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Credit Risk Management and Efficiency: Evidence from Islamic Banking System in Bangladesh

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The banking industry plays a vital role in the economic system by providing credit facilities to other industries. Banks act as intermediaries of funds in the financial market, and the most vital activities of banks is the assembly and distribution of financial resources to diverse segments of the economy. Administration in this industry has been planned to intensify the efficiency of lending, the credit assessment, and the capacity to pay back the principal and the interest for each customer's credit limit. The recent paper attempts to examine whether credit risk management improves the efficiency of the Islamic commercial banks of Bangladesh. The study has been conducted under four stages of analysis. In the first stage, the nonparametric technique, Data Envelopment Analysis (DEA), was used to measure the efficiency of the Islamic Banks. In contrast, the second stage analyzed the credit risks using financial ratios. The third stage examined the association between credit risk and technical efficiency of the banks from 2015 to 2021 using Pearson Correlation analysis. Finally, the impact of credit risk management on the technical efficiency of the banks was tested by panel data analysis. Finally, the study found Exim Bank Limited to be the most technically efficient bank based on the variables to which they were put to the test. The study's findings also revealed a significant positive relationship between credit risk management and the efficiency of the Islamic banks operating in Bangladesh.

INTRODUCTION

A superior banking system not only acts as the heart of the economy, driving the needed finance to every organ of it but is also accountable for its overall progress and health. As a result, the banking system has complete control over the money circulation in a country. The superior banking arrangement is the foundation of a healthier economy proficient in satisfying the needs of society (Quader et al., 2010).

Due to the expansion of both conventional and Islamic banking, intensive competition among the banks has arisen by providing innovative products and efficient management in resource allocation and saving money. It is a well-known fact that an effective and efficient banking system is essential for long-term growth and crucial for economic development (Gaddam et al., 2009). Thus each bank tries to be more distinctive than the others to achieve a higher market share.

Banks are often confronted with a dual-edged sword of returns and risk in doing their business, and they have to make a perfect balance between the two to survive and generate profit. Banks are consistently encountered diverse sorts of risks that may have a possibly harmful consequence on their business if the idea of risk management is pragmatic to the banking area. The key financial and non-financial risks the banking sector faces are credit, market, liquidity, and operational risks.

Credit risk can be defined as the possibility of losses related to a reduction in the creditworthiness of debtors or counterparties (Nissa & Darzi, 2017), and for the

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survival of the banks, it is the most critical and straightly connected to the major as well as the principal activity of banks. Due to o the recent Global Economic breakdown instigated by the subprime mortgage crisis in the US in July 2007 and its negative effect on financial markets, the significance of credit risk came to the forefront. The bank should now-a-days have an intense consciousness of the necessity to recognize, measure, monitor, and regulate credit risk as well as to govern that they grasp sufficient investment against these risks and that they are effectively reimbursed for risks suffered (Ahmed, 2021).

As credit risk is intrinsic in the financial dealings of banks, they need to be ready to face its influence. Cre t risk management is the humanoid action that assimilates identification of risk, risk calculation, designing policies and strategies to cope with it, and modifying risk using managerial assets and resources. Fail res and weaknesses in financial and banking sectors have prompted policymakers to develop discreet risk management devices.

On the other hand, the emergent competition highlights the banks' ability to function efficiently in the market to survive massive competition while protecting their market share. As a result, the competition has improved the efficiency level and will lead the banks to higher risk levels (Chiu & Chen, 2009).

In a purely competitive market, banking services, including fees, charges, and interest rates, are almost identical, set by the controlling authority Bangladesh Bank. As a result, to survive and earn profit in this competitive market, banks are striving to achieve efficiency. So, efficiency may be the driving force for cost reduction and the competitive superiority of commercial banks.

Though the number of studies conducted on the efficiency of banks in several parts of the world has amplified over the last years (Pastor, 1999**,** Chiu & Chen, 2009; Drake & Hall, 2003; Altunbas et al., 2000), there is a gap in this field of study in Bangladesh. When analyzing bank efficiency, the risk factors should be linked together because banks should be efficient and secure. Risk and efficiency concepts are interrelated (Pastor, 2002). Hence, the Problem of the study is to find "Does risk management improves the bank efficiency"? The paper is organized as follows. Sect on two reviews the literature on efficiency and risk management analysis in banking. Section three and section four describe the hypotheses and objectives of the study, respectively, while section five depicts the study's methodology. Finally, section six reveals the study's findings, and section seven concludes.

The study has been conducted with the following specific objectives:

- To measure the technical efficiency of the selected Islamic banks in Bangladesh;
- To examine the relationship between credit risk management and the technical efficiency of the selected banks.
- To analyze the influence of credit risk management on the efficiency of the Islamic banks under study.

REVIEW OF RELATED LITERATURE

Literature on Banking Efficiency

Many studies in the literature concerning the efficiency of the banking sector using DEA. Efficiency measurement shows whether the banks have used a minimum number of inputs to produce a certain number of outputs or whether they can produce maximum output using a certain number of inputs (Fethi & Pasiouras, 2010).

Berger & Mester (1997) measured the banks' efficiencies in the USA from 1990 -1995 by using econometric efficiency frontier models. According to the study's findings, while the average cost efficiencies of the American banks were at 86%, their average profit efficiency scores were 47%. According to these results, the American banks managed their cost efficiency well, but they suffered from severe shortcomings regarding profit efficiency.

Samad (2004) measured the performance of the Islamic banking sector in contrast to that of the Western system in Bahrain and showed no significant differences between the Islamic & the Western banking system in Bahrain regarding profitability and deposit risk. According to him, the Islamic banks had higher equity ratios than Western banks. The finding suggested that Islamic banks in the study exercised more caution when making loans than their Western counterparts did.

Johnes et al. (2009) measured the efficiency of Islamic versus Western banks through the Cooperation Council of the Arab States within the Gulf of GCC area and found that leaders of Islamic banks were less cost-efficient but more revenue and profit efficient than Western banks. Yasmeen (2011) examines the technical efficiency and productivity growth of various banks in Bangladesh by using DEA. The results show significant variation in technical efficiency and PTE across various banks. Efficiency differences were also observed among public, private, and specialized banks.

In their study, San et al., (2011) used nonparametric DEA to measure and compare the efficiency of foreign and domestic banks in Malaysia from 2002 to 2009 and found that domestic banks have higher efficiency levels than foreign banks. The study also suggested that the pure technical efficiency of banks in Malaysia was mainly affected by capital strength, loan quality, expenses, and asset size.

Momena & Masum (2012) measured the technical, allocative, and cost-efficiency of Islamic banks in Bangladesh from 2006 to 2011 using DEA. They found that EXIM Bank Limited was found to be the most efficient Islamic Bank with an average efficiency score of 0.9992 based on the efficiencies to which they were put to the test and ICB Islamic Bank Limited was found to have the highest lack of efficiency among all the Islamic banks in Bangladesh. Islam et al. (2013) explored the contributions of technical efficiency change to the growth of productivity in the Islamic banking sector. Their findings indicated that smaller-sized Islamic banks are more likely to be more efficient in utilizing their inputs to generate more outputs.

Sufian & Kamarudin (2014) examined the profit efficiency and return to scale in the banking sector of Bangladesh by applying the Slack-based DEA method from the year 2004 to 2011 and found that maximum of the banks of Bangladesh has been undergoing economies of scale because of being at less than the optimal size, or diseconomies of scale due to being at more than the optimal size.

Literature on the relationship between Credit Risk and Efficiency

There have been few studies conferring the risk and efficiency in Islamic banks. For example, Berger & Humphrey (1997) instituted a negative association between cost efficiency and risk in unsuccessful banks. They presented the explanations for this negative relationship that incompetent or inefficient banks, over and above having trouble regulating their inner costs, might have tribulations in evaluating the credit risk so that ghastly management of costs goes jointly with more considerable credit risk. In a very recent study, Idris (2015) measured the efficiency of Islamic banks operating in Bangladesh applying DEA from 2010 to 2013 and found that three banks were technically inefficient during 2012. The study recommended that SIBL, AIBL, and ICB Islamic banks must emphasize the efficient utilization of their resources to remove their unstable efficiency and ensure stable efficiency.

Siddiqui (2008) exposed that Islamic banks in Pakistan have enhanced performance in terms of assets and return established to enhance risk management with keeping safe liquidity. Idries (2012) defined liquidity risk as the likely loss stemming from the bank's failure to either congregate its accountability or fundraise in assets as they fall due without gaining unwanted costs or losses.

In a study, Muhammad et al. (2012) investigated liquidity and credit risk, and their findings suggested that profitability and liquidity management in conventional banking executed better performance than in Islamic banking. Alam (2012) scrutinized the association between risk and efficiency inside the conventional and Islamic banking system and demonstrated that bank inefficiency and risk are positively correlated for conventional banks and negatively correlated for Islamic banks, which underscore the innate dissimilarity between risk-efficiency rapports between these two diverse bank types.

In a study, Fernando & Nimal (2013) addressed whether Sri Lankan banks are efficient and how risk management improves the banks' efficiency and found that risk management has improved the efficiency of the licensed commercial banks in Sri Lanka. In another study**,** Keramati & Shaeri (2014) evaluated the credit risk management and performance management of the 19 banks supervised by the Central bank of Tehran, Arak, and Boroujerd cities, and the results suggested that attention to credit risk management in the banking industry effect on the performance of banks.

In a recent study, Said (2013) examined the correlation between risks and efficiency within Islamic banks in the MENA region and revealed that credit risk and operational risk negatively relate to efficiency. Very recently, Nissa & Darzi (2017) identified several parameters core to the conception of credit risk management in banks and investigated the impact of various credit risk parameters on bank efficiency in India.

Hence, the importance of studying the efficiency of Decision-Making Units (DMUs) has been heavily emphasized in the existing literature, but there is no such study relating to efficiency and credit risk management in Bangladesh. As t is study will consider risk management factors, it will be able to add a significant amount of value to the pool of existing knowledge, especially in Bangladesh, since the literature in Bangladesh in this area has only focused on bank efficiency. Following the study's objectives, the researcher will be able to identify the efficient and inefficient banks in Bangladesh and investigate how risk management factors influence bank efficiency. The study findings will benefit various parties, including the researchers, the educationists, banking policymakers, investors, and the regulatory bodies of banking services in Bangladesh and abroad.

METHODOLOGY

Sample and Data Collection

As the study examines the relationship between credit risk and technical efficiency of Islamic Banks in Bangladesh, the population includes all the Islamic banks operating in Bangladesh. There are eight such kinds of banks, and all the banks enlisted in Dhaka Stock Exchange (DSE) have been selected for the study. The data used in this study is secondary data which has been collected from the published annual reports of the banks for a period of 7 years, from 2015 to 2021. The election of banks and the periods have been determined based on two crucial components- enlistment year in DSE on or before2015 and the availability of the required data of the firms.

Data Analysis

The study has been carried out in four stages. In the first stage, the nonparametric technique, Data Envelopment Analysis (DEA) was used to measure the efficiency of the Islamic Banks. In contrast, the second stage analyzed the credit risks using financial ratios, the third stage examined the correlation between credit risk and efficiency of the banks, and the final stage analyzed whether credit risk management influences the technical efficiency of the banks by developing a regression model.

Statistical Tool for Measuring Efficiency

DEA (Data Envelopment Analysis) was initially instigated by Charnes et al. (1978), based on the work of Farrell (1957), concerning all pros and cons that are indicated by Berger & Humphrey (1997). It is a numerical linear programming approach based on technical efficiency (TE); it can measure and analyze TE of different entities: public and private, productive and non-productive, and for-profit and nonprofit organizations. It is a nonparametric technique that estimates efficiency level by doing a linear program for every element in the sample.

The DEA processes the efficiency of the decision-making unit by evaluating the evaluation with the best producer in the sample to originate related efficiency. DEA submits individual measures of working efficiency to the number of similar objects related to each other, with several sample units forming an organized performance frontier curve that envelops all observations. Hence, this method is called Data Envelopment Analysis. Subsequently, DMUs that lie on the curve efficiently allocate their inputs and generate their outputs, while DMUs that do not lie on the curve are considered inefficient.

The obtainable result for the efficiency in this investigation is overall technical efficiency (Coelli, 1996), the technical efficiency provides evidence about managing and their capacity to shape actions in their bank and discover the most acceptable means to transform inputs into outputs. The full technically efficient bank makes the maximum quantity of outputs from the specified level of resources.

If the technical efficiency analysis is made assuming the Constant Return to Scale (CRS), this kind of efficiency is considered "Overall Technical Efficiency" (OTE). In t e case of CRS, we are starting with the assumption of the optimal level of its capacities. This study uses the input-oriented intermediation approach with different return to scale, which Coelli (1996) presented as a mathematical problem, computing the ratio of all outputs over all inputs such as $u'y_i/v'x_i$ (1)

Where, y_i and x_i are output and input respectively, while the symbol ‘u’ is the Mx1 vector of output weights and ‘v’ is the Kx1 vector of input weights. According to (Coelli, 1996), mathematical formulation of the model for the constant return to scale is:

$\max_{u,v}(u'y_i/v'x_i)$
st $u'y_j/v'x_j \leq 1$, $j= 1,2,\ldots..,N$
$u, v \geq 0$.

One problem with this particular ratio formulation is that it has an infinite number of solutions, so it is necessary to impose a constraint $v'x_i= 1$, and then the model gets the following form (Coelli, 1996):

$\max_{\mu,v}(\mu'y_i)$,
st $v'x_i= 1$
$\mu'y_j - v'x_j \leq 0$, $j= 1,2,\ldots,N$
$\mu,v \geq 0$.

By using the duality in linear programming, it is possible to derive the final formulation of the model (Coelli, 1996):

$\min_{\theta,\lambda}\theta$,
st $- y_i + Y\lambda \geq 0$,
$\theta x_i - X\lambda \geq 0$,
$\lambda \geq 0$

Where ‘θ’ is a scalar of the efficiency scores that satisfies the condition $\theta \leq 1$. If it is equal to 1, it indicates full technical efficiency. The ‘λ’ is an Nx1 vector of constants. But for the variable return to scale it is necessary to introduce the convexity constraint $N1'\lambda = 1$ as follows (Coelli, 1996):

$\min_{\theta,\lambda} \theta$,
st $- y_i + Y\lambda \geq 0$,
$\theta x_i - X\lambda \geq 0$,
$N1'\lambda = 1$
$\lambda \geq 0$

Where, N1 is an Nx1 vector of ones.

Selection of Inputs and Outputs

To apply DEA, the critical task is to define the correct inputs and outputs of the process. The application of DEA in financial institutions has many arguments, especially regarding the selection of input and output combinations (Jayamaha & Mula, 2010). There are three basic approaches to selecting inputs and outputs for the DEA method: intermediation, production, and asset transformation (Jayamaha & Mula, 2010). Int mediation approach is a banking function acting as a mediator among fund deficit and surplus units. The production approach emphasizes services banks render to the account holders. It is hard to quantify the relevant variables relevant to the production process. The asset approach is strictly confined to the assets and the loans. They were paying attention to all three approaches, and following the work of Sealey & Lindley (1977), the intermediation approach was adopted in selecting the input and output combinations. Input oriented model has been used in this study because it explains how the proportional reduction of inputs is necessary for maintaining the current level of outputs to become inefficient banks to be efficient.

Hypotheses

For the study, the following hypotheses have been developed:

H_1: The capital adequacy ratio does not significantly influence the efficiency of Islamic Banks
H_2: The NPA ratio does not significantly influence the efficiency of the banks under study
H_4: NPA does not significantly influence the banks' efficiency.

Table 1: The selected variables for the DEA analysis of efficiency of Islamic Banks in Bangladesh

Character of Variable	Variable Name	Definition
Output	Total amount Investment Other Earning Assets	Total short-term and long-term investment Sum of investment securities, the inter-bank fund sold, and other loans to particular sectors
Input	Total Funds Fixed Assets Personnel Expenses	The total deposit plus total borrowed funds The sum of physical capital and premises Total expenditure on employees

Selection of Variables for Credit Risk Management

For measuring the credit risk, the variables that have been taken into consideration include capital adequacy ratio, net non-performing assets and net NPA ratio (i.e., percentage of net NPA to net advances), and the variables have been selected by following Nissa & Darzi (2017).

Regression Model

For analyzing the influence of credit risk management on efficiency a regression model has been developed in the form of $TE_{it} = \beta_0 + \beta_1(CAR_{it}) + \beta_2(NPA_{it}) + \beta_3(NPAR_{it}) + \eta_i + \lambda_t + \varepsilon_{it}$

Where TE = Technical Efficiency of the banks under study.

CAR= Capital Adequacy Ratio
NPA= Net Nonperforming Assets
NPAR= Net NPA Ratio

η_i measures the specific characteristics of each firm, called unobservable heterogeneity, whereas λ_t is a parameter for time dummy variables equal for all firms in each year but changes over time, and ε is the error term.

FINDINGS

The results of different measures of credit risk management and their impact on the technical efficiency of the Islamic banks in Bangladesh are presented in the following section. First, the estimated efficiency of the Islamic Banks is presented, followed by the descriptive analysis of the variables of credit risk management and a Pearson's correlation analysis to see the association between dependent and all the independent variables. Panel data analysis with a fixed-effect model is used to see the impact of credit risk management on the technical efficiency of the Islamic banks in Bangladesh.

Technical Efficiency of the Islamic banks in Bangladesh

The estimated technical efficiency of the Islamic banks in Bangladesh is reported in table 1. The table indicates that there has been a considerable change in the efficiency patterns over the period 2015-2021.

Table 1: Technical Efficiency of Islamic Banks in Bangladesh for the period 2010-2016

Name of the banks	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Average Technical Efficiency**	**Ranking**
Islami Bank Bangladesh Ltd.	0.916	0.984	0.941	0.962	1.000	1.000	0.934	0.962	5
ICB Islami Bank Ltd.	0.780	0.885	0.945	0.932	1.000	1.000	1.000	0.934	6
Al Arafah Islami Bank Ltd.	1.000	1.000	1.000	1.000	0.981	1.000	1.000	0.997	2
Social Islami Bank Ltd.	0.951	1.000	1.000	1.000	1.000	1.000	1.000	0.993	3
EXIM Bank Ltd.	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1
Shahjalal Islami Bank Ltd.	0.954	0.991	1.000	1.000	0.976	1.000	1.000	0.988	4
First Security Islami Bank Ltd.	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1
Average (Approximately)	**94.30%**	**98%**	**98.30%**	**98.40%**	**99.30%**	**100%**	**99%**		

Source: Author's calculation

From the analytical table 1, it is exposed that, in 2015, three banks, including EXIM Bank Ltd., First Security Islami Bank Ltd., and Al Arafa Islami Bank Ltd., were fully technically efficient, whereas ICB Islami Bank Ltd. was the most technically inefficient bank. The table indicates that the inefficient banks in 2015 exhibited significant improvement in their efficiency in the period 2016. Although ICB Islami Bank Ltd. and Islami Bank Bangladesh Ltd. were inefficient in 2012 and 2017, these two banks achieved a hundred percent efficiency in the years 2019 and 2020. In 2020 all the banks under study exhibited a commendable efficiency score, but Islami Bank Bangladesh Ltd. again became inefficient in the next year.

As shown in table 1, among all the Islamic banks, EXIM Bank Limited and First Security Islami Bank were the most consistently efficient banks over all the years, and Al ArafaIslami Bank Ltd. secured the second position. Soci l Islami bank Ltd., Shahjalal Islami Bank Ltd., and Islami Bank Bangladesh Ltd. secured the 3rd, 4th and 5th positions, respectively. On the other hand, ICB Islami Bank Ltd. was the most inefficient bank among all the Islamic banks operating in Bangladesh.

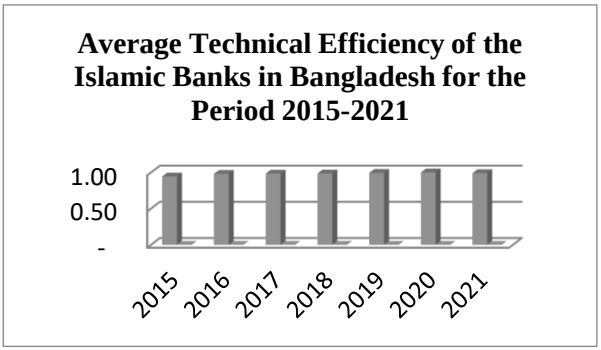

Figure 1: Average Technical Efficiency of the Islamic banks in Bangladesh for the period 2015-2021

From Figure 1, it can be exposed that among the study period, the Islamic banks in Bangladesh were least efficient in 2015 and most efficient in 2021.

Descriptive Statistics

The mean, minimum and maximum values with a standard deviation of different variables in the analysis for the period 2015-2021 are presented in Table 2.

Table 2: Descriptive Statistics of the Variables

Variables	Mean	Std. Deviation	Minimum	Maximum
The efficiency of the Banks	.982	.025	.780	1.000
Capital adequacy ratio	-0.00408	.366997	-1.770	.220
Net Nonperforming Asset Ratio	.12755	.230945	.010	.780
Net Nonperforming Asset	6328418081.71	5431872464.26	533895091	23601592064

The average efficiency score of the selected banks is 0.982. On the other hand, the average capital adequacy ratio, net non-performing asset ratio, and net non-performing asset are -0.00408, .12755, and 6328418081.71, respectively.

Correlation Analysis

The correlation matrix of all variables included in the analysis is presented in Table 3, which is calculated based on 49 observations.

Table 3: Pearson Correlation coefficient between variables of seven banks (49 observations)

		The efficiency of the banks	**Net Non-performing Asset**	**Net Nonperforming Asset Ratio**	**Capital Adequacy Ratio**
The efficiency of the banks	Pearson Correlation	1			
	Sig. (2-tailed)				
Net Non-performing Asset	Pearson Correlation	-.304*	1		
	Sig. (2-tailed)	.034			
Net Non-performing Asset Ratio	Pearson Correlation	-.109	.101	1	
	Sig. (2-tailed)	.457	.490		
Capital Adequacy Ratio	Pearson Correlation	.244	-.041	-.870**	1
	Sig. (2-tailed)	.091	.782	.000	

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

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

The table shows that the Technical Efficiency of the Islamic banks is negatively associated with two measures of credit risk management (Net Non-performing Asset and Net Non-Performing Asset Ratio) and is positively associated with Capital Adequacy Ratio. The correlation coefficient for Net Non-performing Asset is significant. The data reflects a highly significant negative correlation between capital adequacy ratio and net non-performing asset ratio, which is -.870. This has been considered in the regression analysis to avoid multi-co linearity problems.

Empirical Models

The impact of Credit risk management on the technical efficiency of the Islamic banks in Bangladesh is estimated using panel data analysis and is exhibited in table 4. In addition, the individual components of credit risk management Capital Adequacy Ratio, Net Non-performing Asset Ratio, and Net Non-performing Assetare included other variables. In addition, the impact of credit risk management on the technical efficiency of the Islamic banks in Bangladesh is estimated using panel data with a fixed-effect model.

Table 4: Fixed Effect Regression with combined variables

Fixed-effects (within) regression			Number of obs = 49			
			Number of groups = 7			
R-sq: within = 0.3550			Obs per group: min = 7			
Between = 0.8272			avg = 7.0			
Overall = 0.0136			max = 7			
			F(3,39) = 7.15			
corr(u_i, Xb) = -0.6614			Prob> F = 0.0006			
Dependent Variable	**Technical Efficiency**					
Regression Model	**Fixed Effect Model**					
	Coefficient	Std. Err.	t	P>t	[95% Conf. Interval]	
Constant	.9669098	.0103495	93.43	0.000	.945976	.9878436
Capital Adequacy Ratio	.0396285	.0134319	2.95	0.005	.0124598	.0667972
Net Non-performing Asset Ratio	.0714177	.0811448	0.88	0.384	-.0927132	.2355486
Net Non-performing Asset	2.12e-12	7.01e-13	3.02	0.004	7.00e-13	3.54e-12
sigma_u .02891448 sigma_e .01625595 rho .75983349 (fraction of variance due to u_i)						
F test that all u_i=0: F(6, 39) = 8.70 Prob> F = 0.000						

In the analysis, there are 49 observations, and the number of groups is seven, i.e., seven banks. It can be observed from the study that the F statistic is 7.15, and the probability value is 0.0006, which is less than 5%. It indicates that all the coefficients of this model are not equal to zero. When the probability value is significant,

it demonstrates that the model is very well fitted, and the coefficients are not equal to zero. Here technical efficiency of the banks is the dependent variable, and capital adequacy ratio, net non-performing asset ratio, and net non-performing asset are the independent variables. The analysis reveals that two measures of credit risk management- capital adequacy ratio and net non-performing asset are significant variables to explain technical efficiency as the probability value of capital adequacy ratio is very small (0.005), which is less than 5%, and the probability value of a net non-performing asset is also less than 0.05 which is 0.004. However, another measure of credit risk management- the net non-performing asset ratio, is not a significant variable to explain efficiency because the probability value of the net performing asset ratio is not significant as its p-value is 0.384, which is more than 5%.

From the analytical table 4, it is observed that there is a significant positive impact of capital adequacy ratio and net non-performing asset on efficiency. In addition, it means that a higher capital adequacy ratio and net non-performing assets can increase the efficiency of the banks.

CONCLUSION

Numerous suppositions can be drawn from the study. Firstly, the Islamic commercial banks operating in Bangladesh displayed high efficiency over the years. Six banks out of seven unveiled average efficiency above 95% during the study period. This is because the banks strive at par with the best practices for apparent reasons. It is also crucial to the reminder that the Islamic banks must strive not only among themselves but also with the conventional banks by providing innovative Islamic products and efficient management. In recent years, there has been significant progress in banking operations and technologies, and most Islamic banks have embraced the technologies with efficient management and scale of operations.

Further, the study investigated the impact of credit risk management on the efficiency of Islamic banks in Bangladesh. The data analysis reveals that the Islamic banks' efficiency in Bangladesh is positively associated with the credit risk management factors, especially capital adequacy ratio and net non-performing assets. On the other hand, the correlation analysis reveals that the non-performing asset ratio has an inverse relationship with the banks' technical efficiency, which indicates that the lower the NPA ratio, the better the efficiency of the Islamic banks in Bangladesh.

Finally, as a caveat, the findings of this study should be inferred with great caution since prior research varies extensively through different assessment measures. For example, the advance study should contemplate other estimation procedures and stare at the cost efficiency, revenue efficiency, and profit efficiency by considering all types of risks, including other financial, operational, business, and accidental risks, allowing the results to be compared.

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