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An Assessment of Bank-Specific Factors on Operational Efficiency: An Empirical Study on Select Commercial Banks in Bangladesh

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ABSTRACT

Operational efficiency of commercial banks is imperative to ensure economic stability and soundness in Bangladesh. However, it is directly affected by bank-specific factors such as bank size, capital adequacy, credit risk, liquidity, profitability and asset quality. The present study is designed to assess these bank-specific factors on the commercial banks' operational efficiency in Bangladesh. The paper empirically analyses panel data of 30 scheduled commercial banks in Bangladesh over the period from 2011 to 2016. Several statistical techniques like Correlation Analysis, Fixed Effect Regression Model, Fixed Effect Regression Model with Cluster Robust Standard Errors and Driscoll-Kraay Standard Errors along with descriptive analysis are performed to get robust result about the study. The study reports that the bank-specific factors together explain 77.16% of the selected commercial banks' operational efficiency. The result reveals that bank size, capital adequacy, profitability and loan portfolio have positive impact and credit risk, liquidity and asset quality have negative impact on operational efficiency of selected commercial banks in Bangladesh. The paper proposes that commercial banks should have high quality lending policy and loan portfolio after maintaining capital requirement and minimum liquidity and loan loss reserve against impaired loan to reduce insolvency risk and to sustain in the competitive business environment.

Keywords: Commercial Banks, Operational Efficiency, Bank-Specific Factors.

1. INTRODUCTION

Efficiency is the product of firm specific factors which not only blesses a firm with quality production but also cost savings. Specifically, efficiency involves in how to control cost, not to increase income. Banks must have efficiency in their activities as their hallmarks since their sustenance is very important to the economic stability of the country. Several factors form efficiency of banks such as technology improvement, more productive communication, data processing, and management skills that can lead to minimize operating costs and maximize proper utilization of resources.

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Efficient banking system is very crucial to ensure financial stability and higher-quality services at the lowest possible costs for enterprises and households. Similarly, because of increasing competition, business process and new technology evolution along with uncertainty in business sectors, a good operating performance is severely required to gain success in the competitive world (Bhagavath, 2009 andGoel, 2012). Normally, efficient and its determinants are analyzed by supervisory authorities of banks for the designation of regulatory framework and bank management for making their business plan. Besides, increased operational efficiency directly affects an organization's productivity and profitability which ultimately influence the customers to expect better and fair prices, quality services, better security and reliability of financial structures (Berger, Hunter and Time, 1993).Thus, management of bank must consider the role of operational efficiency to curtail unexpected situation and maximize resources capacity which brings healthy and sustainable financial environment through delivering quality products and services to customers (Kalluru and Bhat, 2009; Sufian, 2007).

In the context of Bangladesh, business sectors such as manufacturing, non-manufacturing and agricultural mostly depend on banks for their survival and growth. For this reason, banks' contribution toward economic growth and development of a country is imperative. On the other hand, competition in Bangladesh banking sectors has increased tremendously. Four types of banks are operating their business under the central bank of Bangladesh, Bangladesh Bank, namely government-owned specialized banks or state-owned development financial institutions (DFIs), nationalized commercial banks or state-owned commercial banks (SCBs), domestic private commercial banks (PCBs) and foreign commercial banks (FCBs). As of December 2011, there were 47 scheduled commercial banks in Bangladesh. Of them, four are DFIs, four are SCBs, thirty are PCBs and the remaining nine are FCBs. Only one new licensed private commercial bank has started its operation in 2016 from 2015 and twelve scheduled commercial banks to comprise of two SCBs and ten PCBs are increased in 2016 as compared to 2011. Bank branches have also increased rapidly, particularly in the rural areas. This situation results in reducing transaction costs associated with the mobilization and transfer of funds and increasing savings and investments and deposit creation.

On the other side, many branches of the commercial banks cannot work properly and face heavy losses due to competition, mismanagement and government interference (Nguyen et al 2011). Besides, unhealthy competition is increased in new banks that try to take over loans from older ones (Mustafa, 2017). Moreover, unhealthy competition among different banks causes lack of ethics in doing banking business. Bankers practice immorality such as variation of higher interest rate and profit paid to the client sometimes. Pervasive corruption is existed in Bangladesh in the form of agency problem through which bank management tries to maximize the amount of its personal gains (bribery) (Nguyen et al 2011). Thus, inefficient practices in banking system causes loss of trust, for which shortage of fund is created that may result in bank failure and major economic slowdown in Bangladesh (Muhiuddin and Jahan 2014). According to Bangladesh Bank Report, during 2016 expenditure-income ratio is 76.6% which is increased by 0.39% and 11.66% as compared to 2015 and 2011 respectively. Such situation has a great negative impact on the economy of Bangladesh. In

2016, banks' share of Gross Domestic Product (GDP) is 2.88% which is increased and its contribution to GDP growth is 8.85% which is decreased as compared to year 2015 when it were 2.88% and 8.5% respectively and year 2011 when it were 2.37% and 12.98% respectively. In recent years, banking systems of Bangladesh is greatly plagued by poor capitalization, weak asset quality and substandard management quality despite several attempts by government to reform the sector (Muhiuddin and Jahan 2014). According to 'Managing the banking sector fault lines' by Ahmed (2017), the amount of non-performing loan has been increasing in an alarming rate. As per the information of 'Banking in Jeopardy' by Zamir (2017) total default loan of the banking sector of Bangladesh until June 2017 was Tk. 74148 crore. The total figure is more than 30% of Bangladesh's 2017-18 budget and about 13% of our Gross Domestic Product (GDP) at constant price. The main causes for the unusually high default loans in the state-run banks are the enormous corruption, inefficiency and lack of good governance (Rahman and Rana 2018). The high level of NPLs is largely attributed to politically directed lending extended on non-market terms and lending under government directed schemes. This position is also aggravated by the limited credit appraisal, post-disbursement credit monitoring and risk management skills in these institutions.

Furthermore, some banks do not want to write-off historically bad loans due to the poor quality of underlying collateral and therefore to avoid the recognition of hefty losses on their income statement as well as the legal impediments in recovering loans that are written-off (Muhiuddin and Jahan 2014). During 2016, the NPLs to total loan ratio is 9.23% which is increased by 4.89% and 26.44% as compare to 2015 and 2011 when it was 8.8% and 6.1% respectively. Such increased NPLs force the banks to increase their provision which affects bank's profitability inversely. In 2016, the provision maintained by banks is increased by 15.52% and 101.31% as compare to 2015 and 2011 respectively. Besides, during 2016, the return on asset (ROA) of banks is decreased by 11.69% and 54.67% as compared to 2015 and 2011 respectively. In addition, return on equity (ROE) of banking sectors in Bangladesh is decreased by 10.37% and 44.59%as compare to 2015 and 2011 respectively. Bangladesh Bank currently reduces the maximum requirement of credit-deposit ratio i.e. Advance-Deposit Ratio (ADR) to 83.5% from 85% for conventional banks and Investment-Deposit Ratio (IDR) to 89% from 90% for Islamic Banks by June 2017 to avoid liquidity crisis (Islam, 2018). Liquidity ratio (Liquid Assets to Total Assets ratio) of banking system of Bangladesh follows almost steady trend during 2011, 2012, 2015 and 2016. In line with these, credit to deposit ratio of banking systems in Bangladesh is below the maximum requirement during 2011-2016 and is increased in 2016 by 1.24% as compare to 2015 but decreased by 11.08% as compare to 2011.

Moreover, Bangladesh Bank adopted BASEL-II accord in 2010 where all scheduled banks are required to maintain mandatory Capital Adequacy Ratio (CAR) level of greater than or equal to 10%. CAR of banks in Bangladesh is above the mandatory requirement during 2011-2016 and remain constant during 2016 and 2015 but decreased by 5.26% from 11.4% during 2011. Such CAR are maintained by banks to absorb all possible financial risks like credit risk, market risk, operational risk, residual risk, core risks, credit concentration risk, interest rate risk, liquidity risk, reputation risk, settlement risk, strategic risk, environmental and climate change risk etc. as bank's having CAR below the regulatory requirement are categorized as 'problem banks' and are asked to make-up for

the shortfall byincreasing their paid-up capital (Muhiuddin and Jahan 2014). The performance scenario of banking industry is shown in Appendix A.

Due to increased market competition, banks in Bangladesh are forced to manage their income and expenditure strategically to be profitable in operation. Moreover, as high credit risk in term of high NPLs causes low profitability resulting into low capital adequacy which puts banks in Bangladesh into trouble, dominant factors that influence the banks' operations should be determined. When banks operate their activities efficiently, all banks provide product with optimal pricing that will reduce interest rate spreads and unfair competition in the market. And such banks are able to improve financial system and mitigate uncertainty regarding banks' risks which are associated with capital adequacy, credit, liquidity, profitability and asset management of banks. A number of approaches are available to understand how well a bank operates its activities or how efficient it is. In this study, financial ratios are used as they are considered as convenient and reliable tool to provide a great deal of information about a bank's financial performance especially at the time of comparing with prior periods and with another bank's performance (Oral and Yolalan, 1990; Halkos and Salamouris, 2004).The goal of an efficient management of the banking operation is to ensure growth in profit and such efficiency requires focusing on those factors on which operational efficiency of the commercial banks depends. This research identifies and considers all the factors which have a great impact on operational efficiency.

2. LITERATURE REVIEW

Operational efficiency has become one of the prerequisite conditions for commercial banks to compete in the business world. In this regard, bank-specific factors should be assessed that have impact on a bank's operational efficiency. This literature review shows the role of bank-specific factors in the commercial banks' operational efficiency.

Allen and Rai (1996) argued that operational efficiency is the ability to use the resources at optimum level and deliver product and service with cost effectively. Athanasoglou et al (2008) reveal that operational efficiency as a financial performance determinant has provoked academic research, corporation's management, financial market and regulatory interest. Rahman and Rana (2018) argue that the crisis in the banking sector of Bangladesh is deepening day-by-day. They explained that such worst condition results from the political interventions in various levels, unethical practices/ corruption, unhealthy competition among prevailing banks. For this reason, many banks face capital shortage and have fallen in liquidity crisis. They suggested that the Ministry of Finance of Bangladesh should formulate short, medium, and long-term strategies for coming out of this present crisis situation as well as ensuring a sustainable development in the banking sector of Bangladesh. Yeh (1996) makes a differentiation between efficient and inefficient banks and tries to gain insight into various financial dimensions related to a bank's financial operational decisions. He explains that banks use overhead expenses including salaries and benefit-costs occupancy expenses as well as other operating expenses in generating revenues to measure efficiency ratio. Additionally, Amer (2011) reveals that the asset quality, capital adequacy, credit risk and liquidity of banks affect the operating efficiency positively and significantly in the highly competitive banking industry. He computed operating efficiency for Egyptian banks by dividing interest and non-interest income by operational expenses in his study. Banna et al (2017) state that banking sectors of Bangladesh need

to consider all potential technologies to increase their profit efficiency. In their study, they divide the study period under two heads such as financial crisis period from 2007 to 2008 and post crisis period from 2009 to 2013. They reveal that crisis along with bank size, capital adequacy ratio, return on average equity as profitability ratio and real interest rate as macro-economic factor have a significant effect on bank efficiency in Bangladesh. In their study, they also consider GDP growth rate and inflation rate as macro-economic factors but find no significant determinants of bank efficiency. They imply that banking operation of Bangladesh is either too small to benefit from the economies of scale or too large to be scale efficient.

Miah and Sharmeen (2015) analyze relationship between capital, risk and efficiency of conventional banks and Islamic banks in Bangladesh and reveal that conventional banks are more efficient than Islamic banks. They find that inefficient conventional banks have higher risk that indicates moral hazard hypothesis. They suggest that regulatory authorities should take steps to discourage banks about assuming high risk in order to ensure stability of the overall banking system in Bangladesh. In this regard, Jacques and Nigro (1997) undertook a study in which they analyzed the relationship between bank capital, portfolio risk and the risk-based capital standards. The result explores that the risk-based capital standards are useful in increasing capital ratios and reducing portfolio risk in commercial banks. Supporting this finding, Odunga et al (2013) have suggested that risk-based capital ratios need to be improved by banks to improve operational efficiency and to keep the competitive market in their favor. Shrieves and Dahl (1992) also have explained that although a positive relationship exists between changes in risk and capital, the regulators' and supervisors' actions provide a great contribution to ensure bank efficiency. Moreover, Kwan and Eisenbeis (1997) have found a positive effect of efficiency on risk-taking which indicates that poor performers are more vulnerable to risk-taking than high performance banking organizations. They have investigated the effect of inefficiency on the capital level and found that firms with more capital are operated more efficiently than less well-capitalized banking organizations. They also revealed that operating efficiency is increased at a decreasing rate as loan growth rate is increased. According to Odunga et al (2013) a bank's operational efficiency is positively and significantly affected by liquidity and capital adequacy. In order to improve operating efficiency and capture competitive market, they suggest that banks should try to find out mechanisms to increase their liquid asset ratio to deposit ratio and total capital ratio. Additionally, Mohammad et al (2013) have found that the high liquidity helps to reduce liquidity crisis and increase capital, whereas Kwan (2003) has revealed that higher liquidity causes higher cost to handle the liquid asset. Akhter (2018) reveals that commercial banks in Bangladesh have to maintain minimum liquidity and utilize their customers' deposits and borrowings through making high-quality loan portfolio to increase their shareholders wealth.

Siraj and Pillari (2011) analyze asset quality to determine the stability of banks and reveal factors of operational efficiency that are affected by global financial crisis. Additionally, Podpiera and Weill (2007) have found that the amount of resources allocated to loan monitoring affects both non-performing loans and banks' efficiency. Ezeoha (2011) concludes that banks can achieve operational efficiency through asset quality by ensuring regulatory structure to provide proper direction to the corporate governance and moderate the conduct of bank management. In this case Berger and Udel (1996) suggest that bank should focus on the proper utilization of their asset capacity to increase

their earnings and avoid reckless lending in order to reduce non-performing loans which may lead to decrease in loan loss provision in the long run.

Dimitris (2008) has found a positive relationship among profitability, size of the branches of banks and their efficiency. He reveals that more profitable and larger branches have higher operating efficiency and conclude that rural branches inclined to more efficient on an average than urban branches especially while considering profitability and bank size constant. Similarly, Myron and John (1982) analyze the relationship between bank profitability and operating efficiency and explain that higher earnings banks experience both lower operating costs due to some selected liabilities and higher operating costs due to selected asset items. They concluded that overtime and especially among relatively large banks, information flows and competitive pressure are effective to reduce operating efficiency differences that may appear in short run. Correspondingly, Sayed (2011) has argued that the Indian commercial banks have been more efficient by maintaining credit-deposit ratio. They have stated that improvement in investment deposit ratio and share of percentage of priority sector loan and advances in total credit will improve operational efficiency as well as profitability of the Indian commercial banks.

Hussain (2014) has stated that bank size and its ownership characteristics influence strongly in determining the operational efficiency of banks. In the line with Hussain's research, Ali (2011) has used relative asset size and bank classification to compare the change in efficiency of the western and Islamic banking systems. They found that the effect of the financial crisis is different on the basis of banks' type.

It is now clear that bank-specific factors like bank size, capital adequacy, credit risk, liquidity, profitability and asset quality are related tobanks' operational efficiency. This study uses all those factors to investigate into the conditions of performance of commercial banks' in Bangladesh.

3. METHODS AND DATA

3.1 Sample Design

The sample captures annual reports of 30 scheduled commercial banks to comprise of 3 SCBs and 27 PCBs in Bangladesh (Table—1)over the period from 2011 to 2016. In 2011, the total scheduled SCBs and PCBs in Bangladesh were 34.

Table-1: Name of Selected Commercial Banks in Bangladesh

Name of Bank
AB Bank
Bank Asia
Islami Bank Bangladesh Limited
Jamuna Bank
The City Bank Limited
Southeast Bank Limited

Premier Bank
Social Islami Bank Limited
Dutch Bangla Bank Limited
ONE Bank Limited
United Commercial Bank
Exim Bank
Brac BanK Limited
Dhaka Bank Limited
Mercantile Bank Limited
Mutual Trust Bank Limited
National Bank Limited
Prime Bank Limited
Eastern Bank Limited
International Finance Investment and Commerce Bank Limited (IFIC)
Janata Bank Limited
Uttara Bank Limited
Standard Bank Limited
NCC Bank Limited
Al-Arafah Islami Bank Limited
Trust Bank
Pubali Bank Limited
Shahjalal Islami Bank Limited
Agrani Bank
Rupali Bank

Thus, the study tries to cover most of the scheduled commercial banks in Bangladesh that have available data for at least 6 years.

3.2 Data Collection

In the study, secondary data of the selected scheduled commercial banks in Bangladesh are used to conduct the research. Such data are actually collected from annual reports and web sites of the respective banks. On the other hand, various articles have been reviewed to select related variables which influence the operational efficiency of commercial banks.

3.3 Variables Measurement

3.3.1 Dependent Variable. The dependent variable is operational efficiency of commercial banks which is measured differently in various research papers. Some authors compute Operational Efficiency Ratio (OER)by dividing operational expense by interest and non-interest income where a

decrease in the OER is desirable means that bank is generating more earnings than their spending (Allen and Rai, 1996; Yeh, 1996 and Halkos & Salamouris, 2004). On the other hand, the reciprocal of the ratio is used in several researches (Amer, 2011 and Odunga, 2016). Such ratio is calculated by dividing interest and non-interest income by operational expenses which is followed in this study. The calculation of OER in the study is as follows:

$$OER = \frac{\text{Interest Income + Non-interest Income+ Securities Gains (Losses)}}{\text{Interest Expenses + Non-interest Expenses+ Provision for Loan Loss + Taxes}}$$

Therefore, a higher OER is desirable as it reflects the pricing and production efficiency of the bank.

3.3.2 Independent Variable: The explanatory variables in the study are banks' financial performance indicators which are considered under Bank Size, Capital Adequacy, Credit Risk, Liquidity, Profitability and Asset Quality of the selected commercial banks. The following Table-3shows the selected independent variables:

Table-2: Selected Independent Variables

Independent Variables		**Performance Measure(Ratio)**	**Formula**
Bank Size	LTA	Log Total Asset	Natural Log of Total Asset
Capital Adequacy	T1CR	Tier 1 Risk-Based Capital Ratio	Core Capital to Risk Weighted Assets
	TCA	Total Capital Ratio	Risk Based Capital to Risk Weighted Assets
	ECTA	Equity Capital to Total Asset Ratio	Equity Capital to Total Assets
Credit Risk	NCOAGL	Net Charge-off to Average Gross Loans	Net Charge-off to Average Gross Loans
	LLPTL	Loan Loss Provision to Total Loans	Loan Loss Provision to Total Loans
	LLPTE	Loan Loss Provision to Total Equity	Loan Loss Provision to Total Equity
Liquidity	IBR	Interbank Ratio	Money Due to Other Banks/ Money Due from other Banks
	NLTDB	Net Loans to Total Deposits and Borrowings	Net Loans to Total Deposits and Borrowings
	LADSF	Liquid Assets to Deposits and Short-Term Funding	Liquid Assets to Deposits and Short-Term Funding
Profitability	NIM	Net Interest Margin	Net Interest Income to Earning Assets

	OOPIAA	Other operating Income to Average Assets	Other operating Income to Average Assets
	ROA	Return on Asset	Net Income after Tax to Total Assets
	ROE	Return on Equity	Net Income after Tax to Shareholders Funds
	REP	Recurring Earning Power	Pre-Provision Income to Average total Assets
Asset Quality	LLPNIR	Loan Loss Provision to Net Interest Revenue	Loan Loss Provision to Net Interest Revenue
	LLRIML	Loan Loss Reserve to Impaired Loans	Loan Loss Reserve to Impaired Loans
	IMLTL	Impaired Loans to Gross Loans	Impaired Loans to Gross Loans
	NCOPBLLP	Net Charge-off to Net Income Before Loan Loss Provision	Net Charge-off to Net Income Before Loan Loss Provision

Source: Authors themselves based on the review of literatures

3.4 Mode of Data Analysis

An explanatory approach is followed by using panel research design. Firstly, test of multicollinearity and normality are run to verify the assumptions of regression model. Then, a Fixed Effect Regression Model is selected by performing Hausman test. After performing Fixed Effect Regression Model, three post estimation tests aredone for verifying hetetoscedasticity, autocorrelation and cross-sectional independence. Then, Fixed Effect Regression Model with Cluster Robust Standard Errors and Drisc and Kraay Standard Errors are performed to get the robust and significant variables that affect the operational efficiency of commercial banks in Bangladesh as Fixed Effect Regression Model has heteroscedasticity, autocorrelation and cross-sectional dependence problems in the study. Here, Statistical software STATA 12 is used to perform all those tests for the models.

The estimating equation of the Fixed Effect Regression Model took the following form;

$$Yit=\alpha itk+\sum\sum \beta itkXitk+\varepsilon itk$$

Where: t = 1…6 (time in years)
i = 1…30 (number of banks)
k = 1…n (combination of explanatory variables)
Yit= Bank Operational Efficiency
αitk = the alpha constant
βitk = Coefficient of Bank financial indicators
$Xitk$ = Bank financial indicators

εitk= Estimation error

3.4.1 Multicollinearity Test: Variance Inflation Factor analysis (VIF) is performed to find out the correlation between explanatory variables and exclude the variables having correlation ≥ 0.80 (Kennedy, 2003) and VIF > 5 (Amer et al, 2011). Here due to avoid duplication of multicollinearity, loan loss provision to total loans, return on equity and impaired loans to gross loans ratios are excluded. The following (Table--4) shows those selected explanatory variables having VIF < 5.

Table- 3: Test of Multicollinearity

Test of Multicollinearity		
Variable VIF	**VIF**	**1/VIF**
NCOAGL	3.42	0.292195
LADSF	3.25	0.307642
NLTDB	2.89	0.345725
LLPTE	2.34	0.42711
ROA	2.33	0.42906
LLPNIR	2.32	0.430287
LLRIML	1.71	0.584795
OOPIAA	1.66	0.603449
LTA	1.54	0.648688
ECTA	1.51	0.660505
NIM	1.5	0.665413
REP	1.36	0.735598
NCOPBLLP	1.13	0.885853
TCA	1.05	0.948461
T1CR	1.04	0.961576
IBR	1.02	0.985171
Mean VIF	1.88	

Authors' calculations

3.4.2 Test of Normality: From the following graph it is seen that the histogram of residuals of linear regression model in the study is in the bell shaped curve which satisfies the normally distributed assumption of linear regression model.

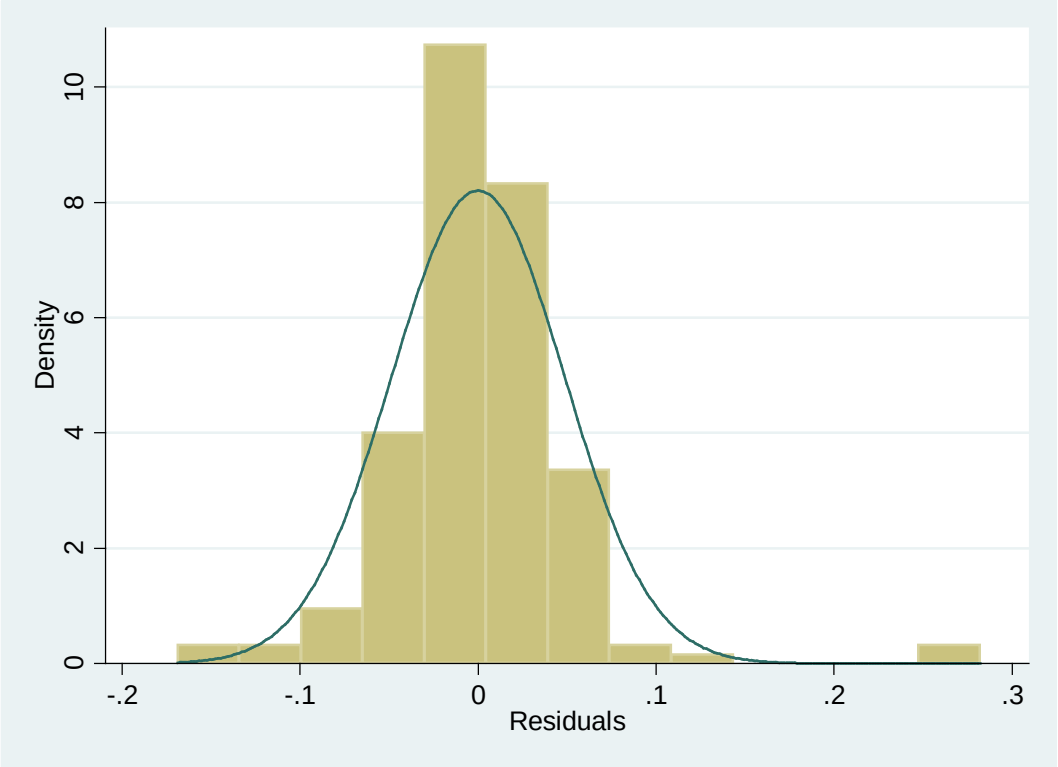

Figure 1: Distribution of Residuals

3.4.3 Hausman Test: Hausman specification test is performed to examine whether to use Fixed Effect Regression Model or Random Effect Regression Model. From Table- 4, the result (χ^2 = 148.78, p = 0.000) suggests that the fixed effect model is appropriate (Hausman, J.A. 1978).

Table- 4: Hausman Test

Hausman Test				
	---- Coefficients ----			
	(b)	**(B)**	**(b-B)**	**sqrt(diag(V_b-V_B))**
Variable	**Fixed**	**Random**	**Difference**	**S.E.**
LTA	0.0353138	0.0120593	0.0232544	0.0160847
T1CR	0.0059909	0.0069288	-0.0009379	…….
TCA	-0.0011564	-0.0332785	0.0321221	…….
ECTA	0.7400199	0.6086407	0.1313792	0.3236125
NCOAGL	-1.26215	-0.4325984	-0.829552	0.1815733
LLPTE	-0.0795806	-0.0706968	-0.0088838	0.0035743
IBR	-1.23E-06	5.75E-07	-1.80E-06	…….
NLTDB	0.1964968	0.1296447	0.0668521	0.0313624

LADSF	-0.1632136	-0.1813687	0.0181551	0.0439948
NIM	-0.5182276	-0.2460712	-0.2721564	0.5591871
OOPIAA	3.839702	1.837866	2.001836	2.087736
ROA	1.870711	2.253369	-0.3826578	0.1928903
REP	2.673534	3.287476	-0.6139422	0.3490106
LLPNIR	-0.0039526	0.0046116	-0.0085643	0.0005617
LLRIML	-0.2227505	-0.2425281	0.0197776	0.0209612
NCOPBLLP	0.0002585	0.0008867	-0.0006282	…….
b = consistent under Ho and Ha; obtained from xtreg				
B = inconsistent under Ha, efficient under Ho; obtained from xtreg				
Test: Ho: difference in coefficients not systematic				
chi2(15) = (b-B)'[(V_b-V_B)^(-1)](b-B)				
= 148.78				
Prob>chi2 = 0.0000				
(V_b-V_B is not positive definite)				

Authors' calculations

3.4.4 Test of cross-sectional independence, autocorrelation and heteroscedasticty. In order to verify the standard OLS assumptions for panel data in the study, three post estimation tests are performed for cross-sectional independence, autocorrelation and heteroscedasticty.

Table-5: Test of cross-sectional independence, autocorrelation and heteroscedasticty

Cross-sectional independence test (Pesaran's test)	Autocorrelation test (Wooldridge test in panel data)	GroupWise heteroscedasticity test (Modified Wald test in fixed effect regression model)
Pesaran's test of cross sectional independence = 2.348	H0: no first order autocorrelation	H0: sigma(i)^2 = sigma^2 for all i
Average absolute value of the off-diagonal elements = 0.441	F(1, 29) = 22.323	chi2 (30) = 3469.90
Probability (Pr) = 0.0189	Prob > F = 0.0001	Prob>chi2 = 0.0000

Authors' calculations

From the above Table-6, it is revealed that the residual error of the study is cross-sectional dependence, autocorrelated and heterogeneous, as the probability of all tests are less than 0.05.

3.4.5 Fixed Effect Regression Model with Cluster Robust Standard Errors and Driscoll and Kraay Standard Errors. After performing post estimation tests for diagnostic analysis, two robust methods like Fixed Effect Regression Model with Cluster Robust Standard Errors (Roger, 1993), and Driscoll-Kraay Standard Errors (Driscoll and Kraay 1998) are performed to compute robust

standard error and find out consistently significant variables that actually influence the operational efficiency of the selected commercial banks.

3.4.5.1 Cluster Robust Standard Errors (CRSEs). Cluster Robust Standard Errors (CRSEs) (Roger 1993) is the modification procedure of White's (1980) robust error, altering the White "sandwich estimator" to allow for dependence between observations inside a cluster.CRSEs is able to indentify harmful misspecification problems that are not reported by adjusting the variance-covariance matrix (Hardin and Hilbe, 2003, pp. 33-34).

3.4.5.1 Driscoll and Kraay (1998) Standard Errors (DKSEs). This is a nonparametric technique of estimating standard error where residual term of the model is assumed to be heteroscedastic, autocorrelated up to some lag and possibly correlated the groups (panels).This technique provides robust standard error to very general forms of cross-sectional and temporal dependence of the model having heteroscedasticity problem (Driscoll and Kraay 1998).

4. Findings and Analysis

4.1 Descriptive analysis

The following Table-6 shows the descriptive statistics of the selected variables.

Table- 6: Descriptive Statistics

Descriptive Analysis					
Variable	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**
OE	180	1.124058	0.086385	0.71432	1.767872
LTA	180	25.95143	0.516428	24.93716	27.42935
T1CR	180	0.138205	0.636037	-0.06152	8.62
TCA	180	0.123565	0.082063	-0.06152	1.186483
ECTA	180	0.083749	0.021494	0.008708	0.154282
NCOAGL	180	0.046889	0.036614	0.000171	0.231823
LLPTL	180	0.011026	0.012188	-0.00114	0.11703
LLPTE	180	0.10113	0.276608	-0.01054	3.471133
IBR	180	16.42795	117.6427	0	1568.532
NLTDB	180	0.839246	0.323073	0.533367	3.157008
LADSF	180	0.174264	0.125417	-0.00563	1.055367
NIM	180	0.031138	0.028071	-0.00786	0.186033
OOPIAA	180	0.003605	0.002454	0.000386	0.015342
ROA	180	0.011106	0.009217	-0.0492	0.07
ROE	180	0.105025	0.215057	-2.5994	0.3009
REP	180	0.035792	0.011404	-0.00544	0.101087
LLPNIR	180	0.490871	1.203601	-1.37308	9.878787

LLRIML	180	0.202765	0.117678	-0.03027	0.5542
IMLGL	180	0.057638	0.041433	0.010228	0.255914
NCOPBLLP	180	1.011567	3.016372	-35.4516	9.639115

Authors' calculation by using computer software

From the Table-6, we see that the average operational efficiency (OER) is 1.124058 with a minimum ratio of 0.71432 and maximum ratio of 1.767872 which indicates that the selected banks are able to meet its all operating cost from revenue and still in a position of making earnings for its shareholders. Here the Tier1 capital ratio is 13.82% and total capital to risk weighted asset is 12.36% on an average which are above the commercial banks'statutory requirement. The average ratio of return on asset is 1.11% with minimum ratio of -4.9% and maximum ratio of 7% which means that the management efficiency is low during the study period. Notably, the return on equity is 10.50% on an average which is considered good return for the owners of the banks compared to the prevailing market rates during the study period.

4.2 Correlation Analysis

Pair-wise correlation coefficients are calculated to know the relationship among the selected variables shown in Table--7.

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Table 7: Correlation Analysis

Correlation Analysis																				
	OER	LTA	T1 CR	TCA	EC TA	NCO AGL	LLP TL	LLP TE	IBR	NLT DB	LAD SF	NIM	OOP IAA	ROA	ROE	REP	LLP NIR	LLR IML	IML GL	NCO PBL LP
OER	1																			
LTA	-0.09	1																		
T1 CR	-0.01	0.00	1																	
TCA	0.09	0.02	0.02	1																
EC TA	0.39***	-0.30***	-0.03	0.10	1															
NCO AGL	-0.25***	0.42***	-0.03	-0.12	-0.31***	1														
LLP TL	-0.50***	0.23***	0.03	-0.13*	-0.16***	0.44***	1													
LLP TE	-0.49***	0.18***	0.00	-0.17***	-0.29***	0.35***	0.84***	1												
IBR	-0.01	0.06	-0.01	-0.01	0.03	0.01	-0.01	-0.01	1											
NLT DB	0.20***	0.00	-0.02	-0.06	-0.10	0.39***	-0.06	-0.04	0.03	1										
LAD SF	0.00	-0.09	-0.01	-0.08	-0.20***	0.41***	-0.05	-0.06	0.02	0.76***	1									
NIM	0.07	-0.13	-0.02	0.03	0.07	-0.27***	-0.03	-0.03	0.01	-0.03	-0.12	1								

		*																	
OOP	0.18***	-0.21***	-0.07	0.04	0.11	-0.15***	-0.07	-0.05	-0.02	-0.07	0.04	0.48***	1						
IAA																			
ROA	0.58***	-0.27***	-0.01	0.11	0.41***	-0.46***	-0.58***	-0.62***	-0.02	-0.07	-0.06	0.16**	0.27***	1					
ROE	0.52***	-0.18***	0.02	0.17***	0.28***	-0.42***	-0.77***	-0.96***	0.00	-0.01	0.01	0.09	0.11	0.67***	1				
REP	0.41***	-0.01	0.00	0.04	0.23***	-0.17**	0.19**	0.11	-0.05	-0.09	-0.16**	0.15**	0.15**	0.21***	0.03	1			
LLP	-0.32***	0.33***	0.00	-0.10	-0.16**	0.56***	0.54***	0.46***	-0.02	-0.14*	-0.12	-0.12	-0.10	-0.47***	-0.49***	-0.02	1		
NIR																			
LLR	-0.25***	-0.06	0.16**	-0.03	0.17**	-0.23***	0.50***	0.32***	0.01	-0.17**	-0.22***	0.13*	-0.14**	-0.10	-0.20**	0.32***	0.11	1	
IML																			
IML	-0.30***	0.44***	-0.05	-0.13*	-0.34***	0.96***	0.50***	0.44***	0.00	0.31***	0.36***	-0.25***	-0.13*	-0.53***	-0.49***	-0.12	0.60***	-0.20**	1
GL																			
NCO	-0.02	0.08	0.00	0.00	0.00	0.07	0.16**	0.10	0.00	-0.13*	-0.03	-0.02	-0.02	-0.09	-0.08	0.09	0.24***	-0.01	0.10	1
PBL																			
LP																			

Note: N (Total Number of Observations) = 180, Significance: * = p < 0.10, **= p < 0.05, *** = p < 0.01.

The correlation results show that equity capital to total asset, net loans to total deposits and borrowings, other operating income to average assets, return on asset, return on equity and recurring earnings power ratios are positively and significantly correlated with operational efficiency whereas, net charge-off to average gross loans, loan loss provision to total loans, loan loss provision to total equity, loan loss provision to net interest revenue, loan loss reserve to impaired loans and impaired loans to gross loans ratios are negatively and significantly correlated with operational efficiency of the selected commercial banks.

On the other hand, log of total asset, tier1 capital, total capital, interbank ratio, liquid asset to total deposits and short term funding, net interest margin and net charge-off to profit before provision ratios have insignificant relationship with operational efficiency of the selected commercial banks.

4.3 Empirical Models and Results

The study performs three models for panel date analysis to get robust bank-specific factors influenced the operational efficiency of the selected commercial banks where Model 1 indicates only Fixed Effect Regression Model (FE) and Model 2 and 3 indicate Fixed Effect Regression Model with Cluster Robust Standard Errors (CRSEs) and Driscoll-Kraay Standard Errors (DKSEs) respectively. The results of these models are showing in the following Table-:

Table-8: Empirical Models

Result of Empirical Models							
Fixed-Effects (within) Regression				Number of observations = 180			
Group variable: BankId				Number of groups = 30			
R-sq: within = 0.7716				Observations per group: minimum = 6			
between = 0.3548				average = 6			
overall = 0.6000				maximum = 6			
Variable		**Model 1 (FE)**		**Model 2 (CRSEs)**		**Model 3 (DKSEs)**	
OER	Coefficient	Std. Err.	t	Std. Err.	t	Std. Err.	t
LTA	0.0353138	0.01851	1.91*	0.020524	1.72*	0.020488	1.72
T1CR	0.0059909	0.006092	0.98	0.002150	2.79*	0.000769	7.79***
TCA	-0.0011564	0.046873	-0.02	0.012373	-0.09	0.008403	-0.14
ECTA	7.40E-01	0.390245	1.9*	0.490986	1.51	0.560131	1.32
NCOAGL	-1.26E+00	0.264615	-4.77***	0.544729	-2.32**	0.418851	-3.01**
LLPTE	-0.0795806	0.021376	-3.72***	0.035919	-2.22**	0.035683	-2.23*
IBR	-1.23E-06	3.22E-05	-0.04	0.000008	-0.15	0.000006	-0.2
NLTDB	0.1964968	0.037227	5.28***	0.034852	5.64***	0.040964	4.8***
LADSF	-0.1632136	0.070249	-2.32***	0.157664	-1.04	0.043944	-3.71**
NIM	-0.5182276	0.583413	-0.89	0.982968	-0.53	0.906424	-0.57
OOPIAA	3.839702	2.889924	1.33	4.083219	0.94	0.757777	5.07**
ROA	1.870711	0.65985	2.84*	1.730000	1.08	1.196524	1.56

REP	2.673534	0.523	5.11***	1.123734	2.38**	0.770807	3.47**
LLPNIR	-0.0039526	0.004858	-0.81	0.006549	-0.60	0.008727	-0.45
LLRIML	-0.2227505	0.04724	-4.72***	0.060602	-3.68***	0.062017	-3.59**
NCOPBLLP	0.000259	0.001247	0.21	0.000487	0.53	0.001024	0.25
_cons	0.008408	0.500285	0.02	0.557269	0.02	0.572734	0.01
sigma_u	0.045482	F(16,134) = 28.30		F(16,29) = 1931.60		F(16, 5) = 182.49	
sigma_e	0.045618	Prob > F = 0.0000		Prob > F = 0.0000		Prob > F = 0.0000	
rho	0.49850241 (fraction of variance to u_i)					maximum lag: 2	
corr(u_i,Xb)= -0.5387	F test that all u_i=0:			F(29, 134) = 2.40		Prob > F = 0.0004	
Note: Significance: * = p < 0.10, **= p < 0.05, *** = p < 0.01.							

Authors' Calculation.

From Table--9,it is revealed that the fixed effect model explains 77.16% (within), 35.48% (between) and 60% (overall) of variations in operational efficiency of the selected commercial banks in Bangladesh. Further, recurring earnings power and net loans to total deposits and borrowings are positively significant and net charge-off to average gross loans, loan loss provision to total equity, loan loss reserve to impaired loans are negatively significant under Model 1(FE), Model 2 (CRSEs) and Model 3 (DRSEs).Log of total asset is positively significant under Model 1 and 2, where liquid asset to total deposits and short term funding is negatively significant under Model 1 and 3. Besides, T1CR is positively significant under Model 2 and 3, ECTA and ROA are positively significant under Model 1 and other operating income to average assets is positively significant under Model 3. In the study, a number of independent variables are significant in explaining variations in operational efficiency of the selected commercial banks which are discussed below under various heads:

4.3.1 Bank Size and Operational Efficiency. From Table--9, it is revealed that log of total assets is positively and significantly related to operational efficiency which means that with the increase in bank size, banks' operational efficiency is also increased. Supporting this view, Miah and Sharmeen (2015) and Akhter (2018) explained that large banks can utilize their resources efficiently. Thus bank should take steps to expand it assets by encouraging customers' deposits and borrowings and loan portfolio.

4.3.2 Capital Adequacy and Operational Efficiency. Table--9 suggests that commercial banks should focus on capital adequacy and particularly on T1CR and ECTA as a way of enhancing their operating efficiency. The significance of T1CR implies that commercial banks' capital resources are more stable with its operation and are able to cushion themselves against negative shocks in the financial markets. Another significance ratio of capital adequacy, Equity Capital to Total Asset ratio represents banks' capital structure along with the ability to withstand loss. The positive signal explains that banks have enough equity to reduce risk exposure and improve their operational efficiency. In this regard, Akhter (2018) found that efficient banks can maintain positive capital adequacy ratio. Gardener (1985) advocated that the role of prudential guidelines of capital adequacy system on bank capital, profitability and efficiency is crucial as it helps to avoid over-trading and

curbs malpractice by management. Thus, Bank should maintain sufficient capital along with regulatory requirement to sustain operating losses in order to maintain a safe and efficient market and reduce liquidity risk (Calominis and Kahm, 1991, and Berger, 1995).The opposite result found by Miah and Sharmeen (2015), stated that regulator authorities may allow more efficient bank to operate their activities with lower level of capital whereas less efficient banks are required to maintain higher capital-base.

4.3.3 Credit Risk and Operational Efficiency. It is revealed from Table--9 that as a credit risk proxy, loan loss provision to total equity ratio and net charge-off to average gross loans are negatively significant which indicate that banks with higher risks are less efficient, as such banks require more resources to monitor and manage existing portfolio which increase their operating cost. For this reasons, efficient banks are encouraged to reduce bad debt of classified loans and loan loss provision against equity. Thus, bank should have experienced and superior management and concentrate on minimizing agency problem between banks' shareholders and management which will reduce the chance of being non-performing loans and ultimately decrease loan loss provision in the future (Saunder and strock, 1990 and Kwan and Eisenbeis, 1997).

4.3.4Liquidity and Operational Efficiency. Net loans to total deposits and borrowings (NLTDB) ratio as a liquidity ratio explains that banks' ability to collect funds as deposits and borrowings and distribute it to third parties in the form of credit. Table--9 shows that there is a positive relationship between NLTDB and OER which indicates that providing loans from deposits and borrowings increases banks' operational efficiency that is supported by Mishin and Eakins (2012), explained that conversion of deposits into loans provides greater efficiency in transforming asset into liabilities. Another significant liquidity ratio is liquid asset to total deposits and short term funding which is negatively correlated with operational efficiency implies that if liquidity asset is increased, the income generating capacity of bank is declined. In this regard Kwan (2003) stated that when liquidity position of bank is increased, it becomes more costly to handle them as it includes additional transportation cost, storage and protection cost and labor cost. Thus, Bank's liquidity should be managed and controlled without sacrificing their investment proposals (Akhter, 2018).

4.3.5Profitability and Operational Efficiency. From Table-9, it is seen that as profitability, other operating income to average assets, return on asset and recurring earnings power ratios are positively related with operational efficiency. The positive relationship between other operating income to average assets and operational efficiency implies that banks are focused on generating more profit and minimizing expenses and costs. Other significant profitability ratios with operational efficiency in the study are return on asset and recurring earnings power that explain that commercial banks should invest in resources to increase their earnings that would boost their operational efficiency. Supporting the findings, Das and Ghosh (2006) explained that Banks having higher profitability attract customers, increase deposits and lendings and are efficient in intermediation activities. The opposite result found by Banna et al (2017) that even technically efficient and well-capitalized bank could have lower profitability.

4.3.6 Asset Quality and Operational Efficiency. In the study, the only proxy of asset quality which is significant with operational efficiency is loan loss reserve to impaired loans (LLRIML) ratio shown in Table-9. The result shows inverse relationship between LLRIML and OER which signals that efficient bank could have lower loan loss reserve against impaired loan as increasing operational efficiency decreases NPLs.

4.4 Proposed Model

A model is proposed to determine the influencing bank-specific factors on operational efficiency of commercial banks on the basis of the findings in the study. This model will help assist bank managers to analyze and take necessary steps to minimize banks' risk exposure in order to improve operational efficiency of commercial banks in Bangladesh. Of the variables which are considered significant and consistent in two empirical models to the minimum in this study have been established as accepted model. The proposed model is as follows:

Table- 9: Proposed Model

Bank-specific factors	Variable (significant ≥ 2 empirical models)	Name of the empirical model
Bank Size	LTA	FE+CRSEs
Capital Adequacy	T1CR	CRSEs+ DKSEs
Credit Risk	NCOAGL	FE+ CRSEs+ DKSEs
	LLPTE	FE+ CRSEs+ DKSEs
Liquidity	NLTDB	FE+ CRSEs+ DKSEs
	LADSF	FE + DKSEs
Profitability	REP	FE+ CRSEs+ DKSEs
Asset Quality	LLRIML	FE+ CRSEs+ DKSEs

Source: Authors' Calculation

It is seen in Table-10that banks should emphasis importance on their size in term of their assets, as there is a possibility of increasing operational efficiency due to increase in banks' size. In addition, in capital adequacy, commercial banks should particularly focus on tier 1 capital ratio to provide safeguard against their risk exposure while for credit risk, loan loss provision to total equity and net charge-off to average gross loans should be considered to provide high quality of loan portfolio. Besides, banks should provide importance on net loans to total deposits and borrowings and liquid asset to total deposits and short term funding under liquidity, recurring earnings power under profitability and loan loss reserve to impaired loans under asset quality to ensure operational efficiency. This explains that after maintaining minimum requirement of liquid assets and loan loss reserve against impaired loans, banks should use their customers' deposits and borrowings for investment and lending purposes to increase their operational efficiency and earnings.

5. CONCLUSION

Commercial banks are the financiers of productive investment to accelerate economic growth of a country. Due to rapid increase in competition, risk exposure and technological development, these banks need to operate their activities more efficiently. To focus on operational efficiency of commercial banks, the study takes into consideration the bank-specific factors and hasfound that these factors have great impact on banks' operational efficiency.

The study collects the data of selected commercial banks in Bangladesh from their annual reports for the period 2011-2016 to assess the impact of bank-specific factors on their operational efficiency. The study selects and applies Fixed Effect Regression model for panel data by performing Hausman test. As the model has heteroscedasticity, autocorrelation and cross-sectional dependence problems, Fixed Effect Regression Model with Cluster Robust Standard Errors and Drisc and Kraay Standard Errors are performed to get the robust and significant variables that influence the operational efficiency of sampled commercial banks. The analysis of the study implies that the efficient commercial banks are existed in Bangladesh as the average operational efficiency of the selected commercial banks is 1.124058 with standard deviation of 0.086385. The empirical results of the study indicate that bank size, capital adequacy, credit risk, liquidity, profitability and asset quality together explain about 77.16% of the banks' operating efficiency. The result reveals that bank size, capital adequacy, profitability and loan portfolio have positive impact and credit risk, liquidity and asset quality have negative impact on operational efficiency of selected commercial banks in Bangladesh.

Based on the findings from the study, the following recommendations are proposed:

Firstly, as a positive relationship exists between size and efficiency for commercial banks in Bangladesh, the banks can concentrate on increasing their size to capitalize on economies of scale. Secondly, Banks with higher capital-base tend to have a positive effect on efficiency level which explains that capital requirement enhances financial stability and improve efficiency by using large capital to ensure safety against financial shock in the market and by lowering moral hazard. Thus, banks should have more capital to keep down insolvency. Besides, Mandatory periodical stress testing routines in banking sector need to be introduced to find out early warning about vulnerability. Thirdly, the study reveals that inefficient banks have higher risk which indicates moral hazard situation. In this case, regulatory authorities should come forward to discouraging banks from exercising such practice in order to maintain greater stability of the overall banking system in Bangladesh. Fourthly, the relationship between liquidity ratio and efficiency of commercial banks explains that inefficient banks has high liquidity ratio which underscores a lack of profitable lending opportunities as well as poor business environment in the banking sectors. On the other hand, depositors' funds disburse by banks as loans are actually increase banks efficiency. Thus, banks should follow high quality lending portfolio with minimum liquidity to increase efficiency. Fifthly, Banks with higher profitability able to cover its expenses, attract customers and increase deposit and lending which ultimately increase their efficiency. Finally, efficient banks can manage their impaired loans at lower loan loss reserve. Therefore, Banks should optimally use their asset capacity to increase their earnings profiles and avoid reckless lending together in order to reduce impaired loans which may lead to decrease in loan loss reserve in the long run. In this regard, the government can

progress by improving the legal framework for debt recovery by enacting and amending Acts from time to time.

Nevertheless, the study provides better insight information and guidance to bank managers as well as policy makers regarding optimal utilization of capacities, improvement in managerial expertise, efficient allocation of scarce resources and the most productive scale of operating activities of commercial banks in Bangladesh. This may also facilitate direction regarding sustainable competitiveness of the Bangladesh banking sector operations in the future.

The study concentrates on State-owned commercial banks and Private commercial banks as sample and excludes foreign commercial banks from sample due to various anomalies in reporting of financial date. Moreover, the study gives importance on some bank-specific factors to determine operational efficiency of commercial banks. Hence, an integrated model can be developed in the further research which will show a complete picture of banks' operational efficiency by considering many other factors along with bank-specific factors such as GDP, inflation rate, real interest rate, composition of board of directors, role of auditors, skills and qualifications of employees, and value of collaterals.

REFERENCES

Ahmed, S. (2017), "Managing the banking sector fault lines", The Daily Star, 21 November, P. B4.

Akhter, N. (2018),"The Impact of Liquidity and Profitability on Operational Efficiency of Selected Commercial Banks in Bangladesh: A Panel Data Study",*Global Journal of Management and Business Research,* Vol. 18 No. 7, pp. 13-24.

Allen, L. & Rai, A. (1996), "Operational Efficiency in Banking: An International Comparison", *Journal of Banking & Finance*, Vol. 20 No. 4, pp. 655-672.

Athansasoglou, P., Brissimis, S. & Delis, M. (2008), "Bank-Specific, Industry-Specific and Macroeconomic Determinants of Bank Profitability",*Journal of International Financial Markets, Institutions and Money*, Vol. 18 No. 2, pp.121-136.

Amer, H. M., Moustafa, W. &Eldomiaty, T. (2011), "Determinants of Operating Efficiency for Lowly and Highly Competitive Banks in Egypt", *Cambridge Business & Economics Conference,* ISBN: 9780974211428.

Bangladesh Bank Annual Report, 2015-1016.

Banna, H., Ahmad, R. &Koh E. H. Y. (2017), "Determinants of Commercial Banks' Efficiency in Bangladesh: Does Crisis Matter?",*Journal of Asian Finance, Economics and Business,* Vol. 4 No. 3, pp. 19-26.

Berger, A.N., Hunter, W. C. &Timme, S.G.(1993),"The Efficiency of Financial Institutions: A Review and Preview of Research Past, Present, and Future",*Journal of Banking and Finance*, Vol. 17, pp. 221-249.

Berger, A. N. (1995), "The Profit-Structure Relationship in Banking: Tests of Market Power and Efficient Structure Hypotheses", *Journal of Money, Credit and Banking*, Vol. 27, pp. 404-431.

Berger, A. &Udell, G. (1996), "Universal banking and the future of small business lending, In Financial System Design: The Case for Universal Banking", pp. 559-627, Burr Ridge, IL: Irwin Publishing.

Bhagavath, V. (2009),"Technical efficiency measurement by data envelopment analysis: An application in Transportation Model", *Alliance Journal of Business research*.

Calomiris, C. W. & Kahn, C. M. (1991), "The Role of Demandable Debt in Structuring Optimal Banking Arrangements", *American Economic Review*, Vol. 81No. 3, pp. 497–513.

Das, A. & Gosh, S.(2006), "Financial deregulation and efficiency: An empirical analysis of Indian banks during the post reform period", *Review of Financial Economics*, Vol. 15 No. 3,pp. 193-221.

Dimitris, I. G. (2008), "Cost Efficiency Impact of Bank Branch Characteristics and Location: An Illustrative application to Greek bank branches", *Journal of Managerial Finance*, Vol. 34 No. 3, pp. 172 – 185.

Driscoll,J. & Kraay, A. (1998), "Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data",*The Review of Economics and Statistics*, Vol. 80No. 4, pp. 549-560.

Ezeoha, E. A. (2011), "Banking consolidation, credit crisis and asset quality in a fragile banking system: Some evidence from Nigerian data", *Journal of Financial Regulation and Compliance*, Vol. 19 No. 1, pp. 33-44.

Gardener, E. P.M. (1985). "A Systems Approach to Bank Prudential Management and Supervision: The Utilization of Feed Forward Control" ,*Journal of Management Studies*, Vol.22 No. 1.

Goel, S. (2012),"The link between operational efficiency and solvency: the case of food processing industry in India" , *Accountancy Business and the Public Interest 2012*.

Halkos, G. E & Salamouris S.D. (2004), "Efficiency measurement of the Greek commercial banks with the use of financial ratios: a data envelopment analysis approach", *Management Accounting Research*, Vol. 15 No. 2, pp. 201-224.

Hardin, J.W. & Joseph, M. H. (2003), "Generialized Estimating Equations", Boca Raton: Chapman & Hall/CRC.

Hausman, J.A. (1978),"Specification tests in econometrics", *Econometrica,* Vol. 46No. 6, pp. 1251-1271.

Hussain, S. (2014),"The Assessment of Operational Efficiency of Commercial Banks in India Using Cost to Income Ratio Approach", *International Journal of Management and Business Research*, Vol. 4 No. 3, Summer 2014, pp. 225-234.

Ibrahim, Dr. M. S. (2011),"Operational Performance of Indian Scheduled Commercial Banks-An Analysis", .*International Journal of Business and Management*, Vol. 6No. 5.

Islam, S. (2018), "Bangladesh Bank cuts loan-deposit ratio 1.5%", *Dhaka Tribune*(Online), 31st January.

Jacques, K. & Nigro, P. (1997),"Risk-based Capital, Portfolio Risk, and Bank Capital: a Simultaneous Equations Approach", *Journal of Economics and Business*, Vol. 49 No. 6, pp. 533–47.

Jahan, N. & Muhiuddin, K.M.G. (2011),"Evaluation of Banking Sector's Development in Bangladesh in light of Financial Reform", *Developing Country Studies*, Vol.4. No.22, 2014.

Kalluru, S. &Bhat, K. (2009),"Determinants of Cost Efficiency of Commercial Banks in India", *ICFAI Journal of Bank Management*, Vol. 8No. 2, pp. 32-50.

Kennedy, P. A Guide to Economics, 5th ed., MIT Press, Cambridge, MA, 2003.

Kwan, S. &Eisenbeis R. A. (1997), "Bank Risk, Capitalization, and Operating Efficiency", *Journal of Financial Services Research*, Vol. 12No. 2&3, pp. 117-131.

Miah, Md. D. & Sharmeen, K. (2015)."Relationship between capital, risk and efficiency: A comparative study between Islamic and conventional banks in Bangladesh", International Journal of Islamic and Middle Eastern Finance and Management, Vol. 8 No. 2, pp. 203-221.

Mishkin F.S. & Eakins S.G. (2012),"Financial Markets and Institutions", 7thed Essex. Pearson Education Ltd.

Mustafa, M. S. (2017), "Unhealthy competition rife among new banks: study" 2017, *The Daily Star*, 24 November, p. B1.

Myron, L., Kwast & John T. R. (1982), "Pricing Operating Efficiency, and Profitability among Large Commercial Banks", *Journal of Banking & Finance*, Vol. 6, pp.233-254.

Nguyen, C. V., Islam, A. M. & Ali, A. M. (2011), "The Current State of the Financial Sector of Bangladesh: An Analysis", AIUB Bus Econ Working Paper Series, No. 2011-03, http://orp.aiub.edu/WorkingPaper/WorkingPaper.aspx?year=2011

Odunga, R. M., Nyangweso, P. M., Carter, D. A., & Mwarumba, M. (2013), "Credit Risk, Capital Adequacy and Operating Efficiency of Commercial Banks in Kenya", *International Journal of Business and Management Invention*, Vol. 2No. 9, pp. 6-12.

Odunga, R. M. (2016),"Specific Performance Indicators, Market Share and Operating Efficiency for Commercial Banks in Kenya", *International Journal of Finance and Accounting*, Vol. 5No. 3, pp. 135-145.

Oral, M. & Yolalan, R. (1990), "An Empirical Study On Measuring Operating Efficiency and Profitability Of Bank Branches", *European Journal of Operational Research*, Vol. 46, pp. 282-294.

Podpiera, J. & Weill, L. (2007), "Bad Luck or Bad Management? Emerging Banking Market Experience", Czech National Bank, available at: www.sciencedirect.com/science/article/pii/S1572308908000120 (accessed 17 May 2016).

Rahman, Md. H. & Rana, S. (2018), "Present Crisis of the Banking Industry of Bangladesh: Causes and Remedial Measures", *Journal of Business and Management*, Vol. 20 No. 4 Ver. II, pp. 13-21.

Rogers, W. (1994),"Regression Standard Errors in Clustered Samples", *Stata Technical Bulletin*, Vol. 3No. 13,pp. 19-23.

Said, A. (2011), "Comparing the Change in Efficiency of the Western and Islamic Banking Systems", *Journal of Money, Investment and Banking*, ISSN 1450-288X Issue 23.

Saunders, A., E. Strock, & Travlos N. G. (1990), "Ownership Structure, Deregulation, and Bank Risk Taking", *Journal of Finance*, Vol. 45, pp. 643-654.

Siraj, K.K. &Pillai P.S.P. (2011), "Asset Quality and Profitability of Indian Scheduled Commercial Banks during Global Financial Crisis", *International Research Journal of Finance and Economics*, Issue 80, pp.55-65.

Shrieves, R. E. & Dahl, D. (1992), "The relationship between risk and capital in commercial banks", *Journal of Banking and Finance*, Vol. 16, pp. 439- 457.

Sufian, F. (2007), "The efficiency of Islamic banking industry: A non-parametric analysis with non-discretionary input variable", *Islamic Economic Studies*, Vol. 14 No. 1&2, pp. 53-78.

Yeh, Q. J. (1996), "The Application of Data Envelopment Analysis in Conjunction with Financial Ratios for Bank Performance Evaluation", *Journal of the Operational Research Society*, Vol. 47, pp. 980-988.

White, H.(1980),"A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity" ,*Econometrica,*Vol. 48, pp. 817-838.

Zamir, M. (2017), "Banking in jeopardy", *The Dhaka Tribune* (Online), 9 December.

APPENDIX – A

Performance of banking system in Bangladesh

Year	Provision Maintained (In Billion Taka[3])	Capital Adequacy ratio (%)	Credit to Deposit Ratio (%)	NPLs (%)	Liquidity Ratio (%)	ROA (%)	ROE (%)	Expenditure-Income Ratio (%)	GDP share of Banks (%)	GDP Growth Contribution by banks (%)
2011	152.7	11.4	80.8	7.3	25.4	1.5	17	68.6	2.37	12.98
2012	189.8	10.5	80	6.1	27.1	0.64	8.20	74.0	2.6	17.6
2013	249.8	11.5	73.9	10.1	32.5	0.90	11.10	77.8	2.7	10.9
2014	281.6	11.3	73.9	8.9	32.7	0.64	8.09	76.1	2.8	8.3
2015	266.1	10.8	70.98	8.8	26.5	0.77	10.51	76.3	2.8	8.5
2016	307.4	10.8	71.85	9.2	24.9	0.68	9.42	76.6	2.9	8.9

Source: Bangladesh Bank Annual Report from 2011 to 2016.

[3] At present $1= Taka 84 (the name of currency of Bangladesh is Taka.)