ST.MARY'S UNIVERSITY
SCHOOL OF GRADUATE STUDIES
MBA PROGRAM

DETERMINANTS OF LIQUIDITY IN COMMERCIAL BANKS OF ETHIOPIA (THE CASE OF SELECTED PRIVATE BANKS)

A Thesis Submitted In Partial Fulfilment of the Requirements for Master of Business Administration in Accounting and Finance

BY

BILILGN EMAWAYEW

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ADDIS ABABA, ETHIOPIA

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Declaration

I Bililgn Emawayew declares that this research entitled **Determinants of liquidity in commercial Banks of Ethiopia (The case of selected private Banks)"** is the outcome of my own effort and that all sources of materials used for the study have been duly acknowledged. I have produced it independently except for the guidance and suggestion of the research advisor.

This study has not been submitted for any degree in this university or any other university. It is offered for the partial fulfilment of the post-graduates program in Accounting and Finance.

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Endorsement

This thesis has been submitted to St. Mary's University, School of Graduate Studies

for examination with my approval as a university advisor.

Asemamaw Gete (Ass. Prof.)   _____

Advisor   Signature

St. Mary's University, Addis Ababa   June 2016

Letter of Certification

This is to certify that Bililgn Emawayew carried out his project on the topic entitled **"*Determinants of liquidity in commercial Banks of Ethiopia (the case of selected private Banks)*"**. This work is original in nature and is suitable for submission for the award of Masters of Business Administration Degree in Accounting and Finance.

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Abstract

Liquidity is one of the major concerns for banks and thus achieving the optimum level of liquidity is crucial. Liquidity management is a concept that is receiving serious attention all over the world especially with the current financial situations and the state of the world economy. The main objective of this study was to identify the determinants of liquidity of private commercial banks in Ethiopia. In order to achieve the research objectives, data was collected from a sample of six private commercial banks in Ethiopia over the period from 2001 to 2015. Bank specific and macroeconomic variables were analysed by using the balanced panel fixed effect regression model. Bank's liquidity is measured by liquid asset to deposit ratio. For the purpose of this study nine variables have been taken, categorized under bank specific and macroeconomic. The findings of the study revealed that, bank specific variables like, bank size (Size) and loan growth (LG) have negative and statistically significant impact on liquidity; while from the macroeconomic variables gross domestic product (GDP) was negatively, inflation (INF) was positively and statistically significant impact on liquidity. And short term interest rate (STIR) was negatively and profitability measured by (ROA) was positively and statistically significant impact on liquidity but opposite sign to the hypothesis. However, capital adequacy (CAP), non-performing loan (NPL), and interest rate margin has statistically insignificant impact on liquidity of Ethiopian private commercial banks.

Keywords: Balanced Panel, Determinants of Liquidity, Ethiopian Private Commercial Banks, Fixed Effect Regression Model, Liquidity Ratio.

Acknowledgments

Acronyms

AIB: Awash International Bank S.C

BCBS: Basel Committee for Banking Supervision

BLUE: Best Linear Unbiased Estimator

BOA: Bank of Abyssinia S.C

CAP: Capital adequacy

CBB: Construction and Business Bank

CBE: Commercial Bank of Ethiopia

CLRM: Classical Linear Regression Model

DB: Dashen Bank S.C

DW: Durbin-Watson

ESRB: European Systemic Risk Board

FEM: Fixed Effect Model

GDP: Gross Domestic Product

HP: Hypotheses

INF: General inflation rate

IRM: Interest Rate Margin

JB: Jarque-Bera

LCR: The Liquidity Coverage Ratio

LG: Loan growth Rate

LOLR: Lender of Last Resort

MOFED: Ministry of Finance and Economic Development

NBE: National Bank of Ethiopia

NIB: Nib International Bank S.C

NPL: Non-performing loans

NSFR: Net Stable Funding Ratio

OLS: Ordinary Least Square

REM: Random Effect Model

ROA: Return on Assets

ROE: Return on Equity

STIR: Short Term Interest Rate

UB: United Bank S.C

WB: Wegagen Bank S.C

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Chapter One

Introduction

1.1. Background of the study

Banks are financial institutions that play intermediary function in the economy through channelling financial resources from surplus (depositors) economic units to deficit (borrowers) economic unit; hence it remained and will continue to be an important institution for any economy as they play the most fundamental role in the payments system. Since the role of capital market in most developing countries like Ethiopia is almost null or not started yet, to some extent informal secondary market that trade shares by commercial banks which is the most dominant financial institutions. Of the main functions of commercial banks is the availing of funds (monetary) to its customers, for a bank to be in a position to do so, it must be in a healthy liquidity position (Litter et al, 2004).

Liquidity management is a concept that is receiving serious attention all over the world especially with the current financial situations and the state of the world economy. Some of the striking corporate goals include the need to maximize profit, maintain high level of liquidity in order to guarantee safety, attain the highest level of owner's net worth coupled with the attainment of other corporate objectives. The importance of liquidity management as it affects corporate profitability in today's business cannot be over emphasized. The crucial part in managing working capital is required maintenance of its liquidity in day-to-day operation to ensure its smooth running and meets its obligation (Pandey, 2007).

According to Bank for International Settlements (2008), liquidity is defined as "the ability of a bank to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses". In this regard, when banks transform short term deposits to long term loans, which are a maturity mismatch, they will be vulnerable to liquidity problem. Effective & efficient liquidity management is a paramount importance since a liquidity problem in one bank can have industry wide repercussion. Hence as liquidity affects profitability in today's banking business, the importance of liquidity management cannot be over emphasized and sustaining the optimal level of liquidity is a real art of bank's management. In the well-developed countries which have financial market, it becomes very complex to manage liquidity. In Ethiopia, the

emergence of private commercial banks vigilant the public banks to actively compete in the banking industry and they have changed their strategy on resource mobilization through expanding branch networks and implementation of new banking strategies.

In the banking industry, maintaining of optimum level of liquidity is greatly linked with the efficient banking operations. As per the study made by Muhammad (2013), when the bank is not adequately manage its liquidity, it may lead to insolvency (in case of low liquidity) or low profitability (in case of high liquidity) and ultimately destroy the wealth of shareholder and breakdown of entire financial institution. Hence maintaining the optimum level of liquidity is very important in order to make the bank successfully functioning and profitable.

Researches were made in different countries on the determinants of bank liquidity. For instance the studies made by Valla & Escorbiac (2006) on England banks has found that profitability, GDP, monetary policy interest rate and loan growth has negative impact on liquidity. Vodova (2011) studies about the determinants of commercial banks liquidity in Czech Republic and found that capital adequacy, interest rate on loans, share of non-performing loans and interest rate on interbank transactions have positively related with bank's liquidity while inflation rate, business cycle and financial crisis has negatively related with bank's liquidity and he found that the influence of bank size is ambiguous. On the other studies made by Vodova (2013) in Hungary commercial banks for the period from 2001 to 2010, the result shows that capital adequacy, interest rate on loans and bank profitability had positively related with bank liquidity while size of the bank, interest rate margin, monetary policy interest rate and interest rate on interbank transaction has negatively related with bank's liquidity. According to his study, the relation between growth rate of GDP and bank liquidity is ambiguous.

The other studies made by Wilbert (2014) in African country , Zimbabwean commercial banks on the determinants of banks liquidity, the result shows that there is a positive relation between bank liquidity and capital adequacy, total asset, gross domestic product and bank rate while the adoption of multi -currency, inflation rate and business cycle have negative impact on liquidity. The same research also made here in Ethiopia by different researchers for example, Tseganesh (2012) on the determinants of liquidity on Ethiopian Commercial banks including public banks, the result shows that capital adequacy, bank size, share of non-performing loans, interest rate

margin, inflation rate and short term interest rate had positive and significant impact on bank liquidity while real GDP growth rate and loan growth rate had statistically insignificant impact on bank liquidity. And also Nigist (2015) studies on determinants of Banks Liquidity evidenced on Ethiopian Commercial Banks and Belete (2015) studies on Factors Affecting Liquidity of Selected Commercial Banks in Ethiopia. Even if, all are working on the same topic and used similar variables the result is different, this indicates that further research is still required and also there is no prior research paper made on the determinants of bank liquidity on private commercial banks in Ethiopia. Therefore, that is why the researcher selected this topic.

1.2 Statement of the problem

The fundamental role of a bank is to channel funds from surplus economic unit to deficit economic units. They also provide a channel for policy makers to conduct monetary policies, indeed avoiding undesired inflations. However, the activity of the bank is not without problems, since depositors (surplus users) kept their money in the bank for unknown period of time and may withdraw as per their demand while the bank is not in a position to meet their financial obligations. In such instance the bank will encounter liquidity problem and may frustrate its costumer and it may affect the financial institution as a whole. On the other hand, when banks hold excess liquid asset which are non-earning assets such as cash and non-interest bearing deposits, the bank's profitability will be affected. Hence every bank have to ensure that it operates to satisfy its profitability target and at the same time to meet the financial demands of its depositors when it becomes due by maintaining optimum level of liquidity.

In recent years, the world economy has experienced a number of financial crises. Often, at the center of these crises are issues of liquidity provision by the banking sector and a financial market. For example, when crises are likely to arrive, banks seem less willing to lend and hold more liquidity due to the low level of liquidity in the market for external finance Acharya, (2011). Berger and Bouwman (2009) found the connection between financial crises and bank liquidity creation: the subprime lending crisis was preceded by a dramatic build-up of positive abnormal liquidity creation, which implies that "too much" liquidity creation may also lead to financial fragility. Acharya and Naqvi (2010) are also successful in explaining how the seeds of a

crisis may be sown when banks are flush with liquidity. Hence, bank liquidity management is important for both bank managers and policymakers in safeguarding overall financial stability.

Generally, in order to undertake their operations properly and profitably commercial banks have to maintain their optimal liquidity. When we say banks are liquid, they are able to serve the demand of new borrowers and the withdrawal of cash by their depositors without affecting their day to day activities. To do so they have to keep sufficient liquid assets on their balance sheet. What is more necessary behind maintaining their liquidity is that properly identifying and managing important factors affecting the liquidity position of banks. According to Asphachs, 2005), banks have three possible layers of insurance; a buffer of liquid assets in banks' individual portfolios, unsecured lending/borrowing in the interbank market and a lender of last resort/LOLR safety net. The first one is internal and the remaining two are external sources of liquidity. Like the sources of their liquidity, the liquidity position of banks can be affected by bank specific factors, macroeconomic factors and government/central bank regulations. Firm specific factors include profitability, loan growth, bank size, capital adequacy, the percentage of non-performing loan on the total volume of loans which measures loan quality and others. Macroeconomic factors include gross domestic products/GDP, the rate of inflation, interest rate margin and other macroeconomic factors.

Managing commercial banks liquidity is the most importance issues of all commercial banks. However, the question tugged in mind is that, what are the factors that allow a bank to maintain its optimum liquidity level? In this regard, different researchers in different countries conduct a research on liquidity and the result is different and even in the case of Ethiopia researchers like, Tseganesh (2012), Nigist (2015) and Belete (2015) conduct a research on determinants of liquidity on Ethiopian Commercial banks in general by including public banks and by using more or less similar variables but the result is still different, therefore, still further research is required, and as far as the researcher knowledge there is no research made on determinants of liquidity on Ethiopian private commercial banks by excluding public banks specifically commercial bank of Ethiopia (CBE). Because the market share of commercial bank of Ethiopia (CBE) compared to private banks is more than half. Therefore, this study seeks to fill the gap by considering the internal and external factors that affects Ethiopian private commercial banks liquidity by incorporating the untouched ones.

1.3 Basic Research Questions

It is known that the banking sector plays an important role in the economic growth of a country. This is made through matching surplus economic units with deficit economic units. However, this fundamental role of banks in the 'maturity transformation' of short term deposits into long term loans make banks inherently vulnerable to liquidity risk, both of an institution specific nature and markets as a whole .

Therefore, this study will conduct to answer the following questions:-

1. What are the significant macroeconomic determinants of bank liquidity in Ethiopian private commercial banks?
2. What are the significant bank specific determinants of bank liquidity in Ethiopian private commercial banks?

1.4 Objective of the Study

    1.4.1 General Objective

The general objective of this study is to identify the determinants of bank liquidity in Ethiopian private commercial banks only and in order to evaluate and identify the determinants.

    1.4.2 Specific Objective

The specific objectives of the study which is derived from general objectives are:-

- ➢ To examine the effect of Real GDP growth rate on bank's liquidity
- ➢ To examine the effect of short term Interest rate on bank's liquidity
- ➢ To examine the effect of Inflation rate on bank's liquidity
- ➢ To examine the effect of Bank size on liquidity
- ➢ To examine the effect of interest rate margin on bank's liquidity
- ➢ To examine the effect of Loan growth on bank's liquidity
- ➢ To examine the effect of Non-performing loans on bank's liquidity
- ➢ To examine the effect of Capital adequacy on bank's liquidity
- ➢ To examine the effect of Profitability on bank's liquidity

1.5 Hypothesis

The purpose of this study is mainly focuses on to identify the determinants of bank liquidity in Ethiopian private commercial banks. Some researchers in other countries have been studied on the determinants of bank liquidity. The result shows that some determinant factors which have positive relation with liquidity in one country's bank may have negative relation with other country's bank. On the other hand, some determinant factors which have significant impact on liquidity in one country's bank may not have significant impact on liquidity in other country's bank. There are different literatures that support both the positive and negative impacts of under listed independent variables on liquidity and some of them are explained below:-

Capital Adequacy:-According to (Diamond and Rajan, 2000, 2001) higher capital reduces liquidity creation and lower capital tends to favour liquidity creation. Under the view of "financial fragility-crowding out" theories predicts that, depositors will be charged a nominal fee for the intermediary service of loaning out their respective deposits and tends to hold more capital instead of liquid assets. This explains the negative relationship of CAP and liquidity. The other view of Al-Khouri (2012) has found that, bank capital increases bank liquidity through its ability to absorb risk. Hence, the higher the bank's capital ratio, the higher is its liquidity creation and on the other hand, higher capital requirement provide higher liquidity to financial institutions. This explains the positive relationship of CAP and liquidity and the study select the second views of positive relationship.

Size of the Bank: According to(Rauch, 2009 and Berger and Bouwman (2009), the relationship between bank size and liquidity state that smaller bank tend to emphasis on intermediation processes and transformation activities and they do have smaller amount of liquidity. and this support the positive relationship of size and liquidity. the other theory says, According to the "too big to fail" argument, large banks would benefit from an implicit guarantee, thus decrease their cost of funding and allows them to invest in riskier assets (Iannotta, 2007).Therefore, "too big to fail" status of large banks could lead to moral hazard behaviour and excessive risk exposure and thus there can be negative relationship between bank size and liquidity and for the purpose of this study the negative relationship is selected.

Loan Growth: According to (Pilbeam 2005) the amount of liquidity held by banks is heavily influenced by loan demand and it is the base for loan growth. If demand for loans is weak, then the bank tends to hold more liquid assets whereas if demand for loans is high they tend to hold less liquid assets since long term loans are generally more profitable. Therefore, loan growth has negative relationship with bank liquidity and the study also consider this view.

Non-performing loans: According to Bloem and Gorter (2001), though non-performing loans may affect all sectors, the most serious impact is on financial institutions which tend to have large loan portfolios. On the other hand, large volume of non-performing loans portfolio will affect the ability of banks to provide credit and leads to loss of confidence and liquidity problems. Therefore, the amount of non-performing loans has a negative impact on bank's liquidity and for the purpose of the study the negative relationship is considered.

Profitability (ROA):-A sound and profitable banking sector is better able to withstand negative shocks and contribute to the stability of the financial system (Athanasoglou, 2005).One of the highest yielding assets of a bank is loans & advances that provide the largest portion of operating revenue. In this respect, banks are faced with liquidity risk since loans and advanced are funds from deposit of customers and this support the negative relationship of Profitability and Liquidity. On the other hand, banks holding more liquid assets benefit from a superior perception in funding markets, reducing their financing costs and increasing profitability Bourke (1989). And this has positive relationship with profitability. The study takes the views of negative relationship of Profitability and liquidity.

Interest Rate Margin: -The size of interest rate margin/ liquidity premium increases with the time to maturity. Therefore, as they got higher premium, lenders give up their liquid money (Pilbeam 2005). Higher interest rate margin will force banks to lend more and reduce their holding of liquid assets and this explains the negative relationship of IRM and liquidity. On the other hand, holding of liquid asset reduce the risk that banks may face liquidity shortage in case of unexpected withdrawals and thus as liquid assets increases, a bank's liquidity risks decreases, which leads to a lower liquidity premium component of the net interest margin (Angabazo,1997). Therefore, there is a negative relationship between interest rate margin and banks liquidity which support the hypothesis of the study.

GDP Growth Rate:-During economic boom, the demand for differentiated financial products is higher and may improve bank's ability to expand its loans and securities at higher rate and thus reduce liquidity. The other study made by Painceira (2010) stated that, banks liquidity fondness is low in the course of economic boom where banks confidentiality expects to profit by expanding loanable fund to sustain economic boom while restricted loanable fund during economic downturn to prioritize liquidity and shows the negative relationship of GDP and liquidity which support the hypothesis of the study.

The Rate of Inflation: -According to Huybens and Smith (1999), the implied reduction in real returns worse the credit market frictions which leads to the rationing of credit, hence credit rationing becomes more severe as inflation rises. As a result, the financial sector makes fewer loans, resource allocation is less efficient, and intermediary activity diminishes with adverse implications for capital/long term investment. Further, the amount of liquid assets held banks will rise with the rise in inflation. This implies, there is a positive relationship between inflation and liquidity and it supports the hypothesis of this study.

Short Term Interest Rate: - according to Pilbeam, (2005) the money market is important because many of these instruments are held by banks as part of their eligible reserves, that is, they may be used as collateral if bank wishes to raise funds from central bank because they are short maturing and have less default risk. The higher short term interest rate induces banks to invest more in the short term instruments and enhance their liquidity position Therefore, short term interest rate has positive relationship with liquidity which support the hypothesis of this study.

Based on the above literatures and in order to evaluate and identify the determinants Liquidity and to answer the research questions, the following null hypothesis has been tested:-

H1: Bank size has negative and significant impact on bank's liquidity
H2: Loan growth has negative and significant impact on bank's liquidity
H3: Non-performing loans has negative and significant impact on bank's liquidity
H4: Capital adequacy has positive and significant impact on bank's liquidity
H5: Interest rate margin has negative and significant impact on bank's liquidity
H6: Profitability has negative and significant impact on bank's liquidity

H7: Real GDP growth rate has negative and significant impact on bank's liquidity

H8: Short term interest rate has positive and significant impact on bank's liquidity

H9: Inflation rate has positive and significant impact on bank's liquidity

1.6 Scope of the Study

This paper is confined in identifying the determinants of bank's liquidity on Ethiopian private commercial banks. Though there are sixteen private and two publicly owned commercial banks in Ethiopia, the study select only six privately owned commercial banks that have at least fifteen years data, i.e., 2001 to 2015.The other private commercial banks are not included since they have less than fifteen years in operation and also publicly owned commercial banks (CBE) are not included in this study.

This study was also limited to see the impact of these variables, capital adequacy, bank size, the share of non-performing loans from the total volume of loans and advances, interest rate margin, loan growth, profitability measured by ROA, GDP growth rate, inflation rate and short term interest rate on bank's liquidity.

1.7 Significance of the Study

The issue of liquidity management has now got great attention in the banking industry. Moreover, the supervisory authority has required banks to have their own liquidity policy which enforces banks to monitor their funding structure and their ability to handle short term liquidity problems and provide them with a better means of assessing the present and future liquidity risk associated. Therefore, the study as a whole will have great contribution to different parties like:-

1.7.1 Significance to the researcher

It helps the researcher to get acquainted with the research undertakings and most importantly, the researcher to practically implement research and to see what challenges are faced in undertaking research and how to overcome. In addition to this, it creates an opportunity for the researcher to read and infer various references on related topics.

1.7.2 Significance to Ethiopian Private Commercial Banks and policy makers

Ethiopian private commercial banks and policy makers benefited from this study in different way. It helps them to assess their liquidity requirement and produce their liquidity policy and give due attention on those factors which have significant impact on bank's liquidity. It has also a great contribution to the existing knowledge in the area of factors determining private commercial banks liquidity. In general it will have great contribution to the supervisory authority, policy makers, like is NBE.

1.7.3 Significance to other researcher

The study provides as a stepping stone for those who would like to carry out further exploration by incorporate large sample size.

1.8 Organizations of the paper

The research report was organized under five chapters. The first chapter provides the general overview of the study. The second chapter reviewed the related literatures on the determinants of bank's liquidity. The third chapter focuses on the methodology of the study. The fourth chapter was provided results and discussion. The final chapter includes Findings, conclusion and recommendations and at the end references and appendixes were attached.

Chapter Two
Review of Related Literatures

Banks play a central role in all modern financial systems. To perform its role effectively, they must be safe and be perceived as such. The single most important assurance is the economic value of a bank's assets to be worth significantly more than the liabilities that it owes. The difference represents a cushion of "capital" that is available to cover losses of any kind. However, the global financial crisis underlined the importance of a second type of buffer, the "liquidity" that enables banks to cover unexpected cash outflows. A bank can be solvent, by holding assets that exceed its liabilities on an economic and accounting basis, and still die a sudden death if the bank does not have enough liquidity to meet its obligations when they fall due including continuing obligation such as those to fund the holding of assets (BCBS, 2004).

Most importantly, the primary role of banks in the economy is to create liquidity by funding illiquid loans with liquid demand deposits - or in other words banks actually collecting short term deposit and issuing loans for long terms (e.g. Diamond 1984, Ramakrishnan and Thakor 1984). This liquidity creation role exposed banks for liquidity problem that banks need to manage in order to prevent itself from a sudden death. When bank does not have enough liquidity to fulfil its obligation, the bank is said to face liquidity risk.

It is an agreed fact that all businesses including banks face liquidity risk. However, the banks liquidity risk is inherent from its intermediation role of providing mismatched maturities of deposit and loans (short-term deposit for long-term loans). As a consequence, banks fundamentally need to hold not only an optimal level of capital but also liquidity to maintain efficiency and operative excellence.

2.1 Banking History in Ethiopia

Modern banking in Ethiopia started in 1905 with the establishment of Abyssinian Bank which was based on a fifty year agreement with the Anglo-Egyptian National Bank. In 1908 a new development bank and two other foreign banks (Banque de l'Indochine and the Compagniedel'Afrique Orientale) were also established (Degefe 1995 cited in Geda 2006). As noted in Geda (2006) these banks were criticized for being wholly foreign owned. In 1931 the Ethiopian government purchased the Abyssinian Bank, which was the dominant bank, and

renamed it the Bank of Ethiopia i.e, the first nationally owned bank on the African continent (Gedey 1990, pp. 83, cited in Geda 2006).

During the five-years of Italian occupation (1936-1941) banking activity of the country was relatively expanded. In that time, the Italian banks were particularly active. As a result, most of the banks that were in operation during this period were Italian banks namely, Banco di Italy, Banco di Roma, Banco di Napoli, Banco Nacionale, Casa de Creito and Society Nacionale di Ethiopia. After independence from Italy's brief occupation, where the role of Britain was paramount owing to its strategic planning during the Second World War, Barclays Bank was established and it remained in business in Ethiopia between 1941 and 1943 (Degefe 1995 cited in Geda 2006). Following this, in 1943 the Ethiopian government established the State Bank of Ethiopia. As noted in Degefe (1995 cited in Geda 2006) the establishment of the Bank by Ethiopia was a painful process because Britain was against it. The Bank of Ethiopia was operating as both a commercial and a central bank until 1963 when it was remodeled into today's National Bank of Ethiopia (the Central Bank, re-established in 1976) and the Commercial Bank of Ethiopia (CBE). After this period many other banks were established; and just before the 1974 revolution those banks were in operation (Degefe 1995 cited in Geda 2006).

As stated in Degefe (1995 cited in Geda 2006), all privately owned financial institutions including three commercial banks, thirteen insurance companies, and two non-bank financial intermediaries were nationalized on January 1975. The nationalized banks were reorganized and one commercial bank (the CBE), a national bank (recreated in 1976), two specialized banks i.e., the Agricultural & Industrial Bank, renamed recently as the Development Bank of Ethiopia and a Housing & Saving Bank, renamed recently as the Construction & Business Bank, which is recently merged with Commercial bank of Ethiopia and one insurance company (Ethiopian Insurance Company) were formed. Following the regime change in 1991 and the liberalization policy in 1992, these financial institutions were reorganized to work to a market-oriented policy framework. Moreover, new privately owned financial institutions were also allowed to work alongside the publicly owned ones. As a result, currently, the country has three public-owned and sixteen private commercial banks have been opened during the last twenty years.

During the last two decades, the financial sector in Ethiopia has been experienced major transformation on its operating environment following the downfall of the Dergue Regime. On top of this, currently there are sixteen private commercial banks have been opened during the last twenty years. On one hand, the competition in the banking industry of Ethiopia becomes stiffer from time to time as more new banks are joining to the industry. On the other hand, as foreign banks and foreign nationals are not allowed to invest in the financial sector, the competition is within domestic banks only. Further, according to NBE directive no. SBB/50/2011, the National Bank of Ethiopia has raised the minimum paid up capital requirement from Birr 75 million to Birr 500 million in order to obtain banking business license effective October 1st 2011, and it limits the new entrants to the industry and advantageous for the existing banks. Though, foreign banks are not allowed and the entrant of new banks to the industry is minimal, there is still stiff competition between existing banks especially in terms of resource mobilization which leads to liquidity problem.

2.2 Review of Related Theoretical Literature

2.2.1 Conceptual Background

A first requirement to study banks' liquid buffers is to find an adequate definition of liquidity. The financial economics literature distinguishes between two concepts of liquidity: market liquidity and funding liquidity (Drehman and Nikolau, 2009). Market liquidity describes a particular characteristic of an asset: a high degree of market liquidity implies the ability to offset or eliminate a position in a given asset at or close to the current market price. This feature of the asset may not be constant over time. An asset which is currently market liquid may not necessarily have been market liquid in the past, nor need it be continuously market liquid in the future. Factors such as market concentration or the prevalence and distribution of asymmetric information may affect the degree of market liquidity.

Funding liquidity describes a particular characteristic of a financial agent: it refers to its ability to meet obligations as they come due. Funding liquidity risk is the risk that the bank will not be able to meet efficiently both expected and unexpected current and future cash flow and collateral needs without affecting either daily operations or the financial condition of the firm. At any point in time, a financial institution is either funding liquid or not. Nevertheless, the two concepts are

linked (Brunnermeier, 2009). Suppose a bank only holds assets which are perfectly market-liquid. In this case the bank will also be funding liquid, as long as it is solvent. Market liquidity, however, may vary over time, and an institution's funding liquidity may thus change accordingly. Suppose a sufficiently large portion of the bank's assets suddenly become perfectly market illiquid, while the bank remains solvent. The bank will no longer be able to honor its short-term obligations and will become distressed. This is, in fact, a stylized description of the difficulties encountered by a large number of financial institutions during 2007, the previously highly liquid market for mortgage-backed securities dried up. This situation highlight the crucial importance of liquidity to the functioning of markets and the banking sector as well as links between funding and market liquidity risk, interrelationships of funding liquidity risk and credit risks, reputation effects on liquidity, and other links among liquidity and other typical banking features.

For the purpose of this study, we require a measure of market-liquid assets held by banks to guarantee constant funding liquidity. Yet the example above highlights the difficulty of obtaining a measure that adequately accounts for the dynamic nature of market liquidity. To circumvent this problem, we focus only on those assets in banks' portfolios which - virtually by their definition are permanently market-liquid: cash and due from banks. We expect that this narrow definition of liquidity captures banks' qualitative choices about liquid buffers.

Liquidity risk refers to the risk that a financial agent will (at some point) be unable to meet obligations at a reasonable cost as they come due. In other words, it reflects the probability that the agent will become funding illiquid during a given time period. As explained in the previous section, banks' core business is to "borrow short and lend long" they are especially prone to liquidity risk. Banks manage the liquidity risk inherent in their balance sheets by maintaining a buffer of (permanently) market-liquid assets - such as cash or government securities - which anticipates their depositors' liquidity demands within the relevant timeframe.

As pointed out by Diamond and Dybvig (1983), banks thus benefit from the ability to pool liquidity risk over a large group of depositors. It would be undesirable for banks to invest only in perfectly market-liquid assets at all times as this would effectively eliminate the pooling advantage banks have compared to the liquidity risk management that could be undertaken by

their individual customers. Yet, it would be equally undesirable for banks not to invest in market-liquid assets at all, as this would burden depositors with excessive liquidity risks.

Until recently, liquidity risk was not the main focus of banking regulators. The 2007-2009 crisis showed, however, how rapidly market conditions can change exposing severe liquidity risks in institutions, many times unrelated to capital levels. Now, there is wide agreement that insufficient liquidity buffers were a root cause of this crisis and the on-going disruptions of the world financial system, making the improvement of liquidity risk analysis and supervision a key issue for the years to come (Brunnermeier, 2009 and BCBS, 2008).

Efforts are underway internationally as well as in individual countries to establish or reform (existing) liquidity risk frameworks, most notably by the Basel Committee for Banking Supervision (BCBS). The BCBS's new regulatory framework (Basel III) proposes a short- and long-term liquidity requirement to reinforce the resilience of banks to liquidity risks (BCBS, 2010 and BCBS, 2013). The Liquidity Coverage Ratio (LCR) is a short-term ratio requiring financial institutions to hold enough liquid assets to withstand a 30-day stress period. The second measure, the Net Stable Funding Ratio (NSFR) aims at improving banks' longer-term, structural funding. BCBS (2013) also requires institutions to disclose certain elements regarding their fulfilment of these minimum requirements. Recently the European Systemic Risk Board (ESRB) has recommended national supervisory agencies to intensify the supervision of liquidity and funding risks as well (ESRB, 2013).

2.2.2 Theory of Corporate Liquidity

Almeida (2002) proposed a theory of corporate liquidity demand that is based on the assumption that choices regarding liquidity will depend on firms' access to capital markets and the importance of future investments to the firms. The model predicts that financially constrained firms will save a positive fraction of incremental cash flows, while unconstrained firms will not. Empirical evidence confirms that firms classified as financially constrained save a positive fraction of their cash flows, while firms classified as unconstrained do not. The cost incurred in a cash shortage is higher for firms with a larger investment opportunity set due to the expected losses that result from giving up valuable investment opportunities. Therefore, it is expected a positive relation between investment opportunity and cash holdings.

The theory further predicts that firms with better investment opportunities have greater financial distress costs because the positive Net Present Value (NPV) of these investments disappears (almost entirely) in case of bankruptcy. In this case, firms with better investment opportunities will keep higher levels of cash to avoid financial distress. To the extent that liquid assets other than cash can be liquidated in the event of a cash shortage, they can be seen as substitutes for cash holdings. Consequently, firms with more liquid asset substitutes are expected to hold less cash.

2.2.3 Theory of Bank liquidity Creation and Financial Fragility

According to the theory of financial intermediation, an important role of banks in the economy is to provide liquidity by funding long term illiquid assets with short term liquid liabilities. Through this function of liquidity providers, banks create liquidity as they hold illiquid assets and provide cash and demand deposits to the rest of the economy. Banks perform valuable activities on either side of their balance sheets; on the asset side, they make loans to illiquid borrowers and on the liability side, they provide liquidity on demand to depositors. As of Diamond and Rajan (1998) Depositors get better access to their funds than they would if they invested directly and earned the same expected return: this is liquidity creation. Borrowing firms too can find the bank to be a more reliable source of funding than another firm or individuals banks insure borrowers against the liquidity risk that funding will be cut off prematurely. Diamond and Dybvig (1983) emphasize the "preference for liquidity" under uncertainty of economic agents to justify the existence of banks: banks exist because they provide better liquidity insurance than financial markets; however, as banks are liquidity insurers they face transformation risk and are exposed to the risk of run on deposits. In general, the higher is liquidity creation to the external public; the higher is the risk for banks to face losses from having to dispose of illiquid assets to meet the liquidity demands of customers.

The usual justification for the existence of deposit taking institutions, thereby giving an explanation for the economically important role of banks in providing liquidity, was initially modelled by (Bryant 1980; Diamond and Dybvig 1983). They showed that by investing in illiquid loans and financing them with demandable deposits, banks can be described as pools of liquidity in order to provide households with insurance against idiosyncratic consumption shocks. However, this structure is also the source of a potential fragility of banks since in case of

an unexpected high number of depositors deciding to withdraw their funds for other reasons than liquidity needs, a bank run will result.

Kashyap, (2002) conducted a related analysis justifying the existence of banks liquidity creation. They argued that as banks carry out lending and deposit taking under the same roof, synergies must exist between these two tasks. These synergies can be found in the way deposits and loan commitments are secured through the holding of liquid assets as collateral against withdrawals. They regard these liquid assets as costly overheads. Diamond and Rajan(2005) provides a detailed analysis of the link between liquidity shortages and systemic banking crises. It is argued that the failure of a single bank can shrink the pool of available liquidity to the extent that other banks could be affected by it. Generally, liquidity risk arises from the fundamental role of banks in the maturity transformation of short-term deposits into long term loans.

2.2.4 Keynes -Liquidity preference Theory

The economics and finance literature analyse possible reasons for firms to hold liquid assets. Keynes (1936) identified three motives on why people demand and prefer liquidity. The transaction motive, here firms hold cash in order to satisfy the cash inflow and cash outflow needs that they have. Cash is held to carry out transactions and demand for liquidity is for transactional motive. The demand for cash is affected by the size of the income, time gaps between the receipts of the income, and the spending patterns of the cash available. The precautionary motive of holding cash serves as an emergency fund for a firm. If expected cash inflows are not received as expected cash held on a precautionary basis could be used to satisfy short-term obligations that the cash inflow may have been bench marked for. Speculative reason for holding cash is creating the ability for a firm to take advantage of special opportunities that if acted upon quickly will favour the firm.

2.2.5 Theory of Bank Liquidity Requirements

Charles C. Florian H. and Marie H(2012) theory of Bank Liquidity requirements states that, not only does cash mitigate the liquidity risks attendant to exogenous shocks, it also mitigates endogenous (banker chosen) default risk. In the model, costly state verification makes debt the optimal form of outside finance (Calomiris 1991). There is a conflict of interest between the banker/owner and the depositors with respect to risk management; the banker suffers a private

cost from managing risk, and does not always gain enough as the owner to offset that cost (Tirole 2010). Greater cash holdings increase the marginal gain to the banker from managing risk, and thereby encourage greater risk management. Diamond and Dybvig (1983), physical costs of liquidation make liquidity risk (the possible need to finance early consumption) costly, which could motivate the holding of inventories of liquid assets. In Calomiris and Kahn (1991), depositors receive noisy and independent signals about the risky portfolio outcome of the bank. By holding reserves, banks insulate themselves against the liquidity risk of a small number of misinformed early withdrawals in states of the world where the outcome is actually good. Without those reserves, banks offering demandable debt contracts (which are optimal in the Calomiris-Kahn model) would unnecessarily subject themselves to physical liquidation costs when they fail to meet depositor's requests for early withdrawal.

2.2.6 Financial Intermediation Theory

According to the theory of financial intermediation, an important role of banks in the economy is to provide liquidity by funding long term, illiquid assets with short term, liquid liabilities (Wang, 2002). Through this function of liquidity providers, banks create liquidity as they hold illiquid assets and provide cash and demand deposits to the rest of the economy. Krueger(2002) emphasize the "preference for liquidity" under uncertainty of economic agents to justify the existence of banks: banks exist because they provide better liquidity insurance than financial markets. However, as banks are liquidity insurers, they face transformation risk and are exposed to the risk of run on deposits. More generally, the higher is liquidity creation to the external public, the higher is the risk for banks to face losses from having to dispose of illiquid assets to meet the liquidity demands of customers (Horne and Wachowicz, 2000).

A usual justification for the existence of deposit-taking institutions, thereby giving also an explanation for the economically important role of banks in providing liquidity, was initially modelled by (Bryant 1980 and Diamond and Dybvig 1983. They showed that by investing in illiquid loans and financing them with demandable deposits, banks can be described as pools of liquidity in order to provide households with insurance against peculiar consumption shocks (Weisel, Harm, and Brandley, 2003).

2.2.7 Liquidity Measurement Theory

Banks generally face liquidity risk which increases in times of crisis and then endanger the functioning of financial markets. Vento and Ganga (2009), defined three methods to measure liquidity risk: the stock approach, the cash-flows based approach and the hybrid approach. The first approach looks at liquidity as a stock. This approach aims to determine the bank's ability to reimburse its short-terms debts obligations as a measurement of the liquid assets' amount that can be promptly liquidated by the bank or used to obtain secured loans. The idea behind this model is that each financial institution is exposed to unexpected cash outflows that may occur in the future due to unusual variations in the timing or extent therefore needs a quantity much higher than the cash amount required for banking projects. The second approach aims to safeguard the bank's ability to meet its payment obligations and calculating and limiting the liquidity maturity transformation risk, based on the measurement of liquidity-at-risk figures. The last approach combines elements of the stock approaches and of the cash flows based approaches.

2.3. Determinants of Bank Liquidity

The determinants of banks' liquidity level can be classified into four broad categories. These include: the opportunity cost of liquidity holding, bank specific characteristics, moral hazard motives and macroeconomic fundamentals, as discussed below.

2.3.1 Opportunity Cost of Liquidity Holdings

The early literature on banks liquidity buffers views liquidity management at banks as akin to a standard inventory problem Baltensperger (1980) and Santomero (1984). The costs of keeping a stock of liquid assets of a particular size are weighed against the benefit of reducing the chance of being 'out of stock'. The key prediction of these theories is that the size of the liquidity buffer should reflect the opportunity cost of return foregone from holding liquid assets rather than loans. It should also relate to the distribution of liquidity shocks the bank may face, and in particular to the volatility of the funding basis as well as the cost of raising funds (eg in the interbank market) at short notice. In an extension of this literature Agenor, (1999) test whether the credit crunch in Thailand, 1998 was related to supply or demand factors, and to this end estimate a banks' demand function for reserves. They derive a demand function for excess

reserves that depends both on the distribution of the deposits withdrawals, the external cost of finance (penalty rates applied by the central bank) and the impact of regulation.

The determination of a bank's optimal liquid buffer involves a trade-off between self-insurance against liquidity risk and the returns from illiquid, higher-yielding assets. Baltensperger (1980) as well as Santomero (1984) for instance argue that the size of banks' liquidity buffers is determined by the opportunity costs to hold liquid assets. Similar arguments can be found in Agénor, (1999) who shows, using aggregate data for Thailand, that banks' liquidity holdings are positively related to the volatility of the money market rate, which proxies the need for self-insurance.

Unfortunately, we cannot observe liquidity risk exposure and banks' investment opportunities directly. We can, however, observe banks' structure and operating environment as well as their realized liquid buffers (i.e. revealed preference). Based on the trade-off described above, we can therefore hypothesize as to the manner in which different firm-specific and environmental aspects of a bank's business should affect its liquid buffer. In particular, any observed factor that would be expected to lower (raise) liquidity risk should reduce (increase) observed liquidity buffers.

2.3.2 Moral Hazard Motives

As noted above, banks have three possible layers of insurance, a buffer of liquid assets in banks' individual portfolios, unsecured lending/borrowing in the interbank market and central banks' Leander of Last Resort (LOLR) safety net. Repullo (2003) develops a model of strategic interactions between the central bank and one representative bank and shows that the presence of LOLR support may affect the bank's choice as regards the share of liquid assets in its portfolio. The central banks' objective is to trade off the fiscal cost of lending to the bank and the cost of the bank's failure. The bank's objective is to maximize the expected payoffs to its shareholders. Given this set-up, Repullo (2003) determines the equilibrium strategy of the bank taking into account the LOLR's response function and vice-versa. One finding is that, the choice among risky assets is not related to the presence of the LOLR. Nevertheless, the presence of a LOLR is shown to influence the level of the optimal buffer of liquid assets. The share of safe assets in the bank's portfolio decreases with the introduction of a LOLR. In an empirical paper, Gonzalez-

Eiras (2003) draws conclusions consistent with Repullo (2003). He examines how Argentinean banks changed the amount of their liquidity holdings and demands after a Repo Agreement was implemented at the end of 1996, which enhanced the ability of the central bank to act as LOLR. He finds that this particular event implied a reduction of approximately 6.7% in banks' liquidity holdings. That is, the greater the potential support from the central bank in case of liquidity crises, the lower the liquidity buffer the banks hold.

2.3.3. Bank Specific Characteristics

The internal (bank-specific factors) are factors that are related to internal efficiencies and managerial decisions. Such factors include determinants such as bank profitability, capital adequacy, bank size, asset quality (non-performing loans), growth of loan, interest rate margin and short term interest rate and the like.

❖ **Bank Size and liquidity**

When bank size grows it will help them to overcome the risk but it should be noted that it may leads also to failure. According to the "too big to fail" argument, large banks would benefit from an implicit guarantee, thus decrease their cost of funding and allows them to invest in riskier assets (Iannotta, 2007). If big banks are seeing themselves as "too big to fail", their motivation to hold liquid assets is limited. In case of a liquidity shortage, they rely on a liquidity assistance of Lender of Last Resort (Vodova, 2011). Thus, large banks are likely to perform higher levels of liquidity creation that exposes them to losses associated with having to sale illiquid assets to satisfy the liquidity demands of customers (Kiyotaki and Moore, 2008). Therefore, "too big to fail" status of large banks could lead to moral hazard behaviour and excessive risk exposure and thus there can be negative relationship between bank size and liquidity.

In agreement for positive relationship between bank size and liquidity (Rauch, 2009 and Berger and Bouwman (2009), state that smaller bank tend to emphasis on intermediation processes and transformation activities and they do have smaller amount of liquidity. Hence, there can be positive relationship between bank size and liquidity.

❖ **Loan Growth and liquidity**

The loans & advances portfolio is the largest asset and the predominate source of revenue of banks. According to Diamond & Rajan (2002), lending is the principal business activity for banks. Since loans are illiquid assets, increase in the amount of loans means increase in illiquid assets in the asset portfolio of a bank. The amount of liquidity held by banks is heavily influenced by loan demand and it is the base for loan growth (Pilbeam 2005). If demand for loans is weak, then the bank tends to hold more liquid assets whereas if demand for loans is high they tend to hold less liquid assets since long term loans are generally more profitable. Therefore, loan growth has negative relationship with bank liquidity.

❖ **Non-performing loans and liquidity**

Non-performing loans are loans & advances whose credit quality has deteriorated such that full collection of principal and/or interest in accordance with the contractual repayment term of the loan or advance is in question (NBE directive No.SBB/43/2008). According to (Ghafoor, 2009), non-performing loans are loans that a bank customer fails to meet his/her contractual obligations on either principal or interest payments exceeding 90 days. Thus, NPLs are loans that give negative impact to banks in developing the economy. Rise of non-performing loan portfolios significantly contributed to financial distress in the banking sector.

The banking systems play the central role of mobilizing and allocating resources in the market by channelling fund from surplus economic units to deficit economic units. This activity of transformation short term deposit to long term loans & advances will generate most profits for banks. However, it involves high risk and eventually if not managed properly will leads to high amount of non-performing loans. The increased on non-performing loan reflects deteriorated asset quality, credit risk and its inefficiency in the allocation of resources. According to Bloem and Gorter (2001), though non-performing loans may affect all sectors, the most serious impact is on financial institutions which tend to have large loan portfolios. On the hand, large volume of non-performing loans portfolio will affect the ability of banks to provide credit and leads to loss of confidence and liquidity problems. Therefore, the amount of non-performing loans has a negative impact on bank's liquidity.

❖ **Capital Adequacy and liquidity**

Capital can be defined as common stock plus surplus plus undivided profits plus reserves for contingencies and other capital reserves. Besides, a bank's loan loss reserves which serve as a buffer for absorbing losses can be included as bank's capital (Patheja 1994). The primary reason why banks hold capital is to absorb risk including the risk of liquidity crunches, protection against bank runs, and various other risks. According to Moh'd and Fakhris (2013), bank's capital plays a very important role in maintaining safety and solidarity of banks and the security of banking systems in general as it represents the buffer gate that prevents any unexpected loss that banks might face, which might reach depositors funds given that banks operate in a highly uncertain environment that might lead to their exposure to various risks and losses that might result from risks facing banks. The recent theories suggest that, bank capital may also affect banks' ability to create liquidity. These theories produce opposing predictions on the relationship between capital and liquidity creation.

Under the first view, the "financial fragility-crowding out" theories predicts that, higher capital reduces liquidity creation and lower capital tends to favour liquidity creation (Diamond and Rajan, 2000, 2001). They stated that, depositors will be charged a nominal fee for the intermediary service of loaning out their respective deposits. However, this fee differs according to the borrowers' capability of repayment. For those with higher risk borrowing but are reluctant to incur higher cost, will provoke depositors to withdraw their funds. Furthermore, Gorton and Winton (2000) show that a higher capital ratio may reduce liquidity creation through another effect: "the crowding out of deposits". They consider that deposits are more effective liquidity hedges for agents than investments in bank equity. Indeed, deposits are totally or partially insured and withdrawable at par value. By contrast, bank capital is not eligible and with a stochastic value that depends on the state of bank fundamentals and on the liquidity of the stock exchange. Consequently, higher capital ratios shift investors' funds from relatively liquid deposits to relatively illiquid bank capital. Thus, the higher is the bank's capital ratio; the lower is its liquidity creation.

The second view is that, higher capital requirement provide higher liquidity to financial institutions. Where risk absorption theory is realized for higher capital improves the ability of

banks to create liquidity. This evidence is provided by Diamond and Dybvig (1983) and Allen and Gale (2004) stating that liquidity creation exposes banks to risk. The greater liquidity needs of banks, incur higher losses due to the disposal of illiquid assets at available market prices rather than the desired prices to meet the customers' obligations. Al-Khouri (2012) has also found that, bank capital increases bank liquidity through its ability to absorb risk. Thus, under the second view, the higher is the bank's capital ratio, the higher is its liquidity creation.

❖ **Interest Rate Margin and liquidity**

Interest rate margin is one of the most important factors that gauge the efficiency of financial institutions. Interest rate margin is the difference between the gross cost paid by a borrower to a bank and the net return received by a depositor (Brock and Suarez 2000).According to (Azeez, 2013), interest rate margin is defined as the difference between interest income from loan and advances as a fraction of the total loan and advances and the interest paid out on deposit as a percentage of total deposits. In the financial intermediation process, a bank collects money on deposit from one group (the surplus unit) and grants it out to another group (the deficit unit). These roles involve bringing together people who have money and those who need money. In such intermediation function, the bank will earn interest from loans & advances and pay interest for depositors. Thus, how well a bank manages its assets and liabilities is measured by the spread between the interest earned on the bank's assets and interest costs on its liabilities.

According to the liquidity preference theory, lenders need high interest rate which includes the liquidity premium in order to lend. The basic idea underlining this theory is that, lenders of funds prefer to lend short, while borrowers generally prefer to borrow long. Hence borrowers are prepared to pay interest rate margin/ a liquidity premium to lenders to induce them to lend long. The size of interest rate margin/ liquidity premium increases with the time to maturity. Therefore, as they got higher premium, lenders give up their liquid money (Pilbeam 2005). Higher interest rate margin will force banks to lend more and reduce their holding of liquid assets. On the other hand, holding of liquid asset reduce the risk that banks may face liquidity shortage in case of unexpected withdrawals and thus as liquid assets increases, a bank's liquidity risks decreases, which leads to a lower liquidity premium component of the net interest margin (Angabazo1997). Therefore, there is a negative relationship between interest rate margin and banks liquidity.

❖ **Profitability and liquidity**

Profitability accounts for the impact of better financial soundness on bank risk bearing capacity and on their ability to perform liquidity transformation (Rauch, 2008 and Shen, 2010). A sound and profitable banking sector is better able to withstand negative shocks and contribute to the stability of the financial system (Athanasoglou, 2005). One of the highest yielding assets of a bank is loans & advances that provide the largest portion of operating revenue. In this respect, banks are faced with liquidity risk since loans and advanced are funds from deposit of customers. The higher the volume of loans & advances extended to customers, the higher the interest income and highest profit potentials for banks but it affects liquidity of the bank. Thus, banks need to strike a balance between liquidity and profitability.

The relationship between profitability and liquidities varies among different literatures. According to Bourke (1989), banks holding more liquid assets benefit from a superior perception in funding markets, reducing their financing costs and increasing profitability. On the other hand, the studies made by (Molyneux and Thornton 1992; Goddard, 2004) argued that holding liquid asset imposes an opportunity cost on the bank and has an inverse relationship with profitability. Further, Myers and Rajan (1998) emphasized the adverse effect of increased liquidity for financial institutions stating that, "although more liquid assets increase the ability to raise cash on short-notice, they also reduce management's ability to commit credibly to an investment strategy that protects investors" which, finally, can result in reduction of the "firm's capacity to raise external finance" in some cases. Thus, this indicates the negative relationship between bank profitability and liquidity. The trade-offs that generally exist between return and liquidity risk are demonstrated by observing that a shift from short term securities to long term securities or loans raises a banks' return but also increases its liquidity risks. As a result of the two opposing views, the management of banks faced with the dilemma of liquidity and profitability.

2.3.4 Macroeconomic Fundamentals

The external or macro determinants are variables that are not related to bank management but reflect the economic and legal environment that affects the operation and liquidity positions of institutions. The macroeconomic factors that can affect bank's liquidity include factors such as GDP growth rate; inflation rate and short term interest rate among others.

❖ **GDP Growth Rate and liquidity**

Gross Domestic Product (GDP) is one of the macroeconomic factors that affect liquidity of banks. A major recession or crises in business operations reduces borrowers' capability to service obligations which increases banks' NPLs and eventually banks insolvency (Gavin & Hausmann, 1998). During economic boom, the demand for differentiated financial products is higher and may improve bank's ability to expand its loans and securities at higher rate and thus reduce liquidity. The other study made by Painceira (2010) stated that, banks liquidity fondness is low in the course of economic boom where banks confidentiality expects to profit by expanding loanable fund to sustain economic boom while restricted loanable fund during economic downturn to prioritize liquidity. In line with this argument the loanable fund theory of interest states that, the supply for loan increases when the economy is at boom or going out of recession (Pilbeam 2005).

Aspachs, (2005) has also inferred that, banks prioritize liquidity when the economy plummets, during risk lending opportunities, while neglecting liquidity during economic boom when lending opportunities may be favourable. On the other hand, the studies made by Bordo, (2001) suggested that during recession, it is likely for an increase in the number of loan default. This causes depositors to perceive high solvency risk and immediately tend to withdraw deposits held at financial institutions. This results in financial institutions face bank run causing liquidity risk.

❖ **Short Term Interest Rate and liquidity**

Short term interest rate is the rate paid on money market instruments. Money market instruments are securities that have a year or less to maturity, which includes Treasury bills, commercial papers banker's acceptances, certificates of deposit, repurchase agreements. Treasury bills are the most important since they provide the basis for all other domestic short term interest rates. The money market is important because many of these instruments are held by banks as part of their eligible reserves, that is, they may be used as collateral if bank wishes to raise funds from central bank because they are short maturing and have less default risk. The higher short term interest rate induces banks to invest more in the short term instruments and enhance their liquidity position Pilbeam, (2005). Therefore, short term interest rate has positive relationship with liquidity.

❖ **The Rate of Inflation and liquidity**

Inflation reflects a situation where the demand for goods and services exceeds their supply in the economy. Existing monetary theories agree that, inflation increases the opportunity cost of holding liquidity and thus distorts the allocation of resources which require liquidity in transaction. Recent theories emphasize the importance of informational asymmetries in credit markets and demonstrate how increases in the rate of inflation adversely affect credit market frictions with negative repercussions for financial sector performance and therefore long-run real activity (Huybens and Smith 1998, 1999).

The feature of these theories is that, there is an informational friction whose severity is endogenous. Given this feature, an increase in the rate of inflation drives down the real rate of return not just on money, but on assets in general. According to Huybens and Smith (1999), the implied reduction in real returns worse the credit market frictions which leads to the rationing of credit, hence credit rationing becomes more severe as inflation rises. As a result, the financial sector makes fewer loans, resource allocation is less efficient, and intermediary activity diminishes with adverse implications for capital/long term investment. Further, the amount of liquid assets held banks will rise with the rise in inflation. High inflation rate and sudden changes of inflation have a negative impact on real interest rates and bank's capital. In this respect, the bank's non-performing loans will expand, collateral security values deteriorate and value of loan repayments on banks loans declines. This way, It has been found that inflation rate significantly determines bank liquidity (Heffernan; 2005).

2.4 Review of Related Empirical Studies

This section gives a brief review of the previous studies made on the determinants of bank's liquidity from both developed and developing nations. Moreover, most of the studies undertaken on bank liquidity consider both internal and external factors to examine determinants of liquidity of banks. So, the studies conducted in related to bank's liquidity are reviewed as follows.

2.4.1 Related Empirical Study in Other Countries

Bank specific and macroeconomic determinants of liquidity of English banks were studied by (Aspachs, 2005). The researchers used unconsolidated balance sheet and profit and loss data, for

a panel of 57 UK-resident banks, on a quarterly basis, over the period 1985to 2003. They assumed that the liquidity ratio as a measure of the liquidity should be dependent on the following factors: Probability of obtaining the support from LOLR, which should lower the incentive for holding liquid assets, interest rate margin as a measure of opportunity costs of holding liquid assets expected to have negative impact, bank profitability which is according to finance theory negatively correlated with liquidity, loan growth, where higher loan growth signals increase in illiquid assets, size of the bank expected to have positive or negative impact, gross domestic product growth as an indicator of business cycle negatively correlated with bank liquidity, and short term interest rate, which should capture the monetary policy effect with expected negative impact on liquidity. The output of the regression analysis showed that probability of getting support from LOLR, interest margin, and loan growth have negative and significant effect on banks liquidity whereas, profitability and bank size had statistically insignificant impact on liquidity. Using a measure of support expectations based on the Fitch support rating, the researchers also found strong evidence of the existence of such an effect, which may point to a rationale for regulatory liquidity requirements as a quid pro quo for LOLR support.

The study made on bank specific determinants of liquidity on English banks studied (Valla, 2006) and assumed that, the liquidity ratio as a measure of the liquidity should be dependent on following factors: bank profitability, which is according to finance theory negatively correlated with liquidity, loan growth, where higher loan growth signals increase in illiquid assets, size of the bank is ambiguous. Emmons (1993) as cited by Nigist (2015), when considering USA banking failures, concludes that increased risk-taking at individual banks alone does not fully account for the observed pattern of bank failures. Local economic conditions are also important predictors of bank failure. It is the coincidence of risky bank portfolios and difficult economic conditions that makes bank failure most likely.

Liquidity created by Germany's state-owned savings banks and its determinants has been analysed by (Rauch, 2009). In the first step, it attempted to measure the liquidity creation of all 457 state owned savings banks in Germany over the period 1997 to 2006.In a second step, it analysed the influence of monetary policy on bank liquidity creation. The study measure the created liquidity using the calculation method set forth by (Berger and Bouwman 2007 and Deep

and Schaefer 2004). To measure the monetary policy influence, the study developed a dynamic panel regression model. According to this study, the following factors can determine bank liquidity: monetary policy interest rate, where tightening monetary policy expected to reduces bank liquidity, level of unemployment, which is connected with demand for loans having negative impact on liquidity, savings quota affect banks liquidity positively, size of the bank measured by total number of bank customers have negative impact, and bank profitability expected to reduce banks liquidity. Rauch, (2010) study the determinants of liquidity risk and attempt to identify the determinants of liquidity creation. Their results highlight that the most important determinants are macro-economic variables and monetary policy, while not showing a significant relationship between liquidity creation and bank specific variables such as size and performance.

Vodova (2011) examined the determinants of liquidity of commercial banks in Czech Republic through four liquidity ratios and related them with bank specific and macroeconomic data over a period from 2001 to 2010. This study observed drop of banks' liquidity as a result of the Global Financial Crisis. The study reveals that the share of liquid assets in total assets and liquid asset in deposits and short term funding decreases with bank profitability, higher capital adequacy and bigger size of banks. In their opinion big banks rely on the interbank market and on liquidity assistance of Lender of Last Resort (LOLR). Liquidity measured by share of loans in total assets and in deposits and short term borrowings increases with growth of domestic product. They did not find any significant relationship between interest rates on loans, interest rate on interbank transactions or monetary policy interest rates, interest rate margins, the share of non-performing loans and the rate of inflation with liquidity.

In another study from Pakistan, Malik and Rafique (2013) examines bank specific and macroeconomic determinants of commercial bank liquidity in Pakistan. Their study period covers from 2007 to 2011. They have used two models of liquidity. The first L is based on cash and cash equivalents to total assets. The second model L2 is based on advances net of provisions to total assets. Their results suggest that, Non-Performing Loan (NPL) and Return on Equity (ROE) have a negative and significant effect coefficient with L. Capital (CAP) and inflation (INF) are negatively and significantly correlated and Total Assets (TOA) Return on Equity (ROE) is significantly and positively correlated with L2. Their results of model 1 suggest that

NPL and TOA and monetary policy interest rates positively determine the bank liquidity whereas the inflation has a negative effect. Bank liquidity is also affected by financial crisis measured by L. The results of model 2 indicate that the bank size and monetary policy interest rate positively and significantly determine bank liquidity. Additionally there is a significant and positive impact of financial crisis on the liquidity of commercial banks. Their studies conclude that bank specific factors such as liquid assets are required as bank size increases. The central bank regulations greatly affect the liquidity of commercial banks which means tight monetary policy can regulate the undesirable effect of inflation on liquidity.

The study made by Lucchetta (2007) on the hypothesis that "interest rates affect banks' risk taking and the decision to hold liquidity across European countries". The liquidity measured by different liquidity ratios should be influenced by: behaviour of the bank on the interbank market, the more liquid the bank is the more it lends in the interbank market, interbank rate as a measure of incentives of banks to hold liquidity, monetary policy interest rate as a measure of banks' ability to provide loans to customers, share of loans on total assets and share of loan loss provisions on net interest revenues, both as a measure of risk-taking behaviour of the bank, where liquid banks should reduce the risk-taking behaviour, and bank size measured by logarithm of total bank assets. The results of the study revealed that the risk-free interest rate negatively affects the liquidity retained by banks and the decision of a bank to be a lender in the inter-bank market. Conversely, the inter-bank interest rate has a positive effect on such decisions. Typically, it is the smaller, risk-averse banks that lend in the inter-bank markets. Meanwhile, the risk-free interest rate is positively correlated with loans investment and bank risk-taking behaviour.

Vodova (2013) had also studied on the determinants of liquidity of Polish commercial banks. The data cover the period from 2001 to 2010. The results of panel data regression analysis showed that bank liquidity is strongly determined by overall economic conditions and dropped as a result of financial crisis, economic downturn and increase in unemployment. Bank liquidity decreases also with higher bank profitability, higher interest rate margin and bigger size of banks. On contrary, bank liquidity increases with higher capital adequacy, inflation, share of nonperforming loans and interest rates on loans and interbank transaction.

Moore (2010) investigated the effects of the financial crisis on the liquidity of commercial banks in Latin America and Caribbean countries and specifically address the behaviour of commercial bank liquidity during crises in Latin America and the Caribbean; identifying the key determinants of liquidity, and; to provide an assessment of whether commercial bank liquidity during crises is higher or lower than what is consistent with economic fundamentals. The regression model was estimated using ordinary least squares. The result of the study showed that the volatility of cash-to-deposit ratio and money market interest rate have negative and significant effect on liquidity. Whereas, liquidity tends to be inversely related to the business cycle in half of the countries studied, suggesting that commercial banks tend to error on the side of caution by holding relatively more excess reserves during downturns.

Choon, (2013) studied the determinants of liquidity of 15 commercial banks in Malaysia in period (2003-2012). They used specific factors (size of bank, capital adequacy, profitability, credit), macroeconomic factors (GDP, interbank rate, financial crisis). The empirical results show that all factors included are significant except interbank rate. The other study made by Vodová (2012) aimed to identify determinants of liquidity of commercial banks in Slovakia. In order to meet its objective the researcher considered the data for bank specific factors over the period from 2001 to 2009. The data was analysed with panel data regression analysis by using an econometric package Eviews7and the findings of the study revealed that bank liquidity decreases mainly as a result of higher bank profitability, higher capital adequacy and with the size of bank. The level of non-performing loans has no statistically significant effect on the liquidity of Slovakia commercial banks.

The study made by Vodová (2013) with the aim of identifying the determinants of liquidity of Hungarian commercial banks which cover the period from 2001 to 2010 and used panel data regression analysis. The result of the study showed that bank liquidity is positively related to capital adequacy of banks, interest rate on loans and bank profitability and negatively related to the size of the bank, interest rate margin, monetary policy interest rate and interest rate on interbank transaction.

Chagwiza (2011) made a study on Zimbabwe regarding the commercial banks liquidity and its determinants. The main objective of his study was to identify the determinants of liquidity in Zimbabwean commercial banks. The result of his study revealed that, there is a positive link

between bank liquidity and capital adequacy, total assets, gross domestic product and bank rate. While the adoption of multi-currency, inflation rate and business cycle have a negative impact on liquidity. The studies made by Laurine (2013) in Zimbabwe regarding Zimbabwean Commercial Banks Liquidity Risk Determinants after Dollarization. The aim of his paper was that empirically investigating the determinants of Zimbabwean commercial banks liquidity risk after the country adopted the use of multiple currencies exchange rate system and to attain the intended objective panel data regression analysis was used on monthly data from the period of March 2009 to December 2012. The result of the study revealed that, capital adequacy and size have negative and significant influence on liquidity risk whereas spread and non-performing loans have a positive and significant relationship with liquidity risk. Reserve requirement ratios and inflation were also significant in explaining liquidity during the studied period.

Agbada and Osuji (2013) studied the efficacy of liquidity management and banking performance in Nigeria using survey research methodology. Data obtained were first presented in tables of percentages and pie charts and were empirically analysed by Pearson product-moment correlation coefficient. Findings from the empirical analysis were quite robust and clearly indicate that there is significant relationship between efficient liquidity management and banking performance and that efficient liquidity management enhances the soundness of bank.

A study made by Fadare (2011), on the banking sector liquidity and financial crisis in Nigeria with the aim of identifying the key determinants of banking liquidity and assessing the relationship between determinants of banking liquidity and financial frictions within the economy. It was employed a linear least square model and time series data from 1980 to 2009. The study found that monetary policy rate and lagged loan-to-deposit ratio were significant for predicting banking sector liquidity. It also showed that a decrease in monetary policy rate, volatility of output in relation to trend output, and the demand for cash, leads to an increase in current loan-to-deposit ratios; while a decrease in currency in circulation in proportion to banking sector deposits; and lagged loan-to-deposit ratios leads to a decline in current loan-to-deposit ratios. The other study made by Mohamed(2015) on Tunisia banks shows that , financial performance, capital / total assets, operating costs/ total assets, growth rate of GDP, inflation rate, delayed liquidity have significant impact on bank liquidity while size, total loans / total

assets, financial costs/ total credits, total deposits / total assets) does not have a significant impact on bank liquidity.

2.4.2 Related empirical evidence in Ethiopia

As to the Authors knowledge, the first study was conducted by Tseganesh (2012). She studied the determinants of banks liquidity and their impact on financial performance on commercial banks in Ethiopia including both public and private banks. The aim of her study focused on two points; first, to identify determinants of commercial banks liquidity in Ethiopia and then to see the impact of banks liquidity up on financial performance through the significant variables explaining liquidity. The data was analysed by using balanced fixed effect panel regression model for eight commercial banks in the sample covered the period from 2000 to 2011 and the result of her study indicate 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. Whereas, Real GDP growth rate and loan growth had statistically insignificant impact on banks liquidity.

Belete (2015) conduct study on Factors Affecting Liquidity of Selected Commercial Banks in Ethiopia and the findings of the study show that capital strength, interest rate margin and inflation had statistically significant and positive relationship with banks' liquidity. On the other hand, loan growth had a negative and statistically significant relationship with banks' liquidity. However, the relationship for profitability, non-performing loans, bank size and gross domestic product were found to be statistically insignificant.

Nigist (2015) also conduct the study on Determinants of Banks Liquidity: Empirical Evidence on Ethiopian Commercial Banks and the result of the study revealed that capital adequacy, profitability, and real GDP growth rate have negative and statistically significant impacts on liquidity of Ethiopian commercial banks while bank size has positive and statistically significant impact on liquidity. Whereas nonperforming loan, loan growth, inflation rate, and interest rate margin were found to be statistically insignificant/ has no any impact on liquidity of Ethiopian commercial banks for the tested period.

2.5. Summary and knowledge Gap

The fundamental role of banks in the maturity transformation of short-term deposits into long-term loans makes banks inherently vulnerable to liquidity risk both of an institution-specific nature and that which affects markets as a whole. Virtually every financial transaction or commitment has implications for a bank's liquidity. Effective liquidity risk management helps ensure a bank's ability to meet cash flow obligations, which are uncertain as they are affected by external events and other agents' behaviour. Liquidity risk management is of paramount importance because a liquidity shortfall at a single institution can have system-wide repercussions.

Financial market developments in the past decade have increased the complexity of liquidity risk and its management. The global market turmoil that began in mid-2007 re-emphasized the importance of liquidity to the functioning of financial markets and the banking sector. In advance of the turmoil, asset markets were buoyant and funding was readily available at low cost. The reversal in market conditions illustrated how quickly liquidity can evaporate and that illiquidity can last for an extended period of time. The banking system came under severe stress, which necessitated central bank action to support both the functioning of money markets and, in a few cases, individual institutions.

During the last two decades, Sixteen private commercial banks have been joined the banking industry in Ethiopia and make the competition stiff. Among others, one of the major areas of competition in the banking industry was resource mobilization which in return affects liquidity of banks. As it was discussed in the literature review part, liquidity of banks can be affected by internal as well as external factors. It was also discussed that some factors which have significant impact on liquidity of banks in one country may not have the same impact on another country. Thus it is important identify the determinants of liquidity of Ethiopian commercial banks. The above three study made in Ethiopia is done on the determinants of bank's liquidity and their impact on financial performance including public banks as well as private commercial banks by using two liquidity measures. While there is no study made to identify the determinants of liquidity by taking private commercial banks only. Therefore, the objective of this study is to identify the determinants of liquidity of private commercial banks in Ethiopia using liquid asset to deposit ratio.

Chapter Three
Research Methodology

Designing appropriate research methodology is a prerequisite in order to conduct a good research work. Accordingly, this chapter discusses about the methodology by which the researcher used to conduct this study. This section explains the research design and provides details regarding the population, sample and sampling technique, the research instruments used in collecting data for the study and the data collection and data analysis methods. It also discusses about the model and the components of the model both the dependent and the independent variables.

3.1. Research Design

The research methodology begins by presenting the overall research design, as the research design provides an important framework & guidelines on how to collect and analyse data. The choice of appropriate research design helps the researcher to answer the research questions and to satisfy the research objectives. Therefore, it is a paramount to properly define and evaluate the research design before conducting the research.

The main objective of this study was to identify the determinants of bank liquidity in Ethiopian private commercial banks and this study adopted an explanatory design by using balanced panel research design to meet the research objective. As explained by Anol.B(2012), explanatory research attempts to identify causal factors and outcomes of the target phenomenon. On the other hand, according to Brooks (2008), a panel of data will embody information across both time and space and it measures some quantity about them over time. The advantage of using panel data is that, it can address a broader range of issues and tackle more complex problems with panel data than would be possible with pure time-series or pure cross-sectional data alone. Panel data has also the advantage of giving more informative data as it consists of both the cross sectional information, which captures individual variability, and the time series information, which captures dynamic adjustment (Brooks 2008).

The study was employed quantitative research approached in which quantitative data research relies on the measurement and analysis of statistical data to produce quantifiable conclusions. Quantitative research is a means for testing objective theories by examining the relationship

among variables (Creswell, 2009). Quantitative methods approach was used to meet the overall objective of the study and to answer research questions and to test hypotheses under it. Quantitative research is empirical research where the data are in the form of numbers. In this study, this approach enabled to see the determinants of bank's liquidity of private commercial banks in Ethiopia by establishing causal relationship.

3.2 Study subject

The study subjects are private Commercial Banks in Ethiopia.

3.3Source and Method of Data Collection

To carry out any research activity, information should be gathered from proper sources. Consistent and reliable research indicates that research conducted by using appropriate data collection instruments increase the credibility and value of research findings. The sources of data for this research were secondary sources. Data were collected from audited financial statements i.e. Balance Sheet and Profit & Loss Statement of each selected commercial banks included in the sample and various journals, published books, related other researches, NBE directives and publications of NBE and MOFED(for Macroeconomic data). The data were collected from 2001 to 2015 on annual base and the figures for the variables were on June 30th of each year under study.

As the study needs historical financial data, which are audited financial reports, accessing publicly available data is assumed as the suitable method for the accuracy of the data. According to Bryman & Bell, 2007(cited in Thanh & Carl, 2014), using secondary data can save cost and time and it has very high quality.

3.4 Study Population & Sampling Frame

The study population in this research is the entire private commercial banks in Ethiopia that exist as of June 30, 2015. According to NBE report at the end of June 30, 2015 there are sixteen privately owned commercial banks and two publicly owned commercial banks (NBE Annual report).The sampling frame for drawing the sample includes those privately owned commercial banks having Fifteen years of working experience in Ethiopia as of June 30, 2015.

3.5 Sampling Technique & Sample Size

For some researches, it is possible to collect data for the entire population as it can be manageable and data is available, while for some other researches data is collected on sample base. Sampling provides a valid alternative when it is impractical to survey the entire population and when there is budget and time constraint to surveying the entire population (Saunders, 2009). There are two types of sampling techniques; probability or representative sampling and non-probability or judgemental sampling. In the probability sampling, the chance or probability, of each case being selected from the population is known and is usually equal for all cases while in the non-probability sampling, the probability of each case being selected from the total population is not known (Saunders, 2009 pp. 212-214). On the other hand, non-probability sampling is sampling technique in which some units of the population have zero chance of selection or where the probability of selection cannot be accurately determined rather samples are selected based on certain non-random criteria, such as quota or convenience(Anol,2012).

The sampling techniques used in this research are a non-probabilistic sampling and among the non-probabilistic sampling methods, this research uses purposive sampling. As stated by Saunders (2009 pp.232), purposive sampling is often used when working with small samples and when we wish to select cases that are particularly informative. Thus the researcher used purposive sampling by considering the availability of full data for the selected time period. In Ethiopia, as of June 30, 2015 there are eighteen commercial banks of which two of them are publicly owned and sixteen of them are privately owned. Among the Sixteen private commercial banks six of them have more than Fifteen years of working experience in the banking industry of Ethiopia. These banks are; Dashen Bank, Awash International Bank, Bank of Abyssinia, Wegagen Bank, NIB International Bank and United Bank. In order to have completed fifteen years data of all the sample banks, those private commercial banks which have less than fifteen years in operation are not selected for this study. The researcher uses fifteen years (2001 to 2015) data in order to get large sample size. The data regarding bank specific variables is collected from audited financial statement of the sample banks for the period from 2001 to 2015(fifteen years data). Moreover, the data regarding macroeconomic variables is gathered for the period from 2001 to 2015 from the National Bank of Ethiopia, MoFED and Central Statistics Authority.

3.6 Variable Definition & Hypotheses of the Study

This study is focused on to identify the determinants of bank's liquidity in Ethiopian private commercial banks through testing the hypotheses regarding to the relationships between liquidity of banks and firm specific and macroeconomic factors affecting it. As it was discussed in the literature part, some determinant factors which have positive relation with liquidity in one country's may have negative relation with other country and some determinant factors which have significant impact on liquidity in one country may not have significant impact on liquidity in other country. For instance the studies made by Valla & Escorbiac (2006) on England banks has found that profitability, GDP, monetary policy, interest rate and loan growth has negative impact on liquidity.

Vodova (2011) studies about the determinants of commercial banks liquidity in Czech Republic and found that capital adequacy, interest rate on loans, share of non-performing loans and interest rate on interbank transactions have positively related with bank's liquidity while inflation rate, business cycle and financial crisis has negatively related with bank's liquidity and he found that the influence of bank size is ambiguous. On the other studies made by Vodova (2013) in Hungary commercial banks for the period from 2001 to 2010, the result shows that capital adequacy, interest rate on loans and bank profitability had positively related with bank liquidity while size of the bank, interest rate margin, monetary policy interest rate and interest rate on interbank transaction has negatively related with bank's liquidity. According to his study, the relation between growth rate of GDP and bank liquidity is ambiguous.

The other studies made by Wilbert (2014) in African country , Zimbabwean commercial banks on the determinants of banks liquidity, the result shows that there is a positive relation between bank liquidity and capital adequacy, total asset, gross domestic product and bank rate while the adoption of multi -currency, inflation rate and business cycle have negative impact on liquidity. On the studies made by Tseganesh (2012) on the determinants of liquidity on Ethiopian Commercial banks including public banks, the result shows that capital adequacy, bank size, share of non-performing loans, interest rate margin, inflation rate and short term interest rate had positive and significant impact on bank liquidity while real GDP growth rate and loan growth rate had statistically insignificant impact on bank liquidity.

Belete, (2015) conduct study on Factors Affecting Liquidity of Selected Commercial Banks in Ethiopia and the findings of the study show that capital strength, interest rate margin and inflation had statistically significant and positive relationship with banks' liquidity. On the other hand, loan growth had a negative and statistically significant relationship with banks' liquidity. However, the relationship for profitability, non-performing loans, bank size and gross domestic product were found to be statistically insignificant.

Nigist, (2015) also conduct the study on Determinants of Banks Liquidity: Empirical Evidence on Ethiopian Commercial Banks and the result of the study revealed that capital adequacy, profitability, and real GDP growth rate have negative and statistically significant impacts on liquidity of Ethiopian commercial banks while bank size has positive and statistically significant impact on liquidity. Whereas nonperforming loan, loan growth, inflation rate, and interest rate margin were found to be statistically insignificant/ has no any impact on liquidity of Ethiopian commercial banks for the tested period.

The studies mentioned above suggest that, bank's liquidity is determined by both bank specific and macroeconomic variables. This study takes among these factors to identify the determinants of bank liquidity on Ethiopian private commercial banks. The description and operational definition of selected variables is discussed here under.

3.6.1. Dependant Variables

Liquidity of Banks: Bank for International Settlements (2008) defines liquidity as "the ability of bank to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses". Liquidity can also be defined as a measure of the relative amount of asset in cash or which can be quickly converted into cash without any loss in value available to meet short term liabilities. There are two methods of measuring liquidity of banks which are liquidity ratios (stock approach) and liquidity gap (flow approach) as discussed in the literature review part. The liquidity gap is the difference between assets and liabilities whereas liquidity ratios are various balance sheet items ratios which identify liquidity trends .The liquidity measure provides suggestions about the level of liquidity on which the commercial banks are operating. The first approach, liquidity ratio, uses different balance sheet ratios and it is easy to compute whereas, the second approach, funding gap, is the difference between inflows and outflows which is

difficult to measure because it is more data intensive and there is no standard technique to forecast inflows and outflows. Most academic literatures prefer liquidity ratio due to a more standardized method and therefore, this study is intended to use liquidity ratios, to measure liquidity of commercial banks, due to the availability of data. For the purpose of this study, the following three types of liquidity ratios, which are most of the time used by the National Bank of Ethiopia and which were previously used by (Vodova (2011, 2012, 2013), Belet (2015), Nigist (2015) and Tseganesh (2012)) are going to be considered.

Liquid Asset to Deposit Ratio (L): According to NBE directive No. SBB/57/2014, liquid asset includes cash (local & foreign currency), deposits with the National Bank and other local and foreign banks having acceptance by the National Bank, other assets readily convertible into cash expressed and payable in Birr or foreign currency having acceptance by the National Bank and other assets as the National Bank may from time to time declare to be liquid assets. On the other hand, deposit refers to demand (current) deposits, savings deposits and fixed time deposits of banks and short term financing refers any borrowing secured from the National Bank of Ethiopia or any other interbank loans with maturity period of less than one year.

This ratio indicates the percentage of short term obligations that could be met with the bank's liquid assets in the case of sudden withdrawals. It is to ascertain whether the bank's short-term assets are readily available to pay off its short-term liabilities. As deposits are able to be withdrawn at any time they play an important role on the bank's liquidity position. This ratio is more focused on the bank's sensitivity to selected types of funding i.e. customer deposit. The higher this ratio signifies that the bank has the capacity to absorb liquidity shock and the lower this ratio indicates the bank's increased sensitivity related to deposit withdrawals

➢ $L = \dfrac{\text{Liquid Asset}}{\text{Deposit}}$

3.6.2. Independent Variables

This section describes the independent variables that are used in the econometric model to estimate the dependent variable i.e. liquidity of private commercial banks.

Size of the Bank (SIZE): The bank's total asset is another bank specific variable that affects the liquidity of a bank. Bank size measures its general capacity to undertake its intermediary function. There are two opposing arguments regarding to the relationship between bank liquidity and bank size. The first view is "too big to fail" which considers negative relationship between bank size and liquidity whereas; the second view considers there is a positive relationship between bank size and liquidity. In this study, bank size is measured by the natural logarithm of total asset of the bank and it is expected positive relationship between bank size and liquidity and then draws the following hypothesis.

H1: Bank size has negative and significant impact on bank's liquidity

Loan Growth of the Bank (LG): According to NBE directive No. SBB/43/2008, loans & advances means any financial asset of a bank arising from a direct or indirect advances fund by a bank to a person that is conditioned on the obligation of the person to repay the fund on a specified date or on demand with interest. Loans & advances are the major earning asset of the bank. Loans & advances are granted to customer from the amount collected from depositors of the bank. In this regard, when banks transform short term deposits to long term loans, which have a maturity mismatch, they will be vulnerable to liquidity problem**.** Therefore, the increase in loan means increase in illiquid assets and decrease in short term/liquid assets. As it was discussed in the literature review part, it is expected that, there is a negative relationship between bank loan growth and liquidity. For this study loan growth is measured by the annual growth rate of outstanding gross loans & advances of the bank and the following hypothesis is drawn.

H2*: Loan growth has negative and significant impact on bank's liquidity*

Non-performing Loans (NPL): Non-performing loans means loans & advances whose credit quality has deteriorated such that full collection of principal and/or interest in accordance with the contractual repayment term of the loan or advance is in question (NBE directive No. SBB/43/2008). The rise of non-performing loan portfolios in banks significantly contributed to financial distress in the banking sector. Non-performing loans are the main contributor to liquidity risk, which exposes banks to insufficient funds for operations. As loans & advances are the major portion of bank's asset, when they become non-performing, it will affect both profitability and liquidity of the bank.

For the purpose of this study, the proxy for non-performing loans is the share of non-performing loans on total volume of loans & advances. Based on prior studies, it is expected that there is a negative relationship between non-performing loans and liquidity of the bank and as a result the following hypothesis is drawn.

H3: Non-performing loans has negative and significant impact on bank's liquidity

Capital Adequacy of Banks (CAP): Capital is the amount of own fund available to support the bank's business and act as a buffer in case of adverse situation Athanasoglou(2005). Capital of a bank includes paid up capital, undistributed profit (retained earnings), Legal reserve or other reserves and surplus fund which are kept aside for contingencies. Regulators in most countries define and monitor CAP to protect depositors, thereby maintaining confidence in the banking system. Though capital adequacy ratio can be measured by the ratio of total capital to risk weight asset, for the purpose this study, the proxy for capital adequacy is the ratio of total capital of the bank to total asset of the bank.

> $$CAP = \frac{Total\ Capital}{Total\ Asset}$$

This ratio measures how much of bank's asset are funded with owner's funds and is a proxy for the capital adequacy of a bank by estimating the ability to absorb losses. As it is discussed in the literature review part, there are two opposing theoretical views regarding to the relationship between banks liquidity and capital adequacy. Some previous studies such as the "financial fragility-crowding out" theories predicts that higher capital reduces liquidity creation (Diamond and Rajan (2000, 2001) and hence, there is negative relationship between capital adequacy and bank liquidity whereas, Al-Khouri (2012) found that, bank capital increases bank liquidity through its ability to absorb risk and thus the higher is the bank's capital ratio, the higher is its liquidity creation. This study considered there is a positive relationship between capital adequacy & liquidity and draws the following hypothesis.

H4: Capital adequacy has positive and significant impact on bank's liquidity

Interest Rate Margin (IRM): In the financial intermediation process, a bank collects money on deposit from one group (the surplus unit) and grants it out to another group (the deficit unit). These roles involve bringing together people who have money and those who need money. In such intermediation function, the bank will earn interest from loans & advances and pay interest

for depositors. If a bank has done a good job of asset and liability management, it can earn substantial income on its assets and pay low costs on its liabilities. Thus, how well a bank manages its assets and liabilities is measured by the spread between the interest earned on the bank's assets and interest costs on its liabilities.

Although there are number of ways to calculate the interest rate margin, for the purpose of this study, it is defined as the difference between interest income from loan and advances as a fraction of the total loan and advances and the interest paid out on deposit as a percentage of total deposits (previously used by Azeez (2013). As this interest rate margin increases, banks are encouraged to grant more loans from short term deposit and it lowers liquidity, thus the following hypothesis is drawn,

H5: Interest rate margin has negative and significant impact on bank's liquidity

Profitability of the Bank (ROA): Liquidity needs constrain a bank from investing its entire available fund. Banks need to be both profitable and liquid which are inherently conflicts between the two and the need to balance them. As more liquid asset is investing on earning assets such as loans & advances, profitability will increase by the expense of liquidity. As a result, banks should always strike a balance between liquidity and profitability to satisfy shareholders' wealth aspirations as well as liquidity requirements. The study made by Owolabi, (2011) evidence that, there is a trade-off between profitability and liquidity in that, the increase in either one would decrease the other. The other study made by Vodova (2013), suggest a negative influence on bank profitability (measured by return on equity) and bank liquidity. Most commonly, profitability is be measured by return on asset (ROA) and return on equity (ROE). For the purpose of this study, profitability is measured by return on asset, because the growth of Asset of commercial banks is higher than the growth of Capital mostly banks her in Ethiopia has assets in billions when we look at their financial statements the give much emphasis on the growth of assets. And hence, it better to measure profitability by using return on asset (ROA) by the ratio of profit before tax to total asset.

> $$\text{ROA} = \frac{\textbf{Net profit before tax}}{\textit{Total Asset}}$$

H6: Profitability has negative and significant impact on bank's liquidity

Gross Domestic Product (GDP): GDP is an indicator of the economic health of a country, as well as the gauge of a country's standard of living. It is the measurement of level of economic activity of a country. According to previous studies, when the economy is at boom or goes out of recession, economic units including banks are optimistic and increase their loans & advances and as a result decrease their holding of liquid assets. On the other hand, during recession, business operations reduces borrowers' capability to service their obligations which increases bank's NPLs and eventually decreases bank's liquidity. For the purpose of this study, GDP is measured by the Annual real Growth rate of gross domestic product and it is hypothesized to affect banking liquidity negatively.

H7: Real GDP growth rate has negative and significant impact on bank's liquidity

Short Term Interest Rate (STIR): Interest rate is the price that has to be paid by a borrower of money to a lender of money in return for the use of the funds. Short term interest rate is the rate paid on money market instruments that have less than one year maturity. The most popular money market instrument (securities) in Ethiopia is Treasury bills. Treasury bills are the most important since they provide the basis for all other domestic short term interest rates. The Treasury bills in Ethiopia have a maturity period of 28, 91, 180 and 364 days (NBE/TRB/001/2011). The higher short term interest rate induces banks to invest more in the short term instruments and enhance their liquidity position Pilbeam, (2005). Treasury Bills are considered as liquid asset of the banks. In this study the proxy for short term interest rate is the annual weighted average interest rate of Treasury Bills and the following hypothesis is drawn

H8: Short term interest rate has positive and significant impact on bank's liquidity

Inflation Rate (INF): Another important macroeconomic variable which may affect liquidity of banks is the inflation rate. During inflation; the central bank can raise the cost of borrowing and reduce the credit creating capacity of commercial banks. Recent theories emphasize the importance of informational asymmetries in credit markets and demonstrate how increases in the rate of inflation adversely affect credit market frictions with negative repercussions for financial sector performance. During inflation, it is expected that, banks will make fewer loans and the amount of liquid or short term assets held by economic agents including banks will rise. On the other hand, during inflation the cost of living will rise and deposits are expected to be reduced and as a result liquidity will be affected negatively.

For the purpose of this study, inflation is measured by the annual general consumer price index and a negative relationship between inflation rate and banks liquidity is expected.

H9: Inflation rate has positive and significant impact on bank's liquidity

In general, the study considered the above nine independent variables as a determinant for banks liquidity. The dependent and independent variables of the study with their respective operational definition and expected signs are explained below:-

Table 3.1. Operational definition of the variables and their expected relationship

Variables	Symbol	Operational Definition	Source	Expected sign
Dependant				
Liquidity (L)	L	The ratio of liquid asset to deposit	Annual report	NA
Independent				
Size of the bank	SIZE	Natural logarithms of total asset	Annual report	-VE
Loan growth	LG	Annual growth rate of loans & advances	Annual report	-VE
Non-performing loans	NPL	Share of non-performing loans on total volume of loans	Annual report	-VE
Capital Adequacy	CAP	Share of equity to total asset	Annual report	+VE
Interest rate margin	IRM	The difference between interest income from loan and advances as a fraction of the total loans and advances and the interest paid out on deposit as a percentage of total deposits.	Annual report	-VE
Profitability	ROA	The ratio of profit before tax to total asset	Annual report	-VE
Gross domestic product	GDP	Annual real Growth rate of gross domestic product	NBE Publication	-VE
Short term	STIR	Annual weighted average interest	NBE reports	+VE

interest rate		rate of Treasury Bills		
Inflation	INF	Annual general consumer price index	CSA reports	+VE

3.7 Model Specification

The model specification, for the determinants of liquidity of Ethiopian private commercial banks, in this study was adopted from Vodova (2011, 2013), Tseganesh (2012), Belete (2015), Nigist (2015) and Muhammad (2013). This study, considered whether the use of the particular variable makes economic sense in Ethiopian private commercial banks context. As a result some variables are excluded from the analysis such as financial crises, interbank rate, political incidents, unemployment rate and impact of economic reforms.

To examine the determinants of liquidity of Ethiopian Private commercial banks, the researcher was used the **fixed effects model**. It is one of panel data model which enables to control for unobserved heterogeneity among cross sectional units and to get the true effect of the explanatory variables. The study used a **balanced panel regression** technique and **ordinary least square (OLS)** methods to analyse the impact of bank specific as well as macroeconomic determinants on Ethiopian private commercial banks liquidity. The panel data or longitudinal data comprises of both cross-sectional elements and time-series elements; the cross-sectional element is reflected by the sample Ethiopian private commercial banks and thetime-series element is reflected in the period of study (2001-2015). For each liquidity ratio, we estimate the following equation:

$Lit = \alpha + \beta Xit + \delta i + \varepsilon it$

where *Lit* is liquidity ratios for bank *I* in time *t*, *Xit* is a vector of explanatory variables for bank *I* in time *t*, *α* is constant, *β* are coefficient which represents the slope of variables, *δi* denotes fixed effects in bank *I* and *εit* is the error term the subscript *I* denote the cross-section and *t* representing the time-series dimension.

Therefore the general models which incorporate all of the variables to test the determinants of liquidity of Ethiopian private commercial banks were:

Lit = α + β1 (CAPit) + β2 (SIZEit) + β3 (LGit) + β4 (NPLit) + β5 (ROAit) + β6 (IRMit) + β7 (GDPt) + β8 (INFt) + β9 (STIRt) +δi + εit

Where:

Lit: represents the bank's liquidity measured by liquid asset to deposit ratio of ith bank on year "t"

CAPit: is capital adequacy of ith bank on the year "t"

SIZEit: is the size of ith bank on the year "t"

LGit: is the loan growth of ith bank on the year "t".

NPLit: is the non-performing loan of ith bank on the year "t".

ROAit: is the return on asset of ith bank on the year "t".

IRMit: is interest rate margin of ith bank on the year "t".

GDPt: is the gross domestic product growth of Ethiopia on the year "t".

INFt: is the inflation rate in Ethiopia on the year "t".

STIRt: is the short term interest rate of Ethiopia on the year "t".

δi: denotes fixed effects in bank "i"

εit: is a random error term

For the purpose of this study, diagnostic tests are performed to ensure whether the assumptions of the CLRM are violated or not in the model. Thus, the following section discusses about the nature and significance of the model misspecification tests.

♣ Testing for the Average value of the error-term is zero

The average value of the errors term should be zero. As per Brooks (2008), if a constant term is included in the regression equation, this assumption will never be violated. Therefore, since the constant term was included in the regression equation, this assumption is expected to be not violated.

♣ Test for heteroscedasticity

To test for the presence of heteroscedasticity, the popular white test was employed. This test involves testing the null hypothesis that the variance of the errors is constant (homoscedacticity) or no heteroscedasticity versus the alternative that the errors do not have a constant variance.

♣ Test for Autocorrelation

This is an assumption that the errors are linearly independent of one another (uncorrelated with one another). If the errors are correlated with one another, it would be stated that they are auto correlated. To test for the existence of autocorrelation or not, the popular Durbin-Watson test was employed.

♣ Test for Normality

As noted in Brooks (2008) a normal distribution is not skewed and is defined to have a coefficient of kurtosis of 3. One of the most commonly applied tests for normality; the Bera-Jarque formalizes these ideas by testing whether the coefficient of skewness and the coefficient of excess kurtosis are zero and three, respectively. Brooks (2008) also states that, if the residuals are normally distributed, the histogram should be bell shaped and the Bera-Jarque statistic would not be significant at 5% significant level.

♣ Test for Multi-collinearity

To test the independence of the explanatory variables or to detect any multicollinearity problem in regression model the study used a correlation matrix of independent variables. The problem of multicollinearity usually arises when certain explanatory variables are highly correlated. Usually, as noted by Hair, (2006) correlation coefficient below 0.9 may not cause multicollinearity problem. In contrary to this, Kennedy, (2008) argued that as any correlation coefficient above 0.7 could cause a serious multicollinearity problem leading to inefficient estimation and less reliable results.

The bank specific variables are both cross-sectional and time variant whereas the macroeconomic variables are only time variant but are converted into panel data type by including macroeconomic variables for each cross sectional unit.

3.8 Methods of Data Analysis

To conduct this research, data was collected from secondary sources. The bank specific variables were collected from annual audited financial reports of the sample banks and the macroeconomic variables were collected from the National Bank of Ethiopia and Central Statistics Agency. To test the proposed hypotheses, statistical analyses carried out using the following methods: First, descriptive statistics of the variables (both dependent and independent) were calculated over the

sample period. This is in line with Malhotra (2007), which states using descriptive statistics methods helps the researcher in picturing the existing situation and allows relevant information. Then, correlation analyses between dependent and independent variables were made. Finally, ordinary least square/OLS regression approach including all of its assumptions was employed.

The assumptions were tested to see the applicability of the regression models developed first to test the relationship between banks liquidity and independent variables and then to see the impact of banks liquidity on financial performance through the significant factors explaining liquidity of commercial banks in Ethiopia. Then the collected data were organized and financial ratios were computed for each bank of each bank specific variables. To conduct this, the researcher uses statistical tools E-views 6 software. The researcher has also performed diagnostic tests to ensure whether the assumptions of the CLRM are violated or not. Based on the results of the regression, each variables and the relative importance to influence liquidity were interpreted and the proposed hypotheses are tested statistically to arrive at the research objective.

Chapter Four

Data Presentation and Analysis

In this chapter, detail analyses about the descriptive statistics and regression result have been made. Specifically, the chapter has four parts. The first part presented **descriptive analysis** of the dependant and independent variables summarized and tabulated to provide an insight on the distribution of the data using average, standard deviation, maximum and minimum for the given period (2001 to 2015) of the studied banks. The second part presented the **correlation analysis** based on the result of dependant and independent variables. The third part presented the **classical linear regression model** diagnosis result. Finally, analysis and discussion of the **regression results** were presented.

4.1. Descriptive Analysis

The descriptive analysis is important in providing an insight about the distribution of the data by bank and across time as well as their averages. This section presents the summary of data by using regression model and provides statistical descriptive analysis of the dependant and independent variables using different measurements.

❖ Descriptive Analysis of Dependant and Independent Variables

In this study the liquidity of private commercial banks can be measured by dependent variable which is measured by liquid asset to deposit (L). As it is explained in the literature, the two most widely used approaches to measure liquidity of banks are liquidity gap approach (flow approach) and liquidity ratio approach (stock approach). Though both approaches are intuitively applying, the flow approach is more data intensive and there is no standard technique to forecast liquidity inflows and outflows. As a result, the stock approaches are more popular in practice and in the academic literature due to the availability of a more standardized method. The ratios which are used in this study are liquid asset-to- deposits.

Variables are classified as dependent and independent variables and or macro and micro. Even though, there are number of independent variable that affect liquidity, for the purpose of the study the following independent variables are used: capital adequacy ratio, bank size, loan growth, non-performing loans, return on asset, interest rate margin, gross domestic product,

inflation and short term interest rate are categorized under microeconomic variables or bank specific. Gross domestic product, inflation and short term interest rate are macroeconomic variables.

Table 4.1 Descriptive statistics of the dependent and independent variables.

	L1	SIZE	LG	NPL	CAP	IRM	ROA	GDP	STIR	INF
Mean	0.458874	8.241858	0.286203	0.077221	0.130712	0.073589	0.035583	0.091133	0.011632	0.123867
Median	0.446288	8.433495	0.239281	0.058350	0.121259	0.070339	0.038300	0.103000	0.011260	0.106000
Maximum	0.781987	10.117150	0.859322	0.379500	0.294393	0.115851	0.056833	0.126000	0.028000	0.364000
Minimum	0.183921	5.365976	-0.099881	0.015300	0.064251	0.044611	0.005131	-0.021000	0.000380	-0.106000
Std. Dev.	0.137676	1.126231	0.293623	0.063465	0.039353	0.018142	0.011345	0.039607	0.007581	0.120470
Observations	90	90	90	90	90	90	90	90	90	90

Source: E-views 6 output from financial statements of sampled banks and own computation

4.1.1 Descriptive Analysis of Dependent variable

Liquid Asset to Deposit (L): The above table 4.1 explains the overall average liquid asset-to-deposit of the studied banks (DB, AIB, BOA, WB, UB, and NIB) was 46%over the period of fifteen years and the standard deviation 14% which is deviate from the average which is moderate in this study liquidity is measured by liquid asset-to-deposit ratio. The maximum liquid asset to current liability or deposit was 78% and the minimum liquid asset ratio was 18%. On average one can say that the studied banks are liquid enough for the period (2001 to 2015), when compared to the requirement set by National Bank of Ethiopia. As per directive number SBB/57/2014 issued by the National Bank of Ethiopia required commercial banks to maintain liquid asset of not less than fifteen percent (15%) of its net current liabilities (which includes the

sum of demand deposits, saving deposits, time deposits and similar liabilities with less than one-month maturity. The studied result for both maximum and minimum values is above the minimum requirement of 15%.

4.1.2 Descriptive Analysis of Independent Variables

As it discussed in the above literature, variables are classified as dependent and independent variables. For the purpose of the study the following independent variables are included: capital adequacy ratio, bank size, loan growth, non-performing loans, and return on asset, interest rate margin, gross domestic product, inflation and short term interest rate. The above listed variables further categorized under macro and microeconomic variables. Only domestic product, inflation and short term interest rate are macroeconomic variables while others are bank specific variables.

Bank Size (SIZE): refers to what the bank possesses and useful to measure the bank's general capability to undertake its intermediary function. In this study, the proxy used to measure bank size was the natural logarithm of the total asset.

As it is shown in figure 4.1 above, the maximum value recorded was 10.11 and the minimum was 5.37 and the average size of total assets was 8.24.The standard deviation of 1.13 reveals that there was high dispersion of the size of average total asset of the studied banks in the given period (2001 to 2015) from its mean value. When the size of the bank increases measured by total asset as the same time the liquidity of the banks also increases.

Loan Growth Rate (LG): it is the other microeconomic variable, which affect liquidity and measured by the annual growth rate of total loans & advances of a bank. The major role of commercial banks are its intermediation function to surplus unit and lending unit, which means that collects money from depositors and grants to needy group. Hence, one can say that lending is the principal business activity for all commercial banks in Ethiopia and the loan portfolio take the largest parts of the asset and the predominate source of revenue.

The above table 4.1 displays, the average loan growth rate of the studied banks for the studied period (2001 to 2015) was 28.6%. The maximum average loan growth rate was 85.9% registered for the six studied banks for the last fifteen years and the minimum average loan growth rate was

(10%) which is negative. This implies that, on average for some specific period the studied banks almost stop giving loans rather collect the dispersed loan in previous years. The standard deviation of 29.4% indicates there was high dispersion of the average loan growth rate towards its mean value at significant amount of percentage. As discussed above, the major activities of commercial banks is providing loans, which has a direct relationship with banks liquidity negatively.

Non-Performing Loans (NPL): As per NBE definition Non-Performing Loans(NPL) is the loan whose credit quality has deteriorated such that full collection of principal and/or interest in accordance with the contractual repayment term of the loan or advance is in question. And it is measured by the share of non-performing loans from the total loans of the bank. The National Bank of Ethiopia has provided direction to all commercial banks to maintain the NPL ratio below 5%.

Table 4.1 above shows that, the average NPL ratio of the studied banks for the given period (2001 to 2015) was 7.7% and their maximum ratio became 37.9% was recorded. But the minimum NPL ratio was 1.5% was recorded which is far from the maximum. The result indicates that the asset quality of banks (NPL) or the collection efficiency of the studied banks has shown an improvement from period to period but compared to the minimum requirement set by national bank still there is a difference from 5% from that of the average 7.7%. On the other hand, the standard deviation of 6.7% reveals there is little dispersion on NPL ratio from its average. If banks cannot manage the quality of the loans, it has an impact on percentage of NPL and further it affect the liquidity and continuous to profitability.

Capital Adequacy Ratio (CAP): As it is shown on the above table 4.1the average capital adequacy ratio of the studied banks were 13% for the studied banks. And the maximum capital adequacy ratio were 29% which was recorded by the six studied banks over fifteen period shows that, during that time the total asset of the studied banks were at its lowest level as compared to its capital of the banks. The average standard deviation of 3% for CAP reveals there was very little dispersion from the average capital adequacy ratio. For this study Capital adequacy refers to the sufficiency of available fund to absorb losses to protect depositors, creditors, etc in the interest of maintaining financial system stability. As per NBE requirement (NBE directive no

SBB/9/95) capital adequacy is measured by the ratio of regulatory capital to risk-weighted assets and accordingly a minimum of 8% is required. However, the proxy for capital adequacy measurement used in this study was the ratio of equity to total asset. The higher this ratio entails the capability of the bank to absorb losses from its own capital. Both maximum and minimum of capital adequacy ratio shows all the selected banks are in better position of the required capital set by NBE.

Interest Rate Margin (IRM): It is one of the microeconomic variables affect liquidity and computed by the difference between the interest earned on loans & advances as a fraction of total loans & advances (interest income) and the interest paid out on deposit as a fraction of total deposits (interest expense). The interest rate for loans and advances is freely determined by the board of directors of each bank and as a result banks have different lending rate. In some literature interest rate margin categorized under macroeconomic variables, especially by considering those countries having managed interest rate for both lending and deposit rate, rather determined by respective national banks, in that case individual banks cannot set their Owen interest rate. The interest rate margin depicts the net interest earned from intermediation activities of the bank. For this study interest rate margin is classified under microeconomic (bank specific) variables.

As one can see from the above table 4.1, revealed that the average interest rate margin of the six studied banks for the period 2001 to 2015) was 7.4 %, in short which is the average difference between lending and deposit rate. The minimum interest rate recorded for the given period for six selected banks ((DB, AIB, BOA, WB, UB, and NIB) was 4.46% and their maximum interest rate margin was 11.6%.The standard deviation reveals that there is little dispersion of the average interest rate margin from its mean value by 1.8% which is very minimal.

Profitability (ROA): defined as the likelihood of a business earning the desired level of income within a specific period of time under certain prevailing business conditions. It can be measured by return on asset (ROA) and return on equity (ROE).For the purpose of this study, profitability was measured by the return on asset and further (ROA) was measured by the ratio of profit before tax to total asset. Profit before tax was used in order to avoid the impact of different period's tax rate on the performance of the bank.

The above table 4.1 shows that the average return on asset of studied banks for the given period (2001 to 2015) was 3.5%.The minimum return on asset became and the maximum return on asset became 5.7%. On the other hand the standard deviation of 1.1% reveals that there was very little dispersion of average return on asset of studied banks towards their mean value. When bank holds productive asset which includes liquid asset directly contribute to the growth of profitability and indirectly when profitability increases it will affect liquidity negatively because the major part of the profit of banks derived from loans.

Gross Domestic Product (GDP): Referred to the above table 4.1, The Ethiopian economy continued to grow and the overall economic performance reflected the rapid expansion of the countryon average GDP growth at a rate of 9.1%for the last fifteen years. The maximum growth of the economy was recorded from the past fifteen years 12.6% and the minimum growth rate recorded was -2.1% negative growth rates. The standard deviation of 3.9 % also indicates that there was little dispersion on the real GDP growth rate from the average or the actual growth rate recorder was deviate from the average by 3.9% which is moderate. The implication of the analysis directly or indirectly implies that, the growth of the country GDP affect the banks liquidity. For the purpose of this study Gross Domestic Product (GDP) defined as an indicator of the economic health of a country as well as the gauge of a country's standard of living. It is the measurement of level of economic activity of a country and measured by the Annual Real Growth rate of Gross Domestic product categorized under macroeconomic variable.

Short term interest rate(STIR): is the rate paid on money market instruments that have less than one year maturity. The most popular money market instrument (securities) in Ethiopia is Treasury bills which is managed by the Government. Treasury bills rate is a risk free rate, and if the rate of interest paid to banks increases, banks tends to invest more as it has short term nature and this enhance their liquidity position. In this study the proxy for short term interest rate is the annual weighted average interest rate of Treasury Bills.

As it is shown in figure 4.1 above, the average short term interest rate of 1.16 was paid by NBE and the minimum rate was 0.04% which is near to zero. The maximum of the rate for the last fifteen years was 2.8%. The standard deviation of 0.7% refers there was very little dispersion towards the mean value which is near to zero.

Inflation Rate (INF): The above table 4.1 depicts, the mean value of the general inflation rate of the country over the past fifteen years was 12.4%, which was more than that of the average real GDP growth by 3.3%. The maximum inflation rate recorded from the last fifteen years was 36.40%and the minimum inflation rate from the last fifteen years taken data was (10.6%) which was negative. The actual rate of inflation was highly deviated from the average over the periods under study was 12.05%, which is more than 10%. Accordingly, the National Bank of Ethiopia has been closely monitoring monetary development so as to arrest the speed of inflation and inflation expectation.

During inflationary period, the central bank can raise the cost of borrowing and reduce the credit creating capacity of commercial banks or reduce Government spending/Investment and other Fiscal measure to control inflation. As the same time, it is expected that, banks will make fewer loans and the amount of liquid or short term assets held by economic agents including banks will rise. On the contrary, during inflation the cost of living of households will rise and depositors may force not to deposit money to banks or they may force to withdraw more money from banks to cover the increase price level of goods and services. As a result liquidity may affect negatively.

4.2 Correlation Analysis

In this section, the correlation between the dependant variables (L) and the independent variables (CAP, SIZE, LG, NPL, ROA, IRM, GDP, INF, and STIR) have been presented and analysed. According to Brooks (2008), correlation between two variables measures the degree of linear association between Independent and dependent variables. To find the association of the independent variables with dependant variables Pearson Product Moment of Correlation Coefficient was used in this study. Correlation coefficient between two variables ranges from +1 (i.e. perfect positive relationship) to -1 (i.e. perfect negative relationship) and a correlation coefficient of zero, indicates that there is no linear relationship between the two variables. If the correlation coefficient of the two variables become +1, it means that when the independent variable increases/decreases and the dependent variable also increases/decreases by equal amount. And if the correlation coefficient of the two variables become -1 it implies that when, the independent variable increases/decreases and the dependent variable also decreases/increases

by equal amount but in opposite direction and if it zero there is no relationship between the two variables.

Table 4.2.1: Correlation matrix of the dependent (L) and independent variables

	CAP	SIZE	LG	NPL	ROA	IRM	GDP	INF	STIR
L	0.156	(0.201)	(0.154)	0.160	0.154	(0.167)	(0.036)	0.191	(0.202)

The above Table 4.2.1 shows the correlation coefficient between the dependent variables and independent variables. The correlation coefficient among variables (bank specific) of capital Adequacy, non-performing loans and return on asset which measures profitability are positively correlated with L with correlation coefficient of 0.156, 0.160 and 154 respectively. While size, loan growth, and interest rate margin are negatively correlated with liquidity with correlation coefficient of 0.201, 0.154 and0.167 respectively. The macroeconomic variables, inflation (INF) are positively correlated with L with correlation coefficient of 0.191 and gross domestic product (GDP) and short term interest rate (STIR) have negatively correlated with L with correlation coefficient of 0.036 and0.202 respectively. Out of the independent variables of both microeconomic (bank specific) and macroeconomic, size and short term interest rate have shown the highest negative correlation with L and inflation from macroeconomic variables shows the highest positive correlation coefficient of 0.191while GDP shows the lowest negative correlation coefficient of 0.036and ROA has shown the lowest positive correlation coefficient of 0.154. In general one can say that there is a correlation between independent variables and dependent variables but it is not strong enough, because it is far from +1 and -1 in both directions.

4.3 Fixed Effect (FEM) versus Random Effect (REM) Model

The data collected for this research is analysed based on two classes of panel estimator approaches; FEM and REM. The panel model also included cross sectional for the selected banks and time series for the observations of selected private commercial banks for the period (2001 to 2015). The selection of panel estimator is done based on the sample determination, to use random

effects model, is more appropriate if the entities in the sample have been randomly selected from the population. While, to use fixed effect model is more appropriate if the entities in the sample effectively constitutes the entire population (Brooks, 2008). On the other hand, according to Gujarati (2004), if the number of time series data is large and the number of cross-sectional units is small, there is likely to be little difference in the values of the parameters estimated by fixed effect model and random effect model. Accordingly in this study, the number of cross section units is six and the number of time series data is Fifteen which is more than the cross section unit and as the sample of private commercial banks were not selected randomly, the fixed effect model is more appropriate than the random effect model and then the fixed effect model is used in this study.

4.4Testingthe Classical Linear Regression Model (CLRM) Assumptions

Once we select between random effect and fixed effect, the next step of the researcher to be carried out relevant diagnostic testing to identify for any violation of the underlining assumption of the classical linear regression model (CLRM). For the purpose of testing the researcher considers five assumptions, which ensures that the estimation technique, it was assumed that **average values of the error-term is zero**, **the variance of the errors are constant (homoscedacticity)**, the covariance between the error-terms are zero (no autocorrelation), the error-terms are normally distributed (normality) and explanatory variables are not correlated (absence of multicollinearity).

4.4.1Testing for the Average value of the error-term is zero

The first CLRM assumption requires, the average value of the errors term should be zero. As per Brooks (2008), if a constant term is included in the regression equation, this assumption will never be violated. Therefore, since the constant term was included in the regression equation, this assumption is expected to be not violated.

4.4.2Testing for the variance of the error-term is constant

It is also known as the assumption of homoscedacticity. The second assumption of classical leaner regression model (CLRM) which explains, that the variance of the error-term is constant. If the errors do not have a constant variance or if the residual of the regression have

systematically changing variability over the sample, they are said to be heteroscedastic means the estimated parameter will not be BLUE because of the inefficient parameter. To test the assumption White test was used, it states that if the **P** value is significant at 95 confidence interval, the data has heteroscedasticity problem, whereas if the value is insignificant (greater than 0.05). Both F-statistics and Chi-square (χ^2) tests were applied to decide whether to reject the null hypothesis by comparing p-value with significant level. Referring to (Appendix II) both the F-test- and χ^2 versions of the test statistic give the same conclusion that there is no evidence for the presence of heteroscedasticity for L, since the p-values 24.09% which is considerably in excess of 0.05 and below 95 confidence level. In general, the entire regression model used in this study reveals that the variance of the error term is constant or homoscedacticity.

4.4.3 Testing for the covariance between the error-terms are zero-(no autocorrelation)

It is the third assumption of the CLRM. In other words, it is assumed that the errors are uncorrelated with one another. If the errors are not uncorrelated with one another, it would be stated that they are 'auto correlated' or they are 'serially correlated'.

The first step in testing whether the error series from an estimated model are auto correlated would be to plot the residuals and looking for any patterns. However, graphical methods are difficult to interpret in practice and hence a formal statistical test should also be applied. The study used Durbin and Watson (1951) (DW), is a test for first order autocorrelation - i.e. it tests only for a relationship between an error and its immediately previous value $(u_t = \rho u_{t-1} + v_t)$. DW is approximately equal to 2(1-p), where p is the estimated correlation coefficient between the error term and its first order lag (Brooks 2008).

According to Brooks (2008), the DW test does not follow a standard statistical distribution such as a *t, F, or χ^2*. DW has 2 critical values: an upper critical value (*dU*) and a lower critical value (*dL*), and there is also an intermediate region where the null hypothesis of no autocorrelation can neither be rejected nor not rejected. The rejection, non-rejection, and inconclusive regions are shown on the number line in figure 4.4.3.1 below:

Figure 4.4.3.1: Rejection and non-rejection regions for DW test

Reject H0: Positive Autocorrelation	Inconclusive	Do not reject H0: No evidence of Autocorrelation	Inconclusive	Reject H0: Negative Autocorrelation

```
|————|————————|————|————|—————————|————————|
0    dL              dU    2    4-dU         4-dL        4
     1.312   DW (1.738267)1.741   2.259        2.688
```
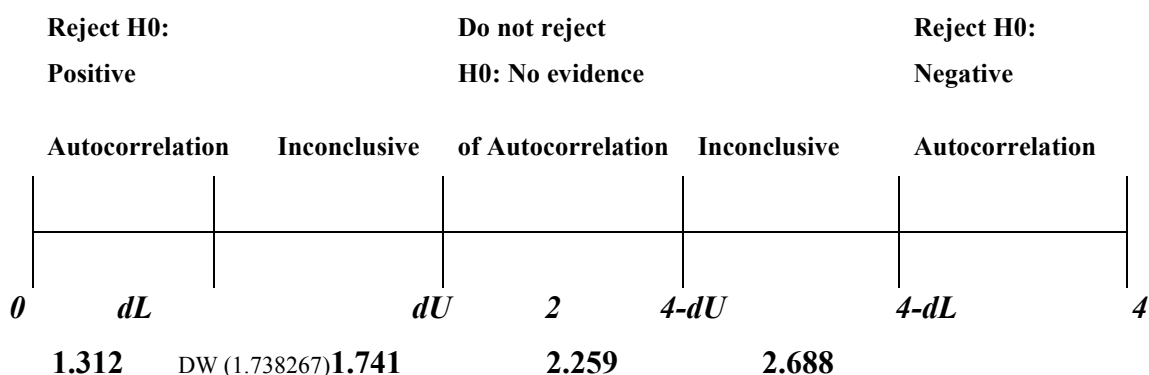
K= 9 and with 90 observation which is read from the attached (Annex V.)

The null hypothesis is rejected and the existence of positive autocorrelation presumed if DW is less than the lower critical value (DL); the null hypothesis is rejected and the existence of negative autocorrelation presumed if DW is greater than 4 minus the lower critical value (4-dL); the null hypothesis is not rejected and no significant residual autocorrelation is presumed if DW is between the upper critical value (DU) and 4 minus the upper critical limits (4-dU) (Brooks 2008).

This study have nine explanatory variables(k) with ninety observations and as per the DW table in Appendix-V for 90 observations with Nine explanatory variables at 1% level of significance, the dL and dU values are **1.312** and **1.741,** respectively. Accordingly, the value of 4-dU and 4-dL are **2.259** and **2.688,** respectively. The DW values of L for 90 observations in this study are **1.73826** (Appendix-I). The DW value of L lies a little far from no evidence of autocorrelation region, but actually in the inconclusive area where the null hypothesis of no autocorrelation still do not be rejected.

According to Brooks (2008), one of the most commonly applied test for normality is the Bera-Jarque (BJ) test. The entire distribution is characterized by the mean, variance, skewness and kurtosis. Skewness measures the extent to which a distribution is not symmetric to its mean value and kurtosis measures how fat the tails of the distribution are (Brooks, 2008). Thus a normal distribution is not skewed and is defined to have a coefficient of **kurtosis of three** and a coefficient of excess kurtosis of zero. If the residuals are normally distributed, the histogram

should be bell-shaped and BJ statistic would not be significant. The p-value of the normality test should be greater than 0.05 in order to not reject the null of normality at 5% level.

For the purpose of this study, the researcher used BJ normality test, to test the null hypothesis of normally distributed assumption. As shown in the histogram of Appendix (III), kurtosis was 3.6606 which is approach to three for L. On the other hand the p-value for the BJ test were 0.218288 for L which is not significant even at 10% level of significant to reject the null hypothesis. Thus the result of the test implies that the data were consistent with a normal distribution assumption.

4.4.4. Test for Normality

According to Brooks (2008), one of the most commonly applied test for normality is the Bera-Jarque (BJ) test. The entire distribution is characterized by the mean, variance, skewness and kurtosis. Skewness measures the extent to which a distribution is not symmetric to its mean value and kurtosis measures how fat the tails of the distribution are (Brooks, 2008). Thus a normal distribution is not skewed and is defined to have a coefficient of **kurtosis of three** and a coefficient of excess kurtosis of zero. If the residuals are normally distributed, the histogram should be bell-shaped and BJ statistic would not be significant. The p-value of the normality test should be greater than 0.05 in order to not reject the null of normality at 5% level.

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4.4.5. Test for Multicollinearity

The fifth assumption of (CLRM), which is describe the existence of exact linear association among some or all explanatory variables in the regression model. The test for multicollinearity helps to identify the correlation between explanatory variables and to avoid double effects of the independent variables. When the explanatory variables are highly correlated with each other,

there exists multicollinearity problem (Brooks, 2008). Though, there is no consistent argument on the level of correlation that causes multicollinearity, Hair et al 2006argues that correlation coefficient below **0.9** may not cause serious multicollinearity problems. Malhotra (2007) stated that multicollinearity problem exists when the correlation coefficient among variables is greater than **0.75**. Kennedy (2008) suggests that any correlation coefficient above **0.7** could cause a serious multicollinearity problem leading to inefficient estimation and less reliable results. This indicates that there is no consistent argument on the level of correlation that causes multicollinearity.

Table 4.4.5.1: Correlation Matrix of Explanatory Variables

	CAP	SIZE	LG	NPL	ROA	IRM	GDP	INF	STIR
CAP	1.000000								
SIZE	(0.193772)	1.00000							
LG	0.181966	(0.42886)	1.00000						
NPL	(0.155197)	(0.58033)	(0.12643)	1.00000					
ROA	0.256395	0.39999	0.10394	(0.66767)	1.00000				
IRM	0.291825	0.70002	(0.30158)	(0.50395)	0.35816	1.00000			
GDP	(0.091770)	0.46039	(0.14348)	(0.51239)	0.56129	0.27143	1.00000		
INF	(0.076304)	0.46487	(0.23008)	(0.33813)	0.33139	0.27084	0.29614	1.00000	
STIR	0.320557	(0.04823)	0.12283	0.00528	(0.11269)	0.38340	(0.48039)	(0.22591)	1.00000

Source: E-view results of the six sample private commercial banks

As the above table 4.4.5.1 displays, the correlation matrix for nine explanatory variables had been estimated and the highest correlation of 0.7000 existed between interest rate margin and bank size while, the second largest correlation coefficient of 0.6676 existed between return on Asset and Non-performing loan. In general the above table shown there is no correlation coefficient that exceeds 0.9, 0.75 and 0.7 based on the three opinions mentioned above, therefore the study doesn't have multicollinearity problem.

4.5. Results of Regression Analysis

This section discusses the regression results of the selected model fixed effect that determines the liquidity of private commercial banks in Ethiopia. There are three models described above, but for the purpose of this study Liquidity One (L), which is measured by the ratio of liquid asset to deposit (L). The reason for the selection of this model became NBE currently used to measure liquidity of commercial banks.

4.5.1. Determinants of Bank Liquidity Measured By L

The empirical model used in this study to identify the significant determinants of Ethiopian private commercial banks liquidity measured by liquid asset to deposit (L) was:

$$Lit = \alpha + \beta 1\ (CAPit) + \beta 2\ (SIZEit) + \beta 3\ (LGit) + \beta 4\ (NPLit) + \beta 5\ (ROAit) + \beta 6\ (IRMit) + \beta 7\ (GDPt) + \beta 8\ (INFt) + \beta 9 (STIRt) + \delta i + \varepsilon it$$

The following table presents the regression result of the determinants variables of private commercial bank's liquidity measured by the ratio of liquid asset to deposit (L).

Table 4.5.1: **Regression results of liquidity measured by L**

Dependent Variable: L

Total panel (Balanced) observations: 90

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.892445	0.176912	5.044570	0.0000
CAP	0.561919	0.337913	1.662908	0.1006
SIZE	(0.073464)	0.021851	(3.362062)	0.0012***
LG	(0.308088)	0.082464	(3.7360460	0.0004***
NPL	0.470693	0.282829	1.664233	0.1004
ROA	3.420375	1.324257	2.582864	0.0118**
IRM	0.529909	1.369528	0.386929	0.6999
GDP	(0.626254)	0.374154	(1.673784)	0.0985*
INF	0.533398	0.100009	5.333503	0.0000***
STIR	(3.980775)	2.005367	(1.985061)	0.0509*

		Effects Specification		

Cross-section fixed (dummy variables)

R-squared	0.734704	Durbin-Watson stat		1.738267
Adjusted R-squared	0.676556			
F-statistic	12.63524			
Prob(F-statistic)	0.000000			

***, **, and * denote significance at 1%, 5%, and 10% levels, respectively

Source: *Financial statement of sampled six commercial banks and own computation through E-views 6*

The above table 4.5.1 shows the results of the regression analysis on the determinant of the dependent variable(liquidity) which is measured by the ratio of liquid asset to deposit and the independent variables of bank specific variables and macroeconomic variables for the sample of six Ethiopian private commercial banks for the period (2001 to 2015).

The value of R-squared was 73.47% which explain coefficient of determination in this model and Adjusted R-squared of 67.66%, which means 67.66% change both increase or decreases of private commercial bank's liquidity (L) can be explained by the change on capital adequacy, bank size, loan growth, non-performing loans, return on asset, interest rate margin, gross domestic product, inflation and short term interest rate. And the remaining of 32.34% changes

was explained by other determinants which can be both macroeconomic or bank specific variables, which are not included in this model. Thus, the explanatory power of the model is high. The value of F-statistics is 12.63524 with p-value of 0.000000 which is used to measure the overall significance of the model. Thus, the p-value of F-statistics is zero at six digits, the null hypothesis is rejected and the model is significant even at 1% significant level.

As it is shown on table 4.5.1 above, among the independent variables categorized under bank specific, bank size (SIZE) and loan growth (LG), were statistically significant at 1% significant level, whereas return on asset (ROA) were statistically significant at 1% significant level. From the macroeconomic variables inflation (INF) had statistically significant at 1% significant level whereas gross domestic product (GDP) and short term interest rate (STIR) were statistically significant at 10% significant level, are factors affecting liquidity of Ethiopian private commercial banks which is measured by L.

Among the significant bank specific variables, bank size (SIZE) and loan growth (LG) had negatively related with liquidity (L) where return on asset (ROA) is positively related with L. From the macroeconomic variables Gross domestic product (GDP) and Short term interest rate (STIR) were negatively related, whereas Inflation (INF) were positively related with Liquidity (L).The other variables such as capital adequacy (CAP), interest rate margin (IRM), non-performing loan (NPL)were statistically insignificant impact on liquidity (L).

On the other hand the coefficient sign of bank size, non-performing loans, and return on asset, interest rate margin, inflation and short term interest rate were contrary to our expectations whereas the coefficient sign of capital adequacy, loan growth and gross domestic product were in-line with our expectations.

4.6. Discussion of the Regression Results

In this section, the relationship between the dependent variable and each independent variable were discussed on the basis of the findings on the study. The dependant variable, liquidity of Ethiopian private commercial banks, were measured by:- liquid asset to deposit ratio (L) and the independent variables were, capital adequacy, bank size, loan growth, non-performing loans, return on asset, interest rate margin, gross domestic product, inflation and short term interest rate. Further, the relationship between dependent and independent variables were discussed on the basis of

the findings of this study and related to the theoretical literature and also the finding of other researchers provided in the empirical review under this study.

4.6.1 Capital Adequacy and Bank's Liquidity

In this study, capital adequacy was measured by the ratio of total capital of the bank to total asset of the bank and it was hypothesized that capital adequacy has positive and significant impact on bank's liquidity. The argument is given by supporting the hypothesis of positive relationship of CAP and liquidity. But, there are theories which support positive and negative relationships of CAP and liquidity.

The results of the regression were displays capital adequacy is statistically insignificant impact on the determination of liquidity of Ethiopian private commercial banks. The coefficient sign of 0.5619 reveals that, there is a positive relation between liquidity of private commercial banks and capital adequacy of banks. This indicates that, when capital to total asset is increases by 1 unit, the liquidity of Ethiopian private commercial banks is also increased by 0.5619 units being other variables remains constant. This positive relation of the share of capital to total asset is consistent with the assumption that a bank with sufficient capital adequacy should be liquid too and in line with the risk absorption theory proposed by Diamond and Dybvig (1983) and it is also in line with our hypothesis and the findings of Tseganesh (2012), Vodova (2011, 2013) on Czech commercial banks and analysis Hungary commercial banks respectively.

In general capital adequacy has no statistically significant impact on liquidity of Ethiopian private commercial banks thus the first hypothesis: capital adequacy has positive and significant impact on bank's liquidity was rejected.

4.6.2. Bank Size and Bank's Liquidity

The second independent variables which is categorized under bank specific variables and measured by the natural logarithm of total asset and hypothesized as bank size has negative and significant impact on bank's liquidity. In the literature part there are theories support the positive and negative impacts of bank size on liquidity, but for the purpose of this study the argument is given based on the hypothesis. For example according to the "too big to fail" argument, large banks would benefit from an implicit guarantee, thus decrease their cost of funding and allows them to invest in riskier assets Iannotta, (2007). If big banks are seeing themselves as "too big to

fail", their motivation to hold liquid assets is limited. Therefore, "too big to fail" status of large banks could lead to moral hazard behaviour and excessive risk exposure and thus there can be negative relationship between bank size and liquidity.

The result of this study found that bank size had a negative and statistically significant impact on liquidity of Ethiopian private commercial banks at 1% significant level. This negative sign of the coefficient indicates an inverse relationship between bank size and bank's liquidity and the results of the study supports the above "too big to fail theories. The result of the study reveals that, being other variables constant, a one unit change on bank size had resulted in a 0.073 units change on liquidity of Ethiopian private commercial banks in opposite direction. This was consistent with the findings of Vodova (2011) on Hungary Commercial banks, Vodova (2013) on Poland Commercial Banks, but totally opposite to Nigist (2015) and Malik and Rafique (2013) on Pakistan commercial banks.

In generally, the result reveals that bank liquidity decreases with the size of the bank measured by natural logarithm of total asset in which medium and small sized banks may hold a buffer of liquid asset. Thus, the hypothesis: bank size has negative and significant impact on bank's liquidity was not-rejected at 1% significant level.

4.6.3. Loan Growth Rate and Bank's Liquidity

Lending is the principal business activity for most commercial banks and loan is one of the greatest sources of risk to a banks safety and soundness. Since loans are illiquid assets, increase in the amount of loans means increase in illiquid assets in the asset portfolio of a bank. In this study, the annual growth rate of gross loans and advances to customers was used to measure loan growth. The result of the study indicated that, loan growth had a negative and statistically significant at 1% significant level impact on liquidity of Ethiopian private commercial banks. The argument given to support the hypothesis, the amount of liquidity held by banks is heavily influenced by loan demand and it is the base for loan growth (Pilbeam 2005). If demand for loans is weak, then the bank tends to hold more liquid assets whereas, if demand for loans is high they tend to hold less liquid assets since long term loans are generally more profitable.

The negative sign of the coefficient indicates that, an inverse relationship between loan growth and liquidity. According to regression the result, a one percent change in the loan growth rate, keeping other things constant, had resulted in 3.08%changes on the level of liquidity of commercial banks in opposite direction. The result is consistent with Tseganesh (2012), Belete (2015) and opposite to Nigist (2015) and Vodova (2013) therefore, the hypothesis of loan growth has negative and significant impact on bank's liquidity was Not-Rejected at 1% significant level.

4.6.4. Non-Performing Loans and Bank's Liquidity

Non-performing loans are loans & advances whose credit quality has deteriorated such that full collection of principal and/or interest in accordance with the contractual repayment term of the loan or advance is in question (NBE directive No.SBB/43/2008). The rise of non-performing loan portfolios in banks significantly contributed to financial distress in the banking sector. Non-performing loan is measured as the share of non-performing loans on total volume of loans & advances.

The results of the regression displays, non-performing loan was statistically insignificant impact on the determination of liquidity of Ethiopian private commercial banks. The regression result of the model indicates that non- performing loans had positive and statistically insignificant impact on liquidity which is opposite to the hypothesis of Non-performing loans has negative and significant impact on bank's liquidity.

The result reveals that, taking all other things constant, a one percent change on non-performing ratio had a 47.07%change on liquidity of private commercial banks in opposite direction. According to Bloem and Gorter (2001), though non-performing loans may affect all sectors, the most serious impact is on financial institutions which tend to have large loan portfolios. On the other hand, large volume of non-performing loans portfolio will affect the ability of banks to provide credit and leads to loss of confidence and liquidity problems which support the hypothesis but the result is different.

The positive and statistically insignificant impact of non-performing loans on liquidity was consistent with the result of Vodova(2011), Tseganesh (2012)and Birehanu (2015).Therefore, the hypotheses stated; the share of non-performing loans in the total volume of loans & advances has negative and significant impact on bank's liquidity was rejected.

4.6.5. Profitability and Bank's Liquidity

The other independent bank specific variables were profitability which is measured by the return on asset (ROA). Profitability can be measured by both (ROA) and the regression result shows that, profitability had positive and statistically significant impact on liquidity at 5% significant level. The hypothesis was supported by the studies made by (Molyneux and Thornton 1992; Goddard et al. 2004) argued that holding liquid asset imposes an opportunity cost on the bank and has an inverse relationship with profitability. The study signifies positive relation was inconsistent with our expectation and the coefficient of 3.4204 revealed that, taking other independent variables constant, a one percent change on return on asset had a 342.04% change on liquidity of Ethiopian private commercial banks in the same direction.

This positive relation shows that, higher profitability leads to increase banks liquidity. However, in reality the major profitability of banks comes from loans and advances and in return the increase on loans leads to decrease in liquid asset as the loan provides from current assets, the result should have been in consistent with the hypothesis. In general, the result of this study was consistent with the findings of Vodova (2011) on Hungary commercial banks but opposite to Vodova (2011, 2013) on Poland and Slovakia commercial banks respectively and opposite to the finding of Nigist (2015) and Vodova (2012).Therefore, the hypothesis stated; profitability has negative and significant impact on bank's liquidity was rejected.

4.6.6. Interest Rate Margin and Bank's Liquidity

Interest rate margin is one of the most important factors that gauge the efficiency of financial institutions and hypothesized as interest rate margin has negative and significant impact on bank's liquidity. In this study, interest rate margin (IRM) was measured by the difference between interest income on loan and advances as a fraction of total loan and advances and the interest paid out on deposit as a fraction of total deposits.

According to the regression result of this study, interest rate margin had positive and statistically insignificant impact on liquidity of commercial. The implication of the result justifies high interest rate margin do not encourage banks to lend more rather it encourage banks to hold more liquid assets. According to the liquidity preference theory, lenders need high interest rate which includes the liquidity premium in order to lend. The basic idea underlining this theory is that,

lenders of funds prefer to lend short, while borrowers generally prefer to borrow long. Hence borrowers are prepared to pay interest rate margin/ a liquidity premium to lenders to induce them to lend long. The size of interest rate margin/ liquidity premium increases with the time to maturity. Therefore, as they got higher premium, lenders give up their liquid money (Pilbeam 2005) and increases lending and result in reduction liquid money, which support the hypothesis not the result.

As per the result of the study, the positive sign of 0.5299 indicated that, a one percent change on interest rate margin leads to 52.99% change on liquidity of Ethiopian private commercial banks. The final output of the result is consistent with Tseganesh (2012) and Nigist (2015). The positive coefficient as well as its statistically insignificant impact on liquidity was opposite to the hypothesis and the expectation, therefore the hypothesis was rejected.

4.6.7 GDP Growth Rate and Bank's Liquidity

Among the three macroeconomic variables taken for this study, GDP is the one that affect liquidity of commercial banks in Ethiopia and measured by the real growth rate. The study made by Painceira (2010) stated that, banks liquidity fondness is low in the course of economic boom where banks confidentiality expects to profit by expanding loanable fund to sustain economic boom while restricted loanable fund during economic downturn to prioritize liquidity. In line with this argument the loanable fund theory of interest states that, the supply for loan increases when the economy is at boom or going out of recession (Pilbeam 2005), those are some of the studies support the hypothesis of Real GDP growth rate has negative and significant impact on bank's liquidity.

As per the regression result, GDP had negative and statistically significant at 10% significant level on private commercial banks of liquidity. The negative coefficient of -0.626 indicated that a unit increases in annual real GDP rate leads to 62.6% unit decreases in liquidity of Ethiopian commercial banks, holding other variables constant. The finding of this study was in line with the findings of Nigist (2015); Vodová (2011) and opposite to Tseganesh (2012). Based on the above supporting analysis and regression result of the hypothesis was not-rejected.

4.6.8. Inflation Rate and Bank's Liquidity

The other macroeconomic variable included in this study was the inflation rate Ethiopia and was measured by the annual general consumer price index. Inflation had positive and statistically significant impact on liquidity of Ethiopian private commercial banks at 1% significant level. This positive relation was based on the theory that during inflationary economy, commercial banks are refraining from long term investment and prefer to hold risk free liquid asset like treasury bills. That is during, inflation it is expected that, banks will make fewer loans and the amount of liquid or short term assets held by economic agents including banks will rise.

The regression result shows, there is a positive coefficient of 0.5333indicates that a one percent change on inflation rate of the country, other things being constant, liquidity of Ethiopian commercial banks a 53.33% change in the same direction. Therefore, the above justification and the result of the study support the hypothesis short term interest rate has positive and significant impact on bank's liquidity was Not- rejected. The result is consistent with other similar studies made by Tseganesh (2012), Berhanu (2015) and opposite to Nigist (2015).

4.6.9 Short Term Interest Rate and Bank's Liquidity

In this study, the proxy for short term interest rate (STIR) is the annual weighted average interest rate of Treasury Bills. As short term interest rate increases and since it has less default risk, banks tend to invest more in Treasury bill and other short term instruments and enhance their liquidity position. The regression result shows, Short term interest rate had negative and statistically significant impact on banks liquidity and opposite to the hypothesis. The coefficient value of STIR(-3.981) indicate taking all other independent variables constant, for a percentage change in annual average short term interest rate, the liquidity position of banks also changed by 398% in opposite direction at 10% significant level . Even though, study support the higher short term interest rate induces banks to invest more in the short term instruments and enhance their liquidity position Pilbeam, (2005) the actual result reject. Therefore, the study rejected the hypothesis.

In general, the above regression results of the hypothesis of the nine independent variable and liquidity is summarised and tabulated as follows:-

Table 4.6.1Summary of Actual and Expected sign of independent variables ofliquidity and decision of the hypotheses

Independent variables	Expected sign & impact on liquidity	Actual sign & impact on liquidity	Hypothesis Decision
Capital adequacy (CAP)	+ve & significant	+ve & Insignificant	Rejected
Size of the Bank (Size)	-ve & significant	-ve & Significant	Not Rejected @ 1% Sig. level
Loan Growth (LG)	-ve & significant	-ve & Significant	Not Rejected @ 1% Sig. level
Non-Performing loans(NPL)	-ve & significant	+ve & Insignificant	Rejected
Profitability (ROA)	-ve & significant	+ve & Significant	Rejected @5% sig. level
Interest rate margin(IRM)	-ve & significant	+ve & Insignificant	Rejected
Gross domestic product(GDP)	-ve & significant	-ve & Significant	Not Rejected @ 10% Sig.
Inflation (INF)	+ve & significant	+ve & Significant	Not Rejected @ 1% Sig.
Short term interest rate(STIR)	+ve & significant	-ve & Significant	Rejected @ 10% Sig. level

Source: the researcher Own Design

Chapter Five

5. Findings, Conclusions and Recommendations

In chapter four the findings of the study analysed and presented. In this section of the last chapter of the paper Findings, conclusions and recommendations based on the findings of the study was discussed. The chapter is organized in to two sub-sections, the first section presented the major conclusions of the study and the second section deals with the recommendation drawn from the study.

5.1 Findings and Conclusion

The main objectives of the study were to identify the determinants of liquidity in selected private commercial banks of Ethiopia. In this study important variables were identified that can affect liquidity directly and which is categorized under microeconomic (bank specific) variables and macroeconomic variables. Under bank specific variables capital adequacy, bank size, loan growth, non-performing loans, profitability, interest rate margin were included and under macroeconomic variables real GDP, inflation rate and short term interest rate were included. The study was used six selected private commercial banks in Ethiopia with fifteen years of experience and data collected (2001 to 2015). The balance of the selected banks was taken as of June 30, 2015 G.C as cut off period. The study used panel data of which data collected from NBE, MOFED and annual audited financial reports of the respective sample banks.

The data was presented and analysed by using descriptive statistics, correlation analysis and balanced fixed effect regression analysis to identify the determinants of liquidity of Ethiopian private commercial banks. Liquidity can be measured by using different ration like, liquid asset to total asset ratio, loan to deposit liquid asset to total asset etc. Among the different measure of liquidity, for the purpose of this study liquid asset to deposit ratio was taken based on the reason mentioned in the preceding chapters.

The data was analysed and presented in five sections, first **descriptive analysis** of the dependant and independent variables, second **correlation analysis** based on the result of dependant and independent variables, third **classical linear regression model** diagnosis result and finally, analysis and discussion of the **regression results.** Diagnostic tests are performed to ensure

whether the assumptions of the CLRM are violated or not in the model, Like Normality, hetroscedacity, autocorrelation, Multicollinearityetc. was done and there is no problem of all.

The result of this study confirmed that, among the bank specific variables; bank size (Size), loan growth (LG), and profitability measured by (ROA) had statistically significant impact on the determination liquidity of Ethiopian private commercial banks and among the macro-economic variables GDP, inflation (INF) and Short term Interest rate (STIR) had statistically significant impact on liquidity of Ethiopian private commercial banks. Whereas capital adequacy (CAP), non- performing loan (NPL) and interest rate margin had no statistically significant impact on the determination of liquidity of Ethiopian private commercial banks which is against the hypothesis.

Among the dependent variables of both bank specific and macroeconomic bank size at 1% significant level, loan growth at 1% significant level, GDP at 10% significant level and inflation at 1% significant level were resulted in supporting the hypothesis and explain more the relationship with liquidity both in sign and significance. For example when size of the bank increases which is measured by total asset, banks are motivated to give more loans to customers rather than holding liquid asset which support the hypothesis and the theory of "too big to fail". When commercial banks provide more loans, it directly affect their liquidity negatively, as they are provide loans from current asset and this also support the hypothesis and the finance theory. The other macroeconomic variable is GDP, which support the hypothesis, explains the country productivity increase it affect banks in providing more loans to investors directly or indirectly to facilitate the economic growth, in turn banks loses liquid cash in the form of investment or by providing loans this affect banks liquidity negatively.

The other macroeconomic variable affect liquidity positively is Inflation, during inflationary period commercial banks provide fewer loans, resource allocation is less efficient, and intermediary activity diminishes with adverse implications for capital/long term investment. Further, the amount of liquid assets held banks will rise with the rise in inflation and indirectly servicing the loan reduces. The remaining variable capital adequacy, Non- performing loan, profitability (ROA), interest rate margin and short term interest rate are opposite to our hypothesis and result in rejection.

The result of the regression shows that, Non-performing loan doesn't have any impact and positively correlated with liquidity which surprisingly opposite to the hypothesis. On the other hand, large volume of non-performing loans portfolio will affect the ability of commercial banks to provide additional loan and leads to loss of confidence and liquidity problems, in practice this is happened currently but the reason of the result is not clear. It was also found that profitability and liquidity had positively related and it was inconsistent with our hypothesis and capital adequacy and liquidity had positively correlated but not significantly and the other result interest rate margin and liquidity had positively correlated but not significantly and finally short term interest rate and liquidity had negatively correlated and opposite to our hypothesis but significantly correlated with liquidity.

Based on the above facts of the study made on the determinants of liquidity in commercial banks explained by independent variables such as CAP, Size, LG, NPL, ROA, IRM, GDP, INF and STIR are not the only factors affect liquidity and the result also displays from the nine independent variables only four (Size, LG, GDP and INF) were support our hypothesis the others fives (CAP, NPL, ROA, IRM and STIR) were rejected.

5.2. Recommendations

This study was intended to identify the determinants of liquidity of Ethiopian private commercial banks; and hence on the basis of the findings of the study, the following recommendations were drown,

- Among the bank specific variables included in this study was loan growth, which is significantly affect the liquidity position of Ethiopian private commercial banks. It is clear that mostly commercial banks provide loans in order to be profitable and maximize the wealth of shareholders and the principal sources of income comes from loan, and the study also support the negative relationship of loan and liquidity. So, private commercial banks in Ethiopia should give more attention in maintaining optimal level of liquid assets by providing short term loans. In addition to this, mixes of investments should use instead of concentrating on long term loans as the principal sources of their revenue.

- The other macroeconomic variable which significantly affects liquidity is GDP. As per the results of the study; it is a clear signal to all private banks in Ethiopia that they cannot ignore the macroeconomic indicators when strategizing to improve on their position of liquidity. Thus, banks in Ethiopia should not only be concerned about internal factors and policies/procedures, but they should also consider the macroeconomic variables like GDP, short term interest rate (STIR), technology etc. in order to efficiently manage their liquidity position by considering and incorporation as one of the internal requirements of liquidity.

- As liquidity is the most crucial and driving factor for commercial banks in running of the day today business activity and by large it affects also the overall economic activity of the country, therefore regulatory bodies like (NBE) should give special attention and follow commercial banks through strong directives in order to maintain the liquidity position safe.

- In Ethiopia, as there is no financial market and inter- bank loans, it is difficult to mobilize adequate resources during liquidity problems. In such instances, banks may mobilize deposit at a higher cost in order to minimize their short term liquidity problems. Regulatory bodies like NBE in particular should establish a rules or directives which allow loans between commercial banks at a reasonable rate of interest which indirectly solve the liquidity requirements of commercial banks.

- The banking business here in Ethiopia is still traditional and all commercial banks provide similar service (products) and depending on cash base transaction which affect the liquidity position of commercial banks. Regulatory bodies like NBE in particular and Government in general should work on modernization of banking business, which indirectly solve the liquidity requirements of commercial banks by transforming from cash-base transaction to cashless transaction. It is also important to establish formal financial security markets to facilitate transaction between customers and commercial banks, also helps to reduce the liquidity requirements and shift to non- cash or cashless transaction.

➕ There are variables affect liquidity significantly as it expected in the hypothesis and there are also variable that doesn't affect liquidity opposite to the hypothesis. And surprising the result of some variables for example Non- performing loan is expected to affect liquidity negatively, which means that when NPL increase and liquidity decreases (inversely related). But the result became opposite to the expectation of the researcher. There are studies made on liquidity by different researcher but the result is still different even with this study and doesn't show clearly the determinants of liquidity. Since liquidity is very crucial to the existence of banks; factors that affect it should be identified, therefore further research is recommended on the same area of factors that affecting liquidity of Ethiopian private commercial banks by incorporating any other firm specific and macroeconomic variables, and giving more attention and time.

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Appendices

Appendix I- Regression Result of L

Method: Panel Least Squares
Date: 05/31/16   Time: 17:36
Sample: 2001 2015
Periods included: 15
Cross-sections included: 6
Total panel (balanced) observations: 90

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.892445	0.176912	5.044570	0.0000
CAP	0.561919	0.337913	1.662908	0.1006
SIZE	-0.073464	0.021851	-3.362062	0.0012***
LG	-0.308088	0.082464	-3.736046	0.0004***
NPL	0.470693	0.282829	1.664233	0.1004
ROA	3.420375	1.324257	2.582864	0.0118**
IRM	0.529909	1.369528	0.386929	0.6999
GDP	-0.626254	0.374154	-1.673784	0.0985*
INF	0.533398	0.100009	5.333503	0.0000***
STIR	-3.980775	2.005367	-1.985061	0.0509*

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.734704	Mean dependent var		0.458874
Adjusted R-squared	0.676556	S.D. dependent var		0.137676
S.E. of regression	0.078299	Akaike info criterion		-2.088125
Sum squared resid	0.447548	Schwarz criterion		-1.615939
Log likelihood	110.9656	Hannan-Quinn criter.		-1.897712
F-statistic	12.63524	Durbin-Watson stat		1.738267
Prob(F-statistic)	0.000000			

*** , **, and * denote significance at 1%, 5%, and 10% levels, respectively*

Appendix II- Heteroscedasticity test of L

Heteroscedasticity Test: White

F-statistic	1.452543	Prob. F(61,28)	0.1399
Obs*R-squared	68.38861	Prob. Chi-Square(61)	0.2409
Scaled explained SS	68.33877	Prob. Chi-Square(61)	0.2422

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/31/16   Time: 17:46
Sample: 2001 2015
Included observations: 90
Collinear test repressor dropped from specification

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.132020	0.690397	-0.191224	0.8497
CAP	3.371731	2.429283	1.387953	0.1761
CAP^2	-1.747896	2.815888	-0.620726	0.5398
CAP*SIZE	-0.257438	0.257216	-1.000862	0.3255
CAP*LG	-1.688914	0.755997	-2.234021	0.0336
CAP*NPL	-5.228030	4.000396	-1.306878	0.2019
CAP*ROA	-7.718871	13.45630	-0.573625	0.5708
CAP*IRM	5.629645	15.82359	0.355776	0.7247
CAP*GDP	2.870139	4.814640	0.596127	0.5559
CAP*INF	-0.810514	1.012766	-0.800297	0.4303
CAP*STIR	-9.064744	18.20961	-0.497800	0.6225
SIZE	0.163486	0.115304	1.417861	0.1673
SIZE^2	-0.006105	0.006641	-0.919364	0.3658
SIZE*LG	-0.041311	0.045348	-0.910970	0.3701
SIZE*NPL	-0.651861	0.325945	-1.999911	0.0553
SIZE*ROA	-1.318477	0.685119	-1.924449	0.0645
SIZE*IRM	0.406144	0.716485	0.566857	0.5753
SIZE*GDP	0.490043	0.338463	1.447848	0.1588
SIZE*INF	0.012948	0.076531	0.169180	0.8669
SIZE*STIR	-0.632041	1.091129	-0.579255	0.5670
LG	0.455167	0.566007	0.804172	0.4281
LG^2	-0.089549	0.151173	-0.592360	0.5584
LG*NPL	-0.987489	1.234080	-0.800182	0.4303
LG*ROA	3.850717	3.135621	1.228056	0.2296
LG*IRM	5.245160	2.314793	2.265930	0.0314
LG*GDP	-2.183659	1.090593	-2.002268	0.0550
LG*INF	-0.043417	0.261555	-0.165995	0.8694
LG*STIR	-12.31764	5.787358	-2.128371	0.0422
NPL	6.612040	3.447022	1.918189	0.0653
NPL^2	-4.133987	2.459286	-1.680970	0.1039
NPL*ROA	-10.69909	13.34521	-0.801718	0.4295
NPL*IRM	22.89446	10.01646	2.285683	0.0300

NPL*GDP	-6.810976	3.800877	-1.791949	0.0840
NPL*INF	-0.337507	0.784782	-0.430064	0.6704
NPL*STIR	-42.16388	26.18238	-1.610391	0.1185
ROA	8.459632	6.662218	1.269792	0.2146
ROA^2	16.18308	19.19645	0.843025	0.4064
ROA*IRM	18.23584	44.17654	0.412795	0.6829
ROA*GDP	6.051345	20.88052	0.289808	0.7741
ROA*INF	3.151173	4.317842	0.729803	0.4716
ROA*STIR	-64.28498	115.2392	-0.557839	0.5814
IRM	-23.31498	8.144714	-2.862591	0.0079
IRM^2	20.29799	28.36644	0.715564	0.4802
IRM*GDP	83.53373	37.07607	2.253036	0.0323
IRM*INF	8.666843	3.791094	2.286106	0.0300
IRM*STIR	149.3081	95.41927	1.564758	0.1289
GDP	-7.659754	3.555670	-2.154237	0.0400
GDP^2	-1.440710	15.71262	-0.091691	0.9276
GDP*INF	1.416099	6.045291	0.234248	0.8165
GDP*STIR	87.19328	190.8716	0.456816	0.6513
INF	-1.120452	0.964335	-1.161891	0.2551
INF^2	1.015793	0.735878	1.380383	0.1784
INF*STIR	-2.147201	18.09719	-0.118648	0.9064
STIR	-4.186596	25.92517	-0.161488	0.8729
STIR^2	134.5442	286.0008	0.470433	0.6417

R-squared	0.759873	Mean dependent var	0.006291
Adjusted R-squared	0.236740	S.D. dependent var	0.010319
S.E. of regression	0.009015	Akaike info criterion	-6.369581
Sum squared resid	0.002276	Schwarz criterion	-4.647489
Log likelihood	348.6311	Hannan-Quinn criter.	-5.675132
F-statistic	1.452543	Durbin-Watson stat	2.034783
Prob(F-statistic)	0.139854		

Appendix III: Normality Test of L

Series: Residuals	
Sample 2001 2015	
Observations 90	
Mean	8.82e-17
Median	0.001114
Maximum	0.224341
Minimum	-0.209590
Std. Dev.	0.079760
Skewness	0.306215
Kurtosis	3.660782
Jarque-Bera	3.043884
Probability	0.218288
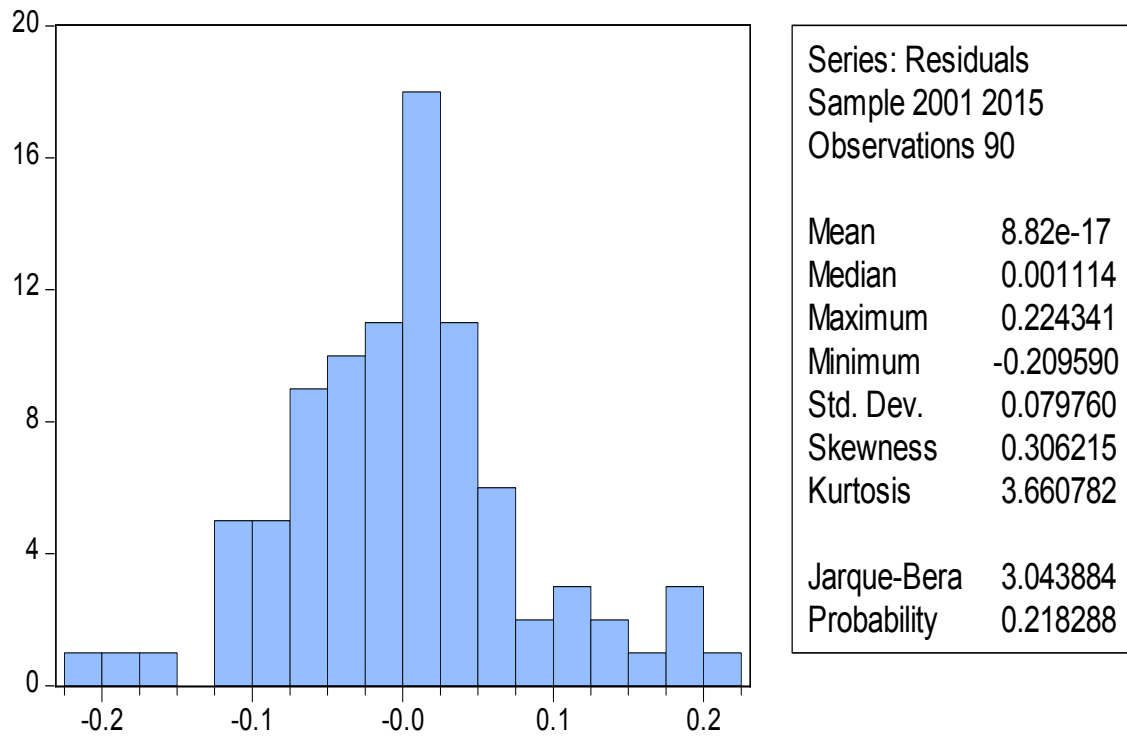
Appendix IV List of Commercial Banks

No.	Bank Name	Year of Establishment	Ownership
1	Commercial Bank of Ethiopia	1963	Public
2	Construction & Business Bank	1983	Public(Merged with CBE)
3	Awash International Bank	1994	Private
4	Dashen Bank	1995	Private
5	Bank of Abyssinia	1996	Private
6	Wegagen Bank	1997	Private
7	United Bank	1998	Private
8	NIB International Bank	1999	Private
9	Cooperative bank of Oromia	2004	Private
10	Lion International Bank	2006	Private
11	Oromia International Bank	2008	Private
12	Zemen Bank	2008	Private
13	Bunna International Bank	2009	Private
14	Birhan International Bank	2009	Private
15	Abbay Bank	2010	Private
16	Addis International Bank	2011	Private
17	Debub Global Bank	2012	Private
18	Enat Bank	2013	Private

Source: NBE and each bank's annual financial report

Appendix V: Durbin-Watson Statistic

Durbin-Watson Statistic: 1 Per Cent Significance Points of dL and dU

*k' is the number of regressors excluding the intercept

N	k'=1 dL	k'=1 dU	k'=2 dL	k'=2 dU	k'=3 dL	k'=3 dU	k'=4 dL	k'=4 dU	k'=5 dL	k'=5 dU	k'=6 dL	k'=6 dU	k'=7 dL	k'=7 dU	k'=8 dL	k'=8 dU	k'=9 dL	k'=9 dU	k'=10 dL	k'=10 dU
6	0.390	1.142	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
7	0.435	1.036	0.294	1.676	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
8	0.497	1.003	0.345	1.489	0.229	2.102	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
9	0.554	0.998	0.408	1.389	0.279	1.875	0.183	2.433	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
10	0.604	1.001	0.466	1.333	0.340	1.733	0.230	2.193	0.150	2.690	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
11	0.653	1.010	0.519	1.297	0.396	1.640	0.286	2.030	0.193	2.453	0.124	2.892	-----	-----	-----	-----	-----	-----	-----	-----
12	0.697	1.023	0.569	1.274	0.449	1.575	0.339	1.913	0.244	2.280	0.164	2.665	0.105	3.053	-----	-----	-----	-----	-----	-----
13	0.738	1.038	0.616	1.261	0.499	1.526	0.391	1.826	0.294	2.150	0.211	2.490	0.140	2.838	0.090	3.182	-----	-----	-----	-----
14	0.776	1.054	0.660	1.254	0.547	1.490	0.441	1.757	0.343	2.049	0.257	2.354	0.183	2.667	0.122	2.981	0.078	3.287	-----	-----
15	0.811	1.070	0.700	1.252	0.591	1.465	0.487	1.705	0.390	1.967	0.303	2.244	0.226	2.530	0.161	2.817	0.107	3.101	0.068	3.374
16	0.844	1.086	0.738	1.253	0.633	1.447	0.532	1.664	0.437	1.901	0.349	2.153	0.269	2.416	0.200	2.681	0.142	2.944	0.094	3.201
17	0.873	1.102	0.773	1.255	0.672	1.432	0.574	1.631	0.481	1.847	0.393	2.078	0.313	2.319	0.241	2.566	0.179	2.811	0.127	3.053
18	0.902	1.118	0.805	1.259	0.708	1.422	0.614	1.604	0.522	1.803	0.435	2.015	0.355	2.238	0.282	2.467	0.216	2.697	0.160	2.925
19	0.928	1.133	0.835	1.264	0.742	1.416	0.650	1.583	0.561	1.767	0.476	1.963	0.396	2.169	0.322	2.381	0.255	2.597	0.196	2.813
20	0.952	1.147	0.862	1.270	0.774	1.410	0.684	1.567	0.598	1.736	0.515	1.918	0.436	2.110	0.362	2.308	0.294	2.510	0.232	2.174
21	0.975	1.161	0.889	1.276	0.803	1.408	0.718	1.554	0.634	1.712	0.552	1.881	0.474	2.059	0.400	2.244	0.331	2.434	0.268	2.625
22	0.997	1.174	0.915	1.284	0.832	1.407	0.748	1.543	0.666	1.691	0.587	1.849	0.510	2.015	0.437	2.188	0.368	2.367	0.304	2.548
23	1.017	1.186	0.938	1.290	0.858	1.407	0.777	1.535	0.699	1.674	0.620	1.821	0.545	1.977	0.473	2.140	0.404	2.308	0.340	2.479
24	1.037	1.199	0.959	1.298	0.881	1.407	0.805	1.527	0.728	1.659	0.652	1.797	0.578	1.944	0.507	2.097	0.439	2.255	0.375	2.417
25	1.055	1.210	0.981	1.305	0.906	1.408	0.832	1.521	0.756	1.645	0.682	1.776	0.610	1.915	0.540	2.059	0.473	2.209	0.409	2.362
26	1.072	1.222	1.000	1.311	0.928	1.410	0.855	1.517	0.782	1.635	0.711	1.759	0.640	1.889	0.572	2.026	0.505	2.168	0.441	2.313
27	1.088	1.232	1.019	1.318	0.948	1.413	0.878	1.514	0.808	1.625	0.738	1.743	0.669	1.867	0.602	1.997	0.536	2.131	0.473	2.269

	dL dU	dL dU	dL dU	dL dU	dL dU	dL dU	dL dU	dL dU	dL dU	dL dU
28	1.104 1.244	1.036 1.325	0.969 1.414	0.901 1.512	0.832 1.618	0.764 1.729	0.696 1.847	0.630 1.970	0.566 2.098	0.504 2.229
29	1.119 1.254	1.053 1.332	0.988 1.418	0.921 1.511	0.855 1.611	0.788 1.718	0.723 1.830	0.658 1.947	0.595 2.068	0.533 2.193
30	1.134 1.264	1.070 1.339	1.006 1.421	0.941 1.510	0.877 1.606	0.812 1.707	0.748 1.814	0.684 1.925	0.622 2.041	0.562 2.160
31	1.147 1.274	1.085 1.345	1.022 1.425	0.960 1.509	0.897 1.601	0.834 1.698	0.772 1.800	0.710 1.906	0.649 2.017	0.589 2.131
32	1.160 1.283	1.100 1.351	1.039 1.428	0.978 1.509	0.917 1.597	0.856 1.690	0.794 1.788	0.734 1.889	0.674 1.995	0.615 2.104
33	1.171 1.291	1.114 1.358	1.055 1.432	0.995 1.510	0.935 1.594	0.876 1.683	0.816 1.776	0.757 1.874	0.698 1.975	0.641 2.080
34	1.184 1.298	1.128 1.364	1.070 1.436	1.012 1.511	0.954 1.591	0.896 1.677	0.837 1.766	0.779 1.860	0.722 1.957	0.665 2.057
35	1.195 1.307	1.141 1.370	1.085 1.439	1.028 1.512	0.971 1.589	0.914 1.671	0.857 1.757	0.800 1.847	0.744 1.940	0.689 2.037
36	1.205 1.315	1.153 1.376	1.098 1.442	1.043 1.513	0.987 1.587	0.932 1.666	0.877 1.749	0.821 1.836	0.766 1.925	0.711 2.018
37	1.217 1.322	1.164 1.383	1.112 1.446	1.058 1.514	1.004 1.585	0.950 1.662	0.895 1.742	0.841 1.825	0.787 1.911	0.733 2.001
38	1.227 1.330	1.176 1.388	1.124 1.449	1.072 1.515	1.019 1.584	0.966 1.658	0.913 1.735	0.860 1.816	0.807 1.899	0.754 1.985
39	1.237 1.337	1.187 1.392	1.137 1.452	1.085 1.517	1.033 1.583	0.982 1.655	0.930 1.729	0.878 1.807	0.826 1.887	0.774 1.970
40	1.246 1.344	1.197 1.398	1.149 1.456	1.098 1.518	1.047 1.583	0.997 1.652	0.946 1.724	0.895 1.799	0.844 1.876	0.749 1.956
45	1.288 1.376	1.245 1.424	1.201 1.474	1.156 1.528	1.111 1.583	1.065 1.643	1.019 1.704	0.974 1.768	0.927 1.834	0.881 1.902
50	1.324 1.403	1.285 1.445	1.245 1.491	1.206 1.537	1.164 1.587	1.123 1.639	1.081 1.692	1.039 1.748	0.997 1.805	0.955 1.864
55	1.356 1.428	1.320 1.466	1.284 1.505	1.246 1.548	1.209 1.592	1.172 1.638	1.134 1.685	1.095 1.734	1.057 1.785	1.018 1.837
60	1.382 1.449	1.351 1.484	1.317 1.520	1.283 1.559	1.248 1.598	1.214 1.639	1.179 1.682	1.144 1.726	1.108 1.771	1.072 1.817
65	1.407 1.467	1.377 1.500	1.346 1.534	1.314 1.568	1.283 1.604	1.251 1.642	1.218 1.680	1.186 1.720	1.153 1.761	1.120 1.802
70	1.429 1.485	1.400 1.514	1.372 1.546	1.343 1.577	1.313 1.611	1.283 1.645	1.253 1.680	1.223 1.716	1.192 1.754	1.162 1.792
75	1.448 1.501	1.422 1.529	1.395 1.557	1.368 1.586	1.340 1.617	1.313 1.649	1.284 1.682	1.256 1.714	1.227 1.748	1.199 1.783
80	1.465 1.514	1.440 1.541	1.416 1.568	1.390 1.595	1.364 1.624	1.338 1.653	1.312 1.683	1.285 1.714	1.259 1.745	1.232 1.777
85	1.481 1.529	1.458 1.553	1.434 1.577	1.411 1.603	1.386 1.630	1.362 1.657	1.337 1.685	1.312 1.714	1.287 1.743	1.262 1.773
90	1.496 1.541	1.474 1.563	1.452 1.587	1.429 1.611	1.406 1.636	1.383 1.661	1.360 1.687	1.336 1.714	1.312 1.741	1.288 1.769
95	1.510 1.552	1.489 1.573	1.468 1.596	1.446 1.618	1.425 1.641	1.403 1.666	1.381 1.690	1.358 1.715	1.336 1.741	1.313 1.767
100	1.522 1.562	1.502 1.582	1.482 1.604	1.461 1.625	1.441 1.647	1.421 1.670	1.400 1.693	1.378 1.717	1.357 1.741	1.335 1.765
150	1.611 1.637	1.598 1.651	1.584 1.665	1.571 1.679	1.557 1.693	1.543 1.708	1.530 1.722	1.515 1.737	1.501 1.752	1.486 1.767
200	1.664 1.684	1.653 1.693	1.643 1.704	1.633 1.715	1.623 1.725	1.613 1.735	1.603 1.746	1.592 1.757	1.582 1.768	1.571 1.779