An internship report submitted in partial fulfillment of the requirements for the Degree of Master of Business Administration (MBA)

An internship report

On

Impact of Bank Liquidity and Macroeconomic Determinants on Profitability of Private Commercial Banks in Bangladesh: A panel Data Analysis

SUBMITTED TO

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Session: 2022-23

Program: MBA

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Date of Submission

26 May,2025

Letter of Transmittal

May 26, 2025

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Subject: Submission of internship report on **Impact of Bank Liquidity and Macroeconomic Determinants on Profitability of Private Commercial Banks in Bangladesh: A panel Data Analysis**

Madam,

It is my great pleasure to submit the report entitled **Impact of Bank Liquidity and Macroeconomic Determinants on Profitability of Private Commercial Banks in Banglades,** as a part of the requirements for Master of Business Administration (MBA) program. I have made every effort to follow your valuable guidance and instructions while preparing this report.

I sincerely appreciate your continuous support, encouragement, and valuable feedback throughout the preparation of this report. I hope this report meets your expectations.

Yours sincerely,

Meherunnesa Salma

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Acknowledgement

First and foremost, I would like to express my deepest gratitude to Almighty Allah for granting me the strength and patience to complete this report within the scheduled time.

I would like to extend my heartfelt thanks and sincere appreciation to my respected teacher and internship supervisor, Akila Rubaiyath whose constant supervision, valuable guidance, and encouragement made it possible for me to prepare this internship report. I am truly indebted to her for her continuous support throughout the study.

I am especially grateful to Faria Huda, Assistant General Manager & Head of the Branch of Sonali Bank PLC, Kotbari Branch, Cumilla for her valuable guidance and support during my internship. I would also like to express my sincere thanks to all other officers of the Branch for their helpful suggestions and for facilitating the successful completion of my internship.

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Declaration

I, Meherunnesa Salma, student of Finance & Banking Department, ID: 22317024, Session: 2022–2023, hereby declare that the internship report entitled, **Impact of Bank Liquidity and Macroeconomic Determinants on the Profitability of Private Commercial Banks in Bangladesh** has been solely prepared by me.

I confirm that this report is the result of my own work and has been prepared exclusively to fulfill the academic requirements of my internship program. It has not been submitted, in whole or in part, to any other institution or for any other purpose.

I also affirm that I have complied with all academic and ethical guidelines, and have properly acknowledged all sources and contributions by others.

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Supervisor Certificate

This is to certify that the internship paper regarding the topic **Impact of Bank Liquidity and Macroeconomic Determinants on the Profitability of Private Commercial Banks in Bangladesh** has been submitted successfully by Meherunnesa Salma, ID: 22317024, Reg. No.: 22317024, as partial fulfilment of MBA program, Department of Finance and Banking.

I found her sincere and hardworking regarding the study under my supervision. I wish her every success in all aspects.

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To Whom It May Concern

This is to certify that, **Meherunnesa Salma, ID No. 22317024, Reg No.22317024,** student of Comilla University, Department of Finance & Banking, under **MBA program** has completed her internship in Sonali Bank PLC, Kotbari Branch , Cumilla. During her internship period she maintained all the rules & provided the services as an employee of the organization.

On the way of accomplishing the task we found her very sincere, hard working and curious to acquire banking knowledge. She devoted herself fully in work area and performed all the duties & responsibilities accordingly. She always engaged herself in work instructed by the personnel of the branch.

We wish her every success in future.

(Faria Huda)
Assistant General Manager & Head Of Branch
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List of Acronyms

ROA = Return on Assets

ROE = Return on Equity

CR = Current Ratio

DGR = Deposit Growth Rate

CAR = Capital Adequacy Ratio

TLTDR = Total Loan to Total Deposit Ratio

OETAR = Operating Expenses to Total Assets Ratio

SB = Size of the Bank measured with log of Total Assets

NPLTLR = Non-Performing Loans to Total Loans Ratio

GDPGR = Gross Domestic Product Growth Rate

INFR = Inflation Rate

IRS = Interest Rate Spread

MSGR = Money Supply Growth Rate

ε = Residual error

H0 – Null Hypothesis

H1 – Alternative Hypothesis

Abstract

This study investigates the impact of bank liquidity and macroeconomic factors on the profitability of private commercial banks in Bangladesh, using data from 10 banks over the period 2014–2023. Return on Assets (ROA) and Return on Equity (ROE) serve as dependent variables, and bank-specific variables such as Current Ratio, Deposit Growth Rate, Capital Adequacy Ratio, Total Loan to Total Deposit Ratio, Operating Expenses to Total Assets Ratio, Size of the Bank measured with log of Total Assets, Non-Performing Loans to Total Loans Ratio, along with macroeconomic variables such as GDP Growth Rate, Inflation Rate, Interest Rate Spread, Money Supply Growth Rate, as independent variables. Four regression models—Pooled OLS, Fixed Effects, Random Effects, and GLS—were applied, alongside Model Specification Test, Diagnostic Tests for Heteroscedasticity, Autocorrelation, Multicollinearity and Unit Root Test to validate the econometric estimations. Based on the estimated outputs, the GLS model was identified as the best-fitting model as there was heteroscedasticity and autocorrelation problem in data set. According to GLS model, Current Ratio, Non-performing Loan to Total Loan Ratio, Total Loan to Total Deposit Ratio and Bank Size have significant negative impact on profitability, while Operating Expenses to Assets Ratio and Interest Rate Spread have significant positive affect on profitability of banks. By exploring the relationship between internal liquidity measures and external macroeconomic determinants with profitability, this research aims to provide valuable insights for bank managers, policymakers, and regulators. The findings are expected to support informed decision-making processes and contribute to strengthening the profitability and resilience of the private banking sector in Bangladesh.

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Chapter-1: Introduction

1. Introduction

In emerging nations like Bangladesh, where financial institutions are essential for directing investments, mobilizing resources, and promoting general economic growth, the banking industry is a pillar of economic development. Among these organizations, private commercial banks have become important participants, making substantial contributions to economic dynamism, job creation, and financial intermediation. It is now more crucial than ever to comprehend the factors that influence bank profitability in order to maintain financial stability and long-term economic growth as competition heats up and macroeconomic conditions change. Although profitability is still a crucial indicator of a bank's performance since it shows how well it can provide returns for shareholders, liquidity and profitability are frequently traded off. Low liquidity may raise the chance of insolvency, whereas high liquidity may limit options to generate money. Therefore, attaining the best possible balance between the two is necessary for efficient bank performance and strategy. The management of liquidity is essential to a bank's financial stability. It describes a bank's capacity to fulfill its immediate obligations without suffering large losses. Banks usually keep cash and liquid assets on hand to guarantee liquidity. But when banks use short-term obligations to support long-term assets, they run the risk of refinancing and interest rate mismatches, which is known as liquidity risk. In this context, liquidity not only determines a bank’s solvency and operational efficiency but also directly influences profitability. Proper liquidity management is therefore crucial for long-term sustainability and resilience.

The main goal of this study is to use an econometric model to investigate the relationship between liquidity and profitability. Numerous external (macroeconomic) and internal (bank-specific) factors affect bank profitability. The management and operations of a bank are closely linked to internal variables. These include measures of liquidity that show the bank's ability to meet short-term obligations, such as the current ratio, loan-to-deposit ratio, and deposit growth rate. The Capital Adequacy Ratio (CAR), which is commonly used to determine capital adequacy, indicates the institution's ability to bear risk and its overall financial health. Total Assets (TA) is a stand-in for bank size, while the Operating Expenses to Total Assets ratio (OPEXTA) measures operational efficiency. The ratio of non-performing loans (NPLs) is a crucial indicator of credit risk and asset

quality. Conversely, external or macroeconomic influences come from the larger economic landscape and comprise elements like GDP, which represents the total amount of economic activity. Interest rates (INT) influence lending and borrowing decisions, whereas the inflation rate (INF) shows how quickly consumer prices are changing. Furthermore, the money supply growth rate offers information about the general state of liquidity in the economy. To evaluate bank profitability, reduce risks, and improve overall financial performance, it is crucial to comprehend how these internal and external components interact. Thus this study focused on the impact of bank liquidity and selected macroeconomic variables on the profitability of private commercial banks in Bangladesh.

1.2 Background of the Study

The banking sector plays a crucial role in fostering economic growth in developing nations like Bangladesh by channeling financial resources and supporting investments. Among financial institutions, private commercial banks have emerged as key players, significantly contributing to the country's economic progress. As competition intensifies within the sector, achieving an optimal balance between profitability and liquidity has become increasingly critical. Profitability reflects a bank's financial strength and long-term viability, while liquidity ensures its capacity to meet short-term obligations and maintain operational stability. The interplay between these two aspects is often complex, as banks must carefully navigate the trade-offs between risk and return. Additionally, macroeconomic factors such as GDP growth, inflation, interest rates, and money supply also influence banking performance. Despite their importance, the combined effects of internal liquidity measures and external macroeconomic variables on bank profitability remain underexplored in the context of Bangladesh. In particular, there is a noticeable gap in empirical research focusing on private commercial banks. This study aims to address that gap by analyzing the relationship between liquidity, key macroeconomic indicators, and profitability in Bangladesh's private banking sector over the period from 2014 to 2023.

1.3 Problem Statement

Despite the growing importance of private commercial banks in Bangladesh, many of these institutions face challenges in maintaining optimal profitability while managing liquidity and adapting to changing macroeconomic conditions. There is a limited body of empirical research that explores how liquidity indicators and macroeconomic variables jointly influence bank

profitability in the context of Bangladesh. Without this understanding, banks may struggle to formulate effective strategies to manage risk, ensure stability, and improve performance. This study seeks to address this gap by analyzing the impact of both internal liquidity factors and external economic indicators on the profitability of private commercial banks in Bangladesh.

1.4 Significance of the Study

This study is crucial as it explores the impact of both internal liquidity variables and external macroeconomic factors on the profitability of private commercial banks in Bangladesh. Given the fast-paced expansion and increasing competitiveness of the banking sector, understanding these interactions is key to achieving effective financial management and ensuring the long-term viability of these institutions. The insights gained from this research will equip bank management with the knowledge needed to optimize liquidity strategies that bolster profitability. Additionally, it will provide policymakers and regulators with empirical evidence on how macroeconomic conditions affect bank performance, enabling the design of regulatory frameworks that support financial stability and sustainable growth.

Moreover, this research fills an important gap in Bangladesh's banking literature, where there is a lack of comprehensive empirical studies addressing these specific relationships. By analyzing data from 2014 to 2023, the study offers a detailed evaluation of the factors influencing profitability, thereby aiding stakeholders in enhancing the sector's financial robustness, contributing to economic stability, and laying a foundation for future academic inquiry in the banking and finance domain.

1.5 Scope of the Study

This study investigates how bank liquidity and selected macroeconomic factors influence the profitability of private commercial banks in Bangladesh. It examines the relationship between internal liquidity measures—such as the Current Ratio, Total Loan-to-Total Deposit Ratio, Deposit Growth Rate, Capital Adequacy Ratio, Operating Expenses to Total Assets Ratio, Bank Size, and Non-Performing Loan to Total Loan Ratio—and bank profitability, which is measured using Return on Assets (ROA) and Return on Equity (ROE). Additionally, the study incorporates key macroeconomic variables, including GDP Growth Rate, Inflation Rate, Interest Rate Spread, and Money Supply Growth Rate.

Focusing exclusively on private commercial banks in Bangladesh, the research covers a ten-year period from 2014 to 2023. It utilizes secondary data sourced from bank annual reports, publications by Bangladesh Bank, online resources, and relevant economic databases. The results are intended to assist banking professionals, policymakers, and academics by offering deeper insights into how liquidity management and economic conditions impact bank performance within the Bangladeshi financial sector.

1.6 Research Questions

- How do internal liquidity indicators influence the profitability of private commercial banks in Bangladesh?
- What effects do macroeconomic variables have on the profitability of these banks?
- Is there a significant relationship between liquidity management practices and key profitability measures such as Return on Assets (ROA) and Return on Equity (ROE)?
- How can banks effectively balance liquidity and profitability to ensure financial stability and sustainable growth?
- How consistent and robust are these relationships when evaluated using different econometric models, including Pooled OLS, Fixed Effects, Random Effects, and Generalized Least Squares (GLS)?
- What policy or strategic recommendations can be derived from understanding the interplay between liquidity, macroeconomic factors, and bank profitability??

1.7 Objectives of the Study

Broad Objective

To identify the Impact of bank liquidity and macroeconomic determinants on profitability of private commercial banks in Bangladesh.

Specific Objectives

Some specific objectives of this study are as following:

- To determine the normality of dataset through descriptive statistic.

- To conduct rigorous multiple regression analysis for measuring the relationship between bank liquidity and macroeconomic variables on bank's profitability.
- To perform various diagnostic tests for measuring the validity and reliability of the regression model.
- To select the best model using model specification tests.

1.8 Limitations of the Study

The limitations of the report are mentioned in the following segment-

- The study exclusively focuses on data from Private Commercial Banks, excluding State-Owned Commercial Banks, Islamic Banks, and Foreign Banks in Bangladesh.
- The report is mostly based on secondary data. Therefore, the accuracy and quality of the data cannot be independently verified by the author. However, the data has been collected from several well-known sources to ensure as much authenticity as possible.
- Various data sets are unavailable.

Based on the aforementioned goal, the rest of this study is structured as follows: The next section offers a review of the relevant literature, followed by a detailed explanation of the research methodology. The fourth section presents the empirical results and key findings, and the final section concludes the study with recommendations.

Chapter-2: Literature review

2.0 Literature review

There are countless studies on the profitability of banks conducted around the world, as this is a crucial area of research for understanding the financial health of banks and their role in the broader economy. The following list includes several studies on how bank liquidity and macroeconomic determinants affect bank profitability:

Chokroborty and Hasan (2024), explored the influence of liquidity management on the profitability of both private sector banks listed on the Dhaka Stock Exchange (DSE) and public sector banks. To assess liquidity, the study employed several key financial ratios, including the current ratio (CR), cash-deposit ratio (CDR), credit-deposit ratio (CRDR), and investment-deposit ratio (IDR). Profitability was measured using return on assets (ROA) and return on equity (ROE). The findings highlighted a significant association between liquidity and profitability in public sector banks, particularly in terms of ROA. Although theoretical frameworks suggest that ratios such as IDR, CDR, CRDR, and CR should have a positive impact on bank profitability, empirical results indicate that this expected positive relationship does not consistently hold in practice.

Ghimire, Chaurasiya and Basnet (2024), studied into Nepalese commercial banks explored the connection between liquidity and profitability, where return on equity (ROE) and return on assets (ROA) were used to gauge profitability. Liquidity was evaluated using several key indicators: the non-performing loan (NPL) ratio, capital adequacy ratio (CAR), loan-to-deposit ratio (LDR), and the liquidity ratio (CCR). To control for broader economic conditions, GDP and interest rates were also included as variables. The study revealed that while there was a negative overall correlation between liquidity and profitability, liquidity still had a statistically significant influence on both ROA and ROE. Specifically, the capital adequacy ratio (CAR) had a positive effect on ROA, suggesting stronger asset performance, but negatively impacted ROE, possibly due to reduced leverage. In addition, the loan-to-deposit ratio (LDR) demonstrated a positive and significant relationship with profitability, indicating that higher levels of lending relative to deposits were associated with improved financial performance.

Karim *et al.* (2023), compared data from before and after the outbreak to investigate how the COVID-19 pandemic affected the liquidity and profitability of commercial banks in Bangladesh. DER, OCFR, DAR, CDR, CaR, CR, and ROA were among the financial metrics that were employed. Although the overall trend remained consistent and statistically insignificant, the results indicated that profitability, as determined by ROE and ROA, became more variable after the pandemic. After the pandemic, however, liquidity positions underwent a substantial shift, with the exception of OCFR and DER, which stayed steady. According to the report, bank liquidity was significantly impacted by COVID-19, but profitability was only slightly impacted.

Amira, Alala and Maniagi (2023), investigated the connection between profitability and liquidity management in Nepalese joint venture commercial banks. Key financial indicators analyzed included the Credit Deposit Ratio (CDR), Capital Adequacy Ratio (CAR), Current Reserve Ratio (CRR), Total Deposit to Total Assets Ratio (TDTAR), and Total Loan to Total Assets Ratio (TLTAR), with Return on Assets (ROA) serving as the primary measure of profitability. The study found a strong overall positive relationship between profitability and these liquidity-related variables. Among them, TLTAR emerged as the most influential factor significantly impacting ROA. In contrast, the influence of CDR, CAR, CRR, and TDTAR on profitability was found to be relatively insignificant.

Islam, *et al.* (2022), analyzed how liquidity influences profitability in the context of Bangladesh's banking sector. Liquidity was assessed using key indicators such as the Loan-to-Deposit Ratio, Deposit-to-Assets Ratio, and Cash-to-Deposit Ratio, which were treated as independent variables. Profitability was measured through Return on Assets (ROA), the dependent variable. The findings indicate that improvements in these liquidity ratios are positively associated with an increase in ROA, suggesting that better liquidity management contributes to higher profitability. The research concludes that commercial banks in Bangladesh are positioned to maintain a healthier equilibrium between liquidity and profitability, supporting the idea that strategic liquidity control can enhance overall financial performance..

Tasnova (2022), examining the influence of both macroeconomic variables and bank-specific factors on the liquidity of 29 listed commercial banks in Bangladesh. Macroeconomic indicators included Gross Domestic Product (GDP), the monetary policy interest rate, and the interest rate

spread, while the bank-specific variables comprised capital adequacy, nonperforming loans (NPLs), and profitability. The findings demonstrated that liquidity levels in banks were negatively influenced by the business cycle and the central bank's policy interest rate—implying that during economic expansions or when interest rates rise, liquidity tends to decline. However, other factors such as nonperforming loans, capital adequacy, and interest rate spread had significant effects on liquidity. Notably, the study found a positive correlation between liquidity and profitability, suggesting that banks with better liquidity positions tend to perform better financially. Overall, the research highlights the complex interplay between external economic conditions and internal financial health in determining the liquidity management of commercial banks in Bangladesh.

Thinh, Thuy and Tuan (2022), explored the interrelationship between profitability and liquidity in Vietnamese listed banks, utilizing both the Ordinary Least Squares (OLS) regression method and a time series analytical approach. To evaluate this relationship, the researchers considered several financial indicators: Return on Equity (ROE), Return on Assets (ROA), Net Interest Margin (NIM), overall liquidity ratio, short-term borrowings, short-term bills payable, and the loan-to-deposit ratio. The findings revealed a generally positive association between banks' liquidity and their profitability, as indicated by improvements in ROE, ROA, and NIM. This suggests that enhanced liquidity levels contribute to better overall financial performance. However, the study also uncovered that certain short-term liquidity components—namely, short-term borrowings, short-term bills payable, and the loan-to-deposit ratio—negatively affect the Net Interest Margin. This implies that while liquidity is crucial for sustaining profitability, excessive reliance on short-term liabilities may reduce a bank's interest-based earnings potential. Overall, the research emphasizes the importance of managing liquidity structure carefully to maintain profitability in Vietnam's banking sector.

Zaharum, *et al.* (2022), studied how Malaysian commercial banks' profitability and liquidity management relate to one another. The Loan to Total Deposit (LTD) ratio, Capital to Asset Ratio (CAR), Current Ratio (CR), Cash Deposit Ratio (CDR), and Nonperforming Loans (NPL) were among the proxies used in the study to gauge liquidity. The main measure of profitability was return on assets, or ROA. The results of the study showed a positive correlation between ROA and the current ratio, suggesting that banks with better short-term liquidity positions typically have greater levels of profitability. This implies that operational efficiency and profitability are

improved by keeping enough current assets to cover liabilities. On the other hand, a significant negative correlation was observed between ROA and Nonperforming Loans, highlighting that higher levels of loan defaults weaken a bank's profitability by increasing credit risk and provisioning costs. Other liquidity indicators showed mixed or less significant effects. In conclusion, the study underscores the critical role of effective liquidity management and asset quality control in boosting the financial performance of Malaysian commercial banks.

Paul, Bhowmik, and Famanna (2021), examined the relationship between liquidity and profitability within Bangladesh's commercial banking sector. Liquidity was assessed through multiple indicators including the Loan-to-Deposit Ratio (LDR), Deposit-to-Assets Ratio (DAR), Cash-to-Deposit Ratio (CDR), Loan-to-Assets Ratio (LAR), and Current Ratio (CR). Profitability was measured using Return on Equity (ROE). Using both correlation and regression analyses, the research revealed that among these liquidity metrics, LDR, DAR, and CDR had a statistically significant effect on banks' profitability. In contrast, LAR and CR were found to be statistically insignificant in influencing ROE. These results suggest that certain aspects of liquidity management are more critical than others when it comes to enhancing profitability in Bangladesh's commercial banks. Ultimately, the study underscores the important role that effective liquidity management plays in boosting financial performance in the country's banking industry.

Adegboye (2021), evaluated the trade-offs between liquidity and profitability in five Nigerian commercial banks using empirical data. It examined the relationships between key liquidity components—marketable debt instruments (MDI), bank advances (BA), and loans (LA)—and profitability indicators, namely profit after tax (PAT) and return on assets (ROA). The correlation analysis demonstrated statistically significant and strong associations, both positive and negative, indicating that changes in liquidity elements directly affect profitability outcomes. The research highlighted that managing liquidity efficiently is a critical factor for banks, as it can either boost or diminish profitability. This is because banks continuously strive to balance maintaining sufficient liquid assets to meet obligations while maximizing returns on their resources. Overall, the study underscores the importance of strategic liquidity management in optimizing financial performance within Nigerian commercial banks.

Lalon and Naher (2020), focused on evaluating and contrasting the liquidity conditions of Bangladesh's leading state-owned commercial banks with those of the top private commercial

banks. Specifically, it analyzed five state-owned banks alongside ten private commercial banks, examining how the Statutory Liquidity Requirement (SLR)—which obligates banks to maintain 18% of their deposits in liquid assets—impacts their liquidity positions. The research assessed several key indicators, including individual liquidity risk ratios, debt-to-equity (D/E) ratios, investment-to-asset (I/A) ratios, bank size, liquid assets, and Return on Equity (ROE). These variables were measured for a randomly selected sample comprising five state-owned and five private banks. Statistical testing using the F-test revealed that most of the variables were significant at both 5% and 10% confidence levels, highlighting their influence on liquidity. However, liquidity risk stood out as an exception within state-owned banks, where it did not show a statistically significant effect. Overall, the findings suggest that while various financial and operational factors meaningfully affect liquidity in both sectors, state-owned banks may experience different liquidity dynamics, particularly regarding liquidity risk, compared to private commercial banks.

Chaudhury (2020), studied on assessing the effect of liquidity management on the profitability of Bangladesh's Nationalized Commercial Banks (NCBs) over the ten-year period from 2008 to 2018. The sample comprised six carefully chosen banks, and the analysis was based on a balanced panel dataset containing 66 observations, which were extracted from the banks' annual reports. To explore the relationships between variables, the study employed a random effects regression model. The empirical findings demonstrated that liquidity management plays a significant role in influencing the profitability of these banks. Specifically, the model's R^2 value of 75.21% indicates that variations in liquidity explain over three-quarters of the differences in Return on Assets (ROA), underscoring liquidity's critical contribution to profit generation. The analysis further revealed that Tier 1 capital relative to risk-weighted assets had a highly significant positive effect on liquidity, suggesting stronger capital adequacy improves liquidity positions. In contrast, the ratios of assets to shareholders' equity and bank size—measured in terms of total deposits—were found to have a significant negative impact on liquidity measures. Additionally, the prevailing market interest rate was shown to negatively affect the profitability of the selected NCBs, highlighting external economic factors' role in shaping financial outcomes. Overall, the study underscores the importance of effective liquidity and capital management alongside macroeconomic conditions in determining the financial performance of Bangladesh's nationalized banks.

Bencharles and Abubakar (2020), explored the effects of liquidity management on the profitability of Nigerian Islamic and conventional banks over the period from 2012 to 2019. Liquidity was assessed using multiple ratios—including cash to total assets, current assets to total assets, and liquid assets to total assets (LATA)—while bank size was controlled for in the analysis to account for its potential influence. Profitability was measured through Return on Assets (ROA). The empirical findings demonstrated a negative correlation between liquidity and profitability in both types of banks, indicating that higher liquidity levels tend to correspond with lower profitability. Notably, the study revealed that Islamic banks' profitability is more significantly affected by variations in liquidity compared to their conventional counterparts. This suggests that Islamic banks are more sensitive to liquidity management practices and that fluctuations in liquidity levels have a greater impact on their financial performance. The research highlights important differences in how liquidity influences profitability across banking models within Nigeria, emphasizing the need for tailored liquidity strategies in Islamic banking.

Parvin, *et al.* (2019), investigated how bank size and liquidity influenced the profitability of commercial banks in Bangladesh between 2011 and 2015. To assess profitability, the researchers examined key indicators including the loan-to-asset ratio, deposit-to-asset ratio, overall liquidity, and bank size. The results revealed that Return on Assets (ROA), used as the measure of profitability, was positively correlated with both bank size and the loan-to-asset ratio, suggesting that larger banks and those with a higher proportion of loans relative to assets tended to be more profitable. Conversely, the deposit-to-asset ratio exhibited a negative relationship with ROA, indicating that a higher proportion of deposits relative to assets may detract from profitability. Despite these observed correlations, the analysis found that bank size, liquidity, and the examined ratios did not have a statistically significant impact on profitability. This suggests that while these factors are related to profitability, other variables or external conditions may play a more decisive role in determining the financial performance of Bangladesh's commercial banks during this period.

Pradhan and Gautam (2019), explored the influence of liquidity management on the profitability of Nepalese commercial banks, focusing on Return on Equity (ROE) and Return on Assets (ROA) as key indicators of profitability. The independent variables analyzed included the investment ratio, quick ratio, liquid asset ratio, current ratio, capital ratio, and total deposits. Findings revealed

a positive association between ROA and the capital ratio, indicating that banks with higher capital adequacy tend to achieve better returns on their assets. Similarly, both ROE and ROA showed strong positive correlations with the investment ratio and current ratio, suggesting that increases in these ratios—reflecting higher investment levels and better short-term liquidity management—are linked to improved profitability. Conversely, the liquid asset ratio exhibited a negative relationship with both ROE and ROA, implying that maintaining excessive liquid assets might reduce profitability, possibly due to lower returns on highly liquid, but less profitable, assets. Overall, the study highlights the nuanced role of different liquidity management metrics in shaping the financial performance of Nepalese commercial banks, emphasizing the need for a balanced approach to liquidity and capital management to optimize profitability.

Gjorgji and Goran (2019), investigated the dynamics between profitability and liquidity within Macedonia's banking industry, aiming to identify the key factors that affect bank liquidity. Researchers examined seven variables believed to influence liquidity: two macroeconomic indicators—GDP growth rate and the central bank's reference interest rate—and five internal bank-specific factors, namely profitability, bank size, capital adequacy, non-performing loans, and the lagged value of liquidity. The analysis revealed that profitability stands out as one of the most significant determinants positively impacting liquidity levels in Macedonian banks. Furthermore, the study found that lagged liquidity, non-performing loans, and the central bank's interest rate also exert a meaningful positive influence on liquidity, though their effects are less pronounced compared to profitability. In contrast, bank size demonstrated a substantial negative correlation with liquidity, suggesting that larger banks tend to maintain relatively lower liquidity ratios. Notably, the macroeconomic variable GDP growth rate and the bank-specific factor capital adequacy did not show any statistically significant effect on bank liquidity. These findings highlight the complex interplay between internal bank factors and external economic conditions in shaping liquidity management strategies in Macedonia's banking sector.

Mishra and Pradhan (2019), analyzed the influence of liquidity management on the profitability of private sector banks in India. Liquidity was measured using three independent variables: the Cash-Deposit Ratio (CDR), Credit-Deposit Ratio (CRDR), and Investment-Deposit Ratio (IDR). Profitability indicators included Return on Equity (ROE) and Return on Assets (ROA) as dependent variables. The study's findings showed that ROA experiences a significant negative

impact from both the Cash-Deposit Ratio and Investment-Deposit Ratio, indicating that higher liquidity holdings in cash and investments relative to deposits tend to lower the efficiency of asset returns. Conversely, the Credit-Deposit Ratio did not exhibit a notable effect on ROA. Regarding ROE, the analysis revealed no significant relationship between liquidity management and profitability when considering all variables collectively across the Indian private banks sampled. This suggests that liquidity levels, while affecting asset profitability, do not have a clear direct influence on returns to equity holders, underscoring a more intricate link between liquidity management and overall bank profitability..

Ghurtskaia, K. (2018) focused on the relationship between liquidity management and profitability in Indian private sector banks. Liquidity was represented by the Cash-Deposit Ratio (CDR), Credit-Deposit Ratio (CRDR), and Investment-Deposit Ratio (IDR) as independent variables, while profitability was gauged using Return on Equity (ROE) and Return on Assets (ROA) as dependent variables. The analysis revealed that both the Cash-Deposit Ratio and Investment-Deposit Ratio exert a significant negative influence on ROA. However, when all factors were considered simultaneously, no significant correlation was observed between liquidity and profitability based on ROE across the banks examined. Additionally, the study indicated that deposits and bank liquidity had a negative and statistically significant link, but that there was no correlation between profitability and liquidity.

Quaid *et al.* (2018), examined on the determinants of liquidity in Pakistani banks, revealing that internal factors like bank size, cost of funds, and capital adequacy ratio (CAR) significantly influence liquidity but affect the ratios of total loans to total deposits and liquid assets to total assets differently. In terms of external influences, GDP was shown to have a significant impact on bank liquidity, though the nature of this impact varies depending on which liquidity ratio is considered. Moreover, unemployment emerged as an important external factor, significantly affecting the liquid assets to total assets ratio, while having little to no effect on the loans to deposits ratio.

Mohanty and Mehrotra (2018), examined how liquidity management affects the profitability of Indian banks in both the public and private sectors. It used Return on Assets (ROA) and Return on Equity (ROE) to represent profitability, while liquidity management was measured using the Cash-Deposit Ratio (CDR), Credit-Deposit Ratio (CRDR), and Investment-Deposit Ratio (IDR). The

study found that ROA is significantly and negatively impacted by the CDR and IDR. However, when all variables were considered together, there was no significant link between liquidity and profitability based on ROE, regardless of the type or ownership of the banks involved.

Charmler, *et al.* (2018), Using descriptive statistics, regression, and correlation techniques, the study examined the trends and effects of liquidity on the profitability of Ghanaian commercial banks. Based on both liquidity indicators, the results demonstrated a favorable correlation between liquidity and return on assets (ROA). The liquid assets to total assets ratio (LIDQ1) showed a modest positive association with return on equity (ROE), whereas the liquid assets to total interest-bearing liabilities ratio (LIQD2) showed a slight negative correlation. As control factors, the study also showed a positive correlation between bank profitability and net interest margin, bank size, capital adequacy ratio, and foreign ownership.

Ojha (2018), explored the relationship between liquidity and various bank-specific factors in Nepalese commercial banks. It focused on liquidity trends and included variables such as non-performing loans (NPL), Return on Assets (ROA), Capital Adequacy Ratio (CAR), Return on Equity (ROE), GDP, inflation, and the interbank rate (IBR). The results indicated a strong connection between several factors and the liquidity performance of Nepalese banks. Notably, ROA, ROE, NPL, GDP, and IBR were found to have a significant impact on the banks' liquidity levels.

Singh and Sharma (2018), studied the liquidity of Indian banks and the effects of various factors including profitability, net interest margin, non-performing assets, capital adequacy ratio, bank size, deposits, and funding costs. Employing fixed effect estimation, the study found that bank size, non-performing assets, and net interest margin negatively influence liquidity. In contrast, capital adequacy ratio, deposits, and profitability were shown to have a positive effect. Additionally, the cost of funding appeared to have little to no significant impact on Indian banks' liquidity.

Shrestha (2018), examined the link between profitability and liquidity management in Nepal's commercial banks. Profitability was measured using Return on Assets (ROA), while liquidity was assessed through the Current Reserve Ratio (CRR) and Credit Deposit Ratio (CDR). To analyze the relationship between liquidity management and profitability, Pearson correlation analysis was applied, followed by regression analysis to examine the effect more closely. The study concluded

that liquidity management does not have a significant influence on the profitability of Nepalese commercial banks.

Ali, Qaisar and Maamor (2018) focused on the influence of key macroeconomic factors on the profitability of Islamic banks. It revealed that variables such as exchange rates and money supply do not significantly affect the banks' profit levels. However, gross domestic product (GDP) and inflation rates were found to have a substantial impact on profitability. This is because GDP reflects the overall economic growth, which directly influences banking activities and earnings, while inflation affects the real value of returns and costs incurred by banks. The researchers emphasized that to accurately measure and understand the true profitability of Islamic banks, it is essential to consider both GDP and inflation rates. Ignoring these factors could lead to misleading conclusions, as the actual profits of banks—when adjusted for economic growth and inflation—may differ markedly from the initially predicted profits based on nominal figures alone. Thus, the study underscores the need for integrating macroeconomic indicators into profitability analyses to provide a realistic and comprehensive assessment of Islamic banks' financial performance.

Ibrahim (2017), studied how liquidity influences the profitability of commercial banks in Iraq. In this study, Return on Assets (ROA) was utilized as the indicator of profitability, while liquidity was measured using three key ratios: the Loan-Deposit Ratio, Deposit-Asset Ratio, and Cash-Deposit Ratio. To assess the relationship between liquidity and profitability, the Ordinary Least Squares (OLS) regression model was employed. The results demonstrated that an increase in any of these liquidity ratios positively impacts the banks' Return on Assets. This implies that better liquidity management, reflected by higher loan-deposit, deposit-asset, and cash-deposit ratios, contributes to improved profitability for Iraqi commercial banks..

Muiruri (2017), examined the influence of liquidity on the profitability of commercial banks in Kenya by utilizing audited financial reports as secondary data sources. To gauge liquidity, the study used metrics such as the liquidity ratio, capital adequacy ratio, and deposit-to-asset ratio. Profitability was measured by the return on assets (ROA). Over the six-year duration of the study, the results indicated a strong positive relationship between liquidity levels and profitability measures among Kenyan commercial banks. This suggests that better liquidity management is closely linked with enhanced profitability in the Kenyan banking sector.

Malik and Aqeel (2017), investigated the effects of liquidity management on the profitability of commercial banks in Pakistan. Profitability was represented by two key metrics: Return on Equity (ROE) and Return on Assets (ROA). To evaluate liquidity management, the study used several indicators, including the investment ratio, current ratio, capital adequacy ratio, credit facilities, and liquid assets ratio. The empirical analysis revealed contrasting impacts of these liquidity measures on profitability. Specifically, an increase in the capital ratio and liquid assets ratio was found to have a detrimental effect on the profitability of Pakistani banks. This suggests that holding excessive capital or liquid assets might reduce earnings. Conversely, higher levels of the current ratio and investment ratio were positively correlated with profitability, indicating that effective management of available funds and maintaining sufficient short-term assets contribute to improved financial performance. Overall, the findings highlight the nuanced role liquidity management plays in shaping the profitability of commercial banks in Pakistan.

Pradhan, Shyam and Shrestha (2016), studied on evaluating how liquidity affects the performance of commercial banks in Nepal. The study identified several key liquidity indicators as independent variables, including the investment ratio, liquidity ratio, capital ratio, and quick ratio. Profitability was measured using Return on Equity (ROE) and Return on Assets (ROA) as dependent variables. To gain a clearer understanding of the dynamic relationship between liquidity and profitability, the study incorporated one-year lagged values of the independent variables to assess how liquidity in the previous year impacts the current year's ROE and ROA. Data for the study were sourced from secondary materials such as the Nepal Rastra Bank's supervisory reports and the annual financial statements of the banks. Using regression models, the findings demonstrated that liquidity management plays a critical and statistically significant role in influencing the financial performance of Nepalese commercial banks, highlighting the importance of effective liquidity strategies for sustained profitability..

Singh and Sharma (2016), examined the factors affecting liquidity in Indian banks by considering both macroeconomic and bank-specific variables. Among the bank-specific factors examined were deposits, capital adequacy, cost of funding, profitability, and bank size. On the macroeconomic front, the study focused on GDP, inflation, and unemployment rates. Additionally, the study highlighted the influence of bank ownership on liquidity management. Using panel data analysis, the findings demonstrated that liquidity in Indian banks is significantly influenced by several

factors. Most notably, GDP and bank size showed a negative relationship with liquidity, indicating that higher economic output and larger bank size may lead to reduced liquidity levels. Conversely, deposits, profitability, capital adequacy, and inflation were found to positively affect liquidity, suggesting that well-capitalized banks with strong earnings and higher deposits tend to maintain better liquidity positions. Inflation's positive effect might reflect banks' adjustments in liquidity buffers during periods of rising prices. Meanwhile, unemployment and the cost of funding appeared to have little to no statistically significant impact on bank liquidity. Overall, the study underscores the complex interplay of internal and external factors shaping liquidity management in the Indian banking sector.

Gautam (2016), aimed to identify the factors influencing liquidity in Nepalese commercial banks by applying a least squares regression model to analyze both macroeconomic and bank-specific variables. The variables examined included non-performing loans, bank size, profitability, capital adequacy ratio, GDP growth rate, and inflation rate to determine their impact on the industry's liquidity. The findings revealed that bank size, capital adequacy, and inflation rate positively influence liquidity, whereas non-performing loans, profitability, and GDP growth rate have a negative effect. However, only profitability, capital adequacy, and non-performing loans were found to have a statistically significant impact on liquidity, while bank size, GDP growth rate, and inflation rate showed statistically insignificant effects.

Waleed Pasha and Akhtar (2016), focused on analyzing the balance—or trade-off—between profitability and liquidity in Pakistan's banking sector over the period from 2010 to 2015, covering all banks listed on the Pakistan Stock Exchange. To assess liquidity and profitability, the research employed key financial ratios such as bank liquidity ratios alongside profitability metrics including net profit margin, return on equity (ROE), return on assets (ROA), return on investment (ROI), and earnings per share (EPS). The findings indicated a strong and positive association between liquidity ratios and profitability indicators like ROE, ROA, and net profit margin, suggesting that banks with better liquidity management tend to achieve higher profitability in these areas. Conversely, the study found minimal or no significant correlation between liquidity and other profitability measures such as earnings per share and return on investment, implying that liquidity may have a limited effect on these particular performance metrics. Overall, the results highlight the complex nature of the relationship between liquidity and different aspects of bank profitability.

Das *et al.* (2015), examined on analyzing the profitability and liquidity management practices of private commercial banks in Bangladesh. The banks were initially selected and grouped into three different generations according to their founding periods. The study then applied various analytical techniques to assess liquidity and profitability, using key indicators such as total deposits, advances, overall profits, advance-to-deposit (AD) ratios, and profit growth rates. The results suggested that, provided other factors remain favorable, efficient liquidity management plays a crucial role in improving the profitability of these banks. Conversely, the study also found that maintaining excessive liquidity can negatively affect profitability, emphasizing the delicate balance banks must maintain in managing their liquid assets within the specific economic and financial environment of Bangladesh.

Samad (2015), examined how macroeconomic factors and bank-specific characteristics influence the profitability of Bangladesh's banking sector. Financial reports from 42 commercial banks in Bangladesh were analyzed to assess the impact of macroeconomic variables, such as economic growth, alongside bank-specific factors including financial risk, operational efficiency, and bank size on profitability. The results highlighted that bank-specific factors—specifically the loan-deposit ratio, loan-loss provisions relative to total assets, equity capital to total assets, and operating expenses to total assets—play a significant role in determining bank profits. However, macroeconomic variables and bank size were found to have no significant effect on earnings.

Bariya, *et al.* (2014) examined the relationship between profitability and liquidity in Nepalese commercial banks, this study selected the current ratio, net liquid balance, asset quality, and liquidity management as independent variables, while return on equity (ROE), return on assets (ROA), and net interest margin (NIM) served as dependent variables. Firm size and financial leverage were included as control variables. The results indicated that improved liquidity management and higher financial leverage are associated with increased ROA. Similarly, a greater net liquid balance was linked to higher ROA. The findings also showed that ROE improves with better financial leverage, liquidity management, net liquid balance, current ratio, and bank size, though higher asset quality was correlated with a lower ROE. Regarding NIM, the study found it rises with increases in current ratio, liquidity management, asset quality, and financial leverage, but decreases with larger net liquid balance and bank size.

2.1 Literature Gap

From the previous literature reviews, it can be said that there have been many studies regarding the Impact of Bank Liquidity on Profitability of Commercial Banks in Bangladesh or many others developed and developing countries like, India, Nepal, Liberia, Kenya, Pakistan and Nigeria. Although numerous studies have examined the individual effects of liquidity and macroeconomic factors on bank profitability. Specifically, most studies focus on either liquidity or macroeconomic variables in isolation, rather than exploring how liquidity and macroeconomic conditions jointly influence profitability over time. There is no existing literature on the interaction between liquidity and macroeconomic factors, particularly how these combined variables influence Profitability of Private Commercial Banks in Bangladesh. So in this study, this gap is identified and will try to show the impact of Bank Liquidity and Macroeconomic Determinants on Profitability of private Commercial Banks of Bangladesh and provides insights into how well banks in Bangladesh manage their resources to remain financially stable and profitable.

2.2 Hypothesis Development

A hypothesis has been created to investigate the Impact of Bank Liquidity and Macroeconomic Determinants on Profitability of private Commercial Banks in Bangladesh.

HO: There is no positive relationship between Profitability of private Commercial Banks with Bank Liquidity and Macroeconomic Determinants.

HI: There is a positive relationship between Profitability of private Commercial Banks with Bank Liquidity and Macroeconomic Determinants.

Chapter - 3: Methodology

3.1 Research Type

This research is classified as explanatory, aiming to uncover the impact of bank liquidity and macroeconomic determinants on the profitability of private commercial banks in Bangladesh. It examines whether these factors significantly influence profitability, measured by Return on Assets (ROA) and Return on Equity (ROE), over the period from 2014 to 2023. The study considers various internal variables, including Current Ratio, Deposit Growth Rate, Capital Adequacy Ratio, Total Loan-to-Total Deposit Ratio, Operating Expenses to Total Assets Ratio, Bank Size, and Non-Performing Loans to Total Loans Ratio. It also incorporates external macroeconomic variables such as GDP Growth Rate, Inflation Rate, Interest Rate Spread, and Money Supply Growth Rate. The study relies on numerical data and statistical techniques.

3.2 Identification of Variables

Table 1 presents the selected variables along with their anticipated effects on the dependent variable, as supported by empirical literature, for use in the multiple regression analysis.

Table 1 Description of Variables included in the Models

	Variables	**Notation**	**Calculation Procedure**	**Expected Impact**	**Data Source**
Dependent variables	Return on equity	ROE	Net Income / Total Equity	_	Annual Report
	Return on asset	ROA	Net income / Total Assets	_	Annual Report
	Current Ratio	CR	Current Assets / Current Liabilities	+ (Positive)	Annual Report

Independent Variables	Deposit Growth Rate	DGR	(Current year Deposits – Previous year Deposits) / Previous years Deposits	+ (Positive)	Annual Report
	Capital adequacy ratio	CAR	(Tier 1 Capital + Tier 2 Capital) / Risk-Weighted Assets	+ (Positive)	Annual Report
	Total Loans to total Deposit Ratio	TLTDR	Total Loans / Total Deposits	+ (Positive) /-(Negative)	Annual Report
	Operating Expense to Total Assets Ratio	OETAR	Operating expense / Total assets	+ (Positive) /-(Negative)	Annual Report
	Size of the Bank	SB	Log of Total Asset	+ (Positive)	Annual Report
	NPL to total Loan Ratio	NPLTLR	Non-Performing Loans / Total loans	-(Negative)	Annual Report
	GDP growth Rate	GDPGR	(GDP in current period – GDP in previous period) / GDP in previous period	+ (Positive)	World Bank
	Inflation Rate	INFR	Average inflation per year	-(Negative)	Bangladesh Bank Website

	Interest rate spread	IRS	Lending rate – Deposit rate	+ (Positive)	Bangladesh Bank Website
	Money Supply Growth Rate	MSGR	(Current year Money Supply – Previous years year Money Supply) / Previous years year Money Supply	+ (Positive) /-(Negative)	Internet

Source: Author's own observation

The plus sign (+) indicates a positive relationship between the independent variable and the dependent variable, meaning that an increase in the independent variable's coefficient is associated with an increase in bank profitability, and vice versa. Conversely, the minus sign (–) denotes a negative relationship, where an increase in the independent variable's coefficient corresponds to a decrease in profitability, and vice versa.

3.3 Data type and sample selection procedure

Preparing this paper requires only secondary data collected for the last 10 years since 2014 of 10 commercial banks operating in Bangladesh using convenience sampling. So, this has become a panel data having a sample size of 100. The banks are:

- ✓ AB Bank PLC
- ✓ Dutch-Bangla Bank PLC
- ✓ Prime Bank PLC
- ✓ Pubali Bank PLC
- ✓ Dhaka Bank PLC
- ✓ City Bank PLC
- ✓ Modhumoti Bank Limited
- ✓ United Commercial Bank PLC
- ✓ Bank Asia PLC
- ✓ Brac Bank PLC

This study focuses exclusively on the impact of bank liquidity and macroeconomic determinants on the profitability of private commercial banks in Bangladesh. A sample of ten conventional private banks was selected, excluding state-owned and Islamic commercial banks. This approach enables a more precise assessment of how liquidity and macroeconomic factors affect the profitability of private commercial banks in the country.

3.4 Sources of Data

In this report, only secondary sources of data are used to meet the objective of this report. Different articles and research papers have also been used as the data source.

Bank-Level Data:

The data for this research cover a ten-year time frame from 2014 to 2023 and were gathered from the annual reports of ten private commercial banks operating in Bangladesh. These reports, which provide sufficient and reliable information, were obtained directly from the banks' official websites.

Macroeconomic Data:

Use official statistics from Bangladesh Bank website, World Bank, Internet and Economic survey.

3.5 Data Analysis and Data Analysis Tools

The data collected from secondary sources will be analyzed using Stata to examine the relationship between the dependent and independent variables. This study employs multiple linear regression analysis to investigate the impact of bank liquidity and macroeconomic determinants on the profitability of private commercial banks in Bangladesh. To ensure consistent and reliable results, various panel data econometric methods will be applied, including Pooled Ordinary Least Squares (Pooled OLS), Fixed Effects (FE), Random Effects (RE), and Generalized Least Squares (GLS), all implemented using the Statistical Software for Data Science (STATA). Additionally, Model Specification Tests and Diagnostic Tests for Heteroscedasticity, Autocorrelation, Multicollinearity, and Unit Root—will be conducted to validate the econometric findings.

3.6 Model Specification

Using regression analysis, the econometric model below has been created to examine how bank liquidity and macroeconomic determinants impact on profitability of private commercial banks in Bangladesh.

$$ROE_{it} = \alpha_{it} + \sum_{k=1}^{10} \delta_{it} X_{itk} + \varepsilon_{it} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. \quad (01)$$

$$ROA_{it} = \alpha_{it} + \sum_{k=1}^{10} \delta_{it} X_{itk} + \varepsilon_{it} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad (02)$$

$$ROE_{it} = \alpha_{it} + \sum_{k=1}^{10} \delta_{it} X_{itk} + \mu_{it} + \varepsilon_{it} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad (03)$$

$$ROA_{it} = \alpha_{it} + \sum_{k=1}^{10} \delta_{it} X_{itk} + \mu_{it} + \varepsilon_{it} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. \quad (04)$$

Where,

$\sum X$ = all explanatory variables assessing the factors influencing profitability are included in the model

εit = within-entity error (error term)

μit = between-entity error

αit = constant.

The coefficients in equations (01) and (02) were estimated using the fixed-effects method to examine the relationship between ROA and ROE, and the bank-specific as well as macroeconomic variables included as regressors. In the fixed-effects model, the entity-specific error term is often assumed to be correlated with the independent variables, as certain unobserved factors may influence or bias the dependent variables or regressors. To compare results, the study also employs

cross-sectional Generalized Least Squares (GLS) and Pooled Ordinary Least Squares (Pooled OLS) techniques to estimate the model coefficients. In equations (03) and (04), the random-effects method is applied to analyze the causal relationship between ROA, ROE, and the explanatory variables. This approach assumes that differences across entities (commercial banks) are random and uncorrelated with the regressors, which justifies the use of the random-effects model.

The above section outlines the study's methodology, including data types, analytical procedures, and the tools and software used. The following chapter presents a detailed discussion of the results obtained from this rigorous analysis.

Chapter-4: Data analysis

4.1 Summary Statistics

4.1.1. Descriptive statistics

Descriptive statistics is a branch of statistics concerned with organizing, summarizing, and presenting data in a meaningful way. It helps in understanding the key features and patterns within a dataset by providing concise numerical summaries.

In this study, descriptive statistics are used to analyze the characteristics of the variables involved. The dependent variables in the analysis are Return on Assets (ROA) and Return on Equity (ROE). The independent variables include bank-specific indicators such as the Current Ratio, Deposit Growth Rate, Capital Adequacy Ratio, Total Loan-to-Deposit Ratio, Operating Expenses to Total Assets Ratio, Bank Size (measured as the logarithm of Total Assets), and Non-Performing Loans to Total Loans Ratio. Additionally, macroeconomic factors such as GDP Growth Rate, Inflation Rate, Interest Rate Spread, and Money Supply Growth Rate are also included as explanatory variables. The table below presents the summary statistics for all variables used in the model:

Table 2 Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Return on Equity	100	.107	.049	.016	.19
Return on Assets	100	.009	.005	.001	.019
Current Ratio	100	1.412	1.088	.8	5.02
Deposit Growth Rate	100	.122	.077	.006	.316
Capital Adequacy Ratio	100	.142	.024	.105	.186
Total Loan to Total Deposit Ratio	100	.84	.133	.522	1.024
Operating Expenses to Total Assets Ratio	100	.024	.008	.015	.04
Size of the Bank	100	13.997	4.252	11.284	26.679
Non-Performing Loans to Total Loans Ratio	100	.046	.018	.017	.087
GDP Growth Rate	100	.065	.012	.034	.079
Inflation Rate	100	.064	.012	.055	.09
Interest Rate Spread	100	.04	.007	.029	.051
Money Supply Growth Rate	100	.12	.025	.092	.161

Source: Based on the output generated from STATA 14.0

The above table depicts the summary of descriptive statistics used in this report. It is based on a total of 100 observations, covering data from 10 private commercial banks in Bangladesh over the period from 2014 to 2023. The table displays the mean, standard deviation, minimum, and maximum values for the bank-specific factors, the dependent variable ROE and ROA, and macroeconomic variables. It provides descriptive statistics for each of the 11 independent variables that potentially influence the return on equity (ROE) and return on asset (ROA). The ROE ranges from 0.016 to 0.19, with a mean value of 0.107 and a standard deviation of 0.049. The change in Return on Asset ranges from .001 to .019, with a mean value of 0.009 and a standard deviation of .005. The variations observed in ROE and ROA suggest that changes in these profitability measures have remained relatively stable over time. This implies that the banks have effectively managed to sustain consistent profitability, likely due to strong performance in their internal operations and bank-specific factors.

The summary statistics for the independent variables indicate a general consistency, as reflected by low standard deviations and relatively narrow ranges between minimum and maximum values—except for the Current Ratio and Bank Size, which show greater variability. All variables exhibit positive mean values, highlighting overall positive performance trends. Notably, Bank Size has the highest mean value among all variables, while Return on Assets (ROA) records the lowest level of dispersion, as indicated by its standard deviation..

4.1.2. Normality Test

A non-significant result (P-value greater than 0.05) indicates a normal distribution. Meanwhile, a significant result (P value less than 0.05) indicates that the distribution deviates from the normality assumption.

Null Hypothesis (H_0): Data is normally distributed.

Alternative (H_1): Data is not normally distributed.

Table 3 Test for Normal Data

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	Z	Prob>z
Return on Equity	100	0.982	1.465	0.847	0.199
Return on Assets	100	0.979	1.712	1.193	0.116
Deposit Growth Rate	100	0.958	3.504	2.782	0.003
Capital Adequacy Ratio	100	0.984	1.356	0.676	0.250
Current Ratio	100	0.477	43.149	8.351	0.000
Total Loan to Total Deposit Ratio	100	0.934	5.469	3.769	0.000
Operating Expenses to Total Assets Ratio	100	0.886	9.420	4.975	0.000
Size of the Bank	100	0.459	44.674	8.428	0.000
Non-Performing Loans to Total Loans Ratio	100	0.970	2.438	1.977	0.024
GDP Growth Rate	100	0.793	17.100	6.298	0.000
Inflation Rate	100	0.748	20.777	6.730	0.000
Interest Rate Spread	100	0.923	6.373	4.109	0.000
Money Supply Growth Rate	100	0.925	6.184	4.042	0.000

Source: Based on the output generated from STATA 14.0

The table shows that among all the variables selected, the P-value of three variables namely return on equity, return on assets and capital adequacy ratio have a non-significant result (P>0.05) and failed to reject null hypothesis which means these three variables follow the normal distribution.

On the other hand, the P-value of all other variables is <0.05. So, as a whole, the data set deviates from the normality assumption. This study used a large sample size, so no significant deviations from the assumption of normality of the error terms were found.

4.2 Empirical Results of Multiple Regression Analysis

The estimated coefficients for various bank-specific and macroeconomic variables of private commercial banks are presented in the following table. These estimates demonstrate the impact of internal and external factors on changes in profitability, utilizing multiple econometric approaches. The analysis employs the Random Effects Model, Fixed Effects Model, Generalized Least Squares (GLS), and Pooled Ordinary Least Squares (OLS) method. The empirical model used for this analysis is presented below:

Table 4 Output of Coefficients of Models (Random effect (RE), Fixed effect (FE), Generalized Least Square (GLS) and Pooled Ordinary Least Square (OLS))

Dependent Variable(ROE)	**Estimation of Model**			
Variable	**Pooled_OLS**	**FE**	**RE**	**GLS**
Current Ratio	-.01926721***	0.003	-.01115257*	-.01926721***
Deposit Growth Rate	0.012	0.014	0.005	0.012
Capital Adequacy Ratio	-0.242	-0.275	-0.221	-0.242
Total Loan to Total Deposit Ratio	-0.005	0.034	0.015	-0.005
Operating Expenses to Total Assets Ratio	1.8694897***	-3.6263396*	1.355	1.8694897***
Size of the Bank	-.00209942*	-0.027	-0.002	-.00209942*
Non-Performing Loan to Total Loan Ratio	-1.1988091***	-.89358602**	-1.2572288***	-1.1988091***
GDP Growth Rate	-0.017	-0.060	-0.018	-0.017
Inflation Rate	0.513	.58308643*	0.537	0.513
Interest Rate Spread	0.788	0.837	0.949	0.788
Money Supply Growth Rate	0.068	-0.132	0.037	0.068
_cons	0.138	0.573	0.113	0.138
N	100	100	100	100
Chi2			46.592357	113.03853
F	9.0430822	4.9148908		
Sigma_u		.13510101	.01477464	
Sigma_e		.028031	.02831	
Rho		.958728	.21741445	

Source: Authors' self-contribution based on output developed by STATA 14.0

Note: *, **, *** indicate level of significance at 5%, 1% and 0.1% respectively

The current ratio, operating expenses to total assets ratio, non-performing loans to total loans ratio are found to be statistically significant under the pooled OLS model and GLS techniques at the selected level of significance (0.1% level of significance) in explaining the fluctuation of the change in ROE based on the estimators' output. The non-performing loans to total loans ratio computed under the random effects model and fixed effect model techniques are determined to be statistically significant at the selected level of significance 0.1% and 1% level of significance. The coefficients derived using GLS and OLS techniques in explaining the variance in the dependent variable as determined by the ROE of specific commercial banks indicate that Bank Size is statistically significant at the chosen level of significance (5% level of significance). Operating expenses to total assets ratio and inflation rate computed under the fixed effects model are determined to be statistically significant at the selected level of significance (5% level of significance). In addition, inflation exhibits positive relation and significant impacts on ROE (5% level of significance) in fixed effect model.

The combined significance of all bank-specific and macroeconomic factors in the model in explaining the impact of bank liquidity and macroeconomic determinants in profitability as measured by the ROE ratio is revealed by the chi-square values for random-effects methods and the generalized least square (GLS) which are 46.592357 and 113.03853 respectively. The F-values of 4.9148908 and 9.0430822 derived under fixed effects and ordinary least squares (OLS) method, respectively reveal that all regressors of the two models are statistically significant when it comes to explaining ROE. F-value shows the joint significance of independent variables to dependent variables.

The rho value of 95.87% and 21.74% respectively for fixed effect and random effect reveals the intra-class correlation explaining the variation in ROE due to differences across the panels.

Table 5 Output of Coefficients of Models (Random effect (RE), Fixed effect (FE), Generalized Least Square (GLS) and Pooled Ordinary Least Square (OLS))

Dependent Variable(ROA)	Estimation of Model			
Variable	**Pooled_OLS**	**FE**	**RE**	**GLS**
Current Ratio	-.00120036**	.0004	-.00120036**	-.00120036***
Deposit Growth Rate	0.005	.002	0.005	0.005
Capital Adequacy Ratio	0.034	-.008	0.034	0.034
Total Loan to Total Deposit Ratio	-.00746831*	.002	-.00746831**	-.00746831**
Operating Expenses to Total Assets Ratio	0.082	-.226	0.082	.08236204*
Size of the Bank	-0.000	-.001	-0.000	-0.000
Non-Performing Loan to Total Loan Ratio	-.12551365***	-.06074509*	-.12551365***	-.12551365***
GDP Growth Rate	0.026	.000	0.026	0.026
Inflation Rate	0.028	.036	0.028	0.028
Interest Rate Spread	.2939794***	.20654132*	.2939794***	.2939794***
Money Supply Growth Rate	-0.006	-.006	-0.006	-0.006
_cons	0.003	.025	0.003	0.003
N	100	100	100	100
Chi2			152.8808	173.72818
F	13.898254	5.0431104		
Sigma_u		.00723531	0	
Sigma_e		.00253892	.00253892	
Rho		.891364	0	

Source: Authors' self-contribution based on output developed by STATA 14.0

Note: *, **, *** indicate level of significance at 5%, 1% and 0.1% respectively

Current ratio under GLS method are determined to be statistically significant at the selected level of significance (0.1% level of significance). Non-performing loans to total loans ratio and interest rate spread are found to be statistically significant under the Pooled OLS method, Random Effect and GLS method at the selected level of significance (0.1% level of significance) in explaining the fluctuation of the change in ROA based on the estimators' output. Current ratio under Random Effect method are determined to be statistically significant at the selected level of significance (1% level of significance). The coefficients derived using Random Effect and GLS method in explaining the variance in the dependent variable as determined by the ROA of specific commercial banks indicate that total loan to total deposit ratios statistically significant at the

chosen level of significance (1% level of significance).Total loan to total deposit ratio under OLS method are determined to be statistically significant at the selected level of significance (5% level of significance).Operating expenses to total assets ratio computed under the GLS method are determined to be statistically significant at the selected level of significance (5% level of significance). Interest rate spread found to be statistically significant under the fixed effect model techniques at the selected level of significance (5% level of significance) and 0.1% in pooled OLS, Rendom effect and GLS method .

The combined significance of all bank-specific and macroeconomic factors in the model in explaining the impact of bank liquidity and macroeconomic determinants in profitability as measured by the ROA ratio is revealed by the chi-square values for random-effects methods and the generalized least square (GLS) which are 152.8808 and 173.72818 respectively. The F-values of 5.0431104 and 13.896254 derived under fixed effects and ordinary least squares (OLS) method, respectively reveal that all repressors of the two models are statistically significant when it comes to explaining ROA.

The rho value computed using the fixed effects technique, commonly known as the intra-class correlation value, of 0.890365 demonstrates that the differences across panels account for 89.03 percent of the variability in the change in ROA throughout the study period.

4.3. Model Specification Test

4.3.1. Random Effect VS Fixed Effect (Hausman Test)

The Hausman test was conducted to identify the most suitable panel data estimation method between the Fixed Effects Model and the Random Effects Model. This test evaluates whether the unique errors (unobserved individual effects) are correlated with the regressors. It relies on two key assumptions: the strict exogeneity of the error term and constant variances of both the idiosyncratic error and the unobserved effects. The null hypothesis (H_0) of the test states that the differences in coefficients are not systematic, implying that the Random Effects Model is more appropriate. The alternative hypothesis (H_1) suggests that the Fixed Effects Model is more consistent and thus preferred.

Table 6 Summary Result of Hausman Test

Hausman Specification test		
	ROE	**ROA**
Chi-square test value	34.79	48.86
P-value	0.0003	0.0000

Source: Based on the output generated from Stata 14.0

The table shows the result of the analysis of the Hausman test. As the P-values for ROE and ROA are both below 5%, specifically 0.0003 and 0.0000 respectively, so the null hypothesis can be rejected. The findings indicate that the Fixed Effects Model is superior to the Random Effects Model.

4.3.2. Random Effect VS Pooled OLS (Breusch and Pagan Lagrangian Multiplier Test)

The Breusch-Pagan Lagrange Multiplier (BPLM) test is employed to evaluate whether the Random Effects model provides a better fit than the Pooled OLS model. This test assesses the presence of panel effects in the data. Under the null hypothesis (H_0), it is assumed that there are no significant differences across entities—that is, the variance of the random effects is zero—indicating that the Pooled OLS model is adequate. The alternative hypothesis (H_1) posits that the Random Effects model is more suitable, as it accounts for unobserved individual-specific heterogeneity across the panel units.

Table 7 Summary Result of BP-LM Test

Breusch and Pagan Lagrangian Multiplier Test for random effects					
wroe[Banks, t] = Xb + u[Banks] + e[Banks,t]			**wroa[Banks, t] = Xb + u[Banks] + e[Banks,t]**		
Estimated results:	**var**	**sd =√(var)**	**Estimated results:**	**var**	**sd =√(var)**
ROE	.002370	.0486874	ROA	.0000256	.0050634
e	.0007857	.028031	e	6.450006	.0025389
u	.0002183	.0147746	u	0	0
Test Var(u)	0		Test Var(u)	0	
Chi-square value	2.89		Chi-square value	0.00	
Prob>chibar	0.0447		Prob>chibar	1.000	

Source: Based on the output generated from Stata 14.0

Since the variation between estimates is zero, the null hypothesis states that there is no significant difference across units. The P-values for ROE is reported as 0.0447. As the p-value is less than the chosen significance level (0.05), thus the null hypothesis can be rejected and conclude that the Random Effects model is more appropriate than the Pooled OLS model. On the other hand the P-value is 1.0000 for ROA which is not statistically significant and thus the null hypothesis cannot be rejected, suggesting there is no significant difference between units and Pooled OLS method generates better estimates than the Random Effect method

4.4. Diagnostic Test

This section includes various diagnostic tests performed to validate the models

4.4.1. Cross-sectional dependence test

The Cross-sectional Dependence (CD) test is used in panel data analysis to check whether the residuals (errors) across different cross-sectional units are correlated with each other.

Table 8 Output of Breusch-Pagan LM Test of Independence

Breusch-Pagan LM Test of Independence		
	ROE	**ROA**
Breusch-Pagan LM Test of Independence	53.443	55.543
P-value	0.1817	0.1348

Source: Based on the output generated from Stata 14.0

Assessing whether the variance of a regression's errors is affected by the values of the independent variables which helps to evaluate how bank liquidity and macroeconomic determinants affect banks' profitability. This test considers the null hypothesis (H_0) is residuals across entities are not correlated or that there is no cross-sectional dependence. The output shows that the Chi-square value is 53.443 with a P-value of 0.1817 for ROE which is >5% .So null hypothesis cannot be rejected indicating that entities are not correlated or there is no cross-sectional dependence. On the other hand for ROA the Chi-square value is 55.543 with a P-value of 0.1348 which is also >5%. So null hypothesis cannot be rejected indicating that entities are not correlated or there is no cross-sectional dependence.

4.4.2. Test of autocorrelation

To assess whether the models are affected by first-order autocorrelation, the Wooldridge (2002) test for autocorrelation in panel data was applied. This test evaluates the presence of serial correlation within the panel structure. The null hypothesis (H_0) states that there is no first-order autocorrelation—meaning there is neither positive nor negative autocorrelation in the residuals. The results of the test, indicating the presence or absence of autocorrelation, are presented below.:

Table 9 Output of Wooldridge test for Autocorrelation

Wooldridge test for autocorrelation in Panel Data		
Null hypothesis, Ho: There is no first order autocorrelation		
	ROE	**ROA**
F-value (1, 9)	10.686	24.660
P-Value	0.0097	0.0008

Source: Based on the output generated from Stata 14.0

As F-values of ROE and ROA are significant (10.686 and 24.660) and the P-values are less than 5% (0.0097 and 0.0008), so null hypothesis is rejected and can conclude that the model suffers from 1st order autocorrelation problem.

4.4.3 Test of Heteroscedasticity

The test of heteroscedasticity is used in regression analysis to determine whether the variance of the errors (residuals) is constant across all levels of an independent variable. If the variance changes (i.e., it increases or decreases as the independent variable changes), the data are said to be heteroscedastic, which can invalidate standard statistical tests. Null hypothesis (H_0): Homoscedasticity (constant variance). Alternative hypothesis (H_1): Heteroscedasticity (non-constant variance).

Table 10 Output Modified Wald Test for group-wise Heteroscedasticity

Modified Wald Test for group Heteroscedasticity in FE regression model		
Null hypothesis, Ho: σ2i = σ2 for all i		
	ROE	**ROA**
chi2 (10)	61.29	16.18
P-Value	0.0000	0.0947

Source: Based on the output generated from Stata 14.0

The fixed-effect model has an issue with non-constant error or variance, as seen in the result. ROE has statistically significant chi-square values of 61.29, with P-values of 0.0000, so null hypothesis is rejected and conclude that error variance is non constant. On the other hand, for ROA, the Chi-square value is 16.18 with a P-value of 0.0947, which is more than 0.05. So the null hypothesis of holding constant error variance is not rejected, suggesting that error variance is constant.

4.4.4. Test of Multicollinearity

Multicollinearity in a regression model is evaluated using the Variance Inflation Faction (VIF). When two or more independent variables in a regression model have a high degree of correlation with one another, it is known as multicollinearity and makes it difficult to distinguish the distinct effects of each variable. A high VIF indicates a high level of collinearity between the connected independent variables in multiple regression models. The model's reliability decreases with increasing VIF value. A variable is producing a multicollinearity issue if its VIF value is more than 5. In the table below, the level of VIF is given:

Table 11 Output of Variance Inflation Factor

	VIF	1/VIF
Interest Rate Spread	2.453	.408
Capital Adequacy Ratio	2.453	.408
Money Supply Growth Rate	1.952	.512
Current Ratio	1.68	.595
Non-Performing Loan to Total Loan Ratio	1.608	.622
Total Loan to Total Deposit Ratio	1.391	.719
Size of The Bank	1.385	.722
Deposit Growth Rate	1.368	.731
GDP Growth Rate	1.227	.815
Operating Expenses to Total Assets Ratio	1.172	.853
Inflation Rate	1.147	.872
Mean VIF	1.622	.

Source: Based on the output generated from Stata 14.0

According to the result the highest individual VIF is 2.45 for interest rate spread and capital adequacy ratio and lowest VIF is 1.15 for inflation rate. Mean VIF is 1.62. As all VIF values are below 5, and most are close to 1. This indicates that there is no significant multicollinearity among the independent variables in the regression model. There's no need to remove or adjust variables due to multicollinearity at this point. So model is statistically sound in terms of multicollinearity.

4.4.5. Test of Unit-Root

Unit-root test has been conducted in order to see whether the variance, covariance and mean of the panel data are stationary or not. For this reason, Levin-Lin-Chu unit-root test has been conducted. Here the hypothesis is:

Null hypothesis (H0): Panels contain unit roots (non-stationary).

Alternative hypothesis (H1): Panels are stationary

Here null hypothesis (H0) will be rejected when the P-value of the specific variable will be less than the significance level and conclude that the variable is stationary.

Table 12 Results of Unit Root Test (LLC)

Variables	Adjusted t*	P-value	Stationary
Return on Equity	-4.8343	0.0000	Yes
Return on Assets	-6.8171	0.0000	Yes

Source: Based on the output generated from Stata 14.0

Since the p-value is less than 0.05 for both ROE and ROA, so reject the null hypothesis. The data series do not contain a unit root and are stationary. This implies that the variables are suitable for further analysis such as regression or cointegration, as stationarity is a key assumption.

4.5 Findings

This study empirically examined the key factors influencing the profitability of ten private commercial banks in Bangladesh over the period from 2014 to 2024, using a balanced panel dataset. Profitability was measured using two dependent variables: Return on Assets (ROA) and Return on Equity (ROE). Several selected bank-specific and macroeconomic variables were used as independent variables. To analyze the impact of bank liquidity and macroeconomic determinants on profitability, multiple regression analyses were conducted using four different econometric models: Pooled Ordinary Least Squares (Pooled OLS), Fixed Effects (FE), Random Effects (RE), and Generalized Least Squares (GLS). Among these models, the Generalized Least Squares (GLS) method was identified as the most appropriate, as the data exhibited both heteroscedasticity and first-order autocorrelation. The GLS model accounts for these issues and thus provides more reliable estimates.

Based on the results of the Hausman test, the Fixed Effects model emerged as the more appropriate choice compared to the Random Effects model, as per the model specification criteria. Meanwhile, the Breusch-Pagan Lagrange Multiplier (BPLM) test indicated that the Pooled OLS model is preferable over the Random Effects model. Therefore, the Pooled OLS approach was initially considered the best-fitting model for this analysis. However, diagnostic tests revealed the presence of heteroscedasticity and first-order autocorrelation in the dataset, which could compromise the reliability of the OLS estimates. To address these issues, the Generalized Least Squares (GLS) method was employed, as it effectively corrects for both heteroscedasticity and autocorrelation, thereby ensuring more robust and consistent estimations.

According to GLS model, Current Ratio, Non-performing Loan to Total Loan Ratio, Total Loan to Total Deposit Ratio and Bank Size have significant negative impact on profitability. Non-performing Loan to Total Loan Ratio and Current Ratio are significantly affecting bank performance at 0.1% significance level, Bank Size and Total Loan to Total Deposit Ratio significantly affecting bank performance at 5% and 1% significance level. A higher NPL ratio indicates poor asset quality and increased credit risk, which leads to a decrease in both Return on Assets (ROA) and Return on Equity (ROE). As non-performing loans rise, banks must set aside more provisions for bad debts, which reduces profits. Similarly, a high current ratio may suggest underutilization of assets or excess liquidity, which could imply inefficient management of

working capital, hence negatively affecting profitability. A negative relationship of Bank Size with profitability may indicate that as banks grow larger, they face diseconomies of scale or inefficiencies in resource allocation. Also, a high Loan-to-Deposit Ratio can increase risk exposure, leading to lower profitability due to insufficient liquidity or a higher likelihood of loan defaults. This was supported by several literatures contributed by Ghimire, Chaurasiya and Basnet (2024), Thinh, Thuy and Tuan (2022), Zaharum, et al. (2022), Lalon and Naher (2020), Chaudhury (2020), Gjorgji and Goran, (2019), Singh and Sharma (2018), Samad (2015).

On the other hand, Operating Expenses to Assets Ratio and Interest Rate Spread have significant positive affect on profitability of banks at 0.1% significance level. Suggesting that higher operating efficiency may contribute to better financial performance and a wider interest rate spread (difference between lending and deposit rates) directly increases the net interest margin, thus enhancing Profitability. This shows the bank's ability to generate income from its core intermediation function effectively which is also found in the literature contributed by Ghimire, Chaurasiya and Basnet (2024) and Singh and Sharma (2016), Samad (2015) and Muiruri (2017). Inflation rate is also positively associated and significantly affecting bank performance at 5% significance level which is also espoused in the literature contributed by Ali, Qaisar and Maamor (2018), Ghurtskaia, K. (2018). The other variables namely deposit growth rate, capital adequacy ratio, money supply growth rate, GDP growth were not found significant in explaining the fluctuation in the change in banks Profitability.

Chapter-5: Recommendations and Conclusions

5.1 Recommendations

Based on the findings of this study, several recommendations can be proposed to enhance the profitability of banks. First, banks should manage liquidity carefully to avoid excess idle assets, as reflected in the negative impact of the current ratio on profitability. This calls for maintaining an optimal level of liquid assets that balances solvency and income generation. At the same time the negative relationship between non-performing loans and profitability calls for stronger credit appraisal, monitoring, and recovery systems to maintain a healthy loan portfolio and reduce credit risk. Furthermore, banks should focus on improving operational efficiency, as the positive relationship between operating expenses to total assets and profitability suggests that effective resource utilization contributes to improved financial performance. Since high loan-to-deposit ratios negatively impact profitability, banks should manage their lending practices more prudently and ensure a sustainable balance between loans and deposits to avoid overextension. The negative impact of size on profitability suggests that larger banks may face inefficiencies. Thus, banks should pursue growth with a focus on maintaining efficiency, leveraging digital transformation, and avoiding excessive operational complexity. Additionally, banks should closely monitor key macroeconomic indicators such as inflation, money supply growth rate, and GDP growth, interest rate spread and adapt their financial planning accordingly. The significant positive link between interest rate spread and profitability highlights the importance of efficient asset-liability management. Banks should regularly review their interest rate strategies to sustain healthy margins. Leverage the positive impact on profitability by optimizing lending and deposit rates. The divergent effects highlight the importance of aligning internal strategies with external economic conditions and the specific profitability metric.

5.2 Conclusions

This paper has successfully accomplished its objective of assessing both the panel and dynamic impacts of bank liquidity and macroeconomic determinants on the profitability of private commercial banks in Bangladesh from 2014 to 2023. Multiple regression techniques, including Pooled OLS, Fixed Effects, Random Effects, and GLS, were employed to estimate the relationships between bank liquidity, macroeconomic factors, and bank profitability. The study indicates several significant relationships between both financial and macroeconomic variables and bank profitability. Specifically, the operating expenses to total assets ratio was found to have a significant positive effect on profitabiliy, suggesting that higher operating efficiency may contribute to better financial performance. In contrast, the current ratio exhibited a significant negative relationship with profitabiliy, implying that excessive liquidity might hinder efficient asset utilization. Additionally total loan to total deposit ratio, bank size, and the ratio of non-performing loans to total loans all showed significant negative relationships with profitability, emphasizing the adverse impact of poor asset quality, excessive leverage, and diseconomies of scale on financial performance. Regarding macroeconomic indicators, interest rate spread demonstrated a significant positive impact on profitability, reflecting the importance of net interest margins in bank performance. Inflation rate was significantly associated with profitability highlighting moderate inflation in enhancing bank earnings.

Therefore, banks should carefully consider these determinants in their strategic planning and risk management. The study recommends that policymakers and financial institutions adopt both panel and dynamic approaches when evaluating and enhancing bank performance in a rapidly changing economic environment. Future research should look at other variables like total loans to total assets ratio, loan loss provision to total loan ratio, unemployment rate and so on over a longer period.

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Appendix -A: Stata output ROE

```
  ___  ____  ____  ____  ____ (R)
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/   14.2   Copyright 1985-2015 StataCorp LLC
  Statistics/Data Analysis             StataCorp
                                       4905 Lakeway Drive
                                       College Station, Texas 77845 USA
                                       800-STATA-PC        http://www.stata.com
                                       979-696-4600        stata@stata.com
                                       979-696-4601 (fax)

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       Serial number:  10699393
         Licensed to:  Andrey


Notes:
      1.  Unicode is supported; see help unicode advice.

. ed

. *(15 variables, 100 observations pasted into data editor)

. extremes roe cr dgr car tltdr oetar sbln npltlr gdpgr infr irs msgr
```

obs:	roe	cr	dgr	car	tltdr	oetar	sbln	npltlr	gdpgr	infr	irs	msgr
55.	.0008	3.54	-.0022	.1003	1.0239	.0173	12.6839	.0514	.0732	.0554	.04	.092
54.	.0013	3.14	-.039	.108	.9733	.0187	12.6589	.0534	.0659	.057	.045	.107
96.	.005	1.13	.1131	.125	.9763	.0281	26.8314	.053	.0788	.0559	.0334	.099
56.	.0073	6.17	.1869	.1012	.9179	.0176	12.8092	.0536	.0788	.0559	.0334	.099
97.	.011	1.15	.0706	.1325	.1767	.0279	26.6793	.1443	.0345	.0569	.035	.126

77.	.1922	.98	.0964	.1784	.5221	.0162	11.197	.0122	.0345	.0569	.035	.126
5.	.197	1.03	.1226	.156	.768	.0454	12.7555	.041	.0732	.0554	.04	.092
2.	.199	1.03	.1199	.137	.815	.0376	12.4052	.037	.0655	.0608	.0487	.123
7.	.199	1.03	.2001	.172	.675	.0341	13.0655	.022	.0345	.0569	.035	.126
64.	.213	1.08	.1953	.1197	.94	.05	12.6435	.034	.0659	.057	.045	.107

```
. winsor roe , gen(wroe) p(0.05)

. winsor cr , gen(wcr) p(0.05)

. winsor dgr , gen(wdgr) p(0.05)

. winsor car , gen(wcar) p(0.05)

.
.
. winsor tltdr , gen(wtltdr) p(0.05)

. winsor oetar , gen(woetar) p(0.05)

.
.
. winsor sbln , gen(wsbln) p(0.05)

.
.
. winsor npltlr , gen(wnpltlr) p(0.05)

. winsor gdpgr , gen(wgdpgr) p(0.05)

. winsor infr , gen(winfr) p(0.05)

. winsor irs , gen(wirs) p(0.05)

. winsor msgr , gen(wmsgr) p(0.05)

.
.
. encode companyname, gen(Banks)

. xtset Banks year
       panel variable:  Banks (strongly balanced)
        time variable:  year, 2014 to 2023
                delta:  1 unit
```

```
. summarize wroe wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr
```

Variable	Obs	Mean	Std. Dev.	Min	Max
wroe	100	.106744	.0486874	.016	.19
wcr	100	1.4124	1.088243	.8	5.02
wdgr	100	.122475	.0769653	.0056	.3162
wcar	100	.142172	.0237294	.1046	.1861
wtltdr	100	.840442	.1333699	.5221	1.0239
woetar	100	.024437	.0083937	.0147	.0402
wsbln	100	13.99669	4.251991	11.2841	26.6793
wnpltlr	100	.045983	.0178465	.017	.0868
wgdpgr	100	.065088	.0116009	.0345	.0788
winfr	100	.06373	.0116586	.0551	.0902
wirs	100	.03982	.007305	.0293	.0512
wmsgr	100	.1204	.0245287	.092	.161

```
. swilk wroe wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr

                    Shapiro-Wilk W test for normal data
```

Variable	Obs	W	V	z	Prob>z
wroe	100	0.98226	1.465	0.847	0.19854
wcr	100	0.47739	43.149	8.351	0.00000
wdgr	100	0.95756	3.504	2.782	0.00271
wcar	100	0.98357	1.356	0.676	0.24958
wtltdr	100	0.93376	5.469	3.769	0.00008
woetar	100	0.88591	9.420	4.975	0.00000
wsbln	100	0.45892	44.674	8.428	0.00000
wnpltlr	100	0.97047	2.438	1.977	0.02403
wgdpgr	100	0.79288	17.100	6.298	0.00000
winfr	100	0.74835	20.777	6.730	0.00000
wirs	100	0.92281	6.373	4.109	0.00002
wmsgr	100	0.92509	6.184	4.042	0.00003

```
. reg wroe wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr
```

Source	SS	df	MS		
				Number of obs	= 100
				F(11, 88)	= 9.04
Model	.124519285	11	.011319935	Prob > F	= 0.0000
Residual	.110156499	88	.001251778	R-squared	= 0.5306
				Adj R-squared	= 0.4719
Total	.234675785	99	.002370462	Root MSE	= .03538

wroe	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
wcr	-.0192672	.0042352	-4.55	0.000	-.0276837	-.0108507
wdgr	.0120222	.054045	0.22	0.824	-.0953809	.1194253
wcar	-.2422517	.2346888	-1.03	0.305	-.7086464	.224143
wtltdr	-.0046155	.0314432	-0.15	0.884	-.0671023	.0578712
woetar	1.86949	.4586186	4.08	0.000	.9580817	2.780898
wsbln	-.0020994	.0009842	-2.13	0.036	-.0040553	-.0001436
wnpltlr	-1.198809	.2526946	-4.74	0.000	-1.700987	-.6966316
wgdpgr	-.0168035	.339549	-0.05	0.961	-.6915858	.6579787
winfr	.5134822	.3266685	1.57	0.120	-.1357029	1.162667
wirs	.7879893	.7624487	1.03	0.304	-.7272172	2.303196
wmsgr	.0684053	.2025202	0.34	0.736	-.3340611	.4708716
_cons	.1383858	.078454	1.76	0.081	-.017525	.2942966

```
. estat ovtest

Ramsey RESET test using powers of the fitted values of wroe
       Ho:  model has no omitted variables
                  F(3, 85) =      0.37
                  Prob > F =      0.7767
```

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
        wirs |      2.45    0.407595
        wcar |      2.45    0.407692
       wmsgr |      1.95    0.512397
         wcr |      1.68    0.595254
     wnpltlr |      1.61    0.621721
      wtltdr |      1.39    0.718991
       wsbln |      1.38    0.722035
        wdgr |      1.37    0.730789
      wgdpgr |      1.23    0.814902
      woetar |      1.17    0.853253
       winfr |      1.15    0.871733
-------------+----------------------
    Mean VIF |      1.62

. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of wroe

         chi2(1)      =     0.30
         Prob > chi2  =   0.5870

. xtserial wroe wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,       9) =     10.686
           Prob > F =      0.0097

. xtreg wroe wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr

Random-effects GLS regression                   Number of obs     =        100
Group variable: Banks                           Number of groups  =         10

R-sq:                                           Obs per group:
     within  = 0.2487                                         min =         10
     between = 0.7181                                         avg =       10.0
     overall = 0.4848                                         max =         10

                                                Wald chi2(11)     =      46.59
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000

------------------------------------------------------------------------------
        wroe |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         wcr |  -.0111526   .0050322    -2.22   0.027    -.0210155   -.0012897
        wdgr |   .0050293   .0510151     0.10   0.921    -.0949585    .1050171
        wcar |  -.2205046   .2394337    -0.92   0.357    -.6897861    .2487769
      wtltdr |   .0150705   .0360669     0.42   0.676    -.0556192    .0857603
      woetar |   1.355317   .7405994     1.83   0.067    -.0962309    2.806865
       wsbln |  -.0016626   .0015558    -1.07   0.285    -.0047119    .0013867
     wnpltlr |  -1.257229    .265003    -4.74   0.000    -1.776625   -.7378326
      wgdpgr |  -.0176985   .3134025    -0.06   0.955    -.6319562    .5965591
       winfr |   .5368837   .2977692     1.80   0.071    -.0467331    1.120501
        wirs |   .9486716    .732798     1.29   0.195     -.487586    2.384929
       wmsgr |   .0374386   .1893708     0.20   0.843    -.3337213    .4085985
       _cons |   .1131781   .0805206     1.41   0.160    -.0446393    .2709955
-------------+----------------------------------------------------------------
     sigma_u |  .01477464
     sigma_e |    .028031
         rho |  .21741445   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
. xtreg wroe wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr, fe

Fixed-effects (within) regression               Number of obs     =        100
Group variable: Banks                           Number of groups  =         10

R-sq:                                           Obs per group:
     within  = 0.4063                                         min =         10
     between = 0.0275                                         avg =       10.0
     overall = 0.0357                                         max =         10

                                                F(11,79)          =       4.91
corr(u_i, Xb)  = -0.9487                        Prob > F          =     0.0000

------------------------------------------------------------------------------
        wroe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         wcr |   .0032766    .005732     0.57   0.569    -.0081327    .0146858
        wdgr |   .0137996   .0455873     0.30   0.763    -.0769397    .1045389
        wcar |  -.2748009   .2513946    -1.09   0.278    -.7751893    .2255875
      wtltdr |   .0341251    .038984     0.88   0.384    -.0434706    .1117209
      woetar |   -3.62634    1.51764    -2.39   0.019    -6.647127   -.6055523
       wsbln |  -.0273594   .0209529    -1.31   0.195    -.0690651    .0143464
     wnpltlr |   -.893586   .2740287    -3.26   0.002    -1.439027   -.3481455
      wgdpgr |   -.060209   .2797944    -0.22   0.830    -.6171259    .4967079
       winfr |   .5830864   .2654641     2.20   0.031     .0546933     1.11148
        wirs |   .8370375   .8664591     0.97   0.337    -.8876062    2.561681
       wmsgr |  -.1317964    .173846    -0.76   0.451    -.4778281    .2142354
       _cons |   .5727581   .3060059     1.87   0.065    -.0363313    1.181848
-------------+----------------------------------------------------------------
     sigma_u |  .13510101
     sigma_e |    .028031
         rho |    .958728   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(9, 79) = 6.80                     Prob > F = 0.0000

. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (10)  =          61.29
Prob > chi2 =          0.0000


. xttest2

Correlation matrix of residuals:

             |      __e1       __e2       __e3       __e4       __e5       __e6       __e7       __e8       __e9      __e10
-------------+------------------------------------------------------------------------------------------------------------------
        __e1 |   .0017252
        __e2 |  -.0004537   .0036871
        __e3 |   .0003288  -.0024302   .0064422
        __e4 |   .0024412  -.0003929  -.0010395   .0095671
        __e5 |   -.002073   .0007391  -.0005843  -.0047008   .0075731
        __e6 |   .0001621     .00011  -.0017762  -.0011879  -.0004498   .0025995
        __e7 |  -.0018327  -.0016648  -.0014218   .0008155   .0058429  -.0014595   .0137086
        __e8 |   .0007197   .0032459  -.0012242  -.0006808   .0006842  -.0003907  -.0036596   .0056481
        __e9 |  -.0008923   .0024311  -.0013306  -.0023695   .0018912  -.0005471  -.0012462   .0027773   .0039731
       __e10 |   .0016196  -.0017204   .0025679   .0031391  -.0037624  -.0019078  -.0006541  -.0000868   .0001042   .0071494

             |      __e1       __e2       __e3       __e4       __e5       __e6       __e7       __e8       __e9      __e10
-------------+------------------------------------------------------------------------------------------------------------------
        __e1 |   1.0000
        __e2 |  -0.1799   1.0000
        __e3 |   0.0986  -0.4986   1.0000
        __e4 |   0.6009  -0.0661  -0.1324   1.0000
        __e5 |  -0.5735   0.1399  -0.0837  -0.5523   1.0000
        __e6 |   0.0766   0.0355  -0.4340  -0.2382  -0.1014   1.0000
        __e7 |  -0.3769  -0.2342  -0.1513   0.0712   0.5735  -0.2445   1.0000
        __e8 |   0.2306   0.7113  -0.2029  -0.0926   0.1046  -0.1020  -0.4159   1.0000
        __e9 |  -0.3408   0.6352  -0.2630  -0.3843   0.3448  -0.1702  -0.1689   0.5863   1.0000
       __e10 |   0.4612  -0.3351   0.3784   0.3796  -0.5113  -0.4425  -0.0661  -0.0137   0.0196   1.0000

Breusch-Pagan LM test of independence: chi2(45) =    53.443, Pr = 0.1817
Based on 10 complete observations over panel units
```

```
. xtreg wroe wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr, re

Random-effects GLS regression                   Number of obs     =        100
Group variable: Banks                           Number of groups  =         10

R-sq:                                           Obs per group:
     within  = 0.2487                                         min =         10
     between = 0.7181                                         avg =       10.0
     overall = 0.4848                                         max =         10

                                                Wald chi2(11)     =      46.59
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000
```

wroe	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
wcr	-.0111526	.0050322	-2.22	0.027	-.0210155	-.0012897
wdgr	.0050293	.0510151	0.10	0.921	-.0949585	.1050171
wcar	-.2205046	.2394337	-0.92	0.357	-.6897861	.2487769
wtltdr	.0150705	.0360669	0.42	0.676	-.0556192	.0857603
woetar	1.355317	.7405994	1.83	0.067	-.0962309	2.806865
wsbln	-.0016626	.0015558	-1.07	0.285	-.0047119	.0013867
wnpltlr	-1.257229	.265003	-4.74	0.000	-1.776625	-.7378326
wgdpgr	-.0176985	.3134025	-0.06	0.955	-.6319562	.5965591
winfr	.5368837	.2977692	1.80	0.071	-.0467331	1.120501
wirs	.9486716	.732798	1.29	0.195	-.487586	2.384929
wmsgr	.0374386	.1893708	0.20	0.843	-.3337213	.4085985
_cons	.1131781	.0805206	1.41	0.160	-.0446393	.2709955
sigma_u	.01477464					
sigma_e	.028031					
rho	.21741445	(fraction of variance due to u_i)				

```
. quietly xtreg wroe wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr, fe

. estimates store FE

. quietly xtreg wroe wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr, re

. estimates store RE

. hausman FE RE
```

	Coefficients (b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
wcr	.0032766	-.0111526	.0144291	.0027446
wdgr	.0137996	.0050293	.0087703	.
wcar	-.2748009	-.2205046	-.0542963	.0766207
wtltdr	.0341251	.0150705	.0190546	.0147964
woetar	-3.62634	1.355317	-4.981657	1.324668
wsbln	-.0273594	-.0016626	-.0256968	.0208951
wnpltlr	-.893586	-1.257229	.3636428	.0697508
wgdpgr	-.060209	-.0176985	-.0425105	.
winfr	.5830864	.5368837	.0462027	.
wirs	.8370375	.9486716	-.1116341	.4623403
wmsgr	-.1317964	.0374386	-.1692349	.

```
                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(11) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                       =       34.79
            Prob>chi2 =      0.0003
            (V_b-V_B is not positive definite)

. quietly reg wroe wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr

. estimates store Pooled_OLS

. quietly xtreg wroe wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr, re

. xttest0
```

```
Breusch and Pagan Lagrangian multiplier test for random effects

        wroe[Banks,t] = Xb + u[Banks] + e[Banks,t]

        Estimated results:
                 |       Var      sd = sqrt(Var)
        ---------+------------------------------
            wroe |    .0023705        .0486874
               e |    .0007857         .028031
               u |    .0002183        .0147746

        Test:   Var(u) = 0
                                chibar2(01) =      2.89
                            Prob > chibar2 =    0.0447

. xtgls wroe wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr

Cross-sectional time-series FGLS regression

Coefficients:  generalized least squares
Panels:        homoskedastic
Correlation:   no autocorrelation

Estimated covariances      =          1           Number of obs      =         100
Estimated autocorrelations =          0           Number of groups   =          10
Estimated coefficients     =         12           Time periods       =          10
                                                  Wald chi2(11)      =      113.04
Log likelihood             =   198.6573           Prob > chi2        =      0.0000
```

wroe	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
wcr	-.0192672	.0039729	-4.85	0.000	-.027054	-.0114804
wdgr	.0120222	.0506987	0.24	0.813	-.0873455	.1113898
wcar	-.2422517	.2201576	-1.10	0.271	-.6737527	.1892493
wtltdr	-.0046155	.0294963	-0.16	0.876	-.0624273	.0531962
woetar	1.86949	.4302224	4.35	0.000	1.026269	2.71271
wsbln	-.0020994	.0009232	-2.27	0.023	-.0039089	-.0002899
wnpltlr	-1.198809	.2370486	-5.06	0.000	-1.663416	-.7342024
wgdpgr	-.0168035	.3185252	-0.05	0.958	-.6411014	.6074944
winfr	.5134822	.3064423	1.68	0.094	-.0871336	1.114098
wirs	.7879893	.7152403	1.10	0.271	-.6138559	2.189834
wmsgr	.0684053	.1899808	0.36	0.719	-.3039502	.4407608
_cons	.1383858	.0735964	1.88	0.060	-.0058604	.282632

```
. estimates store GLS

. estimates table Pooled_OLS FE RE GLS, star stats(N, chi2, F, sigma_u, sigma_e rho)
```

Variable	Pooled_OLS	FE	RE	GLS
wcr	-.01926721***	.00327656	-.01115257*	-.01926721***
wdgr	.01202217	.01379961	.00502931	.01202217
wcar	-.24225172	-.27480086	-.22050458	-.24225172
wtltdr	-.00461552	.03412515	.01507053	-.00461552
woetar	1.8694897***	-3.6263396*	1.3553172	1.8694897***
wsbln	-.00209942*	-.02735935	-.00166258	-.00209942*
wnpltlr	-1.1988091***	-.89358602**	-1.2572288***	-1.1988091***
wgdpgr	-.01680354	-.060209	-.01769854	-.01680354
winfr	.51348222	.58308643*	.53688372	.51348222
wirs	.78798928	.83703749	.94867162	.78798928
wmsgr	.06840527	-.13179635	.03743858	.06840527
_cons	.13838584	.57275813	.11317808	.13838584
N	100	100	100	100
chi2			46.592357	113.03853
F	9.0430822	4.9148908		
sigma_u		.13510101	.01477464	
sigma_e		.028031	.028031	
rho		.958728	.21741445	

legend: * p<0.05; ** p<0.01; *** p<0.001

```
. xtunitroot llc wroe

Levin-Lin-Chu unit-root test for wroe

Ho: Panels contain unit roots                Number of panels  =      10
Ha: Panels are stationary                    Number of periods =      10

AR parameter: Common                         Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 6.00 lags average (chosen by LLC)
```

	Statistic	p-value
Unadjusted t	-7.6788	
Adjusted t*	-4.8343	0.0000

```
. xtabond wroe wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr, vce (gmm)

Arellano-Bond dynamic panel-data estimation     Number of obs      =          80
Group variable: Banks                           Number of groups   =          10
Time variable: year
                                                Obs per group:
                                                              min =           8
                                                              avg =           8
                                                              max =           8

Number of instruments =     48                  Wald chi2(12)      =       31.12
                                                Prob > chi2        =      0.0019
One-step results
```

wroe	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
wroe						
L1.	.1817528	.172138	1.06	0.291	-.1556316	.5191372
wcr	.0019682	.0061061	0.32	0.747	-.0099995	.0139359
wdgr	-.0197268	.0505397	-0.39	0.696	-.1187828	.0793292
wcar	.1611696	.3218131	0.50	0.616	-.4695725	.7919118
wtltdr	-.027507	.0475318	-0.58	0.563	-.1206677	.0656537
woetar	-2.52519	2.297798	-1.10	0.272	-7.028793	1.978412
wsbln	-.0336395	.0341945	-0.98	0.325	-.1006596	.0333806
wnpltlr	-.8885948	.3332681	-2.67	0.008	-1.541788	-.2354013
wgdpgr	-.0658451	.2848289	-0.23	0.817	-.6240995	.4924094
winfr	.7801428	.3427302	2.28	0.023	.108404	1.451882
wirs	1.514571	1.088399	1.39	0.164	-.6186511	3.647794
wmsgr	-.17414	.176647	-0.99	0.324	-.5203618	.1720817
_cons	.5774131	.5039456	1.15	0.252	-.4103022	1.565128

```
Instruments for differenced equation
        GMM-type: L(2/.).wroe
        Standard: D.wcr D.wdgr D.wcar D.wtltdr D.woetar D.wsbln D.wnpltlr
                  D.wgdpgr D.winfr D.wirs D.wmsgr
Instruments for level equation
        Standard: _cons

.
```

Appendix -B: Stata output ROA

```
  ___  ____  ____  ____  ____ (R)
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/   14.2   Copyright 1985-2015 StataCorp LLC
  Statistics/Data Analysis            StataCorp
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                                      College Station, Texas 77845 USA
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                                      979-696-4600        stata@stata.com
                                      979-696-4601 (fax)

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Notes:
      1.  Unicode is supported; see help unicode_advice.

. ed

. *(15 variables, 100 observations pasted into data editor)

. extremes roa cr dgr car tltdr oetar sbln npltlr gdpgr infr irs msgr
```

obs:	roa	cr	dgr	car	tltdr	oetar	sbln	npltlr	gdpgr	infr	irs	msgr
54.	.0001	3.14	-.039	.108	.9733	.0187	12.6589	.0534	.0659	.057	.045	.107
55.	.0001	3.54	-.0022	.1003	1.0239	.0173	12.6839	.0514	.0732	.0554	.04	.092
96.	.0004	1.13	.1131	.125	.9763	.0281	26.8314	.053	.0788	.0559	.0334	.099
56.	.0005	6.17	.1869	.1012	.9179	.0176	12.8092	.0536	.0788	.0559	.0334	.099
57.	.001	4.79	.0403	.1084	.9453	.0147	12.8638	.0483	.0345	.0569	.035	.126

71.	.0253	1.15	.0485	.5109	.4111	.0189	10.7033	0	.0606	.0735	.0512	.161
78.	.0262	.88	.0668	.1805	.5256	.0156	11.2841	.0284	.0694	.0555	.0346	.136
76.	.0292	.94	.3279	.1392	.5976	.019	11.1722	.0253	.0788	.0559	.0334	.099
77.	.0361	.98	.0964	.1784	.5221	.0162	11.197	.0122	.0345	.0569	.035	.126
72.	.0381	.93	.7181	.352	.5906	.0222	10.076	0	.0655	.0608	.0487	.123

```
. xtset Banks year
       panel variable:  Banks (strongly balanced)
        time variable:  year, 2014 to 2023
                delta:  1 unit

. summarize wroa wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr
```

Variable	Obs	Mean	Std. Dev.	Min	Max
wroa	100	.009131	.0050634	.001	.0193
wcr	100	1.4124	1.088243	.8	5.02
wdgr	100	.122475	.0769653	.0056	.3162
wcar	100	.142172	.0237294	.1046	.1861
wtltdr	100	.840442	.1333699	.5221	1.0239
woetar	100	.024437	.0083937	.0147	.0402
wsbln	100	13.99669	4.251991	11.2841	26.6793
wnpltlr	100	.045983	.0178465	.017	.0868
wgdpgr	100	.065088	.0116009	.0345	.0788
winfr	100	.06373	.0116586	.0551	.0902
wirs	100	.03982	.007305	.0293	.0512
wmsgr	100	.1204	.0245287	.092	.161

```
. swilk wroa wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr

                  Shapiro-Wilk W test for normal data
```

Variable	Obs	W	V	z	Prob>z
wroa	100	0.97926	1.712	1.193	0.11649
wcr	100	0.47739	43.149	8.351	0.00000
wdgr	100	0.95756	3.504	2.782	0.00271
wcar	100	0.98357	1.356	0.676	0.24958
wtltdr	100	0.93376	5.469	3.769	0.00008
woetar	100	0.88591	9.420	4.975	0.00000
wsbln	100	0.45892	44.674	8.428	0.00000
wnpltlr	100	0.97047	2.438	1.977	0.02403
wgdpgr	100	0.79288	17.100	6.298	0.00000
winfr	100	0.74835	20.777	6.730	0.00000
wirs	100	0.92281	6.373	4.109	0.00002
wmsgr	100	0.92509	6.184	4.042	0.00003

```
. reg wroa wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr
```

Source	SS	df	MS	Number of obs	=	100
				F(11, 88)	=	13.90
Model	.001610926	11	.000146448	Prob > F	=	0.0000
Residual	.000927268	88	.000010537	R-squared	=	0.6347
				Adj R-squared	=	0.5890
Total	.002538194	99	.000025638	Root MSE	=	.00325

wroa	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
wcr	-.0012004	.0003886	-3.09	0.003	-.0019726	-.0004282
wdgr	.0047296	.0049585	0.95	0.343	-.0051245	.0145836
wcar	.0337039	.0215323	1.57	0.121	-.0090869	.0764948
wtltdr	-.0074683	.0028849	-2.59	0.011	-.0132014	-.0017353
woetar	.082362	.0420774	1.96	0.053	-.001258	.1659821
wsbln	-.0001445	.0000903	-1.60	0.113	-.0003239	.0000349
wnpltlr	-.1255137	.0231843	-5.41	0.000	-.1715875	-.0794398
wgdpgr	.0258106	.031153	0.83	0.410	-.0360994	.0877207
winfr	.0282035	.0299713	0.94	0.349	-.0313581	.0877651
wirs	.2939794	.0699533	4.20	0.000	.1549619	.4329969
wmsgr	-.0064888	.0185809	-0.35	0.728	-.0434144	.0304368
_cons	.003111	.007198	0.43	0.667	-.0111935	.0174156

```
. estat ovtest

Ramsey RESET test using powers of the fitted values of wroa
       Ho:  model has no omitted variables
                  F(3, 85) =      1.29
                  Prob > F =      0.2843

. vif
```

Variable	VIF	1/VIF
wirs	2.45	0.407595
wcar	2.45	0.407692
wmsgr	1.95	0.512397
wcr	1.68	0.595254
wnpltlr	1.61	0.621721
wtltdr	1.39	0.718991
wsbln	1.38	0.722035
wdgr	1.37	0.730789
wgdpgr	1.23	0.814902
woetar	1.17	0.853253
winfr	1.15	0.871733
Mean VIF	1.62	

```
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of wroa

         chi2(1)      =     2.25
         Prob > chi2  =   0.1335

. xtserial wroa wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,       9) =     24.660
           Prob > F =      0.0008

. xtreg wroa wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr

Random-effects GLS regression                   Number of obs     =        100
Group variable: Banks                           Number of groups  =         10

R-sq:                                           Obs per group:
     within  = 0.2221                                         min =         10
     between = 0.9152                                         avg =       10.0
     overall = 0.6347                                         max =         10

                                                Wald chi2(11)     =     152.88
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000
```

wroa	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
wcr	-.0012004	.0003886	-3.09	0.002	-.0019619	-.0004388
wdgr	.0047296	.0049585	0.95	0.340	-.004989	.0144481
wcar	.0337039	.0215323	1.57	0.118	-.0084985	.0759064
wtltdr	-.0074683	.0028849	-2.59	0.010	-.0131225	-.0018141
woetar	.082362	.0420774	1.96	0.050	-.0001082	.1648323
wsbln	-.0001445	.0000903	-1.60	0.110	-.0003215	.0000325
wnpltlr	-.1255137	.0231843	-5.41	0.000	-.170954	-.0800733
wgdpgr	.0258106	.031153	0.83	0.407	-.0352482	.0868694
winfr	.0282035	.0299713	0.94	0.347	-.0305391	.0869461
wirs	.2939794	.0699533	4.20	0.000	.1568735	.4310853
wmsgr	-.0064888	.0185809	-0.35	0.727	-.0429066	.029929
_cons	.003111	.007198	0.43	0.666	-.0109968	.0172189
sigma_u	0					
sigma_e	.00253892					
rho	0	(fraction of variance due to u_i)				

```
. xtreg wroa wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr, fe

Fixed-effects (within) regression               Number of obs     =       100
Group variable: Banks                           Number of groups  =        10

R-sq:                                           Obs per group:
     within  = 0.4125                                         min =        10
     between = 0.0506                                         avg =      10.0
     overall = 0.0784                                         max =        10

                                                F(11,79)          =      5.04
corr(u_i, Xb)  = -0.7821                        Prob > F          =    0.0000

------------------------------------------------------------------------------
        wroa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         wcr |   .0004007   .0005192     0.77   0.442    -.0006327    .0014341
        wdgr |   .0018216   .0041291     0.44   0.660    -.0063972    .0100403
        wcar |  -.0084096   .0227702    -0.37   0.713    -.0537326    .0369134
      wtltdr |   .0018083    .003531     0.51   0.610    -.0052199    .0088366
      woetar |  -.2262048   .1374611    -1.65   0.104    -.4998143    .0474047
       wsbln |  -.0012994   .0018978    -0.68   0.496     -.005077    .0024781
     wnpltlr |  -.0607451   .0248203    -2.45   0.017    -.1101487   -.0113415
      wgdpgr |   .0002275   .0253425     0.01   0.993    -.0502156    .0506706
       winfr |   .0358499   .0240446     1.49   0.140    -.0120096    .0837095
        wirs |   .2065413     .07848     2.63   0.010     .0503307    .3627519
       wmsgr |  -.0060492   .0157462    -0.38   0.702    -.0373912    .0252928
       _cons |   .0247307   .0277167     0.89   0.375    -.0304379    .0798993
-------------+----------------------------------------------------------------
     sigma_u |  .00723531
     sigma_e |  .00253892
         rho |    .890364   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(9, 79) = 7.21                     Prob > F = 0.0000

. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (10)  =          16.18
Prob > chi2 =          0.0947


. xttest2

Correlation matrix of residuals:

             |        __e1       __e2       __e3       __e4       __e5       __e6       __e7       __e8       __e9      __e10
-------------+----------------------------------------------------------------------------------------------------------------
        __e1 |   5.29e-06
        __e2 |   3.76e-07   .0000289
        __e3 |   1.09e-06  -.0000324   .0000793
        __e4 |   9.17e-06   2.77e-06  -.0000295   .0000891
        __e5 |   4.80e-06   .0000106   .0000108  -.0000462   .0000753
        __e6 |  -4.20e-06   8.76e-06  -.0000226  -4.16e-06  -6.43e-06   .0000176
        __e7 |   1.75e-06  -.0000103   .0000182  -4.51e-06   7.28e-06   8.73e-06   .0001032
        __e8 |   6.28e-06   .0000212  -.0000219  -2.83e-06   .0000149  -1.49e-06  -.0000225   .0000376
        __e9 |  -6.20e-06   .0000261  -.0000372  -.0000117   .0000113   .0000116  -.0000149   .0000172   .0000416
       __e10 |  -2.27e-07  -1.39e-07  -5.65e-06   .0000293  -.0000258  -8.43e-06  -9.60e-06   3.18e-06   6.84e-06   .0000316

             __e1     __e2     __e3     __e4     __e5     __e6     __e7     __e8     __e9    __e10
 __e1   1.0000
 __e2   0.0304   1.0000
 __e3   0.0531  -0.6781   1.0000
 __e4   0.4225   0.0546  -0.3508   1.0000
 __e5   0.2407   0.2281   0.1401  -0.5646   1.0000
 __e6  -0.4356   0.3891  -0.6063  -0.1051  -0.1767   1.0000
 __e7   0.0750  -0.1895   0.2008  -0.0470   0.0826   0.2049   1.0000
 __e8   0.4454   0.6446  -0.4019  -0.0489   0.2801  -0.0580  -0.3620   1.0000
 __e9  -0.4179   0.7530  -0.6483  -0.1927   0.2016   0.4280  -0.2269   0.4356   1.0000
__e10  -0.0176  -0.0046  -0.1130   0.5531  -0.5289  -0.3577  -0.1682   0.0924   0.1888   1.0000

Breusch-Pagan LM test of independence: chi2(45) =    55.543, Pr = 0.1348
Based on 10 complete observations over panel units
```

```
. xtcsd, pesaran


Pesaran's test of cross sectional independence =    -0.262, Pr = 0.7934

. xtreg wroa wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr, re

Random-effects GLS regression                   Number of obs     =        100
Group variable: Banks                           Number of groups  =         10

R-sq:                                           Obs per group:
     within  = 0.2221                                         min =         10
     between = 0.9152                                         avg =       10.0
     overall = 0.6347                                         max =         10

                                                Wald chi2(11)     =     152.88
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000
```

wroa	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
wcr	-.0012004	.0003886	-3.09	0.002	-.0019619	-.0004388
wdgr	.0047296	.0049585	0.95	0.340	-.004989	.0144481
wcar	.0337039	.0215323	1.57	0.118	-.0084985	.0759064
wtltdr	-.0074683	.0028849	-2.59	0.010	-.0131225	-.0018141
woetar	.082362	.0420774	1.96	0.050	-.0001082	.1648323
wsbln	-.0001445	.0000903	-1.60	0.110	-.0003215	.0000325
wnpltlr	-.1255137	.0231843	-5.41	0.000	-.170954	-.0800733
wgdpgr	.0258106	.031153	0.83	0.407	-.0352482	.0868694
winfr	.0282035	.0299713	0.94	0.347	-.0305391	.0869461
wirs	.2939794	.0699533	4.20	0.000	.1568735	.4310853
wmsgr	-.0064888	.0185809	-0.35	0.727	-.0429066	.029929
_cons	.003111	.007198	0.43	0.666	-.0109968	.0172189
sigma_u	0					
sigma_e	.00253892					
rho	0	(fraction of variance due to u_i)				

```
. quietly xtreg wroa wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr, fe

. estimates store FE

. quietly xtreg wroa wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr, re

. estimates store RE

. hausman FE RE
```

	(b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
wcr	.0004007	-.0012004	.0016011	.0003443
wdgr	.0018216	.0047296	-.002908	.
wcar	-.0084096	.0337039	-.0421135	.0074056
wtltdr	.0018083	-.0074683	.0092766	.0020361
woetar	-.2262048	.082362	-.3085668	.1308627
wsbln	-.0012994	-.0001445	-.0011549	.0018957
wnpltlr	-.0607451	-.1255137	.0647686	.0088621
wgdpgr	.0002275	.0258106	-.0255831	.
winfr	.0358499	.0282035	.0076465	.
wirs	.2065413	.2939794	-.0874381	.035576
wmsgr	-.0060492	-.0064888	.0004396	.

```
                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(11) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                       =       48.86
            Prob>chi2 =      0.0000
            (V_b-V_B is not positive definite)
```

```
. quietly reg wroa wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr

. estimates store Pooled_OLS

. quietly xtreg wroa wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr, re

. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        wroa[Banks,t] = Xb + u[Banks] + e[Banks,t]

        Estimated results:
                     |       Var     sd = sqrt(Var)
             ---------+------------------------------
                wroa |    .0000256       .0050634
                   e |   6.45e-06       .0025389
                   u |          0              0

        Test:   Var(u) = 0
                            chibar2(01) =     0.00
                        Prob > chibar2 =   1.0000

. xtgls wroa wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr

Cross-sectional time-series FGLS regression

Coefficients:  generalized least squares
Panels:        homoskedastic
Correlation:   no autocorrelation

Estimated covariances      =         1          Number of obs     =        100
Estimated autocorrelations =         0          Number of groups  =         10
Estimated coefficients     =        12          Time periods      =         10
                                                Wald chi2(11)     =     173.73
Log likelihood             =   437.528          Prob > chi2       =     0.0000
```

wroa	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
wcr	-.0012004	.0003645	-3.29	0.001	-.0019148	-.0004859
wdgr	.0047296	.0046515	1.02	0.309	-.0043873	.0138464
wcar	.0337039	.0201991	1.67	0.095	-.0058855	.0732934
wtltdr	-.0074683	.0027062	-2.76	0.006	-.0127724	-.0021642
woetar	.082362	.0394721	2.09	0.037	.0049981	.159726
wsbln	-.0001445	.0000847	-1.71	0.088	-.0003105	.0000215
wnpltlr	-.1255137	.0217488	-5.77	0.000	-.1681405	-.0828868
wgdpgr	.0258106	.0292241	0.88	0.377	-.0314676	.0830888
winfr	.0282035	.0281155	1.00	0.316	-.0269019	.0833089
wirs	.2939794	.065622	4.48	0.000	.1653626	.4225962
wmsgr	-.0064888	.0174304	-0.37	0.710	-.0406518	.0276741
_cons	.003111	.0067523	0.46	0.645	-.0101233	.0163454

```
. estimates store GLS

. estimates table Pooled_OLS FE RE GLS, star stats(N, chi2, F, sigma_u, sigma_e rho)
```

Variable	Pooled_OLS	FE	RE	GLS
wcr	-.00120036**	.00040073	-.00120036**	-.00120036***
wdgr	.00472955	.00182157	.00472955	.00472955
wcar	.03370395	-.0084096	.03370395	.03370395
wtltdr	-.00746831*	.00180834	-.00746831**	-.00746831**
woetar	.08236204	-.22620479	.08236204	.08236204*
wsbln	-.0001445	-.00129943	-.0001445	-.0001445
wnpltlr	-.12551365***	-.06074509*	-.12551365***	-.12551365***
wgdpgr	.02581062	.0002275	.02581062	.02581062
winfr	.02820349	.03584995	.02820349	.02820349
wirs	.2939794***	.20654132*	.2939794***	.2939794***
wmsgr	-.00648881	-.00604919	-.00648881	-.00648881
_cons	.00311104	.02473072	.00311104	.00311104
N	100	100	100	100
chi2			152.8808	173.72818
F	13.898254	5.0431104		
sigma_u		.00723531	0	
sigma_e		.00253892	.00253892	
rho		.890364	0	

legend: * p<0.05; ** p<0.01; *** p<0.001

```
. xtunitroot llc wroa

Levin-Lin-Chu unit-root test for wroa
-------------------------------------

Ho: Panels contain unit roots               Number of panels  =     10
Ha: Panels are stationary                   Number of periods =     10

AR parameter: Common                        Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 6.00 lags average (chosen by LLC)
```

	Statistic	p-value
Unadjusted t	-9.3660	
Adjusted t*	-6.8171	0.0000

```
. xtabond wroa wcr wdgr wcar wtltdr woetar wsbln wnpltlr wgdpgr winfr wirs wmsgr, vce (gmm)

Arellano-Bond dynamic panel-data estimation     Number of obs     =         80
Group variable: Banks                           Number of groups  =         10
Time variable: year
                                                Obs per group:
                                                              min =          8
                                                              avg =          8
                                                              max =          8

Number of instruments =     48                  Wald chi2(12)     =      43.85
                                                Prob > chi2       =     0.0000
One-step results
```

wroa	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
wroa						
L1.	.4452793	.1994277	2.23	0.026	.0544081	.8361505
wcr	-.000063	.0005274	-0.12	0.905	-.0010966	.0009706
wdgr	-.0011222	.004742	-0.24	0.813	-.0104163	.0081719
wcar	.0227369	.0277768	0.82	0.413	-.0317046	.0771784
wtltdr	-.0037424	.0043106	-0.87	0.385	-.012191	.0047062
woetar	-.1635981	.2049413	-0.80	0.425	-.5652756	.2380795
wsbln	-.0021708	.0031488	-0.69	0.491	-.0083424	.0040008
wnpltlr	-.0450878	.0294969	-1.53	0.126	-.1029007	.0127251
wgdpgr	-.007326	.0240495	-0.30	0.761	-.0544621	.0398101
winfr	.0296546	.029121	1.02	0.309	-.0274216	.0867307
wirs	.1511775	.0923726	1.64	0.102	-.0298695	.3322244
wmsgr	-.0172003	.0153071	-1.12	0.261	-.0472017	.0128012
_cons	.0361333	.0467042	0.77	0.439	-.0554053	.1276718

```
Instruments for differenced equation
        GMM-type: L(2/.).wroa
        Standard: D.wcr D.wdgr D.wcar D.wtltdr D.woetar D.wsbln D.wnpltlr
                  D.wgdpgr D.winfr D.wirs D.wmsgr
Instruments for level equation
        Standard: _cons
```

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