Benchmarking the banking sector of Bangladesh: a comprehensive analysis of performance and efficiency

Received 1 August 2021
Revised 28 October 2021
21 December 2021
Accepted 9 February 2022

Tamanna Yesmine, Md. Emran Hossain and Md. Akhtaruzzaman Khan
Department of Agricultural Finance and Banking, Bangladesh Agricultural University, Mymmensingh, Bangladesh
Sandip Mitra
Department of Agricultural Finance and Cooperatives, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh
Sourav Mohan Saha
Department of Agricultural Finance, Co-operatives and Banking, Khulna Agricultural University, Khulna, Bangladesh, and
Md. Ruhul Amin
Department of Agribusiness, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh

Abstract

Purpose – The economic development of Bangladesh is heavily reliant on the banking industry, yet it faces numerous hurdles, including liquidity issues, capital shortages, non-performing loans, inefficiencies and so on. Therefore, this study investigated the performance and efficiency of scheduled banks (state-owned, private commercial, foreign commercial and specialized banks) operating in Bangladesh.

Design/methodology/approach – The research was conducted using secondary data from annual reports of banks. The CAMELS rating system and Data Envelopment Analysis (DEA) methods were employed to measure the performance and efficiency of banks, respectively.

Findings – In the overall bank rankings, results revealed that foreign commercial Standard Chartered Bank and state-owned Sonali Bank Limited came in first and last position, respectively. Among the four categories of banks, foreign commercial banks were the best performer, while state-owned banks were the worst. Only two banks, i.e. Citibank NA and HSBC Bank, were scale efficient while the remaining banks were inefficient. In terms of performance and efficiency, state-owned and specialized banks were deemed wanting.

Practical implications – This study proposes recommendations to the policymakers that could lead to more effective tactics for improving the banking industry's performance and efficiency.

Originality/value – As far as the authors are concerned, this study presents empirical evidence on the performance and efficiency of different types of banks and explores comparisons among them, which has never been done to this extent in the country before.

Keywords Banking sector, CAMELS rating, Data envelopment approach, Scale efficiency, Performance

Paper type Research paper

Asian Journal of Economics and Banking
Vol. 7 No. 1, 2023
pp. 121-145
Emerald Publishing Limited
e-ISSN: 2633-7991
p-ISSN: 2615-9821
DOI 10.1108/AJEB-08-2021-0094

1. Introduction

In most economies, the banking sector is regarded as the financial system's backbone, and it plays a critical role in attaining economic growth and expansion (Kamarudin *et al.*, 2016). The expansion of trade and commerce, the creation of jobs and the promotion of the industrial revolution in an economy all require the development of the banking sector. The banking system of Bangladesh is evolving and has witnessed unprecedented development during the previous two decades (Ahamed, 2012). However, due to a lack of capital sufficiency, strong governance, rising non-performing loans, liquidity issues and other factors, the pace of development slowed, resulting in unsatisfactory performance and efficiency. These are some of the prime concerns for the banking sector in Bangladesh as they eroded the industry (Zheng *et al.*, 2020; Amir, 2019; Habib, 2018). The financial regularity authority injects capital into the banking sector every year to confront capital inadequacy, but the improvement is not yet visible (Uddin and Bristy, 2014). These issues affect the country's banking system as well as the entire economy.

The introduction of reassuring foreign commercial banks into the local banking system due to the liberalization of monetary policies in recent decades has increased competition (Mirzaei *et al.*, 2013). This may result in a reduction in monopoly power and profits, affecting bank performance and efficiency (Banna *et al.*, 2017). Banks' poor performance and inefficiency can lead to issues such as bank failure and a loss of trust in the banking system, which can lead to economic stagnation (Mahmud *et al.*, 2016). To perform well, however, all Bangladeshi banks are focusing more on cost containment and providing high-quality services and products (Ahmed and Liza, 2013). In this context, effective regulatory rules and rating frameworks for evaluating banking performance in Bangladesh are desperately needed, with a special focus on managerial efficiency, asset and earnings quality, risk mitigation and financial stability (Moudud-Ul-Haq, 2017).

Thus, an imperative issue regarding being efficient is on the rise (Shameem, 1995) and, attention has been paid to improve the efficiency of the banking industry in Bangladesh. As a result of this process, banks are compelled to operate close to the "best-practice" or efficient in terms of providing service (Rashid *et al.*, 2020). However, most of the banks underperform from the intended level due to managerial bottlenecks, capital inadequacy, low earnings, market risk and other factors (Bangladesh Bank, 2019). Contrarily, bank efficiency depends on different elements such as bank capitalization and profitability, inflation rate, economic expansion and real interest rate (Pancurova and Lyocsa, 2013; Banna *et al.*, 2017). Furthermore, the ownership position of banks may have a substantial impact on their efficiency (Kamarudin *et al.*, 2016). The ownership of banks in Bangladesh generally can be categorized into four groups, namely State-Owned Commercial Banks (SCBs), Specialized Development Banks (SDBs), Private Commercial Banks (PCBs) and Foreign Commercial Banks (FCBs) (Jahan and Muhiuddin, 2020; Boubakri *et al.*, 2005). However, the efficiency of all types of banks is critical to the overall banking system's stability and seamless operation (Rashid *et al.*, 2020; Sufian and Kamarudin, 2013).

Since its inception, the banking industry as a whole has faced critical ups and downs in terms of performance and efficiency (Samad, 2008). To investigate the category-wise banks' performance and efficiency level over the years (2011–2018), this study employs the CAMELS rating system and nonparametric Data Envelopment Analysis (DEA) method. Several empirical studies determined the bank's efficiency in developed economies (e.g. Al-Gasaymeh and Samarah, 2020; Mirzaei and Moore, 2019; Henriques *et al.*, 2018). Recently, some studies focused on the efficiency of the banking system in developing and emerging economies (e.g. Moudud-Ul-Huq, 2019; Tamatam *et al.*, 2019; Chaluvadi *et al.*, 2018; Banna *et al.*, 2017). In Bangladesh, some researches were also conducted on the performance measurement (Rahman and Islam, 2018; Moudud-Ul-Huq, 2017; Ahsan, 2016) and efficiency of banks (Ali, 2015; Sufian and Kamarudin, 2014; Ahmed and Liza, 2013; Haque and Rayhan, 2013), but

these studies only looked at a part of the banking industry. There is a minimum, or close to none studies assessed overall banking sectors' performance and efficiency in Bangladesh. Besides, no study was conducted evaluating performance and efficiency based on banks' categories which is a decisive factor in the country's banking sector. A research including all types of banks (state-owned banks, private commercial banks, specialized banks and foreign commercial banks) is required to represent a comprehensive assessment of the country's overall banking system.

To bridge the gap, this study aims to investigate the performance and efficiency of different types of banks. However, this study is expected to contribute to the banking literature by helping the authority improve the condition of the banking sector by minimizing the causes responsible for their substandard condition. The authority also would be able take category-based policy rather than for a specific bank to improve overall performance and efficiency of the banking sector. Furthermore, as this study also ranks the banks according to their performance and efficiency, it will also guide the problematic banks to follow the policies of top-ranked banks to overcome their difficulties.

The sections that follow are grouped as follows: Section 2 reviews related literature, whereas Section 3 summarizes the data and methodology employed in this research. Section 4 presents the findings and discusses the outcomes, and Section 5 concludes. Finally, section 6 discusses the policy implications of with future research directions.

2. Literature review

2.1 Theoretical background

Since the country's whole economy relies upon the banking sector, sound banking performance is a requirement for economic success (Eyuboglu, 2016). Economists pay a great deal of attention to banks' performance, which is expressed in terms of effectiveness, productivity and profitability (Bikker and Bos, 2008). According to Rengasamy (2012), banking performance reflects how the resources of a bank are used in a form that enables it to achieve its desired objectives. Furthermore, the term "bank performance" refers to the use of a set of indicators to assess a bank's current state and improve its ability to achieve goals. Since Bangladesh's banking sector is highly competitive in recent days, measuring bank performance in a competitive market is critical because it informs depositors and investors on whether to invest or withdraw cash from the bank (Rayhan *et al.*, 2011). Due to the result of the substantial loan losses and bank failures that happened after the 1980s, the demand for banking supervision has grown in Bangladesh. Following that, banks began to use the CAMEL analysis to measure their performance. A lot of studies have been done in developed countries on the application and utility of the CAMEL model. However, a modified version of the CAMEL model introducing sensitivity of market risk to the original model is used to assess bank financial performance, and the central bank of Bangladesh recommended each of its indicators and components.

On the other hand, Drucker (1977) termed efficiency as "doing things right". Efficiency refers to how well a system works to produce the maximum outputs for a given input (Alrafadi *et al.*, 2016; Aguenaou *et al.*, 2017). It is not evaluated in terms of success in the marketplace rather operational excellence in utilizing the resources (Kumar and Gulati, 2010). For banks, maintaining efficiency is very crucial as it enhances the capability of a country to compete with its domestic and international affairs more fluently (Uddin and Bristy, 2014). Banks can improve efficiency in their operations by reducing operating expenses, developing branches' technical capabilities and increasing recovery rates (Islam *et al.*, 2017). The early researches on bank efficiency focused mostly on European countries, the United States and Japan (Aissia and Ellouz, 2021). The non-parametric method (DEA) and the parametric approach (Stochastic Frontier Analysis [SFA]) were used in the existing literature to measure

bank efficiency. Charnes *et al.* (1978) developed DEA as a non-parametric method for assessing the efficiency of a set of decision-making units (DMUs) (Emrouznejad and De Witte, 2010). The earliest DEA models assume a constant return to scale (CRS), ignoring the possibility that distinct DMUs (banks) operate at different scales. To address this flaw, Banker *et al.* (1984) developed the variable returns to scale (VRS) model, which assures that each bank is only compared to other banks of similar size. DEA compares a bank's technical efficiency to that of a peer group of banks' input and output (Anouze and Bou-Hamad, 2019). Both the input- and output-oriented models can be estimated based on suitability.

2.2 Empirical background

Several studies on the measurement of bank's performance and efficiency have been undertaken around the world. Alemu and Aweke (2017) analyzed the performance of six private commercial banks of Ethiopia for the period of 2007–2016 using panel data where CAMEL rating analysis was used to measure the overall performance of banks. In another study, Khatik and Nag (2015) also used the CAMEL model approach to measure the performance of 10 banks operating in India for the period of 2007–2012. In Bangladesh, Rushdi (2009) used the partial and total factor productivity approach instead of the CAMEL approach to measure the performance of banks. However, the majority of the authors used the CAMELS framework (e.g. Sarker, 2005; Islam *et al.*, 2014; Moudud-Ul-Huq, 2017; Rahman and Islam, 2018; Ahsan, 2016) to measure the performance of banks.

Kumar and Gulati (2010) collected cross-sectional data for the financial year 2006–2007 to measure the efficiency of banks using the DEA method because of some advantages of using this method, such as it could simultaneously use several inputs and outputs and any assumptions about the functional form of the production function were not required in this method. The same method was used by Abbas *et al.* (2016) to measure the efficiency of some selected Islamic and conventional banks operating in Pakistan from 2004 to 2009. Hoque and Rayhan (2013) collected data of 21 banks working in Bangladesh for the year 2009, where the non-parametric DEA technique was used to measure the efficiency of banks. Chaity and Alam (2021) employed both non-parametric DEA and parametric SFA to assess the efficiency of listed private commercial banks in Bangladesh for the period of 2007–2016. Although many researches had been done in Bangladesh on the performance and efficiency measurement of banks' operating in the country, they covered only a part of the banking sector. Research covering all the four sectors of banks (state-owned banks, private commercial banks, specialized banks and foreign commercial banks) had not been done yet. So, this study had been picked up covering all the sectors of banks to have an idea about the overall banking situation in Bangladesh.

3. Data source and empirical approach

3.1 Data

This empirical study examines the performance and efficiency of Bangladesh's banking sector at the individual bank level. Given the challenges of obtaining all available and relevant data from all banks, this study focused on a sample of 20 banks, including three state-owned banks, twelve private commercial banks, two specialized banks and three foreign commercial banks. The annual reports of selected banks were utilized to compile all banking data. This research was mainly based on secondary data collected from the annual reports from the banks. To measure the efficiency and performance of different categories of banks, unlike sampling periods were used. We had no choice but to choose an unlike study period due to unavailability of data. Panel data of state-owned commercial banks and private commercial banks for the period of 2011–2018; specialized banks for 2013–2018; and foreign

commercial banks between 2016 and 2018 were collected to achieve the objectives. Table 1 presents the list of banks according to their types considered in this study.

3.2 Measurement of bank performance

In 1993, the central bank of Bangladesh–Bangladesh Bank first implemented the CAMELS Rating System in Bangladesh to evaluate the performance of banks and financial regulatory institutions using a ranking system (Rahman and Islam, 2018). In this study, 27 indicators from the CAMELS model were used to examine various aspects of performance analysis (Table 2).

The six components mentioned above were used to measure the performance of 20 selected banks. Each of the components was ranked based on the ratings of respective indicators, while indicators of all the components were used to calculate the overall ranking of banks. Then a composite rating was given to each bank based on the average ratings of the CAMELS components (Table 3). The performance of banks in CAMELS rating analysis is rated from 1 to 5. A lower value (1) of composite ranking indicates the best performance, while a higher value (5) indicates the worst performance of the banks.

3.3 Efficiency measurement of banks

Many researchers have evaluated the banking sector's efficiency due to advancements in the banking structure. However, most of them used ratios analysis to measure a bank's efficiency (Fatema *et al.*, 2019). But ratios analysis can be misleading the estimation of the bank's efficiency (Rao and Lakew, 2012). To overcome this dilemma, researchers are trying to use frontier analysis methods in past decades (Sufia and Kamarudin, 2013). There are two types of approaches-parametric and nonparametric approaches in measuring the technical efficiency of banks. Among these approaches, the nonparametric DEA technique was used in this research to measure the efficiency of banks as it is capable of managing multiple inputs and outputs and no need to explicitly provide any particular functional form as well as it can deal with small sample size smoothly.

SL. No	Bank name	Bank type
1	Sonali Bank Limited	State-owned
2	Janata Bank Limited	
3	Agrani Bank Limited	
4	Al-Arafah Islami Bank Ltd	Private commercial
5	BRAC Bank Ltd	
6	Bank Asia Ltd	
7	Dutch Bangla Bank Ltd	
8	Dhaka Bank Ltd	
9	Eastern Bank Ltd	
10	First Security Islami Bank Ltd	
11	IFIC Bank Ltd	
12	Premier Bank Ltd	
13	Prime Bank Ltd	
14	Pubali Bank Ltd	
15	Standard Bank Ltd	
16	Bangladesh Krishi Bank	Specialized
17	Probashi Kallyan Bank	
18	Standard Chartered Bank	Foreign commercial banks
19	CITI Bank NA	
20	HSBC Bank	

Table 1. List of banks considered in this study

Component	Indicators
Capital adequacy (C)	Total Capital/Total Assets (TC/TA) Total Equity/Total Assets (TE/TA) Capital adequacy ratio (CAR) Total Debt/Total Assets (TD/TA) Govt. Securities/Total Investment (GS/TI)
Asset quality (A)	Loan Loss Provision/Total Loan (LL/TL) Fixed Assets/Total Assets (FA/TA) Total Loan/Total Assets (TL/TA) Non-Performing Loan/Total Loan (NPL/TL) Total Investment/Total Assets (TI/TA)
Management soundness (M)	Total deposits per branch (TDB) Net profit per employee (NPE) Funds Borrowed/Total Assets (FB/TA) Operating Income/Operating Expenses (OI/OE) Total Loan/Total Deposits (TL/TD)
Earnings ability (E)	Return on Assets (ROA) Return on Equity (ROE) Operating Profit/Total Assets (OP/TA) Net Interest Income/Total Assets (Net II/TA) Non-interest Income/Total Assets (Non-II/TA)
Liquidity (L)	Liquid Assets/Total Assets (LA/TA) Liquid Assets/Total Deposits (LA/TD) Liquid Assets/Short-term Liabilities (LA/SL) Govt. Securities/Total Assets (GS/TA)
Sensitivity to market risk (S)	Interest Rate Risk (IRR) Equity Position Risk (EPR) Foreign Exchange Risk (FER)

Source(s): Bangladesh Bank (2019)

Table 2. Indicators of CAMELS rating against each component

Group rank	Composite range	CAMELS rank	Description
1–4	1.00–1.49	1	Strong
4.1–8	1.5–2.49	2	Satisfactory
8.1–12	2.5–3.49	3	Fair
12.1–16	3.5–4.49	4	Marginal
16.1–20	4.5–5.00	5	Unsatisfactory

Source(s): Huq (2017)

Table 3. Description of CAMELS rating

DEA is a nonparametric method for estimating production frontiers in operations research and economics (Sickles and Zelenyuk, 2019; Charnes *et al.*, 1978; Banker *et al.*, 1984)). Several studies have been adopted the DEA approach to measure the efficiency of Bangladeshi banks (e.g. Banna *et al.*, 2017; Ali, 2015; Sufian and Kamarudin, 2014; Ahmed and Liza, 2013; Haque and Rayhan, 2013; Khanam and Nghiem, 2006).

However, technical efficiency through DEA can be measured using two approaches, i.e. output-oriented and input-oriented. An output-oriented method aims to produce the maximum possible outputs from a given set of inputs, whereas an input-oriented approach aims at using minimum possible inputs for producing a given amount of outputs

(Alam, 2011). When CRS assesses, these two technical efficiency measurements will coincide, but they are likely to differ otherwise (Alam, 2011). Scale efficiency can be measured by dividing CRS by the VRS, representing pure technical efficiency (Alam, 2011). Since controlling a bank's inputs is relatively easier than controlling its outputs, input-oriented approach was employed to estimate the bank's efficiency in this study. The input-oriented DEA model with variable returns to scale can be described as follows:

$$min_{\theta,\lambda}\theta$$

Subject to:

$$y_{fk} \leq \sum_{n=1}^{F} \lambda_n y_{nk} \qquad k = 1, 2, \ldots\ldots\ldots, K$$

$$\theta x_{fm} \geq \sum_{n=1}^{F} \lambda_n x_{nm} \qquad m = 1, 2, \ldots\ldots\ldots, M$$

$$\lambda_n \geq 0, \sum_{n=1}^{F} \lambda_n = 1 \qquad n = 1, 2, \ldots\ldots\ldots, F$$

Here, f ($f = 1, \ldots, F$) is the fth bank, where F is the total number of banks; $y_{f,k}$ denotes the kth ($k = 1, \ldots, K$) output for the fth bank; x_{fm} indicates the mth ($m = 1, \ldots, M$) input for the fth bank and λ_n = an intensity variable used to construct the frontier. The scalar θ measures the redial reduction in the input necessary to make the bank technically efficient and is between 0 and 1 in an input-oriented approach. If θ equals 1, it implies that the farm is technically efficient (Mitra *et al.*, 2019).

Since our data analysis is based on the panel data, so we employed the panel DEA. The panel DEA is an extension of the DEA analysis (Chaitip *et al.*, 2014), and the TE_{it} of the panel DEA can be calculated using the equation below.

$$TE_{it} = \frac{OQ_{it}}{OP_{it}}$$

where TE_{it} denotes the technical efficiency of bank $i = 1, \ldots, n$ (number of bank) and $t = 1, \ldots, n$ (number of year)). However, $\frac{OQ_{it}}{OP_{it}}$ represents the ratio of technical efficiency belong to this bank(i) at the year (t). Furthermore, the value of TE_{it} ratio ranges from zero to one. When TE_{it} equals zero, it means that bank (i) has no technical efficiency at the time period (t). On the other hand, the TE_{it} equates to one denotes that the bank (i) has the highest technical efficiency during the time period (t).

Each bank was considered as a single decision-making unit (DMU) in the DEA. For example, DMU 1 represented Janata Bank Ltd., DMU 2 represented Agrani Bank Ltd., DMU 3 represented Sonali Bank Ltd. and so on. In DEA, the frontier was constructed for each DMU while a linear program was used to generate an efficient frontier in which each DMU had 100% efficiency against all other DMUs (Hoque and Rayhan, 2013).

It is noteworthy that bank inputs are those cost items that banks incur during the process of making profits, and outputs of the banks are mainly the revenue items. The eight inputs considered for measuring the efficiency of banks have been listed in Table 4. The selection of inputs and output variables was made according to the studies of Sufian and Kamarudin (2015), Ali (2015), Sufian *et al.* (2012), Ariff and Can (2008), Bader *et al.* (2008).

4. Empirical results and discussion

4.1 Performance measurement of banks

Before diving into measuring the performance of the banking sector, we need to address the current situation of each bank in light of the components of CAMELS analysis. Thus, the following section delves deeper into each CAMELS indicator.

4.1.1 Capital adequacy of sampled banks. Higher capital adequacy increases the depositors' confidence and prevents the banks from being bankrupt in an adverse situation. Regarding categories of banks, the results (Table A1) revealed that the foreign commercial banks ranked at the first position in terms of capital adequacy ratio with a group average of 1.8 and state-owned commercial banks stood in the last position with a group average of 3.2 (Figure 1-A). Higher capital adequacy ratio (CAR) and higher total equity contribute to the better performance of foreign banks. On the other hand, a higher amount of debt, lack of capital and equity are responsible for the worst performance of state-owned commercial banks. It was found that Citibank NA stood at the top position with a group average of 1.4 and obtained ratings 1 in total equity to total assets ratio, capital adequacy ratio and government securities to the total investment ratio (Table A1). Standard Chartered Bank and HSBC Bank ranked second and third, respectively. It appeared that all the top three banks in the capital adequacy ratio were foreign commercial banks. First Security Islami Bank stood in the last position with an average score of 17.8. This is because it used a huge amount of debt capital, which made its total debt to total assets ratio higher. However, it used 95% debt to its total assets in 2018.

4.1.2 Asset quality of selected banks. To a large extent, the profitability of a bank depends on the ability of its assets to generate income. Non-performing loans can threaten the quality of assets. Five indicators were used to estimate the quality of the assets in this study. The results (Table A2) found that private commercial banks stood in the first position and specialized banks ranked last in the asset quality ratio (Figure 1-B). The foreign commercial banks and private commercial banks of Bangladesh used their assets most efficiently by investing more in the productive sectors. On the other hand, state-owned commercial banks and specialized commercial banks were in vulnerable conditions in asset quality. State-owned banks ranked at the top in loan loss provision to total loan ratio, and foreign commercial banks ranked at the top in fixed assets to total assets ratio and had the least amount of non-performing loans.

Results further showed that Sonali Bank Ltd. ranked at the top in loan loss provision to total loan ratio, and Standard Chartered Bank ranked at the top in fixed assets to total assets ratio (Table A2). Bangladesh Krishi Bank (BKB) disbursed the highest amount of loans relative to its total assets. On the other hand, Citibank NA, a foreign commercial bank, had the least amount of non-performing loans. Al-Arafah Islami Bank Ltd. ranked 1 in total investment to total assets ratio. However, First Security Islami Bank stood at the first position regarding asset quality while Probashi Kallyan Bank (PKB) stood at the last position. A considerable amount of non-performing loans was responsible for this inferior condition of PKB. The percentage of non-performing loans to its total disbursed loan was 28% which indicated the alarming situation of this bank.

4.1.3 Management soundness of selected banks. The performance of other components of CAMELS analysis depends on how efficiently the management of the bank is executing its

Inputs	Output
• Operating Expenses • Interest Expenses • Total Assets • Total Capital • Total Investment • Total shareholders' Equity • No. of branches • No. of Employees	• Operating Profit

Table 4.
Definition of inputs and output of the DEA approach

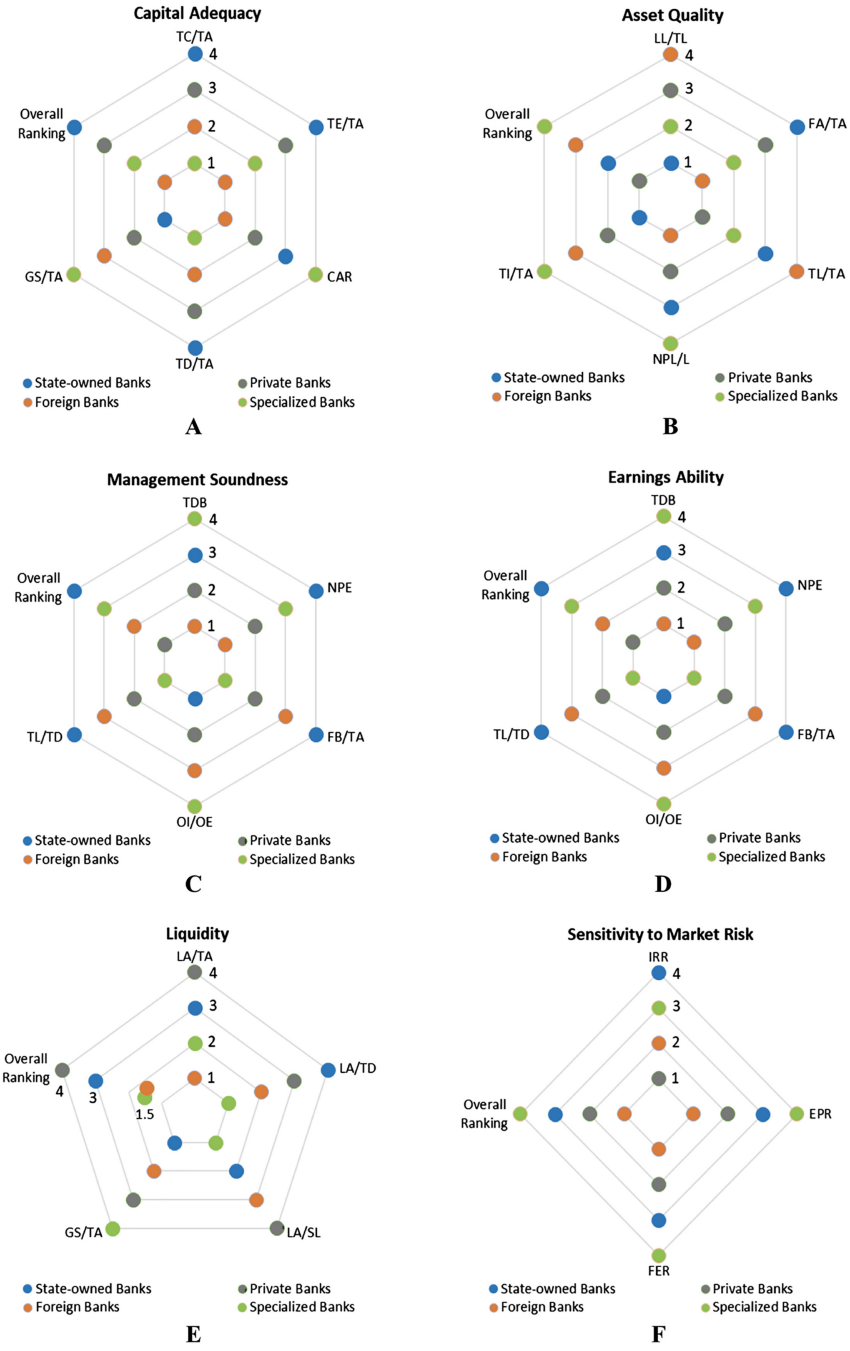

Figure 1.
Component-wise CAMELS ranking of four types of banks in Bangladesh

operation. The survival and profitability of a bank depend on the management soundness of the bank. The results (Table A3) showed that state-owned commercial banks had the lowest net profit per employee and lowest total loan to total deposits ratio, making them the worst performer with ranking 4 (Figure 1-C). On the other hand, private commercial banks ranked 1 with a group average of 2. Its higher net profit per employee, total deposits per branch had contributed to the better performance of private commercial banks.

HSBC bank achieved the top position in total deposits per branch ratio and Standard Chartered Bank in the net profit per employee ratio. In the same way, Eastern Bank stood at the first position in funds borrowed to total assets ratio and Agrani Bank in operating income to operating expense ratio. Eastern Bank Limited achieved the top position regarding management soundness, followed by Standard Chartered Bank and Dhaka Bank, while Probashi Kallyan Bank (PKB) was the worst performer. The results of this study tend to align with previous studies (e.g. Rahman and Islam, 2018; Haq, 2017) found that the management capacity of private commercial banks – Eastern Bank Ltd., Dhaka Bank Ltd., Bank Asia, NCC Bank, were in a strong position.

4.1.4 Earnings ability of sampled banks. If the bank has better earnings ability, it can afford to sustain future unforeseen shocks. So, higher earnings ability indicates better performance of the bank. Five indicators were used to measure the earnings ability of banks in this study (Table A4). It was found that foreign commercial banks stood the first position in earnings ability calculation (Figure 1-D). Its higher Return on Assets (ROA) ratio and operating profit to total assets ratio availed the foreign commercial banks to perform satisfactorily. Private commercial banks ranked two, followed by state-owned commercial banks. On the other hand, specialized banks stood in the last position with a group average of 3. Its poor return on assets ratio (−0.06) was mainly responsible for such a bad condition of the banks.

Standard Chartered Bank had secured the first position in the category of earnings ability with a group average of 2.5. It also topped in Return on Assets (ROA) indicator (2.98%). Moreover, it secured the second position in operating profit to total assets ratio indicator and non-interest income to total assets ratio indicator. BRAC Bank and Eastern Bank respectively achieved the second and third position in the earnings ability component of CAMEL analysis. On the other hand, Bangladesh Krishi Bank (BKB), one of the specialized banks of Bangladesh, stood in the last position in this category with a group average of 17.5. It failed to maintain its sustainability in earnings as its ROA ratio was negative (−2.13) and its ROE ratio was also very low (5.47), which is considered alarming for the better performance of a bank.

4.1.5 Liquidity position of selected banks. Every bank should maintain a minimum amount of money as liquid assets to handle its short-term liabilities and meet the demand for cash of its customers. If it failed to fulfill the demand of its customers, then it is called liquidity risk. So, a higher liquidity ratio is preferable for a bank though higher liquidity indicates lower investment. Therefore, the bank should maintain an optimum level of liquidity to avoid liquidity risk and enhance investment. Four indicators were used in this study to estimate the liquidity position of different banks (Table A5). Foreign commercial banks and specialized banks achieved the top position jointly (Figure 1-E). Higher liquid assets of the two banks contributed to the good performance of the banks. On the other hand, private commercial banks were the worst performers in this group. Private commercial banks were suffering from liquidity problems that made their liquid assets to total assets ratio and liquid assets to short-term liabilities ratio lower.

Results also found that Citibank NA had achieved the top position in terms of liquidity measurement of sample banks and also ranked first in liquid assets to total assets indicators. Probashi Kallyan Bank (PKB) had achieved the first position both in the liquid assets to total deposits ratio and in liquid assets to short-term liabilities ratio indicators of measuring banks' liquidity. Sonali Bank Ltd. used the highest amount of government securities in its total

assets, which made the government securities to total assets ratio higher than all other banks. On the other hand, Al-Arafah Islami Bank Ltd. showed the poorest performance and ranked at the bottom. The reason for this type of poor performance was its lower liquid assets to short-term liability ratio, which indicated that its liquid assets were not enough to meet the short-term liabilities of the bank.

4.1.6 Sensitivity to market risk. Sensitivity to market risk is the degree to which changes in interest rate, foreign exchange rate, equity prices and commodity prices adversely affect the earnings of the banks. Three indicators were used in this study to measure the market risks of the selected banks (Table A6). Commercial banks are the top performer as their equity position risk and foreign exchange risk were lower, which made its market risk lower (Figure 1-F). Private commercial banks ranked two, followed by state-owned commercial banks. Besides, a massive amount of equity position risk (Tk. 1668.6 million) and foreign exchange risk (Tk. 965.15 million) made specialized banks the worst performer (Table A6).

Citibank NA and Standard Chartered Bank jointly stood at the first position to measure sensitivity to market risk (Table A6). Equity position risks of these two banks were found to be zero, which makes them top-ranked banks. On the other hand, Bank Asia Limited was the worst performer due to its increasing interest rate, foreign exchange rate and equity position risk making its performance terrible. In the case of interest rate risk and foreign exchange risk, Dutch Bangla Bank (DBBL) and Citibank NA achieved the top positions, respectively.

4.1.7 Composite ranking of banks in the CAMELS rating system. Foreign banks and private commercial banks were found as the best performer in three separate components of CAMELS (Figure 1). The highest rating of a bank in specific components does not imply a strong position in the banking sector. Therefore, to understand the overall position of the banks, a composite ranking was given to each after analyzing all the components of the CAMELS rating system (Table 5). It was observed that foreign commercial banks and private commercial banks operate more perfectly, which made them top-ranked banks, respectively in the CAMELS analysis. Better management capacity, sufficient capital adequacy, better loan recovery, efficient use of their assets, higher per employee profit, etc., were the main reason for being top performers, which were absent in the case of state-owned commercial and specialized banks. Besides, lack of skillful and dedicated human resources, lack of liquidity and lack of proper planning during loan disbursement resulted in default loans made the worse performance of state-owned commercial banks and specialized banks.

The results also found that four banks (Eastern Bank Limited, Citibank NA, HSBC Bank and Standard Chartered Bank) were ranked first jointly, indicating strong performance. Standard Chartered Bank, one of the reputed foreign commercial banks of Bangladesh, ranked in the top position having the lowest average rating of 2.42. This bank had higher net profit per employee, liquid assets and higher operating income to operating expenses, which improved the bank's overall performance.

On the other hand, Sonali Bank Ltd., the biggest state-owned commercial bank of Bangladesh, achieved the last position and made more unsatisfactory performance due to lack of adequate capital, lower fixed assets to total assets ratio, lower total loan to total deposits ratio and lack of liquid assets. Results also revealed that foreign commercial banks performed best and ranked first among all other types of banks. Private commercial banks ranked second, followed by specialized banks. State-owned commercial banks were the worst performer, ranked four in the composite ranking of CAMELS analysis. Rahman and Islam (2018) found that the composite rating of Eastern Bank Ltd. ranked first, and IFIC Bank was the worst performer among the sampled private commercial banks of Bangladesh.

Name of banks	C	A	M	E	L	S	Avg	Composite rank	CAMELS rank
Janata Bank	18.5	6	17	18	14	17.5	15.17	19	5
Agrani Bank	18.5	13	15.5	11	7.5	15	13.42	16	4
Sonali Bank	17	17	19	19	10	19	16.83	20	5
State-owned	*4*	*2*	*4*	*3*	*3*	*3*	*4*		*4*
Al-Arafah Islami Bank	14	2	5	6.5	20	6.5	9.00	6	2
Pubali Bank	8	8	18	12	13	14	12.17	14	4
Standard Bank	11	9	9	4.5	9	13	9.25	7	2
Dhaka Bank	12.5	15	3	13	18	10	11.92	12	3
Prime Bank	4	17	7	15	3	4	8.33	5	2
First security Islami Bank	20	1	15.5	17	15	3	11.92	12	3
IFIC Bank	16	11	13.5	14	6	11	11.92	12	3
DBBL	9	19	11	4.5	17	6.5	11.17	10	3
Premier Bank	12.5	17	11	16	11	6.5	12.33	15	4
BRAC Bank	10	7	13.5	2	12	12	9.42	8.5	3
Bank Asia	5	10	4	10	7.5	20	9.42	8.5	3
Eastern Bank	6	13	1	3	2	6.5	5.25	3	1
Private	*3*	*1*	*1*	*2*	*4*	*2*	*2.17*		*2*
Citibank NA	1	4.5	6	9	1	1.5	3.83	2	1
HSBC Bank	3	4.5	8	8	16	9	8.08	4	1
Standard Chartered	2	3	2	1	5	1.5	2.42	1	1
Foreign	*1*	*3*	*2*	*1*	*1.5*	*1*	*1.58*		*1*
BKB	7	13	11	20	19	16	14.33	18	5
PKB	15	20	20	6.5	4	17.5	13.83	17	5
Specialized	*2*	*4*	*3*	*4*	*1.5*	*4*	*3.08*		*3*

Table 5.
The composite rank of sample banks

4.2 Efficiency measurement of banks

Efficient banks can achieve maximum profit using the minimum amount of inputs such as operating and interest expenses, total assets, total capital, total investment, total shareholders' equity and least number of branches and employees. The findings of technical efficiency over study period of different banks are shown in Table 6. Results revealed that state-owned banks suffer from serious inefficiency during the period of 2013–2018. This is due to managerial failures or external circumstances that have transpired during this time period. During this time, not just state-owned banks, but also private commercial banks, are affected by similar concerns. Moreover, the country's all financial institutions went through severe issue of capital shortage during this period. This can be attributed to the fact that the money market rate has plummeted, resulting in a significant drop in the bank's interest margin. Another reason for the drop-in efficiency is that the government has reformed the money market structure during this period and strengthened the regulatory structure for lending, especially individual consumer and business lending. Nonetheless, the substantial improvement in bank efficiency witnessed following this period can be attributed to an increase in revenue collection as a consequence of interest rates and various fees and levies.

The findings of the VRS, CRS, and the scale efficiency score for each DMU are shown in Table 7 to delve deeper into the efficiency analysis and ranking of different banks. Results found that the technical efficiency score of Citibank NA, HSBC Bank and PKB was found to be efficient as their VRS scores were 1. In the same way, Citibank NA and HSBC Bank were found to be technically efficient under CRS efficiency as their efficiency scores were 1. Moreover, only two banks, i.e. Citibank NA and HSBC bank, were found to be scale efficient as

DMU	Bank name	Efficiency score 2011	2012	2013	2014	2015	2016	2017	2018
1	Janata Bank	1.00	1.00	0.57	0.49	0.48	0.42	0.47	0.36
2	Agrani Bank	1.00	1.00	0.80	0.68	0.56	0.29	0.22	0.07
3	Sonali Bank	1.00	1.00	0.15	0.28	0.32	0.16	0.41	1.00
4	Al-Arafah Islami Bank	1.00	0.88	0.81	0.87	0.81	0.83	0.71	0.61
5	Pubali Bank	0.83	0.72	0.75	0.64	0.61	0.54	0.66	0.66
6	Standard Bank	1.00	0.88	0.83	0.89	0.66	0.61	0.57	0.53
7	Dhaka Bank	1.00	0.76	0.71	0.70	0.64	0.82	0.75	0.87
8	Prime Bank	0.86	0.91	0.72	0.58	0.52	0.51	0.56	0.56
9	First Security Islami Bank	0.82	0.75	0.67	0.57	0.54	0.68	0.76	0.76
10	IFIC bank	0.85	0.82	0.73	0.68	0.72	0.58	0.50	0.41
11	DBBL	1.00	0.96	0.71	0.72	0.88	0.67	0.69	0.73
12	Premier Bank	0.56	0.48	0.55	0.64	0.61	0.64	0.74	0.87
13	BRAC Bank	1.00	0.99	1.00	0.80	0.92	1.00	1.00	0.89
14	Bank Asia	0.87	0.93	0.89	0.82	0.72	0.69	0.76	0.82
15	Eastern Bank	1.00	0.91	0.89	0.83	0.72	0.86	0.86	0.83
16	Citibank NA	–	–	–	–	–	1.00	1.00	1.00
17	HSBC Bank	–	–	–	–	–	1.00	1.00	1.00
18	Standard Chartered Bank	–	–	–	–	–	1.00	0.93	1.00
19	BKB	–	–	–	0.98	0.86	1.00	0.98	1.00
20	PKB	–	–	–	1.00	1.00	1.00	1.00	1.00

Table 6.
Year-wise efficiency scores of different banks

DMU	Bank name	VRS	CRS	Scale efficiency	Score
1	Janata Bank	0.598	0.578	0.97	4
2	Agrani Bank	0.578	0.56	0.93	6
3	Sonali Bank	0.54	0.44	0.87	10
4	Al-Arafah Islami Bank	0.81	0.8	0.98	3
5	Pubali Bank	0.67	0.66	0.98	3
6	Standard Bank	0.74	0.69	0.92	7
7	Dhaka Bank	0.77	0.75	0.96	5
8	Prime Bank	0.65	0.64	0.98	3
9	First Security Islami Bank	0.69	0.61	0.88	9
10	IFIC bank	0.66	0.59	0.91	8
11	DBBL	0.79	0.78	0.98	3
12	Premier Bank	0.63	0.51	0.77	11
13	BRAC Bank	0.94	0.91	0.96	5
14	Bank Asia	0.81	0.78	0.96	5
15	Eastern Bank	0.86	0.85	0.99	2
16	Citibank NA	1	1	1	1
17	HSBC Bank	1	1	1	1
18	Standard Chartered Bank	0.98	0.97	0.99	2
19	BKB	0.96	0.94	0.98	3
20	PKB	1	0.93	0.93	6

Table 7.
VRS efficiency, CRS efficiency and scale efficiency of banks

their scale efficiency score was 1. The scale efficiency of another foreign commercial bank Standard Chartered Bank was near to 1. So, it can be said that the foreign commercial banks were found to be more efficient than other types of banks operating in Bangladesh. Hoque and Rayhan (2013) measured the efficiency of 21 commercial banks operating in Bangladesh; only two banks (Citi bank and One Bank Ltd.) were scale efficient, and the other 19 banks were inefficient. However, Standard Chartered bank's scale efficiency was found to be a

standard of 0.99 or 99%, which means by adjusting the scale, Standard Chartered Bank could reduce their inputs by (1–0.99) or 1%. Scale efficiency can be improved by increasing the operating profits of the bank as its operating profit was very small. In bank categories, the foreign commercial bank was found relatively more efficient than others, while state-owned banks were less efficient among all categories (Figure 2).

The efficient banks (Citibank NA and HSBC Bank) had a minimal number of bank branches, and operating profits were Tk. 1249.2 million and Tk. 6020.9 million, respectively, leading their profit per branch higher enough to make the banks efficient. Their other related input costs, such as operating and interest expenses, are also lower comparing the other banks. In contrast, the reasons for the inefficiency of state-owned commercial banks were their higher expenses, larger capital and assets, and operating profit, which was not higher enough compared to their massive number of branches and employees. Among the specialized banks, a large amount of capital to operate its 1030 branches and their higher interest expenses made Bangladesh Krishi Bank inefficient. Among the private commercial banks, Premier Bank had the lowest scale efficiency because its operating profit was meager, although it had a large amount of total assets and only 91 branches.

Comparing the performance and efficiency of banks, it was found that, in case of measuring the performance of banks using the CAMELS rating system Standard Chartered Bank, one of the foreign banks ranked one. However, the scale efficiency score of Standard Chartered Bank was 0.99, which was very close to efficient. On the other hand, other two foreign commercial banks – Citibank NA and HSBC Bank – were efficient in efficiency measurement. Their composite performance ratings were two and four, respectively, alongside their CAMELS rank was first, which can be considered good ratings. So, in terms of performance and efficiency measurement of banks, the rankings of foreign commercial banks were more satisfactory, but the state-owned banks showed dissatisfactory results.

5. Conclusion

The banking sector of a country reflects the growth potentiality of the economy of that country. However, it is a matter of concern that the banks of our country are facing many problems that slow down the pace of development of the banking sector and nation. Therefore, this study tried to assess the performance and efficiency of 20 scheduled banks operating in Bangladesh based on secondary data collected from the annual reports. This study included all categories of banks

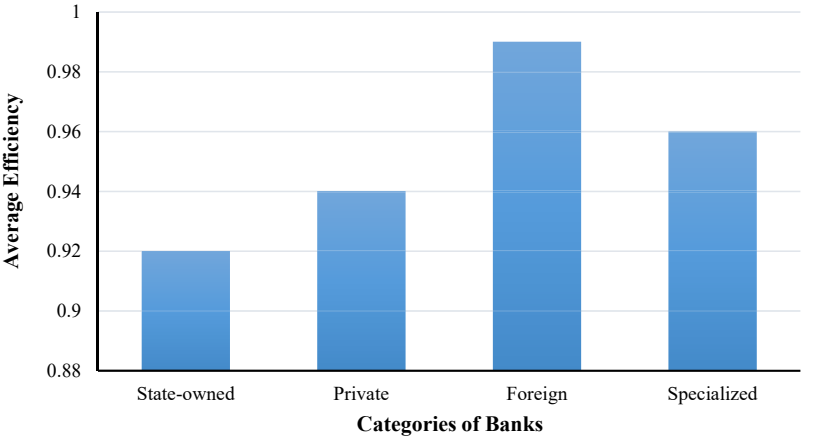

Figure 2.
Average efficiency level of four categories of banks

operating in Bangladesh, i.e. state-owned banks, private commercial banks, foreign commercial banks and specialized banks. To measure the performance of banks, the CAMELS rating system was considered, and a ranking was provided to each of the banks. Besides, the efficiency of the banks was measured through DEA. Results found that not all bank categories perform equally well, and not all banks within the same category are equally efficient. The foreign commercial banks were the best performers and state-owned commercial banks were the worst performer. In addition, foreign commercial banks were more efficient than other categories of banks in Bangladesh. Results revealed that four banks, i.e. Prime Bank Limited, First Security Islami Bank Limited, Citibank NA and Standard Chartered Bank, provided strong performance in CAMELS rating. In contrast, Janata Bank Limited, Sonali Bank Limited, Bank Asia, and Probashi Kallyan Bank exhibited dissatisfactory performance. However, due to the amending of money market structure, all banks experienced significant inefficiency from 2013 to 2018. Only two banks, i.e. Citibank NA and HSBC Bank, were efficient, and the other eighteen banks were found to be inefficient.

6. Policy implications and future research

To the best of our knowledge, this study is the first of its kind in Bangladesh, focusing on different bank categories for analyzing performance and efficiency simultaneously. From the findings of the study, it can be concluded that the activities of most of the banks operating in Bangladesh are not satisfactory, especially the activities of state-owned commercial banks. These as well as specialized banks need to improve in most of the components in CAMELS, particularly capital adequacy, managerial soundness and earning ability by taking component-oriented strategies. Specialized banks also require recovery in its asset quality through adopting strong asset and liability management strategies which ultimately would reduce their market risk sensitivity. Therefore, Bangladesh Bank, the country's central bank, should precisely monitor and control the operations of poor-performing banks. In addition, state-owned commercial banks are more prone to corruption, which should concern the authority while evaluating the respective bank's performance. Followed by problem identifications, strict steps should be taken through the individual bank authority or direct involvement of the central bank to solve identified issues efficiently for making its performance better. In this regard, first of all, the banks should strictly maintain liquidity to meet the demand of their customers before investing funds and providing loans to their borrowers. Second, since non-performing loans degrade banks' asset quality, banks should use a supervisory strategy to limit the number of non-performing loans. Third, banks should raise the amount of deposits and investments they make in order to boost their earnings. Our empirical findings are confined to data obtained from a few sampling banks over a defined time period, which may limit the capacity to generalize our findings. However, it is anticipated that this study contributes to the extant literature of banks and the financial sector, which are relevant in developing economies, particularly Bangladesh and other similar countries. Future studies may explore productivity changes over time due to technological progress and bank-specific determinants of efficiency and performance compared to developed countries. Furthermore, the efficiency analysis of this study was entirely based on the DEA approach, which has several limitations, including the fact that the results from this method are potentially sensitive to the inputs and outputs selection and may not produce most reliable results without applying other supporting methods. Therefore, future research should address this by using more robust methods.

References

Abbas, M., Azid, T. and Besar, H. (2016), "Efficiency, effectiveness and performance profile of Islamic and conventional banks in Pakistan", *Humanomics*, Vol. 32 No. 1, pp. 2-18.

Aguenaou, S., Lahrech, A. and Bounakaya, S. (2017), "Analyzing banks' efficiency as a measurement of performance in the Moroccan context: application of CAMEL framework", *International Review of Research in Emerging Markets and the Global Economy (IRREM)*, Vol. 3 No. 1, pp. 1105-1121.

Ahamed, M. (2012), "Market structure and performance of Bangladesh banking industry: a panel data analysis", *The Bangladesh Development Studies*, Vol. 35 No. 3, pp. 1-18.

Ahmed, M.S. and Liza, F.F. (2013), "Efficiency of commercial banks in Bangladesh-A data envelopment analysis", *European Journal of Economics, Finance and Administrative Sciences*, Vol. 56, pp. 130-152.

Ahsan, M.K. (2016), "Measuring financial performance based on CAMEL: a study on selected Islamic banks in Bangladesh", *Asian Business Review*, Vol. 6 No. 1, pp. 7-56.

Aissia, D.B. and Ellouz, M. (2021), "Estimation of the efficiency of Tunisian bank branches using a stochastic Frontier approach", *SN Business and Economics*, Vol. 1 No. 10, pp. 1-19.

Al-Gasaymeh, A. and Samarah, M.R. (2020), "Does country risk affect banking efficiency: empirical evidence from Turkey and selected countries from the European union", *Global Business Review*. doi: 10.1177/0972150920933973.

Alam, F. (2011), "Measuring technical, allocative and cost efficiency of pangas (Pangasius hypophthalmus: sauvage 1878) fish farmers of Bangladesh", *Aquaculture Research*, Vol. 42 No. 10, pp. 1487-1500.

Alemu, M.M. and Aweke, M.M. (2017), "Financial performance analysis of private commercial banks of Ethiopia: CAMEL ratings", *International Journal of Scientific and Research Publications*, Vol. 7, pp. 367-395.

Ali, I. (2015), "Measuring efficiency of Islamic banks in Bangladesh: an application of data envelopment analysis", *Manarat International University Studies*, Vol. 4 No. 1, pp. 12-24.

Alrafadi, K.M.S., Yusuf, M.M. and Kamaruddin, B.H. (2016), "Measuring efficiency in banks: a brief survey on non–parametric technique (data envelopment analysis)", *International Journal of Business, Economics and Management*, Vol. 3 No. 5, pp. 52-68.

Amir, M.K. (2019), "Does excess bank liquidity impact non-performing loan? a study on Bangladeshi economy", *International Journal Business Technopreneurship*, Vol. 9, pp. 287-298.

Anouze, A.L.M. and Bou-Hamad, I. (2019), "Data envelopment analysis and data mining to efficiency estimation and evaluation", *International Journal of Islamic and Middle Eastern Finance and Management*, Vol. 12 No. 2, pp. 169-190.

Ariff, M. and Can, L. (2008), "Cost and profit efficiency of Chinese banks: a nonparametric analysis", *China Economic Review*, Vol. 19 No. 2, pp. 260-273.

Bader, M.K.I., Mohammed, S., Ariff, M. and Hassan, T. (2008), "Cost, revenue and profit efficiency of Islamic versus conventional banks: international evidence using data envelopment analysis", *Islamic Economic Studies*, Vol. 15 No. 2, pp. 24-76.

Bangladesh Bank (2019), *Bangladesh Bank Annual Report 2018-2019*, Bangladesh Bank, Dhaka.

Banker, R.D., Charnes, A. and Cooper, W.W. (1984), "Some models for estimating technical and scale inefficiencies in data envelopment analysis", *Journal of Management Science*, Vol. 30, pp. 1078-1092.

Banna, H., Ahmad, R. and Koh, E.H. (2017), "Determinants of commercial banks' efficiency in Bangladesh: does crisis matter?", *The Journal of Asian Finance, Economics and Business (JAFEB)*, Vol. 4 No. 3, pp. 19-26.

Bikker, J.A. and Bos, J.W.B. (2008), *Bank Performance: A Theoretical and Empirical Framework for the Analysis of Profitability, Competition, and Efficiency*, Routledge, London.

Boubakri, N., Cosset, J.C., Fischer, K. and Guedhami, O. (2005), "Privatization and bank performance in developing countries", *Journal of Banking and Finance*, Vol. 29 Nos 8-9, pp. 2015-2041.

Chaitip, P., Chaiboonsri, C. and Inluang, F. (2014), "The production of Thailand's sugarcane: using panel data envelopment analysis (panel DEA) based decision on bootstrapping method", *Procedia Economics and Finance*, Vol. 14, pp. 120-127.

Chaity, N.S. and Alam, S.M.S. (2021), "The impact of monitoring mechanism on efficiency change and productivity growth of private commercial banks in Bangladesh", *European Scientific Journal*, Vol. 17, pp. 216-231.

Chaluvadi, S., Raut, R. and Gardas, B.B. (2018), "Measuring the performance efficiency of banks in a developing economy: the case study of Indian public sector vs private sector", *Benchmarking: An International Journal*, Vol. 25 No. 2, pp. 575-606.

Charnes, A., Cooper, W.W. and Rhodes, E. (1978), "Measuring the efficiency of decision-making units", *European Journal of Operational Research*, Vol. 2, pp. 429-444.

Drucker, P. (1977), *An Introductory View of Management*, Harper College Press, New York, NY.

Emrouznejad, A. and De Witte, K. (2010), "COOPER-framework: a unified process for non-parametric projects", *European Journal of Operational Research*, Vol. 207 No. 3, pp. 1573-1586.

Eyuboglu, K. (2016), "Comparison the financial performances of developing countries' banking sectors with topsis method", *Sosyal Bilimler Araştirmalari Dergisi*, Vol. 14, pp. 220-236.

Fatema, N., Siddik, A.B. and Ibrahim, A.M. (2019), "Efficiency and productivity of commercial banks: evidence from Bangladesh", *North American Academic Research*, Vol. 2 No. 7, pp. 190-208.

Habib, S.M.A. (2018), "Addressing challenges of the banking sector", *The Financial Express*, available at: https://thefinancialexpress.com.bd/public/views/addressing-challenges-of-the-banking-sector-1545148259 (accessed 9 October 2019).

Henriques, I.C., Sobreiro, V.A., Kimura, H. and Mariano, E.B. (2018), "Efficiency in the Brazilian banking system using data envelopment analysis", *Future Business Journal*, Vol. 4 No. 2, pp. 157-178.

Hoque, M.R. and Rayhan, M.I. (2013), "Efficiency measurement on banking sector in Bangladesh", *Dhaka University Journal of Science*, Vol. 61 No. 1, pp. 1-5.

Huq, S.M. (2017), "Performance of banking industry in Bangladesh: insights of CAMEL rating", *International Journal of Financial Engineering*, Vol. 4 No. 2, pp. 1-15.

Islam, M.A., Siddiqui, M.H., Hossain, K.H. and Karim, L. (2014), "Performance evaluation of the banking sector in Bangladesh: a comparative analysis", *Business and Economic Research*, Vol. 4, pp. 70-107.

Islam, M.N., Sabur, M.A. and Khan, A.G. (2017), "Efficient and effective operations of commercial banks in Bangladesh: an evaluation", *Journal of Science and Technology*, Vol. 7, pp. 93-108.

Jahan, N. and Muhiuddin, K.M. (2020), "Evaluation of banking sectors development in Bangladesh in light of financial reform", *Developing Country Studies*, Vol. 4, pp. 13-20.

Kamarudin, F., Sufian, F. and Nassir, A.M. (2016), "Global financial crisis, ownership and bank profit efficiency in the Bangladesh's state owned and private commercial banks", *Contaduríay Administración*, Vol. 61 No. 4, pp. 705-745.

Khanam, D. and Nghiem, H.S. (2006), "Efficiency of banks in Bangladesh: a nonparametric approach", *Regional Studies-Islamabad*, Vol. 25 No. 1, p. 93.

Khatik, S.K. and Nag, A.K. (2015), "Performance measurement system in Indian banking sector in CAMEL framework: a comparative study of private and foreign banks in India", *Journal Press India*, Vol. 16 No. 1, pp. 75-85.

Kumar, S. and Gulati, R. (2010), "Measuring efficiency, effectiveness and performance of Indian public sector banks", *International Journal of Productivity and Performance Management*, Vol. 59 No. 1, pp. 51-74.

Mahmud, K., Mallik, A., Imtiaz, M.F. and Tabassum, N. (2016), "The bank-specific factors affecting the profitability of commercial banks in Bangladesh: a panel data analysis", *International Journal of Managerial Studies and Research*, Vol. 4 No. 7, pp. 67-74.

Mirzaei, A. and Moore, T. (2019), "Real effect of bank efficiency: evidence from disaggregated manufacturing sectors", *Economica*, Vol. 86 No. 341, pp. 87-115.

Mirzaei, A., Moore, T. and Liu, G. (2013), "Does market structure matter on banks' profitability and stability? Emerging vs. advanced economies", *Journal of Banking and Finance*, Vol. 37 No. 8, pp. 2920-2937.

Mitra, S., Khan, M.A., Nielsen, R. and Islam, N. (2019), "Total factor productivity and technical efficiency differences of aquaculture farmers in Bangladesh: do environmental characteristics matter?", *Journal of the World Aquaculture Society*, Vol. 51 No. 4, pp. 918-930.

Moudud-Ul-Huq, S. (2017), "Performance of banking industry in Bangladesh: insights of CAMEL rating", *International Journal of Financial Engineering*, Vol. 4 No. 2, pp. 1-15.

Moudud-Ul-Huq, S. (2019), "Banks' capital buffers, risk, and efficiency in emerging economies: are they counter-cyclical?", *Eurasian Economic Review*, Vol. 9 No. 4, pp. 467-492.

Pancurova, D. and Lyocsa, S. (2013), "Determinants of commercial banks' efficiency: evidence from 11 CEE countries", *Czech Journal of Economics and Finance (Finance a uver)*, Vol. 63 No. 2, pp. 152-179.

Rahman, M.Z. and Islam, M.S. (2018), "Use of CAMEL rating framework: a comparative performance evaluation of selected Bangladeshi private commercial banks", *International Journal of Economics and Finance*, Vol. 10 No. 1, pp. 120-128.

Rao, K.R.M. and Lakew, T.B. (2012), "Cost efficiency and ownership structure of commercial banks in Ethiopia: an application of nonparametric approach", *European Journal of Business and Management*, Vol. 4 No. 10, pp. 36-47.

Rashid, M.H.U., Zobair, S.A.M., Chowdhury, M.A.I. and Islam, A. (2020), "Corporate governance and banks' productivity: evidence from the banking industry in Bangladesh", *Business Research*, Vol. 13 No. 2, pp. 1-23.

Rayhan, S.J., Ahmed, S.M.S. and Mondal, R.K. (2011), "Performance evaluation and competitive analysis of state-owned commercial banks in Bangladesh", *Research Journal of Finance and Accounting*, Vol. 2 No. 3, pp. 99-114.

Rengasamy, D. (2012), "The need to evaluate bank performance", *Borneo Post Online*, available at: https://www.theborneopost.com/2012/11/06/the-need-to-evaluate-bank-performance/ (accessed 27 September 2021).

Rushdi, A.A. (2009), "Performance measure for the commercial banks in Bangladesh: an application of total factor productivity", AIUB Bus Econ Working Paper Series No. 2009-01, available at: http://orp.aiub.edu/abewps-2009.

Samad, A. (2008), "Market structure, conduct, and performance: evidence from the Bangladesh banking industry", *Journal of Asian Economics*, Vol. 19 No. 2, pp. 181-183.

Sarker, M.A.A. (2005), "CAMEL rating system in the context of Islamic banking: a proposed 'S' for Shariah framework", *Journal of Islamic Economics and Finance*, Vol. 1 No. 1, pp. 78-84.

Shameem, A.K.M. (1995), "Impact of flexible interest rate on savings and investment", *Bangladesh Journal of Political Economy*, Vol. 13 No. 2, pp. 62-78.

Sickles, R.C. and Zelenyuk, V. (2019), *Measurement of Productivity and Efficiency: Theory and Practice*, Cambridge University Press, Cambridge.

Sufian, F. and Kamarudin, F. (2013), "Efficiency of the Bangladesh banking sector: evidence from the profit function", *Jindal Journal of Business Research*, Vol. 2 No. 1, pp. 43-57.

Sufian, F. and Kamarudin, F. (2014), "Efficiency and returns to scale in the Bangladesh banking sector: empirical evidence from the slack-based DEA method", *Inzinerine Ekonomika – Engineering Economics*, Vol. 25 No. 5, pp. 549-557.

Sufian, F. and Kamarudin, F. (2015), "Determinants of revenue efficiency of Islamic banks: empirical evidence from the southeast Asian countries", *International Journal of Islamic and Middle Eastern Finance and Management*, Vol. 8 No. 1, pp. 36-63.

Sufian, F., Kamarudin, F. and Noor, N.H.H.M. (2012), "Determinants of revenue efficiency in the Malaysian Islamic banking sector", *Journal of King Abdulaziz: Islamic Economics*, Vol. 25 No. 2, pp. 195-224.

Tamatam, R., Dutta, P., Dutta, G. and Lessmann, S. (2019), "Efficiency analysis of Indian banking industry over the period 2008-2017 using data envelopment analysis", *Benchmarking: An International Journal*, Vol. 26, pp. 2417-2442.

Uddin, M.R. and Bristy, J.F. (2014), "Evaluation of some private commercial banks in Bangladesh from performance perspectives", *International Journal of Managing Value and Supply Chains (IJMVSC)*, Vol. 5 No. 4, pp. 1-17.

Zheng, C., Bhowmik, P.K. and Sarker, N. (2020), "Industry-specific and macroeconomic determinants of non-performing loans: a comparative analysis of ARDL and VECM", *Sustainability*, Vol. 12 No. 1, p. 325.

Appendix

Table A1.
Capital adequacy ratio of sampled banks

Name of banks	TC/TA		TE/TA		CAR		TD/TA		GS/TI		Group	
	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank
Janata	5.47	18	6.24	17	9.43	18	93.76	18	86.45	8	15.8	18.5
Agrani	4.92	19	6.30	16	9.65	17	93.70	17	81.12	10	15.8	18.5
Sonali	3.88	20	5.82	18	10.64	15	94.18	19	90.78	5	15.4	17
Sate-owned	*4.75*	*4*	*6.12*	*4*	*9.90*	*3*	*93.87*	*4*	*86.11*	*1*	*3.2*	*4*
Al-Arafah	9.01	13	7.80	12	13.22	5	92.20	13	4.13	18	12.2	14
Pubali	9.23	10	8.59	8	12.02	10	91.41	9	78.22	13	10	8
Standard	9.78	9	8.29	9	11.47	13	91.71	10	76.58	14	11	11
Dhaka Bank	8.81	14	7.47	13	11.84	11	92.53	14	86.66	7	11.8	12.5
Prime Bank	11.65	6	9.42	6	12.74	8	90.58	7	96.65	3	6	4
First security	5.63	17	3.96	19	10.56	16	96.04	20	5.42	17	17.8	20
IFIC Bank	8.02	16	6.98	14	10.92	14	93.02	15	78.40	12	14.2	16
DBBL	8.55	15	6.78	15	13.26	4	93.22	16	94.94	4	10.8	9
Premier	9.06	11	8.10	10	11.52	12	91.90	11	75.54	15	11.8	12.5
BRAC Bank	9.01	12	8.01	11	12.63	9	91.99	12	80.36	11	11	10
Bank Asia	10.32	7	8.61	7	13.14	6	91.39	8	86.84	6	6.8	5
Eastern Bank	10.30	8	10.56	5	12.87	7	89.44	6	82.23	9	7	6
Private	*9.11*	*3*	*7.88*	*3*	*12.18*	*2*	*92.11*	*3*	*70.49*	*2*	*2.6*	*3*
Citibank NA	25.19	2	24.99	1	40.85	1	75.01	2	99.92	1	1.4	1
HSBC	21.16	4	19.58	3	29.30	2	80.42	4	0.00	19.5	6.5	3
Standard chartered	14.77	5	13.72	4	16.94	3	86.28	5	98.77	2	3.8	2
Foreign	*20.3*	*2*	*19.4*	*1*	*29.03*	*1*	*80.56*	*2*	*66.23*	*3*	*1.8*	*1*
BKB	22.22	3	22.22	2	−40.61	19	77.78	3	15.18	16	8.6	7
PKB	62.71	1	0.92	20	−53.02	20	37.63	1	0.00	19.5	12.3	15
Specialized	*42.4*	*1*	*11.5*	*2*	*−46.82*	*4*	*57.70*	*1*	*7.59*	*4*	*2.4*	*2*

Name of banks	LL/TL		FA/TA		TL/TA		NPL/L		TI/TA		Group	
	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank
Janata	6.25	4	1.57	9	54.86	14	15.24	16	26.25	5	9.6	6
Agrani	9.16	3	2.79	18	48.50	16	18.06	17	28.96	4	11.6	13
Sonali	13.32	1	3.11	19	38.86	18	28.69	18	31.79	3	11.8	17
State-owned	*9.5*	*1*	*2.5*	*4*	*47.4*	*3*	*20.6*	*3*	*29.1*	*1*	*2.4*	*2*
Al-Arafah	1.10	19	1.24	5	71.40	3	3.49	6	71.41	1	6.8	2
Pubali	2.67	7	1.46	8	63.30	12	5.51	13	16.65	10	10	8
Standard	1.65	15	1.69	11	69.85	4	4.39	8	15.54	13	10.2	9
Dhaka bank	2.13	11	1.91	13	67.58	8.5	4.87	10	11.36	16	11.7	15
Prime bank	2.21	10	2.35	15	65.66	11	6.55	15	18.98	8	11.8	17
First security	1.09	18	1.25	6	76.19	2	2.50	3	68.52	2	6.2	1
IFIC bank	1.98	13	1.87	12	68.70	6	5.30	12	13.55	14	11.4	11
DBBL	2.10	12	2.21	14	62.84	13	3.96	7	9.27	18	12.8	19
Premier	1.58	16	1.55	10	67.84	7	5.61	14	16.05	12	11.8	17
BRAC bank	3.87	6	1.41	7	67.60	8.5	5.17	11	10.39	17	9.9	7
Bank Asia	2.34	8	2.64	16	65.96	10	4.67	9	16.38	11	10.8	10
Eastern Bank	1.90	14	3.35	20	69.60	5	2.98	4	12.72	15	11.6	13
Private	*2.1*	*3*	*1.9*	*3*	*68.1*	*1*	*4.6*	*2*	*23.4*	*2*	*2.2*	*1*
Citibank NA	1.25	17	0.45	3	34.46	19	1.69	1	20.80	7	9.4	4.5
HSBC	0.9	20	0.24	2	48.31	17	2.19	2	22.71	6	9.4	4.5
Standard chartered	2.23	9	0.13	1	52.62	15	3.42	5	18.60	9	7.8	3
Foreign	*1.4*	*4*	*0.3*	*1*	*45.1*	*4*	*2.4*	*1*	*20.7*	*3*	*2.6*	*3*
BKB	9.96	2	2.77	17	79.68	1	23.64	19	0.02	19	11.6	13
PKB	5.10	5	0.92	4	28.14	20	32.47	20	0.00	20	13.8	20
Specialized	*7.5*	*2*	*1.9*	*2*	*53.9*	*2*	*28.1*	*4*	*0.01*	*4*	*2.8*	*4*

Table A2.
Asset quality of sampled banks

Table A3.
Management soundness of sampled banks

Name of banks	TDB		NPE		Fb/TA		OI/OE		TL/TD		Group	
	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rating	Avg	Rank
Janata	595.49	16	37.89	15	1.10	16	2.23	9	67.69	17	14	17
Agrani	454.84	18	10.64	19	2.48	13	3.29	1	62.75	18	12.75	15.5
Sonali	688.97	15	37.31	16	0.26	18	1.69	14	47.61	20	15.75	19
State-owned	*579.8*	*3*	*28.6*	*4*	*1.2*	*4*	*2.4*	*1*	*59.4*	*4*	*3.2*	*4*
Al-Arafah	1343.98	10	91.42	8	5.69	5	2.60	3	90.25	4	6.5	5
Pubali	477.34	17	32.06	18	2.16	14	2.15	11	82.09	13	15	18
Standard	1041.80	14	80.86	10	3.86	11	2.35	7	86.91	6	10.5	9
Dhaka bank	1617.86	6	103.52	5	5.73	4	2.48	5	86.76	8	5	3
Prime bank	1392.24	8	82.63	9	5.92	3	2.18	10	86.38	9	7.5	7
First security	1430.12	7	35.63	17	1.90	15	1.93	12	86.85	7	12.75	15.5
IFIC bank	1121.36	12	52.21	12	2.80	12	1.78	13	84.68	11	12.25	13.5
DBBL	1168.01	11	44.32	13	4.46	9	1.65	15	80.27	14	12	11
Premier	1120.99	13	80.78	11	4.62	8	1.65	16	84.06	12	12	11
BRAC bank	1383.74	9	42.94	14	4.83	7	0.81	19	94.59	3	12.25	13.5
Bank Asia	1658.26	5	102.94	6	5.46	6	2.49	4	86.27	10	5.25	4
Eastern Bank	1685.96	4	165.33	4	16.86	1	2.41	6	103.47	2	3.75	1
Private	*1286.8*	*2*	*76.2*	*2*	*5.3*	*2*	*2.04*	*2*	*87.7*	*2*	*2*	*1*
Citibank NA	9429.68	2	417.34	2	1.09	17	2.25	8	50.38	19	7.25	6
HSBC	14597.27	1	399.21	3	0.00	19.5	1.05	18	69.37	16	10.37	8
Standard chartered	9389.60	3	604.25	1	4.02	10	2.78	2	71.86	15	4	2
Foreign	*11138*	*1*	*473.6*	*1*	*1.7*	*3*	*2.03*	*3*	*63.9*	*3*	*2.2*	*2*
BKB	204.18	19	95.51	7	12.64	2	0.23	20	89.30	5	12	11
PKB	11.64	20	8.02	20	0.00	19.5	1.19	17	292.27	1	19.12	20
Specialized	*107.9*	*4*	*51.7*	*3*	*6.3*	*1*	*0.71*	*4*	*190.8*	*1*	*2.6*	*3*

Name of banks	ROA		ROE		OP/TA		Net II/TA		Non-II/TA		Group	
	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank
Janata	0.1	18	13.14	8	1.95	16	0.73	18	1.04	14	15	18
Agrani	0.98	12	37.70	1	1.81	17	0.83	17	3.19	1	11.75	11
Sonali	0.08	19	24.58	2	1.03	20	−1.03	20	1.17	11	15.25	19
State-owned	*0.41*	*3*	*25.14*	*1*	*1.60*	*4*	*0.18*	*4*	*1.80*	*1*	*2.6*	*3*
Al-Arafah	1.18	8	13.98	6	2.89	9	3.09	5	1.00	15	7	6.5
Pubali	0.92	14	10.08	17	2.73	10	2.65	7	0.94	17	12	12
Standard	1.11	9	12.82	9	5.32	1	2.16	8	0.94	16	6.75	4.5
Dhaka bank	1.05	10	12.61	10	2.60	14	1.84	15	1.13	13	12.25	13
Prime bank	0.96	13	10.24	16	2.66	11	1.67	16	1.20	10	14	15
First security	0.63	17	11.33	13	1.16	19	2.06	10	0.32	20	14.75	17
IFIC bank	0.86	16	12.12	11	2.06	15	2.12	9	1.23	9	12.75	14
DBBL	1.26	7	18.26	4	2.61	13	4.01	3	1.78	5	6.75	4.5
Premier	0.91	15	10.96	14	1.78	18	2.01	11	1.40	8	14.5	16
BRAC bank	1.32	6	16.05	5	3.17	6	4.19	2	2.03	4	4.75	2
Bank Asia	1.01	11	11.78	12	2.93	8	1.99	14	1.43	7	11.25	10
Eastern Bank	1.49	5	13.50	7	3.26	5	2.80	6	1.53	6	5.75	3
Private	*1.06*	*2*	*12.81*	*2*	*2.76*	*3*	*2.55*	*2*	*1.24*	*3*	*2.4*	*2*
Citibank NA	1.58	4	6.25	18	2.30	7	1.99	12	2.36	3	10.25	9
HSBC	2.39	2	10.74	15	4.17	3	1.99	13	0.34	19	8.25	8
Standard chartered	2.98	1	20.46	3	4.61	2	3.64	4	2.62	2	2.5	1
Foreign	*2.32*	*1*	*12.49*	*3*	*3.93*	*1*	*2.54*	*3*	*1.77*	*2*	*2*	*1*
BKB	−2.13	20	5.47	19	2.62	12	0.25	19	0.55	18	17.5	20
PKB	2.02	3	2.65	20	3.61	4	6.38	1	1.17	12	7	6.5
Specialized	*−0.06*	*4*	*4.06*	*4*	*3.11*	*2*	*3.32*	*1*	*0.86*	*4*	*3*	*4*

Table A4.
Earning ability of sampled banks

Name of banks	LA/TA Avg	LA/TA Rank	LA/TD Avg	LA/TD Rank	LA/SL Avg	LA/SL Rank	GS/TA Avg	GS/TA Rank	Group Avg	Group Rank
Janata	86.52	19	106.74	18	1.799	8	22.988	3	12	14
Agrani	89.04	18	114.96	16	3.130	4	23.910	2	10	7.5
Sonali	82.15	20	100.02	19	4.114	2	28.985	1	10.5	10
State-owned	*85.90*	*3*	*107.2*	*4*	*3.01*	*2*	*25.2*	*1*	*2.5*	*3*
Al-Arafah	91.27	15	115.34	15	1.171	18	2.947	17	16.25	20
Pubali	89.61	16	116.16	13	1.647	10	13.070	8	11.75	13
Standard	92.96	10	115.62	14	2.032	7	11.933	10	10.25	9
Dhaka bank	91.48	14	117.41	9	1.205	16	9.878	13	13	18
Prime bank	93.27	8	122.20	7	1.717	9	18.360	5	7.25	3
First security	95.117	3	108.40	17	1.551	13	3.791	16	12.25	15
IFIC bank	94.483	4	116.38	11	1.636	11	10.575	11	9.25	6
DBBL	91.817	12	117.25	10	1.354	15	8.815	14	12.75	17
Premier	94.006	7	116.33	12	1.199	17	12.095	9	11.25	11
BRAC bank	91.727	13	128.38	6	1.612	12	8.438	15	11.5	12
Bank Asia	92.631	11	121.17	8	1.512	14	14.285	7	10	7.5
Eastern Bank	94.273	5	140.18	2	3.465	3	10.466	12	5.5	2
Private	*84.86*	*4*	*119.6*	*3*	*1.68*	*4*	*10.4*	*3*	*3.5*	*4*
Citibank NA	95.815	1	139.45	3	3.026	5	20.788	4	3.25	1
HSBC	94.261	6	135.36	4	1.109	20	0.000	19.5	12.375	16
Standard chartered	95.812	2	130.64	5	1.135	19	18.308	6	8	5
Foreign	*95.30*	*1*	*135.2*	*2*	*1.76*	*3*	*13.1*	*2*	*2*	*1.5*
BKB	89.282	17	100.01	20	2.882	6	0.003	18	15.25	19
PKB	93.110	9	805.39	1	7.983	1	0.000	19.5	7.625	4
Specialized	*91.20*	*2*	*452.7*	*1*	*5.43*	*1*	*0.002*	*4*	*2*	*1.5*

Table A5. Liquidity measurement of sample banks

Name of banks	IRR		EPR		FER		Group	
	Avg	Rank	Avg	Rank	Avg	Rank	Avg	Rank
Janata	133.2	19	1224.3	15	920.4	17	17.0	17.5
Agrani	98.4	16	530.1	13	478.2	13	14.0	15
Sonali	136.5	20	1329.3	16	964.2	18	18.0	19
State-owned	*122.7*	*4*	*1027.9*	*3*	*787.61*	*3*	*3.33*	*3*
Al-Arafah	0.53	2	110.3	8	356.9	11	7.0	6.5
Pubali	34.40	9	991.8	14	612.4	14	12.3	14
Standard	32.10	8	420.2	10	427.4	12	10.0	13
Dhaka bank	51.63	11	7.4	5	170.3	9	8.3	10
Prime bank	2.50	3	89.4	7	287.5	10	6.7	4
First security	11.30	5	78.9	6	138.6	6	5.7	3
IFIC bank	16.19	6	2200.1	20	86.43	2	9.3	11
DBBL	0.00	1	1.3	4	765.3	16	7.0	6.5
Premier	26.97	7	436.2	11	100.1	3	7.0	6.5
BRAC bank	52.00	12	369.0	9	148.2	8	9.7	12
Bank Asia	128.50	18	2105	19	2785	20	19.0	20
Eastern Bank	11.17	4	508.4	12	132.7	5	7.0	6.5
Private	*30.6*	*1*	*609.9*	*2*	*500.94*	*2*	*1.67*	*2*
Citibank NA	58.67	13	0.0	2	24.33	1	5.3	1.5
HSBC	70.00	14	0.0	2	144.0	7	7.7	9
Standard chartered	35.67	10	0.0	2	108.3	4	5.3	1.5
Foreign	*54.8*	*2*	*0.0*	*1*	*92.22*	*1*	*1.33*	*1*
BKB	99.40	17	1920.4	18	723.8	15	16.7	16
PKB	86.20	15	1416.8	17	1206	19	17.0	17.5
Specialized	*92.8*	*3*	*1668.6*	*4*	*965.15*	*4*	*3.67*	*4*

Table A6.
Sensitivity to market risk of sampled banks

Corresponding author
Md. Emran Hossain can be contacted at: emranaerd@gmail.com