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EFFICIENT AND EFFECTIVE OPERATIONS OF COMMERCIAL BANKS IN BANGLADESH : AN EVALUATION

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Abstract

Banking industry plays a significant role in the economic development of Bangladesh. The efficient and effective operations are considered as the key elements to achieve greater business success in banking sector. This study attempts to evaluate operational efficiency and effectiveness, covering 31out of 59 commercial banks in Bangladesh during 2009-2015, using multiple output and input variables applying non parametric (DEA) techniques and parametric statistical tools. The study found that the average technical efficiency under Input Oriented CRS and VRS approaches were 94% and 97% respectively during the study period. The study also revealed that the average scale efficiency was 94% during the study period. The predictable result showed the average technical efficiency scores of 30 banks were bellow standard efficiency level and only 01 bank succeed to obtain average full efficiency score under Input Oriented CRS approach. On the other hand, 9 banks average technical efficiency scores showed their full efficiency and rest of the banks fail to attain average satisfactory efficiency scores under Input Oriented VRS approach which implied inefficiency of operations. According to the results, profitable banks are operating at higher level of efficiency. The study suggests that the inefficient banks should improve loan recovery strategies and reduce their annual expenditures within reasonable extent. Finally, some suggestions and recommendations have been provided to run the banking industry with efficient and effective operations that ensure the sector with sound position.

Key words: DEA, commercial banks, efficiency, effectiveness, operations, CRS, VRS, Bangladesh

Introduction

Banking industry is one of the most vivacious and growing industry of Bangladesh governed by the Central Bank named Bangladesh Bank. In Bangladesh, currently 59 Scheduled and 5 nonscheduled banks are operating their functions for strengthening the

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economy. Among these there are 54 commercial banks in which 6 are National Commercial Banks, 31 local conventional private commercial banks, 08 Islamic Shariah based commercial banks and 9 foreign commercial banks (Bangladesh Bank, 2016). Commercial banks have been contributing as one of the most dominating factors in the financial sector of Bangladesh. Bangladeshi bank industry has been significantly developed over last few years. Banks play a significant role in serving the society representing a crucial position in the process of promoting economic growth which leads to the attention of measuring bank performance over past several years (Wanke *et al*., 2015). Efficiency and effectiveness is well thought-out as the key fundamentals to achieve greater business performance and a better decision making (Lu and Hung, 2011).Banks managers are assigned to select and develop techniques to provide banking services, marketing, human resource management, customer management and competition with other banks and mainly increasing productivity and efficiency of the banks for the financial condition, and lack of inputs, technology and production factors (Jelodar, 2016).

Considering the importance of commercial bank in economic activities the investigation on the efficient and effective operations become more important, hence the studies relating to this issues have been increased in developing and emerging economies (Roghanian, 2012). Efficiency is oriented in the direction of successful input makeover into outputs and effectiveness measures how outputs interact with the social and financial environment (Bartuseviciene and Sakalyte, 2013). Efficiency is how well a system is functioning for generating the maximum outputs at a given input (Alrafadi *et al*., 2016) and they mentioned that efficiency of banking industry is the most important terms in financial market because this efficiency can affect in the stability of banking sector and the effectiveness of a country's whole monetary system. Technical efficiency means the ability of an organization to attain maximum output from a given set of inputs and allocative efficiency measures the ability of a firm to utilize the inputs in discretionary proportions, given their production technology and prices and then combination of these two efficiencies is termed as overall economic efficiency (Kocisova, 2014). In addition, technological development, the globalization of financial services and deregulation of banking industry forces banks to be vulnerable to upgraded pressure of competitive (Kadir *et al*., 2011). Recently several new commercial banks have entered in the market which creates a strong competition among the commercial banks in Bangladesh. The competition among the banks has increased mainly due to market liberation, technological developments and the entrance of non-banking institutions. These new environmental forces all the commercial banks to improve their performance to raise their profitability. For this reason invertors, government and all other stakeholder are always concerned regarding the performance and efficiency of commercial banks. Efficiency of banking sector enables a country domestically and internationally more competitive and

helps in generating more income and employment opportunities (Uddin and Bristy, 2014). So, the central purpose of this study is to evaluate the efficient and effective operations of commercial banks in Bangladesh during 2009-2015 by applying a nonparametric approach (DEA) and other parametric statistical tools. However, the study also evaluates the relationship between efficiency scores that will be calculated by DEA and partial productivity among the selected banks competing in the banking business in Bangladesh. The memento of the study is designed as follows. In the next section literature review of prior similar studies are presented, objectives and hypothesis are developed. After that methodology and suggested DEA approach are described. Then the next section is analyzing results and discussion. Finally, the last section represents the conclusions and policy connotation from the results obtained. Though, the issue efficiency and effectiveness measurement of bank as a control device has got huge attention in last few decades, there is no doubt that most of the studies related to this issue were done in the context of the developed countries in the world. *Practice of DEA for efficiency measurement is not popular in Bangladesh.* Some of the prior studies relating to these issues are specified below: Bank efficiency is measured by the ability of individual banks to maximize output given a certain level of input. Efficiency measurement serves as an early warning or benchmark of its operational performance which can define future improvement in many areas. Banking industry uses two approaches of DEA that are production or intermediation approach. Production approach highlights banks as delivering services in the form of transaction and intermediation approach states that bank intermediate funds between surplus units to deficit units (Othman *et al*., 2016).

Yannicka *et al*. (2016) used DEA approach to address the topics of transform of deposit into credits efficiently of 14 banks of Cote d'Ivoire during the year 2008-2010. Using the main two approaches of DEA, the study found that the Ivorian banks do not perform efficiently in case of loan allocation and the foreign ownership banks are more efficient than that of public ones. The study claimed that the source of inefficiency affect to an incompatibility of production scale. Sufian (2016) first used DEA to measure efficiency of individual banks during 1999-2008 in Malaysia and secondly used panel regression to test the impact of ownership of bank on efficiency. On the basis of DEA efficiency scores they indicated an increase in efficiency during the study period and the panel regression showed that productivity efficiency is positive linked to bank size, foreign ownership and capitalization. Adhegaonar (2015) measured efficiency of 19 Indian commercial banks using DEA and Tobit regression analysis during 2010-2013. Data were analyzed with the help of R-software. They found that the overall average technical and scale efficiency varies under CRS and VRS method for each year under review. They also found that the Tobit regression model has positively related with all independent variable except non-performing assets.

Agarwal *et al*. (2014) used DEA method for measuring performance of 18 Indian banks during the period 204-2013. They claimed that private sector banks are performing well than that of public sectors banks and indicating the possibility of further improvisation for the public sector banks. Financial organizations around the world have changed over the last few years. It was argued that technological progress reduced information costs both for bank and non –bank financial institutions and ongoing deregulation all led to change in various financial systems (Haque and Rayhan, 2013). They attempted to rank some of Bangladeshi banks and most efficient bank was identified on the basis of efficiency score using DEA approach (Akther *et al*., 2013) examined the performance of 31 banks in Bangladesh during 2005-2008 using slacks- based inefficiency measure and found that the current period performance to maximize expected loans and securities investments and minimizing bad loans depends on how efficiently inputs are transformed into outputs. They also found that current period outputs were constrained due to non-performing loans. Maletic *et al*. (2013) used DEA technique to measure operation efficiency of Serbia's banking sector. The efficient banks were measured using different input- output variables following comparative analysis of the results applying BCG matrix. They ranked the selected banks according their efficiency (Ar and Kurtaran, 2013) claimed that banks which are not efficient should improve their non-cash loan and focus on their annual expenditure. They tried to measure the relative's efficiency of 13 commercial banks in Turkey for the year 2011 using the DEA approach taking two outputs and four inputs variables. They found that the state owned banks were more efficient as compared to foreign-owned commercial banks. In addition the above many DEA studies analyze bank efficiency (Hakos *et al*., 2004; Li, 2005; Kao and Liu, 2013; Yu *et al*., 2012; Dadashi *et al*., 2013; Chansaran, 2008). Dekker and Post (2001) opinioned that there is not an acceptable model for the technology for providing bank service and products. Very few studies were done related to the developing countries and especially in context of Bangladesh. In addition, none of the studies mentioned above show the relationship between efficiency scores and partial productivity. Considering the research gap, we undertake this study to measure efficiency of Bangladeshi commercial banks using DEA (non parametric) and other parametric statistical tools.

The study attempts to measure the extent of efficiency and effectiveness of selected banks and to find outcomes and effects of banking sector in Bangladesh. The specific objectives of the study are considered as below: (i) to make an understanding of the banking sector regarding effectiveness and efficiency during the study period; (ii) to identify the input factors that are related to outputs of the selected banks; (iii) to find out the cause and effect of effectiveness and efficient use of inputs to achieve better outputs during the study period; and(iv) to provide suggestions and recommendations for the betterment of the banking sector in Bangladesh.

Hypothesis of the study

1. There is no positive correlation of each of the partial productivity of inputs with efficiency scores obtained by DEA.
2. There are no differences among the banks and selected periods of the study regarding efficiency scores obtained by DEA.

Materials and Methods

For the study, only commercial banks have been selected where all the product and services are analogous that helped us to compare among the banks more transparently. There are 54 commercial banks operating in Bangladesh (Bangladesh Bank, 2016). Among them 31 banks has been selected under simple random sampling technique that covers 57.40% of study population. The secondary data were collected from the annual performance reports published by the individual banks. The study covers seven years period from 2009 to 2015. We applied both non-parametric and parametric statistical techniques to reach the objectives of the study.

We used DEA (non parametric technique) to measure the technical and scale efficiency of the selected banks under input oriented Constant Return to Scale (CRS) and Variable Return to Scale (VRS) approach. We also used correlation, arithmetic mean, minimum, maximum, co- efficient of variance and ANOVA (parametric techniques) to make the articles easier and more understanding. In practical, the accurate measurement of input and output variables is difficult for the different nature of business. Factors connected with direct cost to the firm are good to have as input and revenues/ profit reflected the goal of the firm should taken as output. In banking study there are two different approaches of selecting input and output variables of DEA named as operating approach and intermediation approach (Haque and Tariq, 2012).We have taken interest/investment income (x_1) and non- interest income (x_2) as two output variables and investment (Y_1), loan and advances (Y_2),fixed assets(Y_3),operating expenses(Y_4) and Share holder's Equity(Y_5) as five input variables after considering the correlation among the input and output variables of the selected banks.Table-1 shows the descriptive Statistics of Selected Outputs and Inputs Variables of sample banks and table-2 Correlation coefficient among the outputs and input variables during the year 2009-2015.

DEA: Data Envelopment Analysis (DEA) is a non-parametric mathematical programming approach to frontier estimation and is a powerful service management technique developed by Charnes, Cooper and Rhodes (1978) to evaluate non-profit and public sector organizations. DEA is well established as theoretically sound framework for conducting efficiency measurement to multi-dimensional system perspective (Lu and Hung, 2011). This DEA technique is mainly applied in banks, supermarkets, hospitals,

schools, public universities, public libraries and so forth. DEA involves the use of linear programming methods to construct a non-parametric piecewise surface (or frontier) over the data so as to be able to calculate efficiencies relative to this surface (Coelli, 2005). DEA is used to measure the technical efficiency of homogenous production units termed as Decision Making Units (DMU) and technical efficiency is the ratio of weighted sum of outputs to the weighted sum of inputs (Flegg *et al.*, 2003). DEA approach helps us to design a virtual (Hypothetical) unit for each of inefficient unit and virtual units are a part of efficient frontier and are calculated as a the combination of selected efficient units called as peer units or peer. CCR (Charnes, Cooper and Rhodes) model and BCC (Banker, Charnes and Cooper) model are two basic models of DEA. CCR model assuming constant returns to scale and BCC model assuming variable returns to scale and all of the method can be input- and output-oriented (Mikosova, 2015). The input and output oriented measures will only provide equivalent measures of technical efficiency when constant returns to scale exist, but will be unequal when variable returns to scale are present (Fare and Lovell, 1978). In DEA analysis logically sequencing there are some units regarded as efficient and in turn, some of these are considered non efficient (Alrafadi *et al*., 2016). According to DEA approach a DMU will be called efficient only when the optimal value of efficiency is equal to 1 and the inefficient units have value of efficiency less than 1. This study utilizes input oriented CRS and VRS approach where DMUs deemed to produce optimum amount of output with a proportional reduction on inputs usage and their proper utilization.

Table 1. Descriptive Statistics of Selected Outputs and Inputs Variable of sample banks (DMUs) **Tk. (in millions)**

Particulars	Outputs		Inputs				
	x_1	x_2	Y_1	Y_2	Y_3	Y_4	Y_5
Average	3672.34	4826.84	28565.45	111071.22	3760.76	3889.75	16221.46
Max.	15011.00	16736.03	136823.45	349069.37	11814.55	9071.67	46670.68
Min.	590.66	721.17	4775.43	56589.94	470.57	1547.30	5551.42
C.V	70.41	69.27	100.15	55.86	79.22	53.06	70.85

Source: Calculated from annual reports during the periods 2009-2015, the number of banks, N=31

This table shows the descriptive statistics of the selected outputs and inputs variables of the selected sample banks for the year 2009-2015. The outputs variables are taken as interest /investment income (x_1) and non- interest income (x_2). The inputs variables have been selected as investment (Y_1), loan and advances (Y_2), fixed assets (Y_3), operating expenses (Y_4) and Share holder Equity (Y_5). The average, the maximum level (Max.), the minimum level (Min) and co-efficient of variation (C.V) of the selected outputs and inputs variables have been furnished in the above mentioned Table 1.

Table 2. Correlation coefficient among the outputs and input variables

Variables	Output variables		Input variables				
	x_1	x_2	Y_1	Y_2	Y_3	Y_4	Y_5
Interest/investment income (x_1)	1.000						
Non- Interest Income (x_2)	0.229	1.000					
Investment(Y_1)	0.130	0.961**	1.000				
Loan and advanced (Y_2)	0.733**	0.703**	0.689**	1.000			
Fixed Assets (Y_3)	0.505**	0.689**	0.694**	0.759**	1.000		
Operating Expenses (Y_4)	0.640**	0.799**	0.697**	0.803**	0.751**	1.000	
Shareholders' Equity (Y_5)	0.436*	0.599**	0.519**	0.612**	0.493**	0.728**	1.000

Source: Calculated from annual reports during the periods 2009-2015, the number of banks, N=31

**Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

The above table depicts the correlation coefficient among the outputs and input variables. In the above table we see that the output variable Interest income (x_1) has significant correlation with input variables Loan and advanced (Y_2), Fixed Assets (Y_3), Operating Expenses (Y_4) at the 1% level and with Shareholders' Equity (Y_5) at the 5% level. The output variable Interest income (x_1) has also insignificance correlation with Non-Interest/ Investment Income (x_2) and Investment (Y_1). On the other hand the output variable Non-Interest Income (x_2) has significant correlation with all input variables at the 1% level. The input variable Loan and advanced (Y_2) has significant correlation with input variables Fixed Assets (Y_3), Operating Expenses (Y_4) and Shareholders' Equity (Y_5) at the 1% level. The table also indicates that the input variable Operating Expense (Y_4) has significant correlation with input variable Shareholders' Equity (Y_5) at the 1% level.

Results and Discussion

The above mentioned Table 3 depicts the measurement of technical efficiency scores of selected sample banks under DEA, input oriented constant return to scale (CRS) approach during the period under review. The input oriented measures told us how much input quantities can be proportionally reduced without changing the output quantities produced. The decision making units (DMUs) AABL, FSIBL, NBL and JBL were found to be showed technical efficiency scores one six times out of seven years of the study period. On the other hand technical inefficiency scores are found for the ABBL and RBL where these two DMUs are failed to attain the efficiency score one during the study period. Moreover the increasing efficiency trend has been found for the sample banks during the study period.

Table 3.Technical Efficiency under Input Oriented CRS Approach

DMUs	2009	2010	2011	2012	2013	2014	2015	Mean	Maxi.		Min.	C.V	Total Peers	Rank.
									Score	Time				
SHIBL	0.92	1.00	0.97	1.00	0.93	0.85	0.82	0.93	1.00	2.00	0.82	7.62	8.00	25
ISBL	0.93	1.00	1.00	1.00	0.98	0.90	0.84	0.95	1.00	3.00	0.84	6.57	4.00	17(4)
AABL	0.95	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	6.00	0.95	1.90	40.00	2(40)
FSIBL	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	1.00	6.00	0.98	0.76	19.00	1
SIBL	1.00	1.00	0.92	1.00	0.91	1.00	1.00	0.98	1.00	5.00	0.91	4.26	30.00	10
TBL	0.88	0.93	1.00	0.88	1.00	1.00	1.00	0.96	1.00	4.00	0.88	6.04	9.00	15
MTBL	0.96	0.89	0.88	0.73	1.00	1.00	0.78	0.89	1.00	2.00	0.73	11.84	5.00	27
EBL	0.82	0.82	0.89	1.00	1.00	1.00	1.00	0.93	1.00	4.00	0.82	9.32	16.00	23
EXBL	1.00	1.00	1.00	1.00	1.00	0.86	0.94	0.97	1.00	5.00	0.86	5.56	27.00	12
PBL	1.00	0.82	0.98	1.00	0.94	0.92	1.00	0.95	.1.00	3.00	0.82	6.96	3.00	16
CBL	1.00	1.00	0.96	0.99	0.98	0.91	1.00	0.98	1.00	3.00	0.91	3.38	1.00	8
BAL	0.89	0.88	0.80	0.98	1.00	1.00	0.96	0.93	1.00	2.00	0.80	8.12	9.00	24
PRBL	0.80	1.00	0.88	0.76	0.80	0.84	0.70	0.83	1.00	1.00	0.70	11.59	1.00	29
DBBL	0.91	0.74	1.00	1.00	1.00	1.00	1.00	0.95	1.00	5.00	0.74	10.37	12.00	17(12)
DBL	1.00	0.96	1.00	0.86	0.94	0.99	0.97	0.96	1.00	2.00	0.86	5.14	11.00	14
BBL	0.92	0.95	1.00	1.00	1.00	1.00	1.00	0.98	1.00	5.00	0.92	3.35	32.00	5
UBL	0.96	0.79	1.00	1.00	1.00	1.00	1.00	0.96	1.00	5.00	0.79	8.12	16.00	13
MBL	0.84	0.82	0.99	0.79	1.00	0.90	0.83	0.88	1.00	1.00	0.79	9.57	7.00	28
ABBL	0.62	0.54	0.79	0.89	0.89	0.96	0.83	0.79	0.96	0.00	0.54	19.50	0.00	30
STBL	1.00	0.99	1.00	1.00	1.00	0.97	0.88	0.98	1.00	4.00	0.88	4.53	4.00	8
SEBL	1.00	1.00	1.00	1.00	0.76	0.88	1.00	0.95	1.00	5.00	0.76	9.95	32.00	19
NBL	0.86	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	6.00	0.86	5.40	26.00	6
PBL	0.99	0.65	1.00	1.00	1.00	1.00	0.98	0.95	1.00	4.00	0.65	13.81	6.00	20
OBL	0.99	1.00	1.00	0.89	0.94	1.00	1.00	0.97	1.00	4.00	0.89	4.43	13.00	11
NCCBL	1.00	0.90	0.87	0.99	1.00	0.95	0.91	0.95	1.00	2.00	0.87	5.62	13.00	21
UCBL	0.84	0.80	0.88	0.90	1.00	1.00	0.96	0.91	1.00	2.00	0.80	8.58	2.00	26
IFICBL	1.00	1.00	1.00	1.00	0.88	0.87	0.80	0.94	1.00	4.00	0.80	8.98	27.00	22
BABL	1.00	0.91	1.00	1.00	0.96	0.98	1.00	0.98	1.00	4.00	0.91	3.46	4.00	7
RBL	0.69	0.50	0.89	0.83	0.71	0.93	0.93	0.78	0.93	0.00	0.50	20.26	0.00	31
JBL	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.99	1.00	6.00	0.95	1.90	21.00	2(21)
ABL	0.93	0.97	1.00	1.00	1.00	1.00	1.00	0.99	1.00	5.00	0.93	2.74	8.00	4
Mean	0.93	0.90	0.96	0.95	0.96	0.96	0.94	0.94						
Max. Score	1.00	1.00	1.00	1.00	1.00	1.00	1.00							
Max. Time	12.00	12.00	17.00	19.00	18.00	16.00	16.00							
Mini.	0.62	0.50	0.79	0.73	0.71	0.84	0.70							
C.V	10.36	15.25	6.66	8.56	7.95	5.72	9.05							

Source: Computed from original data of banks annual reports during the period 2009-2015 using DEA version2.1. N=31

The C.V of the sample period of efficiency scores are shown highest (15.25%) in 2010 and for the unit RBL (20.26%) indicating that less uniformity to attain desired efficiency score of the period and units respectively. On the other hand the C.V of efficiency scores of the unit FSIBL is the least by 0.76 percentages and among the period the least C.V is found in 2014 by 5.72 percentages showing the more consistency among the units and periods respectively regarding efficiency scores. The study ranked the banks on the basis of average technical efficiency scores and also used total number of peers count during study period to rank the banks whose average technical efficiency scores were same under input oriented CRS and VRS approaches. For the banks whose technical efficiency scores are same, we rank the bank upper position whose total number of peers was more than the others. On the basis of the set criteria the FSIBL stood first and RBL last position among the selected banks under input oriented CRS approach. It is to be noted that the AABL and JBL attained the same position (2^{nd}) on the basis of average technical efficiency scores but the position of AABL is upper than that of JBL, because total number of peer counted for AABL (40) is more than the total number of peer counted for JBL (21) and vice- versa.

Table 4 delineates the enumeration of technical efficiency scores of the selected banks under DEA, input oriented variable return to scale (VRS) approach during the study period. The input oriented VRS approach is used assuming that all the DMU are not operating at the optimal scale. Technically efficiency score under VRS approach had been founded for RBL one (1), one times out of seven years of the study period which showed the inefficiency for this DMU for rest of the six years. In addition to the technical efficiency scores for the DMUs ABBL, BAL and MBL were found one (1), only two times out of the study periods this indicated that they were technically efficient only for two years among the study periods. On the other hand the DMUs SHIBL, ISBL, AABL, FSIBL, SIBL, BABL, STBL, OBL, JBL and ABL were found to be showed technical efficiency scores one (1), all the years under reviewed which definitely indicated their technical efficiencies and operating successes. Moreover the fluctuating efficiency trend had been founded for the sample banks during the study periods. The C.V of efficiency scores of the DMUs SHIBL, AABL, FSIBL, SIBL, BBL, STBL, OBL, JBL and ABL were the 0.00 percentage and among the period the least C.V was found in 2015 by 4.24 percentages indicating more uniformity among the units and periods respectively regarding the efficiency scores. On other hand the C.V of the study periods of efficiency scores were shown highest 10.60 percentages in 2011 and for the DMU RBL by 20.52 percentages showing the less consistency to capture efficiency score of the period and units respectively. On the basis of average technical efficiency scores and total number of peer count the SIBL NBL stood 1^{st} and 2^{nd} position respectively and RBL took last position among the selected banks under input oriented VRS approach.

Table 4. Technical Efficiency under Input Oriented VRS Approach

DMUs	2009	2010	2011	2012	2013	2014	2015	Mean	Max.		Min.	C.V	Total Peer	Rank
									Score	Time				
SHIBL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00	1.00	0.00	4.00	1(4)
ISBL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00	1.00	0.00	12.00	1(12)
AABL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00	1.00	0.00	12.00	1(12)
FSIBL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00	1.00	0.00	13.00	1(13)
SIBL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00	1.00	0.00	19.00	1(19)
TBL	0.95	0.92	1.00	1.00	1.00	1.00	1.00	0.98	1.00	5.00	0.92	3.35	4.00	19(4)
MTBL	1.00	0.91	1.00	1.00	1.00	1.00	1.00	0.99	1.00	6.00	0.91	3.45	6.00	15(6)
EBL	1.00	0.95	0.92	1.00	1.00	1.00	1.00	0.98	1.00	5.00	0.92	3.35	6.00	19(6)
EXBL	1.00	1.00	1.00	1.00	1.00	0.87	0.99	0.98	1.00	5.00	0.87	4.96	14.00	22
PBL	1.00	1.00	1.00	1.00	1.00	0.92	1.00	0.99	1.00	6.00	0.92	3.06	5.00	14
CBL	1.00	1.00	0.99	1.00	1.00	0.92	1.00	0.99	1.00	5.00	0.92	3.02	2.00	15(2)
BAL	0.93	0.92	0.83	0.98	1.00	1.00	0.99	0.95	1.00	2.00	0.83	6.55	4.00	28
PRBL	0.84	1.00	0.96	1.00	1.00	1.00	1.00	0.97	1.00	5.00	0.84	6.01	2.00	24
DBBL	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.99	1.00	6.00	0.95	1.90	9.00	11(9)
DBL	1.00	0.98	1.00	0.90	0.96	1.00	1.00	0.98	1.00	4.00	0.90	3.82	9.00	23
BBL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00	1.00	0.00	16.00	1(16)
UBL	1.00	0.87	1.00	1.00	1.00	1.00	1.00	0.98	1.00	6.00	0.87	5.01	12.00	19(12)
MBL	0.85	0.83	1.00	0.85	1.00	0.91	0.94	0.91	1.00	2.00	0.83	7.85	4.00	29
ABBL	0.82	0.68	0.80	0.89	0.95	1.00	0.83	0.85	1.00	1.00	0.68	12.37	1.00	30
STBL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00	1.00	0.00	10.00	1(10)
SEBL	1.00	1.00	1.00	1.00	0.77	0.90	1.00	0.95	1.00	5.00	0.77	9.32	13.00	27
NBL	0.95	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	6.00	0.95	1.90	16.00	1(16)
PBL	1.00	0.91	1.00	1.00	1.00	1.00	0.99	0.99	1.00	5.00	0.91	3.41	2.00	17
OBL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00	1.00	0.00	15.00	1(15)
NCCBL	1.00	0.90	0.99	1.00	1.00	1.00	1.00	0.98	1.00	5.00	0.90	3.79	7.00	18
UCBL	1.00	0.94	0.88	0.91	1.00	1.00	1.00	0.96	1.00	4.00	0.88	5.32	0.00	25
IFICBL	1.00	1.00	1.00	1.00	0.95	0.87	0.88	0.96	1.00	4.00	0.87	6.17	12.00	26
BABL	1.00	0.94	1.00	1.00	1.00	1.00	1.00	0.99	1.00	6.00	0.94	2.29	2.00	13
RBL	0.73	0.53	0.94	0.83	0.77	1.00	1.00	0.83	1.00	2.00	0.53	20.52	0.00	31
JBL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00	1.00	0.00	7.00	1(7)
ABL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00	1.00	0.00	11.00	1(11)
Mean	0.97	0.94	0.98	0.98	0.98	0.98	0.99	.97						
Max. Score	1.00	1.00	1.00	1.00	1.00	1.00	1.00							
Max. Time	24.00	17.00	23.00	25.00	26.00	25.00	25.00							
Mini	0.73	0.53	0.80	0.83	0.77	0.87	0.83							
CV	937	7.098	10.6	5.264	4.88	5.913	4.243							

Source: Computed from original data of banks annual reports during the period 2009-2015 using DEA version2.1. N=31, Note: irs=increasing returns scale, drs=decreasing return scale

Table 5. Scale Efficiency under VRS Approach

Bank	2009	2010	2011	2012	2013	2014	2015	Mean	Max.		Mini.	CV
									Score	Time		
SHIBL	0.92 irs	1.00	0.97 irs	1.00	0.93 irs	0.85 irs	0.82 irs	0.93	1.00	2.00	0.82	7.62
ISBL	0.93drs	1.00	1.00	1.00	0.98drs	0.9 drs	0.84 drs	0.95	1.00	3.00	0.84	6.57
AABL	0.95 irs	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	6.00	0.95	1.90
FSIBL	1.00	1.00	0.98irs	1.00	1.00	1.00	1.00	1.00	1.00	6.00	0.98	0.76
SIBL	1.00	1.00	0.92irs	1.00	0.91	1.00	1.00	0.98	1.00	5.00	0.91	4.26
TBL	0.88 irs	0.93 irs	1.00	0.88irs	1.00	1.00	1.00	0.96	1.00	4.00	0.88	6.04
MTBL	0.96 irs	0.89 irs	0.88irs	0.73irs	1.00	1.00	0.78 irs	0.89	1.00	2.00	0.73	11.4
EBL	0.82 irs	0.82 drs	0.89irs	1.00	1.00	1.00	1.00	0.93	1.00	3.00	0.82	9.32
EXBL	1.00	1.00	1.00	1.00	1.00	0.86 drs	0.94 drs	0.97	1.00	5.00	0.86	5.56
PBL	1.00	0.82 drs	0.98drs	1.00	0.94drs	0.92 drs	1.00	0.95	1.00	3.00	0.82	6.96
CBL	1.00	1.00	0.96 irs	0.99irs	0.98 irs	0.91 irs	1.00	0.98	1.00	3.00	0.91	3.38
BAL	0.89drs	0.88 drs	0.8 irs	0.98drs	1.00	1.00	0.96 irs	0.93	1.00	2.00	0.80	8.12
PRBL	0.8 irs	1.00	0.88 irs	0.76irs	0.8 irs	0.84 irs	0.7 irs	0.83	1.00	1.00	0.70	11.59
DBBL	0.91drs	0.74 drs	1.00	1.00	1.00	1.00	1.00	0.95	1.00	5.00	0.74	10.37
DBL	1.00	0.96 drs	1.00	0.86 irs	0.94 irs	0.99 irs	0.97 irs	0.96	1.00	2.00	0.86	5.14
BBL	0.92drs	0.95 drs	1.00	1.00	1.00	1.00	1.00	0.98	1.00	5.00	0.92	3.35
UBL	0.96drs	0.79 drs	1.00	1.00	1.00	1.00	1.00	0.96	1.00	5.00	0.79	8.12
MBL	0.84drs	0.82 irs	0.99 irs	0.79 irs	1.00	0.9 irs	0.83 irs	0.88	1.00	1.00	0.79	9.57
ABBL	0.62drs	0.54 drs	0.79 irs	0.89	0.89drs	0.96 drs	0.83 irs	0.79	0.96	0.00	0.54	19.50
STBL	1.00	0.99 irs	1.00	1.00	1.00	0.97 irs	0.88 irs	0.98	1.00	4.00	0.88	4.53
SEBL	1.00	1.00	1.00	1.00	0.76drs	0.88 irs	1.00	0.95	1.00	5.00	0.76	9.95
NBL	0.86drs	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	6.00	0.86	5.40
PBL	0.99drs	0.65drs	1.00	1.00	1.00	1.00	0.98 drs	0.95	1.00	4.00	0.65	13.81
OBL	0.99 irs	1.00	1.00	0.89 irs	0.94 irs	1.00	1.00	0.97	1.00	4.00	0.89	4.43
NCCBL	1.00	0.9 drs	0.87 irs	0.99 irs	1.00	0.95 irs	0.91 irs	0.95	1.00	2.00	0.87	5.62
UCBL	0.84drs	0.8 drs	0.88 irs	.90 drs	1.00	1.00	0.96 drs	0.91	1.00	2.00	0.80	8.58
IFICBL	1.00	1.00	1.00	1.00	0.88 irs	0.87 irs	0.8 irs	0.94	1.00	4.00	0.80	8.98
BABL	1.00	0.91 drs	1.00	1.00	0.96 irs	0.98 irs	1.00	0.98	1.00	4.00	0.91	3.46
RBL	0.69drs	0.5 drs	0.89 irs	0.83 irs	0.71 irs	0.93 irs	0.93 irs	0.78	0.93	0.00	0.50	20.26
JBL	1.00	0.95 drs	1.00	1.00	1.00	1.00	1.00	0.99	1.00	6.00	0.95	1.90
ABL	0.93drs	0.97 drs	1.00	1.00	1.00	1.00	1.00	0.99	1.00	5.00	0.93	2.74
Mean	0.93	0.90	0.96	0.95	0.96	0.96	0.94	.94				
Max. score	1.00	1.00	1.00	1.00	1.00	1.00	1.00					
Max. Time	12.00	12.00	17.00	19.00	18.00	16.00	16.00					
Min	0.62	0.50	0.79	0.73	0.71	0.84	0.70					
CV	10.36	15.25	6.66	8.56	7.95	5.72	9.05					

Source: Computed from original data of banks annual reports during the period 2009-2015 using DEA version2.1. N=31

The above Table 5 depicts the result of scale efficiency scores of selected banks under input oriented VRS approach during the study periods. Scale efficiency was calculated from the difference between the VRS technical efficiency and CRS technical efficiency score. Scale efficiency does not indicate whether the DMU is operating in an area of increasing or the decreasing returns to scale. The scale efficiency scores for the decision making units DMUs AABL, FSIBL, NBL and JBL were found one (1), six time out of seven years of the study period. On the other hand the scale efficiency for the DMUs ABBL & RBL were failed to reach the efficiency level one (1) during the study period.

Table 6. There is no positive correlation of each of the partial productivity of inputs with efficiency scores obtained by DEA (CRS approach)

	Mean technical efficiency	*PP-y_1*	*PP-y_2*	*PP-y_3*	*PP-y_4*	*PP-y_5*
Mean technical efficiency	1.00					
PP-y_1	0.26	1.00				
PP-y_2	0.06	0.12	1.00			
PP-y_3	0.29	0.09	0.02	1.00		
PP-y_4	0.19	0.44	0.17	0.10	1.00	
PP-y_5	-0.04	0.29	0.48	0.10	0.13	1.00

Source: Calculated from the partial productivity of selected variables of the banks.
Where PP= Partial Productivity

The trend of scale efficiency is moderately increased during the study period. The C.V of the sample period of efficiency scores are shown highest (15.25%) in 2010 and for the unit Rupali bank (20.26%) indicating that less uniformity to attain desired efficiency score of the period and units respectively. On the other hand the C.V of efficiency scores of the unit First security islami bank is the least by 0.76 percentages and among the period the least C.V is found in 2014 by 5.72 percentages showing the more consistency among the units and periods respectively regarding efficiency scores.

Table 7. There is no positive correlation of each of the partial productivity of inputs with efficiency scores obtained by DEA (VRS approach).

	Mean technical efficiency	*PP-y_1*	*PP-y_2*	*PP-y_3*	*PP-y_4*	*PP-y_5*
Mean technical efficiency	1.00					
PP-y_1	0.30	1.00				
PP-y_2	0.13	0.12	1.00			
PP-y_3	0.32	0.09	0.02	1.00		
PP-y_4	0.21	0.44	0.17	0.10	1.00	
PP-y_5	0.09	0.29	0.48	0.10	0.13	1.00

Source: Calculated from the partial productivity of selected variables of the banks.
Where PP= Partial Productivity. Partial productivity measures are simple and operational measures as it may contribute to a set of performance indicators (Rushdi, 2009).

The table shows the correlation analysis of partial productivity and efficiency scores of the selected banks under input oriented CRS approach. There is a positive correlation of each of the variables named partial productivity of investment (PP-y_1), partial productivity of loan and advanced (PP-y_2), partial productivity of fixed assets (PP-y_3), partial productivity of operating expenses (PP-y_4) with technical efficiency score by the degree of 0.26, 0.06, 0.29, 0.19 respectively except the variable partial productivity of owner's equity (PP-Y^5) by -0.04. Hence the hypothesis is rejected for each of the variable except partial productivity of owner's equity.

The table depicts the correlation analysis of partial productivity and efficiency scores of the selected banks under input oriented VRS approach. There is a positive correlation of each of the variables named partial productivity of investment (PP-y_1), partial productivity of loan and advanced (PP-y_2), partial productivity of fixed assets (PP-y_3), partial productivity of operating expenses (PP-y_4) and partial productivity of owner's equity (PP-Y^5) with technical efficiency score by the degree of 0.30, 0.13, 0.32, 0.21 and 0.09 respectively. Hence the hypothesis is rejected for each of the variables.

Table 8. There are no differences among the banks and selected periods of the study regarding efficiency scores obtained by DEA (ANOVA model CRS approach).

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Banks	0.64	30	0.02	3.83	0.00	1.52
Periods	0.09	6	0.02	2.83	0.01	2.15
Error	1.00	180	0.01			
Total	1.73	216				

Source: Calculated from Table no.3

This table shows the ANOVA among the banks and selected periods of study regarding efficiency scores under DEA (input oriented CRS approach).The calculated value of F-ratio for banks and selected periods of study are F(3.83) and F(2.83) are greater than critical values of F(1.52) and F(2.15) respectively. So there are significance differences among banks and selected years of study periods regarding efficiency scores obtained by DEA (input oriented CRS approach). Hence the hypothesis is rejected.

Table 9. There are no differences among the banks and selected periods of the study regarding efficiency scores obtained by DEA (ANOVA model VRS approach)

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Banks	0.35	30	0.01	4.68	0.00	1.52
Periods	0.04	6	0.01	2.69	0.02	2.15
Error	0.45	180	0.00			
Total	0.84	216				

Source: Calculated from table. no 4.

This table depicts the ANOVA among the banks and selected periods of study regarding efficiency scores under DEA (input oriented VRS approach). The calculated value of F-ratio for banks and selected periods of study are F(4.68) and F(2.69) are greater than critical values of F(1.52) and F(2.15) respectively. So there are significance differences among banks and selected years of study periods regarding efficiency scores obtained by DEA (input oriented VRS approach). Hence the null hypothesis is rejected.

Conclusion

The study examined the efficient and effective operations of 31 commercial banks operating in the study period 2009-2015 by using DEA technique. To achieve this goal several definitions of efficiency and effectiveness were explored and some other important issues regarding banking efficiencies were identified. Finally the gap of the study was found. The study obtained the efficiency scores for selected 31 banks of the study periods. The results revealed that under input oriented CRS approach the AABL, FSIBL, NBL and JBL banks were technically efficient and ABBL and RBL were technically inefficient during the study period. Under input oriented VRS approach the DMUs SHIBL, ISBL, AABL, FSIBL, SIBL, BABL, STBL, OBL, JBL and ABL were found technically significant and the DMUs RBL. ABBL, BAL and MBL were technically inefficient during the study period. The study ranked the banks on the basis of efficiency scores and also ranked the banks whose efficiency scores were same on the basis of total number of peer count during study period. Under input oriented CRS approach the DMU FSIBL ranked as top and the DMURBL as last position among the selected DMUs .Under input oriented VRS approach the DMU SIBL stood first and the DMU RBL stood last position among the selected DMUs. The finding also showed that there was a positive relationship between efficiency scores and partial productivity and a difference was found among the banks and selected period of the study regarding efficiency scores obtained by DEA. A wide variation in efficiency scores of selected banks were found under input oriented VRS approach but increasing efficiency trend was found under input oriented CRS approach through the study period. The study expects that the concern authorities of selected banks, policymakers, competitors and other stakeholders will get a precise overview of the operational efficiency trend of the selected banks that will assist them to take necessary steps as their requirements. This study makes a new direction for future research in Bangladesh since the proposed methodological tools can be employed as benchmarking for other industries. Bank management can consider the results of the study as useful tools to assess their performance. It is mentioned that this study just evaluated the relative efficiency of Bangladeshi banks not absolute efficiency, indicating the selected banks to be considered as efficient just the best bank in comparison to other banks in the study. So there is a possibility of efficient banks to be ranked in lower or upper one when new banks are added to the study. It should be mentioned that the limitation of DEA technique is that it

rely on accounting data and not on market value. To survive in the competitive market banks should strive to perform their functions more efficient and effectively. Reduction of operating expenses could be the key factor for the banks to the improvement of efficient operations in future. Foreign and Islami Shariah based banks should be well come by policy makers because they proved their operational efficiency. Bank management should pay more concern for personnel expenditures among input variable and non cash loan among the output variables. Opportunities for rightsizing the operation should be explored so that operations on efficiency level could be kept under control. Banks should provide various service channels to serve the customers. For meeting the customer's changing expectations banks need to adopt strategies to extend the working hours and to develop the technical capabilities of all branches. Inefficient banks have to sanction loan and advance to the sectors from which its recovery would be higher to increase the interest income that ultimately enhance the efficiency of the banks. Finally, the results of the study would help the management to develop right policies and guide the managers in making strategic actions for improving the performance.

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