ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF ACCOUNTING AND FINANCE

Effect of liquidity risk on the performance of banks in Ethiopia: The case of selected private commercial banks.

A Thesis Submitted to the School of Graduate studies of Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Master of Science in Accounting and Finance

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June, 2024

Addis Ababa, Ethiopia

Statement of Declaration

I, Yisehak Hailemariam, declare that the thesis entitled: "Effect of liquidity risk on the performance of banks in Ethiopia: The case of selected private commercial banks", hereby submitted by me in partial fulfillment of the requirements for the Degree of Master of Science in Accounting and Finance at Addis Ababa University, is my original work and has not been presented for the award of any degree in any other University or Institution. I have undertaken this research independently with the guidance and advice of my advisor, Kelifa Srmolo (PhD). Throughout the completion of this thesis, I have utilized various sources and materials, all of which have been duly acknowledged and referenced.

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Date 02-07-24

Statement of Certification

I hereby state that Yisehak Hailemariam has conducted this research thesis on the topic entitled "Effect of liquidity risk on the performance of banks in Ethiopia: The case of selected private commercial banks." This research work is original in nature and has not been previously presented for a degree in any university. All sources of materials used for the study have been duly acknowledged, and the work is sufficient for submission for the partial fulfillment for the award of Master of Science Degree in Accounting and Finance.

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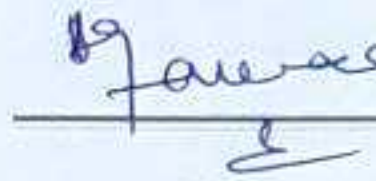
Alem Hagos (PhD)	
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Acknowledgements

First and foremost, I would like to express my sincere gratitude to Almighty God for his wisdom and guidance throughout my research endeavors.

My deepest appreciation goes to my advisor, Dr. Kelifa Srmolo, for his invaluable support and mentorship. His insightful comments and guidance were instrumental in shaping this study.

I am also grateful to the staff of the National Bank of Ethiopia for their kind cooperation in providing access to the necessary financial data for this research. Their assistance was essential in conducting the analysis.

Finally, I would like to acknowledge my family and friends for their unwavering moral and emotional support throughout my studies and career. Their encouragement and understanding helped me persevere during challenging times.

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Abstract

This study investigates the Effect of liquidity risk on the financial performance of commercial banks, with a specific focus on Ethiopian banks. The analysis employs data from Ethiopian commercial banks, encompassing financial statements and relevant economic indicators, ten commercial banks operating in Ethiopia over a period of ten years were selected based on their performance and years of establishment. The study analyzed seven variables that are known to influence the financial performance of commercial banks. Panel data analysis was conducted using data from 2013 to 2022, resulting in a total of one hundred observations. To indicate the effect of liquidity risk on the performance of banks financing gap ratio (FGR), liquid asset to total asset ratio (LATAR), loan-to-asset ratio (TLA), cash reserve ratio (CRR), bank size, GDP growth rate, and inflation rate were used in this study while the financial performance of commercial banks was measured by the Net Interest Margin (NIM).The study employed descriptive statistics to present the data, followed by a correlation matrix and regression analysis. Before running the regression analysis, a model specification test was used to select an appropriate model that satisfied the assumptions of a classical linear regression model. Based on the results of the model specification test, a random effects model was chosen for the study. The multiple regression analysis revealed that the Financing Gap Ratio (FGR) has a positive and statistically significant effect on NIM. This suggests strategic management of financing gaps, a key liquidity risk variable, is associated with higher profitability for Ethiopian banks. However, other variables like Liquid Asset Ratio (LATAR), Loan-to-Asset Ratio (TLA), Cash Reserve Ratio (CRR), bank size, GDP growth, and inflation did not have significant individual effects on NIM. Additionally, the analysis identified significant variation in NIM across different bank groups. In Conclusion this study highlights the importance of strategic liquidity management for Ethiopian banks while maintaining adequate liquidity is crucial, actively managing financing gaps can contribute to higher profitability. Further research is needed to explore the reasons behind the non-significant effects of other variables and the observed group-level heterogeneity in NIM.

Keywords: liquidity risk, financial performance, commercial banks, financing gap, panel data analysis, random effects model.

List of Acronyms

AB: Abay Bank

AIB: Awash Bank

BB: Bunna Bank

BOA: Bank of Abyssinia

BCBS: Basel Committee on Banking Supervision

CBO: Cooperative Bank of Oromia

CC: Correlation Coefficients

CI: Condition index

CLRM: Classical Linear Regression Model

CRR: Cash Reserve Ratio

DB: Dashen Bank

FGR: Financing gap ratio

FEM: Fixed Effect Model

GDP: Gross Domestic Product

HB: Hibret Bank

LATA: Liquid asset to total asset ratio

LR: Liquidity Ratio

NBE: National Bank of Ethiopia

NIB: Nib International Bank

NIM: Net Interest Margin

OLS: Ordinary Least Square

REM: Random Effect Model

TLA: Total loan to Total Asset Ratio

VIF: Variance Inflation Factor

WB: Wegagen Bank

ZB: Zemen Bank

CHAPTER ONE
INTRODUCTION

1.1 Background of the study

Banks stand out from other financial institutions due to the variety of goods and services they provide. An important and necessary mechanism for these businesses' survival is the evaluation of bank performance. Additionally, a strong banking system is a foundational element of economic growth. Therefore, banks are the financial institutions that are most involved in financing the economy (Dang et al, 2017).

According to the traditional roles, the foundation of banking activities is liquidity. Liquidity is thus the first good or service offered by any banking institution. Given the significant role that liquidity plays in banking activities, the liquidity risk has received significant attention. This risk puts bank stability at risk and increases the likelihood of bank failure(Berger and Bouwman, 2009).

Liquidity risk is the condition in which a bank is unable to fully or partially satisfy all of the depositor's requests for a specific period of time (Jenkinson, 2008) . It can also be described as a bank's inability to meet immediate financial needs. Liquidity risk can have an impact on a bank's reputation in addition to its performance. Lack of liquidity damages depositor confidence, which results in lost opportunities.

Liquidity risk is defined as the inability of a bank to accommodate decreases in liabilities or to finance increases in assets by the BCBS. A bank's profitability is impacted when it lacks sufficient liquidity because it is unable to quickly convert assets into cash or increase liabilities at a reasonable cost (BCBS, 1997).

The literature on the link between bank performance and liquidity is unclear. According to Diamond and Dybvig (1983), there is still debate regarding the relationship between liquidity risk and bank performance. According to several studies, liquidity has a positive impact on bank performance in Europe (Bourke, 1989; Poposka & Trpkoski, 2013), Asia (Arif & Anees, 2012), and Africa (Aburime, 2009). Other studies, however, supported the opposing thesis. They came to the conclusion that, when

resources are misallocated, liquidity has a negative impact on bank performance (Kosmidou, 2008). Banks with a high level of liquidity will finance risky projects that have a high rate of return but low likelihood of success.

The main contributions of this study are its unique approach of using multiple liquidity risk measures beyond just the liquidity ratio, as well as being the first to investigate the causes of liquidity risk. Additionally, the study finds that liquidity risk is an endogenous determinant of bank performance, meaning it is an internal factor that influences bank performance. This represents advancement in the literature by taking a more comprehensive approach to analyzing liquidity risk and its relationships, going beyond the typical focus on the liquidity ratio alone.

The remainder of this chapter is organized as follows. Section 2 presents a clear and concise problem statement that identifies the issues that need to be addressed. Section 3 provides a recent and brief literature review on liquidity risk and bank performance in Ethiopia. Section 4 describes the research methodology used in this study, including the study design, sampling method, and data analysis techniques. Finally, Section 5 lists the references used in the chapter.

1.2 Statement of the problem

The banking sector is the backbone of an economy's financial system (Rushchyshyn et al 2021). However, banks play a vital role in maturity transformation, which involves converting short-term deposits into long-term loans, in addition to their traditional role of resolving financial issues. This process is inherently vulnerable to liquidity risk, as banks must be able to meet the short-term withdrawal demands of depositors while also maintaining sufficient liquidity to cover long-term loan commitments.

The global financial crisis has shown that one of the key components to a bank's survival is liquidity. After the global financial crisis of 2007, the threat to liquidity has become one of the main concerns for monetary institutions worldwide. For instance, many banks found it difficult to maintain sufficient liquidity during the global economic crisis. (Vodova, 2013).

Additionally, Marozva (2015) explains that numerous banks ran into trouble at some point during the recent global financial crisis as a result of their inability to exercise prudent liquidity control. As a

result, the crisis highlighted how important liquidity is to the proper operation of financial markets and the economy as a whole.

The U.S. sub-prime mortgage crisis, according to Shen, Chen, Kao, and Yeh (2009), has had an impact on the global economy in addition to posing a threat to the U.S. economy as a whole. Furthermore, it represents a significant undertaking for the short-term and long-term growth of the global banking sector. The operational environment for banks was also significantly impacted by the liquidity crisis. Financial organizations such as the Basel Committee for Bank Supervision promoted the active management of liquidity risk in response to the catastrophe (Basel, 2008).

he nation's system of economic intermediation is mostly dependent on private commercial banks since they have been instrumental in the development and financing of Ethiopia's economy during the previous two to three decades and because they control the industry rather than the capital market. However, foreign countries or companies are not allowed to purchase all or a portion of the shares of Ethiopian banks under the legislation that control the country's banking sector.

The National Bank of Ethiopia has made it mandatory for banks to have their own liquidity policies. These policies compel banks to reveal their funding sources, show that they can manage short-term liquidity problems, and improve their capacity to evaluate both present and potential liquidity threats in relation to their liquidity position going forward. As a result, it's critical to keep liquidity at the optimal level. (NBE, 2010)

Liquidity risk has a negative impact on bank financial performance, as demonstrated by multiple studies (Chen et al., 2018; Zaghdoudi & Hakimi, 2017; Musiega et al., 2017; Muriithi and Waweru, 2017; Tabari et al., 2013; Ben Moussa & Boubaker, 2020). However, the independent variables used in these studies differ, suggesting that more research is needed to fully understand the relationship between liquidity risk and bank performance.

Researchers in Ethiopia have studied the relationship between liquidity risk and commercial banks' performance for many years. Notable studies include Tseganesh (2012), Workneh (2015), Berhanu (2015), and Eyob (2019).

Tseganesh (2012) and Berhanu (2015) examined two goals: (1) to identify the factors that influence the liquidity of commercial banks, and to determine the impact of these factors on banks' financial

performance. Tseganesh's study focused on macroeconomic factors, while Berhanu used net interest margin (NIM) as a measure of bank performance, in contrast, this study appears to take a broader, more holistic approach.

Eyob (2019) and Workneh (2015) also investigated the effect of liquidity on the performance of commercial banks in Ethiopia. Eyob used return on equity (ROE) as a measure of bank performance, while Workneh focused on internal bank-specific factors.

Overall, the literature on the relationship between liquidity risk and commercial banks' performance in Ethiopia is mixed. Some studies find that liquidity has a positive impact on bank performance, while others find a negative impact. More research is needed to better understand the complex relationship between these two variables.

Numerous factors have increased the liquidity issues in different countries and presented significant challenges to banks. Researchers and decision-makers have focused a lot of attention on these issues in relation to the connections between liquidity risk, regulation, supervision, and bank performance. Ly, K. C. (2015).

Today, dealing with liquidity is a problem and a challenge in developing nations like Ethiopia. (NBE, 2022). Therefore, more research must be done in this area. Since banks depend heavily on liquidity to function, it is important to identify the factors that affect that liquidity and present significant challenges to bank performance.

Traditional banks rely on their ability to lend money at a higher interest rate than they pay on deposits to generate profits. This is known as the net interest margin (NIM). ROA and ROE are also important measures of bank performance, but they do not take into account the bank's ability to generate profits from its core lending business. In Ethiopia, most banks have a traditional business model. Therefore, NIM is a better measure of bank performance for Ethiopian banks than ROA or ROE. (NBE 2022)

In general, statements of financial positions can be used to calculate liquidity risk measures better practices for measuring liquidity risk in the past centered on applying liquidity ratios. However, Poorman and Blake (2005) pointed out that using only liquidity ratios to measure liquidity was insufficient and was not the answer and also Utilizing liquidity ratios was the main focus of previous

measures of liquidity risk. Banks must adopt a new perspective on liquidity measurement that goes beyond simple liquidity ratios.

In recent years, methods other than conventional liquidity ratios have been offered to evaluate bank liquidity risk. This study's goal is to use alternative liquidity risk metrics in addition to the liquidity ratio. Keeping in mind that (Tabari et al., 2013) used the financial gap ratio as an alternative liquidity risk measure in their study, which was inspired by (Saunders and Cornett, 2006) for that reason financing gap measures is used in this study to evaluate the risk to bank liquidity. The study thus considers financial gap ratio as an endogenous variable in the estimation of its effects on bank performance while controlling for other determinants in order to more accurately estimate its impact on bank performance. This is an important consideration that reflects the complex, interdependent nature of liquidity risk and financial performance. The study therefore seeks to analyze whether liquidity risk has a positive or negative effect on the performance of Ethiopian private banks.

This study investigate the following independent variables that may affect bank performance: financing gap ratio, liquid asset to total asset ratio, total loan to total asset ratio, cash reserve ratio, bank size, growth rate of gross domestic product, and inflation.

In this study, I used net interest margin (NIM) to assess the performance of banks with a traditional business model, such as Ethiopian banks. NIM is a good measure of performance for these banks because it is a direct measure of how efficiently they are generating revenue from their interest-earning assets. It is also a key driver of profitability and less sensitive to changes in accounting rules and macroeconomic conditions than other measures of performance, such as return on assets (ROA) and return on equity (ROE).

1.3. Objective of the Study

1.3.1. General Objective of the Study

The General objective of this study is to investigate the effect of liquidity risk on the performance of Ethiopian private commercial banks. Specifically, the study aims to:

1.3.2. Specific Objective of the Study

The specific objective of this study mainly had seven purposes. Those are:

1. Examine the effect of the financing gap ratio on bank performance (net interest margin, NIM).
2. Analyze the effect of the liquid asset to total asset ratio on bank performance (NIM).
3. Investigate the effect of the total loan to total asset ratio on bank performance (NIM).
4. Examine the effect of the cash reserve ratio on bank performance (NIM).

1.4. Research Hypothesis

The financing gap ratio, which measures the difference between a bank's loans and deposits, is a key indicator of liquidity risk (Distinguin et al., 2013). Theory suggests that a higher financing gap ratio, indicating greater reliance on non-deposit funding, can expose banks to higher liquidity and funding risks, which may negatively impact their financial performance (Drehmann & Nikolaou, 2013). Empirical studies have found a negative relationship between the financing gap ratio and bank profitability measures such as net interest margin (NIM) (Bordeleau & Graham, 2010; Vodová, 2013). Therefore, the first hypothesis (H1) is formulated based on this theoretical and empirical evidence.

The liquidity management theory posits that banks need to maintain an optimal level of liquid assets to balance the trade-off between liquidity and profitability (Acharya et al, 2015). A higher ratio of liquid assets to total assets can enhance a bank's ability to meet short-term obligations and funding needs, ultimately improving its profitability (Bourke, 1989; Demirgüç-Kunt & Huizinga, 1999). Numerous studies have documented a positive relationship between the liquid asset ratio and bank performance measures like NIM (Bordeleau & Graham, 2010; Vodová, 2013). This forms the theoretical basis for hypothesis H2.

The loan-to-asset ratio is a measure of a bank's asset composition and liquidity risk. A higher ratio of loans to total assets indicates a greater focus on lending activities, which can potentially generate higher net interest income and improve profitability (Athanasoglou et al., 2008). However, an excessive concentration in loans may also expose the bank to higher credit risk, which could offset the positive impact on performance (Drehmann & Nikolaou, 2013). Empirical studies have found a positive relationship between the loan-to-asset ratio and bank profitability (Bourke, 1989; Demirgüç-Kunt & Huizinga, 1999), supporting the formulation of hypothesis H3.

The cash reserve ratio, which represents the fraction of a bank's deposits that must be held in the form of cash reserves, is a key regulatory tool used by central banks to manage liquidity and monetary policy (Borio & Disyatat, 2010). From a theoretical perspective, a higher cash reserve ratio can have a positive impact on bank profitability by reducing liquidity risk and ensuring sufficient short-term funding to meet obligations (Vodová, 2011). This, in turn, can enhance a bank's net interest margin and overall financial performance.

Empirical studies have provided mixed evidence on the relationship between the cash reserve ratio and bank performance. Some researchers have found a positive and significant effect, suggesting that higher cash reserves improve a bank's liquidity position and profitability (Vodová, 2011; Alam, 2013). In contrast, other studies have reported a negative impact, as the opportunity cost of holding non-interest-earning cash reserves can weigh on a bank's net interest income and overall profitability (Bordeleau & Graham, 2010; Demirgüç-Kunt & Huizinga, 1999).

Given the theoretical arguments and the mixed empirical evidence, the fourth hypothesis (H4) posits that the cash reserve ratio has a positive and significant effect on the performance of Ethiopian private commercial banks, as measured by their net interest margin (NIM).

From the theoretical and empirical evidence, the study formulates the following research hypotheses:

H1: The financing gap ratio has a negative and significant effect on the performance of Ethiopian private commercial banks (NIM).

H2: The liquid asset to total asset ratio has a positive and significant effect on the performance of Ethiopian private commercial banks (NIM).

H3: The total loan to total asset ratio has a positive and significant effect on the performance of Ethiopian private commercial banks (NIM).

H4: The cash reserve ratio has a positive and significant effect on the performance of Ethiopian private commercial banks (NIM).

1.5. Scope of the study

The focus of this study is to examine the effect of liquidity risk on the performance of Ethiopian private commercial banks. The liquidity risk is measured using three key ratios: the financing gap ratio, the liquid asset to total asset ratio, and the total loan to total asset ratio.

In addition, the study also investigates the effects of certain bank-specific or internal factors, namely the cash reserve ratio and bank size. It also looks at the influence of macroeconomic or external factors, such as GDP growth rate and inflation rate, on bank performance. The performance of the banks is assessed using the net interest margin (NIM) as the dependent variable.

The study period covers 10 years, from 2013 to 2022, and the sample includes 10 selected private commercial banks in Ethiopia. So in summary, the scope of the study is limited to analyzing the determinants of liquidity risk and its impact on the performance of Ethiopian private commercial banks during the 2013-2022 period, using NIM as the key performance indicator.

1.6. Significance of the study

The research project's findings would be important to financial sector regulators as they developed guiding principles and regulations regarding liquidity risk in Ethiopia's banking industry. The study's findings would provide evidence for experts in the banking industry about the relationship between liquidity risk and the financial performance of commercial banks in Ethiopia. The study's advice and conclusions would help create credit policies and operational procedures for dealing with liquidity. The results of this study would not only advance our understanding of the subject, but they would also be useful to academics considering conducting research on a related subject. Therefore, the most significant gainers from this study are each commercial bank, the nation's academic community, the regulatory agencies, and other researchers who learn more about the impact of liquidity risk on commercial banks' performance.

1.7 Organization of the study

The study is divided into five different chapters. Chapter one provides the introduction, giving the general idea about the research topic and the subject matter. It covers the background of the study, problem statement, research hypothesis, research objectives, scope and limitations, and the significance of the study.

Chapter two includes two parts - a review of the theoretical and empirical literature on the concept of liquidity and liquidity risk, measures of liquidity risk, measures of performance, and the effect of liquidity risk on bank financial performance.

The third chapter outlines the research methodology, including the research design, data sources, econometric specifications, justification of variables, population and sampling method, data collection, presentation and analysis methods, and the model specification.

Chapter four presents the data in an organized form to find the major conclusions of the research work. It contains the analysis, interpretations of the estimations, and the research findings.

Finally, Chapter five provides the summary, conclusions, and implications of the study. The summary relates the major findings, and the discussions are based on the interpretation of data to address the research problem. The report also includes references and annexes in the supplementary section.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter focuses on the review of literature related to this research. It focused on a review of past studies done on the effect liquidity risk management practices on performance of Commercial Banks. This chapter also presents a review of the theories guiding the study, meaning and importance of liquidity risk on the performance of commercial banks. The review also uses theoretical content from the internet, financial reports, magazines, books, and research papers. After that, a review of relevant empirical studies conducted both domestically and abroad is covered. The chapter summary and gap are discussed and also presented the study's conceptual framework.

2.2 Theoretical Review

2.2.1 Banks and Liquidity

Hangli, Ajorsu, and Bakpa (2019) stated that "liquidity" typically refers to an entity's capacity to convert its assets into cash quickly without losing value. In other words, the ability of an organization to strategically manage current assets and current liabilities, with a focus on maintaining adequate levels, is referred to as liquidity. This allows the business to have a steady stream of cash to meet its short-term obligations and, as a result, continue to exist for the foreseeable future. According to Zaghdoudi et al. (2017), this refers to a bank's inability to meet immediate financial needs.

According to Golubeva, Duljic, and Keminen (2019), modern financial theories have long acknowledged that banks play two essential roles in the economy: creating liquidity and transforming risk (Berger & Bouwman, 2009 as cited in Golubeva, Duljic & Keminen, 2019). Indeed, banks are essential for extending credit and mobilizing deposits. According to Bank for International Settlements (2008), liquidity refers to a bank's ability to finance an increase in assets and fulfill its obligations, assuming no losses. It is essential to the long-term viability of any banking enterprise. As a result, managing liquidity is one of the most important tasks performed by banks.

The concept of liquidity in finance typically refers to two things: the liquidity of financial instruments on the financial market and the liquidity related to solvency. Although they are closely related ideas, liquidity and solvency is not the same thing. Liquidity is the capacity to quickly and affordably deal with cash outflows, while solvency is the capacity to pay back debts owed to banks and fulfill other commitments over the long term, (Scannella2016).

Simply put, a bank's liquidity is its ability to hold enough cash to cover its maturing obligations. This allows the bank to promptly satisfy cash, checks, withdrawal obligations, and good new loan demand while adhering to existing reserve requirements (Ibe, 2013). Banks provide liquidity to the sector by delivering funds from depositors and extending them to borrowers. They also provide liquidity for any withdrawal of deposits.

Liquidity has been cited by Diamond and Rajan (2005) and Leykun (2016) as one of the essential requirements for the proper operation of the banking system. Banks are currently unable to carry out some of their fundamental tasks, including settling their interbank obligations, due to a lack of liquidity. In addition, too much liquidity in the banking system regularly encourages the expectation of falling interest rates, while too little liquidity heightens the anticipation of rising interest rates. A controlled environment where people and businesses can make better-informed decisions about savings, investments, and other expenditures is created by maintaining easy money flows and reducing volatility in short-term interest rates.

Another critical aspect of liquidity is that it is essential to every company's existence, and proper management is required to ensure ongoing cash flows for the firm's ongoing operations. (Hangli et al 2019.).

Many different risks affect banks. Market, operational, credit, and liquidity risks are the four main risk categories that can be used to categorize banking risks. The last ten years have seen a significant increase in the importance of liquidity risk in banking due to the financial crisis and new financial regulations. It is now more crucial than ever to monitor, control, and evaluate how liquidity risk affects the banking industry's economics. Liquidity risk has become increasingly important for financial institutions and the financial system's stability in recent years. The financial crisis has encouraged the adoption of much more sophisticated liquidity risk management procedures and liquidity risk assessment techniques. (Scannella2016).

Adalestinsson (2014), cited in Ben Moussa et al. (2020), notes that there are three ways to obtain liquidity: by selling assets, borrowing money from creditors on the financial markets, or relying on debtors to repay creditors.

2.3 Theories of Bank Liquidity and Liquidity Management

A commercial bank's primary responsibilities include creating liquidity and maintaining financial stability. But there are several aspects to how banks manage their liquidity risk. It could be said that different theories of liquidity management compete.

There are various competing theories of liquidity. The five theories that are pertinent to the research topic is discovered in this section.

2.3.1 Liquid Asset Theory

This theory, which focuses on the balance sheet's left side, or asset side, contends that banks need to hold a lot of liquid assets as a buffer against potential demand or as a way to pay for unforeseen events. (Ahmadyan, 2018; citing Ngwu, 2006).

2.3.2 Commercial Loan Theory

According to this theory, the central bank should lend to the banks on the security of any short-term, self-liquidating loans made by commercial banks. (Ben Mossa et al, 2020). This principle ensures that each bank has the proper level of liquidity and that the overall economy has a suitable amount of money supply.

The theory further assumes that liquidity would be sufficiently provided by repayment from the bank's self-liquidating assets. This disregards the possibility of seasonal deposit withdrawals and fulfilling credit requests having a negative impact on the liquidity position. Furthermore, the theory fails to take into account the typical stability of demand deposits when taking liquidity into account.

This obvious factor might eventually affect the bank's liquidity situation. The theory further assumes that sufficient liquidity would be provided by repayment from a bank's self-liquidating assets. This disregards the possibility of seasonal deposit withdrawals and fulfilling credit requests having a negative impact on the liquidity position.

Ibe (2013) the theory's biggest drawback, from a variety of perspectives, is that it doesn't take into account the requirements of economic development, particularly for developing countries where long-term loans are the growth engine. The theory also places a strong emphasis on the maturity structure of bank assets (loans and investments), rather than necessarily on the assets' marketability or transferability. The idea further believes that liquidity would be sufficiently provided by repayment from the bank's self-liquidating assets.

2.3.3 The Shiftability Theory

The shiftability theory was initially put forth by H.G. Moulton in 1915, who stated that if commercial banks persisted, a sizable amount of assets could be transferred to other banks in exchange for cash without any material loss. According to the shiftability theory, a currency's liquidity is maintained if it contains assets that can be traded on a secondary market or sold to other investors or lenders in exchange for cash. Marketable securities are considered part of liquidity in the theory**.** (Barus et al, 2017).

According to this theory, investing in bank assets is more beneficial due to their marketability. in relation to the argument, banks provide longer-term financing that is more permanent in nature. It acknowledges that short-term self-liquidating loans are becoming less significant.. (Edem, 2017).

The shiftability theory also states that treasury bills and bills of exchange, which can be sold directly by banks whenever they need to raise money, are excellent sources of short-term market investments that provide liquidity. However, the shiftability theory requires all banks to acquire such assets that can be transferred to the central bank, which acts as the lender of last resort; in general situations where all banks require liquidity.

2.3.4 Anticipated Income Theory

On the basis of the practice of US commercial banks extending term loans, H.V. Prochanow put forth this theory in 1944. According to this theory, the bank plans the term loan's liquidation from the borrower's anticipated income, regardless of the nature and characteristics of the borrower's business. A term loan is one that lasts longer than one year but less than five years.

Ibe (2013) states that this theory supports the idea that a bank's liquidity can be controlled by properly phasing and structuring the loan commitments it makes to its clients. If a customer's scheduled loan payments are based on the borrower's future, then the liquidity in this situation can be planned.

According to the anticipated income theory, banks' liquidity can be predicted. . The theory holds that a bank's liquidity can be affected by the maturity structure of its loan portfolio and investment holdings, with short-term business and consumer installment loans having a higher liquidity level than those secured by real estate. (Barus et al, 2017)

2.3.5 Liabilities Management Theory

In the 1960s, this theory experienced further development. According to this theory, banks do not need to provide self-liquidating loans or keep liquid assets because they can always borrow reserve funds from the money market. By creating more liabilities against it from various sources, a bank can hold reserves.

These include borrowing and issuing, time certificates of deposit, other commercial banks, central banks, raising capital through the issuance of shares, and reinvesting profits.

On the liability side of the bank balance sheet, the liquidity management theory focuses. This theory holds that a bank's liabilities may be used to generate additional liquidity. (Ibe, 2013).

2.4 Measurements of liquidity risk

Understanding some of the potential sources of liquidity risk and strategies for mitigating them is crucial before beginning the process of measuring liquidity risk.

Vodova (2011) asserts that the liability side of banks' balance sheets, where demandable deposits are collected and invested in long-term, illiquid assets like loans, is the primary cause of the banks' vulnerability to a liquidity shock.

Vodova (2011) cites Rochet (2008) who identifies three primary sources of liquidity risk: In terms of liabilities, there is a great deal of uncertainty regarding the size of deposit withdrawals or the renewal of rolled-over interbank loans, particularly when the bank is under investigation for insolvency or when there is a brief shortage of aggregate liquidity, On the asset side, there is uncertainty regarding

the volume of future loan requests that a bank will receive Off-balance sheet activities include positions taken by banks on the derivatives market as well as credit lines and other commitments.

Understanding the early signs of a liquidity crisis is one of the most important aspects of measuring and managing liquidity risk. A company needs to be able to measure risk magnitude in addition to recognizing these signs so that it can act quickly and appropriately to stop a downward trend. Shortening asset maturities, issuing more equity, increasing the average liquidity of assets, and obtaining liquidity protection are just a few ways that banks can meet their liquidity needs.

Banks' capacity to fulfill their financial obligations is typically assessed by looking at their balance sheet and relating some or all of their current liabilities to their current assets. Fundamentally, a company's liquidity depends less on its balance sheet than it does on how well and profitable it is. If a company is losing money, having a strong balance sheet and a high current ratio simply delays liquidity issues temporarily. Because of the uncertainty surrounding the size of the potential liquidity needs at any given time and the availability of sources of liquidity large enough to meet them, developing an appropriate measure is difficult. Additionally, active asset and liability management has an effect on liquidity management. (Ibe, 2013).

Thus, an accurate assessment of liquidity necessitates going beyond the technical liquidity suggested by the stock-flow approach to include an evaluation of the range of conditions that could put a bank under pressure and have a negative impact on its marketability. Both a stock at a specific moment in time and a flow over time can be used to measure liquidity. The stock approach is the most popular. One of them is the loan-to-deposit ratio, the most well-known and frequently applied metric in commercial banking. (Ibe, 2013).

Financial ratio analysis, comprehension of these ratios' meanings, and the best course of action implementation are all necessary for good liquidity management. Financial ratios give a company up-to-date indicators of liquidity risk based on past performance, enabling it to make the necessary operational and financial adjustments to ensure it achieves desired future results. Liquidity risk is measured differently by various academics. The following measurements include;

2.4.1 Financial Gap ratio

According to Poorman and Blake (2005), using liquidity ratios to measure liquidity risk was insufficient and not a solution. In the past, the use of liquidity ratios was the main focus of the measurement of liquidity risk. Banks should adopt a new perspective on measuring liquidity in addition to the conventional liquidity ratios. There are many methods available today to examine bank liquidity risk without using standard liquidity ratios. For instance, a large southeast regional bank has used more than thirty liquidity ratios to measure liquidity. However, liquidity risk ultimately caused it to fail. (Chen et al, 2009). As a result, this study uses the financial gap ratio as used by Chen et al. in 2009 and Tabari et al. in 2013 by Saunders and Cornett (2006). They stated that the financial gap is used to determine the liquidity risk criterion.

The majority of bank managers believe that core deposits are a reliable source of money that can perpetually finance the supply of banking loans. Core deposits are typically thought of as the most cost-effective loan resources. The difference between a loan and a bank's core deposits is known as the financial gap. If there is a positive financial gap, the bank should close it with cash funds obtained from selling cash assets and borrowing from the money market. As a result, the financial gap can be calculated by deducting borrowed money from cash assets.

After selling its cash assets, the bank's financial needs are represented by this financial gap. Banks are more vulnerable to liquidity risk when the economy is stagnant and the financial market is demanding more cash. As a result, it appears from this study that a financial gap is a more suitable substitute for bank liquidity risk. The financial gap variable is divided by total assets in order to standardize it. (Tabari, et al 2013).

2.4.2 Liquid asset over total asset ratio

The ratio of liquid assets to total assets evaluates a bank's capacity to withstand fluctuations in liquidity. A high ratio indicates a strong capacity for shock absorption. Liquid assets are those that can be quickly changed into cash, cash equivalents, or other forms of cash. This ratio shows what percentage of total assets are liquid assets. A greater ratio indicates that banks maintain more liquid assets relative to their overall assets, which improves their liquidity. This ratio was used to evaluate liquidity risk by some writers, including (Barus et al. 2017), (Ahmadyan, 2018), and (Vodova, 2013).

2.4.3 Total loan over Total asset ratio

The proportion of loans in total assets is calculated as total loans over total assets. It displays the portion of the bank's assets that are made up of risky loans. A high value for this ratio indicates that the bank is less liquid. One of a bank's key sources of income comes through loans, which can help the bank perform well. The more a bank's deposits are converted to loans, the more money is made. Due to the possibility of illiquidity, it might have adverse effects. (Gaber, 2018).

2.4.4 Cash reserve ratio

Every commercial bank must keep a specific minimum amount of deposits as a reserve, known as the cash reserve ratio (CRR) by the central bank requirement. The Economics Times describes the legal reserve as a portion of deposits that commercial banks are obligated to retain in cash under instructions from the central bank.

According to (Gray, 2011), the central bank's imposition of the legal reserve has three key reasons, which are: Prudential: When commercial banks were required to carry proportionate reserve amounts either directly or at the central bank, which in turn retained gold reserves, limiting their capacity to accept deposits and issue their banknotes. These reserves provide some defense against hazards related to solvency and liquidity.

Monetary control: First, the reserve ratio may limit the expansion of commercial banks' balance sheets if reserve money cannot be easily expanded. In order to affect the expansion of monetary aggregates and subsequently inflation, the central bank may, second, alter the level of (unremunerated) reserve ratio in a way that would affect the difference between deposit and lending rates.

Management of liquidity: It could be either active or passive. By actively utilizing the reserve ratio, a central bank can administratively immobilize excess reserves, preventing the impact of a surplus on bank behavior (low-interest rates, increased demand for foreign currency, etc.) from triggering inflation or devaluation. Similar to the last example, the central bank may cut the reserve ratio if the supply of reserves is insufficient to meet demand. If the reserve ratio can be reached on average over a period of time, a passive strategy can be used. This facilitates the commercial banks' ability to manage short-term liquidity, which lowers the volatility of short-term interest rates.

2.4.5 Bank Size

The total assets of the bank serve as a proxy for the bank's size, which is an independent variable in the model. It is anticipated that the size variable will have a negative effect on the likelihood. In other words, the possibility that banks will raise their profits decreases as their size grows. Greater access to new financing sources is advantageous for bigger banks, but managing liquidity issues and risk diversification is another challenge. This is likely because larger banks profit from failed policy plans and are thought to have higher survival rates than smaller banks. As a result, the regression model is used to concentrate on the study's success in relation to asset size. (Aldwan2015). The expanding size influence on performance is shown to have some favourable effects. However, for exceptionally large banks, the impact of bank size could be detrimental (Athanasoglou et al., 2008 in Ly, 2015).

2.4.6 GDP Growth

Gross domestic product (GDP) is a measure of an economy's overall output and prosperity within a country. It represents the total value of all goods and services produced over a given time period. As noted by Shen et al. in 2010, GDP is a key macroeconomic indicator that can be used to assess various economic parameters.

The GDP growth rate is expected to have a significant impact on factors related to the supply and demand for loans and deposits. When GDP growth slows, especially during economic recessions, the credit quality of borrowers typically deteriorates and default rates rise. This, in turn, leads to lower returns for financial institutions.

Conversely, periods of stronger economic growth tend to encourage banks to lend more, allowing them to charge higher profit margins and improve the quality of their loan portfolios. In essence, GDP is a comprehensive measure of all economic activity occurring within a country.

2.4.7 Inflation rate

According to Revell (1979), one of the variables that could affect the performance of commercial banks is inflation. In their analysis, Devinaga and Rasiah (2010) claimed that central banks' ability to manage inflation increased borrowing costs and decreased their capability to provide credit, which resulted in money being given to commercial banks as loans. Because of this, borrowing costs rise and banks tighten their lending standard, which in turn causes a decrease in demand for credit and a rise in

the amount of expenditure. The emergence of such circumstances will certainly have a negative impact on the profitability of commercial banks because banks receive the majority of their income from the loans that they extend to customers. If demand for loans declines as a result of the higher cost of borrowing, then earnings will definitely decline and consequently the profit.

2.5 Determinants of Bank Performance

The three key profitability measures for banks are Return on Assets (ROA), Return on Equity (ROE), and Net Interest Margin (NIM). ROA measures the efficiency of a bank in generating profits from its assets, while ROE reflects the bank's ability to generate profits from the funds invested by its shareholders. NIM, on the other hand, measures the difference between the interest income earned on a bank's interest-earning assets and the interest expenses paid on its interest-bearing liabilities, expressed as a percentage of its total interest-earning assets (Athanasoglou et al., 2008).

Bank performance refers to how successful a bank utilizes its operating resources to earn income. In this model, we consider performance measures, liquidity risk measures, bank-specific variables, and macroeconomic conditions. This study used net interest margin (NIM) to evaluate bank performance. Average assets and equities are being used in order to capture any differences that occurred in assets and equities during the fiscal year (or season effects). NIM measures the gap between what the bank pays savers and what the bank receives from borrowers. Thus, NIM focuses on the traditional borrowing and lending operations of the bank.

NIM is a particularly appropriate choice as the independent variable in the analysis, as it is directly influenced by a bank's ability to manage its liquidity position and the associated funding costs, making it a relevant measure for examining the impact of liquidity risk. Additionally, NIM provides a comprehensive view of a bank's financial performance, as it reflects the bank's efficiency in utilizing its interest-earning assets and managing its interest rate risk exposure.

The use of NIM as a dependent variable in studies examining the determinants of bank performance is also well-established in the banking literature, allowing for comparability and consistency with prior research (Athanasoglou et al., 2008). Ultimately, by focusing on NIM as the dependent variable, the analysis can provide valuable insights into how liquidity risk affects the profitability and financial health of banks, which is of great importance to both bank management and policymakers.

2.6 Liquidity risk and Bank performance relationship

Numerous variables in recent years, particularly those that followed the financial crisis of 2007–2009, have increased the liquidity issues in many nations and presented significant challenges to banks. (Ly, 2015). Liquidity risk makes it harder for the bank to fulfill its financial obligations as they become due. Banks will lose clients if this risk is not controlled, lowering the amount of deposits. When deposits fall, the bank won't have enough money for additional investments, which sharply lowers profitability. Once more, a large liquidity risk results in a bank run. The panic withdrawal of bank deposits is what started this run. Turning away potential customers and investors has a negative impact on the bank's potential. As a result, the bank's operations considerably decrease, significantly lowering its profit. (Ahmadyan, 2017; Ndifon Ojong et al., 2014).

2.7 Empirical Literature Review

There are several studies that deal with the liquidity and profitability of banks; however, they significantly differ from one another. There have been many contentious discussions about this topic in earlier studies. While other investigations discover a negative association, some find a strong positive relationship between the two factors. Here are some references to earlier studies from various countries, including Ethiopia, to help make the current study more significant.

2.7.1 Empirical Studies in Other countries

In a study conducted by (Hakimi and Zaghdoudi 2017), they examined the influence of liquidity risk on the performance of Tunisian banks with a sample of ten banks in Tunisia from 1990 to 2013. Panel data and the random effect regression approach were utilized for analysis, and the study's findings indicated that (liquidity measured by total over total deposits) has a negative effect on bank profitability (NIM). The performance of Tunisian banks has seen a significant reduction in liquidity risk. Additionally, research demonstrates that the global financial crisis and inflation have a negative and considerable impact on bank performance.

Tabari, Ahmadi, & Emami (2013) studied to find out the liquidity risk effect on the performance of commercial banks in Iran. The research included panel data techniques and a sample of 15 Iranian banks from 2003 to 2010. Both bank-specific and macroeconomic variables were incorporated into the model. They discovered that macroeconomic variables such as gross domestic product and inflation as

well as bank-specific variables like bank size and asset had a beneficial impact on the performance of Iranian banks. While credit risk and liquidity risk have a detrimental impact on banks' performance as assessed by the financing gap to total assets.

Chen, Shen, Kao, & Yeh (2009) studied 12 advanced economies' commercial banks over the period 1994-2006 To determine the connection between bank performance and liquidity risk. The panel dataset was imbalanced. For the study, various liquidity risk (funding gap to total asset) indicators were used. Liquidity risk FGR had a negative and significant impact on the bank's performance (ROA and ROE), according to the study's findings. The relationship with net interest margins (NIM) is, nonetheless, favorable. The study was structured according to the financial systems used by the various nations, such as market- or bank-based systems. Findings demonstrated a non-linear relationship between bank performance and liquidity risk in nations with market-based financial systems. However, there was no connection between liquidity risk and bank performance in nations with bank-based financial systems.

2.7.2 Empirical Studies in Ethiopia

There are number of studies conducted in Ethiopia. For example, Tseganesh, (2012) investigated the determinants of commercial bank liquidity in Ethiopia and then seen the impact of banks liquidity up on financial performance through the significant variables explaining liquidity. Balanced fixed effects panel regression was used for the data of eight commercial banks in the sample covered the period from 2000 to 2011. The study finds that capital adequacy, bank size, share of non-performing loans in the total volume of loans, interest rate margin, inflation rate and short term interest rate had positive and statistically significant impact on banks liquidity. Among the statistically significant factors affecting bank are liquidity, capital adequacy and bank size had a positive impact on financial performance, whereas non-performing loans and short term interest rate had a negative impact on financial performance. Therefore, the impact of bank liquidity on financial performance was non-linear/positive and negative.

Workneh (2015) investigated the impact of liquidity on the performance of eight private commercial banks using multilevel linear regression models. The author employed a quantitative research approach and secondary financial data to evaluate the performance of three banks using return on asset (ROA),

return on equity (ROE), and net interest margin (NIM) metrics. The loan-to-deposit ratio (LDR), loan-to-asset ratio (LAR), and liquid asset-to-deposit ratio (LADR) were utilized by the author to calculate liquidity. The study demonstrates a substantial association between the liquidity measurements of LDR, LAR, and LADR and the performance measure NIM. Although ROA and LADR have a positive and substantial relationship, ROE and LADR have a positive and significant association. Finally, the author concludes that the relationship between liquidity and the financial performance of private commercial banks in Ethiopia is considerable but differs depending on the measure.

The study by Eyob (2019) examined the impact of liquidity risk on the financial performance of commercial banks in Ethiopia from 2007 to 2016. The researchers used secondary data sources and a fixed-effect panel data approach to analyze eight variables that influence bank performance. The study found that the financial performance, as measured by return on equity (ROE), of Ethiopian commercial banks was significantly impacted by liquidity risk. Specifically, the liquidity coverage ratio, net stable funding ratio, loan to deposit ratio, and liquidity ratio (liquid assets / total assets) were all found to have a significant effect on bank ROE. In contrast, the cash reserve ratio, percentage of non-performing loans, consumer price index, and GDP growth rate were found to have a negative but statistically insignificant impact on the financial performance of Ethiopian commercial banks during the study period. The overall conclusion of the study was that liquidity risk was detrimental to the financial performance of commercial banks in Ethiopia over the 2007-2016 time period examined.

Berhanu (2015) studied From 2002/03 to 2013/14, eight commercial banks to look into the factors that affect liquidity and how it affects commercial banks' profitability. Using regression analysis on panel data. According to the study, the ratio of liquid assets to total assets, which is used to evaluate liquidity, has a nonlinear relationship with bank size and loan growth and is statistically significant. The ratio of liquid assets to total assets was significantly impacted linearly by the GDP growth rate, inflation rate, non-performing loans, reserve ratio, and short-term interest rate. However, profitability as assessed by NIM was significantly and linearly impacted by bank size. While the GDP growth rate, the actual reserve rate, and non-performing loans among the variables that determine liquidity had a non-linear relationship and a considerable impact on NIM.

2.7.3 Summary on the Literature Review and Knowledge Gap

This chapter includes a thorough discussion of key theoretical and empirical research on liquidity risk and how it affects bank performance. The main topic has been covered, along with the measurement of liquidity risk and bank performance, bank-specific and macroeconomic performance control variables, and the theory of liquidity and the relationship between liquidity risk and performance. The ability of a bank to fulfill all contractual commitments when they become due is referred to as liquidity. Mobilizing surplus deposits to shortage economic units, or creating liquidity, is one of a commercial bank's primary roles. Liquidity is crucial to the efficient operation of the banking industry and the economy as a whole.

When banks lack sufficient funds, they are unable to accommodate an increase in assets or a decrease in liabilities. This situation is known as a liquidity risk. According to the study, several empirical researches on the impact of liquidity risk on bank performance done in the wake of global financial crises has shown that liquidity is a crucial factor in determining a bank's survival. Many banks failed during the 2008 financial crisis as a result of excessive lending to subprime mortgages and an imbalance between the maturities of assets and liabilities.

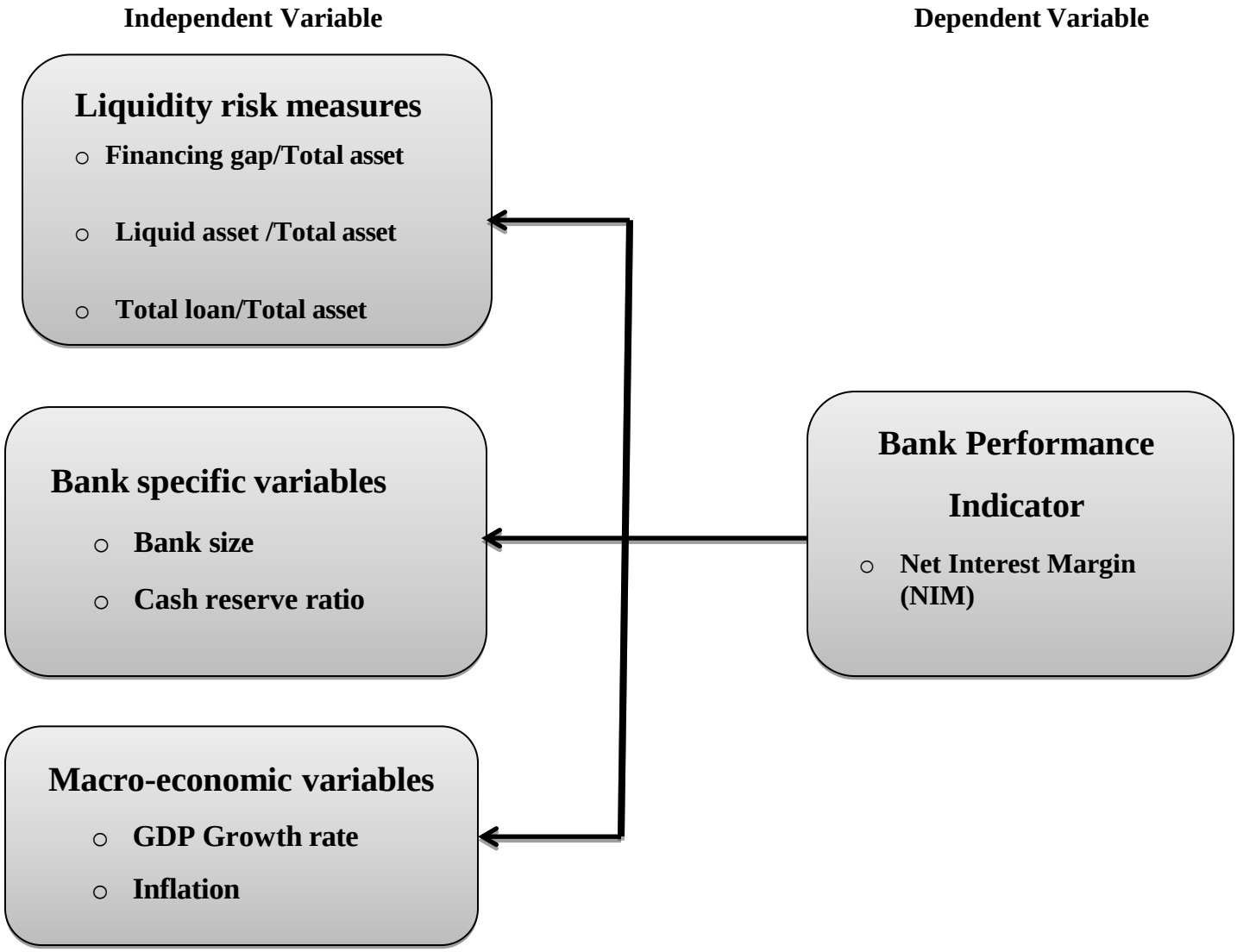
The central bank's standard liquidity ratio was found to be violated by many institutions. During the bank run, those banks took a significant impact. As a result, it is clear that liquidity has a significant impact on the stability and sustainability of the bank.

Numerous researches have been conducted on the topic of liquidity risk and how it affects bank performance; however, the empirical findings were inconsistent. To account for liquidity risk and its impact on the performance of commercial banks in Ethiopia, this study takes use of gaps in the literature. NIM used as a measurement of bank performance by controlling for other factors. As a result, NIM focuses on the bank's traditional borrowing and lending operations, which are appropriate for Ethiopian banks. According to (Tabari, et al 2013) and (Chen, et al 2009), the financial gap ratio is used in this study as an alternative to other methods of measuring liquidity risk.

2.7.4 Conceptual Framework

The conceptual framework presented in the study depicts the interaction between the dependent and independent variables. The dependent variable is the financial performance of Ethiopian commercial banks, as measured by the net interest margin (NIM). Liquidity risk, as determined by the financing gap ratio, the liquid asset to total asset ratio, the total loan to total asset, as well as internal and external factors, would be the independent parameters. The conceptual framework that follows is created to demonstrate how liquidity risk affects the financial performance of Ethiopian commercial banks.

Figure 2.7.4 Conceptual framework



Source: designed by a researcher

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research design and methodology of the study. It provides a full description of the research design, the research variables, and a broad view of the description and selection of the sample and population. The research instruments, data collection techniques, and data analysis procedures have also been outlined in this section.

3.2 Research Design

According to (Cooper & Schindler 2014), Research design is the blueprint for fulfilling research objectives and answering research questions. The primary goal of the study is to examine liquidity risk and how it affects the performance of Ethiopian commercial banks. So, based on the research hypothesiss, both descriptive and explanatory statistics design is used to gain a comprehensive understanding of the data and the relationships between variables..

3.3 Research Approach

The research approach refers to the overall orientation and strategy used to conduct a research study therefore this research employed a quantitative methodology to investigate the relationships and test the proposed hypotheses within the study.

3.4 Sampling Design

3.4.1 Relevant population

The target population for this study consists of all 24 registered and fully operational private commercial banks in Ethiopia. As defined by (Cooper and Schindler 2014), the population refers to the collection of all the elements from which the study aims to draw conclusions.

The sampling frame for this study focused on the private commercial banks in Ethiopia, as the research aimed to examine the effect of liquidity risk on bank performance. Using a non-probability sampling

approach based on the level of capital and years of establishment (as per the NBE annual report 2021/22), 10 banks were selected as the relevant sample from the total target population of 24 registered and fully operational private commercial banks in Ethiopia.

The sample banks included: Awash Bank (AIB), Bank of Abyssinia (BOA), Abay Bank (AB), Bunna Bank (BB), Cooperative Bank of Oromia (COOP), Dashen Bank (DB), Nib International Bank (NIB), Hibret Bank (HB), Wegagen Bank (WB), and Zemen Bank (ZB).

From the total population of private commercial banks in Ethiopia, more than 50% were considered as the sample population for this study. The selected sample banks have been operating in the industry for more than 10 years.

3.5 Source and Methods of Data Collection Procedure

The secondary source was the major way that the data is gathered. The financial statements of commercial banks submitted to the National Bank of Ethiopia between 2013 and 2022 served as the secondary data source for this study. Additionally, scholarly publications and pertinent textbooks were used to aid in the research.

3.6 Data Analysis Methods

The data analysis in this study utilized explanatory statistics in order to establish the relationship between the seven independent variables (financing gap ratio, liquid asset to total asset ratio, total loan to total asset ratio, cash reserve ratio, bank size, GDP growth rate, and inflation rate) and the dependent variable (NIM) representing bank performance. This research used Stata software version 14.2 to conduct the data analysis. Regression analysis techniques were employed to test the study's hypotheses.

3.6.1 Descriptive Statistics

The data analysis will commence with descriptive statistics to summarize the key characteristics of the variables. Measures of central tendency (mean, median, and mode) and measures of variability (standard deviation, variance, minimum, maximum kurtosis and skewness) is calculated to provide an initial overview of the data.

3.6.2 Inferential Statistics

The term "inferential statistics" is also known as "explanatory statistics", and it describes the techniques used to infer information about a population from sample data. To ascertain the type and degree of the association between the two variables in this study, regression, and correlation analysis is used. Regression analysis and correlation analysis are usually employed to assess how well the dependent variable's fluctuation is explained by the regression line.

The study employed a variety of approaches to measure the liquidity risk and bank performance variables. For assessing liquidity risk, this research used bank-specific variables such as total deposits, total loans, liquid assets, total assets, and cash reserve, as well as macroeconomic variables like GDP and inflation. These variables were used to calculate several liquidity risk ratios, including the total loan to total asset ratio, the ratio of financing gap to total asset, the liquid asset to total asset ratio, and the cash reserve ratio. To measure the banks' performance, the study utilized the net interest margin (NIM) as the dependent variable. Therefore, the study's variables are described below.

3.6.2.1 Measurement of Variables

The dependent variable in this study is Net Interest Margin (NIM), which is a measure of the bank's profitability.

Net interest margin (NIM)

The term "net interest margin" (NIM) refers to a comparison between a financial institution's net interest income from credit products like loans and mortgages and the interest payments it makes to holders of savings accounts and certificates of deposit (CDs). The NIM, which is profitability metric expressed as a percentage, provides an approximation of the likelihood that a bank or investment firm would prosper over the long term. This indicator offers transparency into the profitability of a financial services company's interest revenue compared to its interest expenses. This helps potential investors decide whether to invest in the institution. In this study, NIM is used as the dependent variable, as it represents the measure of profitability for the banks being examined.

3.6.2.2 Independent variable

The independent variables in this study include the financing gap ratio, liquid asset to total asset ratio, total loan to total asset ratio, cash reserve ratio, bank size, GDP growth rate, and inflation rate. These variables are being examined to understand their relationship with the dependent variable, which is the net interest margin (NIM) - the measure of bank profitability.

Financing gap measure (FGR)

The financing gap ratio (FGR) is considered a measure of liquidity risk in this model. Previous studies by (Chen, et al 2009 & Tabari, et al 2013) have indicated that banks can measure their liquidity risk exposure by determining the financing gap. Banks with a higher financing gap ratio must use their cash, sell liquid assets, and rely more on external funding to cover this gap, thereby facing greater liquidity risk. Bank managers often view the average core deposit as a stable source of funds that can permanently fund a bank's average loans. The financing gap is defined as the difference between a bank's loans and its core deposits. The first hypothesis **(H1)** of this study is that the financing gap ratio has a negative and significant effect on the performance of commercial banks.

Liquid asset over Total asset ratio (LATA)

In this study, the ratio of liquid assets to total assets (LATA) is used to measure liquidity risk. This ratio shows how well a bank can withstand liquidity shocks. Generally, the higher the LATA ratio, the more liquid the bank is and the better it can absorb a liquidity shock (Vodova, 2013). However, a higher LATA ratio might also be seen as a sign of bank inefficiency, as liquid assets have lower yields and higher opportunity costs. Therefore, it is important for banks to maintain profitability while also ensuring sufficient liquidity. The second hypothesis **(H2)** of this study is that the liquid asset to total asset ratio (LATA) has a positive and significant effect on the financial performance of commercial banks.

Loan to Assets Ratio (TLA)

The total loan to total asset ratio (TLA) is another measure of liquidity risk used in this study. This ratio represents the bank's liquidity in terms of the overall assets owned. It indicates the percentage of the bank's total assets that are tied up in illiquid loans and advances. A greater loan-to-asset ratio suggests the bank has the ability to meet demand, as it indicates how much of the total asset is invested in loans.

However, a higher TLA ratio also means the bank is taking on more risk, which can impact its profitability. At the same time, a higher TLA ratio may also indicate greater potential for profitability for the bank. The third hypothesis **(H3)** of this study is that the loan to asset ratio (TLA) has a positive and significant effect on the financial performance of commercial banks.

Cash reserve ratio (CRR)

According to financial institution supervisory requirements, every commercial bank must maintain a specific minimum amount of deposits as a cash reserve requirement (CRR). The central bank may use the CRR as a tool for monetary policy, adjusting the required reserve levels. Maintaining the required CRR ensures that banks have enough cash on hand to meet customer withdrawal demands. This benefits the bank's operations, as it prevents the bank from running out of cash. However, it is important to note that a higher CRR leads to lower overall liquidity in the financial system, while a lower CRR results in higher system-wide liquidity. The cash reserve ratio at national banks to total deposits serves as a proxy for the cash reserve in this study. The fourth hypothesis **(H4)** is that the cash reserve ratio has a positive and significant effect on the financial performance of commercial banks.

Bank size (SIZE)

In the banking industry, bank size is commonly used to measure the presence of scale economies or diseconomies. If significant economies of scale exist, the cost differences may result in a positive association between bank size and performance (Goddard et al., 2004). Additionally, size is directly tied to a bank's capital sufficiency, as Short (1979) contends, as relatively large banks have the propensity to issue capital at lower costs and so appear to be more profitable. In earlier research, some studies (Altunbaş et al., 2001; Athanasoglou et al., 2006) found scale economies for large banks, while others (Kosmidou et al., 2005; Pasiouras and Kosmidou, 2007) found diseconomies for larger banks. However, according to Eichengreen and Gibson (2001), the impact of a growing bank's size on profitability may be favorable—up to a point. Beyond this threshold, bureaucratic effects of size could be negative. As a result, a non-linear relationship may be anticipated. As in earlier research, it has been utilize the square of the natural logarithm of the total assets of the bank ($SIZE^2$) to represent the non-linear relationship and as a proxy for size. The fifth hypothesis **(H5)** is that bank size has a positive and significant effect on the performance of commercial banks.

Gross domestic product (GDP)

Gross domestic product (GDP) is a key economic indicator that represents the total value of all goods and services produced within a country over a given period, without including inputs used for other outputs. GDP is one of the most crucial economic indicators used by governments and business decision-makers to plan and create policies. It is the primary measure for determining the overall state of the economy. GDP encompasses the production of consumer goods and services, government services, and investment commodities (Hamza & Khan, 2014). As such, GDP is a broad metric that provides insight into the general economic conditions and performance of a country. Given the importance of GDP as a macroeconomic indicator, it is often included in studies analyzing the factors that influence the financial performance of commercial banks. The GDP variable can help capture the impact of broader economic conditions on bank performance.

The literature suggests that greater economic development encourages banks to lend more effectively and allows them to charge higher margins, which can enhance the quality of their assets (Chen et al, 2009). GDP is expected to have a direct impact on deposit availability and customer loan demand, which in turn affects the generation of cash flows and profitability for banks (Sufian & Habibullah, 2010 as cited in Kanwal & Nadeem, 2013). Moreover, favorable economic conditions tend to positively impact the level of financial transactions, allowing well-managed banks to earn more from loans and the sale of securities. Therefore, a positive relationship between economic growth (GDP growth rate) and bank performance is predicted. Based on this rationale, the sixth hypothesis **(H6)** is that the GDP growth rate has a positive and significant effect on the performance of commercial banks.

Inflation

The relationship between inflation and bank performance is ambiguous, as per the literature. According to Perry (1992), the relationship between inflation and performance depends on whether inflation is fully anticipated by the bank's management. If inflation is fully anticipated, banks can appropriately adjust their interest rates to increase revenues faster than costs, leading to higher economic profits. In this case, the impact of inflation on bank performance would be positive.

However, if inflation is unanticipated, banks may be slow in adjusting their interest rates. This can result in a faster increase in bank costs than revenues, which would have a negative impact on bank profitability. Therefore, the effect of inflation on bank performance can be positive or negative,

depending on whether the inflation is fully anticipated by bank management or not. This ambiguity in the relationship between inflation and bank performance is an important consideration in the analysis. Most studies found a positive relationship between inflation and bank profitability (e.g. Bourke, 1989; Kosmidou et al., 2005; Athanasoglou et al., 2006; Pasiouras and Kosmidou, 2007; Athanasoglou et al., 2008). However, Kosmidou (2008) found a negative relationship. Besides, Huybens and Smith (1999) develop a theoretical model in which interest margins tend to rise in the presence of inflation. Empirical studies found that inflation has positive effect on bank's NIM (e.g. Demirgüç-Kunt and Huizinga, 1999; Kosmidou et al., 2005). Therefore, hypothesis **(H7)** GDP growth rate has positive and significant effect on performance of commercial banks.

Table 3.1. Summary of independent variable and their expected result on dependent variable

Independent Variable	Definitions	Expected result
Financing gap ratio	Financial gap is defined as the difference between loan and bank's core deposits.	Negative and Significant
Liquid asset holding	The ratio of liquid assets to total assets evaluates a bank's capacity to withstand fluctuations in liquidity. A high ratio indicates a strong capacity for shock absorption	Positive and significant
Loan to asset ratio	It represents the portion of total asset tied up in the illiquid loans. Higher the ratio lesser liquid the bank.	Positive and Significant
Cash reserve ratio	The ratio of cash reserve held on NBE on total deposit	Positive and significant
Bank Size	the square of the natural logarithm of the total assets of the bank	Positive and Significant
GDP growth rate	Growth rate of real GDP	Positive and Significant
Inflation	Measured by Customer index price	Positive and Significant

3.7. Model specification

This study utilized a panel data or longitudinal data model because the dataset combined both time-series and cross-sectional elements. Using panel data offers several advantages, as noted by (Brook, 2008). One key benefit is that panel data covers a wider range of topics and can help address more complex problems compared to using only time-series or cross-sectional data.

As had been demonstrated, employing panel data can help mitigate the biases that may arise from omitted variables in the regression analysis. The panel data structure allows for a more appropriate specification of the regression model, which is represented by the equation provided.

In summary, these researches use a panel data approach because the dataset contained both temporal and cross-sectional dimensions. This type of data structure provides greater flexibility and the ability to better control for unobserved factors that could impact the regression findings, compared to relying solely on time-series or cross-sectional data.

The regression equation takes the following form:

$$y_{it} = \alpha + \beta' x_{it} + u_{it}$$

Where:

y_{it} = the explained/dependent variable for individual i at time t

α = the intercept parameter

β = a vector of q regression coefficients (parameters) associated with the independent variables

x_{it} = a vector of q independent variables for individual i at time t

u_{it} = the error term representing unobserved factors for individual i at time t

The key components are:

- y_{it}: The dependent variable being explained or predicted
- x_{it}: The independent variables or predictors
- α: The intercept or constant term
- β: The coefficients/parameters associated with the independent variables
- u_{it}: The error term capturing the unexplained variation

This linear regression model is a common framework used to analyze the relationship between the dependent variable and the set of independent variables, while accounting for the error term. The subscripts i and t indicate that the data has both cross-sectional (i) and time series (t) dimensions, meaning it is a panel or longitudinal dataset.

To investigate the link between bank liquidity and bank performance, the study will employ a multiple regression model. The econometric equation for this model can be specified as:

$Y\_it = \beta0 + \beta1X\_it + \beta2X\_it + \beta3X\_it + \ldots + \beta nX\_it + u\_it$

In this equation, the dependent variable Net Interest Margin represents the performance of the bank at a given time period. The key independent variable is Financing Gap Ratio, which captures the liquidity position of the bank. The coefficient β1 will estimate the relationship between bank liquidity and bank performance.

Additionally, the model includes several other independent variables denoted as X2, X3, ..., Xn. These variables represent other factors, such as bank-specific, and macroeconomic variables, that may also influence bank performance. The corresponding coefficients β2 through βn will quantify the effects of these additional explanatory variables.

Lastly, the Error term accounts for any unobserved factors that may affect the dependent variable but are not explicitly included in the model. The primary focus of the analysis is on the sign and statistical significance of the coefficient β1, as this will indicate the nature and strength of the relationship between bank liquidity and bank performance, after controlling for the other explanatory variables.

$$\mathbf{NIMit = \beta0 + \beta1(FGRit) + \beta2(LATAit) + \beta3(TLAit) + \beta4(CRRit) + \beta5(SIZEit) + \beta6(GDPit) + \beta7(INFit) + uit}$$

Where:

NIMit = Net Interest Margin, which is the dependent variable representing the performance of bank i at time t.

β0 = the constant or intercept term.

β1 to β7 = the coefficients associated with the independent variables, which represent:

- β1: Financing Gap Ratio (FGR)
- β2: Liquid Assets to Total Assets ratio (LATA)
- β3: Total Loans to Total Assets ratio (TLA)
- β4: Cash Reserve Ratio (CRR)
- β5: Bank Size (SIZE)
- β6: Gross Domestic Product growth rate (GDP)
- β7: Inflation rate (INF)

These coefficients will indicate the direction and magnitude of the relationship between each independent variable and the dependent variable NIM, after controlling for the other factors in the model.

uit = the error term, which captures the unobserved factors that may affect NIM but are not included in the model.

The goal is to estimate these coefficients and assess their statistical significance to understand how the various bank-specific and macroeconomic factors impact the net interest margin (NIM) of banks.

$$\textbf{NIM} = \frac{\textit{Interest Income} - \textit{Interest Expense}}{\textit{Average Earning Asset}}$$

FGR it = the Financing Gap Ratio (FGRit) is defined as the ratio of the financing gap for bank i at time t. The financing gap is calculated as the difference between a bank's loans and its customer deposits.

Mathematically, the Financing Gap Ratio is represented as:

$$\textbf{FGR} = \frac{\textit{Financing Gap}}{\textit{Total asset}}$$

Or Financing Gap Ratio = (Loans - Customer Deposits) / Total Assets

LATAR it = Liquid Assets to Total Assets Ratio is defined as the ratio of total liquid assets to total

assets for bank i at time t.

Mathematically, the LATAR is represented as:

$$\textbf{LATAR}=\frac{\boldsymbol{Liquid\ Asset}}{\boldsymbol{Total\ Asset}}$$

TLAit = The Total Loans to Total Assets Ratio is defined as the ratio of total loans to total assets for bank i at time t.

Mathematically, the TLA is represented as:

$$\textbf{TLA}=\frac{\boldsymbol{Total\ Loan}}{\boldsymbol{Total\ Asset}}$$

CRR it = The Cash Reserve Ratio is defined as the percentage of cash reserves that bank i is required to hold at time t, compared to its total deposits.

Mathematically, the CRR is represented as:

$$\textbf{CRR}=\frac{\boldsymbol{Cash\ Reserves}}{\boldsymbol{Total\ Deposits}}\times\mathbf{100}$$

SIZEit = The Size (SIZEit) of bank i at time t is represented by the natural logarithm of the bank's total assets.

Mathematically, the SIZE variable is calculated as:

$$\textbf{Size = ln(Total Asset)}$$

GDPt= GDP growth rate is a measure of the percentage change in the Gross Domestic Product at time t.

INFt = The inflation rate (INFt) is a measure of the change in the Consumer Price Index (CPI) at time t.

CHAPTER FOUR
DATA ANALYSIS AND DISCUSSION OF RESULTS

This chapter examines the effect of liquidity risk on the performance of banks. It is divided into three main sections. The first section contains a descriptive analysis of the study variables, including their means, standard deviations, and a correlation analysis to explore the relationships between the different factors. The second part focuses on testing the underlying assumptions of the classical linear regression model, ensuring the validity and reliability of the statistical techniques used. Finally, the third section presents the results of the regression analysis and provides a thorough discussion of the key findings, interpreting the significance and implications of the relationship between liquidity risk and bank performance.

4.1 Descriptive statistics

Table 4.1 descriptive statistics of explained and explanatory variables

Variable	Obs	Mean	Std.Dev.	Min	Max
NIM	100	5.779	1.73	1.82	9.33
FGR	100	-0.236	0.0862	-0.408	-0.0391
LATAR	100	19.54	7.627	4.36	52.41
TLA	100	0.547	0.0922	0.324	0.758
CRR	100	8.245	3.786	0.533	19.47
Size	100	4.329	0.416	3.29	5.263
GDP	100	7.42	0.901	6.1	8.5
Inflation	100	8.92	4.521	2.1	18.5

Table 4.1 presents the descriptive statistics for the variables used in the study. The dependent variable is Net Interest Margin (NIM), which is the variable being explained. The independent variables include the loan to total asset ratio, financing gap ratio, liquid asset to total asset ratio, cash reserve ratio, bank size (measured by the natural logarithm of total assets), GDP growth rate, and inflation rate.

For each of these variables, the table provides the mean, minimum value, maximum value, standard deviation, and the total number of observations. This descriptive information gives an overview of the characteristics and distribution of the variables included in the regression analysis examining the effect of these factors on the banks' net interest margin performance.

As indicated in the above table that the total number of observations for each variable is 100. NIM has a mean of 5.78% which implies that, on average, Ethiopian commercial banks generate a profit of 0.0578 birr for every 1 birr in assets. This means that for every 100 birr in assets, banks earn an average profit of 5.78 birr and the standard deviation of 1.73% indicates that there is a moderate dispersion in the NIM values across banks. In other words, there is some variation in the profitability of different banks. The highest and lowest value of NIM was 1.82 and 9.33 respectively. The minimum NIM of 1.82% and the maximum NIM of 9.33% show the range of profitability across banks. The highest NIM of 9.33% was achieved by Hibret Bank (HB) in 2022. This suggests that HB was the most profitable bank among the ones included in this data in that year.

The mean value of the financing gap ratio is -0.24%. This suggests that, on average, the bank had a negative financing gap, indicating that customer deposits exceeded the bank's loans. This indicates that the bank had excess funds available for lending. The standard deviation of 0.0862% measures the dispersion or variability of the financing gap ratio values around the mean. A higher standard deviation suggests greater variability in the financing gap ratio, indicating that the bank's financing needs may fluctuate over time. The minimum value of the financing gap ratio is -0.41%. This indicates the lowest observed financing gap ratio during the given period. It suggests that, at its lowest point, the bank had a negative financing gap of 0.41%, meaning that customer deposits significantly exceeded the bank's loans. The maximum value of the financing gap ratio is -0.0391%. This represents the highest observed financing gap ratio during the given period. It indicates that, at its highest point, the bank had a negative financing gap of 0.0391%, implying a relatively smaller difference between loans and customer deposits.

Liquid assets holdings are shown to has a mean 19.54% This indicates that, on average, Ethiopian commercial banks hold 19.54% of their total assets in liquid form. This means that for every 100 birr in total assets, 19.54 birr are readily convertible into cash. And standard deviation is 7.63% this suggests a moderate dispersion in the LATAR values across banks. In other words, there is some variation in the proportion of liquid assets held by different banks. The minimum and maximum values for liquid assets holdings are 4.36% and 52.41%. This shows that the lowest and highest proportion of liquid assets held by any bank in the sample is 4.36% and 52.41% respectively.

Total loan to total asset ratio has a mean of 0.55% this implies that, on average, Ethiopian commercial banks in this sample have 0.55% of their total assets invested in loans. In other words, for every 100 birr in total assets, 0.55 birr are dedicated to loans this suggests that, on average, Ethiopian commercial banks in this sample have a moderate focus on lending activities. This means that a significant portion of their assets is dedicated to providing loans to borrowers. The standard deviation is 0.1% this suggests a relatively low dispersion in the TLA values across banks. This means that most banks have a TLA close to the average of 0.55% this low standard deviation indicates that the proportion of assets invested in loans is fairly consistent across most banks in the sample. However, there are still some variations, with some banks focusing more heavily on loans than others. The minimum value for total loan to total asset is 0.32% while the maximum value was 0.76% which implies that on average the lowest and highest proportion of assets invested in loans by any bank in the sample is 0.32% and0.76% respectively. The relatively low minimum and maximum TLA values compared to the mean suggest that most banks in the sample fall within a narrow range in terms of their loan exposure. This could be due to factors such as regulatory requirements or risk management strategies.

The Mean of CRR of 8.245% indicates that, on average, Ethiopian commercial banks hold 8.25% of their cash reserves at the National Bank of Ethiopia (NBE). The standard deviation of 3.786% shows that there is some variability in this ratio across different banks, with some holding closer to the minimum requirement (5%) and others holding more. The minimum CRR of 0.533% is indeed lower than the standard requirement of 5%, suggesting that there might be exceptional circumstances where banks can temporarily dip below the minimum. The maximum

value of 19.47% highlights the significant range in CRR across banks, with some holding nearly four times the required amount.

The mean value of Cash reserve ratio is 4.33% suggests that, on average, the size of commercial banks, as measured by the metric used, is approximately 4.33%. This represents the average scale or magnitude of the banks' operations or assets. The standard deviation of 0.42% indicates the dispersion or variability of bank sizes around the mean. With a moderate standard deviation, it implies that the sizes of commercial banks tend to vary moderately from the average. This suggests that there is some diversity in bank sizes within the dataset. The minimum value of 3.29% represents the smallest observed bank size in the dataset. This suggests that there are commercial banks with relatively smaller sizes, indicating a lower scale of operations or assets compared to other banks in the dataset.The maximum value of 5.263% represents the largest observed bank size in the dataset. This indicates that there are commercial banks with relatively larger sizes, signifying a higher scale of operations or assets compared to other banks in the dataset.

The mean value of GDP growth rate is 7.42% indicates that, on average, Ethiopia's GDP grew by 7.42% each year over the past ten years. This is a high average growth rate, suggesting a period of significant economic expansion. The standard deviation of 0.901% shows that there was some variability in the growth rate across the ten years. While the average was high, some years experienced faster growth than others. Minimum and maximum values: The minimum value of 6.1% and the maximum value of 8.5% highlight the range of growth rates observed. This range is relatively narrow, suggesting that economic performance was generally stable during the past decade.

Inflation has a Mean value of 8.92% indicates the average annual inflation rate over the past ten years. This is a relatively high average, suggesting sustained price increases across the economy. Standard deviation is 4.521% reveals the substantial variability in inflation rates from year to year. This means that while the average was high, some years witnessed significantly lower or higher inflation compared to the average. the Minimum and maximum values is 2.1% and 18.5% highlight the wide range of inflation rates observed within the data set. This indicates that inflation has not been stable or predictable, with both periods of relative price stability and significant spikes in price increases.

4.2 Correlation Analysis

This research employed correlation analysis to examine the strength and direction of the relationships between the dependent variable (Net Interest Margin) and the various explanatory variables in the study. The most common type of correlation used was Pearson's correlation coefficient, which measures the linear association between continuous variables.

Specifically, the researchers conducted a Pearson product-moment correlation analysis to assess the relationships between the independent and dependent variables. The Pearson correlation coefficient provides a measure of the linkage between the observed and predicted variables, with values ranging from -1 to +1.

A correlation coefficient of +1 indicates a perfect positive relationship between two variables, while a coefficient of -1 suggests a perfect negative correlation. Conversely, a correlation coefficient of 0 means there is no linear relationship between the variables. Positive correlation coefficients signify a direct association, while negative values represent an inverse relationship.

The results of this correlation analysis are presented in the following matrix, providing insights into the direction and strength of the relationships among the variables in the study.

Table 4.2. Correlation Matrix between Dependent and Independent Variables

(obs=100)								
	NIM	FGR	LATAR	TLA	CRR	Size	GDP	Inflat~n
NIM	1							
FGR	0.503	1						
LATAR	-0.559	-0.687	1					
TLA	0.506	0.899	-0.77	1				
CRR	-0.314	-0.375	0.458	-0.483	1			
Size	0.295	0.599	-0.617	0.759	-0.422	1		
GDP	-0.213	-0.463	0.166	-0.507	-0.0042	-0.351	1	
Inflation	0.0501	0.104	-0.0495	0.108	0.0532	0.117	0.237	1

From the finding in the table above, the study found that there was **Net Interest Margin (NIM)** has positively correlated with **Financing Gap Ratio (FGR)** with a correlation coefficient of

0.503. Banks with a higher net financing gap (meaning they borrow more than they deposit) tend to have higher NIMs. **Liquid asset to total asset ratio** was negatively correlated with Net Interest Margin with a correlation coefficient of -0.559. Banks with a higher loan-to-asset ratio (meaning they allocate more assets to loans) tend to have lower NIMs.

Total Loan to Total Assets (TLA) positively correlated with Net Interest Margin a correlation coefficient of 0.506. This correlation suggests that banks with a higher proportion of assets allocated to loans tend to have higher NIMs. **Cash Reserve Ratio (CRR)** negatively correlated with Net Interest Margin a correlation coefficient of -0.314. Banks with higher cash reserve ratios (meaning they hold more cash at the central bank) tend to have lower NIMs. This is because holding reserves generates no income, effectively reducing the bank's earning potential.

Bank Size has a positively correlated with Net Interest Margin a correlation coefficient of 0.295. Larger banks tend to have slightly higher NIMs. This could be due to economies of scale, better access to funding sources, or diversification benefits.

The macroeconomic factor **GDP growth rate** has negatively correlated with Net Interest Margin a correlation coefficient of -0.213. A negative correlation with GDP suggests that higher economic growth might be associated with slightly lower NIMs for the banks. This could be due to factors like increased competition or lower lending needs as businesses access other financing options. **Inflation** has a weakly positively correlated with Net Interest Margin a correlation coefficient of 0.0501. This weak correlation suggests that inflation has little to no significant impact on the NIMs of the banks.

4.3 Testing assumptions of CLRM

The study employed the Classical Linear Regression Model (CLRM) and the Ordinary Least Squares (OLS) estimation technique to analyze the relationship between the variables. However, the CLRM is based on several underlying assumptions that must be satisfied for the regression estimates to be unbiased, efficient, and valid.

Before conducting the regression analysis, the researchers thoroughly tested the model to ensure it met the key assumptions of the CLRM. This involved examining the data to verify that it adhered to the required conditions, such as linearity, homoscedasticity, normality, and absence of multicollinearity.

Validating these classical linear regression assumptions is crucial, as the OLS estimation method can only provide the best and most reliable results when these assumptions are upheld. The researchers carefully assessed the data and the model specifications to confirm that the necessary assumptions were met, ensuring the validity and reliability of the subsequent regression analysis and interpretation of the findings.

By thoroughly testing the CLRM assumptions, the study established the appropriate conditions for employing the OLS technique and generating unbiased, efficient, and statistically valid estimates of the relationships between the variables of interest.

4.3.1 Zero Conditional Mean

A key assumption of the Classical Linear Regression Model is that the average or expected value of the error term is zero, given the independent variables. This means the errors are not systematically related to the explanatory variables in the model (Brook ,2008).

For the regression to provide unbiased estimates, it is crucial that the mean value of the error term equals zero. Importantly, when a constant term is included in the regression equation, as was the case in this study, this assumption is always satisfied.

Without an intercept in the model, if the average error was non-zero, it could lead to biased and inconsistent estimates. However, since the regression equation used in this analysis did include a constant term, the researchers expected the mean of the error term to be zero, meeting this key assumption of the CLRM.

Verifying that the mean of the error term is zero ensures the regression model produces unbiased estimates of the relationships between the dependent variable and the explanatory variables.

4.3.2 No heteroskedasticity (Homoscedasticity)

A key assumption of the Classical Linear Regression Model (CLRM) is that the error terms have constant variance, a condition referred to as homoscedasticity (Brooks, 2008). Homoscedasticity means the spread or dispersion of the residuals is the same across all levels of the independent variables.Conversely, heteroscedasticity describes a violation of this assumption, where the error variance is not constant. In such cases, the error terms would have varying degrees of dispersion depending on the values of the predictors.

To examine whether the homoscedasticity assumption held for the regression model, the researchers employed the Breusch-Pagan test. This statistical test was used to check for the presence of heteroscedasticity across the set of independent variables included in the analysis. By conducting the Breusch-Pagan test, the study was able to verify whether the error terms had constant variance, as required by the CLRM. Confirming the homoscedasticity of the errors was an important step in ensuring the validity and reliability of the regression results.

Table 4.3.2 Heteroscedasticity test using Breusch-Pagan test

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

         chi2(1)      =     0.92
         Prob > chi2  =   0.3387
```

The Breusch-Pagan test or Cook-Weisberg test is commonly used to test for heteroscedasticity in a regression model. The null hypothesis (Ho) of the test is that there is constant variance (homoscedasticity) in the error term.

In the output that provided in table 4.3, the test statistic for the Breusch-Pagan test is chi2(1) = 0.920, and the associated p-value is Prob>chi2 = 0.339.

Interpreting the results, since the p-value (0.339) is greater than the significance level (commonly set at 0.05), we fail to reject the null hypothesis. This suggests that there is no

significant evidence of heteroscedasticity in the regression model. Therefore, based on the Breusch-Pagan test, the assumption of constant variance in the error term (homoscedasticity) is supported in this study.

4.3.3 Multicollinearity Test

Multicollinearity occurs when two or more independent variables in a regression model are highly correlated with each other. This can lead to several problems, including Increased variance of coefficient estimates It becomes difficult to isolate the individual effects of each variable on the dependent variable. Unreliable coefficient signs and magnitudes: Signs and sizes of coefficients might become unstable and hard to interpret. Reduced model accuracy and prediction power: The model might not accurately capture the relationships between variables, leading to poor predictions. Therefore, it's crucial to test for multicollinearity before drawing conclusions from a regression analysis.

An implicit assumption of the Ordinary Least Squares (OLS) estimation method is that the explanatory variables in the regression model are not correlated with one another. If the variables are uncorrelated or "orthogonal", adding or removing a variable would not change the coefficients of the other variables (Brooks, 2008).

In practice, the explanatory variables will generally have some degree of association, though this mild correlation is usually not problematic. However, a more serious issue arises when the explanatory variables are very highly correlated, which is known as multicollinearity.

Two types of multicollinearity can be distinguished: perfect multicollinearity, where there is an exact linear relationship between variables, and near multicollinearity, where the variables are highly but not perfectly correlated.

To test for the presence and severity of multicollinearity, this study examined:

- Variance Inflation Factors (VIFs) of the explanatory variables
- Correlation coefficients (CCs) between the explanatory variables
- Condition index (CI) values

Analyzing these multicollinearity diagnostics allowed the researchers to assess whether the degree of correlation between the independent variables was problematic for the regression analysis.

To test for the presence of multicollinearity in a regression model, the study utilized the Variance Inflation Factor (VIF). The VIF measures the extent to which the variance of an estimated regression coefficient is inflated due to multicollinearity. A higher VIF value indicates a stronger correlation between the independent variable in question and other independent variables in the model.

By calculating the VIF for each independent variable, the study assessed the level of multicollinearity present in the regression model. A VIF value greater than 1 suggests some degree of multicollinearity, with higher values indicating stronger multicollinearity. As a rule of thumb, VIF values above 5 or 10 are often considered indicative of high multicollinearity.

Table 4.3.3.1 Summery of VIF of explanatory variables

Variable	VIF	1/VIF
TLA	13.15	0.076043
FGR	5.80	0.172271
LATAR	3.13	0.319332
Size	2.62	0.381951
GDP	2.24	0.445608
CRR	1.62	0.617045
Inflation	1.30	0.767040
Mean VIF	4.27	

In this study, the average VIF was reported to be 4.270. Since this value is below the threshold of 5, it suggests that multicollinearity was not a significant concern with the given dataset. However, it's important to note that individual variables may still have higher VIF values, indicating some degree of multicollinearity. Therefore, it is recommended to examine the VIF values for each independent variable to identify potential multicollinearity issues at the variable level.

Table 4.3.3.2 Correlation Matrix between Explanatory variables

(obs=100)							
	FGR	LATAR	TLA	CRR	Size	GDP	Inflat~n
FGR	1						
LATAR	-0.687	1					
TLA	0.899	-0.77	1				
CRR	-0.375	0.458	-0.483	1			
Size	0.599	-0.617	0.759	-0.422	1		
GDP	-0.463	0.166	-0.507	-0.0042	-0.351	1	
Inflation	0.104	-0.0495	0.108	0.0532	0.117	0.237	1

The study used the Pearson correlation method to examine the correlations among the explanatory variables, as presented in **Table 4.3.3.2**. Based on the information in this table, it appears that none of the correlation coefficients between any pair of explanatory variables exceeded 0.90. Since there were no correlations above the 0.90 threshold, this suggests that there is no extremely high correlation, or severe multicollinearity, among the explanatory variables included in the regression model.

Therefore, based on the correlation analysis results, the study concluded that multicollinearity does not appear to be a significant concern or issue that would undermine the validity of the regression analysis. The absence of very high correlations among the predictors indicates the multicollinearity assumption was likely satisfied.

4.3.4 Normality Test (ut ~N (0, σ2)

One of the commonly used tests for normality of the residuals is the Bera-Jarque test (Brooks, 2008). If the residuals are normally distributed, the histogram should have a bell-shaped appearance and the Bera-Jarque statistic should not be statistically significant.

Specifically, for the residuals to be considered normally distributed, the p-value associated with the Bera-Jarque test should be greater than 0.05. This would mean failing to reject the null hypothesis that the residuals are normally distributed at the 5% significance level.

The Bera-Jarque test formalizes the assessment of normality by evaluating whether the skewness and kurtosis coefficients of the residual distribution are approximately 0 and 3 respectively. Skewness measures the asymmetry of the distribution, while kurtosis indicates how heavy the tails of the distribution are.

The hypotheses for the normality test were formulated as:

H0: The residuals are normally distributed
H1: The residuals are not normally distributed

By conducting this Bera-Jarque normality test, the study was able to evaluate whether the key assumption of normally distributed errors was satisfied in the regression analysis.

Table 4.3.4 Summary of normality test: Bera—Jarque

Skewness/Kurtosis tests for Normality					
Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
uhat	100	0.6096	0.5288	0.67	0.7158

As per the above table 4.3.4. both the Skewness and Kurtosis p-values are above 0.05, with values of 0.6096 and 0.5288, respectively. This suggests that the data is consistent with a normal distribution, as there is no strong evidence to suggest otherwise. Additionally, the adjusted chi-square statistic is 0.67, with a corresponding p-value of 0.7158. Since this p-value is also greater than 0.05, we do not have sufficient evidence to reject the null hypothesis of normality based on this statistic.

In summary, the test results indicate that the residuals or data are normally distributed. The Jarque-Bera test's p-value of 0.716 suggests no evidence for the presence of abnormality in the data. Therefore, we fail to reject the null hypothesis that the data is normally distributed, as the p-value exceeds 0.05.

4.4. Model Selection (Random Effect versus Fixed Effect Models)

In panel data analysis, there are two main categories of estimator techniques - fixed effects models and random effects models (Brooks, 2008). Fixed effects models allow the intercept term to vary across cross-sectional units, while keeping the slope coefficients constant across both the cross-sectional and time dimensions. This means the regression model's intercept can differ for each cross-sectional entity, but the slope estimates are the same.

In contrast, random effects models assume distinct intercept terms for each entity, but these intercepts are treated as random variables rather than fixed parameters. The intercepts are also assumed to remain constant over time under the random effects approach. Similar to fixed effects, the slope coefficients are assumed constant across cross-sections and time periods.

Selecting the appropriate model - fixed effects or random effects - is a key challenge for researchers, as noted by (Gujarati and Porter 2009). To determine whether the fixed effects or random effects model is more suitable, this study employed the Hausman test. The Hausman test evaluates the null hypothesis that the random effects model is appropriate against the alternative hypothesis that the fixed effects model is more suitable.

The hypotheses for the Hausman test were formulated as:

H0: The random effects model is appropriate
H1: The fixed effects model is appropriate

The results of the Hausman test would then guide the selection of the fixed effects or random effects estimation approach for the panel data analysis.

Table 4.4 Hausman Test (Choosing Random effect (RE) versus fixed effect (FE) models)

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
FGR	4.823016	4.762052	.0609634	.
LATAR	-.0103942	-.0151015	.0047073	.
TLA	.1685252	.3546308	-.1861057	.
CRR	-.008324	-.0111693	.0028453	.
Size	.71876	.5736792	.1450808	.0376349
GDP	-.0601469	-.0720498	.0119029	.
Inflation	.0037925	.005363	-.0015705	.

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(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 2.51
Prob>chi2 = 0.9262
(V_b-V_B is not positive definite)

The Hausman test conducted in the study had a p-value of 0.9262, which is greater than the 0.05 significance level. Since the p-value is greater than 0.05, this means the null hypothesis of the Hausman test cannot be rejected at the 5% significance level.

The null hypothesis for the Hausman test was that the random effects model is appropriate. Therefore, with a p-value of 0.9262, which is greater than 0.05, the study concludes that the random effects model is more appropriate than the fixed effects model for this analysis.

In other words, the alternative hypothesis of the fixed effects model being appropriate is rejected at the 0.05 significance level. The results of the Hausman test indicate that the random effects model should be used for the panel data analysis, as it is the more suitable model compared to the fixed effects approach.

4.5. Multiple Regression Analysis

Table 4.5: random effect model regression results

```
. xtreg NIM FGR  LATAR  TLA CRR Size  GDP Inflation, re

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

R-sq:                                           Obs per group:
     within  = 0.5805                                         min =          10
     between = 0.1874                                         avg =        10.0
     overall = 0.2598                                         max =          10

                                                Wald chi2(7)      =      109.15
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =      0.0000
```

NIM	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
FGR	4.762052	2.261558	2.11	0.035	.3294804	9.194625
LATAR	-.0151015	.0198618	-0.76	0.447	-.0540299	.0238268
TLA	.3546308	3.494907	0.10	0.919	-6.495261	7.204523
CRR	-.0111693	.0255599	-0.44	0.662	-.0612658	.0389272
Size	.5736792	.4507887	1.27	0.203	-.3098504	1.457209
GDP	-.0720498	.1191144	-0.60	0.545	-.3055097	.1614101
Inflation	.005363	.0175856	0.30	0.760	-.0291041	.0398301
_cons	5.100031	2.752354	1.85	0.064	-.2944836	10.49455
sigma_u	1.0655804					
sigma_e	.65532051					
rho	.72557788	(fraction of variance due to u_i)				

The xtreg results provided indicate a random-effects generalized least squares (GLS) regression analysis. Here is the interpretation:

The regression model aims to explain the variation in the dependent variable NIM (Net Interest Margin) using the independent variables FGR, LATAR, TLA, CRR, Size, GDP, and Inflation. The analysis includes 100 observations grouped into 10 different groups based on the bankID variable.

The R-squared values provide information about the proportion of variance explained by the model. In this case, the within-group R-squared is 0.5805, indicating that approximately 58.05% of the variation in NIM is explained by the independent variables within each group.

The between-group R-squared is 0.1874, suggesting that around 18.74% of the variation occurs between the different groups. The overall R-squared is 0.2598, which represents the proportion of total variation in NIM explained by the independent variables.
The Wald chi-squared test statistic of 109.15 with 7 degrees of freedom indicates that the model is statistically significant overall (Prob > chi2 = 0.0000).

4.6 Discussion of regression results

The results of the Regression output provide insights into the relationship between various independent variables and the net interest margin (NIM). The coefficients of each independent variable and their statistical significance levels are examined to understand their impact on NIM.
Starting with the variable FGR (Financing Gap Ratio), the coefficient of 4.762052 is statistically significant at the 0.035 level. This indicates a positive effect on NIM. Holding other variables constant, a one-unit increase in FGR is associated with an approximate 4.76 unit increase in NIM. This aligns with some studies (e.g., Chen et al., 2009) that posit a diversified income stream (reflected by a higher FGR) can help banks mitigate risk, potentially leading to higher profitability.

Moving on to LATAR (Liquid asset to total asset ratio), the coefficient of -0.0151015 suggests a negative relationship with NIM. However, this coefficient is not statistically significant at the conventional significance level of 0.05 (p-value = 0.447). Therefore, we cannot conclude that LATAR has a significant effect on NIM. While a higher Liquid Asset to Total Asset Ratio (LATAR) might indicate better liquidity management, studies like (Arif and Anees 2012) suggest a potential negative association with profitability in some contexts.

This inconclusive finding for LATAR could be due to limitations like sample size or require further exploration through alternative model specifications. Additionally, bank-specific factors like liquidity risk management strategies might influence how LATAR translates into profitability. This result could be attributed to the specific liquidity risk management strategies employed by banks in the Ethiopian context, as highlighted by (Beck et al. 2003).

Next, the coefficient for TLA (Total Loan to Assets) is 0.3546308. However, it is not statistically significant (p-value = 0.919), indicating no significant effect on NIM. Similarly, the coefficient for CRR (Cash Reserve Ratio) is -0.0111693, but it is not statistically significant (p-value = 0.662), suggesting no significant effect on NIM. The coefficient for Bank Size is 0.5736792, but it is not statistically significant (p-value = 0.203), indicating no significant effect on NIM. This results warrant for further discussion. While a higher TLA (more loans) could increase liquidity risk (potentially impacting profitability), the Ethiopian banking context or model specification might require further investigation. Likewise, the potential trade-off between CRR (liquidity) and the performance needs to be examined within the specific regulatory environment. This could be due to the unique regulatory environment, market dynamics, or other bank-specific factors that influence the profitability-liquidity relationship, as discussed in studies by (Demirgüç-Kunt and Huizinga, 1999) and (Berger and Bouwman, 2009).

The coefficient for GDP (Gross Domestic Product) is -0.0720498, but it is not statistically significant (p-value = 0.545), suggesting no significant effect on NIM. Likewise, the coefficient for Inflation is 0.005363, but it is not statistically significant (p-value = 0.760), suggesting no significant effect on NIM. The constant term (intercept) has a value of 5.100031 and is marginally statistically significant at the 0.064 level. Studies by (Demirgüç-Kunt and Huizinga 1999) and (Albertazzi and Gambacorta, 2009) suggest that the influence of macroeconomic factors on bank profitability can vary across different economic and institutional environments.

Additionally, the estimated random effects model suggests that 72.56% of the total variance in NIM can be attributed to unobserved group-level heterogeneity (ui). The estimated standard deviations of the random effects are sigma_u = 1.0655804, representing the variability within groups, and sigma_e = 0.65532051, representing the residual variability. The high unexplained variance (72.56%) in our model suggests significant group-level differences in NIM between bank groups that are not captured by the current model. This aligns with the existing literature by (Beck et al. 2003) highlighting that bank-specific factors like risk management practices can influence performance. Liquidity risk management strategies might vary between bank groups, contributing to the unexplained variance in our study.

In summary, based on the Regression output, we find that FGR has a statistically significant positive effect on NIM. However, LATAR, TLA, CRR, Size, GDP, and Inflation do not have statistically significant effects on NIM. The intercept term is marginally significant. The estimated random effects model suggests that a significant portion of the variance in NIM can be attributed to unobserved group-level heterogeneity. The high unexplained variance points towards the importance of bank-specific factors, particularly liquidity risk management strategies.

CHAPTER FIVE
SUMMARY OF MAJOR FINDINGS AND RECOMMENDATIONS

This chapter summarizes the key findings of the study and provides recommendations based on those findings, in contrast to the previous chapter which focused on the data analysis and discussion of the results. The chapter is divided into two main sections - a summary of the major findings, and a section dedicated to providing recommendations.

5.1 Summary of findings

As explained in the study's previous chapter, banks play a crucial role in any economy by engaging in maturity transformation, converting short-term deposits into long-term loans. This fundamental function exposes banks to liquidity risk, which can arise from both internal and external factors. This study's goal was to find out how liquidity risk affects bank performance by concentrating on factors that contribute to liquidity risk.

In this study, a sample of ten commercial banks operating in Ethiopia was selected based on their performance and years of establishment. The study focused on analyzing the impact of seven selected variables on the financial performance of these Ethiopian commercial banks. Panel data analysis was conducted using data from the years 2013 to 2022, resulting in a total of one hundred observations.

Descriptive statistics were used to present the study's data, providing a summary of the variables. The links between the variables were investigated using correlation analysis. A model specification test was used to identify the appropriate regression model prior to performing the regression analysis.

The study can conclude from the findings of the classic linear regression model. From the total seven independent variables (FGR) Financing Gap Ratio has a positive and statistically significant effect on NIM, while the other variables namely: (LATAR) Liquid Asset to Total Asset Ratio, (TLA) Total Loan to Total Asset Ratio, (CRR) Cash Reserve Ratio, Bank Size, GDP growth rate and Inflation included in the model do not have statistically significant effects. There is also evidence of significant group-level heterogeneity in NIM. Strategic management of

liquidity, particularly through financing gaps, seems to be associated with higher profitability. However, maintaining adequate liquidity remains crucial.

5.2 Recommendation

This study investigated the effect of liquidity risk on the performance of commercial banks in Ethiopia. The analysis revealed that strategic management of liquidity, particularly through financing gaps, can be associated with higher profitability for banks. This aligns with some existing literature, suggesting that actively managing lending and deposit activities can generate profit maintain liquidity Banks should establish plans that optimize the balance between profitability and risk. This involves actively managing financing gaps to generate income from lending activities while maintaining sufficient levels of liquid assets to meet short-term obligations..

However, the study also identified a negative correlation between the level of liquid assets and profitability. This suggests a potential trade-off between holding highly liquid assets and earning interest income from loans. Ethiopian banks might benefit from analyzing the cost-effectiveness of their liquid asset holdings and exploring alternative investment strategies. Evaluate the opportunity cost of holding excess liquid assets. Explore alternative investment strategies that offer potentially higher returns while maintaining adequate liquidity. This could involve optimizing the types of liquid assets held or considering alternative instruments.

While the focus has been on short-term effects, further research is needed to explore the long-term impact of macroeconomic factors like GDP growth and inflation on bank profitability in Ethiopia. Additionally, investigating strategies for smaller banks to compete and improve profitability in this landscape would be valuable. This can help them negotiate better rates, manage costs more efficiently, and potentially improve their overall liquidity.

By emphasizing the importance of strategic liquidity management and highlighting areas for further exploration, this conclusion provides a balanced perspective on the relationship between liquidity risk and bank performance in Ethiopia.

5.2.1 Limitations and Future Research Directions:

This study acknowledges some limitations those open doors for future research endeavors. The analysis focused on a select set of performance indicators, a ten-year data timeframe, and a limited number of liquidity measures. To solidify the understanding of the connection between liquidity and performance in Ethiopian banking, future studies could:

- **Expand the Performance Indicators:** Include a broader range of metrics to comprehensively assess bank performance beyond the current set.
- **Increase Variable Inclusion:** Incorporate additional variables that might influence bank performance and liquidity risk.
- **Utilize More Data:** Extend the data analysis period to capture a wider timeframe and potentially reveal long-term trends.
- **Explore Qualitative Factors:** Delve deeper by incorporating qualitative research methods like interviews with bankers to understand their perspectives on liquidity management strategies.
- **Consider Macroeconomic Influences:** Broaden the scope to investigate how other macroeconomic factors beyond those currently examined might affect liquidity risk in the Ethiopian banking sector.

By addressing these limitations and incorporating these future research directions, a more comprehensive understanding of the interplay between liquidity risk and bank performance in Ethiopia can be established.

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Appendixes

Appendixes I

Summary of descriptive statistics of all dependent and independent variables

```
. sum NIM FGR LATAR TLA CRR Size GDP Inflation
```

Variable	Obs	Mean	Std. Dev.	Min	Max
NIM	100	5.7793	1.729613	1.82	9.33
FGR	100	-.2360683	.0862066	-.4078993	-.039059
LATAR	100	19.5364	7.627481	4.36	52.41
TLA	100	.5470005	.0922002	.323682	.7583333
CRR	100	8.245362	3.786213	.5327724	19.47482
Size	100	4.328817	.4162662	3.290279	5.263378
GDP	100	7.42	.9009535	6.1	8.5
Inflation	100	8.92	4.520615	2.1	18.5

Source: Stata output

Appendix II

Summary of correlation matrix between dependent and independent variables

```
. corr NIM FGR LATAR TLA CRR Size GDP Inflation
(obs=100)
```

	NIM	FGR	LATAR	TLA	CRR	Size	GDP	Inflat~n
NIM	1.0000							
FGR	0.5035	1.0000						
LATAR	-0.5594	-0.6866	1.0000					
TLA	0.5056	0.8988	-0.7700	1.0000				
CRR	-0.3141	-0.3746	0.4580	-0.4831	1.0000			
Size	0.2954	0.5991	-0.6173	0.7595	-0.4216	1.0000		
GDP	-0.2130	-0.4628	0.1655	-0.5075	-0.0042	-0.3512	1.0000	
Inflation	0.0501	0.1044	-0.0495	0.1077	0.0532	0.1169	0.2372	1.0000

Source: Stata output

Appendix III

Summary of test for homoscedasticity assumption using Breusch-Pagan test

```
. reg NIM FGR LATAR TLA CRR Size GDP Inflation
```

Source	SS	df	MS	Number of obs	=	100
				F(7, 92)	=	7.80
Model	110.324601	7	15.7606573	Prob > F	=	0.0000
Residual	185.839843	92	2.01999829	R-squared	=	0.3725
				Adj R-squared	=	0.3248
Total	296.164444	99	2.99156004	Root MSE	=	1.4213

NIM	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
FGR	4.137252	3.992192	1.04	0.303	-3.791584	12.06609
LATAR	-.1142647	.0331402	-3.45	0.001	-.180084	-.0484453
TLA	-.9686046	5.618183	-0.17	0.863	-12.1268	10.18959
CRR	-.0582863	.048028	-1.21	0.228	-.1536741	.0371014
Size	-.9050321	.5552426	-1.63	0.107	-2.007792	.1977276
GDP	-.2996874	.2375083	-1.26	0.210	-.7713995	.1720247
Inflation	.0300126	.0360787	0.83	0.408	-.0416429	.1016681
_cons	15.8724	4.960598	3.20	0.002	6.020224	25.72457

```
. estat hettest

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

         chi2(1)      =     0.92
         Prob > chi2  =   0.3387
```

Source: Stata output

Appendix IV

Summary of test for absence of series Multi collinearity assumption

```
. vif
```

Variable	VIF	1/VIF
TLA	13.15	0.076043
FGR	5.80	0.172271
LATAR	3.13	0.319332
Size	2.62	0.381951
GDP	2.24	0.445608
CRR	1.62	0.617045
Inflation	1.30	0.767040
Mean VIF	4.27	

```
. corr FGR LATAR TLA CRR Size GDP Inflation
(obs=100)
```

	FGR	LATAR	TLA	CRR	Size	GDP	Inflat~n
FGR	1.0000						
LATAR	-0.6866	1.0000					
TLA	0.8988	-0.7700	1.0000				
CRR	-0.3746	0.4580	-0.4831	1.0000			
Size	0.5991	-0.6173	0.7595	-0.4216	1.0000		
GDP	-0.4628	0.1655	-0.5075	-0.0042	-0.3512	1.0000	
Inflation	0.1044	-0.0495	0.1077	0.0532	0.1169	0.2372	1.0000

Source: Stata output

Appendix V

Summary of test for normality assumption using Bera—Jarque

```
. sktest uhat
```

Skewness/Kurtosis tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	joint adj chi2(2)	joint Prob>chi2
uhat	100	0.6096	0.5288	0.67	0.7158

Source: Stata output

Appendix VI

Summary of Choosing Random Effect (RE) versus Fixed Effect (FE) Models

```
. hausman fe re
```

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
FGR	4.823016	4.762052	.0609634	.
LATAR	-.0103942	-.0151015	.0047073	.
TLA	.1685252	.3546308	-.1861057	.
CRR	-.008324	-.0111693	.0028453	.
Size	.71876	.5736792	.1450808	.0376349
GDP	-.0601469	-.0720498	.0119029	.
Inflation	.0037925	.005363	-.0015705	.

```
                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(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =        2.51
            Prob>chi2 =      0.9262
            (V_b-V_B is not positive definite)
```

Source: Stata output

Appendix VII

Summary of Random Effect regression model result

```
. xtreg NIM FGR  LATAR  TLA CRR Size  GDP Inflation, re

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

R-sq:                                           Obs per group:
     within  = 0.5805                                         min =        10
     between = 0.1874                                         avg =      10.0
     overall = 0.2598                                         max =        10

                                                Wald chi2(7)      =    109.15
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =    0.0000
```

NIM	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
FGR	4.762052	2.261558	2.11	0.035	.3294804	9.194625
LATAR	-.0151015	.0198618	-0.76	0.447	-.0540299	.0238268
TLA	.3546308	3.494907	0.10	0.919	-6.495261	7.204523
CRR	-.0111693	.0255599	-0.44	0.662	-.0612658	.0389272
Size	.5736792	.4507887	1.27	0.203	-.3098504	1.457209
GDP	-.0720498	.1191144	-0.60	0.545	-.3055097	.1614101
Inflation	.005363	.0175856	0.30	0.760	-.0291041	.0398301
_cons	5.100031	2.752354	1.85	0.064	-.2944836	10.49455
sigma_u	1.0655804					
sigma_e	.65532051					
rho	.72557788	(fraction of variance due to u_i)				

Source: Stata output