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Determinants of Efficiency of the Islamic Banks of Bangladesh during 2008-2012

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Abstract

Applying the Data envelopment Analysis (DEA), this paper, first, estimated technical efficiency (TE), pure technical efficiency (PTE), and the scale efficiency (SE) of the Islamic banks of Bangladesh during 2008-2012. The DEA results found that the average TE, PTE, and SE score ranged between 98.4 percent and 99.5 percent, 99.6 percent and 99.7 percent, and between 98.4 percent and 99.8 percent respectively. Second, the paper applied Tobit for estimating the significant factors determining the efficiency of the Islamic banks of Bangladesh during 2008-2012.The Tobit results showed that the efficiency of Islamic bank was positively related to the capital adequacy (EQTA), the number of bank branches (BRANCH), and negatively related to the poor loan quality (LLTA), higher liquidity claim (DEPLOAN), and the bank size (BKSIZE).

JEL Classification: G21; G28

Keywords: Bank efficiency, commercial Bank, DEA, Bangladesh

1. Introduction

This study focuses on the determinants of the efficiency of the Islamic banking sector of Bangladesh. The examination bank efficiency and the efficiency factors are important for several reasons. First, the productive efficiency of banks is of great interest to regulatory authorities, bank managements and bank depositors and borrowers. All of them is interested to know the productive efficiency of banks. In a competitive market environment, bank depositors and borrowers are certainly interested to know the efficiency status of individual bank before they deposit their hard-earned savings. Borrowers of bank are most likely to approach banks which are more efficient in advancing loans.

Second, Islamic banking is a new phenomenon. As a new breed of banks, Islamic banks do not deal with interest in business transaction and are competing with centuries-old conventional banks. Interest, the corner stone of the conventional banks, is prohibited in Islamic banking. This prohibition of interest is based on the Quran and hadith. The prohibition of interest has led Islamic banks to innovate a new device called the profit and loss sharing (PLS). Instead of charging fixed interest in loan financing the Islamic banks are engaged in PLS in all banking transactions. Islamic banks' assets are growing globally. Paul Koster, Chief Executive of DFSA said the Islamic finance industry was set to grow from $700 billion to $4 trillion by 2013, and despite the global financial crisis (GFC), Islamic banking was still projected to grow by 15-20 percent annually (Koster,2009). Islamic banking is not only growing in the Muslim countries or Muslim majority countries but alsobecoming popular in the Western world (Samad, 2006). Since Islamic banking is recent phenomenon, it deserves the exploration of its efficiency study.

Third, the efficiency study of Bangladesh Islamic banking was more pressing. Bangladesh is a Muslim majority country and was born in 1971. Although Bangladesh is a Muslim majority country, there was no single Islamic bank until 1983. Now there are seven Islamic banks operating side by side with the conventional banks of Bangladesh.

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Islami Bank of Bangladesh Ltd, established in 1983, is the third largest bank in the banking sector of Bangladesh. Six other Islamic banks are ICB Islamic Bank Ltd, Al Arafa Islamic Bank LTD, Social Security Islamic Bank LTD, First Security Islamic Bank Ltd, EXIM Bank Ltd, and Shahjalal Islamic Bank Ltd. All of these bank are not only competing with their counterpart conventional banks but also competing with among themselves for market share. So, the study of their technical efficiency is important for bank management in determining their relative efficiency position in the market.

Fourth, the identification of efficiency determinants is important for resource allocation and policy prescriptions. Bank resources are scarce and have an opportunity cost. In the competitive market, a bank cannot afford to have misuses of resources. Increased efficiency not only increases bank profits but also elevates market shares. Inefficient bank cannot survive. So, the study is very important for all parties, bank management, bank customers, and bank regulators. The paper aims to contribute to the banking literature by identifying factors that were significant in determining the technical efficiency (TE) of the Islamic banking of Bangladesh. This paper is organized as: a brief characteristic feature of the Islamic bank is outlined in section 2. Section 3 provides the survey of the literature. Data, methodology, and models are discussed in section 4. Section 5 provides empirical results. Conclusions are presented in Section 6

2. Key Characteristic Features of Islamic Bank

The Islamic bank is a different breed of the financial institution. The basic operating principles of the Islamic bank are derived from the Quran and Sunnah, the corner-stone of Muslims' way of life. All activities including the banking business are guided by the Quran and the Sariah law.

Among distinguishing characteristics of Islamic banks, first, Islamic banks do finance or engage in activities that are harmful to people. Islam prohibits the consumption and production of any harmful activity such as wine, opium, alcohol, and destructive weaponry, etc. Islamic banks do not finance the production and consumption which are repugnant to mankind.

Second, the most unique feature of Islamic banking is the avoidance of riba (usury) in all financial transactions. This is because, the Quran, the Divine book of Islam strongly prohibits riba in business transactions. The Quran says: "… whereas Allah permitted trading and forbidden riba" (Quran: 2: 275). However, neither the Quran nor the Prophet of Islamic did define what riba is[2]. At present, riba is interpreted as interest. The present scholars of Sariah agreed that the predetermined fixed rate of return is not permitted in the business transactions of the Islamic bank and financing.

Third, the prohibition of riba (usury) in Islam, gave birth the rise in profit and loss sharing (PLS) mode of production. This is the most important characteristic of the Islamic banks that distinguishes the Islamic banks from the interest-based conventional banks. The key features of profit and loss sharing (PLS) is that (i) both parties (bank and borrower) share the outcome of business venture (profit or loss). Unlike conventional bank equity contracts where banks do not bear the risk of financing investments, Islamic banks share the risk of investment. That is, if there are losses, Islamic banks share the losses of investments (ii) Unlike conventional banks' equity contracts where banks enjoy the fixed rate of return from investments, even when there are losses for the project, there is no predetermined rate of returns on investments for Islamic banks. Justice requires that both partners of business must share the risk of the business. Thus, the PLS, avoiding of fixed interest, and Sariah based business conduct are key features of the Islamic banks and financing.

3. Review of Literature

The survey of the efficiency literature of Islamic banks is presented in two broad categories. Category A. Efficiency of the Islamic banks. B. Efficiency determinants of the banks/Islamic banks. Important studies in the category of A include the followings: El-gamal and Inanoglu (2004) estimated the comparative cost efficiency of the Turkish banks for the period 1990-2000 using the data envelopment analysis (DEA) method. They found that the Islamic banks were more efficient due to Islamic banks' asset-based financing.

[2][Umar b. al-Khattab said, "There are three thing:. If God's Messenger had explained them clearly, it would have been dearer to me than the world and what it contains: (These are) *kalalah*, *riba*, and *khilafah*." (*Sunan Ibn Majah*, Book of Inheritance, Vol. 4, #2727;

Sufian and Majid (2006) investigated the comparative efficiency of the foreign and domestic banks of Malaysia during 2001-2005. They found that banks' scale inefficiency dominated pure technical efficiency during the period. They also found that the foreign banks had higher technical efficiency than the domestic banks.

Kumar and Gulati (2008) examined the technical, pure technical and scale efficiencies of the 27 public sector banks of India just for 2004. The empirical evidence of the paper shows public sector banks operated at 88.5 percent level of TE i.e. the inefficiency was 11.5 percent. Only 7 banks were technically efficient. The regression results of the paper found that the off-balance activities positively affected the Indian bank efficiency.

Samad (2013) investigated the efficiency of Islamic banks using the time-varying Stochastic Frontier function on the Islamic banks of 16 countries. Mean efficiencies between the pre-global financial crisis and the post-global crisis were estimated at 39 and 38 percent respectively and the difference was not statistically significant suggesting that the efficiencies of Islamic banks did not deteriorate during the global financial crisis.

Samad (2013) empirically estimated the technical efficiencies (TE) of Islamic banks of Bangladesh and compared these with conventional banks in deposit mobilizations and loans production for 2010. TE was estimated applying the stochastic frontier production function. The paper found the mean TE of Islamic banks and conventional banks for loans were 59.6 percent and 62.8 percent respectively, and for deposits, the mean efficiency was 0.61 and 0.60 respectively. Parametric tests such as Satterthwaite-Welch t-test, ANOVA F-test, and Walch F-test, found no statistical evidence of significant differences between the TE of Islamic and conventional banks.

Samad (2107) estimated the loan and the deposit efficiencies of the Islamic banks of Malaysia during 2008-2012 applying the Data Envelopment Analysis (DEA) technique. Between the two production efficiencies, the study found that the Islamic banks of Malaysia enjoyed the higher TE in deposit mobilizations than in the loan financings. The average technical efficiency of loan was 83 percent, 88 percent, 87 percent, 97 percent, and 94 percent in 2008, 2009, 2010, 2011, and 2013 respectively whereas the average technical efficiency in deposit mobilizations was 87 percent, 94 percent, 94 percent, 96 percent, 92percent, and 96 percent in 2008, 2009, 2010, 2011, and 2012 respectively. Whereas in loan financing, only four banks in 2008, two banks in 2009, three banks in 2010, two banks in 2011-2012 were efficient both technically and scale-wise. On the other hand, in deposit mobilization, four banks in 2008 and 2009, five banks in 2010 and 2011, three banks in 2012, and five banks in 2013 were efficient technically and scale-wise. Most of the Islamic banks operated below the optimum scale of production.

Applying both parametric method (SFA) and non-parametric frontier methods (DEA) in assessing the cost, profit, allocative, technical, pure technical and scale efficiency of 43 Islamic banks in 21 countries from Middle East, Asia, Africa and Europe over the period 1995-2001, Hassan (2006) found that Islamic banks were more cost inefficient than profit inefficient meaning that Islamic banks were more efficient in profit-making and technical inefficiency dominated the scale efficiency. His study confirmed the findings of Yudistira (2004) who examined the cross-country technical efficiency of 18 Islamic banks of GCC, East Asian, African and Middle Eastern countries during the period 1997-2000 and found that the overall technical inefficiency score of Islamic banks was on average just over 10%.

Sufian and Noor (2009) applied panel DEA method and estimated the technical efficiencies of the MENA Islamic banks and the Asian Islamic banks and then compared their technical efficiency over the period 2001-2006. They found that the efficiency score of the MENA Islamic banks was higher than the technical efficiency of the Asian Islamic banks. Pure technical inefficiency was less prominent than the scale inefficiency i.e. scale inefficiency was the major source of inefficiency.

Using DEA Noor and Ahmad (2012) investigated the efficiency of 78 Islamic banks operating in 25 countries during the period 1992–2009 and found that the technical efficiency of many Islamic banks in the world has increased during and after the global financial crisis period. According to the financial crisis has decreased trust in the conventional banking system in favor of the Islamic banking model. They further found that the pure technical efficiency scores of sampled Islamic banks were higher than their scale efficiency scores which contradicted the findings of Sufian and Noor (2009) and Yudistira (2004).

Using the data of 25 Islamic banks in GCC countries for the period 2003-2009 and applying DEA, Srairi and Kouki (2012) found: (i) the overall technical inefficiency of GCC Islamic banks was the result of pure technical

inefficiency (29.3%) rather than that of the scale inefficiency (17%). (ii) The overall technical efficiencies of the Islamic banks increased during and after the global financial crisis.

Applying the DEA method, Rahman and Rosman (2013) and Rosman et al. (2014) compared the technical efficiency levels of Middle Eastern Islamic banks with those of their Asian counterparts over periods 2007-2009 and 2007-2010, respectively and found the technical efficiency of Middle Eastern Islamic banks declined, while the technical efficiency of the Asian Islamic banks increased.

Hassine and Limani (2014) examined 22 MENA Islamic banks over the period 2005-2009 found that the pure technical inefficiency was the main source of Islamic banks' technical inefficiency.

Bahrini (2016) examined the technical efficiencies of the 33 MENA Islamic banks during and after the global financial crisis using DEA and bootstrap DEA and found that the technical inefficiencies of the MENA Islamic banks were mainly attributed to pure technical inefficiencies (17.9%) rather than scale inefficiencies (9.1%).There are relatively a few studies on the determinant of the efficiency of Islamic banks compared to efficiency studies of the Islamic banks.In 2009, Sufian (2009) made another study in estimating the various efficiencies and the determinants of these efficiencies of Malaysian. His studies found that the efficiencies were negatively related to bank expenses and economic conditions, while the efficiencies were positively related to loan intensity.

Zelenyuk (2015) using bootstrap DEA and then used truncated regression with double bootstrap (Simar and Wilson, 2000) for determining bank inefficiencies of Ukraine banks with a particular focus on foreign banks. Among various bank-specific factors, equity-asset and log assets were significant factors and they affected the inefficiency of bank negatively. 100% foreign ownership bank was more efficient than the locally owned banks. Equity capital has a positive impact on bank efficiency.

Nafla and Hammas (2016) compared the technical efficiencies of Islamic banks vis-à-vis conventional banks of eight countries and then determined the determinants of the technical efficiencies using DEA and Tobit model. They found that the asset quality of the Islamic banks had a positive impact during the crisis.

Ftiti, Nafti, and Sreiri (2013) investigated the constant return scale (CRS) and variable return scale (VRS) efficiency of the Islamic bank in GCC countries around the subprime crisis of 2008 using the Data envelopment approach (DEA) and then applied a regression panel analysis to examine the relationship between efficiency scores derived from the DEA to a set of explanatory variables combined (macroeconomic variables and microeconomic variables). Their main finding was that the Islamic bank remained efficient under subprime crisis

Assaf *et al* (2011) analyzed the technical efficiency of Saudi banks using a two-stage DEA-data envelopment analysis approach. Using the bootstrapped truncated regression model they found, among significant internal factors, bank efficiency was positively related to ROA and liquidity.

Ahmad *et al.* (2015) estimated the technical efficiency score and the sources of technical efficiency of the conventional banking sector of Pakistan by applying the DEA double bootstrap technique. Applying the bootstrapped truncated maximum likelihood regression model to determine the sources of technical efficiency, they found bank size was irrelevant for technical. Bank liabilities were negatively and significantly affected the efficiency of banks. Privately owned banks significantly perform better than public sector banks in terms of efficiency scores. Privately owned banks significantly perform better than public sector banks in terms of efficiency scores.

To sum: (i) There are more studies on the technical efficiencies of the Islamic banks than there are studies on the determinants of the efficiency of Islamic banks (ii) There is no study on the technical efficiencies as well as on factors determining technical efficiencies of the Islamic banks of Bangladesh. So, this study is an important contribution to the Islamic banking efficiency literature.

4. Data, Methodology, Model and Specification of Variables

4.1 Data

This study covers the period 2008-2012. Banks' input and output data related to efficiency estimates as well as efficiency determinants variables were obtained from Bank-Insurance and Financial Institutions Activities published by the Division of Banks and Financial Institutions of the Ministry of Finance, Government of Bangladesh. The value of variables is in local currency (TK) and in million except labor.

4. 2 Methodology

First, Data Envelopment Analysis (DEA) was employed in estimating the efficiency of Bangladesh banking industry during 2008-2012. Second, Tobit regression was, first, run on each year's technical efficiency and then it was run on the pooled data of technical efficiency for determining significant factors. There are two approaches for obtaining the efficiencies of any decision making unit (DMU) such: (i) Stochastic frontier function/method (SFM) developed byAigner, Lovell, and Schmidt (1977) and later refined by Pitt and Lee (1981) and Batties and Colie (1992). The SFM is a parametric approach. (ii) Data Envelope Analysis (DEA) method.

The DEA is a linear programming technique, originally developed by Charnes et al. (1978), for constructing the *best practice* frontier from the observed inputs and outputs of all the sampled Decision-Making Units (DMUs). By comparing DMUs outside the frontier (inefficient DMUs) with those that lie on the frontier (efficient DMUs), this method can provide efficiency measures for each DMU (Coelli et al., 2005). The DEA has two versions. The DEA model proposed by Charnes, Cooper, and Rhodes (1978) is known as the CCR model. It measures the efficiency of the DMU under the assumption of constant returns to scale (CRS). As all DMUs do not operate under the CRS, Banker, Charnes, and Cooper (1984) proposed a DEA model called the BCC model. The BCC model assumes that DMUs operate under a variable return to scale (VRS) (increasing, constant or decreasing returns to scale.

The difference between the CCR and BCC models can be illustrated by the following graph:

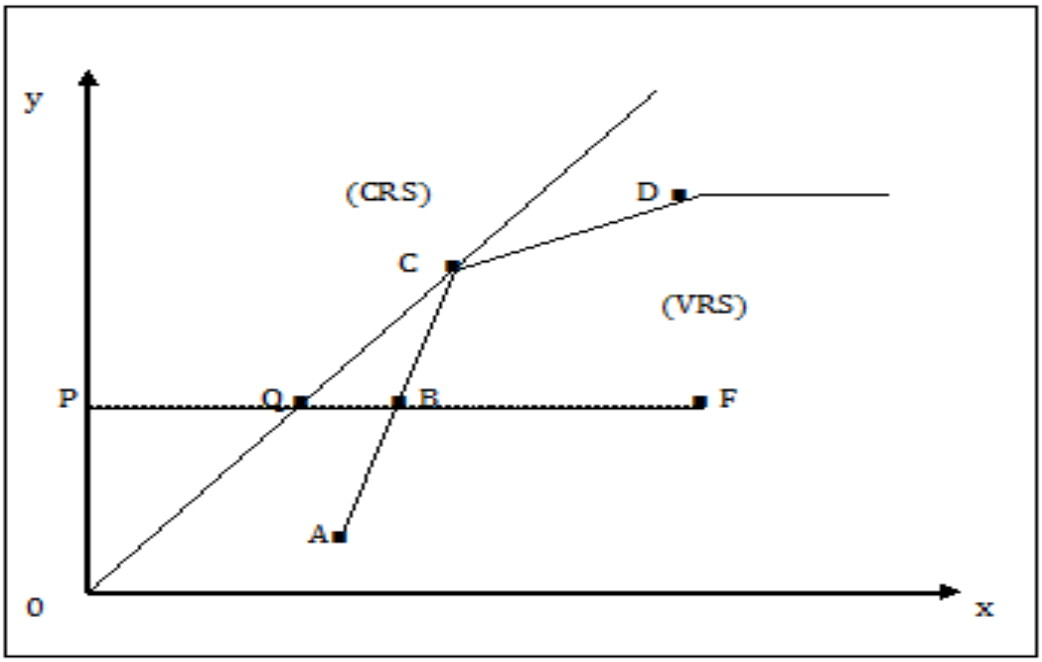

Figure 1: CRS and VRS efficiency frontiers (Coelli et al, 2005).

The line through the points Q and C represents the CRS efficiency frontier and the curve (ABCD) represents the VRS efficiency frontier. Each DMU that is on the frontier is technically efficient. For this reason, the particular DMU "F" is technically inefficient. When we refer to the CRS frontier, the distance FQ measures the technical inefficiency of the DMU "F". However, when we consider the VRS frontier, the technical inefficiency of the DMU "F" is only the distance FB. The difference between the CRS and the VRS frontiers is the distance QB which is a measure of scale inefficiency.

The overall technical efficiency score (under the CRS frontier): TE_{CRS} = PQ/PF
The pure technical efficiency score (under VRS frontier): TE_{VRS} = PB/PF
The scale efficiency score: SE = PQ/PB

From this, we can deduce that TE_{CRS}= TE_{VRS} x SE which means that the overall technical efficiency (OTE) of a particular DMU is the product of two efficiencies: pure technical efficiency (PTE) and scale efficiency (SE).Suppose that there are nDMUs to be evaluated. Each DMUj, *j =1, …., n* uses *m* different inputs, noted *(i = 1, . . ., m),* to produce *s* different outputs, noted *(r = 1, . . ., s).* The technical efficiency score for a particular DMU, called

DMUo, is determined by solving the following linear programming problem. The technical efficiency score $\theta$for a particular DMU, called DMUo, is determined by solving the following linear programming problem:

$$\begin{aligned} \theta^* &= \text{Min } \theta \\ \text{s.t. } \sum_{j=1}^{n} \lambda_j x_{ij} &\leq \theta x_{io} \qquad i = 1, \dots\dots, m; \\ \sum_{j=1}^{n} \lambda_j y_{rj} &\geq y_{ro} \qquad r = 1, \dots\dots, s; \\ \lambda_j &\geq 0 \qquad j = 1, \dots\dots, n; \end{aligned} \tag{1}$$

$\theta < 1$ Means that the evaluated DMU is technically inefficient. $\theta = 1$ Indicates a point on the frontier and hence a technically efficient DMU. In order to estimate the efficiency scores of all the DMUs in the sample, the above problem must be solved n times, once for each DMUj*, j =1, n* (Coelli et al., 2005).The efficiency score, θ (PTE), TE, and SE of each DMU (each bank) is presented in the empirical section.

4.3 Input-Output Controversy and model selection

In a production firm such as coal mine, inputs and outputs are easy to find. The output is the amount of coal and the inputs are labor and capital. However, in the multiproduct firms such as a bank which produces a series of services and uses a vector of inputs, deciding inputs and outputs are controversial. Which are the bank's inputs and which are the bank's outputs are a debatable issue for a long time. Based on production approach (Benston, 1965), a bank is a producer of services for the bank account holders and it produces deposit accounts and loan services with labor and capital. In this sense, the number of deposit account or deposits can be used as output. Depositors' income which is equivalent to interest paid to depositors is an important factor for mobilizing total deposits. Under the intermediation approach, first used by Sealey and Lindley (1977), the bank is a financial intermediary which collects deposits from the savers and channels funds to borrowers. It treats earning assets as outputs and deposits as inputs. In this sense, loans, investments in securities, and advances are the outputs of a bank and labor, capital, deposits, and expenses related to them are inputs of a bank

4.5 Estimated Efficiency Model

Based on the definition of intermediate method, provided above, the estimated model is:

$Loan_{it} = \alpha_0 + \alpha_1 L_{it} + \alpha_2 K_{it} + \alpha_3 Dep_{it}$ (1)

Where L= labor of i^{th}bank in t^{th}period, K = Capital of i^{th}bank in t^{th} period, and Dep = Deposit of i^{th} bank intth period. All values are in million Taka, the local currency of Bangladesh, except labor. Variables are expressed in natural log for estimating the model. The descriptive statistics of the variables of model is provided in Table 2.

Table 2Descriptive Statistics of the Inputs and output Variables of Model

	LABOR	FIXED CAPITAL	DEPOSITS	LOANS& AD	INVESTMENT 0
Mean	2630.943	1982.554	93673.80	88419.94	5296.452
Median	1440.000	968.0000	62965.00	61440.00	3483.000
Maximum	12188.00	14816.00	417744.0	361168.0	20710.00
Minimum	623.0000	184.0000	12381.00	11007.00	11.00000
Std. Dev.	3353.721	2893.343	96045.20	83875.38	5198.151
Skewness	2.035634	2.957170	1.928841	1.749667	1.341889
Kurtosis	5.405165	12.47650	6.181792	5.598250	4.019414
Jarque-Bera	32.60838	181.9758	36.46636	27.70285	12.01940
Probability	0.000000	0.000000	0.000000	0.000001	0.002455
Sum	92083.00	69389.40	3278583.	3094698.	185375.8
Sum Sq. Dev.	3.82E+08	2.85E+08	3.14E+11	2.39E+11	9.19E+08

Observations	35	35	35	35	35

The probability of Jarque-Bera shows that all variables are not normally distributed.

4.6 Estimated Tobit Model

Once the efficiency of each DMU is obtained, Tobit model is applied in determining the factors that have significant impact on the efficiency of banks. Two models are estimated for determining the significant factors: (1) CAMEL model (2) CAMEL PLUS model. The CAMEL Plus model consists of CAMEL variables along with other bank specific internal variables. The estimated CAMEL model and CAMEL plus model are provided in (EQ 2) and (EQ 3) respectively:

$Eff_{bkit} = \alpha_0 + \alpha_1 EQTA_{it} + \alpha_2 LLOSTA_{it} + \alpha_3 ROA_{it} + \alpha_5 EXPSTA_{it} + \alpha_6 Loandep_{it} + \upsilon_{it}$ (EQ 2)

$Eff_{bkit} = \alpha_0 + \alpha_1 EQTA_{it} + \alpha_2 LLOSTA_{it} + \alpha_3 ROAit + \alpha_5 EXPSTA_{it} + \alpha_6 Londe_{it} + \alpha logTA_{it} + \alpha_7 BRNC_{it} + \upsilon_{it}$ (3)

Where Eff_{bkit}= i^{th}bank efficiency in $t^{th\ period}$, $EQTA_{it}$=i^{th}bank equity capital as a percentage of total assets in $t^{th\ period}$, $LLOSTA_{it}$ = i^{th}bank's total loan loss as a percentage of total assets in $t^{th\ period}$, ROA_{it}= i^{th}bank net profits as a percentage of total assets in $t^{th\ period}$, $EXPSTA_{it}$= i^{th}bank total operating expenses as a percentage of total assets in $t^{th\ period}$, $Loandep_i$= i^{th}bankstotal loans as a percentage of total deposits in $t^{th\ period}$, $logTA_{it}$ = natural log of bank's total assets, and $BRNC_{it}$ = number of branch of i^{th} bank in t^{th} period.

The definition of all variables of model 2 and model 3 and the expected impacts of these variables on the efficiency of bank are provided in Table 1

Table Index of CAMEL and CAMEL PLUS Variables and Their Expected Impact on Efficiency		
Variables	Index of Measure	Expected relation with efficiency
Capital Adequacy	EQ/TA:	(+,-) Bank efficiency may increase if the equity capital is transformed into loan advances and investment, otherwise it may decrease efficiency
Asset quality	LLOSS/TA	(-) Loan losses are heavy burdens on bank's assets. It decreases bank's efficiency.
Management quality	ROA	(+) Bank efficiency increases with higher profits/return on
Efficiency (cost)	EXPENSE/TA	(-) A higher cost to generate per dollar asset decreases bank efficiency
Liquidity Index	Loan/Deposit	(+) A higher percentage of loans out deposit increases efficiency in loan production by decreasing bank's liquidity
Bank Size	Natural log of TA	(+, -) Efficiency may increase if economies of scale arise when the bank size is optimum. Otherwise efficiency decreases when a bank size is large and generates diseconomies of scale

5. Empirical Results

5.1.1 Technical Efficiencies (TE)

The TE is the combination of pure technical efficiency (PTE) and scale efficiency (SE). TE is also called the overall technical efficiencies. Thus, there are two sources of technical inefficiencies (TIE)[3]. It may arise due to pure technical inefficiencies (PTIE)[4] i.e. misallocation of inputs and inefficiencies or it may arise due inappropriate bank size, i.e. scale inefficiency (SIE)[5]. The TE score of the banking industry of Bangladesh is provided in Table 2

Table 2. Description of TE of All Islamic Banks of Bangladesh during 2008-2012

TE of Islamic Banks					
Banks	2008	2009	2010	2011	212
Islamic Bank Bangladesh LTD	0.998	0.971	1	0.995	0.999
ICB Islamic Bank Ltd	1	1	0.955	1	0.992
Al Arafa Islamic Bank LTD	0.995	0.998	0.951	0.977	0.989
Social Security Islamic Bank	0.983	0.980	1	0.999	0.992

[3] TIE = (1-TE)*100

[4] PTIE = (1- PTE)*100

[5] SIE = (1-SE)*100

LTD					
First Security Islamic Bank Ltd	1	1	0.991	0.984	0.995
Shahjalal Islamic Bank Ltd	0.992	0.996	0.951	0.982	1
EXIM Bank Ltd	1	1	1	1	1
Mean	0.995429	0.992143	0.984000	0.989714	0.995286
Maximum	1.000000	1.000000	1.000000	1.000000	1.000000
Minimum	0.983000	0.971000	0.951000	0.977000	0.989000
# of efficient bank (%)	3 (42.8%)	3(42.8%)	3(42.8%)	2(28.5%)	2(28.5%)
# below mean (%)	2(28.5%)	2(28.5%)	3(42.8%)	3(52.8%)	2(28.5%)
# above mean (%)	4(57.1%	5(71.4%)	4(57.1%)	4(57.1%)	3(42.8%)

The mean TE efficiency ranged between 98.4 percent and 99.5 percent during 2008-2012. The minimum TE was 95.1 percent and the maximum TE was 100 percent. Among technically efficient banks, EXIM bank ranked first as its efficiency was 100 percent in all five years during 2008-2012. ICB Islamic bank and First Security Bank ranked second and third respectively. The number of technically efficient banks ranged between two and three i.e.28.5 % and 42.8%The percentage of bank operated below the average technically efficiency ranged between 28.5 percent and 52.5 percent. On the other hand, the percentage of banks operating above the mean efficiency ranged between 42.8 percent and 71.4 percent.

5.1.2 Pure Technical Efficiencies (PTE)

The PTE is called the managerial efficiency. The (1 – PTE) is the pure technical inefficiency (PTIE) which results from managerial underperformance. PTIE arises due to poor input utilization (Kumar and Gulati (2008). The descriptive statistics of the PTE score of the banking industry of Bangladesh is provided in Table 3.

Table 3. Description of PTE of All Islamic Banks of Bangladesh during 2008-2012

PTE of Islamic Banks					
Banks	2008	2009	2010	2011	212
Islamic Bank Bangladesh LTD	1	1	1	1	1
ICB Islamic Bank Ltd	1	1	1	1	1
Al Arafa Islamic Bank LTD	0.996	1	0.991	0.998	0.989
Social Security Islamic Bank LTD	0.99	0.986	1	1	1
First Security Islamic Bank Ltd	1	1	1	0.996	0.995
Shahjalal Islamic Bank Ltd	0.994	0.997	0.986	0.986	1
EXIM Bank Ltd	1	1	1	1	1
Mean	0.997143	0.997571	0.996714	0.997143	0.997714
Maximum	1.000000	1.000000	1.000000	1.000000	1.000000
Minimum	0.990000	0.986000	0.986000	0.986000	0.989000
# of efficient bank (%)	4(57.1%)	5(71.4%)	5(71.4%)	4(57.1%)	5(71.4%)
# below mean (%)	3(42.8%)	2(28.5%)	1(14.2%)	2(28.5%)	1(14.2%)
# above mean (%)	4(57.1%)	5(71.4%)	6(85.7%)	5(71.4%)	5(71.4%)

The mean managerial efficiency i.e. PTE of the Islamic banks of Bangladesh was relatively stable and it ranged between 99.6 percent and 99.7 percent. The minimum PTE was 99 percent and maximum was 100 percent.

Among Islamic banks, Islamic Bank Bangladesh LTD, ICB Islamic Bank Ltd, and EXIM Bank Ltd ranked first in managerial efficiency (PTE). The PTE of these banks were 100 percent in all five years during 2008-2015. First Security bank and Social security bank stood second. They had 100 percent efficiency in three years out of five years. The percentage of bank operated below the average pure technical efficiency ranged between 14.2 percent and 42.8 percent. On the other hand, the percentage of banks operating above the mean efficiency ranged between57.1 percent and 71.4 percent.

5.1.3 Scale Efficiency

Table4. Description of Scale Efficiency (SE) of All Islamic Banks of Bangladesh during 2008-2012

SE of Islamic Banks					
Banks	2008	2009	2010	2011	212
Islamic Bank Bangladesh LTD	0.998 DRS	0.971 DRS	1 CRS	0.995 DRS	0.999 DRS
ICB Islamic Bank Ltd	1 CRS	1 CRS	0.955 IRS	1 CRS	0.992 IRS
Al Arafa Islamic Bank LTD	0.999 DRS	0.998 IRS	0.959 IRS	0.989 IRS	0.999 IRS
Social Security Islamic Bank LTD	0.993 IRS	0.994 IRS	1 CRS	0.999 IRS	0.992 IRS
First Security Islamic Bank Ltd	1 CRS	1 CRS	0.991 IRS	0.987 IRS	0.999 IRS
Shahjalal Islamic Bank Ltd	0.998 DRS	0.999 DRS	0.963 IRS	0.996 IRS	1 CRS
EXIM Bank Ltd	1 CRS	1 CRS	1 CRS	1 CRS	1 CRS
Mean	0.998286	0.994571	0.981143	0.995143	0.997286
Maximum	1.000000	1.000000	1.000000	1.000000	1.000000
Minimum	0.993000	0.971000	0.955000	0.987000	0.992000
# of DRS Bank	3(42.8%)	2(28.5%)	0(0%)	1(14.2%)	1(14.2%)
# of CRS	3(42.8%)	3(42.8%)	3(42.8%)	3(42.8%)	3(42.8%)
# of IRS	1(14.2%)	2(28.5%)	4(57.1%)	4(57.1%)	4(57.1%)

The mean SE ranged between 98.4 percent and 99.8 percent. The minimum SE was 95.5 percent and the maximum was 100 percent.

Among all Islamic banks, EXIX Bank Ltd ranked the first. It was the most scale efficient Islamic bank of Bangladesh. Its scale efficiency was 100 percent all five years during 2008-2012. Its scale size was most efficient as the bank operated under the constant return to scale in all through five years. ICB Islamic bank ranked the second in SE.Islami Bank Bangladesh, the largest Islamic bank of Bangladesh, was not scale efficient. Its scale size was too large as such the bank operated under the decreasing returns to scale i.e. increasing cost. Similarly, Shahjalal Islamic Bank Ltd operated under the decreasing returns to scale in two years. The rest of Islamic banks operated under decreasing returns to scale i.e. decreasing cost.

A comparative summary of TE score and PTE score reveals, from Table 2 and Table 3, the following: (1) The managerial efficiency i.e. PTE of the banks of the Islamic banks of Bangladesh dominates the TE in the Islamic banking sector of Bangladesh. That is, banks of Bangladesh were managerially more efficient than TE. This is reflected from the fact the mean PTE ranged from 99.6 percent to 99.7 percent whereas the mean TE fluctuated between 98.4 percent and 99.5 percent. (2) The Islamic banking banking sector of Bangladesh is dominated by the DRS and IRS. From 0 percent to 42.8 percent of the Islamic banks of Bangladesh operated under the DRS during 2008-2012 compared to 14.2 percent to 57.1 percent of banks which operated under the IRS.

5.2.1 TE Tobit Regression Results

Two Tobit regressions were run. First, Tobit regression was run for determining the significance of CAMEL variables. The results of CAMEL model was presented in Table 4.

Second, Tobit was run in determining the significance of bank internal factors along with CAMEL factors. The results of this CAMEL Plus model is provide in Table 5.

Table 5. TE Regression Results of CAMEL Model

```
Tobit regression                                  Number of obs     =         35
                                                  LR chi2(5)        =      12.12
                                                  Prob > chi2       =     0.0332
Log likelihood =  53.582985                       Pseudo R2         =    -0.1275

------------------------------------------------------------------------------
      VRS_TE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      EQTA08 |   .0059221   .0077818     0.76   0.453    -.0099703    .0218146
      LLTA08 |  -.0405006   .0220427    -1.84   0.076    -.0855179    .0045167
       ROA08 |  -.1045323   .1645014    -0.64   0.530     -.440489    .2314244
   EXPNSTA08 |   .1492385   .2064584     0.72   0.475    -.2724058    .5708827
Deploan|  -.0550585   .0359156    -1.53   0.136    -.1284081     .018291
       _cons |    1.04153    .044821    23.24   0.000     .9499937    1.133067
-------------+----------------------------------------------------------------
      /sigma |   .0228858   .0033885                      .0159655    .0298061
------------------------------------------------------------------------------
*=significant at 1 percent level, **=significant at 5 percent level, ***=significant at 10 percent level
```

Table 4 shows that none of the CAMEL variables except the LLTA (asset/loan quality) were significant. The sign of asset quality (LLTA) was negatively related to bank efficiency and is consistent as per theory. The higher amount of loan loss reduces the loan efficiency of the Islamic banks by 4 percent during 2008-2012.
The 0.03 probability of LR Ch^2 suggests the significance of regression model. The model explains 12.75 percent of the efficiency.

Table 6. TE Regression Results of CAMEL PLUS Model

```
Tobit regression                                  Number of obs     =         35
                                                  LR chi2(7)        =      20.56
                                                  Prob > chi2       =     0.0045
Log likelihood = 57.803801                       Pseudo R2         =    -0.2163

------------------------------------------------------------------------------
      VRS_TE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      EQTA08 |   .0170032   .0077345     2.20**   0.036     .0011599    .0328466
      LLTA08 |  -.0433812   .0195979    -2.21**   0.035    -.0835257   -.0032366
       ROA08 |   .0927604   .1578333     0.59   0.561    -.2305464    .4160672
   EXPNSTA08 |   .1134596   .1764801     0.64   0.526    -.2480434    .4749626
Deploan|  -.0770302   .0282803    -2.72**0.011    -.1349597   -.0191007
logBKSIZE|  -.0262911     .00944    -2.79**0.009    -.0456281   -.0069541
  Branches08 |   .0003428    .000117     2.93**   0.007     .0001031    .0005824
       _cons |   1.314724   .1069273    12.30**   0.000     1.095693    1.533755
-------------+----------------------------------------------------------------
      /sigma |   .0201155   .0029565                      .0140593    .0261716
*=significant at 1 percent level, **=significant at 5 percent level, ***=significant at 10
percent level
```

Table 5 shows that both CAMEL and other bank specific variables did have impact on the efficiency of Islamic banks during 2008-2012. Among the CAMEL variables, capital adequacy (EQTA), asset quality (LLTA), and bank liquidity (DEPLOAN) were significant factors.

The signs of these variables were consistent as per expectation of the model. The amount of Loan loss as a percentage of total assets (LLTA) negatively impacted the efficiency of the Islamic banks of Bangladesh by 3.4 percent. The higher amount of loan losses the lower the asset quality and, thus, the loan efficiency. The higher

amount of equity capital to the total bank assets (EQTA) positively impacted the efficiency of the Islamic banks by 1.7 percent. The higher amount of equity capital enhances bank capital adequacy and lending ability.

The higher deposit to loan ratio (DEPLOAN), means more deposits claims are outstanding out of every dollar loan which negatively affected loans. In other words, bank faces more liquidity problems. The higher liquidity claim by depositors led to decreased loan production by 7.7 percent in Bangladesh during 2008-2012. So, the sign of DEPLOAN was consistent as per the expectation of model. Other than the CAMEL variable, bank size (logTA) and the branches of bank were significant factors affecting the efficiency of Islamic Banks. The negative sign of bank size (LogSize) indicated diseconomies of bank in loan. The bank size negative affected the loan production of the Islamic bank by 2.6 percent.

The number of bank branch (BRANCH) of the Islamic banks were positively related to the efficiency of the Islamic banks of Bangladesh. This suggests that the branches of the banks increases the TE of the Islamic banks. The policy implication suggests that banks should reconsider opening new branches.

6. Conclusions

This paper investigated the efficiency of the Islamic banks of Bangladesh and the significant factors that determined the efficiency of the Islamic banks during 2008-2015 employing two stage DEA method. First, technical efficiency (TE), the pure technical efficiency (PTE), and the scale efficiency (SE) score of each bank were obtained by DE.Labor, fixed capital and deposits were used as inputs and loans and advances and investments were used as output of banks. The results of TE score revealed that the mean TE of the Islamic banking industry of Bangladesh ranged between 98.4 percent and 99.5 percent during 2008-2012. This suggests that the technical inefficiency of the Islamic banking sector of Bangladesh ranged between 1.6 percent and 0.5 percent. The DEA results of PTE score shows that the average pure technical efficiency (PTE) of the Islamic banks of Bangladesh, in Table 3, was relatively stable and it fluctuated between 99.6 percent and 99.7 percent during 2008-2012. This suggests that the managerial inefficiency of the Islamic banking sector of Bangladesh ranged between 0.4 percent and 0.3 percent.

A comparative summary of TE score, PTE score, SE score reveals, from Table 2, Table 3, and Table 4 that the PTE of the Islamic banks of Bangladesh dominates the TE. That is, the Islamic banks of Bangladesh were managerially more efficient than TE. This is reflected from the fact the mean PTE ranged from 99.6 percent to 99.7 percent whereas the mean TE fluctuated between 98.4 percent and 99.5 percent. The Islamic banking sector of Bangladesh was dominated by the DRS. Tobit regressions results of CAMEL model revealed that LLTA was the only significant factors affecting the efficiency of the Islamic bank of Bangladesh. On the other hand, the Tobit results of CAMEL Plus model (Table 6) demonstrated that(EQTA), LLTA, DEPLOAN, BKSize, and BRANCH had impact on the efficiency of Islamic banks of Bangladesh.

Capital adequacy (EQTA) and bank branches (BRAMCH) had positive impact on the loan efficiency of the Islamic banks of Bangladesh. The poor credit quality (LLTA), the higher depositors claim of liquid cash (DEPLOAN), and bank size had significant negative impact on the efficiency of the Islamic banks of Bangladesh. The positive coefficient of bank branch (BRANCH) and the negative coefficient of credit quality (LLOSSTA) provides policy implication for bank management. Since bank branches were positively related and LLOSSTA was negatively related to the loan efficiency of the Islamic banks of Bangladesh, the paper provides a policy prescription. The policy implication suggests that bank management should put extra efforts in scrutinizing in loan finances as loan loss provisions as they significantly decreased bank efficiency. Similarly, for banks' opening of a new branch, bank managements should encourage the opening of new branches as they are positively related to increased efficiency. The opening of new branch helped banks' increasing more deposits and more loans and advances.

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