



Impact of Bank Liquidity and Macroeconomic Determinants on Profitability of Commercial Banks in Bangladesh

Raad Mozib Lalon*, Anika Afroz, Tasneema Khan

Department of Banking and Insurance, University of Dhaka, Bangladesh. *Email: raadmozib@du.ac.bd

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ABSTRACT

This paper aims at investigating the relationship between profitability and liquidity of the State-Owned Commercial Banks of Bangladesh. An important motive of this study is to provide valuable insights into how liquidity influences profitability. There are various research papers on liquidity exposure and the profitability relationship of banks in Bangladesh. But those researches are separately conducted for conventional or Islamic banks or there is a comparative analysis of both banks. But there is little research on the state-owned banking industry. During the Pandemic the banking industry of Bangladesh was affected severely in respect of liquidity risk and it also affected its profitability. There is no recent paper focused on this study. So, this study will try to identify the significant factors that affect the liquidity of a bank and its profitability. In this regard, 10 years' data from Annual Report of the State-Owned Commercial Banks and macroeconomic data from Bangladesh Bank website and several journals have been collected from 2012 to 2021. This study primarily aims at exploring the liquidity-profitability relationship using econometric model. Loan to Deposit ratio is used measuring liquidity of a bank. Other control variables Loan Loss Provision to Total Asset (LLPTA) for credit risk, Equity to Total Asset (EQTA) for capital efficiency, Operational expense to Total Asset (OPEXTA) for operational efficiency, Total Asset (TA) for Bank size, Non-performing Loan (NPL) for asset quality, Gross Domestic Product (GDP) for economy size, Inflation (INF) for consumer price index, Interest Rate (INT) for opportunity cost, and the Unemployment rate for measuring labor force. The major finding of this study show that there is a significant positive relationship between liquidity risk and profitability. Among bank-specific variables credit risk, capital efficiency, and bank size have a significant relationship with Profitability which also supports the theory. Macroeconomic variables like interest rate, inflation rate, and GDP have a significant relationship with profitability which also supports the theory. Here BDBL and BASIC should have maintained the liquidity standard mentioned by Bangladesh Bank and BIS to mitigate their liquidity crisis. This study also shows that there is no severe effect of the COVID pandemic on the State-Owned Commercial Banks of Bangladesh. The findings of this study will provide valuable insights for banks and regulators to make informed decisions regarding risk management, liquidity decision, capital allocation, and strategic planning.

Keywords: Profitability, ROA, LDR, Pooled OLS Method, Liquidity, Panel Data

JEL Classifications: C22, C23, C26

1. INTRODUCTION

A financial intermediary that offers deposits to the individual and the institution which is payable on demand and provides different services including credit service, payment service, agency service, etc. is known as a bank. In Bangladesh, 61 scheduled banks are operating in the country. A bank's ability to satisfy expected and unforeseen financial and securities commitments at a fair cost and without suffering intolerable damages is referred to as liquidity

(Ratnovski, 2013). The danger of rescheduling or refinancing is exposed when long-term investments are financed with short-term commitments, which raises the banks' liquidity risk during COVID-19. The banking industry is an Oligopoly market as it is strongly regulated by the regulator (Bangladesh Bank) and the product or services offered by the banks are similar and the price does not differ much. Bangladesh Bank set guidelines to provide onsite and offsite supervision and monitor the banking activities of the banks' regulations. Besides, there is a regulatory

act “Bank Act –1991” and several international guidelines including Basel (BIS) to be followed by the banks. The banking industry deals with a complex and changing environment, where profitability and liquidity are the prime factors of a bank’s financial health. Profitability represents the bank’s capability to maintain sustainable earnings and liquidity reflects its ability to meet short-term obligations and manage cash flows. The relationship between those two factors is significant to regulators, investors, and bank management, as it has a great impact on risk management strategies, capital allocation, and overall performance.

Bank profitability is a key metric in its long-term success. It measures the ability to provide value to its shareholders. Liquidity refers to the ability to meet its short-term obligations without incurring sufficient losses for ensuring liquidity. Bank typically holds a certain amount of cash and other liquid assets that can be easily converted into cash. Liquidity risk mainly arises when the banks fund its long term assets by short term liabilities making subject to refinancing risk and from the mismatching of interest rate, the reinvestment risk arises (Keri et al. 2007). The profitability of a bank is typically measured by its ability to generate earnings. The primary source of earnings is interest from loans. Besides, fees, various service charges, etc. are also a great source of bank earnings. ROA is a primary indicator of the bank’s profitability of the bank but Flamini et al. (2009) show that ROA is a better indicator of profitability than ROE as it considers financial leverage but ROE ignores it. Liquidity risk is a significant term for a bank because it determines the solvency, operational efficiency, and profitability of a bank. Appropriate liquidity management is very crucial for a bank to sustain itself in the long run. It is also a major concern for a bank as it is a primary indicator of insolvency.

Bank performance highly depends upon the liquidity and profitability strategy of the banks. How much liquid assets the bank holds to perform its daily operation and how they manage its risk? The concept of risk is associated with the unexpected losses that caused for the lack of large standard portfolio of credit (Crouhy et al. 2006). However, liquidity and profitability are negatively correlated, liquidity measures of the bank have enough ability to meet current ability. It is the early warning of the bank failure. Similarly, profitability determines whether the bank’s strategy is to make a profit and survive in the bank and survival in the long run. Bank takes an optimal position in liquidity and also profitability to operate its activities like market position strategy etc.

The main scope of this study is to find out the factors that affect the liquidity and profitability of a bank. So, identifying the determinants of bank liquidity is necessary for a better understanding of the concept and also for appropriate positioning of the liquidity risk concerning the other financial risks. The major concern of this study is to find out the factors that affect the profitability of a bank concerning on the liquidity exposure. It will also show how liquidity risks affect the profitability of a bank. It also shows the area of future improvement.

The paper is divided into some sections. In the first section there is a brief introduction of the liquidity and profitability relationship of a bank. A brief review of literature is given in the second section.

Research techniques or methodology is given in the third section. In the fourth section analysis of data result as well as findings are showed. Finally, the paper is demonstrated with some concluding remarks in the fifth section.

2. LITERATURE REVIEW

Liquidity is the bank’s ability to fulfill its obligations on the due date without suffering significant losses (Bessis, 2011). Liquidity is crucial for banks and financial institutions as it determines the ability to meet all of its anticipated suspense like funding of new loans, and withdrawals from customer accounts. When there is a substantial lack of liquidity, there may be a financial collapse.

Fahmi (2015) has told that liquidity is the ability of a company to fulfill its short-term obligations on time. The assessment of liquidity risk cannot be separated from the role of bank liquidity itself.

Bourke (1989) has observed that profitability is positively correlated with both capital and liquidity ratios.

Samad (2008) has used ROA as the profitability ratio. ROA is the profit earned per dollar asset b. it is calculated in terms of percentage as profit to total asset.

Flamini et al. (2009) have used ROA as the profitability ratio instead of ROE. He showed that ROA is the better measurement of profitability. It considers financial leverage but ROE ignores it.

According to Van Horne and Wachowizy (2005), there is an inverse relation between bank liquidity risk and profitability. High bank liquidity will produce a low profit. On the contrary low level of liquidity generates high profit.

Lalon (2013) has shown that the factors like credit disbursement, interest rates, investments and savings, economic growth, and others have an impact on Bank’s liquidity. He also investigates how the crowding out of private investors caused by government borrowings contributed to the liquidity.

Molyneux and Thornton (1992) analyzed the data of the banking industry of Europe from 1986 to 1989. They find that there is a negative relationship between liquidity and profitability.

According to Nugraha et al. (2021), liquidity risk (Loan to Deposit Ratio) has a significant positive relationship with Profitability (ROA). He also has shown a significant negative relationship between Non-performing loans (NPL) the Profitability (ROA).

Raharjo et al. (2014) have shown that there are internal and external factors that affect the liquidity of the bank. The internal factors are the growth of assets, profitability efficiency, and capital adequacy. The external factors are Market power, inflation, and interest rate. The loan deposit ratio is the indicator of liquidity which have a positive relationship with the net interest margin (NIM).

Larbi-Siaw (2015) has also examined the relationship of the Profitability (ROA) with the Deposit, Loan Loss Provision to Total Asset (LLPTA), Non-Interest Income to Gross Income Ratio Inflation, etc. He has found a significant effect of those independent variables on the dependent variable.

According to Mohanty et al. (2018), there is a significant negative relationship between ROA with Liquidity risk (LDR), bank size, Expense ratio, and productivity. He has also analyzed the positive effect of the solvency ratio, Capital adequacy ratio on ROA.

Rahman and Banna (2015) has shown that liquidity risk may occur from diverse factors. He shows a comparative analysis of conventional and Islamic banks. In Islamic banks size of the banks, return on Asset (ROA), and net working capital has insignificant relation with liquidity. Whereas in conventional banks the size of the banks and net working capital has negative relation with the liquidity. But return on the asset has a positive relationship with the liquidity risk.

According to Chowdhury et al. (2016) there is a negative relationship of cash to asset ratio (CA) to net interest margin (NIM). But the Loan to asset ratio (LA) has a positive effect on the net interest margin (NIM). Loan to Deposit ratio (LDR) has also a positive effect on net interest margin (NIM). They also showed the impact of liquidity risk on the conventional bank's profitability

Ramzan and Zafar (2014) have evaluated the relationship between liquidity risk and bank's specific factors of Islamic banks. There is a positive and significant correlation between bank size and liquidity risk. The capital efficiency ratio, return on Asset and return on equity harm Liquidity risk.

According to Shaykhul Islam (2019), certified management lists various causes of liquidity issues. The banking industry has not yet reached the anticipated degree of improvement because of NPL, Unlawful capital outflows from Bangladesh to other countries, corruption, inefficiency, and a lack of strong governance.

Ahamed (2021) has shown that the bank has a specific and external effect that affects liquidity risk. Asset size has a negative relation with liquidity risk. Return on equity, and capital efficiency ratio have a positive but insignificant relationship with liquidity risk. Gross Domestic Products, domestic credit has positive relation but inflation has negative relation with liquidity risk. Loan to asset ratio has a positive relation with liquidity risk.

Jedia and Hamza (2015) have shown that liquidity risks depend on idiosyncratic factors such as bank profitability, capital efficiency ratio, and investment ratio. Capital efficiency ratio and investment ratio have a statistically significant negative relation with liquidity risks and return on the asset has a positive relation with liquidity risk. Bank size has irrelevant relation and gross domestic product has negative but insignificant relation with the liquidity risk.

Arif and Nauman Anees (2012) have shown that liquidity risks affect a bank's profitability significantly with liquidity gaps and

non-performing loans. They have a negative relationship with profitability.

Imani and Pracoyo (2018) has shown that liquidity risk is affected significantly by Capital efficiency ratio, non-performing loan, and return on asset. This research paper shows that capital and liquidity risk have an insignificant effect on profitability. But credit risk (NPL) has a significant effect on profitability.

Lartey et al. (2013) conducted a time series analysis of the liquidity and profitability ratios of the bank and found that there was a very weak positive relationship between the liquidity and profitability of the listed banks in Ghana.

Rahman et al. (2015) have investigated capital strength, credit risk, ownership structure, bank size, non-interest income, etc. as the potential factors of profitability of Bangladeshi Banks. The findings suggest that capital strength and loan intensity has a positive and significant impact on profitability. Cost efficiency has a negative and significant effect on profitability.

Samad (2015) has examined the impact of bank-specific characteristics and macroeconomic variables in determining the bank's profitability in the Bangladeshi Banking Industry with panel data. He showed that financial risk, operational efficiency, bank size, and economic growth, have a great impact on bank profits.

Financial institutions including Banks have faced a great challenge regarding the liquidity exposure and maintaining steady profitability now-a-days. It is always a major concern for a bank to balance the liquidity profitability position as they are inversely related. For globalization and rapid economic development, the interdependence of financial institutions is increasing which also accelerates the crucial decision taking regarding profitability and liquidity position of a bank. There are several researches on liquidity-profitability relationship of a bank or any financial institution. But a few research is available on State-Owned Commercial Banks. After COVID-19 pandemic the decision of holding liquidity-profitability position is greatly affected which are not reflected on those research papers. The study seeks to deepen our bankers' understanding of the dynamics and implications of these critical financial metrics and other variables having effects on the profitability of the banks.

Following hypothesis has been developed based on the mentioned literatures above. The aim of this hypothesis is to find out the impact of liquidity risk on profitability of the state-owned banks of Bangladesh.

H_0 : There is no significant relationship between liquidity risk and Profitability where profitability is measured through ROA and liquidity is measured through Loan to Deposit ratio (LDR).

H_1 : There is a significant relationship between liquidity risk and Profitability where profitability is measured through ROA and liquidity is measured through Loan to Deposit ratio (LDR).

3. METHODOLOGY

This is an explanatory research which investigates the effect of liquidity on profitability. The relationship of liquidity and profitability has been explored by taking ROA as a profitability indicator and LDR as a liquidity risk determinant.

All State-Owned Commercial banks are taken to conduct this study. To undertake the analysis, data is acquired from the respective bank's annual report, Bangladesh Bank's website resulting in a panel sample of 60.

Data are collected from the following Bank's annual Report: Sonali Bank, Rupali Bank, Janata Bank, Agrani Bank, BASIC Bank, and BDBL. As this paper focus only the liquidity-profitability relationship of the State-Owned Commercial Banks, all the State-Owned Commercial Banks are taken excluding the specialized State-Owned Banks (SOBs), Private Commercial Banks (PCBs) and the Islamic Commercial Banks (ICBs). Data are collected from the year 2012-2021 as a period of 10 years considering sufficient data availability.

3.1. Identification of Variables

To conduct this study a panel data set is developed including nine independent or explanatory variables and on dependent variable. Here for measuring profitability of a bank (dependent variable), ROA is taken and independent variables are included from various literature review and established model.

To conduct this study, the independent variables that are taken is following: From Bank Specific Variables Loan to Deposit ratio (LDR), Loan Loss Provision to Total Asset (LLPTA), Equity to Total Asset (EQTA), Operational expense to Total Asset (OPEXTA), Total Asset (TA), Non-performing Loan (NPL), are taken to perform this study. From Macro-economic variable, Gross Domestic Product (GDP), Inflation (INF), Interest Rate (INT), the Unemployment rate are taken.

The following table (Table 1 dependent and independent variables for regression analysis) is developed showing the dependent and independent variables. Here the expected sign of coefficient is developed through the empirical evidence from literature. The positive sign shows the positive effects of the independent variables on the dependent variables and the negative sign shows the inverse effect as well. For positive effective when the coefficient rises, the profitability rises and vice versa. For negative effect when the coefficient rises the profitability falls and vice versa.

3.2. Empirical Model

Multiple regression model is used to conduct this study. To test the hypothesis following model is developed including the dependent and independent variables.

$$ROA_{it} = \alpha_i + \sum_{k=1}^7 \beta_{ik} X_{itk} + u_{it} \quad (1)$$

$$ROA_{it} = \alpha + \sum_{k=1}^7 \beta_{ik} X_{itk} + \varepsilon_{it} + u_{it} \quad (2)$$

To perform this study Pooled OLS method is used to highlight the relationship between the ROA and the independent variables. To compare the outcomes of this model, Fixed Effect model (FE) and Random Effect model (RE) have been done. We have estimated the equation number 01 using Pooled OLS and Fixed Effect followed by Equation number 02 has been estimated with Random effect method where a_{it} , a_i , $a =$ Constant for Pooled OLS, Fixed Effect, and Random Effect method respectively. $\sum X =$ all independent variables. $\beta =$ coefficient of the explanatory variable; $u_{it} =$ error term of the model or error term within the entity; $\varepsilon_{it} =$ error term between the entity;

4. EMPIRICAL ANALYSIS WITH DISCUSSION

This chapter shows the analysis of the 6 State-Owned banks for 10 years to gauge the relationship of dependent and independent variables containing statistical model. This chapter focuses on the most important section of the paper that is the analysis and concluding remarks. Here I have included summary statistics, regression analysis, Pearson's Correlation Matrix analysis, multicollinearity test, group heteroscedasticity test using White test, Autocorrelation test using Wooldridge test, model specification test using Hausman Test and B/P LM test.

4.1. Summary Statistics

It is a branch of statistics that focuses on summarizing and describing data sets. It presents data in a meaningful and concise manner to gain insights and understand the characteristics of the data. It provides a summary of the data. Here in the following table (Table 2 Summary Statistics of the Variables) ROA is included as dependent data and all the explanatory variables are included regarding bank specific and macro-economic variables.

Here ROA is negative which indicates the negative profitability and the inefficient banking industry. ROA is -0.2% . Here the LDR is 70% which indicates the lower liquidity. LLPTA refers to credit risk. Here the mean value of LLPTA is 4.9% which indicates a lower credit risk. EQTA is 10.4% which refers to capital efficiency. LnAsset refers to the bank size. NPL refers to bad loans. Here it is 27.8% which is very high. The bank should take necessary actions to reduce it. GDP, INF, INT, and Unemployment rate are the market indicators. So, there is a negative Profitability (ROA) of the Banks. Although the Banks have high credit risk (LLPTA) and high NPL, these Banks have high Capital and Operational Efficiency. A high GDP growth and low inflation rate are examined in this study.

4.2. Empirical Results of Multiple Regression Analysis

It is a statistical method used to explore the relationship between a dependent variable and one or more explanatory variables. It aims to identify and quantify the nature and strength of the association between these variables. Table 3 represents the results of the coefficients in the model. Here I have used fixed effects, random effects, pooled OLS method (Tables 11-13 in the appendix section respectively) to determine the coefficients that explain the dependent variable ROA.

The regression equation is written based on the values of the coefficients (Pooled OLS) given below:

$$\text{ROA} = 0.004 + 0.006 \text{LDR} - 0.169 \text{LLPTA} + 0.107 \text{EQTA} + 0.037 \text{OPEXTA} + 0.005 \text{Ln Asset} - 0.026 \text{NPL} - 0.334 \text{GDP} - 0.778 \text{INF} + 0.607 \text{INT} - 0.54 \text{Unemp rate}$$

The loan to Deposit Ratio (LDR) represents the liquidity risk. A higher ratio means higher liquidity risk. So, there is theoretically a positive relation between them. Here in Pooled OLS Random Effect method and Fixed Effect method, the relation is supported by the theory. But it is not statistically significant for Pooled OLS and Random Effect. Rather it is significant at 5% for Random Effect. Nugraha et al. (2021) also showed that LDR has a positive relation at a 1% significant level with ROA.

Loan Loss Provision to Total Assets refers to credit risk. Here the coefficient is statistically significant for Pooled OLS at a 1% significance level. It has a negative relation with the ROA and it supports the theory. Islam et al. also have found that credit risk has a significant negative relation with Profitability (ROA). Larbi-Siaw (2015) has also found an inverse relation of credit risk (LLPTA) with ROA.

The equity to Total Asset variable shows Capital Efficiency. It shows a positive relation with Profitability and it is also statistically

significant at a 99% confidence level for both Pooled OLS and Random effect. For FE the coefficient is not statistically significant. Raman and Zafar have also found a significant relationship between Capital Efficiency and Profitability. Jedidia and Hamza (2015) also have showed Capital Efficiency has a positive relation with Profitability.

The log of assets represents the bank size. Theoretically, there is a positive relation with the Return on Assets, but the Fixed Effect method, shows a negative relationship which doesn't support the theory. They are also not statistically significant for fixed effect and Random effect. But for pooled OLS it is significant at a 10% confidence level. Samad (2015) also has found a positive relation of the Bank Size (Asset) with the Profitability (ROA).

Gross Domestic Product is a macroeconomic indicator. It is not statistically significant for both Pooled OLS and Fixed Effect method. However, it is significant at a 10% significance level for the Random effect method. Though it should have a positive relationship with Profitability, there is an argument regarding the negative effect of GDP growth on ROA. The high growth of GDP tends to increase Inflation in the economy and also inspires the bank to extend the loan. But bad credit appraisal increases bad loans which decrease the profitability of the banks. It is also found in the rising amount of NPL of the banks. Mohanty et al. (2018) have found a significant negative relation of GDP growth with ROA.

Table 1: Dependent and independent variables for regression analysis

Types of variables	Measurement	Expected sign of coefficient	Data source
Dependent variables			
ROA	Net income to Total Assets		Annual Report
Independent variables			
(Bank Specific Variables)			
LDR	Total Loans to Total Deposits	+ (positive)	Annual Report
LLPTA	Loan Loss Provision to Total Asset	- (negative)	Annual Report
EQTA	Equity to Total asset	+ (positive)	Annual Report
OPEXTA	Operational Expense to Total asset	+ (positive)	Annual Report
LnAsset	Log of Total Asset	+ (positive)	Annual Report
NPL	Non-Performing Loan to Total Asset	- (negative)	Annual Report
(Macro-economic variables)			
GDP	Gross Domestic product	+ (positive)	Economic survey published by MOF
INF	Inflation	- (negative)	Bangladesh bank website
INT	Interest Rate	+ (positive)	Bangladesh bank website
Unemprate	Unemployment rate	- (negative)	Internet

Source: Author's estimation

Table 2: Summary statistics of the variables

Variable	Observation	Mean	Std deviation	Minimum	Maximum
Return on Asset (ROA)	60	-0.002	0.016	-0.075	0.026
Loan to Deposit Ratio (LDR)	60	0.701	0.233	0.373	1.967
Loan Loss Provision to Total Asset (LLPTA)	60	0.049	0.034	0.001	0.197
Equity to Total Asset (EQTA)	60	0.104	0.117	-0.003	0.48
Operational Expense to Total Asset (OPEXTA)	60	0.019	0.016	0.012	0.139
Log of Total Asset (LnAsset)	60	12.784	1.097	10.395	14.355
Non-Performing Loan (NPL)	60	0.278	0.144	0.082	0.598
Gross Domestic Product (GDP)	60	0.066	0.012	0.034	0.079
Inflation (INF)	60	0.063	0.01	0.054	0.087
Interest (INT)	60	0.043	0.015	0.018	0.071
Unemployment Rate (Unemprate)	60	0.046	0.004	0.041	0.054

Source: Authors' Estimation Based on results generated by STATA 17.0

Table 3: Results of the coefficients in the model

Dependent variable: ROA	Estimation methods		
	Pooled OLS	Fixed effect (Robust)	Random effect (Robust)
Bank specific variables			
LDR	0.006 (0.009)	0.009** (0.002)	0.006 (0.006)
LLPTA	-0.169*** (0.06)	-0.147 (0.114)	-0.169 (0.103)
EQTA	0.107*** (0.021)	0.119 (0.063)	0.107*** (0.02)
OPEXTA	0.037 (0.102)	0.059 (0.058)	0.037 (0.05)
LnAsset	0.005* (0.003)	-0.007 (0.223)	0.005 (0.003)
NPL	-0.026 (0.017)	-0.036 (0.033)	-0.026 (0.026)
			-0.334* (0.193)
Macroeconomic variables			
GDP	-0.334 (0.217)	-0.267 (0.223)	
INF	-0.778*** (0.276)	-1.027** (0.371)	-0.778** (0.331)
INT	0.607*** (0.166)	0.615** (0.184)	0.607*** (0.19)
Unemprate	-0.54 (0.79)	-0.063 (1.436)	-0.54 (1.076)
Constant	0.004 (0.066)	0.15 (0.118)	0.004 (0.068)
N (total observations)	60	60	60
Multiple R	0.7667	0.6293	0.7667
R Square	0.5868	0.396	0.5868
Adjusted R square	0.5037	0.4768	0.5037
F value	6.99	-	-
rho	0.6297	0	
Sigma-u		0.01556	0
sigma-c		0.11936	0.11936
0.11936	0.11936	0.11936	0.11936

Source: Authors' Estimation Based on results generated by STATA 17.0. Note: *, **, *** denote 10%, 5%, and 1% level of significance respectively

Table 4: Output of Hausman test of ROA

Hausman specification test	
Chi-square test	1.661
P-value	0.98

Source: Authors' Estimation Based on results generated by STATA 17.0

Table 5: Output of B/P LM test of ROA

B/P LM test	
Chi-square test	0.000
P-value	1.000

Source: Authors' Estimation Based on results generated by STATA 17.0

Inflation is a macroeconomic variable. It shows the negative relationship which supports the theory. It is also statistically significant at 1% for the Pooled OLS and Random effect and at 5% Fixed Effect Method. Larbi-Siaw (2015) has also found an inverse relationship between Inflation and ROA.

Interest rate shows a positive relationship with the Return on Asset and it is statistically significant. It also supports the theory. All the coefficients are statistically significant. For Pooled OLS and Random effect method, it is statistically

significant at a 1% significance level, and for Fixed Effect, the coefficient is significant at a 5% significance level. Lalon (2013) has shown that Interest rate has a significant relation with profitability.

Multiple R shows the relation between the independent variable and the dependent variable. It is 76.67% for Pooled OLS and RE which indicates a significant relation between them. For the FE method, it is 63%. R square shows how well the independent variables determine the dependent variable. For both Pooled OLS and RE it is 58.68% which indicates the dependent variable is explained 58.68% by the independent variable. For FE it is 39.6% indicating the independent variable explains the dependent variable by 39.6%. Adjusted R Square represents that 50.37% of the variation of ROA is caused by the independent variables for both Pooled OLS and RE and FE which is 47.68%. F value shows the joint significance of the independent variables to the dependent variable. It is 6.99 which is >0.05 . So, at a 95% confidence level, the model is significant. The intra-class correlation or rho value shows panel differences account for 62.97% of ROA ratio fluctuation across the research period. The Pooled-OLS, FE and RE methods are showed in the table 11, 12 and 13 accordingly in the appendix section.

Table 6: Variance inflation factor (ROA)

Variables	VIF	1/VIF
Template	4.405	0.227
LnAsset	4.224	0.237
INF	3.547	0.282
GDP	3.093	0.323
INT	2.729	0.366
NPL	2.639	0.379
EQTA	2.598	0.385
LDR	2.01	0.498
LLPTA	1.821	0.549
OPEXTA	1.175	0.851
Mean VIF	2.824	0.

Source: Authors' Estimation Based on results generated by STATA 17.0. **Notes:** When the VIF value of any variable is more than 10, then there is a multicollinearity problem within the model. Here no variable has a VIF value of 10 or more than 10. So it is noted that there is no multicollinearity problem

Table 7: Output of white test of ROA

White test for group heteroscedasticity in Pooled OLS method	
Chi-square test	60.000
P-value	0.4392

Source: Authors' Estimation Based on results generated by STATA 17.0

Table 8: Output of Wooldridge test of ROA

Wooldridge test for Autocorrelation in panel data	
F-value (1,5)	23.347
P-value	0.0047

Source: Authors' estimation based on results generated by STATA 17.0

4.3. Model Specification Test

It is conducted to show the appropriate model that describes best the relationship of dependent and independent variables with those data. It is a statistical test used to evaluate the validity of a specific regression model. Here in this section (Table 4 Output of Hausman Test of ROA), Hausman and Breusch and Pagan Lagrangian Multiplier Tests for random effects are used to explore how liquidity affects profitability.

4.3.1. Hausman test: Random effect versus fixed effect

It shows whether the estimates of two different regression models are significantly different from each other commonly employed in panel data analysis. It chooses between fixed effects and random effects models. Jerry A. Hausman was developed in 1970. The Hypothesis is following

H_0 : RE is better than FE

H_1 : RE is not better than FE.

Here Chi-square is 1.661 and the $P = 0.998$ which is far beyond 0.05. So, at a 95% significance level the null hypothesis is accepted. So, RE is a better model to explain the dependent variable through independent variables.

4.3.2. B/P LM test: Random effect versus pooled OLS method

It is also known as the "Breusch-Pagan Lagrange Multiplier (LM) test for random effects." In a panel data analysis, it is analyzed to choose between Fixed Effects (FE) and Random Effects (RE). The output of this test is shown in the following Table 5 Output

of B/P LM Test of ROA The Hypothesis is following:

H_0 : RE is not better than pooled OLS method

H_1 : RE is better than pooled OLS method.

Here Chi-square is 0.000 and the $P = 1.000$ which is greater than the significance level of 0.05. So, at a 95% significance level the null hypothesis is accepted. So, RE is not a better model to explain the dependent variable through the independent variable. So the Pooled OLS method is better to explain the mode.

4.4. Other Diagnostic Tests

This section measures the validation of the model through a number of Diagnostic Test.

4.4.1. Pearson's correlation matrix test

Correlation measures the linear positive or negative correlation of the independent variables with the dependent variable. Here +1.0 represents a strong positive correlation and -1.0 indicates a strong negative correlation. The value ranges are nearly or close to zero representing weak or no linear relationship.

When the relation of two variables is more than 75%, it is considered to have a multicollinearity problem. In this model, no variable correlates more than 75%. The Equity to Total Asset has a 76% correlation with the Log of Assets. It is marginally 1% greater than the ideal correlation matrix. So it is overlooked considering the multicollinearity problem. Pearson's correlation Matrix table has been presented in the appendix section in the Table 9.

4.4.2. Variance inflation factor (VIF)

It is a statistical measure used to assess multicollinearity in regression analysis. Multicollinearity refers to the high correlation between two or more predictor variables in a regression model, which can lead to unreliable and misleading results. Table 6 Variance inflation factor (ROA) shows the individual and mean VIF of the variables used in the model.

4.4.3. Test for group heteroscedasticity

Heteroscedasticity refers to a situation in a regression analysis where the variability of the errors in a regression model is not constant across different levels of the predictor variables. It means that the spread or dispersion of the residuals is not the same throughout the range of the predictor variables. Here we have used White Test of the dependent variable that is displayed in the Table 7 output of White Test of ROA. The P values of this test in respect of its degrees of freedom (df) in the appendix section at the Table 10. The Hypothesis is following:

H_0 : Constant variance

H_1 : No Constant variance.

Here Chi-square is 60.00 and the $P = 0.4392$ which is greater than the significance level of 0.05. So, at a 95% significance level the null hypothesis is accepted. So, there is a constant variance in the model. So, it can be concluded that there is no heteroscedasticity problem for the Pooled-OLS method.

4.4.4. White test for autocorrelation of ROA

Autocorrelation is a statistical concept that is also detect serial correlation. In simpler terms, it quantifies the relationship between data points within a sequence at different time lags. It refers to the correlation of a variable with itself over time within the same cross-sectional unit. Autocorrelation in panel data can arise due to various reasons, such as serial dependency, omitted variables, or unobserved heterogeneity across units. Here I have used the Wooldridge (2002) test to check the autocorrelation. Table 8 Output of Wooldridge test of ROA is conducted to detect autocorrelation. The null hypothesis, indicating neither a positive nor a negative autocorrelation and the alternative hypothesis are following:

H_0 : No first-order autocorrelation

H_1 : First-order autocorrelation.

Here, F-values of ROA is statistically insignificant at 0.1% level, hence we could reject the null hypothesis. The panel data model does not suffer from the first order autocorrelation problem, as a result.

5. CONCLUSION

This analysis's key motive is to explore the relationship of liquidity with profitability in Bangladesh's State-owned Commercial Banks of Bangladesh. In addition, the general research issue is to assess the effect of other variables (credit risk, capital efficiency, operational efficiency, bank size, asset quality, and macroeconomic variables) on the liquidity of state-owned banks. Here, the research period is from 2012 to 2021, which is the period since the 2020, Covid-19 Pandemic severely affected the economy of the whole world. A panel regression is calculated to show the effects of liquidity and other variables on profitability. However, this study showed that Liquidity risk has a significant positive relation with Profitability. Credit Risk, Inflation, NPL, GDP, etc. have a negative relation, and Capital Efficiency, Operational efficiency, bank size, interest rate, etc. have a positive relationship with Profitability. Some variables like the Unemployment rate, operational efficiency, etc. have an insignificant relation with profitability. While there is no serious effect of the financial crisis caused by the Pandemic Covid-19 in Bangladesh like many other major nations. Almost all the banks have maintained a steady liquidity position according to Basel III requirements. Most banks depend on Stored Liquidity Management to meet their current obligations. BASIC bank has a very high LDR which reflects its serious liquidity crisis.

The BASIC bank has faced a severe liquidity crisis recently and BDBL should be more careful to manage their liquidity position. State-owned banks should not only focus on the profit maximization theory but should also focus on steps to ensure effective liquidity management, considering the importance of the Liquidity-Profitability relationship of the banks. Especially BASIC and BDBL should focus on their liquidity management to reduce their excessive and insufficient liquidity as they have detrimental consequences. Also the government should be more careful regarding capital injection of these State-Owned Banks with a view to increasing their efficiency. As the

sustainability of State-owned banks relies on liquidity control and profitability of any bank, banks should take viable steps to ensure their liquidity and the required steps to satisfy those current obligations.

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APPENDICES

Table 9: Pearson's correlation matrix test

Particulars	ROA	LDR	LLPTA	EQTA	OPEXTA	LnAsset	GDP	INF	INT	Unemp rate	NPL
ROA	1.00										
LDR	-0.11	1.00									
LLPTA	-0.37	0.32	1.00								
EQTA	0.40	0.41	0.18	1.00							
OPEXTA	0.11	0.09	-0.08	0.08	1.00						
LnAsset	-0.07	-0.60	-0.32	-0.76	0.01	1.00					
GDP	-0.05	0.00	0.15	0.00	-0.30	0.00	1.00				
INF	-0.06	0.21	0.20	0.06	-0.07	-0.22	-0.17	1.00			
INT	0.15	0.02	0.26	0.04	-0.20	-0.18	0.23	0.66	1.00		
Unemp rate	0.04	-0.05	-0.34	-0.02	0.23	0.18	-0.59	-0.49	-0.69	1.00	
NPL	-0.28	0.49	0.56	0.36	-0.03	-0.55	0.15	-0.15	-0.04	-0.06	1.00

Diagnostic Test for Heteroscedasticity

H_0 : Constant variance

H_1 : No Constant variance.

Table 10: Whitetest (Pooled-OLS method)

Cameron and Trivedi's decomposition of the IM-test Chi2	df	P-value
60.000	59	0.439
14.550	10	0.149
1.160	1	0.281
75.710	70	0.299

Autocorrelation (Pooled-OLS Method)

Wooldridge test for autocorrelation in panel data

H_0 : No first-order autocorrelation

$F(1, 5) = 23.347$

Prob > F = 0.0047.

Regression output

Table 11: Pooled OLS method

ROA	Coef.	St. Err.	t-value	P-value	[95% Conf	Interval]	Sig
LDR	0.006	0.009	0.61	0.542	-0.013	0.024	
LLPTA	-0.169	0.06	-2.81	0.007	-0.289	-0.048	***
EQTA	0.107	0.021	5.15	0	0.065	0.149	***
OPEXTA	0.037	0.102	0.37	0.715	-0.167	0.241	
LnAsset	0.005	0.003	1.77	0.083	-0.001	0.011	*
NPL	-0.026	0.017	-1.54	0.13	-0.06	0.008	
GDP	-0.334	0.217	-1.54	0.13	-0.77	0.102	
INF	-0.778	0.276	-2.82	0.007	-1.332	-0.224	***
INT	0.607	0.166	3.66	0.001	0.274	0.941	***
Unemprate	-0.54	0.79	-0.68	0.497	-2.127	1.046	
Constant	0.004	0.066	0.06	0.956	-0.129	0.136	
Mean dependent var		-0.002		SD dependent var		0.016	
R-squared		0.588		Number of obs		60	
F-test		6.987		Prob > F		0.000	
Akaike crit. (AIC)		-355.194		Bayesian crit. (BIC)		-332.157	

***P < 0.01, **P < 0.05, *P < 0.1

Table 12: FE(robust)

ROA	Coef.	St. Err.	t-value	P-value	[95% Conf	Interval]	Sig
LDR	0.009	0.002	3.81	0.012	0.003	0.015	**
LLPTA	-0.147	0.114	-1.29	0.253	-0.438	0.145	
EQTA	0.119	0.063	1.88	0.118	-0.043	0.281	
OPEXTA	0.059	0.058	1.02	0.354	-0.089	0.207	
LnAsset	-0.007	0.013	-0.57	0.592	-0.041	0.026	
NPL	-0.036	0.033	-1.08	0.328	-0.122	0.05	
GDP	-0.267	0.223	-1.20	0.285	-0.839	0.306	
INF	-1.027	0.371	-2.77	0.039	-1.981	-0.074	**
INT	0.615	0.184	3.35	0.02	0.143	1.087	**
Unemprate	-0.063	1.436	-0.04	0.967	-3.753	3.628	
Constant	0.15	0.118	1.26	0.262	-0.155	0.454	
Mean dependent var		-0.002		SD dependent var		0.016	
R-squared		0.396		Number of obs		60	
F-test		.		Prob > F		.	
Akaike crit. (AIC)		-369.716		Bayesian crit. (BIC)		-359.244	

***P < 0.01, **P < 0.05, *P < 0.1

Table 13: RE(robust)

ROA	Coef.	St. Err.	t-value	P-value	[95% Conf	Interval]	Sig
LDR	0.006	0.006	0.87	0.385	-0.007	0.018	
LLPTA	-0.169	0.103	-1.64	0.101	-0.37	0.033	
EQTA	0.107	0.02	5.37	0	0.068	0.146	***
OPEXTA	0.037	0.05	0.74	0.458	-0.061	0.136	
LnAsset	0.005	0.003	1.61	0.107	-0.001	0.011	
NPL	-0.026	0.026	-1.00	0.316	-0.077	0.025	
GDP	-0.334	0.193	-1.73	0.084	-0.713	0.045	*
INF	-0.778	0.331	-2.35	0.019	-1.428	-0.128	**
INT	0.607	0.19	3.20	0.001	0.235	0.98	***
Unemprate	-0.54	1.076	-0.50	0.616	-2.65	1.569	
Constant	0.004	0.068	0.05	0.957	-0.129	0.137	
Mean dependent var		-0.002		SD dependent var		0.016	
Overall r-squared		0.588		Number of obs		60	
Chi-square		.		Prob > chi2		.	
R-squared within		0.380		R-squared between		0.982	

***P < 0.01, **P < 0.05, *P < 0.1