. The mean PE, PTE, and SE scores for Rupali Bank are 0.8366, 0.8454, and 0.9796, respectively. This means that Rupali Bank has 16.34% inefficiency in TE, 15.46% in PTE, and 2.04% in SE.

### 4.1.2. Returns to Scale (RTS) of State-owned commercial Banks (SCBs)

Sonali Bank and Janata Bank among the sample's state-owned commercial banks (SCBs) exhibit constant returns to scale (CRS) in each year from 2014 to 2020. (Table 2) and both have the most effective operational and CRS scales each year (2014-2020). Every year from 2014 to 2020,

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Agrani Bank's returns to scale (DRS) are declining, suggesting that during these years, this bank might have gained efficiency by scaling back. Inferred from Rupali Bank's diminishing returns to scale (DRS) in the first two years (2014-2020) and growing returns to scale (IRS) in the subsequent four years is that this bank might have boosted efficiency by scaling back during that time (2015, 2018, 2019 and 2020).

**Table 2: RTS of State-Owned Commercial Banks (SCBs) Scale Level**

| SCB | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|
| SONALI | crs | crs | crs | crs | crs | crs | crs |
| RUPALI | drs | irs | drs | drs | irs | irs | irs |
| AGRANI | drs | drs | drs | drs | drs | drs | drs |
| JANATA | crs | crs | crs | drs | drs | crs | crs |

Source: author's own calculation.

### 4.2.1 Efficiency of Conventional private commercial Banks (CPCBs)

During the investigation time, no traditional private commercial bank in the sample was particularly effective (Table 3). No traditional private commercial bank has a TE and SE efficiency score of 1. According to the efficiency score of one of the three efficiency categories, the National Bank receives 100 percent PTE. The efficiency is 0.48 percent, with TE and SE both at 0.9951. AB Bank ranks second in TE among the sample banks. With an average TE score of 0.9736, only 2.64 percent of work is inefficient. According to the mean PTE and SE ratings of 0.9778 and 0.9961, respectively, pure technical and scale inefficiencies are 2.21 and 0.39 percent.

Bank Asia ranks third in TE among the sample banks. Efficiency is only 6.39 percent on average with a TE score of 0.9360. The average PTE and SE scores are 0.9471 and 0.9891, representing 4.30 and 0.98 percent pure technical and scale inefficiency, respectively. NCC Bank and Eastern Bank both rank fourth in the TE among the sample banks. The mean PTE and SE scores for the two banks are 0.9304, 0.9939, and 0.9325, 0.9926, respectively. This suggests that scale

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inefficiency has a smaller role in the technical inefficiency of the two banks than pure technical inefficiency.

Prime Bank ranks sixth among the sample's typical private commercial banks, with a TE score of 0.9008, a PTE score of 0.9386, and a SE score of 0.9589. Prime banks have a 9.91 percent TE inefficiency, with scale inefficiency and pure technology inefficiency both accounting for 4.11 percent. City Bank ranks it sixth, while Premier Bank ranks it seventh among conventional private banks in the sample.

**Table 3: Efficiency Scores of Conventional Private Commercial Banks (CPCBs)**

| **CPCBS** | Efficiency | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Mean Scores | Inefficiency (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| PUBALI | TE | 0.8599 | 0.8822 | 0.8981 | 0.9347 | 0.9052 | 0.8633 | 0.8729 | 0.8880 | 11.1981 |
| | PTE | 0.9155 | 0.9319 | 0.9355 | 0.9641 | 0.9257 | 0.8699 | 0.9236 | 0.9237 | 7.6283 |
| | SE | 0.9393 | 0.9467 | 0.9600 | 0.9695 | 0.9779 | 0.9923 | 0.9451 | 0.9615 | 3.8452 |
| AB | TE | 0.9552 | 1.0000 | 0.9686 | 1.0000 | 1.0000 | 0.8913 | 1.0000 | 0.9736 | 2.6422 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.8934 | 0.9513 | 0.9778 | 2.2186 |
| | SE | 0.9552 | 1.0000 | 0.9686 | 1.0000 | 1.0000 | 0.9976 | 1.0512 | 0.9961 | 0.3917 |
| NBL | TE | 0.9660 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9951 | 0.4858 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| | SE | 0.9660 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9951 | 0.4858 |
| IFIC | TE | 0.8537 | 0.8939 | 0.8820 | 0.8983 | 0.8884 | 0.8125 | 0.8779 | 0.8724 | 12.7612 |
| | PTE | 0.8681 | 0.9011 | 0.8869 | 0.8983 | 0.8893 | 0.8150 | 0.8808 | 0.8771 | 12.2937 |
| | SE | 0.9834 | 0.9920 | 0.9945 | 1.0000 | 0.9990 | 0.9969 | 0.9967 | 0.9947 | 0.5341 |
| UCB | TE | 0.9021 | 0.9562 | 0.9213 | 0.9330 | 0.9689 | 0.6249 | 0.6249 | 0.8473 | 15.2659 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.8808 | 0.9396 | 0.9743 | 2.5655 |
| | SE | 0.9021 | 0.9562 | 0.9213 | 0.9330 | 0.9689 | 0.7095 | 0.6650 | 0.8652 | 13.4842 |
| NCC | TE | 0.9835 | 0.9799 | 1.0000 | 0.9589 | 0.9443 | 0.8158 | 0.7918 | 0.9249 | 7.5114 |
| | PTE | 1.0000 | 0.9820 | 1.0000 | 0.9617 | 0.9472 | 0.8263 | 0.7960 | 0.9304 | 6.9555 |
| | SE | 0.9836 | 0.9979 | 1.0000 | 0.9971 | 0.9969 | 0.9873 | 0.9947 | 0.9939 | 0.6073 |
| DBBL | TE | 0.7837 | 0.8070 | 0.8369 | 0.8250 | 0.8050 | 0.5817 | 0.6614 | 0.7572 | 24.2769 |
| | PTE | 0.7999 | 0.8197 | 0.8759 | 0.8603 | 0.8321 | 0.7534 | 0.8251 | 0.8238 | 17.6216 |

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|---|---|---|---|---|---|---|---|---|---|---|
| | SE | 0.9797 | 0.9845 | 0.9555 | 0.9590 | 0.9674 | 0.7720 | 0.8016 | 0.9171 | 8.2911 |
| BRAC | TE | 0.8979 | 1.0000 | 1.0000 | 0.9582 | 0.9038 | 0.5924 | 0.6564 | 0.8584 | 14.1621 |
| | PTE | 0.9181 | 1.0000 | 1.0000 | 0.9717 | 0.9234 | 0.8055 | 0.8469 | 0.9237 | 7.6338 |
| | SE | 0.9780 | 1.0000 | 1.0000 | 0.9860 | 0.9787 | 0.7355 | 0.7751 | 0.9219 | 7.8105 |
| PREMIER | TE | 0.8591 | 0.9173 | 0.9742 | 0.9794 | 0.9760 | 0.8164 | 0.7476 | 0.8957 | 10.4280 |
| | PTE | 0.8799 | 0.9193 | 0.9750 | 0.9812 | 0.9769 | 0.8230 | 0.7681 | 0.9034 | 9.6645 |
| | SE | 0.9764 | 0.9979 | 0.9992 | 0.9981 | 0.9990 | 0.9919 | 0.9733 | 0.9908 | 0.9166 |
| PRIME | TE | 0.9312 | 0.9475 | 0.9551 | 0.9805 | 1.0000 | 0.7295 | 0.7622 | 0.9008 | 9.9154 |
| | PTE | 0.9926 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.7704 | 0.8075 | 0.9386 | 6.1357 |
| | SE | 0.9381 | 0.9475 | 0.9551 | 0.9805 | 1.0000 | 0.9469 | 0.9439 | 0.9589 | 4.1147 |
| EASTERN | TE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9931 | 0.7595 | 0.7344 | 0.9267 | 7.3289 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9963 | 0.7770 | 0.7540 | 0.9325 | 6.7521 |
| | SE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9967 | 0.9775 | 0.9741 | 0.9926 | 0.7399 |
| CITY | TE | 1.0000 | 0.9946 | 1.0000 | 1.0000 | 1.0000 | 0.5906 | 0.6621 | 0.8925 | 10.7532 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.7812 | 0.8510 | 0.9475 | 5.2537 |
| | SE | 1.0000 | 0.9946 | 1.0000 | 1.0000 | 1.0000 | 0.7560 | 0.7780 | 0.9327 | 6.7347 |
| BANK ASIA | TE | 1.0000 | 1.0000 | 0.9801 | 0.9520 | 0.9783 | 0.7924 | 0.8495 | 0.9360 | 6.3960 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9861 | 0.7924 | 0.8501 | 0.9470 | 5.3044 |
| | SE | 1.0000 | 1.0000 | 0.9801 | 0.9520 | 0.9921 | 0.9999 | 0.9992 | 0.9891 | 1.0950 |

Source: author's own calculation.

Pubali Bank and IFIC Bank, with TE ratings of 0.8880 and 0.8724, PTE scores of 0.9237 and 0.8775, and SE scores of 0.9615 and 0.9947, respectively, were ranked eighth and ninth. Technical inefficiencies at these institutions range from 11.19 to 12.76 percent, pure technical inefficiencies from 7.62 to 12.29 percent, and scale inefficiencies from 3.84 to 0.53 percent.

Brac Bank, UCB, and DBBL are placed tenth, eleventh, and twelfth, respectively, with TE ratings of 0.8584, 0.8473, and 0.7572. PTE values are 0.923, 0.9743, and 0.8238, and the SE values are 0.9219, 0.8652, and 0.9171, respectively.

### 4.2.2 Returns to Scale (RTS) of Conventional Private Commercial Banks (CPCBs)

From 2014 to 2020, only UCB, among the sample's traditional private commercial banks, displays a declining return-to-scale (DRS) (Table 4). Accordingly, between 2014 and 2020, UCB

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could scale back manufacturing to increase efficiency. The return-to-scale (DRS) and the level of production from Pubali Bank could decline between 2014 and 2018 and 2020. In 2019, raise it to encourage efficiency. Under CRS in 2015 and 2017, DRS in 2014 and 2016, and IRS in 2019 and 2020, AB bank operates at the ideal scale and could decrease manufacturing scale in 2014 and 2016 to boost efficiency, and subsequently expand it. NBL operates at the optimal scale under CRS in all years except 2014, and it may cut its production scale in 2014. IFIC bank exhibits DRS in 2014, 2015, and 2016 and IRS in 2017, 2018, 2019, and 2020, implying that IFIC bank may reduce its production scale in 2014, 2015, and 2016 while increasing its production scale in 2017, 2018, 2019, and 2020. NCC bank exhibits constant return-to-scale (CRS) in 2016, indicating that it exhibits the optimum scale of production, as well as DRS in 2014, 2015, and 2017, indicating that this bank could reduce the production scale in 2014, 2015, and 2017. And IRS in 2018, 2019, and 2020, indicating that this bank could increase the production scale in 2018, 2019, and 2020. DRS is shown in DBBL in 2014 and from 2016 through 2020 together with IRS in 2015. DRS and CRS are shown by Brac Bank for the years 2014, 2017, and 2020. Premier Bank first displayed DRS in 2014, although IRS was displayed from 2015 to 2020. The CRS and IRS for Eastern Bank are displayed from 2014 to 2017. City Bank will display DRS in 2015, 2019 and 2020 while CRS will be presented in 2014, 2016 and 2018. DRS from 2016 to 2018, CRS from 2014 to 2015, and IRS from 2019 are all listed on The Bank of Asia's website.

**Table 4: RTS of Conventional Private Commercial Banks (CPCBs) Scale Level**

| CPCBs | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|
| PUBALI | drs | drs | drs | drs | drs | irs | Drs |
| AB | drs | crs | drs | crs | crs | irs | Irs |
| NBL | drs | crs | crs | crs | crs | crs | crs |
| IFIC | drs | drs | drs | irs | irs | irs | irs |
| UCB | drs | drs | drs | drs | drs | drs | drs |
| NCC | drs | drs | crs | drs | irs | irs | irs |
| DBBL | drs | irs | drs | drs | drs | drs | drs |
| BRACK | drs | crs | crs | drs | drs | drs | drs |
| PREMIER | drs | irs | irs | irs | irs | irs | irs |
| PRIME | drs | drs | drs | drs | crs | irs | irs |

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|---|---|---|---|---|---|---|---|
| EASTERN | crs | crs | crs | crs | irs | irs | irs |
| CITY | crs | drs | crs | crs | crs | drs | drs |
| BANK ASIA | crs | crs | drs | drs | drs | irs | irs |

Source: author's own calculation.

### 4.3.1 Efficiency of Foreign private commercial banks (FPCBs)

Table 5 shows that HSBC and Bank Alfalah were 100 percent effective in the TE, PTE, and SE during the study period (2014–2020). However, the Standard Chartered Bank's pure technical efficiency (PTE), technical efficiency (TE), and scale efficiency (SE) sources are 0.9943 and 0.9943, respectively. Technical inefficiency percentages are 0.56 and 0.56, respectively.

**Table 5: Efficiency Scores of Foreign Commercial Bank**

| FCBs | Efficiency | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Mean Scores | Inefficiency (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard Charterd Bank | TE | 0.9603 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9943 | 0.5676 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| | SE | 0.9603 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9943 | 0.5676 |
| HSBC | TE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| | SE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| Bank Alfalah | TE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| | SE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |

Source: author's own calculation.

### 4.3.2 Returns to Scale (RTS) of Foreign Private Commercial Banks (FPCBs)

Both HSBC and Bank Alfalah exhibit a similar return to size every year (table 6). HSBC and Bank Alfalah both exhibit the optimal, or most productive, the scale of production, and neither bank needs to alter its scale of production. With the exception of 2014, when this bank might lower production, Standard Chartered Bank demonstrates a consistent return to scale (DRS), which suggests that it operates at its optimal or most productive scale of production in all other years.

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| Table 6: RTS of Foreign Commercial Banks (FCBs) Scale Level | | | | | | | |
|---|---|---|---|---|---|---|---|
| FCBs | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| SC Bank | drs | crs | crs | crs | crs | crs | crs |
| HSBC | crs | crs | crs | crs | crs | crs | crs |
| Alfala | crs | crs | drs | crs | crs | crs | crs |

Source: author's own calculation.

### 4.4.1 Competency of Islamic private Commercial Banks (IPCBs)

Table 7 illustrates the scale efficiency (SE), technical efficiency (TE), and pure technical efficiency (PTE) of Islami commercial banks. According to table 7, no Islamic private commercial bank from 2014 to 2020 received a perfect efficiency score of 1 (one). The EXIM Bank and FSIB are the Islamic banks in the sample with the highest technological efficiency. Technical inefficiency scores for them are 0.87 and 0.39 percent, and technical efficiency scores for them are 0.9912 and 0.9960, respectively. Scale efficiencies for both are 0.9912 and 0.9886, with respective inefficiencies of 0.87 and 0.28 percent. Al-Arafah Islami Bank is the second-most effective Islami bank in the sample (SE). Technical efficiency (TE), pure technical efficiency (TPE), and scale efficiency (SE) for this Islamic bank have mean values of 0.9630, 0.9701, and 0.9927, respectively. SE are somewhat inefficient. Shajalal Islamic Bank, the third-placed Islamic bank in the sample, had mean scores of 0.9478, 0.9586, and 0.9787 in TE, PTE, and SE, respectively. As a result, Islamic banks are slightly inefficient in TE, 4.14 percent in PTE, and 1.14 percent in SE. Islami Bank Bangladesh Limited (IBBL), Bangladesh's second-largest bank, is placed fourth among Islamic banks, with TE, PTE, and SE scores of 0.8747, 1.0000, and 0.8747, respectively.

| Table 7: Competency Scores of Islamic Commercial Banks (ICBs) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ICBs | Efficiency | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Mean Scores | Inefficiency (%) |
| IBBL | TE | 0.7701 | 0.9730 | 0.9101 | 0.9269 | 0.9260 | 0.8319 | 0.7847 | 0.8747 | 12.5319 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| | SE | 0.7701 | 0.9730 | 0.9101 | 0.9269 | 0.9260 | 0.8319 | 0.7847 | 0.8747 | 12.5319 |
| SIBL | TE | 0.8853 | 0.9047 | 0.9122 | 0.8929 | 0.9260 | 0.1974 | 0.1552 | 0.6962 | 30.3755 |
| | PTE | 0.8874 | 0.9081 | 0.9180 | 0.9165 | 0.9277 | 0.2196 | 0.1794 | 0.7081 | 29.1905 |

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|---|---|---|---|---|---|---|---|---|---|---|
| | SE | 0.9976 | 0.9963 | 0.9936 | 0.9743 | 0.9981 | 0.8990 | 0.8655 | 0.9606 | 3.9371 |
| AIBL | TE | 1.0000 | 0.9591 | 1.0000 | 1.0000 | 0.9357 | 0.8757 | 0.9705 | 0.9630 | 3.6998 |
| | PTE | 1.0000 | 0.9690 | 1.0000 | 1.0000 | 0.9367 | 0.8847 | 1.0000 | 0.9701 | 2.9935 |
| | SE | 1.0000 | 0.9898 | 1.0000 | 1.0000 | 0.9989 | 0.9898 | 0.9705 | 0.9927 | 0.7286 |
| FSI | TE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9947 | 1.0000 | 0.9776 | 0.9960 | 0.3965 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9947 | 1.0000 | 0.9977 | 0.9989 | 0.1087 |
| | SE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9999 | 1.0000 | 0.9799 | 0.9971 | 0.2885 |
| Shajalal | TE | 0.8860 | 0.9234 | 1.0000 | 1.0000 | 0.9962 | 0.9317 | 0.8973 | 0.9478 | 5.2209 |
| | PTE | 0.8902 | 0.9527 | 1.0000 | 1.0000 | 1.0000 | 0.9549 | 0.9121 | 0.9586 | 4.1442 |
| | SE | 0.9953 | 0.9692 | 1.0000 | 1.0000 | 0.9962 | 0.9758 | 0.9838 | 0.9886 | 1.1409 |
| EXIM | TE | 0.9453 | 1.0000 | 0.9931 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9912 | 0.8796 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 |
| | SE | 0.9453 | 1.0000 | 0.9931 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9912 | 0.8796 |

Source: author's own calculation.

### 4.4.2 Returns to Scale for Islamic Commercial Private Banks (IPCBs)

Only IBBL, among all Islamic private commercial banks, exhibits declining returns to scale (DRS) each year between 2014 and 2020 (Table 8), aiming to scale back manufacturing to improve productivity. Every year since SIBL's inception, with the exception of 2015 and 2016, has seen rising returns to scale and may decrease production, then ramp it up the following year. In 2014, 2016 and 2017, AIBL displays CRS, indicating that this bank is operating at its most productive scale during those years and does not need to adjust it. IRS may have lowered production scale in 2015, 2018, and 2019, whereas DRS could have done so in 2020 to maximize efficiency. The FSB presents CRS, whereas IRS and DRS from 2018 to 2020 demonstrate that production is increasing in 2018 and falling in 2020. Shajalal Islami Bank reports CRS in 2016 and 2017, indicating that it produces at its optimal level and does not change its scale in these years, and IRS in 2014, 2015, 2018, and 2020, suggesting that it may have increased its production scale in these years. The EXIM Bank displays DRS in 2014 and 2016, suggesting that the production scale may have been lowered, and CRS in 2015, 2017 and 2020, suggesting that the production scale is at its peak during these years.

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| Table 8: RTS of Islamic Commercial Banks (ICBs) Scale Level | | | | | | | |
|---|---|---|---|---|---|---|---|
| ICBs | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| IBBL | drs | drs | drs | drs | drs | drs | drs |
| SIBL | irs | drs | irs | drs | irs | irs | irs |
| AIBL | crs | irs | crs | crs | irs | irs | drs |
| FSI | crs | crs | crs | crs | irs | crs | drs |
| Shajalal | irs | irs | crs | crs | irs | irs | irs |
| EXIM | drs | crs | drs | crs | crs | crs | Crs |

Source: author's own calculation.

## 4.5 Competency Comparisons between State-Owned, Private Commercial, Islamic, and Foreign Banks

### 4.5.1 State-owned, conventional private commercial, foreign, and Islamic banks' comparative efficiency

When state-owned, traditional private, foreign commercial and Islamic banks are examined for efficiency, foreign commercial banks outperform in three areas: 0.9811 in technical efficiency, 0.9811 in scale efficiency, and complete efficiency in pure technical efficiency. State-owned commercial banks outperform private commercial banks in terms of TE (0.9196), PTE (0.9424), and SE (0.9729). State-owned commercial banks outperform Islamic commercial banks in terms of PTE and SE. In terms of technological efficiency, Islamic commercial banks outperform typical private commercial banks (TE). Foreign commercial banks outperform domestic commercial banks in all three efficiency categories: technical efficiency, pure technical efficiency, and scale efficiency.

| Table 9: Mean Efficiency of State-Owned, Conventional Private and Foreign Commercial and Islamic Banks | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Bank | Efficiency | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Mean | Inefficiency (%) |
| SCB | TE | 0.9372 | 0.9482 | 0.9487 | 0.9101 | 0.8792 | 0.8972 | 0.9166 | 0.9196 | 8.040593 |
| | PTE | 0.9561 | 0.9716 | 0.9653 | 0.9428 | 0.8974 | 0.9330 | 0.9308 | 0.9424 | 5.757929 |
| | SE | 0.9805 | 0.9582 | 0.9823 | 0.9662 | 0.9793 | 0.9605 | 0.9835 | 0.9729 | 2.706443 |
| CPCB | TE | 0.9225 | 0.9522 | 0.9551 | 0.9554 | 0.9510 | 0.7592 | 0.7878 | 0.8976 | 10.24039 |

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| | PTE | 0.9519 | 0.9657 | 0.9749 | 0.9721 | 0.9598 | 0.8299 | 0.8611 | 0.9307 | 6.925187 |
| | SE | 0.9694 | 0.9859 | 0.9796 | 0.9827 | 0.9905 | 0.9126 | 0.9152 | 0.9623 | 3.773129 |
| FCB | TE | 0.9868 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9981 | 0.1892 |
| | PTE | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0 |
| | SE | 0.9868 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9981 | 0.1892 |
| ICB | TE | 0.9145 | 0.9600 | 0.9692 | 0.9700 | 0.9631 | 0.8061 | 0.7976 | 0.9115 | 8.850686 |
| | PTE | 0.9629 | 0.9716 | 0.9863 | 0.9861 | 0.9765 | 0.8432 | 0.8482 | 0.9393 | 6.072819 |
| | SE | 0.9514 | 0.9880 | 0.9828 | 0.9835 | 0.9865 | 0.9494 | 0.9307 | 0.9675 | 3.2511 |

Source: author's own calculation.

## 5.0 Concluding remarks and Policy implications

This paper assesses and compares, using data envelopment analysis (DEA), the performance of state-owned banks (SCBs), conventional private commercial banks (CPCBs), foreign commercial banks (FCBs), and Islamic commercial banks (ICBs) operating in Bangladesh from 2014 to 2020. According to the data, FCBs outperform in all three efficiency categories: technical efficiency (TE), pure technical efficiency (PTE), and scale efficiency (SE). Efficiency shows that SCBs, CPCBs, and ICBs can all raise their aggregate efficiency by improving managerial performance. SCBs perform better than PCBs and ICBs in PTE and TE, and better than CPCBs in TE. CPCBs can improve their technical effectiveness by diversifying their product offerings. In terms of scale efficiency (SE), FCBs have the highest score while ICBs have the lowest. Lower SE values imply activities with declining returns to scale, where there is still room to expand operations to achieve optimal scale. Additionally, macroeconomic variables like GDP growth and inflation as well as environmental features like bank size, staff, asset quality, ownership, and labor productivity have an impact on bank efficiency. Moreover, Islamic banks' performance evaluation must use methods other than conventional methods because these institutions are required to follow Islamic Shariah laws.

Future studies may utilize two methods for methodological cross-checking rather than one, select additional tools for Islamic banks' performance analysis, employ a larger sample size over a longer time period, and incorporate environmental factors into the models chosen for Bangladeshi commercial banks' performance analysis.

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The paper's findings can be used to derive the following policy implications:

1. State-owned commercial banks (SCBs) with DRS should diversify their product lines or pull back on their production in order to increase their technical efficiency. To boost technological efficiency, SCBs with IRS must expand their production capacities.

2. According to the efficiency findings, conventional private commercial banks (CPCBs) must improve management performance in order to improve technical efficiency, because poor management leads to pure technical inefficiency.

3. In order to improve their technical efficiency, Islamic commercial banks (ICBs) should scale their operations more effectively. Therefore, Islamic banks that adhere to DRS take measures to diversify their product offerings or scale back output. Islamic banks show that in order to achieve technical efficiency, IRS must scale their production.

4. According to the efficiency findings, scaling up efficiency will aid foreign commercial banks (FCBs) in scaling up their technical efficiency. It produces pure technical efficiency of 100 percent, indicating that its management addressed different financial offerings skillfully.

## References

Aghimien, P. A., Kamarudin, F., Hamid, M., & Noordin, B. (2016). Efficiency of gulf cooperation council banks: empirical evidence using data envelopment analysis. *Review of International Business and Strategy*.

Annual Report, 2020-2021, Bangladesh Bank, www.bb.org.bd.

Berger, A. N., & Humphrey, D. B. (1997). Efficiency of financial institutions: International survey and directions for future research. *European journal of operational research*, *98*(2), 175-212.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European journal of operational research*, *2*(6), 429-444.

Cvilikas, A., & Jurkonyte-Dumbliauskiene, E. (2016). Assessment of risk management economic efficiency applying economic logistic theory. *Transformations in Business & Economics*, *15*(3/39), 207-219

Hassan, M. K., & Sanchez, B. (2007). Efficiency determinants and dynamic efficiency changes in Latin American banking industries. *Available at SSRN 3263102*.

ISSN: 2521-828X(Print)
2706-9303 (Online)
2706-9311(CD-ROM)

Katib, M. N., & Mathews, K. (2000). A non-parametric approach to efficiency measurement in the Malaysian banking sector. *The Singapore Economic Review*, *44*(2), 89-114.

Nabi, M. G., Islam, M. A., & Bakar, R. (2019). Do private commercial banks outperform state-owned commercial banks? Empirical Evidence from Bangladesh. *Journal of Applied Finance and Banking*, *9*(5), 167-186.

Singh, P. K., & Gupta, V. K. (2013). Measuring technical efficiency of Indian banking sector in post subprime crises scenario: A non-parametric frontier based approach. *European Journal of Business and Management*, *5*(5), 87-99.

Soteriou, A., & Zenios, S. A. (1999). Operations, quality, and profitability in the provision of banking services. *Management science*, *45*(9), 1221-1238.

Wozniewska, G. (2008). Methods of measuring the efficiency of commercial banks: an example of Polish banks. *Ekonomika*, *84*, 81-91.