Efficiency of Islamic and Conventional Banks in Bangladesh: Comparative Study using DEA Approach

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Abstract

This study involves comparing the efficiency between Islamic and conventional banks in Bangladesh using the Data Envelopment Analysis. It considers 25 commercial banks, of which seven are Islamic, while eighteen are conventional, covering the period from 2009 to 2013.The study finds that the Islamic banks have been pure technically efficient but their scale efficiency is not satisfactory, suggesting that scale inefficiency is the main source of inefficiency of the Islamic banks. In contrast, the conventional banks are found to be pure technically inefficient, but their scale efficiency is satisfactory. The study hopes to contribute towards providing important inputs for the betterment of the banking industry in Bangladesh.

Keywords: *Efficiency, Islamic banks, conventional banks, DEA, Bangladesh*

1. Introduction

The financial deepening process as well as the competitiveness, efficiency and profitability of the banking industry are among the major indicators for the development of a financial system. The banking sector, in particular plays a critical role as a financial intermediary that channels funds from the surplus units to the deficit units, thereby promoting savings, investments and trade, while simultaneously functions as a repository of money. In view of the diverse role of the banking sector in the economy, the performance and stability of the banking industry have a direct bearing on the sustainability of the economy. According to Sharma et al. (2012), an efficient financial sector is a primary requirement for a country's economic

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development. Efficiency measurement of the banking sector, in particular has significant impact on the overall performance of the economy.

In Bangladesh, the total size of the banking industry is approximately 61% of the total Gross Domestic Product (GDP), which is proportionately large for a country with a per capita income of only about US$870 (*Bangladesh Bank Quarterly Review*, 2011). The banking sector is comprised of the commercial banks and development financial institutions. The commercial banks can further be categorized into state-owned, private, and foreign commercial banks. According to the central bank of Bangladesh – the Bangladesh Bank, the banking industry has continued to expand as reflected by the increasing number of branches, deposits and advances of all the bank types in both the rural and urban areas of the country. More importantly, the banks continue to record profitability and stability in spite of the global financial crisis in 2007-2008 (Bangladesh Bank, 2013). In view of this, it would be interesting to investigate the efficiency measurement of this crucial financial segment of the Bangladesh economy. While there has been a rich literature focusing on the issues of bank performance, its stability and specific bank characteristics, studies comparing the efficiency between conventional and Islamic banks, particularly in Bangladesh have been very few.

This study aims to undertake an empirical investigation on comparing the efficiency between the conventional and Islamic banks in Bangladesh. In achieving its objective, this study attempts to compare the efficiency levels between selected Islamic and conventional banks, and examine the sources that may influence the efficiency levels of these banks.

2. Overview of Bangladesh Banking Industry

The banking institutions in Bangladesh can be divided into four groups based on the period of their establishments. Banks which started their operations in the period of 1971-1990 are classified as first generation banks, 1991-2000 as second generation banks, 2001-2010 as third generation banks and post-2011 as fourth generation banks (Haque, 2013). All categories of banks continued to record expansion in their operations despite the difficult financial and economic background during the 2007-2008 global financial crisis (Bangladesh Bank, 2013).

Of the total Bangladesh banking industry which comprised of the commercial banks and development financial institutions, the commercial banking sector dominates the industry (Table 1). As at end-2012, there were four state-owned commercial banks (SCBs), thirty private commercial banks (PCBs), nine foreign commercial banks (FCBs) and four development financial institutions (DFIs) in Bangladesh. Among the

thirty PCBs, seven were Islamic commercial banks (ICBs) operating within the Islamic *Shari'ah* framework.

Table 1. Bangladesh: Structure of the Banking System, 2012

Bank Type	Number of banks	Number of branches	Total assets (billions Taka)	Percent of industry assets (%)	Total deposits	Percent of industry Deposits (%)
SCBs	4	3478	1831.9	26.0	1377.9	25.5
DFIs	4	1440	385.5	5.5	260.4	4.8
PCBs	30	3339	4371.5	62.2	3430.7	63.6
FCBs	9	65	441.8	6.3	327.0	6.1
Total	**47**	**8322**	**7030.7**	**100**	**5396**	**100**

Source: Bangladesh Bank *Annual Report*, 2013.

As shown in Table 1, the total assets of the Bangladesh banking system stood at 7,030.7 billion taka, of which about 95% contributed by the commercial banking sector. Of the total banking asset, the PCBs contributed a significant amount of 62.2%, followed distantly by the SCBs at 26% (Bangladesh Bank, 2013). Similarly, on the deposit side of the banking system, the PCBs contributed about 64% of the total deposits mobilized by the Bangladesh banking system. There has been an increasing and positive trend of assets and deposits for the PCBs (both Islamic and conventional) which is an indication of the growth and development of this sector.

Since the establishment of the Islamic commercial banks, Bangladesh has been implementing a dual banking system with the Islamic system operating in parallel with the conventional banking system. Islamic banking implies to a system of banking that complies with Islamic law. The Islamic banks operate based on the underlying principles of mutual risk and profit sharing between the provider of capital (investor) and user of funds (entrepreneur). These principles would help to ensure that all parties involved contributing and sharing the outcome of the business. These are the core values of Islamic banking where entrepreneurship, trade and commerce are highly encouraged. In Islamic banking and finance, the activities involving interest (*riba*), gambling (*maysir*) and speculative trading (*gharar*) are strictly prohibited.

In the recent years, many large international conventional banks have started to offer Islamic banking products and services. Consequently, the competition among the Islamic banks as well as with the conventional banks continues to accelerate. Knowledge and practice of Islamic banking are also spreading quickly with more customers demanding Islamic banking products and services in many countries including Bangladesh. As the Islamic banking industry continues to expand, new

regulations, policies, and accounting standards are being designed to support the operations of the Islamic banking institutions both at the domestic and global fronts.

3. Literature Review

The DEA approach has been widely adopted in bank efficiency studies throughout the world. Several studies applied cross-country approach such as that of Bader et al. (2008) which measured and compared the cost, revenue and profit efficiency of 43 Islamic and 37 conventional banks over the period 1990-2005 in 21 countries. The study finds that there is no significant difference between the overall efficiency results of the conventional and Islamic banks. For both the conventional and Islamic banks, most inefficiency comes from the revenue side, suggesting that the banks should improve their revenue efficiency. In a study comparing the efficiency of Islamic banks in Malaysia and Saudi Arabia using the DEA method, Shili (2013) finds that the Islamic banks in Saudi are more efficient than those in Malaysia. An investigation of the nature and distribution of the inputs and outputs of the two groups of banks indicate that the better efficiency levels of the Saudi banks comes mainly from good management in a less restrictive competitive environment in Saudi compared to that in Malaysia.

Technical inefficiency comes from the misuse of resources or the wrong combinations of inputs and outputs. Karray and Chichti (2013) analyzed 402 commercial banks from 15 developing countries over the period of 2000-2003 and assessed the effect of bank size on technical efficiency and its two components: pure technical and scale efficiencies using the DEA method. The results indicate that the sample banks suffer severely from technical inefficiency incorporating a total average wastage of resources. Banks of all size classes indicate the highest levels of pure technical efficiency and the most serious problems of scale inefficiency, except for the category of the largest banks.

Several studies investigate the source of inefficiency as the DEA method allowed for the determinations of the source of the inefficiency, either from pure technical or scale inefficiency. For instance, Yudistira (2004) measured the efficiency of 18 banks from 12 countries in the period from 1997 to 2000. Using the intermediation approach of the DEA, the study finds that scale inefficiency is glaring for most banks in the sample. It is also found that inefficiency across the Islamic banks is relatively small at just over 10% which is lower compared to their conventional counterparts. The largest degree of scale inefficiency comes from the large size banks with most of the banks exhibited either decreasing or increasing returns to scale and subsequently merged to constant returns to scale. Similarly, Rahman and Rosman (2013) find that the main source of technical inefficiency of the Islamic banks in MENA and Asian countries is due to scale inefficiency. The study, however show that the Islamic banks

are able to efficiently control the costs and use the mix of inputs to produce outputs regardless of the scale effects. The differences in scores for the Islamic banks in the MENA and Asian countries might be due to the country-specific factor that influences the efficiency score. In another study, Tahir et al. (2011) investigated the efficiency of Islamic banks in Africa, the Far East and Central Asia, Europe and the Middle East during 2003-2008 and found that pure technical inefficiency dominates the overall inefficiency, indicating that these banks are inefficient in controlling their cost rather than operating at the wrong scale.

Specific country studies have also been highly researched. Focusing on the Malaysian banking system, Sufian (2007) applied the DEA method with intermediation approach on 58 observations of domestic and foreign Islamic from 2001 to 2004. Comparing the two types of banks, the study finds that scale inefficiency dominates pure technical inefficiency for the Islamic banks, suggesting that they are operating at the wrong scale of operation. It is also found that the share of scale efficient banks declined and the share of banks experiencing economies of scale increased dramatically while the share of banks with diseconomies of scale decreased sharply.

Several studies find that the conventional commercial banks to be more efficient in utilizing information technology and offering electronic banking compared to the Islamic banks, while the Islamic banks are more efficient in allocating and utilizing their resources. Ismail et al. (2013) compared the efficiency of eight Islamic and nine conventional commercial banks in Malaysia from 2006 to 2009 by using DEA with intermediation approach and find that scale efficiency is the main source of technical efficiency for both Islamic and conventional commercial banks. The results indicate that the technical, pure technical and cost efficiency for the conventional banks are higher than the Islamic banks. Moreover, scale efficiency is found to be the main source of technical efficiency rather than pure technical efficiency. Several other studies arrived at similar findings are Sufian (2006 and 2007) and Mohamad and Said (2013).

Hassan et al. (2007) investigated the relative efficiency of the banking industry in Bahrain by analyzing 31 banks from 1998 to 2000 using the DEA method. The study finds that technical inefficiency is the dominant source of inefficiency of the banks rather than allocative inefficiency and diseconomies of scale. The results suggest that the major source of the total technical inefficiency is from pure technical inefficiency, not scale inefficiency. Similarly, Ahmad and Luo (2010) compared efficiency of 8 Islamic and 33 conventional banks in three European countries – Germany, Turkey and the United Kingdom from 2005 to 2008 by using DEA with intermediation approach. They found that in general, Islamic banks are better at controlling costs compared to conventional banks. Focusing on the case of selected OIC countries, Hassan, Mohamad and Bader (2009) conducted a cross-country analysis to compare

the efficiency levels of 40 conventional and Islamic banks in 11 Organisation of Islamic Conference (OIC) countries over the period 1990-2005. The findings based on the DEA approach document no significant differences between the overall efficiency of conventional and Islamic banks. However, it was noted that, on average, banks are more efficient in using their resources compared to their ability to generate revenues and profits. The study suggests further improvement in cost minimization, and revenue and profit maximisation in both banking systems.

There have been relatively few studies focusing on the case of Bangladesh. For example, Ahmed and Liza (2013) adopted the DEA method to measure efficiency of 35 commercial banks in Bangladesh from 2002 to 2011. Most of the second and third generation banks and foreign commercial banks are found to be highly efficient and they are very competitive with each other. These banks maintained not only their efficiency but also the consistency of the efficiency during the period under review.

The technical efficiency and scale efficiency are positively related and banks that are technically efficient are scale efficient also. Hoque and Rayhan (2012) applied the DEA method with 21 commercial banks in Bangladesh and found that the scores of both input and output related to technical efficiency is similar under constant returns to scale (CRS). Banks with higher technical efficiency possess top ranks. This finding seems to indicate that continuous increasing competition in the private commercial banking industry in Bangladesh has helped to enhance the efficiency of this sector. In another study, Haque (2013) examined five conventional banks of different age group during 2006-2011 and found that there is no particular relationship between bank's performance and its age and all generation banks can be efficient irrespective of their age. The banks with foreign and private ownership are found to be income-efficient in Bangladesh. Uddin and Suzuki (2011) analyzed income efficiency, cost efficiency, NPL and ROA of 38 commercial banks in Bangladesh by applying the DEA approach from 2001 to 2008. Both the income efficiency and cost efficiency of all sample banks are found to increase in 2008 compared to 2001, indicating improvement in bank performance during the sample period.

Few studies focused on comparing the efficiency between conventional and Islamic commercial banks in the case of Bangladesh. The only available study is that of Bhuia et al. (2012) which examined the relative efficiency of Bangladesh online banking for three Islamic and 17 conventional banks during 2001–2007 using the DEA based on the intermediation approach. The study found that the source of efficiency of the banks is due to scale efficiency rather than pure technical efficiency.

4. Methodology

4.1 The DEA Approach

This study investigates the efficiency level of Islamic and conventional banks within the context of banking industry in Bangladesh. The DEA provides a measure of the degree of efficiency where the sample size is small and there are multiple inputs and multiple outputs. It is the most widely used non-parametric approach of measuring efficiency using mathematical programming techniques. The production or performance function of decision making units (DMUs) is the initial highlight of the DEA method. Then, it evaluates the multiple inputs consumed and multiple outputs produced by the DMUs to find-out the units which are on the efficient frontier and those lie below the frontier (Hoque and Rayhan, 2012). The method is explained as the weighted sum of outputs divided by weighted sum of inputs (Charnes et al., 1978). It made used of the mathematical programming and constant returns to scale assumption. In addition, Banker et al. (1984) added the concept of variable returns to scale in order to measure efficiency. Each DMU wants to maximize its efficiency ratio by defining the weights of inputs and outputs. Sherman and Gold (1985) were the first to apply DEA in the context of the banking industry.

Under the constant returns to scale (CRS) assumption, there is no significant relationship between the scale of operation and efficiency and it defines the overall technical efficiency. It is reasonable to use CRS when all DMUs are operating at the optimal scale under CRS assumptions. But if all DMUs are not operating at the optimal scale, the technical efficiency (TE) will not give proper results with scale efficiency (SE). Banker et al. (1984) proposed that by adding variable returns to scale (VRS) to examine the efficiency of DMUs. The VRS gives the measurement of TE without the SE. If there exists a difference between the TE and pure technical efficiency (PTE) in a particular DMU, it means there is scale inefficiency (Sufian, 2007). The basic difference between the two methods is the returns to scale. For the current study, each bank in the sample is considered as a DMU.

DEA does not focus on a predetermined benchmark of a performance measurement. If a DMU deserve an efficiency score of 1, it will be considered as the best practice firm. For example, an efficiency score of 0.80 for a DMU means that the firm is 80% efficient compared to the best practice firms. In other words, the firm is 20% less efficient compared to the firms lying on the efficient frontier (Uddin and Suzuki, 2011). So, DEA is an appropriate alternative approach of regression analysis to measure the efficiency of banks which have multiple inputs and multiple outputs. Dyson et al. (2001) developed a series of homogeneity assumptions. Firstly, the DMUs' are performing similar activities and producing comparable products and services so that a common set of outputs can be defined. Secondly, all the units are enjoying a similar range of resources and are operating in a similar environment. If we increase the sample size, the efficiency reduces the average score because including more sample size enhances the scope for DEA to compare between similar

partners. One rule is the sample size should be greater than equal to the product of inputs and outputs (Kumar and Gulati, 2008). The another rule is that the number of organizations in the sample should be at least three times greater than the sum of the number of outputs and inputs included in the specification (Nunamaker, 1985).

Efficiency is the ability to produce the maximum amount of output with a minimum cost. Efficiency is measured for three purposes and they are maximization of output, maximization of profit and minimization of costs. In other words, efficiency is the economic optimization related to market prices and competition, not only based on the use of technology. Firms can be technically and allocative efficient by producing the optimal level of output (Mester, 2003). One of the simplest and easiest ways to measure efficiency is: Efficiency=Output/ Input. The relative efficiency can be measured as: Efficiency = Weighted sum of output/ Weighted sum of input.

DEA is a linear programming method that provides a means of calculating apparent efficiency levels within a group of organizations. There are three types of efficiencies which are used most commonly. The technical efficiency is the conversion of physical inputs (such as the services of employees and machines) into outputs relative to best practice. In other words, with a given current technology, there is no wastage of inputs to produce a given quantity of output. An organization can be 100% technically efficient if it is operated at best practice. Pure technical efficiency indicates whether a DMU is operating at the right or wrong scale of operation. Finally, scale efficiency refers to the ratio of technical efficiency under constant returns to scale and variable returns to scale.

4.2 Sample Selection

Eighteen conventional and seven Islamic commercial banks are chosen as the sample for this study (Table 2). Both types of banks are listed in the Dhaka Stock Exchange and Chittagong Stock Exchange. Five conventional banks are not included in the sample size due to the unavailability of data. Finally, the sample size in this study is feasible and larger than that used in some of the studies in the DEA literature.

4.3 Specification of Inputs and Outputs Variables

The selection of inputs and outputs is always a controversial issue among the researchers. The choice of the inputs and outputs is guided by the relevant literature as well as based on the data availability. Two approaches are commonly used in determining the inputs and outputs to measure the efficiency of banking system: production approach and intermediation approach. In the production approach, the banks are treated as firms using capital and labor to produce the deposit and credit accounts existing in different categories (Colwell and Davis, 1992). Meanwhile, the intermediation approach produces the credits and other assets and the banks use the capital and the labor with the items that are related with financial based on deposits

(Fortin and Leclerc, 2007). The latter approach basically relies on the role of the financial institutions which intermediaries in the fund transfer process. Moreover, this approach is in line with the Islamic banking function that relies on profit-sharing contracts and an equity participation principle with depositors (Majid et al., 2009).

Table 2. List of Selected Islamic and Conventional Banks

No	Bank Name	Abbreviation	Year of establishment	Age as at 2013	Total assets as at 2013
Panel A: Islamic banks					(million BDT)
1	Al-Arafah Islami Bank Limited	AIBL	1995	18	169,058.00
2	Export Import Bank of Bangladesh Ltd.	EXIM	1999	14	191,727.60
3	First Security Islami Bank Limited	FSIBL	1999	14	159,494.50
4	ICB Islamic Bank	ICB	1987	26	10,154.50
5	Islami Bank Bangladesh Limited	IBBL	1983	30	538,430.00
6	Shahjalal Islami bank Limited	SJIBL	2001	12	122,087.30
7	Social Islami Bank Limited	SIBL	1995	18	123,843.20
Panel B: Conventional banks					
8	AB Bank Limited	ABBL	1981	32	204,025.20
9	Bank Asia Limited	BAL	1999	14	159,665.10
10	BRAC Bank Limited	BRAC	2001	12	164,913.30
11	Dutch Bangla Bank Limited	DBBL	1995	18	181,656.90
12	Eastern Bank Limited	EBL	1992	21	154,308.10
13	IFIC Bank Limited	IFIC	1976	37	129,584.70
14	Jamuna Bank Limited	JBL	2001	12	112,779.60
15	Mercantile Bank Limited	MBL	1999	14	141,421.80
16	Mutual Trust Bank Limited	MTBL	1999	14	98,798.20
17	National Bank Limited	NBL	1983	30	232,148.50
18	NCCBL Bank Limited	NCCBL	1985	28	120,696.40
19	One Bank Limited	OBL	1999	14	100,073.90
20	Prime Bank Limited	PRBL	1995	18	238,867.60
21	Pubali Bank Limited	PUBL	1972	41	222,250.90
22	Southeast Bank Limited	SEBL	1995	18	216,701.20
23	The Premier Bank Limited	PREBL	1999	14	88,536.10
24	United Commercial Bank Ltd.	UCBL	1983	30	223,602.50

25	Uttara Bank Limited	UBL	1965	48	130,966.00

Each feature has some degree of advantage over the other though both approaches are not fully perfect. The production approach is more suitable for measuring the efficiency of branches and the intermediation approach is more suitable for evaluating all the financial institutions (Berger and Humprey, 1997). In production approach, banks or DMUs are considered as production units that transform inputs into outputs. According to this approach, the number of accounts or its related transactions is the best measures for output, while the number of employees and physical capital is considered as inputs (Sufian, 2007). In contrast, in intermediation approach banks are considered as entities, which intermediates funds between savers and borrowers. In this approach, total loans and securities are considered as outputs whereas deposits, labour and physical capital are defined as inputs.

Hence, this study applied intermediation approach or asset approach developed by Sealey and Lindley (1977). Previous banking efficiency studies for Islamic and conventional banks that adopted this approach includes that of Kamaruddin et al. (2008), Bader et al. (2008), Abdul Majid et al.(2009), and Mohamed and Said (2013). The approach is also adopted due to lack of data from the *BankScope* for implementing the production approach (Brissimis et al., 2008). In fact, the intermediation approach may be superior for assessing the profitability of financial institutions because it minimizes of total costs and not just the production costs which are an important precondition to maximize profits (Iqbal and Molyneux, 2005).

In DEA, technical efficiency (TE) can be measured from two perspectives: input-oriented or output-oriented. In general, when inputs and outputs are semi-positive, the choice between the input-oriented version and the output-oriented version can be simply depends on users' preferences. The input-oriented version assumes that outputs are fixed only inputs can be adjusted. In contrast, the output oriented version assumes that inputs are fixed only outputs can be adjusted (Sufian and Haron, 2009). Coelli (1996) prescribed that the choice of orientation has only minor influences upon the efficiency scores obtained. The focus on costs in banking and the fact that outputs are inclined to be demand determined means that input-oriented models are most commonly used (Kumbhakar and Vivas, 2005).

This study follows the inputs and outputs by Isik and Hassan (2002), Hassan (2006), Ismail et al. (2013) and Shamsher et al. (2008). The three inputs are total deposits, fixed assets and personnel expenses. Meanwhile, the three outputs are total loans,

other earning assets and off-balance sheet items. Table 3 explains the inputs and outputs variables used in this study.

Table 3. Descriptions of Inputs and Outputs Variables

Inputs	**Description**
Total Deposits	Total deposits, money market and short-term funding
Fixed Asset	Book value of premises and fixed assets
Personnel Expenses	Labour expenses
Outputs	
Total Loan	Loans, reserves for impaired loans (NPLs)
Other Earning Assets	Investment securities, loans and advances to banks,
	interbank loans and other securities
Off- Balance Sheet Items	Off-balance sheet items

4.4 Data Sources

The data for this study is chosen from the annual reports of the central bank and the selected commercial banks covering the period from 2009 to 2013. The information from the annual balance sheets and income statements are used to construct the variables for the empirical analysis. The main sources of data used in this study are secondary data collected from *Bankscope* database. All monetary values are expressed in Bangladeshi currency which is Taka. The efficiency of individual banks is analyzed from DEA results with respect to technical efficiency, pure technical efficiency, and scale efficiency.

5. Findings and Analysis

The efficiency of the commercial banks operating in Bangladesh is initially examined by applying the DEA method for each year under investigation by using a common frontier. The analysis is then extended by examining the efficiency of conventional banks, Islamic banks and for all the selected banks for each year. Table 4 presents the summary statistics for the outputs (Panel A) and inputs (Panel B) variables for Islamic and conventional banks in Bangladesh during the study period. A few findings can be drawn from this table. Firstly, over the five-year period, all the inputs and outputs variables have grown significantly. During the years from 2009 to 2013, total loans and deposits grew by about 102.38% and 113.76%, respectively. Secondly, it is apparent that there has been increasing awareness among the people about conventional and Islamic banking and finance during the study period.

Thirdly, conclusion could also be made about employment opportunities in the commercial banking industry during this period. As shown in Table 4 (Panel B) that the commercial banking industry has created significant employment during this period. Since data on the number of employees are not available, the researcher has

used personnel expenses as a proxy measure. From the descriptive statistics, it is apparent that personnel expenses have expanded by approximately 123.81% from 2009 to 2013. Finally, the conventional and Islamic banking industry has increasingly generated high returns to the banking industry in Bangladesh. During the period of study, it is witnessed that other earning assets, off-balance sheet items and fixed assets have increased by 165.97%, 138.90% and 181.80%, respectively. Among all the variables, the growth of fixed assets is the highest and the growth of all other variables is more than 100%. These statistics show a very positive and significant growth of the banking sector in Bangladesh.

Table 4. Descriptive Statistics for Outputs and Inputs Variables (in million BDT)

A: Outputs	**2009**	**2010**	**2011**	**2012**	**2013**
Total Loans					
Min	13,419.00	13,904.00	14,222.00	11,009.00	9,788.00
Max	219,275.00	261,725.00	305,790.00	372,920.00	406,604.00
Mean	56,158.92	73,121.64	87,313.56	102,791.96	113,653.76
S.D.	38,509.08	45,674.00	53,044.01	64,746.20	70,627.48
Other Earning Assets					
Min	2,583.00	1,540.00	760.00	1,288.00	1,838.00
Max	28,076.00	28,726.00	40,688.00	58,640.00	78,799.00
Mean	13,422.00	14,842.88	21,223.32	31,361.52	35,698.64
S.D.	6,822.49	6,981.99	9,638.64	13,985.37	17,719.09
Off-Balance Sheet Items					
Min	476.00	379.00	277.00	272.00	249.00
Max	62,335.00	113,098.00	113,420.00	110,044.00	113,715.00
Mean	20,365.24	34,224.92	37,729.12	42,033.16	48,651.64
S.D.	13,381.46	24,353.94	25,973.42	27,636.79	28,483.93
B: Inputs					
Total Deposits					
Min	18,113.00	18,657.00	17,680.00	17,365.00	17,016.00
Max	241,746.00	288,956.00	338,991.00	413,629.00	469,011.00
Mean	67,346.52	84,103.44	104,284.24	130,439.64	143,963.20
S.D.	42,056.76	49,811.85	57,939.05	70,230.50	80,496.85
Fixed Assets					
Min	376.00	463.00	468.00	433.00	1,079.00
Max	6,512.00	6,757.00	7,301.00	14,816.00	15,732.00
Mean	1,402.12	2,051.80	2,719.28	3,451.04	3,948.44
S.D.	1,367.53	1,485.07	1,795.37	2,892.37	3,126.21
Personnel Expenses					
Min	244.00	277.00	267.00	288.00	271.00
Max	3,149.00	4,304.00	4,670.00	5,989.00	7,580.00
Mean	942.84	1,252.12	1,486.88	1,814.16	2,110.16

S.D.	635.50	831.00	885.85	1,132.17	1,369.31

As suggested in Table 5, the mean pure technical efficiency dominates both technical and scale efficiency throughout the years for the Islamic banks, indicating that the Islamic banks in Bangladesh experienced proper allocation of resources between the inputs and outputs during the period under review. The technical inefficiency comes mainly from scale inefficiency rather than pure technical inefficiency. Bhuia et al. (2012) found the similar results for Bangladesh banking industry.

Table 5. Summary Statistics of Efficiency Measures

	Panel A: Efficiency measure of Islamic banks				Panel B: Efficiency measure of conventional banks				Panel C: Efficiency measure of all banks			
2009	Min	Max	Mean	S.D	Min	Max	Mean	S.D	Min	Max	Mean	S.D
Technical	0.861	1	0.979	0.052	0.882	1	0.973	0.038	0.810	1	0.967	0.047
Pure Technical	1	1	1	0	0.903	1	0.984	0.029	0.890	1	0.986	0.028
Scale	0.861	1	0.979	0.052	0.945	1	0.989	0.018	0.810	1	0.981	0.039
2010												
Technical	0.780	1	0.954	0.081	0.891	1	0.970	0.042	0.780	1	0.953	0.058
Pure Technical	0.981	1	0.997	0.007	0.902	1	0.983	0.033	0.887	1	0.976	0.038
Scale	0.780	1	0.957	0.081	0.904	1	0.987	0.023	0.780	1	0.977	0.049
2011												
Technical	0.892	1	0.985	0.041	0.881	1	0.978	0.039	0.876	1	0.971	0.042
Pure Technical	1	1	1	0	0.887	1	0.983	0.036	0.877	1	0.981	0.035
Scale	0.892	1	0.985	0.041	0.969	1	0.995	0.009	0.892	1	0.989	0.023
2012												
Technical	0.703	1	0.956	0.112	0.883	1	0.976	0.032	0.703	1	0.967	0.062
Pure Technical	0.994	1	0.999	0.002	0.884	1	0.985	0.030	0.884	1	0.983	0.027
Scale	0.703	1	0.957	0.112	0.932	1	0.991	0.019	0.703	1	0.984	0.059
2013												
Technical	0.664	1	0.952	0.127	0.891	1	0.984	0.030	0.644	1	0.969	0.074
Pure Technical	1	1	1	0	0.897	1	0.990	0.027	0.897	1	0.988	0.027
Scale	0.664	1	0.952	0.127	0.945	1	0.994	0.013	0.644	1	0.981	0.071

Table 5 reports the sample statistics of the various efficiency scores of the selected commercial banks for each year separately. It reports the sample statistics of the various efficiency scores of Islamic, conventional and all the selected banks operating in Bangladesh for the years from 2009to 2013. Based on Panel A of Table 5, Islamic banks have exhibited the highest mean technical efficiency score of 98.5% in year 2011, declined to 95.6% in year 2012 and 95.2% in year 2013. The decomposition of technical efficiency into its pure technical and scale efficiency components suggest that mean pure technical efficiency dominates mean scale efficiency of Islamic banks during all years. The scores are one in three years and 99.7% and 99.9% in year 2010 and 2013 respectively which are very close to one. This implies that Islamic banks have been operating at the right scale of operations during the period of study.

Panel B of Table 5 suggests that the conventional banks have exhibited mean technical efficiency is 97.0% in four years and further increases to 98.4% in 2013. The mean scale efficiency dominates the technical and pure technical efficiency all over five years. The high scale efficiency scores imply that conventional banks have been operating at the wrong scale of operations during the review period. It means that conventional banks in Bangladesh experienced misallocation of resources between the inputs and outputs during the study period. This finding explains that Islamic banks are found to be relatively more efficient at allocating resources compared to conventional banks. Ismail et al. (2013) found the same results in comparison of Islamic and conventional banks in Malaysia.

The results for all banks (Panel C) in all years have in general confirmed that scale efficiency scores are higher compared to pure technical efficiency in three consecutive years for all banks. Technical inefficiency comes from scale during these three years and from pure technical for the rest two years. During the period 2009-2013, the results for all banks suggest that, all banks have exhibited higher mean pure technical and scale efficiency in the study period. The scores of both types of efficiency are very close to each other and consistent as well. It can be observed that all the three kinds of efficiency are consistent and close to one during the study period. So, the conventional and Islamic banks have a very good efficiency scores from 2009 to 2013. Besides this, the reported standard deviation shows that there is a small dispersion in terms of all kinds of efficiency among all sample banks in Bangladesh from 2009 to 2013.

It is observed from Table 5 that technical efficiency scores are the lowest for all banks all years. Relatively low technical efficiency in all these years is due to pure technical or scale inefficiency or the mismatch in the production mix. Therefore, the bank management has lack of proper management strategies to further enhance the banking operations. If technical efficiency under CRS and technical efficiency under VRS are equal, then there is no scale inefficiency and overall technical inefficiency is due to a pure technical inefficiency. It also means that the bank is operating at constant return to scale. The overall technical inefficiency is due to a pure technical inefficiency if the value of scale efficiency equals one (Gishkori and Ullah, 2013). On the other hand, if technical and scale efficiency scores are equal, it indicates pure technical efficiency.

5.1 Technical Efficiency

Table 6 displays the technical efficiency calculated using DEA under the assumption of constant returns to scale for Islamic and conventional banks separately. As evidenced in Islamic banks results (Panel A), EXIM, FSIBL and SIBL are consistently efficient throughout the sample period. Being consistently efficient, these

three banks have the highest average technical efficiency at an annual average level of one. AIBL and SJIBL followed with annual scores of 99.2% in 2012 and 96.1% in 2010 and their efficiency scores are one for the rest four years. ICB is the least technically efficient bank with a lowest annual average score of 66.4% in 2013 and highest score of 89.2% in 2011 which are far away from the efficiency frontier. IBBL has got 99.0% in 2009 and 93.8% in 2010 and rest of the year it is on the efficiency frontier. The least technical efficiency score for Islamic banks as a whole is 95.2% in 2013. If ICB is discarded from the list, the score becomes one which is on the efficiency frontier. But the mean technical efficiency for five years is volatile for Islamic banks compared to conventional banks. There has been notable change in the technical efficiency patterns of Islamic banks over 2009 -2013 and that efficiency scores vary across banks with both increasing and decreasing trend. The technical efficiency of Islamic banks has decreased 2.73% from 2009 to 2013. This result indicates that Islamic banks have failed to keep pace with technically feasible production possibilities and improved their distance to the industrial production frontier.

In contrast, among the conventional banks (Panel B) BAL, NCCBL, PRBL and SEBL have recorded scores one and they are technically efficient over the five years. Then IFIC, NBL, OBL, PREBL and UBL have recorded scores of one for four years during the study period. DBBL is the least efficient bank with an annual average score of 89.1% in 2013. The rest of the banks have scores above 90.0% for all years. The annual average scores for all conventional banks are consistent for five years which is a positive indicator for them. Overall, all the conventional banks possess the highest average technical efficiency level of 98.4% in 2013. This results show that, on average, conventional banks can produce the same level of output by actually using 98.4% of the input mix. The technical efficiency of conventional banks has increased 1.14% from 2009 to 2013. Therefore, conventional banks have recorded higher scores in 2010, 2012 and 2013 than Islamic banks and the situation is reverse in 2009 and 2011. Overall, the technical efficiency scores are stable and consistent for the industry as a whole during the review period.

5.2 Pure Technical Efficiency

Table 7 displays pure technical efficiency calculated using DEA under the assumption of variable returns to scale. As evidenced in the results (Panel A), five Islamic banks are pure technically efficient among the seven banks and they are EXIM, FSIBL, ICB, IBBL and SIBL. AIBL and SJIBL follows with annual average scores of 99.4% in 2012 and 98.1% in 2010 respectively which are very close to one. So, Islamic banks are pure technically efficient during the sample period. Overall, mean pure technical efficiency scores are one for 2009, 2011 and 2013 while it is

99.7% in 2010 and 99.9% in 2012 which is higher than conventional banks and very satisfactory as well.

Table 6. DEA Technical Efficiency of Selected Banks from 2009 to 2013 (CRS)

Panel A: Islamic banks

ID	Bank name	2009	2010	2011	2012	2013	Mean
1	AIBL	1	1	1	0.992	1	0.998
2	EXIM	1	1	1	1	1	1
3	FSIBL	1	1	1	1	1	1
4	ICB	0.861	0.78	0.892	0.703	0.664	0.780
5	IBBL	0.99	0.938	1	1	1	0.986
6	SJIBL	1	0.961	1	1	1	0.992
7	SIBL	1	1	1	1	1	1
	Geomean	**0.979**	**0.954**	**0.985**	**0.956**	**0.952**	**0.965**

Panel B: Conventional banks

8	ABBL	0.922	0.891	0.882	0.938	1	0.927
9	BAL	1	1	1	1	1	1
10	BRAC	0.932	0.978	0.988	0.971	1	0.974
11	DBBL	0.933	0.909	0.881	0.883	0.891	0.899
12	EBL	1	1	0.995	0.973	1	0.994
13	IFIC	1	1	1	1	0.99	0.998
14	JBL	0.947	0.915	0.948	1	0.997	0.961
15	MBL	1	1	0.939	1	0.996	0.987
16	MTBL	1	0.904	1	0.932	0.955	0.958
17	NBL	0.961	1	1	1	1	0.992
18	NCCBL	1	1	1	1	1	1
19	OBL	1	0.984	1	1	1	0.997
20	PRBL	1	1	1	1	1	1
21	PUBL	0.941	0.976	0.99	0.972	0.944	0.965
22	SEBL	1	1	1	1	1	1
23	PREBL	1	1	1	0.952	1	0.990
24	UCBL	0.882	0.91	0.972	0.969	0.945	0.936
25	UBL	1	1	1	0.973	1	0.995
	Geomean	**0.973**	**0.970**	**0.978**	**0.976**	**0.984**	**0.976**
	Overall Geomean	**0.967**	**0.953**	**0.971**	**0.967**	**0.969**	

The results of Table 7 (Panel B) suggest that BAL, IFIC, NCCBL, OBL, PRBL, SEBL and PREBL have pure technical efficiency scores one in five years. EBL,

MBL, MTBL, NBL and UBL follows efficiency scores one for four years and the rest of the banks have scores above 90.0%during the study period. On average, conventional banks possess lower average pure technical efficiency level for five years compared to Islamic banks.

But their efficiency scores are consistent over the five years period and it becomes 99.0% in the final year. It means conventional banks can produce the same level of output by using 99.0% of the input mix. The wastage of input is only 1.00% which is very insignificant. The pure technical efficiency of conventional banks has increased . 61% from 2009 to 2013. In addition, their mean efficiency scores are consistent with each other and uprising during five years period. Therefore, the competition among the commercial banks in Bangladesh is very intense and it is increasing day by day. This finding is also same with Ahmed and Liza (2013). Finally, Islamic banks are more pure technically efficient than conventional banks. Thus, the high efficiency scores indicate those banks' efficiency level increases with the scale of operation (Gee, 2011). Overall, the pure technical efficiency scores are stable and consistent for the industry as a whole during the review period.

Table 7. DEA Pure Technical Efficiency of Selected Banks, 2009 to 2013 (VRS)

Panel A: Islamic banks

ID	Bank name	2009	2010	2011	2012	2013	Mean
1	AIBL	1	1	1	0.994	1	0.999
2	EXIM	1	1	1	1	1	1
3	FSIBL	1	1	1	1	1	1
4	ICB	1	1	1	1	1	1
5	IBBL	1	1	1	1	1	1
6	SJIBL	1	0.981	1	1	1	0.996
7	SIBL	1	1	1	1	1	1
	Geomean	**1**	**0.997**	**1**	**0.999**	**1**	**0.999**

Panel B: Conventional banks

8	ABBL	0.941	0.902	0.89	0.938	1	0.934
9	BAL	1	1	1	1	1	1
10	BRAC	0.954	0.995	0.991	0.981	1	0.984
11	DBBL	0.94	0.918	0.887	0.884	0.897	0.905

12	EBL	1	1	1	0.974	1	0.995
13	IFIC	1	1	1	1	1	1
14	JBL	1	0.951	0.978	1	1	0.986
15	MBL	1	1	0.96	1	1	0.992
16	MTBL	1	1	1	1	0.971	0.994
17	NBL	0.979	1	1	1	1	0.996
18	NCCBL	1	1	1	1	1	1
19	OBL	1	1	1	1	1	1
20	PRBL	1	1	1	1	1	1
21	PUBL	0.995	0.998	1	0.991	0.952	0.987
22	SEBL	1	1	1	1	1	1
23	PREBL	1	1	1	1	1	1
24	UCBL	0.903	0.926	0.982	0.99	1	0.960
25	UBL	1	1	1	0.976	1	0.995
	Geomean	**0.984**	**0.983**	**0.983**	**0.985**	**0.990**	**0.985**
	OverallGeomean	**0.986**	**0.976**	**0.981**	**0.983**	**0.988**	

5.3 Scale Efficiency

Table 8 displays the scale efficiency calculated using DEA results for Islamic and conventional banks individually. As evidenced in the Islamic banks results (Panel A), EXIM, FSIBL and SIBL are consistently efficient throughout the sample period. Being consistently efficient, these three banks have the highest average technical efficiency at an annual average level of one. AIBL and SJIBL followed with an annual average level of 99.8% in 2012 and 98.0% in 2010 and their efficiency scores have been recorded one for the rest four years. ICB is the least efficient bank with a lowest annual average score of 66.4% in 2013. If ICB is dropped from the list in 2011 and 2013, the score becomes one which is on the efficiency frontier. But the mean scale efficiency for five years is volatile for Islamic banks compared to conventional banks. The scale efficiency of Islamic banks has decreased 2.73% from 2009 to 2013 which is exactly equal to technical efficiency change.

In contrast, among the conventional banks (Panel B) BAL, NCCBL, PRBL and SEBL have scores one and they are scale efficient over the five years. Then IFIC, NBL, OBL, PREBL and UBL have come with annual average scores of one for four years

during the study period. DBBL has recorded good scores of 99.3, 99.1, 99.4, 99.9 and 99.4% in five years respectively. Meanwhile, ABBL, BRAC, JBL, MBL, MTBL, PUBL, UCBL have achieved very good scores which are above 95.0% in all years. The annual average scores for all conventional banks are consistent for five years with high efficiency scores. The scale efficiency of conventional banks has increased .54% from 2009 to 2013. Therefore, conventional banks have higher average scores compared to Islamic banks for five years. Overall, scale efficiency scores are consistent and close to one for the industry as a whole during the study period.

Table 8. DEA Scale Efficiency of Selected Banks, 2009 to 2013

Panel A: Islamic banks

ID	Bank name	2009	2010	2011	2012	2013	Mean
1	AIBL	1	1	1	0.998	1	0.999
2	EXIM	1	1	1	1	1	1
3	FSIBL	1	1	1	1	1	1
4	ICB	0.861	0.780	0.892	0.703	0.664	0.780
5	IBBL	0.99	0.938	1	1	1	0.986
6	SJIBL	1	0.98	1	1	1	0.996
7	SIBL	1	1	1	1	1	1
	Geomean	**0.979**	**0.957**	**0.985**	**0.957**	**0.952**	**0.966**

Panel B: Conventional banks

8	ABBL	0.98	0.988	0.991	1	1	0.992
9	BAL	1	1	1	1	1	1
10	BRAC	0.977	0.982	0.997	0.99	1	0.989
11	DBBL	0.993	0.991	0.994	0.999	0.994	0.994
12	EBL	1	1	0.995	0.999	1	0.999
13	IFIC	1	1	1	1	0.99	0.998
14	JBL	0.947	0.962	0.969	1	0.997	0.975
15	MBL	1	1	0.978	1	0.996	0.995
16	MTBL	1	0.904	1	0.932	0.983	0.964
17	NBL	0.982	1	1	1	1	0.996
18	NCCBL	1	1	1	1	1	1
19	OBL	1	0.984	1	1	1	0.997

20	PRBL	1	1	1	1	1	1
21	PUBL	0.945	0.977	0.99	0.981	0.992	0.977
22	SEBL	1	1	1	1	1	1
23	PREBL	1	1	1	0.952	1	0.990
24	UCBL	0.977	0.984	0.989	0.978	0.945	0.975
25	UBL	1	1	1	0.997	1	0.999
	Geomean	**0.989**	**0.987**	**0.995**	**0.990**	**0.994**	**0.991**
	Overall Geomean	**0.981**	**0.977**	**0.989**	**0.984**	**0.981**	

From the above discussion, it is observed that the technical inefficiency of Islamic banks comes from scale inefficiency (2.73%) rather than pure technical inefficiency (no change) from 2009 to 2013. This result is supported by Sufian (2007) and he got the similar findings for Islamic banks in Malaysia. Among the Islamic banks EXIM, FSIBL and SIBL have been able to keep their scores one for all the three kinds of efficiency throughout the study period. Meanwhile, among the conventional banks BAL, NCCBL, PRBL and SEBL have scores one with respect to three kinds of efficiency. It means that the production process of these banks is not characterizing any waste of inputs and the resource utilization process of these banks is functioning well. In DEA terminology, these banks are called *peers* and these banks can be an example of good operating practices for inefficient banks (Kumar and Gulati, 2008). Moreover, two Islamic banks (AIBL and SJIBL) and three conventional banks (IFIC, NBL and UBL) have efficiency scores one for four years for three types of efficiency.

However, both second and third generation banks are efficient for both Islamic and conventional cases. This result is supported by the result of Ahmed and Liza (2013) and they found the same results for commercial banks in Bangladesh. In addition, three Islamic banks EXIM, FSIBL and SIBL are consistently efficient over the five years for all kinds of efficiency during the study period. Four conventional banks BAL, NCCBL, PRBL and SEBL have been able to maintain efficiency scores one for the five years period with respect to three kinds of efficiency. Therefore, both generation banks can become efficient or inefficient irrespective of their years of operation. In other words, there is no specific relationship between the years of operation and its performance. This finding is consistent with that of Haque (2013). Overall, the analysis indicates a very prospective and bright future for both kinds of commercial banks operating in Bangladesh.

5.4 Returns to Scale

From microeconomic point of view, the one of the basic objectives of a firm is to operate at the optimal scale of production. In the short-run, firms might operate under IRS or DRS but in the long- run they move towards CRS to compete in the market. A DMU exhibits DRS when a percentage increase of inputs produces a less than proportional amount of outputs. Conversely, a DMU exhibits IRS when a percentage increase in inputs produces a more than proportional amount of outputs. Further, a DMU exhibits CRS produces the optimum or most productive scale of operation.

As shown by Table 9, the number of Islamic banks (Panel A) experiencing economies of scale (IRS) and diseconomies of scale (DRS) are very few. The share of scale efficient banks (operating at CRS) are 71.43% and 57.14% in 2009 and 2010 respectively and increased 85.71% in year 2011 and remained constant up to 2013. The number of efficient banks is consistent from 2011 to 2013 and only one bank has faced IRS and there are no banks in DRS during these three years. It indicates that the majority of Islamic banks have been operating at the efficient scale of operation.

The number of conventional banks (Panel B) has remained constant during 2010, 2011 and 2012 for IRS, DRS and CRS. The percentage share of conventional banks are also same in 2009 and 2013 under CRS but difference is seen in both IRS and DRS. In 2009, the percentage share is 83.33% higher for the banks operating under DRS compared to IRS. Conversely, the percentage share is 60.0% higher for IRS operating banks in year 2013. It seems to be an appropriate strategic option for these banks to reduce their unit costs. On the whole, decreasing returns-to-scale is observed to be the dominant source of scale inefficiency for conventional banks in Bangladesh. Kumar and Gulati (2008) also found the similar results for Indian banking industry.

Table 9. Returns to Scale by Type of Banks, 2009 to 2013

Panel A: Islamic banks

	2009		2010		2011		2012		2013	
RTS	No. of banks	% of share	No. of banks	% of share	No. of banks	% of share	No. of banks	% of share	No. of banks	% of share
IRS	1	14.3	2	28.6	1	14.3	1	14.3	1	14.3
DRS	1	14.3	1	14.3	0	0.00	0	0.00	0	0.00

CRS	5	71.4	4	57.1	6	85.7	6	85.7	6	85.7
Total	7	100	7	100	7	100	7	100	7	100

Panel B: Conventional banks

IRS	1	5.6	4	22.2	4	22.2	4	22.2	5	27.8
DRS	6	33.3	4	22.2	4	22.2	4	22.2	2	11.1
CRS	11	61.1	10	55. 6	10	55.6	10	55.6	11	61.1
Total	18	100	18	100	18	100	18	100	18	100

Panel C: All banks

IRS	5	20	9	36	11	44	5	20	8	32
DRS	7	28	6	24	2	8	5	20	4	16
CRS	13	52	10	40	12	48	15	60	13	52
Total	25	100	25	100	25	100	25	100	25	100

There are both increasing and decreasing trend in IRS and DRS operating banks if all banks (Panel C) in the sample size are considered. The banks operating under CRS have increasing trend from 2010 to 2012 but the rest two years the number remains the same. Furthermore, the number of efficient banks is significantly higher compared to banks operating under IRS and DRS for Islamic, conventional as well as all banks during the study period. It is also observed that the number of banks operating under optimal scale is also higher for conventional rather than Islamic banks and scale inefficiency might be the reason for this. Therefore, it is again proved that scale efficiency is higher for conventional banks rather than Islamic banks.

6. Conclusion

This research seeks to analyze and compare the efficiency of Islamic and conventional commercial banks in Bangladesh by using the DEA method. The technical efficiency of Islamic banks is not satisfactory and scale inefficiency is the main source of technical inefficiency rather than pure technical inefficiency. The deterioration of scale efficiency of Islamic banks is exactly equal to the technical inefficiency.

However, the Islamic banks are more pure technically efficient throughout the study period compared to conventional banks and their efficiency scores have been recorded one in most of the years. These findings indicate that Islamic banks in Bangladesh have been operating at the right scale of operation during the study period. The annual average scores of technical efficiency for conventional banks are better than Islamic banks and consistent for five years review period. The mean scale

efficiency of conventional banks was higher rather than Islamic banks during the five years. It means conventional banks were operating at the wrong scale of operation. But their pure technical efficiency is also close to scale efficiency scores. The number of efficient banks is significantly higher compared to banks operating under IRS and DRS for Islamic, conventional as well as all banks during the study period. The most of Islamic banks have been operating at the optimal scale of operation. Contrarily, decreasing returns to scale is the dominant factor for scale inefficiency for conventional banks. They have to decrease their input cost and wastage to become more efficient.

Overall, the technical, pure technical and scale efficiency scores are satisfactory and consistent during the review period for the industry as a whole. The efficiency scores are close to one for all banks all years suggest that the competition among the banking industry is very intense in Bangladesh. Both second and third generation banks have been able to prove their efficiency in recent years. Actually, no relationship is found between the efficiency scores and the years of operation.

The findings of this study have provided updated information and the current context of Bangladesh banking industry. Several important implications regarding the Bangladesh banking industry can be derived from this study. The overall industry experienced a good score in efficiency with few exceptions. It is also noted that there have been some developments of banking operations and technologies used by conventional banks in recent years. This has been further enhanced to start online banking, automated teller machine (ATM), credit card and debit card. These facilities and innovation might make commercial banks more efficient in recent years. These findings are supported by Yasmeen (2011) and she got the same results for banking industry in Bangladesh. In other words, Islamic banks are still lag behind to implement this kind of facilities compared to conventional banks. Both Islamic and conventional banks should be able to implement the advance technology efficiently with good management and optimal scale of operations.

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