
**ADDIS ABABA UNIVERSITY**
**SCHOOL OF GRADUATE STUDIES**

**COLLEGE OF BUSINESS AND ECONOMICS**

**DEPARTMENT OF ECONOMICS**

# MACROECONOMIC FACTORS AFFECTING CREDIT RISK IN THE ETHIOPIAN COMMERCIAL BANKS: AN AUTOREGRESSIVE DISTRIBUTED LAG (ARDL) APPROACH

**BY**

BELAYNEW BERHANU

**A THESIS SUBMITTED TO SCHOOL OF GRADUATE STUDIES OF ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF SCIENCE IN ECONOMICS (DEVELOPMENT ECONOMICS)**

June, 2020

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June, 2020
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## DECLARATION

I, Belaynew Berhanu, declare that, this study, "*Macroeconomic Factors Affecting Credit Risk in the Ethiopian Commercial Banks: An Autoregressive Distributed Lag (ARDL) Approach*" is my own work. I have undertaken the research work independently with the guidance and support of the research supervisor. This study has not been submitted for any degree or diploma in this or any other institution. It is in partial fulfillment of the requirements for the Degree of Master of Science in Economics (Development Economics). All sources of material used for the research have been duly acknowledged.

**Name:** Belaynew Berhanu

**Signature _____**

**Date _____**

## ENDORSEMENT

This thesis has been submitted to Addis Ababa University, Collage of Business and Economics for examination with my approval as a university supervisor.

**Supervisor:** Atnafu G/Meskel (PhD)

**Signature**_____

**Date** _____

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### Board of Examiners Approval Sheet

As members of board of examining of the final MSc thesis, we certify that we have read and evaluated the Thesis prepared by Belaynew Berhanu entitled "*Macroeconomic Factors Affecting Credit Risk in the Ethiopian Commercial Banks: An Autoregressive Distributed Lag (ARDL) Approach''* and recommend that the Thesis is accepted as fulfilling the thesis requirement for the degree of Master of Science in Economics (Development Economics).

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| Name of External Examiner | Signature | Date |

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# ABSTRACT

The main objective of the study was to investigate the macroeconomic factors affecting non-performing loans in the Ethiopian commercial banks. The study employed Auto Regressive Distribute Lagged (ARDL) model employed to quarterly data for the period of 2001/02Q1 to 2018/19Q4 to investigate the existence of short-run and long-run relationship between non-performing loans (NPLs) and set of macroeconomic variables. Additionally, the study employed the variance decomposition (VDC) and impulse response functions (IRF's) were used to test for the response of non-performing loans to innovations in macroeconomic variables. The major findings are that there is a long run relationship between non-performing loans (NPLs) and real GDP growth rate, growth of broad money supply and terms of trade are negatively and statistically significant. Inflation rate, lending interest rate and unemployment rate are found be statistically insignificant in the long run. The short run results also shows that the real GDP growth rate, growth of Broad money supply, and terms of trade affect non-performing loans negatively and are statistically significant while the Inflation rate affects non-performing loans positively and statistically significant. In additional to this result, unemployment rate and lending interest rate found statistically insignificant in the short run. Further the variance decomposition results show that innovations in terms of trade highly contributed to the forecast error variance of non-performing loans in the Ethiopian commercial banks compared to other explanatory variables. The study suggests that, commercial banks should consider the macroeconomic factors before extending loans and the government can also play important role in improving the level of NPLs in the economy by influencing the macroeconomic variables. Also the study suggest for future researcher to explore the other macroeconomic factors affecting credit risk. Few of the variables that can be used in the future studies are gross fixed capital formation, growth in investment, consumption, exchange rate and loan to GDP ratio.



**Keywords:** Macroeconomic factors, non-performing loans, Ethiopian commercial Banks, ARDL model

# List of Acronyms and Abbreviations

| | |
|---|---|
| ADF: | Augmented Dickey Fuller |
| AIC: | Akaike Information Criteria |
| ARDL: | Auto Regressive Distributed Lag |
| CUMSUM: | Cumulative Sum of Recursive Residuals |
| CUMSUMSQ: | Cumulative Sum of Squares Recursive Residuals |
| CSA: | Central Statistical Authority |
| ECM: | Error Correction Model |
| ECB: | Ethiopia Commercial Banks |
| GDP: | Gross Domestic Product |
| HQ: | Hannan-Quinn Criterion |
| INF: | Inflation rate |
| IMF: | International Monetary Fund |
| LIR: | Lending Interest rate |
| M2: | Money supply |
| NBE: | National Bank of Ethiopia |
| NIB: | NIB International Bank |
| NPLs: | Non-performing Loans |
| OLS: | Ordinary Least Square |
| PP: | Philips -Peron |
| SBIC: | Schwarz's Bayesian information criterion |
| TOT: | Terms of Trade |
| UNE: | Unemployment rate |
| VAR: | Vector autoregressive |
| WDI: | World Development Indicator |

# CHAPTER ONE

## 1. INTRODUCTION

This chapter proceeds as follow: the following section deals with the background of the study, statement of the problem, research question, Hypothesis, followed by objective of the study, scope of the study, limitation of the study, significance of the study and finally concludes by how the paper is planned to progress.

### 1.1. Background of the Study

The pursuit of economic growth and sustainable development is one of the core macroeconomic goals in every country. A country with a robust macroeconomic structure has a strong banking industry (Ricardas, 2015). According to Levine (1997), an effective financial system contribute to the economic transformation role, provides the possibility of better savings mobilization and allocation of same for country development purpose. This can be achieved through increasing the level of investment in general as well as in human resources in particular to induce and sustain economic growth and development. The goal of financial development is to achieve efficiency in the financial sector and an important driver for economic welfare in that it reduces the prevalence of income poverty and undernourishment.

A financial system comprises banking institutions, financial markets, other financial intermediaries such as pension funds and insurance companies, and a large regulatory body – a central bank, which oversees and supervises the operations of these intermediaries. It is a sector in the economy that utilizes productive resources to facilitate capital formation through the provision of a wide range of financial intermediaries to promote investment and rise output growth through borrowing and lending. Thus, the financial system plays a crucial role in mobilizing and intermediating saving, and ensuring these resources are allocated efficiently to productive sectors (James, 2008).

A well-functioning financial system leads to more efficient allocation of resources. According to Tobin and Brainard (1963), the ability to evaluate investment projects, financial intermediaries allow investor to expand their business by borrowing at lower rates and lowering the risk of an

individual. Financial intermediaries evaluate different investment opportunities available by assessing the associated risks so that funds are channeled to the most promising projects. This leads to improved quality of investments that can have an expansionary effect on the economy. Financial markets may have a comparative advantage over financial intermediaries to fund mobilizing between savers and investors since market participants can acquire relevant information on firms quickly, leading to more efficient allocation of resources.

The commercial banks are the part of financial system that plays a fundamental role in the country‘s economy as the environment between agents who need to borrow and those who want to lend or invest and is naturally linked to all economic sectors. If the financial system does not function properly, its problems have a strong negative impact on the whole economy (Rodriguez-Moreno & Pena, 2013). According to Gounder and Sharna (2012), the main banks' deposit mobilization and credit allocation functions have important implications for economic growth and development. The significance of this intermediation process is likely to be greater in economies with thin financial markets and small non-bank sectors where a larger percentage of enterprises and individuals are likely to depend on banks for external funding.

The soundness of the banking enterprise is exposed to different risks such as market risk, liquidity risk, operational risk, credit risk, concentration risk and other risk country, settlement, legal, investment, etc. The greatest risk of all is credit risk (Daniel, 2010). Credit risks are the risk of negative effect on the financial result which means losses from the refusal or inability of credit customers to pay what is owed in full and on time to the bank. Credit risk in lending activities is the possibility that actual returns on a loan may vary from what the lenders expected, the difference of which represents financial loss. In other word, credit risk is the risk of repayment or the possibility that an obligor will fail to perform as agreed and adversely affects capital and earnings (Al-Jarrah, 2012).

The lending function is considered by the banking industry as one of the main income generating engine. Since, loans are the major assets of commercial banks that generate the income. The quality of loan portfolios seriously affects the profitability of banks and financial development. Thus, the non-performing loans ratio is the best indicator for the assets quality of loan portfolio. In the process of providing credit granted to the investment activities and projects in the economy, financial institutions face inherent risks because of borrowers take out large loans not

because it is financial wise but because they see others doing it in the form of this risk which results in build-up of Non-Performing Loans (NPLs) that have a negative effect on the profitability of the financial institutions and country economic development (Ongore and Kusa, 2013)

A loan is categorized under non-performing loan status depending on the number of days a repayment is delayed or discontinued. According to National Bank of Ethiopia's Directive No SBB/69/2018 Asset Classification and Provisioning Directive, Non-performing loans are defined as "loans or advances whose credit quality has deteriorated such that full collection of principal and/or interest in accordance with the contractual repayment terms of the loan or advances is past due and uncollected for 90 (ninety) consecutive days or more beyond the scheduled payment date or maturity". In other word the loans are categorized under substandard, doubtful and loss status.

There are several empirical studies that analyses the influence of macroeconomic factors, bank specific factors and industry factors on the credit risk jointly and separately. Some of the studies conducted focused on the macroeconomic factors that affect credit risk. In particular, Vogiatzis and Nikolaidou (2011), Castro (2013), Ali and Daly (2010), Demirguc-Kunt and Detragiache (1997), Gavin and Hausmann (1995), Makri et al (2014), Mesai and Jouini (2013), Klein (2013), Louzis et al (2012), Greenidge and Grosvenor (2009), Nkusu (2011), Fofack (2005), Love and Turk Ariss (2014), and Akinlo and Emmanuel (2014), among others, concentrate their research essentially on the impact of macroeconomic variables over the credit risk growth and stress.

However, Ethiopia's financial system is dominated largely by banks, followed by insurers and microfinance institutions. Of the eighteen banks, sixteen were private and two state-owned. Similarly, the number of insurance companies stood at seventeen and thirty-eight micro finance institutions operate in the economy, with the majority of the banks and insurance companies being owned privately (NBE, 2019). So many researchers have focused on the role of banks but it is limited studies focused on the determinant of credit risk. For instance, Wondimagegnehu (2012), Meshesha (2015) and Habtamu (2015) assessed the determinants of NPLs of commercial banks. But both of them did not observe the macroeconomic factors. And also the study by Anisa (2015) and Mesay (2017) focused on both the macroeconomic factors and bank specific factors but both the studies utilize the same macroeconomic variable. Therefore, this study is to deep

investigating the macro-economic factors affecting non-performing loans in the Ethiopia commercial banks.

## 1.2. Statement of the problem

Bank's quality of the loan portfolio is among the most important aspects of the lending processes of any commercial bank. The loan portfolio is typically the largest asset and the predominant source of revenue for commercial banks. This credit creation and loan disbursement process is one of the greatest sources of risk to a bank's safety and soundness. Lax credit standards, poor portfolio risk management, or weakness in the economy, loan portfolio problems have leads to financial distress including bankruptcy because of NPLs. According to Ali (2013), Very important indicator of the financial risks of the commercial banks is credit risk connect directly with the level of NPLs. NPLs indicate the borrowers are not paying their principal and interest properly as per their payment schedule, unable to meet their current financial obligation when borrowers fail to repay their loan amount. NPL considered as one of the main cause of financial crises banking failure and impair the profitability of bank. Thus, NPLs are likely to hamper economic growth and reduce the Bank profitability (Hou, 2007).

In Ethiopia, the commercial banks have 80% share in the financial system and a total of 18 commercial banks are providing various facilities to the Ethiopian people. Considering the various risk faced by bank, the National Bank of Ethiopia issues various guidelines and directives such as Risk Management Guidelines 2003, Asset classification and provisioning directives are modified from time to time for commercial banks. And also NBE imposed restriction the total NPLs position of the Bank shall not exceed 5% of the total outstanding balance of loans and advances at any given time (NBE, 2012). After the restriction the NPLs of ECBs have shown improve. For instance Awash Bank, Abyssinia Bank and NIB international Bank are NPLs ratio below 5%. However, according to Mehari (2012) reduction of NPLs in Ethiopian commercial banks is not resulted from improved credit risk controlling, measuring and monitoring system. Rather, by writing off and restructuring of loans. For instance (NBE 2016) announced that coffee trader loan faced repayment problem due to deteriorating international coffee price and order ECBs to reschedule their loan. Both writing off and restructuring of NPLs is a post active measurement. The issue of preventing NPLs in Ethiopia commercial banks is still in question.

Despite the significant growth made in terms of improving the efficiency and competitiveness related with financial system in the country, non-performing loans in some of the commercial banks is still high i.e. Banks are not fulfilling the maximum (5%) allowable limit of NPLs. For instance, in 2013, 2014 & 2015 NPLs of Zemen Bank was 8.50%, 8.80% and 5.86 % respectively, in 2012 NPLs of Dashn Bank was 5.50% and in 2015 NPLs of Bank of Abyssinia was 5.37%. The amount of NPLs fluctuates year to year for example in 2015, 2016, 2017 and 2018 NPLs of NIB was 3.13%, 3.95%, 2.90% and 4.17 % respectively. Therefore, it becomes motivated to study how macroeconomic factors affecting credit risk on loan portfolio of Ethiopia commercial Banks.

Moreover, many studies have examined the causes of non-performing loans in several countries around the world; however, little research has gone to the study of the causes of NPLs in Africa. Like most Africa countries, in Ethiopia, to the knowledge of the researcher, there has not been much research which is conducted on determinants of loan defaults except for the study of Daniel (2010), Wondimagegnehu (2012), Tesfaye (2015), Habtamu (2015), Anisa (2015), Mesay (2017), Mekdes (2017) and Sitina (2018). The related studies conducted by Daniel (2010), Wondimagegnehu (2012), Tesfaye (2015) and Habtamu (2015) assessed the determinants of NPLs in Ethiopian commercial banks focusing on bank-specific variables. The study by Anisa (2015), Mesay (2017), Mekdes (2017) and Sitina (2018) combined both the macroeconomic and bank specific factors but both the studies some important macroeconomic factors cannot incorporated in the model and they utilize limited macroeconomic variables which are not sufficient for conclusion. To the best of my knowledge, no in-depth studies have been conducted to investigate the macroeconomic determinants of credit risk in Ethiopia Commercial banking industry. This research intends to fill a gap in research as the in-depth study in to the macro-economic factors affecting credit risk in the Ethiopian Commercial Banks. Therefore, the study can critical investigate the effect of macroeconomic factors on credit risk in the Ethiopia commercial Banks.

## 1.3. Research Questions

Depending on pieces of literature the researcher motivated to answer the following questions:-

I. What are the most relevant macroeconomic factors that affect non-performing loans in Ethiopia commercial banks?
II. Is there economic relationship between macro-economic factors and Non-performing loans of Ethiopian commercial banks?
III. How can the Ethiopia commercial banks default rates responds to innovation (shocks) in macroeconomic factors for the relevant future time period?

## 1.4. Hypothesis

In this section the researcher developed testable hypotheses relating association between non-performing loans and macroeconomic variables in Ethiopia commercial banks. Based on the existing evidence reviewing in the literature part the researcher developed the following sematic hypotheses to estimate the sign effect of macroeconomic factors on non-performing loans of Ethiopia commercial banks.

**I.** H0: The growth in RGDP results in the decline of NPLs.
H1: The growth in RGDP results in the growth of NPLs.

**II.** H0: The increase in Unemployment rate results in the growth of NPLs.
H1: The increase in unemployment rate results in the decline of NPLs.

**III.** H0: The increase in lending interest rate results in the growth of NPLs.
H1: The increase in lending interest rate results in the decline of NPLs.

**IV.** H0: The inflation rate results in the growth of NPLs.
H1: The inflation rate results in the decline of NPLs.

**V.** H0: The growth in Broad money supply results in the decline of NPLs.
H1: The growth in Broad money supply results in the increase of NPLs.

**VI.** H0: Improvement in terms of trade results in reducing NPLs.
H1: A drop terms of trade results in the growth of NPLs.

## 1.5. Objective of the Study

### 1.5.1. General objective:

The main objective of the study is to investigate the macro-economic factors affecting non-performing loans in the Ethiopia Commercial Banks.

### 1.5.2. Specific objectives:

Specifically, this study addresses the following objectives;

I. To identify the relevant macroeconomic factors affecting non-performing loans in the Ethiopia Commercial Banks.
II. To estimate an empirical relationship between the non-performing loans of Ethiopia commercial banks and macroeconomic variables through regression analysis.
III. To forecast the statistically and economically significant macroeconomic factors for the relevant future time period.

## 1.6. Scope of the Study

The study concentrated on all commercial banks in Ethiopia that are registered by NBE. Moreover the researcher wants to see macro-economic factors that affect the level of NPLs on Ethiopia commercial banks. Therefore, the current study limits its coverage on the possibility of macro-economic factor that influence the level of nonperforming loan in Ethiopia commercial banks using Quarterly data from 2001/02Q1 up to 2018/19Q4.

## 1.7. Limitations of the study

The study has mainly limitations related to: period of the study and data. First, on the availability of data the period of study is limited from 2001/02Q1 to 2018/19Q4. Second, since there is a great limitation of finding quarterly data, for some variables in the data are generated by interpolating annual data using Eviews 9. In addition, to find the full data figure for all variables we are forced to take the data from different sources.

## 1.8. Significance of the Study

NPLs are one of the most significant causes of the economic stagnation problem. If the issue of non-performing loans is left unresolved, it can compound into financial crisis. Therefore, minimization of NPL is a necessary condition for improving financial development and country economic growth. In this study analyzed the main peculiarities of credit risk management considering the macroeconomic factors. The effect of macro-economic factors on credit risk in banks was revealed what extends the knowledge of external factors causing the serious problems of non-performing loans in banks. The finding of the research gives important suggestions for bankers, regulating authorities and policy makers to understanding of the macroeconomic factors on credit risk and can help to construct the sound credit risk management system that enables to keep the stability of banking sector and whole economy. Moreover, the study narrows the literature gap in Ethiopia banking system regarding the determinants of NPLs by utilizing macroeconomic variables. Finally, it will serve as a reference for further studies in the related area.

## 1.9. Organization of the study

The rest of the paper is organized as follows: The next section will deal with the theoretical and empirical literature related to the determinant of Non-performing loan on bank specific, industry factors and Macro-economic indicator followed by focuses on overview of Ethiopia macro economy and Banking system. Chapter four presented Data, Methodology and method frame work. Chapter five presents the result and discussion of outcomes of ARDL estimation. Finally the last chapter presents conclusion and recommendation of the paper.

# CHAPTER TWO: REVIEW OF THEORTICAL LITREATURE AND EMPERICAL EVIDENCES

This chapter is organized as follows: It is divided into four main sections. The first section explores the theoretical literature and the second section reviews empirical studies related to the topic. The third section presents summary of the literature and research knowledge gap and finally conceptual framework of the study.

## 2.1. Theoretical Literature Review

### 2.1.1. The role of commercial banks in country‘s financial system and Economic Growth

Commercial banks are considered the most important role in the economics by accumulating and intermediate the financial resources, providing the credit operations and financial services, activating the financial flows what influences the economic development of a country (Rose, 2002). According to Eshete et al. (2013), the efficient financial intermediation increases the ability of the business enterprises to transfer the industry inputs into outputs that increases the growth of the whole economy. In fewer developing countries, like Ethiopia, financial sector is dominated by banking industry but the banking industry is infant and one of under-banked economy in the world. For developing countries, improvements in the banking sector could have significant impact on the allocation of financial resources since the sector is still the most important source of financing investment where financial markets underdevelopment (Sufian and Habibullah, 2010). In this respect, effective and efficient functioning of the Banks has significant role in financial development and accelerating economic growth.

According to Ricardas (2015), commercial banks perform specific tasks in the country‘s financial system, such as the mobilizing savings, allocating resources, diversifying risks, monitoring borrowers and exerting corporate control. The development of financial system positively affects economic growth of every country. It means that the growth rates of a country’s economy are higher when the banks are able to perform their tasks in the financial systems effectively. The recent empirical works suggest growth rates are higher when the legal environment enables financial systems to perform their tasks more effectively. In other word, the countries with more healthy financial systems achieve higher rates of economic growth and the

statistical data clearly demonstrates that the origins of financial crises in the countries could be noticed by incompetent or inefficient operations of banks. Such facts may explain cross country differences in economic growth: countries with more sophisticated financial systems achieve higher rates of economic growth (Williams and Gardener, 2003). So, the evaluation of banks' performance attracts significant attention from public and financial regulators as banks are the critical institutions in most country economies.

Moreover, the banking sector is considered as a vital role in the modern economy, where the banks implement their important role and carry out specific functions (Stankeviciene and Mencaite, 2012). As the profit seeking enterprises, the banks currently have also been increasingly focusing on customers' demands. They have also switched their business models from the sale of traditional financial products to marketing and customer orientation. Nowadays banks perform towards the relationship marketing with a focus on long-term relationships and mutual benefits with customers. The long-term, stable, and cooperative relationships with customers enable the financial industry to provide different services for different customers so as to enhance the profitability and efficiency of the bank (Lee et al, 2010).

The main source of commercial bank's interest income is loan portfolio which is the assets in the balance-sheet and it is created when the money fund is accumulated in the process of intermediation by accepting deposits. The basic function of intermediation is a source of credit and liquidity risks for any banking institution. The banks typically face numerous risks, including credit, interest rate, currency, liquidity, systemic risk and other. Also compared to other industries, banking stability is very dependent on trust and reputation. Because banks are clearly important to national and even global economic stability, the various indicators are needed to monitor the bank's performance, financial status and operational competence, the key drivers of bank performance are remain earing, efficiency, risk-taking and leverage (Chen and Cheng, 2013).

According to Andersen et al. (2012), Bank revenues have a time variation pattern over the business cycle up or down. Since revenues are a major determinant of bank service and lending capacity, the time variation may have an impact on the real economy growth and may potentially amplify the business cycle. Banks may have a preference for smoothing total income, loan

growth decreased and thus compensate for lower volumes by charging higher margins during recessions. At the same time, the limited loan supply affects economic development and causes economic slowdown. Furthermore, credit risk and adverse selection may be more severe problems for banks during recessions and thus require higher risk premium. Also, the loan markets may be slowdown during recessions, meaning that incumbents who resort to limit pricing may maintain higher margins without encouraging potential entrants and decreased loan demand would presumably indicate demand factors. All of these descriptive rely on banks having some market power, and that market power may itself be stronger during recessions.

To keep the banking system of a country stable, the activity of banks must be profitable. Sharma et al. (2013) argued that high bank profits may be market power or efficiency driven. If it is the case that profits are market power-driven, then households and firms are likely to experience high cost of borrowing, credit rationing and compromised banking services, among others. More importantly, these experiences are likely to have adverse consequences for the economic growth and development, thus aggravating the social and economic conditions of the regions where the economic growth and poverty reduction policies are predominantly financed by banks and the capital markets are small or inactive. However, high profitability may also be due to greater efficiency such that the implications of market power effects on profits may be discarded.

The analysis results of this section allow to confirm that commercial banks have the crucial role in the country‘s financial system and the economic development. For this reason the banking sector is highly regulated to assure the banking system stability and the implementation of the financial intermediation and other financial services. Many studies have proved that macroeconomic imbalances have the very negative impact on banks ‘financial results that depend on the bank‘s internal and external factors.

### 2.1.2. Commercial banks’ risks

Risk is a major concern for all financial institutions including banks and the different types of risks accompany their business. Although banks are in the business of persistent taking risk, managing the risks banking institutions need to avoid, absorb risk or it can be transferred to other participants. In the existing literature and banking practice there are many classifications of

banks ‘risks and the main commercial banks ‘risks are credit, market, liquidity, operational, concentration, and other risks: country, settlement, legal e.t.c. (Jaseviciene & Valiuliene , 2013).

According to Faure (2013), describes these main risks that must assess and manage all commercial banks: interest rate risk, market risk, Liquidity risk, credit risk, currency risk, counter party risk and operational risk. Al-Jarrah (2012) points that the sources of risks facing financial institutions can be decomposed into two main factors: systematic factors and non-systematic factors. The systematic or market risk is the risk that has a broad impact on all financial institutions in the market though the magnitude of the impact might not be uniform. Furthermore, the sources of systematic risk are related to variables that are outside of the bank’s control. On the other hand, the non-systematic factors sources of risk vary and related partly to bank-specific variables.

In general, the bank is exposed to various types of financial risks, the most important of which are credit risk, liquidity risk, Operational risk and Liquidity risk. The detail is presented as follows:

### I. Credit risk

Credit risk is also known as default risk, and it is the risk that a customer or counterparty will default on its contractual obligations resulting in financial loss to the Bank. The Bank’s main income generating activity is lending to customers and therefore credit risk is the principal risk. The National Bank of Ethiopia (NBE) sets credit risk limit for a single borrower, one related party and all related parties to not exceed 25% of Bank’s total capital amount as of the reporting quarterly period respectively. In addition, credit risk is one of the main risks in commercial banks and the ability to manage it meaning affects banks’ stability. This risk arises due to the particular reasons related to the possibility to lose loans if the debtors are not able meet their financial obligation.

### II. Liquidity risk

Liquidity risk is the risk that the Bank cannot be able to meet obligations in terms of funds demanded by client. Liquidity risk arises because of the possibility that the Bank might be unable to meet its payment obligations when they fall due as a result of mismatches in the timing of the

cash flows under both normal and stress circumstances. Such scenarios could occur when funding needed for illiquid asset positions is not available to the bank on acceptable terms.

The main objective of the bank's liquidity risk framework is to maintain sufficient liquidity in order to ensure that we meet our maturing obligations.

### III. Operational risk

Operational risk is risk of loss resulting from inadequate or failed internal processes, inappropriate persons and inappropriate or weak systems in the Bank as well as external events. The Bank defined its framework for managing operational risk by adopting the policy and procedure on operational risk management as approved by the board of directors of the Bank.

### IV. Market risk

Market risk (also called position risk, trading risk and price risk) is defined as the risk of loss risk that the fair value or future cash flows of a financial instrument will fluctuate by unexpected changes in market risk factors such as interest rates, foreign exchange rates, equity prices, credit spreads and their volatilities. Market risk can arise in conjunction with trading and non-trading activities of a financial institution. Market risk can only apply to marketable securities, and these are shares, debt and derivatives.

Market risk exposure may be explicit in portfolios of securities and instruments that are actively traded. Therefore, market risk is the risk that the value of on and off-balance sheet positions of a financial institution will be adversely affected by movements in market rates or prices such as interest rates, foreign exchange rates, equity prices, credit spreads and commodity prices resulting in a loss to earnings and capital of the bank (Al-Jarrah, 2012). Market risk can be divided into the interest rate and foreign exchange risk.

- **Interest rate risk** refers to volatility in net interest income and the economic value of a bank's assets, liabilities, and capital and off-balance sheet financial instrument.

- **Foreign exchange risk (also called currency risk)** is the risk of changes in exchange rate values unfavorably affecting the values of assets and liabilities that are denominated in currencies other than the domestic currency (Faure, 2013).

The analysis of this section assures the continuity of banks 'performance it is necessary to develop the risk management system in every bank considering the regulatory requirements. As the banks play very important role in the country's financial system and whole economy, the risk management actions must be directed towards the whole changing environment, because the financial problems of banks mostly depend on the improperly evaluated risk determinants. This is evident according to the recent financial crisis and the macroeconomic deterioration in many countries. While this study is concentrated to the credit risk, the ability to assess the credit risk has the critical importance for banks because the default of even a small number of borrowers can cause the large loss which further leads to the insolvency of bank.

### 2.1.3. Macroeconomic impact on credit risk in banks

The specific characteristics of debtors have the importance influence on their likelihood to repay the debts, but the change in economic environment must be also estimated in banks. The macroeconomic shocks can disimprove the banks' balance sheets through the deterioration in quality of loan portfolios that can cause significant losses of the banks and may even cause banking crisis. The economic cycle is quite a natural phenomenon in the market economics which consists of the stages of growth, peak, recession and a bottom as the lowest point of the economic decline. In the top phase of the cycle the economics of countries is over-heated and accompanied with high gross domestic product (GDP), the low unemployment rate and the high inflation starts to cause problems. Conversely, the boom is followed by the recession phase which is closely associated with a decrease of the employment and also with a decline of the pressure on inflation (Baran, 2011). According to Kaihatsu & Kurozumi (2014), the main sources of economic fluctuations are: output growth, consumption growth, investment growth, labor, wage growth, consumption price inflation, changes in the relative price of investment, the economic policy, the loans rate, loans growth, and net worth growth.

In the literature there is an important distinction between the kinds of factors that can affect banking credit risk:

I. Factors influencing the unsystematic credit risk.

II. Factors influencing the systematic credit risk.

Castro (2013) noted the factors influencing the unsystematic credit risk are the specific factors of borrowers: The individual borrower‘s specific characteristics like the individual personality, financial solvency and capital, credit insurance. The company’s specific characteristics like management, financial position, sources of funds and financial reporting, their ability to pay the loan and specific factors of the industry sector.

Include a number of unsystematic control variables in their empirical model to control the firm creditworthiness and risk. Specifically, they split firm risk and quality into two separate categories: Trading quality, demand and production risk and financial risk. To control for the former, they include controls of firm‘s profitability, historical and predicted sales growth, business outlook, labour and non-labour costs. To control for financial risk, the researchers include indicators for changes in firms ‘capital positions, debt to asset ratios, interest expenses and credit histories (Casey and O‘Toole, 2014).

According to Castro (2013), the factors influencing the systematic credit risk are: Macroeconomic factors like the employment rate, growth in gross domestic product, stock index, inflation rate, and exchange rate movements, e.t.c; Changes in economic policies like changes in monetary and tax policies, economic legislation changes, as well as import restrictions and export stimulation and Political changes or changes in the goals of leading political parties. All these variables can have an important influence on repayment of borrowers, but as changes in political situation and economic policies are difficult to examine, the study has mainly focused on the macroeconomic factors.

Teker et al. (2013) the main systematic credit risk variables are nine economic indicators (GDP per capita, inflation rate, trade balance, international reserves, fiscal balance, export growth rate, external debt to GDP, financial depth and efficiency, and exchange rate) and three political variables: political stability, government effectiveness and corruption levels. Macroeconomic shocks can feed into banks’ profitability through the credit risk transmission channel following deterioration in the credit quality of loan portfolios that can cause significant losses for banks.

A large number of researchers found that bank loan portfolio quality can be explained by both macroeconomic factors and specific borrowers' features. Recent studies show that factors like banking specific factors, industry factors and macroeconomic factors are major determinants of credit risk. There is a close link between business cycles, bank credit, and credit risk. The financial crises were often accompanied by deep and lasting recessions. According to the financial instability hypothesis a period of prolonged prosperity may induce speculative euphoria and excess borrowing which push the economy on the brink (Bucher et al., 2013).

The growth phase of the economy is usually characterized by a relatively low rate of non-performing loans in banks, as both consumers and firms have face a sufficient stream of income and revenues to repay their debts. However, as the booming period continues, credit is provided to lower-quality borrowers and subsequently, when the decline phase sets in; the non-performing loans tend to increase. The unemployment rate may provide additional information regarding the impact of economic conditions. An increase in the unemployment rate should influence negatively the financial performance of households and increase the debt burden and it lead to contribute higher NPLs. With regards to firms, increases in unemployment, the decrease of compensation of employees and the consumption expenditure throw households into deep financial problems and insolvency (Castro, 2013).

The empirical literature provides evidence on the linkages between business cycles and performance in banking. According to Steiner (2014), the sudden negative changes in markets and the whole economy affect the overall profitability of the firms. In a booming economy, increase the revenues of households and business sales increase, driving up profits and increase the ability to service debt payments. In their quest to increase market share during a boom, the bank also deepen the financial crisis by themselves, because credit extend their lending activities often reaching out for lower credit quality borrowers. The unrestricted credit expansion harms banking performance and deteriorates non-performing loans dynamics due to the overheating of the economies.

Subsequently, when the recession occurs, during this time the extension of credit to subprime borrowers inevitably increases non-performing loans (NPLs). The recessions usually cause the asset prices fall and still, it is well known that poor asset quality is one of the major causes of

bank failures. Thus, macroeconomic shocks are inevitably transmitted to banks' financial statement through a worsening of their credit portfolio. To examine the macroeconomic determinants of credit risk, studies generally use different proxies of loan quality, including loan loss provisions, NPLs, and loan write offs (Love and Ariss, 2014).

The financial sector development promotes economic growth by enhancing physical capital accumulation. Following this evidence, the studies of Ngare et al. (2014) argued that financial sector development is the key to economic growth subject to dismantling financial repression. The literature has recognized the important role played by credit markets in shaping real outcomes. A credit expansion by reducing interest rates would increase investment relative to savings. The rising consumer prices as a result of increased consumption, indicates that consumer goods are more profitable than producer goods, thus forcing producers to reassess investment plans. That situation would eventually cause recession.

According to Dore and Singh (2012), in the economy the disposable income, corporate profits, and total spending are highly related. The disposable income and revolving credit cause the aggregate spending. Spending in turn causes corporate profits. There is, however, some feedback effect, as spending causes disposable income. Revolving credit as well as corporate profits also causes disposable income. The over-expansion of credit when profits and house prices are declining and the informational asymmetries on the quality of credit slows the economy and leads to the recession.

Many studies evidence the influence of the macroeconomic risk on banks 'financial condition. In addition, the macroeconomic downturn influences the loan portfolio diversification level. The homogeneity of bank portfolios would increase in response to an increase in macroeconomic risk and uncertainty. The macroeconomic shocks affect bank signals about expected returns and the greater economic uncertainty hinders banks' ability to foresee investment opportunities. The deteriorating information quality should lead to a narrowing of the cross-sectional composition of bank portfolios, as banks reducing the risk tend to allocate assets in their portfolio more homogeneously when macroeconomic uncertainty increases (Calmes and Theoret, 2014).

Nevertheless the above arguments, Chan et al. (2013) also highlight the possibility that diversification in the activities of financial institutions can result in value reduction via poor

investment decisions. In this context, moral hazard can lead managers of banks to take on risks that are entirely borne by shareholders, resulting in higher cost inefficiencies as well as a larger proportion of non-performing loans. When the loan portfolio quality decreases banks can look for more non-interest income activities, but this diversification can also adversely affect banks' efficiency levels by disturbing revenue stability. Moreover, the involvement of banking institutions in non-interest income activities might increase fixed costs, resulting in higher operational leverage.

The analysis of this section shows that debtors 'credit risk in banks has the significant dependence on the macroeconomic factors of a country. The development of internal credit risk assessment models must include not only specific characteristics of loan applicants, but the macroeconomic indicators must be also taken into consideration. Banks are vulnerable to external macroeconomic shocks because they must finance illiquid assets with liquid liabilities and such shocks are the main driver of financial crisis. There is no one set of macroeconomic variables defined in the researches that are important for the credit risk of debtors, however the GDP and its growth, consumption, investment, wages, inflation, unemployment rate are often mentioned. The research proved that the performance of banks is highly influenced by the economic environment and, conversely, the economic development of a country is dependent on the condition of commercial banks and whole financial system. In the economic recession the restricted credit supply usually slows the recovery of economy, so the ability to keep the banking system stable is crucial for every country. As the business cycles are typical for the economies of countries, the understanding of their consistent patterns is very important not only for banks and their supervisors, but for the every enterprise and household this knowledge allows managing the finances more efficiently. The growth of non-performing loans is often related to the misunderstanding of economic processes and the irresponsible borrowing. This problem for households is especially difficult to solve in the economic downturns.

## 2.2. Empirical Evidences

The empirical literature that estimates credit risk (NPLs) drivers varies according to the countries investigated, methodologies applied and variables considered. A vast majority of studies focus on a group of countries instead of analyzing individual cases. Some of them consider both macro and microeconomic variables, whereas others rely on only bank specific factors for an accurate

credit risk modeling. Accordingly, the empirical evidences presents as follow. The first sub-section presents factors affecting non-performing loans in cross countries. The second sub-section discusses review of empirical evidence in Africa and the last sub-section focus on empirical evidence in Ethiopia.

### 2.2.1. Cross Countries

Vogiatzis and Nikolaidou (2011) investigated the deterministic factors of non-performing loans in the Romanian banking industry using monthly data covering the period between December 2001 and November 2010 by employing the Autoregressive Distributed Lag (ARDL) approach to co-integration. The empirical findings confirm that the rate of inflation, the unemployment rate, and the country's external debt and the money supply significantly influences on Romania's credit risk both in the short and in the long-run.

Castro (2013) analyze the link between the macroeconomic developments and the banking credit risk in a particular group of countries employing dynamic panel data approaches to these five countries of Europe where analyzed for the period 1997Q1-2011Q3. He concluded that GDP growth, unemployment rate, interest rates, share price indices, credit growth and the real exchange rate are crucial in determining credit risk. Ali and Daly (2010) confirmed the relevance of the macroeconomic environment to credit risk when Australia and the U.S. data for the period 1995-2009. Find that GDP growth, short term-interest rates and total debt provide meaningful indicators for aggregate default, although not on the same scale in each country.

Demirguc-Kunt and Detragiache (1998) examine the factors associated with the emergence of systemic banking crises in a large sample of developed and developing countries over the period 1980-94. The result suggest that a weak macroeconomic environment characterized by slow GDP growth, high inflation and high real interest as well as banks' low liquidity and a high share of credit to the private sector, are at the core of the banking crises. Antonio et al (2018) investigate the determinants of non-performing loans: evidence from European banks over the period 2011-2015 through a multivariate regression with panel data. The finding confirms that adverse cyclical conditions, resulting from a lower GDP growth and a higher unemployment rate, can generate a lower loan quality.

Klein (2013) investigates the non-performing loans (NPLs) in Central, Eastern and South-Eastern Europe (CESEE) in the period of 1998-2011 employed by VAR method. The main findings confirm that the level of NPLs in Central, Eastern and South Eastern Europe (CESEE) is influenced by GDP growth, unemployment and inflation as well as from moral hazard incentive, level of equity and excessive risk taking of the banks. Moreover, the examination of the feedback relationship between NPLs and macroeconomic downturns was noted, meaning that validating the nation that a healthy and sustainable economic growth cannot be achieved without a sound and strong banking system.

Among the few studies that apply ARDL co-integration techniques to study the short-term and long-term relationship between a set of macro and microeconomic variables and NPLs, Gourgoura and Nikoaidou (2017) investigate the determinant of non-performing loans in the Spanish banking system over the period 1997q4 to 2015q3 employs the ARDL approach to co-integration to identify the existence of a long run or short run relationship. The finding confirms that the real GDP, return on equity, long-term government bond yield, total credit granted by the Spanish banks and capital to assets ratio are affects credit risk in Spain both in the short and long run.

Fawad and Taqadus (2013) investigate the explanatory power of macro-economic variables as determinants of non-performing loans by using the Pakistani banking over the period of 1990-2011. The study applied OLS to test nine macroeconomic variables as a determinant of NPLs; results suggest that GDP growth, interest rate, inflation rate, CPI, exports and industrial production are significantly influence in affecting the level of NPLs whereas unemployment rate, real effective exchange rate and FDI are no impact on NPLs.

Azar Ghyasi (2016) examines the effect of macroeconomic factors on credit risk of banks in developed and developing countries using Dynamic panel method. He concluded that GDP growth, credit risk of the previous period, inflation, unemployment, government debt and private sectors contribute to the credit risk of the banks. By comparison of the coefficient of the model estimation, it can be show that credit risk of the previous period has the highest contribution to the credit risk of the current period.

Ravi Prakash (2013) to investigate the macroeconomic determinants of credit risk in the Nepalese banking sectors using time series modeling over the period of 2001-2011. The findings of the study conclude that inflation rate and foreign exchange fluctuation affect bank credit risks negatively and are statistically significant while other macroeconomic variable GDP growth, Broad money supply and market interest rate has no any influence in credit risk of banks in Nepal.

Nikolaidou and Vogiazas (2014) investigate the credit risks determinants in the Bulgarian banking sectors using time series approach over the period of January 2010 to December 2010. Findings suggest that the unemployment rate, the industry production index, the construction index and the real effective exchange rate are influence the credit growth and the quality of banks' assets.

Gustavo and Carmem (2011) investigated credit risk and macroeconomic interaction: empirical evidence from Brazilian banking system for the period from 2000 to 2006. The finding suggested that the level of economic activity and the basic interest rate are factors with great influence on the default risk. And the authors also analyze the reaction of the financial sector to structural risks, suggesting a new approach to credit risk. The assumption that credit risk is the result of an interactive process between banks and the economic environment is confirmed. The results also point to differences in the behavior of private and public banks. Specifically, banks in the private sector respond more actively to the impacts of the macroeconomic situation than do public banks.

### 2.2.2. Empirical studies in Africa

There are evidences which show different macro and micro economic factors that influence credit risk level of commercial banks in Africa. For example, using data from 16 Sub-Saharan African countries in the 1990s, Fofack (2005) investigates the leading causes of non-performing loans during the economic and banking crisis. He finds that the dramatic increases of non-performing loans are largely driven by macroeconomic volatility, reflecting the heavily exposed of external shocks and the impact of insufficient economic diversification. The result reveals that, a strong causality between non-performing loans and the real interest rate, real exchange rate, economic growth, net interest margin and interbank loans.

By applying the Autoregressive Distributed lag (ARDL) framework, Baoko et al (2017) examines the relevant factors influencing allocation of bank credit risk in the Ghanaian economy for the period 1970 to 2011. The finding shows that bank assets, real lending rate, broad money supply, and bank deposits are impact on credit risk in both short and long-run. And also inflation is significant impact on credit risk only in the short run. Nikolaidou and Vogiazas (2017) identify the determinants of bank credit risk focusing on five sub-Saharan Africa countries: Kenya, Namibia, South Africa, Zambia and Uganda using ARDL approach to co-integration. The finding confirm that increased money supply have a decreasing effect on NPLs in all countries.

Fatima and Zeyneb (2017) investigate the macroeconomic determinants of credit risk in the Algerian banking system using ordinary Least Squares (OLS) method from period 1980 to 2014. The finding shows that financial development, GDP, political stability and money supply are influence on credit risk in Algerian banks. Nabila and Younes (2011) examine the determinants of bank credit risk in Tunisia over the period of 1995 to 2008. They conclude that ownership structure, prudential regulation of capital and profitability are the main determinants of bank credit risk.

Love and Turk Ariss (2014) investigates macro-financial linkages in Egypt using a panel vector autoregressive method over 1993-2010, and the finding shows that positive shock to capital inflows and growth in gross domestic product improves bank's loan portfolio quality. For four African countries (Kenya, Uganda, Zambia and Nigeria) over the period 1985-1994, Brown Bridge (1998) investigates the causes of financial distress in local bank. The finding suggests that a major determinant is insider lending, low level of capitalization, political pressure, access to public sector deposits and the degree of capitalization.

For a sample of 46 banks in 12 countries in the Middle East and North Africa (MENA) region, over the period of 2002-2006, Boudriga et al. (2010) analysis the determinants of non-performing loans. The finding reveals that among bank specific factors, foreign participation coming especially from developed countries, high credit growth and loan loss provisions have a significant impact on the level of non-performing loans. And also the institutional environment enhancing banks credit quality.

Akinlo and Emmanuel (2014) identify the determinants of non-performing loans in Nigeria over the period of 1981-2011. The study provides that increase in real GDP tends to reduce non-performing loans in the long run. On the other hand, exchange rate, credits to the private sector and unemployment rate are positive influence on nonperforming loans in Nigeria. In addition, the study reveals that in the short run, stock price index, exchange rate, lending rate and credit to the private sector are the main determinants of non-performing loans.

Brei et al (2018) investigates the impact of bank competition in Sub-Saharan Africa on bank non-performing loans, a measure of credit risk. Using bank-level data for a sample of 221 banks from 33 countries over the period 2000-15, the authors a non-linear or U-shaped relationship between bank competition and credit risk. In other words, increased bank competition has the potential to lower credit risk via efficiency gains (lower credit cost, operational gains). However, the positive effects may be outweighed by adverse effects of excessive competition (lower profit margin erosion, increased risk taking by banks). They also find that credit risk in Sub-Saharan Africa is not only related to macroeconomic determinants, such as growth, public debt, economic concentration, financial deepening and inclusion, but also to the business and regulatory environment.

David K (2013) investigate bank-specific, industry-specific and macroeconomic determinants that influence credit risk (CR) in commercial banks in Ghana using unbalanced panel data set from 33 commercial banks covering the 21-year period 1990 to 2010. The finding suggest that credit risk in Ghana is significantly influenced by management efficiency, GDPPC, Government borrowing and the financial sector development. Government borrowing and financial sector development have a negative relationship with credit risk whereas management inefficiency and GDPPC have a positive relationship.

### 2.2.3. Empirical studies in Ethiopia

A lot of empirical studies focus on factors that affect Banks non-performing loan by bank specific factors, business characteristics specific and macroeconomic factors jointly and separately focused on bank specific factors in Ethiopia. For instance, Wondimagegnehu (2012) investigate the determinants of nonperforming loans in Ethiopian commercial banks focusing on bank-specific variables by adopting mixed research approach from 2005-2010. The findings

reveals that poor credit assessment, failed loan monitoring, underdeveloped credit culture, lenient credit terms and conditions, aggressive lending, compromised integrity, weak institutional capacity, unfair competition among banks, willful default by borrowers and their knowledge limitation, fund diversion for unintended purpose, over/under financing by banks are the causes of non-performing loans.

For a sample of 96 observations has been analyzed over the period 2006-2016 and used unbalanced penal data, Mekdes (2017) examines the bank-specific and macro-economic determinants of Non-performing loans (NPLs) of Ethiopian commercial banks used quantitative research approach. The result shows the cause-effect relationship between the bank specific, macroeconomic factors and non-performing loans of Ethiopia commercial banks. Particularly, the findings of the study show that return on equity and capital adequacy have negative and significant impact on NPLs while loan loss provision and loan to deposit have positive significant relationship with NPLs.

Anisa (2015) investigates the determinants of nonperforming loans in Ethiopian commercial banks by combining the bank specific variables with macro-economic variables. The study used balanced fixed effect panel regression for the sample of eight commercial banks in Ethiopia from 2004 to 2013. The results of balanced fixed effect panel data regression analysis shows that deposit rate, loan to deposit ratio and lending interest rate had positive and significant factors that affect the level of non-performing loans in Ethiopian commercial banks. From macroeconomic variable the study also find lending interest rate is a very important determinant of non-performing loan in Ethiopia banking industry. Cost efficiency had negative and significant influence on banks non-performing loan.

Habtamu (2015) assess the bank specific factors affecting non-performing loans in Ethiopian six private commercial banks used SPSS software and collected data through Interview and questionnaires to bank staff. The major findings reveals that poor loan follow up, poor credit assessment, underdeveloped credit culture, knowledge limitation, lenient credit terms and conditions, compromised integrity, fund diversion for unintended purpose, unfair competition among bank and shareholders influences are the major factors affecting NPLs. On the other hand

the research found that bank size and credit growth have no impact on the occurrence level of non-performing loans.

Gebru (2015) identify the determinants of non-performing loans in the Ethiopian commercial banks used structured questionnaire to collect data for the study from both private and state-owned banks. The finding revealed that poor credit analysis on the part of lending banks and unsound lending practices, lack of focused loan monitoring and follow-up, borrowers' undesired culture, compromised integrity, and fund diversion are the major factors that contribute to non-performing loans.

Tamrat (2016) examine bank specific and macroeconomic factors that play in determining the credit risk of Ethiopian commercial banks used fixed effect panel regression model from the period 2011-2014. The finding of the study shows that bank specific factors like; capital adequacy ratio, size of a bank, loan growth, managerial efficiency, loan to deposit, return on equity, and ownership structure, and macroeconomic factors like gross domestic product were statistically significant effect on the level of non-performing loans of Ethiopia commercial banks.

Mesay (2017) investigate bank specific, macroeconomic and business characteristics specific determinants of non-performing loan growth rate in Ethiopian commercial banks by emphasizing on the manufacturing sector. The study adopted a mixed methods research approach over the period of 2000 to 2015. The findings of the study show that loan growth rate, loan to deposit ratio, credit follow-up and monitoring, deposit interest rate, absence of adequate man power, lack of compressive studies on the credit applicants are statistically significant and the major determinant of non-performing loans in Ethiopia commercial banks. On the other hand, variables like exchange rate and inflation rate are not influence non-performing loans of Ethiopian commercial banks.

Sitina (2018) examines the bank-specific and macro-economic determinants of Non-performing loans (NPLs) of nine commercial banks in Ethiopia employs an explanatory research design and a quantitative research approach over the period of 2007 to 2016. The major finding of the study shows that trade openness, unemployment rate, exchange rate and loan growth are impact on non-performing loans. Particularly, trade openness affects non-performing loans positively and

statistically significant, whereas, exchange rate, unemployment and loan growth affects NPLs negatively and are statistically significant.

## 2.3. Summary of the literature and research knowledge Gap

From the above theoretical and empirical reviews it can be concluded that NPLs have a great impact on commercial banks. The empirical studies reveal that banks NPLs can be determined by many factors which can be grouped as macroeconomic factor, Bank specific factor and industry factors. However, Most of the literatures that are discussed so far appeared to have focused on macroeconomic factors that were conducted in the banking sector of different countries outside Ethiopia. Consequently, the commercial banking sector of Ethiopia has so far received inadequate attention in the macroeconomic factors affecting credit risk. Conclusions cannot be made on the causes of NPLs of the banking sector of a given country based on the finding of other countries because the financial sector policies may still differ due to the effectiveness of those institutions that design and implement the policies. And also the studies were carried out based on the data from diverse countries, the data originated from; those literatures by themselves provided contradictory conclusions because of different models and methodologies they used.

Many studies have examined the causes of non-performing loans in several countries around the world; however, little research has gone to the study of the causes of NPLs in Africa (Onsarigo, et al., 2013). Like most Africa countries, in Ethiopia, to the knowledge of the researcher, there has not been much research which is conducted on determinants of loan defaults except for the study of Wondimagegnehu (2012), Tesfaye (2015), Habtamu (2015), Anisa (2015), Gebru (2015), Tamrat (2016), Mesay (2017), Mekdes (2017) and Sitina (2018). The related studies conducted by Wondimagegnehu (2012), Tesfaye (2015), Gebru (2015) and Habtamu (2015) assessed the determinants of NPLs in Ethiopian commercial banks focusing on bank-specific variables. The study by Anisa (2015), Tamrat (2016), Mesay (2017), Mekdes (2017) and Sitina (2018) combined both the macroeconomic and bank specific factors but both the studies some important macroeconomic factors cannot incorporated in the model and they utilize limited macroeconomic variables which are not sufficient for conclusion. To the best of my knowledge, no in-depth studies have been conducted to investigate the macroeconomic determinants of credit risk in the banking industry in Ethiopia. This research intends to fill a gap in research as the first

in-depth study in to the macro-economic factors affecting credit risk in the banking industry of Ethiopia.

In general, the lack of adequate research on the Macroeconomic factors affecting non-performing loans in Ethiopian commercial Banks , the focus of most of the existing studies being only on the bank specific determinants of NPLs and the existing knowledge gap initiates this study. Hence, the purpose of this study is to investigate in-depth the macroeconomic factors affecting credit risk in Ethiopian commercial banking sector by utilizing an appropriate econometrics model and also further contribute to the stock of literatures.

## 2.4. Conceptual Framework

The main objective of this study is to investigating the macroeconomic factors affecting credit risk (NPLs) in Ethiopia commercial banks. Based on the objective of the study, the following conceptual model is framed. As previously discussed in the related literature review parts; non-performing loans are affected by macroeconomic factors. Macro-economic factors are Real GDP growth rate, Unemployment rate, Inflation, Broad money supply growth rate, Lending interest rate and term of trade. The conceptual framework indicates that non-performing loans (NPLs) of bank is dependent variable and the other six macro-economic factors are independent variables.

The coefficient of growth of real GDP is expected to be negative. This is based on the previous literature point out the negative impact of real GDP growth on non-performing loans (Castro (2013), Ali and Daly (2010), Klein (2013), Demirguc-Kunt and Detragiache (1998), Gourgoura and Nikoaidou (2017), Fawad and Taqadus (2013) and Akinlo & Emmanuel (2014)). Growth in real GDP usually leads to increase in income which ultimately enhances the loan repayment capacity of the borrower which leads to contributes lower non-performing loans. Conversely, when there is a slowdown in the economy, the level of non-performing loans is expected to increase.

The coefficient of inflation rate is expected to be positive. This is based on the previous literature point out higher inflation can weak the loan repayment capacity of bank borrowing customer by reducing the real income of the customer (Kiln (2013) and Bohachove (2008)). The coefficient of Lending interest rate is expected to be positive. This is based on the previous literature that an increase in lending rate tends to weaken loan payment capacity of the borrower and thus increase

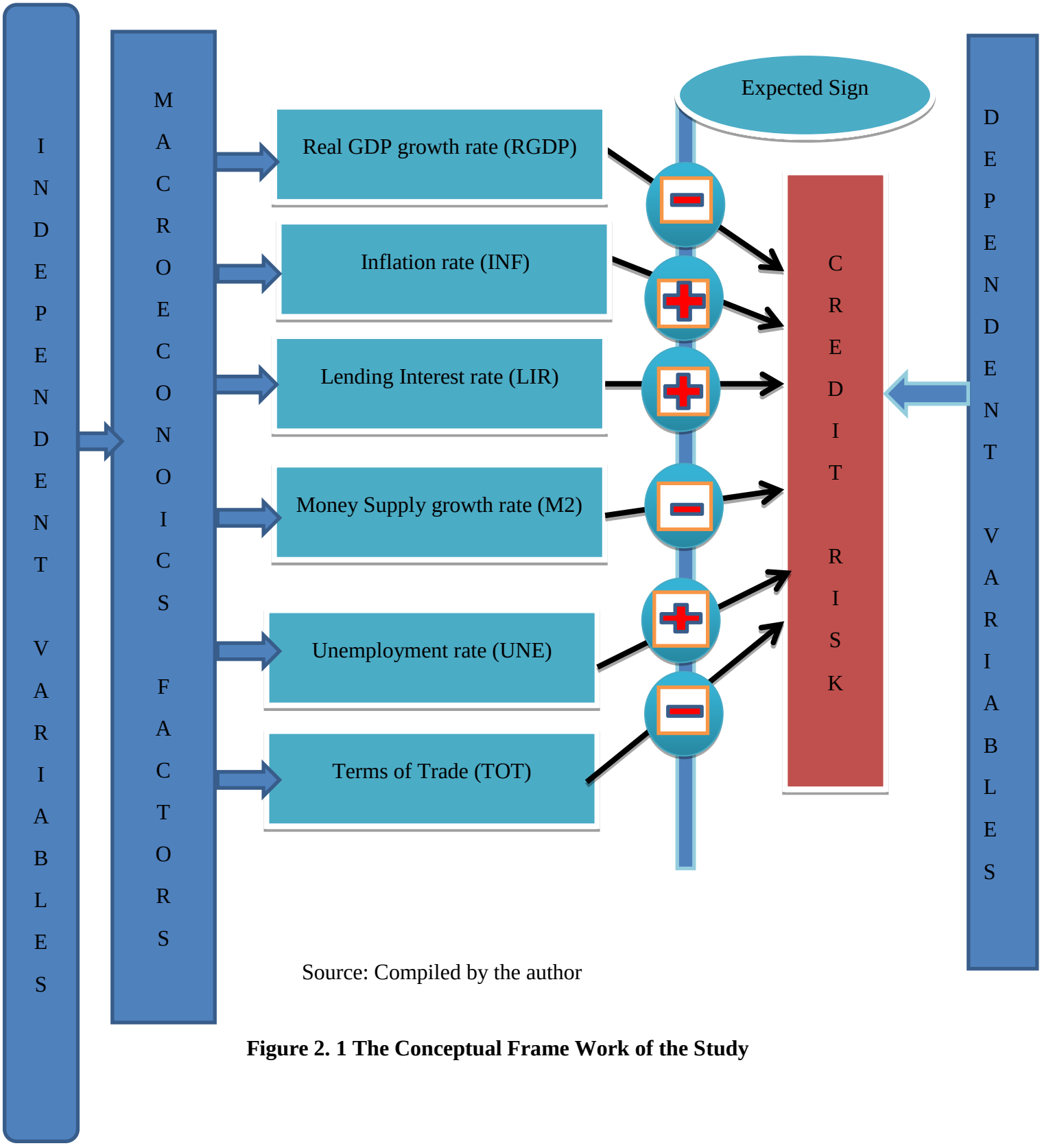
non-performing loans (Akinlo & Emmanuel (2014), Nkusu (2011), Fofack (2005), Castro (2013)). A rise in the interest rates increase the cost of borrowing and a rise in non-performing loans, because borrower who mostly have low and fixed income cannot repay their debt before due dates. Asymmetric information and the resulting adverse selection problem can lead borrowers inducing them to take on riskier project, in which some borrowers are denied loans given when they are willing to pay a higher interest rate (Stiglitz and Weiss 1981).

The coefficient of growth of broad money supply is expected to be negative. This is based on the existing literature point out the growth of broad money supply affect banks' credit risk i.e. a negative relationship between growth of broad money supply and non-performing loans (Ahmed (2001), Vogiazas and Nikolaidou (2011)). Increasing money supply will decrease the interest rate and create the opportunity of cheaper fund and also the ability of debtors to honor their financial obligation and this will contribute to decreasing non-performing loans (Ahmad & Ariff 2007).

The coefficient of unemployment rate is expected to be positive. This is based on the previous literature point out a strong correlation between unemployment rate and non-performing loans i.e. a positive and significant relationship (Nkusu (2011), Selam & Jouini (2013), Akinlo and Emmanuel (2014), Vogiazes & Nikolaidu (2011), Bucur and Dragomirescu (2014) and Bofondi and Ropele (2011). An increase in the unemployment in the country negatively affects the income of the individuals which increase their non-performing loans of the banks.

The coefficient of terms of trade is expected to be positive. This is based on the existing literature point out falling terms of trade are expected to increase banks' credit risk (Bochachova (2008) and Caprio et al., (1998)). The terms of trade also affect bank risks by influencing the profitability of bank borrower, that is, they too primarily affect credit risk. A drop a terms of trade occurs when imports become expensive relative to export, eroding the purchasing power in a country. This leads to increase bank credit risk.

The following conceptual model is framed to summarize the main focus of the study is developed by the researcher.




Source: Compiled by the author

**Figure 2. 1 The Conceptual Frame Work of the Study**

# CHAPTER THREE: OVERVIEW OF THE MACROECONOMIC AND BANKING SECTOR PERFORMANCE OF ETHIOPIA

In this section present the general overview of the development and performance of Ethiopian macro economy Indicators and banking sector performance from 2001/02 to 2018/19 with emphasis given to variables those included in our study.

## 3.1. Macroeconomic Performance

Ethiopia is the second largest populous country in Africa after Nigeria with a population of more than 100 million. About 83% of the population lives in rural areas driving their livelihoods from subsistence agriculture. The population census estimate of the Central Statistical Authority (CSA) report further indicates that 17% of the total population of the country currently lives in urban areas. As a developing nation, urbanization in Ethiopia also has been increasing with an average growth rate of 4.4% per annum.

Review of the country's macroeconomic performance trends over the period covering from 2007/08 through 2017/18 shows that the country has been achieving a sustainable economic growth with double digits except in the year 2011/12, 2012/13 and 2017/18 which is 8.7% , 9.9% and 7.7% respectively. Overall, during this period, the country has recorded an average Gross Domestic Product (GDP) growth rate of about 9.92% which makes it one of the fastest growing nations in the continent of Africa. Different international studies like the World Bank and IMF proved that Ethiopian GDP growth significantly outperformed the world average and Sub-Saharan Africa's average in the past years, and is likely to continue in the years to come.

The following figure shows the country's Real GDP data trends as extracted from the National Bank of Ethiopia's Annual Report Bulletin 2018.

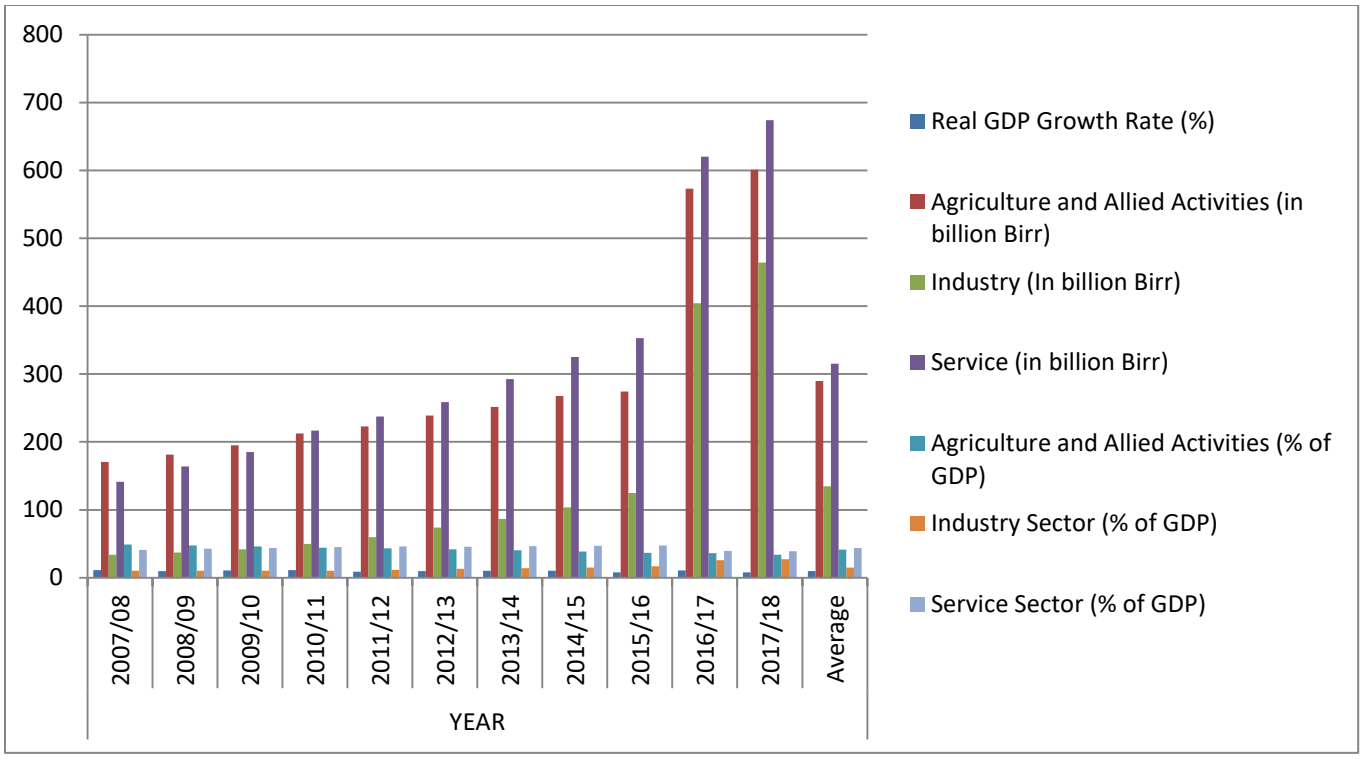



**Figure 3. 1 Trend of Real GDP Data in the period of 2007/08 to 2017/18**

**Brief Analysis on RGDP growth rate**

Review of Ethiopia's GDP growth rate trends over the past eleven years for the period covering from 2007/08 through 2017/18 indicates that the country has registered a positive growth averaging 9.92% annually. The policies and strategies as well as political stability have contributed for the impressive growth in new investments and corresponding economic growth of the country. However, the growth rate of GDP in 2017/18 was 7.70% which is slower than the average of the past eleven years. This was mainly attributed to growth deceleration in agriculture and industry.

Economic sector wise, as depicted on the figure above, the major Economic Sectors of the country showed a consecutive expansion. In light of composition, the lion's share had been that of the service sector beginning 2007/08 till the 2017/18 followed by Agriculture and allied activities and the Industrial Sector. As the past trend in all sectors indicates, all the economic sectors in the country in the review period showed increasing trend in absolute terms. However, the share of Agriculture and Allied services exhibited continuous decline. The share of same contracted to 33.80% in 2017/18 from 48.8% registered in 2007/08. The share of the Industrial

sector registered continuous expansion and reached 27% at the end of the review period from 10.1% of 2007/08.

### 3.1.1. International Trade performance

**Table 3. 1 International Trade Data (Million Birr)**

| Description | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 | 2017/18 | Average Growth Rate |
|---|---|---|---|---|---|---|---|
| **Export Sector** | | | | | | | |
| *Values* | 108,227 | 123,496 | 121,532 | 122,366 | 139,805 | 184,282 | |
| *Annual Growth Rate* | | 14% | -2% | 1% | 14% | 32% | **12%** |
| **Import Sector** | | | | | | | |
| *Values* | 251,301 | 308,691 | 393,189 | 424,528 | 428,400 | 502,113 | |
| *Annual Growth Rate* | | 23% | 27% | 8% | 1% | 17% | **15%** |
| *Trade Balance* | (143,074) | (185,195) | (271,657) | (302,162) | (288,595) | (317,831) | |

Source: NBE's Quarterly Bulletin 4th Quarter 2017/18

**EXPORT TRADE PERFORMANCE**

As shown in the above table, the export sector has exhibited a fluctuating trend during the stated periods of 2012/13 through 2017/18. However, in those years the export sector grew on average at a rate of 12% per annum. In the last three years the growth was at an increasing rate. Yet, the overall performance of exports was short of targets set for the second GTP. The performance of this sector has a meaningful benefit to financing banks as it offers multifaceted advantages by supporting other economic sectors mainly import and the manufacturing sectors. Plus, the growth of export sector signifies the country's potential for increasing its traditional exportable commodities and this in turn indicates stakeholders involved in the channel can be beneficiaries.

**Import Trade Performance**

Imports had a positive but a fluctuating movement in the period from 2012/13 through 2017/18. On average it had an annual growth rate of 15% per annum. However, the growth of this sector

has a negative implication by eroding the country's scarce foreign currency and creating huge trade imbalances.

**IMPLICATIONS OF THE INTERNATIONAL TRADE MOVEMENT**

The declining trend in the export sector poses negative implications to the financial sector in terms of their ability to provide foreign exchange to support the import of different consumable and capital goods. The diverging trade deficit in the past years exhibited in the table above exhibit same situation.

### 3.1.2. Development of Money Supply, Interest rate and Inflation rate

The National Bank of Ethiopia is responsible for the formulation and implementation of the country's monetary policy. The main objectives of the monetary policy of NBE include the maintenance of price stability, exchange rate stability and to provide support for sustainable economic growth. Maintenance of price stability is highly emphasized since it is considered as a proxy for the achievement of overall macroeconomic stability. The motive behind is that price stability helps to stabilize major economic activities like investment, consumption, international trade and saving; and in the end it will enhance employment and economic growth. The main trust of monetary policy continued to be geared toward ensuring price stability and macroeconomic environment for economic growth.

#### Development of Money supply ($M_2$)

Broad money ($M_2$) consists of both narrow money and quasi-money, where narrow money contains basic amount of notes and coins and operational deposits at bank, and quasi-money embraces both saving and time deposits. The whole components were raised up thought the reviewing period with Narrow money supply has a greater share than Quasi-money supply. At the close of the first quarter 2004/05, broad money supply reached Birr 34.6 billion reflected quarterly and annually growth rate of 3% and 13%, respectively. Year-on-year basis, the growth in broad money was largely ascribed to 20.7% expansion in domestic credit and 2.5 % build up in net foreign assets of the banking system (NBE: 2004/05). In the fourth quarter of 2017/18 broad money supply ($m_2$) which stood at Birr 740.6 billion this increment comes largely due to

the increase in net foreign assets and domestic credit by 3.5 and 24.3% respectively (NBE: 2017/18).

**Development lending interest rate**

Since 1998, interest rate structure is freely determined by the market force except minimum saving deposit rate. Commercial banks are free to pay depositors any rate they want above the minimum rate set by National Bank of Ethiopia. Interest rate structure of commercial banks did not show significant changes during the period of 2001/02 to 2018/19. Simple average savings deposit rate all most the same in the past twenty years of 4.72 % per annum. At the same time, simple average lending rate stood at 11.77 % per annum.

**Development of Inflation rate**

Inflation in Ethiopia during the review period showed a fluctuating behavior characterized by successive ups and downs. Ethiopia was characterized as a low inflation country with an inflation rate of single digit level. For instance According to Zerayehu (2006), explained from 1971 – 2003, the inflation averaged 6.70%. In this period the highest inflation of 45% was registered in 1991, the year which marks the end of the civil war and the incumbents the Ethiopian People's Revolutionary Democratic Front took power. From 2003/04 to 2018/19, however, inflation started to rise rapidly but fluctuating year to year. The average inflation in this period of 2003/04Q1 up to 2018/19Q4 rose to 14.61% with the highest inflation rate of 36.8 % registered in 2008/9Q3.

## 3.2. Ethiopia Banking Sector

Modern Banking in Ethiopia began towards the end of the reign of Emperor Menilek. This period witnessed the establishment of the country's first bank. Called the Bank of Abyssinia, it was an affiliate of the National Bank of Egypt, and established in 1905. It was established in Addis Ababa and to widen its reach in the country the Bank had opened its branches to Dire Dawa, Gore and Dessie. It also had an agency and a transit office in Gambella and at the port of Djibouti respectively. After its formal liquidation on August 29, 1931 the Bank of Abyssinia was replaced by a new bank, the Bank of Ethiopia, under government control (Wondimagegneh, 2012).

According to NBE (2010) Bank of Ethiopia, was purely Ethiopian institution and was one of the first indigenous banks in Africa. The Bank of Ethiopia continued successfully until 1935 and ceased to function because of the Italian invasion. During the years of the Italian occupation period, many branches of the Italian Banks opened such as Banco d'italia, Banco di-Roma, Banco Di-Napoli and Banco Nazianali del lavoro were operational in the main towns of Ethiopia.

After departure of Italians, in 1941 another foreign bank, Barclays Bank, come to Ethiopia with the British troops and organized banking services in Addis Ababa, until its withdrawal in 1943. After withdrawal of Barclays Bank, the State Bank of Ethiopia was established on November 30, 1943 with a capital of one million Marian Treasury of the Ministry of Finance. Pursuant to the Monetary and Banking Law that come into force of 1963 the State Bank of Ethiopia that had served as both a central and a commercial bank was dissolved and split into the National Bank of Ethiopia and Commercial Bank of Ethiopia Share Company. Accordingly, the central banking functions and the commercial banking activities were transferred to the National Bank Ethiopia and the Commercial Bank of Ethiopia Share Company respectively (Wondimagegneh, 2012).

Following the declaration of socialism in 1974 the government extended its control over the whole economy and nationalized all large corporations. Accordingly, Addis bank and commercial bank of Ethiopia Share Company were merged by proclamation No. 84 of August 2, 1980 to form single commercial bank in the country until the establishment of private commercial banks in 1994. To this end, financial sector were left with three major banks namely; NBE, CBE and Agricultural and development bank during the socialist government (Habtamu, 203).

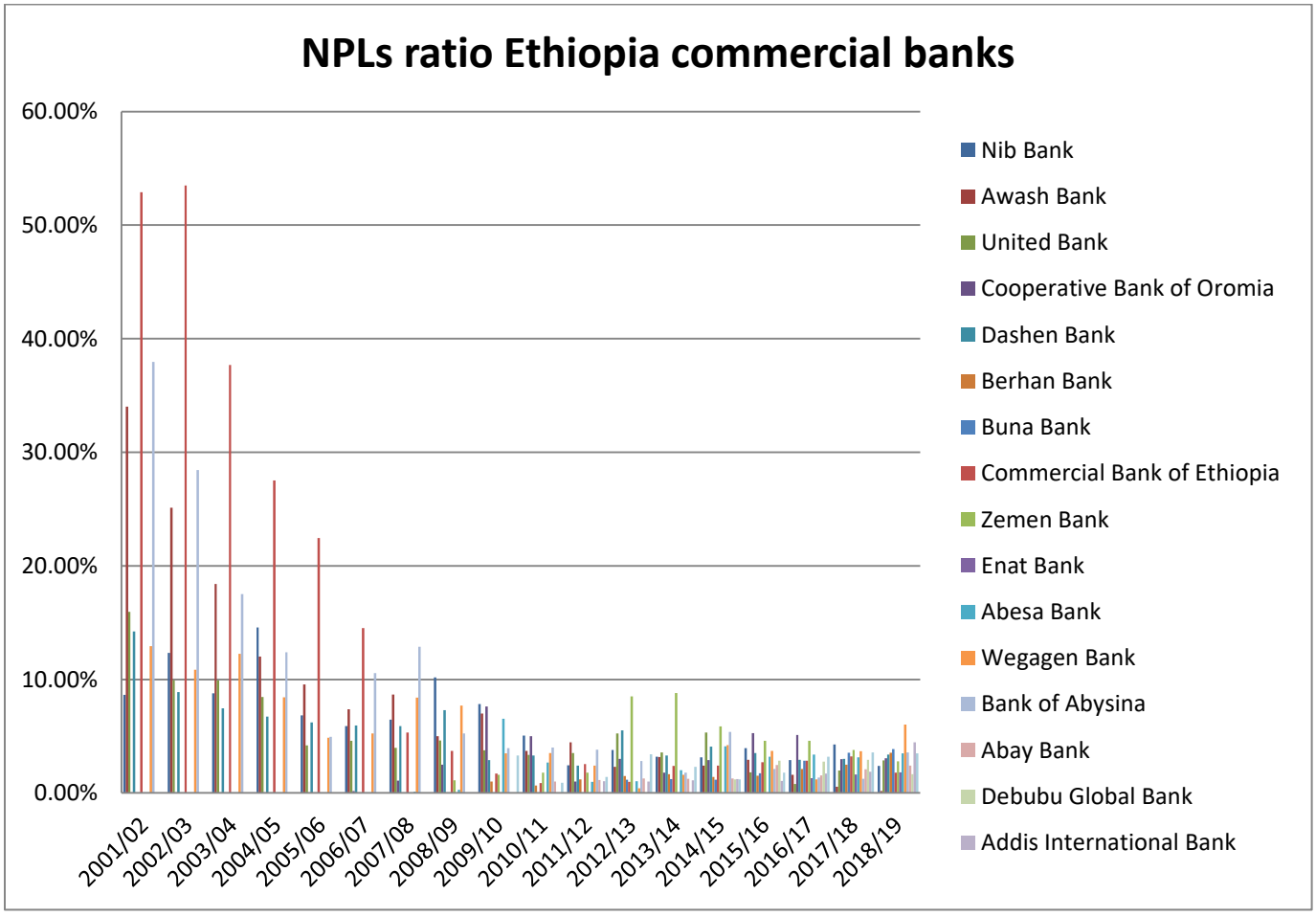
Following the departure of Derg regime Monetary and Banking proclamation of 1994 established the national bank of Ethiopia as a legal entity. Following this, Monetary and Banking proclamation No. 84/1994 and the licensing and supervision of banking business proclamation No.84/1994 laid down the legal basis for investment in banking sectors. Commercial Banks both public and private are currently operational in line with Banking Proclamation No. 592/2008.

Following the enactment of the banking legislations in the country in the 1990s, a fairly good number of private banks have been established. In the 2017/18 fiscal year the number of banks operating in Ethiopia remained at 18 at end June 2018. These included 16 private and 2 public owned banks (NBE, 2018). There still is also under process establishing other new commercial banks by different individuals and groups for instance Amhara bank, Geda bank e.t.c. currently commercial banks work for profit and the role of licensing and supervision is entrusted to the NBE.

### 3.2.1. Trend of Nonperforming Loans (NPLs) of Ethiopia Commercial Banks

In this study, NPL is measured by the share of non-performing loans from the total loans & advances of the bank. The National Bank of Ethiopia has provided direction to all commercial banks to maintain the NPL ratio below 5%. The below figure implied that non –performing loan in the period of 2001/02 to 2018/19 at each bank level.

**Figure 3. 2 Trend of Nonperforming Loans from 2001/02 -2018/19**




*Source Banker association and Each Banks Annual report*

Accordingly, the figure 3.2 provides a respective pictorial presentation for NPLs figure from 2001/02- 2018/19. In the figure shows; x-axis represents the years whereas y-axis represents the NPLs level of Commercial banks in Ethiopia. As can been seen from the above figure, the trend of nonperforming loans of commercial banks in Ethiopia for the period from 2001/02 to 2018/19 are decreasing. This significant decline of NPLs might imply either improvement in the level loan quality or being escaping of banks from providing loan and advances. Even if, there is a decreasing trend in the level of NPLs ratio from 2001/02 to 2018/19, the descriptive result shows that NPLs problem is still challenge on commercial banks in Ethiopia.

# CHAPTER FOUR: METHODOLOGUY AND ESTMATION STRATEGY

This chapter provides a brief discussion on research methodology and method framework used to achieve the objectives of the study. It is organized in to four sections. The first section presents research approach. The second and the third section presents source of data and model specification. The last section presents method framework.

## 4.1. The Approach of this Study

The aim of the study is to investigate the Macroeconomic factors affecting NPLs of commercial banks in Ethiopia. The characters of the study examine derived hypotheses and specify the relationship among variables (typically in terms of magnitude or direction) rather than developing it. The study is an explanatory research that used quantitative research approach, as it is the best approach to test hypotheses and to identify factors that influence on outcome (Creswell, 2013). Quantitative approach specifies how and why the variables are interrelated and why independent variable, influence or affect a dependent variable non-performing loan so, the quantitative approach better provides and explain cause and effect relation. In time series analysis, it is important to understand the behavior of variables, their interactions and integrations over time.

## 4.2. Source of the Data

The study investigates macroeconomic factors affecting credit risk in the Ethiopian commercial banks. And to assess how the Ethiopian commercial banks historical default rates have changed relative to the change in each of the relevant macroeconomic factors; by employing quarterly data over the period of 2001/02Q1 to 2018/19Q4. Using secondary data obtained from the National bank of Ethiopia, Ministry of Finance and Economic Cooperation, world development indicators, Banker association and Banks annual report. Here in the model there are only use six macroeconomic variables namely Real GDP growth rate, Inflation rate, unemployment rate, Leading interest rate, Money supply, Terms of trade and Dependent variable namely Non-performing loans.

Inflation rate, Money supply, and interest rate are Quarterly data obtained from National Bank of Ethiopia and Real GDP growth rate is annually data collected from Ministry of Finance and

Economic Cooperation (MFOEC). Terms of trade and Unemployment rate are annually data collected from world development indicators (WDI). Non-performing loans are same years quarterly data collected from Banker Association & the remaining years collected from Banks annual report and different source. Some variables are not available in quarterly data. We have to generate quarterly data by interpolating annual data using Eviews 9. An econometric method of data analyzed using E-view version 9 statistical software packages.

### 4.3. Model Specification

In this study, to investigate the macroeconomic factors affecting credit risk in Ethiopia commercial banks using quarterly data over the period of 2001/02Q1 up to 2018/19Q4. Non-performing loans to total loan ratio is used as a proxy for credit risk is the dependent variable of the study while the independent variables are Real GDP growth rate (RGDPG), Inflation rate (INF), Unemployment rate (UER), Lending Interest rate (LIR), Broad Money supply growth rate (M2) and Term of Trade (TOT). The variables are taken from different papers discussed in the empirical literatures taking into consideration the availability of data. The regression model of this study is estimated in the following form:

$$LNPLs_t = \beta_0 + \beta_1 RGDPG_t + \beta_2 INF_t + \beta_3 UNE_t + \beta_4 LTOT_t + \beta_5 M2_t + \beta_6 LIR_t + \varepsilon_t$$

Where

$\beta_0$: Intercept of the Regression

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ & $\beta_6$ : Parameters to be estimated

$NPLs_t$ : Non-performing loans at time period "t"

$RGDPG_t$ : Real GDP growth rate at time period "t"

$INF_t$ : Inflation rate at time period "t"

$UNE_t$ : Unemployment rate at time period "t"

$TOT_t$ : Terms of trade at time period "t"

$M2_t$ : Broad money supply growth rate at time period "t"

$LIR_t$ : Lending interest rate at time period "t"

$\varepsilon_t$ : Error term period "t"

t: time period (2001/02Q1 to 2018/19Q4)

## Definition and Measurement of Variables

- **Nonperforming Loans (NPLs):-** Nonperforming loan is any loan in which interest and principal payments are more than 90 days overdue or more than 90 days' worth of interest has been refinanced (IMF 2009). NPLs indicate the borrowers are not paying their principal and interest properly as per their payment schedule, unable to meet their current financial obligation when borrowers fail to repay their loan amount. NPL considered as one of the main cause of financial crises banking failure and impair the profitability of bank. Thus, NPL are likely to hamper economic growth and reduce the banking profitability.

- **Real GDP growth rate (RGDPG):-** the real economic growth or Real GDP growth rate, measures economic growth as it related to the gross domestic product (GDP) from one period to another. It is the most popular method of measuring an economy's output and is therefore considered a measure of the size of an economy. A strong economic condition measured by GDP, as motivating factor to banks has statistically significant impact on issuance of more private credit to businesses and a strong economic condition also creates more demand for goods and services which lead to more investment in different sectors hence increase the per capita income as well as the savings, collectively these factors convince to banks to issue more private credit (Kashif and Mohammed, undated). Credit quality is affected by a country's economic development for example a bad economic growth will reduce the level of per capital income and as a result individuals will have difficulty in paying the loan amount. According to Salas and Suarina (2002), real GDP growth reflects the soundness and stability of an economy that will in turn enhances borrowers' capacity to repay their outstanding obligation and hence reduce the amount of NPLs.

- **Inflation rate (INF): -** Inflation is the rate at which the general level of prices for goods and services is rising and, consequently, the purchasing power of currency is falling. It is

a situation in which the economies overall price level is rising. It represents sustained and pervasive increment in aggregate price of goods and services resulting decline in purchasing power of money. Accordingly, when inflation is high and unexpected, it can be very costly to an economy. At the same time, inflation generally transfers resources from lender and savers to borrowers since borrowers can repay their loans with birr that are worthless. It is determined as the general consumer price index. This indicates that, as inflation increase, the cost of borrowing gets more expensive and deteriorates the quality of loan portfolio, which leads to an increase in the obligation of borrowers resulting in an increase in the credit risk.

- **Unemployment Rate (UNE):-** The unemployment rate is a phenomenon that occurs when a person who is actively searching for employment is unable to find work. Unemployment is often used as a measure of the health of the economy. This is based on the argument that an increase in the unemployment rate in the country negatively affects the incomes of the individuals which increases their debt burden (Bofondi and Ropele, 2011; Vogiazes and Nikolaidu, 2011). An increase in the unemployment rate should influence negatively the financial performance of household and increase the debt burden, which is the increase in unemployment, labor losses their source of income and has no money to repay their loans; as a result NPLs increases (Baboueek and Janear, 2005).

- **Broad Money Supply growth rate (M2):-** Money supply is the total amount of monetary assets (entire stock of currency and other liquid instruments) available in an economy at a specific time. Ahmad and Ariff (2007) explained the relationship between money supply and credit risk appears through the behavior of borrower resulting from change in money supply in the economy. However, if the central bank decides to follow expansionary monitory policy, it lowers the required reserve rate and reduces the discount rate. This leads to increase money supply, which means increase productivity and profitability which in turn stimulates investment and consumption. As a result, income increases. Moreover, increasing money supply will decrease an interest rate and increase the opportunity of public to have cheaper fund. These conditions increase the ability of borrowers to pay back their obligations and contribute in decreasing the banks‟ exposure to credit risk.

- **Interest Rate (IR):-** Interest rate is the rate at which interest is paid by a borrower (debtor) for the use of money that they borrow from a lender (creditor). An increase in interest rates means higher loan installments to be paid and more opportunities for borrowers to have difficulty in paying their loans. Interest rate is a major factor in banking system because it is the driving force of banks deposits and loans hence an important variable in analyzing loan performance of banks (Castro, 2013).

- **Terms of Trade (TOT):-** terms of trade represent the ratio between a country's export prices index and its import prices index. An increase in export price index or a decrease in import price index leads to improved terms of trade which is expected to increase exports earnings. The terms of trade is affect bank credit by influencing the profitability of bank borrowers, that is, they too primarily affect credit risk. If the terms of trade occurs when imports price become more expensive relative to exports price, eroding the purchasing power in a country (Bohachova, 2008). It leads to increase banks' credit risk.

## 4.4. Method Framework

Applying appropriate methodology for the time series data is most crucial part of the time series analysis as wrong specification of the model or using wrong method provides biased and unreliable estimates. Primarily, the method selection for time series analysis is based on the unit root test results which determine the stationarity of the variable. Methods commonly used to analyze the stationary time series at I(0) or I(1) cannot be used to analyze non-stationary series. If all the variables of interest are stationary at level, the methodology becomes simple. In such a case, ordinary least square (OLS) or vector autoregressive (VAR) models can provide unbiased estimates. If all the variables of interest are non-stationary, OLS or VAR models may not be appropriate to analyze the relationship the appropriate model is Johansen test. If the variables are non-stationary we shall convert this variable into stationery by taking first difference or I(1). Similarly, when the variables used in the analysis are of mixed type, i.e., some are stationary and others are non-stationary. In this case, the application of ARDL approach to co-integration will give realistic and efficient estimates. ARDL model is appropriates.

The following figure shows the general methodological framework in time series analysis

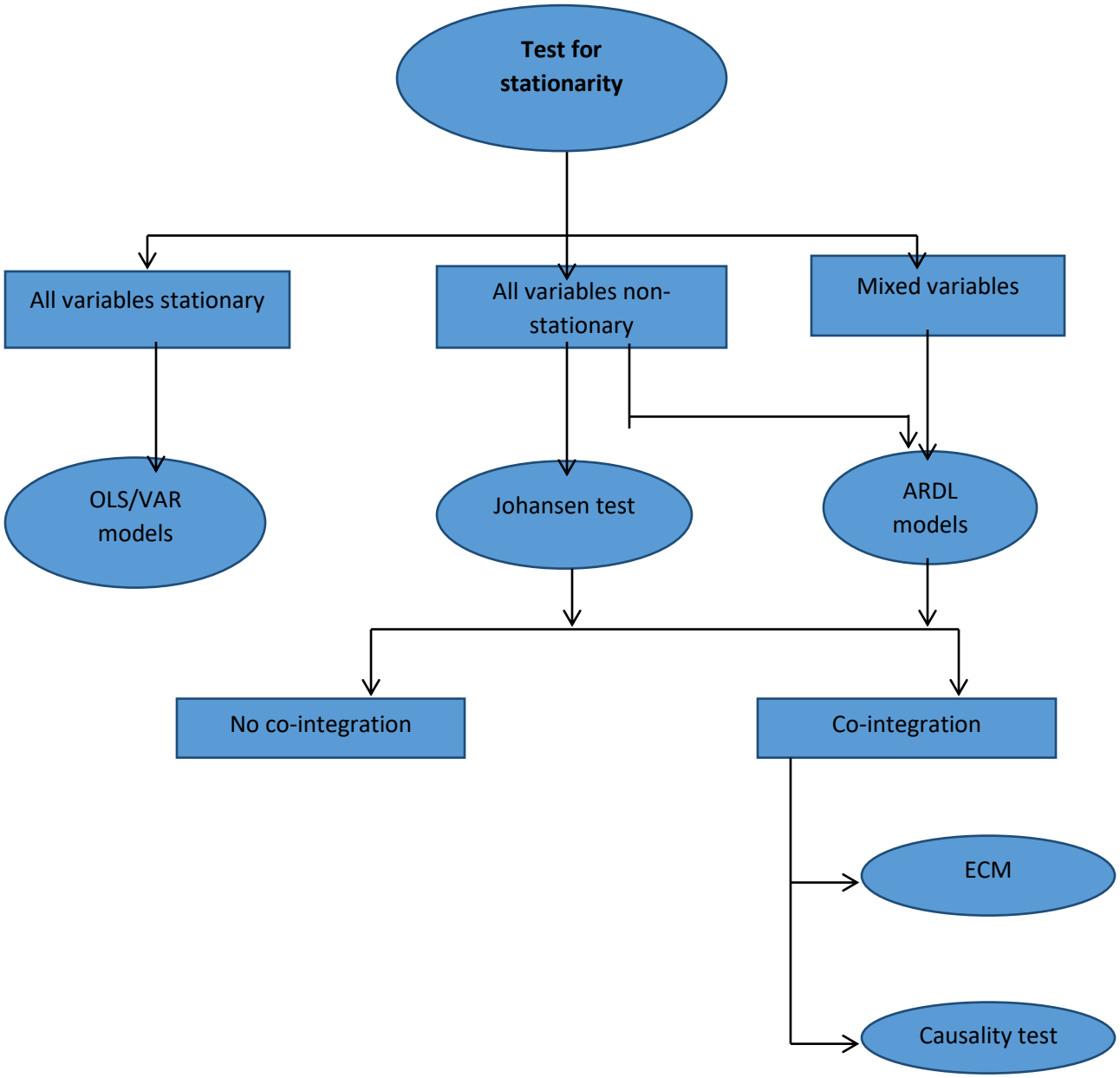



**Figure 4. 1 Shows Method Selection for Time Series Data**

OLS: Ordinary least squares; VAR: Vector autoregressive; ARDL: Autoregressive distributed lags; ECM: Error correction models.

In this study basically we employ the Autoregressive distributed lag (ARDL) model to identify the existence of a long-term and short term relationship between NPLs and the set of macroeconomic variables, vector error correction model (VECM) and Granger Causality test. In

additional, the study employed the variance decomposition (VDC) and impulse response functions (IRF's) were used to test for the response of non-performing loans to innovations in macroeconomic variables. The reason for selecting this methodology is it has money attractive features over alternatives. The primary advantage of the ARDL approach is that doesn't require establishing the order of integration of the unit-root test. The ARDL method is applicable when dealing with variables that are integrated of different order, I (0), I (1) or combination of the both. The ARDL model also robust when there is a single long run relationship between the underlying variables in a small sample size. However, this method will crash in the presence of integrated stochastic trend of I (2).

The Autoregressive Distributed Lag (ARDL) or Bound test approach to co-integrate developed by Pesaran and Shin (1999) and Pasaran et.al (2001) is adapted this study. The procedure is adopted for the following reasons. First, the underling variables are I(0) or I(1) or combination of both, ARDL technique can be applied. This helps to avoid the pretesting problems associated with standard co-integration analysis which requires the classification of the variable into I(0) and I(1). This means the bound testing procedure does not require the pre-testing of the variable including in the model for unit root and in robust when there is a single long run relationship between the underling variables. Second, if the F-statistics establish that there is a single long-run relationship and the sample size is small or finite. The ARDL error correction representation becomes relatively more efficient. Third, endogeneity is less of a problem in the ARDL technique because it is free of residual correlation (i.e. all variable are assumed endogenous). When there is a single long-run relationship, the ARDL procedures can distinguish between dependent & explanatory variable (Pesaran, Smith, and Shin, 2001). Fourth, The ARDL co-integration approach lies the error correction model (ECM) can be derived from ARDL model through a simple linear transformation, which integrated the short-run dynamics with the long-run equilibrium without losing long-run information and avoids problems such as spurious relationship resulting from non-stationary time series data.

The ARDL approach allows using a sufficient number of optimal lags, on the basis of standard criterion such as Akaike Information Criteria (AIC) and Schwarz Bayesian Criteria (SBC) (Mallick and Agarwal, 2007). The issue of finding the appropriate lag length for each of the underling variable in the ARDL model is very important because we want to have Gaussian

error terms ( i.e. standard normal error terms that do not suffers from non-normality, serial correlation and heteroskedasticity) Before the selected model is estimated by ordinary least squares. For quarterly observation 1 to 8 lag is appropriate. From this, the lag length that minimize to SBC or BIC is selected.

The ARDL modeling approach, the following simple model can be considered:

$$Y_t = \alpha + \beta X_t + \delta Z_t + \varepsilon_t \quad \text{.....Equation (4.1)}$$

The error correction version of the ARDL model is given by:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta x_{t-i} + \sum_{i=1}^{p} \varepsilon_i \Delta z_{t-1} + \lambda_1 y_{t-1} + \lambda_2 x_{t-1} + \lambda_3 z_{t-1} + \upsilon_t \quad \text{.....Equation (4.2)}$$

The first part of the equation with β, δ and ε represents short run dynamics of the model. The second part with λs represents long run relationship and $\upsilon_t$; Disturbance (white noise) term . The null hypothesis in the equation is $\lambda_1 + \lambda_2 + \lambda_3 = 0$ , which means non-existence of long run relationship.

Based on the above equation we have stated the model in this specific case.

$$\Delta L(NPLs)_t = \alpha_0 + \sum_{i=1}^{p} \emptyset_i L(NPLs)_{t-i} + \sum_{i=1}^{p} \partial_i \Delta(RGDPG)_{t-i} + \sum_{i=1}^{p} \gamma_i \Delta(INF)_{t-i} + \sum_{i=1}^{p} \sigma_i \Delta(LIR)_{t-i} + \sum_{i=1}^{p} \theta_i \Delta(M2)_{t-i} + \sum_{i=1}^{p} \delta_i \Delta(UNE)_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta(LTOT)_{t-i} + \lambda_1 LNPLs_{t-1} + \lambda_2 RGDPG_{t-1} + \lambda_3 INF_{t-1} + \lambda_4 LIR_{t-1} + \lambda_5 M2_{t-1} + \lambda_6 UNE_{t-1} + \lambda_7 LTOT_{t-1} + \varepsilon_t \quad \text{..... Equation (4.3)}$$

Where, $\alpha_0, \emptyset_i, \partial_i, \gamma_i, \sigma_i, \theta_i, \delta_i \; and \; \varphi_i$ characterize the coefficient of the short run dynamics of the model whereas, $\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5, \lambda_6 and \; \lambda_7$ coefficient show the long run relationship. The null and alternative hypotheses for co-integration test among variables in equation (4.3) are:

**Ho**: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = \lambda_7 = 0$ (no long run relationship) against

**H1:** $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq \lambda_6 \neq \lambda_7 \neq 0$ (long run relationship)

The co-integration test is bases on based on the F-statistics or Wald statistics. The F-test ha a non-standard distribution which depend on variables included in the model are I(0) or I(1). The lower critical bound assumes that all the variables are I(0), meaning that there is no co-integration among the variables, while the upper bound assumes that all the variables are I(1). To apply the ARDL bound test approach, the computed F-statistics is compare with the lower bund critical value and the upper bound critical value (Pesaran et.al, 2001). If the computed F-statistics is greater than the upper critical bound, then the null hypothesis will be rejected, suggesting that there exists a co-integration relationship among variables.

If there is evidence of long run relationship (co-integration) of the variable, the following long run model is estimated:

$$LNPLs_t = \lambda_0 + \lambda_1(LNPLs)_{t-1} + \lambda_2(RGDPG)_{t-1} + \lambda_3(INF)_{t-1} + \lambda_4(LIR)_{t-1} + \lambda_5(M2)_{t-1} + \lambda_6(UNE)_{t-1} + \lambda_7(LTOT)_{t-1} + \varepsilon_t \quad \text{.....Equation (4.4)}$$

After the long run model is estimated the ARDL specification of the short run dynamic can be derived by constructing an error correction model (ECM) of the following form;

$$\Delta LNPLs_t = \alpha_0 + \sum_{i=1}^{p} \emptyset_i \Delta(LNPLs)_{t-i} + \sum_{i=1}^{p} \partial_i \Delta(RGDPG)_{t-i} + \sum_{i=1}^{p} \gamma_i \Delta(INF)_{t-i} + \sum_{i=1}^{p} \sigma_i \Delta(LIR)_{t-i} + \sum_{i=1}^{p} \theta_i \Delta(M2)_{t-i} + \sum_{i=1}^{p} \delta_i \Delta(UNE)_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta(LTOT)_{t-i} + \omega ECM_{t-1} + \varepsilon_t \quad \text{.....Equation (4.5)}$$

Where $ECM_{t-1}$ is the lagged error correction term (ECM)

All coefficient of short run equation are coefficient relation to the short run dynamic of the model's convergence to equilibrium and $\omega$ represents the speed of adjustment.

### 4.4.1. Stationary test

Most of the modeling techniques applied in time series analysis are primarily concerned with stationarity of the data. The starting point is to examine the properties of series graphically and confirm it statistically. Graphs are the most preliminary tool to get the rough idea about the stationarity of the series. However, statistical tests are required for final decision. According to Guajarati (2004), as stochastic process is said to be stationary if its mean and variance are

constant over time and the value of covariance between two time periods depends only on the distance or gap between the two time periods and not on the actual time at which the covariance is computed.

According to Granger and Newbold (1973), Regression with non-stationary variables often leads to a problem of spurious regression; residual from a spurious regression behaves like a unit root process. A spurious regression is one that the model result has a high and significant *t-statistics*, but extremely low Durbin-Watson (DW) statistics that indicates the results are without any economic meaning. In addition, it implies that the variables have only contemporaneous relationship rather than meaningful causal relation. One source of non-stationarity is the presence of a unit root in a series. The presence of a unit root implies that a time series under consideration is non-stationary while the absence of it entails that a time series is stationary. Hence, through testing the presence of unit root we know the behavior of the series.

### 4.4.2. Unit root test methods

The statistical procedure employed to determine the stationarity of a series is called 'unit root test'. The issue of whether a time series is trend stationary (TS) or difference stationary (DS) time series has both economic and statistical implications. Therefore testing unit root is not questionable. The following section discusses the widely used stationarity test methods, Augmented Dickeye-Fuller (ADF) test and Phillipse-Perron (PP) test.

#### I. Augmented Dickey Fuller (ADF) test

The Augmented Dickeye-Fuller (ADF) test is the most common method for testing unit root. Suppose, we have a series $y_t$ for testing unit root. Then, ADF model tests unit root as follows

$$\Delta y_t = \mu + \delta y_{t-1} + \sum_{i=1}^{k} \beta_i + \Delta y_{t-1} + e_t \quad \text{.....Equation (4.6)}$$

Where,

$\Delta = \alpha - 1$

$\alpha$ = coefficient of $y_{t-1}$

$\Delta y_t$ = First difference of $y_t$, i.e. $y_t - y_{t-1}$

The null hypothesis of ADF is δ=0 against the alternative hypothesis of δ < 0. If we do not reject null, the series is non-stationary whereas rejection means the series is stationary.

### II. Phillipse-Perron (PP) test

Phillipse-Perron (PP) test is an alternative model to test the presence of unit root in a time series. This model tests in the following form:

$\Delta y_t = \prod y_{t-1} + \beta_i D_{t-1} + e_t$.....Equation (4.7)

Where,

The hypothesis is tested for Π=0. The basic difference between the ADF and PP tests is that PP is a non-parametric test, meaning that it does not need to specify the form of the serial correlation of $\Delta y_t$ under the null hypothesis. Thus, the calculation procedure of t-ratio to get the value of Π becomes different. Furthermore, PP corrects the statistics to consider the autocorrelation and heteroskedasticity issues. The hypothesis testing procedure is similar as of ADF test. Although the ADF test has been reported to be more reliable than the PP test, the problem of size distortion and low power of test make both these tests less useful. For the larger volume of financial data, PP test is also suggested.

## 4.4.3. Bound Co-integration test

Having confirmed that the variables are stationary the next step is to test the existence of a co-integration relationship between the variables. Using ordinary least square or other similar methods for non-stationary time series may produce spurious results. In other words, the test results of regression may show that a significant relationship exists between two given variables, which in fact are uncorrelated. This type of regression is termed as 'spurious regression' which mainly occurs due to the non-stationarity of the time series used in the regression model. On the other hand, two or more variables may form long term equilibrium relationship even though they may deviate from the equilibrium in the short run. Due to these issues, Engle and Granger (1987) developed co-integration test method to analyze the relationships among non-stationary variables. This co-integration testing procedure specifically helps us to know whether the underlying variables in the models are said to be co-integrated or not.

### 4.4.4. Granger Causality test

The co-integration relationship indicates the existence of causal relationship between variables but it does not indicate the direction of causal relationship between variables. Therefore, we use VECM Granger causality test for detects the direction of causality among underlined dependent and independent variable. The Granger Causality test is an essential econometrics technique that shows causation among various vectors and possesses both long-term and short-term policy implication. If two variables are not co-integrated, then one does not affect the other and are independent. To determine the pattern of such relationship, Granger (1969) has developed causality test method. If current and lagged values of X improve the prediction of the future value of Y, then it is said that X 'Granger causes' Y. The simple model of Granger causality is as follows:

$$\Delta Y_t = \sum_{i=1}^{n} \alpha_i \, \Delta Y_{t-i} + \sum_{j=1}^{n} \beta_j \, \Delta X_{t-j} + U1_t \quad \text{.....Equation (4.8)}$$

$$\Delta X_t = \sum_{i=1}^{n} \lambda_i \, \Delta X_{t-i} + \sum_{j=1}^{n} \delta_j \, \Delta Y_{t-j} + U1_t \quad \text{.....Equation (4.9)}$$

The equation (4.8) shows that the current value of ΔY is related to the past values of itself and the past values of ΔY. Similarly, Equation (4.9) postulates that ΔX is related to the past values of itself and that of ΔY.

The null hypothesis in Eq. (4.8) is $\beta_j = 0$ which means, "ΔX does not Granger cause ΔY". Similarly, the null hypothesis in Eq. (4.9) is $\delta_j = 0$, and states "ΔY does not Granger cause ΔX." The rejection or non-rejection of the null hypothesis is based on the F statistics. If the null hypothesis is rejected for equation (4.8), it can be said that there is a unidirectional causality from X to Y. Conversely, if the null hypothesis is rejected for equation (4.9) it can be said that there is a unidirectional causality from Y to X. If the null hypothesis is rejected for both equations, it can be said that there is bidirectional causality between Y and X.

### 4.4.5. Diagnostic tests of Autoregressive Distributed Lag (ARDL) model

To make the estimated model robust and unbiased, we need to determine the fitness of the model through checking goodness of fit statistics and conducting diagnostics tests. Common tests for goodness of fit include $R^2$, which shows a correlation in bivariate case and hence the value closer

towards 1 is considered to be better. In a multivariate regression, adjusted $R^2$ is chosen instead of $R^2$. $R^2$ increases with the increase in the number of variable while adjusted $R^2$ increases only when the new variable improves the prediction power. Durbin Watson (DW) statistics measure of autocorrelation (also called serial correlation) in residuals from regression analysis. If the value of DW is near to two, then model is considered to be 'non-autocorrelation'. Diagnostic tests tell us about the robustness of estimated coefficients and stability of Model. The diagnostic test examines the serial correlation, functional form, normality test and hetroscedasticity test associated with the model. The structural stability test is conducted by employing the Cumulative residual (CUSUM) and the Cumulative sum of squares of recursive residuals (CUSUMSQ).

### 4.4.6. Variance Decomposition and Impulse Response Functions

In order to test for the response of the dependent variable to the shocks from other variables included in the model the study employs the variance decomposition function (VDF) and the impulse response function (IRF). The variance decomposition function (VDF) and impulse response function (IRF) were developing under the vector autoregressive (VAR) model. The VDF and IRF in the context of the vector autoregressive (VAR) estimation are conducted to elaborate the dynamic relations between two variables. The VDF is conducted to determine whether a proportion of forecast error variance of one variable is attributed to the effects of the other variable whereas the impulse response function (IRF) assessed the dynamic behavior of the model, which means the response of one variable in the system to a sudden temporary change in other variable in the system while holding all other shocks at zero. In order to evaluate the VDCs and IRFs, the study first estimates a VAR model in order to compute the VDCs and IRFs as expressed below;

$$Y_t = C + \gamma_1 Y_{t-1} + \gamma_2 Y_{t-2} + \cdots + \gamma_p Y_{t-p} + \mu \quad \text{.....Equation (4.10)}$$

Where Y represents the dependent variable, C is the vector, $\gamma_p$ are parameters, t represents the time trend, p represents the optimal lag length and μ represents the white noise.

In stimulating a standard VDFs and IRFs, the orthogonalized responses are normally used where the underlying shocks of the VAR model are orthogonalized using the Cholesky decomposition. The major advantage of the generalized forecast error variance to the orthogonalized forecast

error variance analysis is that, it is invariant to the ordering of the variable in the VAR model because ordering of the variables are distinctively determined by the VAR system.

# CHAPTER FIVE: RESULT AND DISCUSSION

To meet research objective and to answer explore questions and also to test research hypothesis also discussed in the preceding chapter. In this chapter, finding of the analysis and discussion of the result in order to achieve research objectives are discussed. This chapter has five sections. Mainly starts Data Inspection and Regression Diagnostics. Then Long Run ARDL model estimation results and Short run ARDL model estimation results were presented. Finally, presents granger causality test and the VDF & IRF results.

## 5.1. Data Inspection and Regression Diagnostics:

### 5.1.1. Unit Roots Test

Before testing for the existence of co-integration relationship, we need to tests for the presence of unit root in the series for each variable. The test for the existence of stationery is to find out if a time series contains a unit root using Augmented Dickey Fuller (ADF) and Phillipse- Perron (PP) test (See Table 5.1 and Table 5.2). Even though the ARDL framework does not require pre-testing of variable, the unit root test could help us in deciding whether or not the ARDL model should be used. In all unit root test, we assume that the series contain both trend and intercept. The results in Table 5.1 and Table 5.2 below are the unit root tests of the Augmented Dickey Fuller (ADF) and Phillipse- Perron (PP) test respectively.

**Table 5. 1 Unit-Root Estimation (ADF test)**

| **ADF tests results** | | | | |
|---|---|---|---|---|
| **Level** | | | | |
| Variable | Intercept | | Trend and intercept | |
| | t-statistics | Critical value | t-statistics | Critical value |
| LNPLs | -2.672728 | -2.903566 | -0.518616 | -3.475305 |
| RGDPG | -4.608103 | -3.527045*** | -4.473358 | -4.094550*** |
| M2 | -2.071936 | -2.904848 | -2.040605 | -3.477275 |
| INF | -4.048403 | -3.527045*** | -3.962350 | -3.475305** |
| LIR | -0.929762 | -2.902953 | -4.788450 | -3.474363** |
| UNE | -2.213383 | -2.903566 | -3.207332 | -3.479367 |
| LTOT | -2.170688 | -2.905519 | -2.241293 | -3.475305 |
| **First difference** | | | | |
| Variable | Intercept | | Trend and intercept | |

| | t-statistics | Critical value | t-statistics | Critical value |
|---|---|---|---|---|
| LNPLs | -3.340806 | -2.903566** | -4.465756 | -4.094550*** |
| RGDPG | -5.965938 | -3.531592*** | -7.932761 | -4.110440*** |
| M2 | -12.56019 | -3.530030*** | -12.54328 | -4.098741*** |
| INF | -5.438307 | -3.528515*** | -5.517935 | -4.096614*** |
| LIR | -8.256103 | -3.527045*** | -8.668469 | -4.094550*** |
| UNE | -3.470858 | -2.903566** | -3.630484 | -3.475305** |
| LTOT | -3.651250 | -3.527045*** | -4.653861 | -4.100935*** |

Source: own computation from Eviews 9

*Note: *, **, *** represents 10%, 5% and 1% level of significance respectively.*

The ADF value with less than its critical value shows that the underlying series is non-stationery. Contrarily, when ADF value that is greater than its critical value shows that the underlying series is stationery. As the above table shows, based on the ADF test result, it seems that the inflation rate and real GDP growth rate are stationery at level, I(0) when we consider both intercept, and intercept and with trend while the Lending interest rate seems stationary if we consider with intercept and trend. However, the other variables at level they are non-stationery but when we convert them to first differenced, all variables become stationery, I(1) when we consider both intercept, and with intercept and trend at 5% level of significant.

**Table 5. 2 Unit-Root Estimation (Philips-Perron Test)**

| **Philipse-Perron tests results** | | | | |
|---|---|---|---|---|
| **Level** | | | | |
| Variable | Intercept | | Trend and intercept | |
| | t-statistics | Critical value | t-statistics | Critical value |
| LNPLs | -3.059405 | -2.902953** | -0.134831 | -3.474363 |
| RGDPG | -2.750799 | -2.902953 | -2.543436 | -3.474363 |
| M2 | -8.022883 | -3.525618*** | -8.922258 | -4.092547*** |
| INF | -2.485245 | -2.902953 | -2.395818 | -3.474363 |
| LIR | -0.988951 | -2.902953 | -4.861207 | -4.092547*** |
| UNE | -2.194179 | -2.902953 | -2.184014 | -3.474363 |
| LTOT | -1.958820 | -2.902953 | -1.477595 | -3.474363 |
| **First difference** | | | | |
| Variable | Intercept | | Trend and intercept | |
| | t-statistics | Critical value | t-statistics | Critical value |
| LNPLs | -3.339501 | -2.903566** | -4.512699 | -4.094550*** |

| | | | | |
|---|---|---|---|---|
| RGDPG | -4.032904 | -3.527045*** | -4.083412 | -3.475305** |
| M2 | -30.46608 | -3.527045*** | -36.16076 | -4.094550*** |
| INF | -5.598052 | -3.527045*** | -5.589029 | -4.094550*** |
| LIR | -8.256103 | -3.527045*** | -8.668469 | -4.094550*** |
| UNE | -3.493547 | -2.903566** | -3.676346 | -3.475305** |
| LTOT | -3.748667 | -3.527045*** | -3.766927 | -3.475305** |

Source: own computation from Eviews 9

*Note: *, **, *** represents 10%, 5% and 1% level of significance respectively.*

On the bases of the Philips-Perron test the above table 5.2 shows, the money supply growth rate ($M_2$) seem stationery at level i.e. I(0) when we consider both intercept, and with intercept and trend while the nonperforming loans (LNPLs) seems stationery if we consider intercept and with no trend and Lending interest rate is stationery with intercept and trend. However, all other variables are stationery at the first differencing i.e. I(1). Whichever test may be used, both the Augmented Dicky-Fuller and Phillip-Perron tests confirmed that the underlying series are integrated of order less than two i.e. either I(0) or I(1). In the case of mixed variable i.e. some variables stationery but others non-stationery, in such case ARDL model are appropriate. Therefore, we can proceed the next section with ARDL testing (bound testing) approach.

### 5.1.2. Bound test for Co-integration

Co-integration is defined as the presence of a long-run equilibrium relationship between two variable or more having unit root at level (Gujarati, 2004). Many time series variable are stationery only after differencing. Hence, using differenced variables for regressions imply loss of relevance long run properties or information of the equilibrium relationship between the variables under consideration. This means that we have to devise a way of retaining the relevant long run information of the variables. Co-integration makes it possible to retrieve the relevant long run information of the relationship between considered variables that has been lost on differencing. That is, it integrates short run dynamics with long run equilibrium. This is the basis for obtaining estimates of a model, which is the driver of a meaningful forecast and policy implementation. The estimation of ARDL /EC model has become increasingly popular over the last decades. The associate bound testing procedure is an attractive alternative to other co-integration tests. In our study adopt Autoregressive distribute lag co-integration technique or bound co-integration testing approach with the ARDL framework.

The issue of finding the appropriate lag length for each of the underlying variable in the ARDL model is very important because we want to have Gaussian error terms (i.e. standard normal error terms that do not suffer from non-normality, autocorrelation, heteroskedasticity etc.). In order to select the appropriate model of the long run underlying equation, it is necessary to determine the optimum lag length (k) by using proper model order selection criteria such as; the Akaike information criterion (AIC), Schwarz-Bayesian Criteria (SBC) or Hannan-Quinn Criterion (HQ). As suggested by pasaran and shin (1999) and Nareyn (2004) since the observation is annually, we choose 2 as the maximum order of lag in the ARDL. Similarly, in quarterly observation 1 to 8 lags is appropriates, before the selected model is estimated by OLS regression for the first difference part of the equation. Specifically, in our study use the Akaike information criterion (AIC) in lag-selection because of it advantage for small sample size. We use the offered model is ARDL (2,0,2,0,2,2,0) selection based on the Akaike information criterion (AIC) and estimate to the period of 2001/02Q1 – 2018/19Q4.

The existence of the long-run relation between the variables under investigation is tested by computing the bound F-statistic (bound test for co-integration) in order to establish a long run relationship among the variables. In practice, estimate of equation with the optimal lag length gives the calculated F-statistic value show in the table 5.3. This F-statistics is to be compared with the bound critical value based. The table shows the computed F-statistic of the bound test 4.798795 is larger than the lower bound and the upper bound critical value at any level of significance. In this case, the null hypothesis of no co-integration can be rejected at any level of significance. Hence there is a co-integration relationship among the variable or a stable long-run equilibrium. In other word, we reject the null hypothesis at 1%, 5% and 10% level of significance, there exists of Co-integration relationship among non-performing loans (NPLs) and the other explanatory variables i.e. Real GDP growth rate, Broad Money supply growth rate (M2), Inflation (INF), Landing interest rate (LIR), Unemployment rate (UNE) and Terms of trade (TOT).

**Table 5. 3 F-Statistic Result and Critical Values (lower and upper bound) for the ARDL Modeling Approach**

| Test Statistic | Value | K |
|---|---|---|
| F-statistic | 4.798795 | 6 |
| Critical Value Bounds | | |
| Significance | I0 Bound | I1 Bound |
| 10% | 2.12 | 3.23 |
| 5% | 2.45 | 3.61 |
| 2.5% | 2.75 | 3.99 |
| 1% | 3.15 | 4.43 |

Source: Author's computation in Eviews

### 5.1.3. Diagnostic and Stability Test of the model

To make the estimated model robust and unbiased, we need to determine the soundness of the model through checking goodness of fit statistics and conducting diagnostic test. This study carried a number of diagnostic checking; the diagnostic test examines the serial correlation (Brush and Godfray LM test), normality test (Jaque- Bera test), functional misspecification test (Ramseys RESET test) and Hetrosedasticity test associated with the model.

#### I. Test for serial correlation

Serial correlation is usually a result of a specification error of the function form. It is used to test whether serial the residual is serially correlated or not. If the residual is not serially correlated our model is best model. The following table 5.4 Breusch- Godfrey serial correlation LM Test result clearly shows that the p-value of 0.0988 (9.88%) which is more than 5 % we cannot reject null hypothesis. Our null hypothesis is there is no serial correlation. Therefore, the model is good regression model.

**Table 5. 4 Serial correlation test**

Breusch-Godfrey Serial Correlation LM Test:

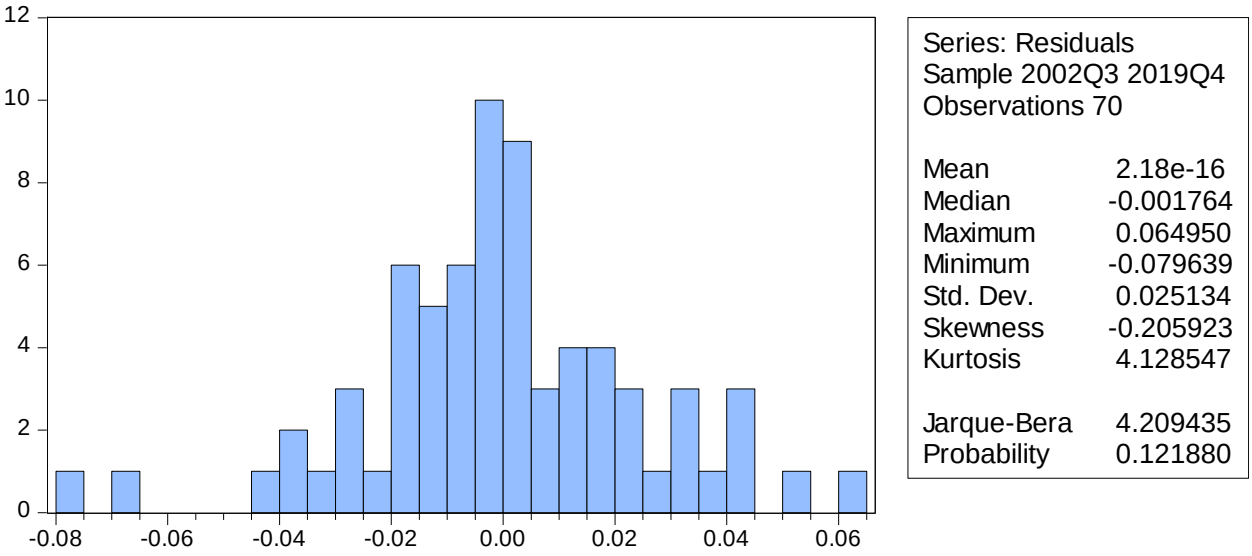
| | | | |
|---|---|---|---|
| F-statistic | 2.418889 | Prob. F(2,53) | 0.0988 |
| Obs*R-squared | 5.855075 | Prob. Chi-Square(2) | 0.0535 |

Source: Author's computation in Eviews

## II. Normality test

Normality test is used to test the residual of our model follows a normal distribution or not. The following graph 5.1 the outcome of Jaque- Bera test shows that the P-value is 0.1218 (12.18%) it's greater than 5%, which means that we accept the null hypothesis. The null hypothesis is that the residuals are normally distributed. This means that the residual of our model follows normally distributed. Therefore, the model is good regression model.

**Figure 5. 1 Normality test**




*Source: Author's computation in Eviews*

## III. Hetrosckedasticity test

Hetrosckedasticity test is a systematic change in the spread of the residuals over the range of measure value. It is used to test the whether the residuals heterosckedasticity or not, that means to be a best model the residuals must be homoscedasticity. The following table 5.5 shows the p-value of both the F- and $\chi^2$ (LM') version of the test statistic and the P-value of scaled explained SS more than 5%, meaning that we can accept the null hypothesis. Our null hypothesis is that residual no hetrosckedasticity which is desirable. Therefore our model is good.

**Table 5. 5 Heteroskedasticity Test**

Heteroskedasticity Test: Breusch-Pagan-Godfrey

| | | | |
|---|---|---|---|
| F-statistic | 1.587767 | Prob. F(14,55) | 0.1122 |
| Obs*R-squared | 20.14809 | Prob. Chi-Square(14) | 0.1255 |
| Scaled explained SS | 19.45700 | Prob. Chi-Square(14) | 0.1482 |

Source: Author's computation in Eviews

**IV. Ramsey RESET test**

Ramset RESET test is a general specification test for the linear regression model. It is indicates that the models are well constructed or not. If the test is rejected null hypothesis, this indicates sign of misspecification or particularly non-linearity in the data. The following table 5.6 results shows that the P-value 0.0622 (6.22%) which is greater 5 % level of significance. In this case we should not reject the null hypothesis. That means the result proved that the model did not have omitted variable bias and the model is specified well.

**Table 5. 6 Ramset RESET test**

| | Value | Df | Probability |
|---|---|---|---|
| t-statistic | 1.904213 | 54 | 0.0622 |
| F-statistic | 3.626026 | (1, 54) | 0.0622 |

F-test summary:

| | Sum of Sq. | Df | Mean Squares |
|---|---|---|---|
| Test SSR | 0.002743 | 1 | 0.002743 |
| Restricted SSR | 0.043588 | 55 | 0.000793 |
| Unrestricted SSR | 0.040845 | 54 | 0.000756 |

Source: Author's computation in Eviews

As indicated in the above diagnostic checking results revealed that the long-run model successfully passed all tests of normality, serial correlation, conditional heteroscedasticity, and functioning form. Robust results of the diagnostic test imply that the result of the ARDL model

can be trusted and relied upon for policy modeling. Hence, the model is stable, and results can be trusted for policy use.

In addition to the above diagnostic test, the stability of long-run estimates using the sensitivity analysis of the cumulative sum of recursive residuals (CUMSUM) and Cumulative sum of squares recursive residuals (CUMSUMSQ) tests recommended by (Pesaron, 2001). For the stability test the graph Plots both the cumulative sum of recursive residuals (CUMSUM) and Cumulative sum of squares recursive residuals (CUMSUMSQ) tests indicates the model is significant at 5 % critical level of significance and it is the indication of stable parameter under study.

**Figure 5. 2 Graphical Representation of CUMSUM Result**

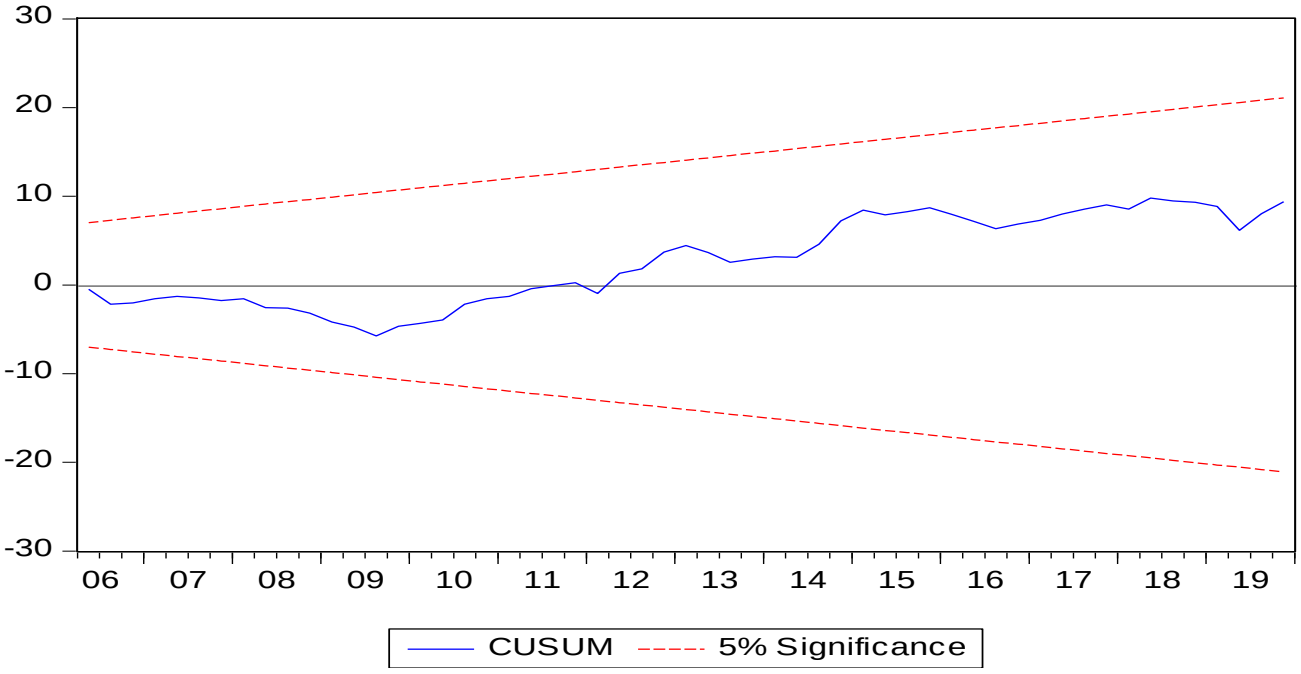
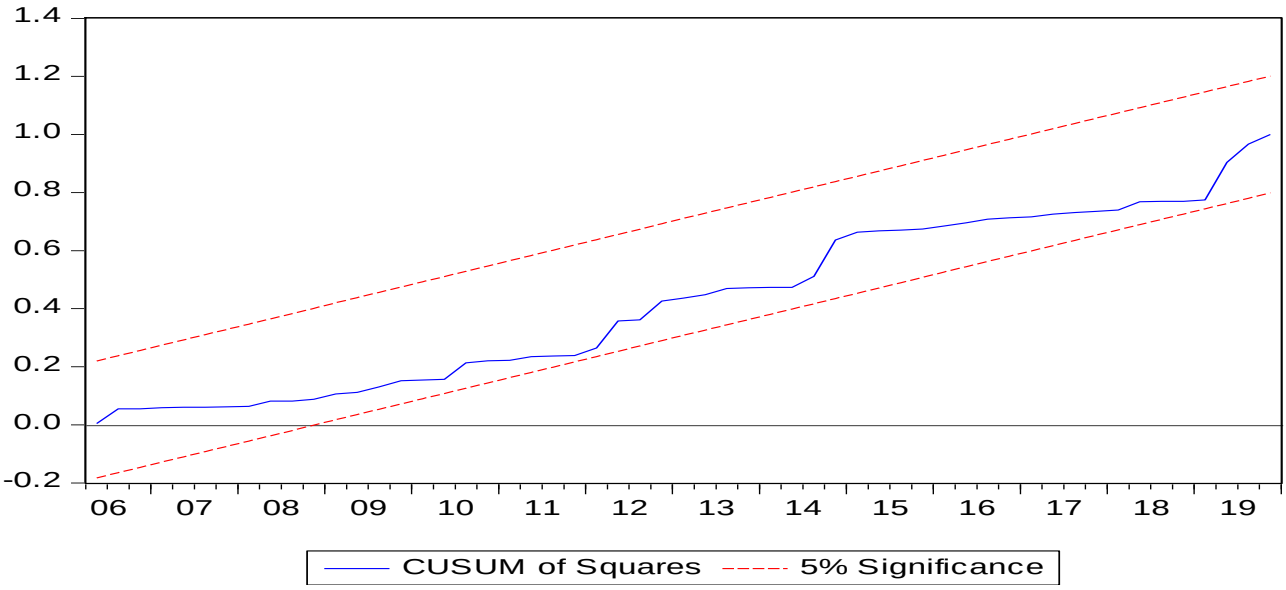


**Figure 5. 3 Graphical Representation of CUMSUMSQ Result**




*Source: Author's computation in Eviews*

The result of both the cumulative sum of recursive residuals (CUMSUM) and Cumulative sum of squares recursive residuals (CUMSUMSQ) are shown in Figs. 5.1 and 5.2. The two straight lines in the figures shows critical bound at the 5% level of significance. The line within the critical bounds represents the results of both the short-run and long-run analyses and this implies that the equation is correctly specified and the model is stable. Furthermore, the result shows that there is no structural instability in the model during the sample period. Therefore, we can conclude that long and short run estimates are quite stable and there is no any structural break showing the results of the estimation model are reliable and efficiency.

## 5.2. Long Run ARDL Model Estimation Results

We have established in the previous sub-section that a long-run (co-integration) relationship exists. In this section, presents long run relationship among variables in order to achieve the first two objectives of the study.

In the stationary test, the results confirmed that the variables are stationery at level and first difference. The computed F-statistic of the bound test result shows the existence of long run co-integration among the variables also confirmed to proceed to the estimation of the long run

relationship among the variables. The following table 5.7 presents the empirical results found after running the appropriate ARDL model to find out the long run coefficient.

**Table 5. 7 Estimated Long Run Coefficients using the ARDL Approach**

Long Run Coefficients

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| RGDPG | -0.066534 | 0.039523 | -1.68343 | 0.0980 |
| INF | 0.020078 | 0.012129 | 1.655383 | 0.1035 |
| LIR | -0.00257 | 0.088262 | -0.029121 | 0.9769 |
| UNE | -0.07222 | 0.345413 | -0.209082 | 0.8352 |
| M2 | -12.354492 | 3.957066 | -3.122134 | 0.0029 |
| LTOT | -3.299064 | 0.679009 | -4.858645 | 0.0000 |
| C | 18.432796 | 3.123957 | 5.900464 | 0.0000 |

*Source: Author's computation in Eviews*

The above empirical results of the long run model shows that among the variables which appear to effect of non-performing loans, Real GDP growth rate (RGDPG), Broad Money supply growth rate (M2) and Terms of trade (TOT) are statistically significant factors whereas the other variables, Inflation rate (INF), Lending interest rate (LIR) and Unemployment rate (UNE) are insignificant factors in the long run at 10% level of significance. The detail interpretation presents as follow

The Long-run estimation shows statistically significant relationship between non-performing loans (LNPLs) and Real GDP growth rate (RGDPG). The result of long-run estimation confirms the negative relationship between non-performing loans and Real GDP growth rate. 1% increase in the growth of Real GDP results in 0.067 % decrease Non-performing loans of the banks. The negative relationship implies that the Real GDP growth rate increases the income of individuals, resulting in the increase in debt paying ability of individuals and declines in the NPLs ratio. Hence, this funding suggested that, Real GDP growth rate is one of the critical macroeconomic factors of non-performing loans in Ethiopia commercial banks. The result of the regression output supporting the pervious study conducted by Salas & Saurian (2002), Jimenez and Saurina (2006), Tamrat (2016), Das & Ghosh (2007), Castro (2012) and Anisa (2015) found negative relationship between Real GDP growth and nonperforming loans. The result confirms the validity of null hypothesis that Real GDP growth rate is negative related to non-performing loans is accept.

The results in Table 5.7 shows insignificant positive associate of Non-performing loan with Inflation rate, the finding suggesting that the inflation rate results in the growth of non-performing loans rate. The long-run relationship is insignificant therefore inflation rate has no significant influence in non-performing loans in the long-run. Thus, the hypothesis, inflation rate is negatively related with non-performing loans is not accepted.

The Table 5.7 provides negative associate of non-performing loan and Lending interest rate. The relation between non-performing loan and lending interest rate is statistically insignificant, the funding suggesting that the long-run relationship is insignificant therefore lending interest rate has no significant influence on nonperforming loans in the long-run. Thus, the hypothesis that lending interest rate is negatively related with non-performing loan is not accepted.

The result in Table 5.7 shows that the coefficient of unemployment rate is positive and insignificance relationship with nonperforming loans. That means the finding suggesting that the long-run relationship is insignificant therefore unemployment rate has no significant influence on non-performing loans in the long-run. Thus, the hypothesis, unemployment rate is positive related with non-performing loans is not accepted.

Long-run estimation shows negative significant association between Broad money supply growth and non-performing loans. 1% increase in the growth of money supply results in 12.35% decrease non-performing loans of the commercial banks. This implies that the high growth of money supply leads to reduce the interest rate; as a result the domestic borrowers will have a cheap fund, which contributes to an increase in their ability to repay their debt obligation. Conversely the decline Broad money supply growth leads to higher interest rate, it will make more difficult for borrowers to service their debts to the banking system, and the contraction in bank credit that is further pressure on borrowers and, therefore, commercial banks. Hence, this funding suggesting that, growth of money supply is one of the critical macroeconomic factors of non-performing loans in Ethiopia commercial Banks. The result of regression output supported by the previous study conducted by Ahmed (2003), Kalirai and Scheicher (2002) and Vogiazas and Nikolaidou (2011) found a significant and negative relationship between money supply and credit risk. In opposite direction Bofondi and Ropele (2011) found positive relationship between

money supply and credit risk in Italian banking system. Thus, the null hypothesis, the growth of money supply is negatively related with non-performing loan is accepted.

The long-run relationship between Non-performing loans and Terms of Trade is negative, which is statistical significant coefficient. 1% increase in terms of trade result in 3.29% decrease in Non-performing loans. This result implying that an improvement in terms of trade has impact in borrowers' profitability or purchasing power as change in the real exchange rate. In other words, improvement in terms of trade leads to relatively higher export revenue than import expenditure, which results increase the profitability of the borrower. In addition to, the negative association of terms of trade with NPLs suggests that with the increase in exports, economic activities in the economy increases, resulting in the income growth of individuals and profit of investors. As a result, income increases the ability of individuals and investors have the funds to repay the loans, contributing in decreasing the bank's non-performing loans. Hence, this finding suggests that Terms of trade is one of the relevant macroeconomic factors of non-performing loans in Ethiopia commercial banks. Thus the null hypothesis that Terms of Trade is negatively related with non-performing loans is accepted.

In general, the estimated long run equation can be presented as follows:

$$LNPLs = 18.43 - 0.066534(RGDPG) + 0.020078(INF) - 0.00257(LIR) - 0.07222(UNE) - 12.354492(M2) - 3.299064(LTOT)$$

## 5.3. Short Run ARDL Model Estimation Results

The previous section has analyzed the long-run relationship among the variable. In this section, and in order to achieve the first two objectives of the study, focuses on short run relationship among variables.

Short run relationships between non-performing loans and macroeconomic variables are examined with the Error Correction model (ECM) based on the ARDL approach. In indicates the speed of adjustment to restore equilibrium in the dynamic model and the coefficient of the ECM which has to be negative statistically significant shows how quickly the dependent variables converge to the long run equilibrium. Results of the error correction model based on the ARDL model are presented in Table 5.8

**Table 5. 8 Error Correction Representation for the Selected ARDL Model**

Dependent Variable: LNPLS
Selected Model: ARDL(2, 0, 2, 0, 2, 2, 0)
Date: 03/13/20 Time: 09:36
Sample: 2002Q1 2019Q4
Included observations: 70

| Cointegrating Form | | | | |
|---|---|---|---|---|
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| D(LNPLS(-1)) | 0.509614 | 0.093507 | 5.450019 | 0.0000 |
| D(RGDPG) | -0.005868 | 0.002196 | -2.671681 | 0.0099 |
| D(INF) | 0.003362 | 0.000752 | 4.468007 | 0.0000 |
| D(INF) | -0.001591 | 0.000685 | -2.323491 | 0.0239 |
| D(LIR) | -0.000227 | 0.007791 | -0.029096 | 0.9769 |
| D(UNE) | 0.153751 | 0.163993 | 0.937545 | 0.3526 |
| D(UNE(-1)) | -0.693900 | 0.164786 | -4.210929 | 0.0001 |
| D(M2) | -0.390429 | 0.173110 | -2.255386 | 0.0281 |
| D(M2(-1)) | 0.332963 | 0.170389 | 1.954129 | 0.0558 |
| D(LTOT) | -0.290975 | 0.135673 | -2.144681 | 0.0364 |
| CointEq(-1) | -0.088199 | 0.033519 | -2.631353 | 0.0110 |

*Source: Author's computation in Eviews*

Short run analysis results reveal that the Non-performing loans (NPLs) affected by the lagged value of itself and it is statistically significant. The coefficient of difference of Real GDP growth rate (RGDPG), Inflation rate (INF), Growth of money supply (M2) and Terms of trade (TOT) in the ECM are statistically significant factors whereas the other variables, the coefficient of difference of Unemployment rate (UNE) and Lending interest rate (LIR) are insignificant factors at 5% level of significant.

From the tables above the coefficient of differences of Real GDP growth rate is negatively related to non-performing loans and statistically significant. 1% increase in Real GDP growth rate results in 0.0059% decrease in non-performing loans. This suggests that increase in economic growth will increase the level of income and as a result the customer able to pay back their loans and hence reduce the amount of NPLs. The result is consistence with long-run estimation results.

Short-run relationship between non-performing loans and Inflation rate is positive and statistically significance. Meaning that, 1% increases in inflation rate results in 0.0034 % increases non-performing loans. This implies that high inflation rate is general associate, with high loan interest rate. Thus, high interest rate increase cost of borrowing, which lead to an increase in the non-performing loans. In addition to this, an increase in inflation would lead to reduced purchasing power, lower trade volumes and hence increased NPLs. This result supported by the previous studies kiln (2013) and Bohachove (2008). Therefore, high inflation rate are relatively good early warning macroeconomic signals of worsening loan quality. Hence, this funding suggests that in short run relationship inflation rate is one of the relevant macroeconomic factors of non-performing loans in Ethiopia commercial Banks. Thus, the null hypothesis, in short run inflation rate is positive related with non-performing loan is accepted.

The short run effect of growth of Money supply on nonperforming loan is negative and statistically significant. Meaning that, 1% increases in the growth of money supply result in 0. 39% decrease in nonperforming loans. This suggest that as increase growth money supply in this condition increase the ability of borrowers to pay back their obligation and contributes in decrease of non-performing loans. The result coefficient is similar to long-run model estimation results.

The coefficient of Terms of Trade is negative and statistically significance in the short-run. Meaning that, 1% increases in terms of trade result in 0.29% decrease in nonperforming loans. This implies that an improvement of terms of trade lead to a fall in non-performing loans of Ethiopia commercial banks. The result is consistence with long run estimation results.

The error correction coefficient CointEq (-1) has negatively sign and statistically significant meaning that there is evidence of co-integration. The coefficient -0.0882 indicates that there is high speed of adjustment to the long run equilibrium after the short run shock has been occurred. This implies deviation from the long-run equilibrium is corrected by 8.82% over each year. In other words, the adjustment time which is -0.0882 shows that the deviation to long-run equilibrium is at adjustment speed of 8.82%.

In general, the short run relationship between unemployment rate and Lending interest rate with non-performing loan is negative and the variables are statistically insignificant. Hence, the

consistence of long run estimation result these variables have no relevant macroeconomic factors of non-performing loans in Ethiopia commercial Banks.

## 5.4. Granger Causality Tests

The co-integration relationship indicates the existence of causal relationship between variables but it does not indicate the existence of causal relationship between variables. There for, we use Pairwise Granger Causality test for detects the direction of causality among underlined dependent and independent variables. If the variable A and B co-integrate, then there may exist any of the three relationship; I, A affect B, II, B affect A and III, A and B affect each other. The first two i.e. (I &II) shows unidirectional relationship while the third shows bidirectional relationship. If the two variables are not co-integrated or statistically insignificance, it implies that the one variables does not affect the other variables. This indicates that the variables are independent. The Granger causality test result in table 5.9 shows that there is unidirectional causality between terms of trade and non-performing loans. This is because the p-value lowers than 0.05 i.e. (0.0112 lower than 0.05) reject the null hypothesis of LTOT does not Granger cause LNPLs. There is unidirectional causality between non-performing loans and growth of money supply because the p-value lowers than 0.05 i.e. (0.00001 lower than 0.05) reject the null hypothesis of LNPLs does not Granger cause M2. There is unidirectional relationship between terms of trade and growth of money supply because the p-value is 0.000009. However, there is no bidirectional relationship among variables.

**Table 5. 9 Granger Causality test**

Pairwise Granger Causality Tests
Date: 03/14/20 Time: 06:19
Sample: 2002Q1 2019Q4
Lags: 2

| Null Hypothesis: | Obs | F-Statistic | Prob. |
|---|---|---|---|
| INF does not Granger Cause RGDPG | 70 | 0.82123 | 0.4444 |
| RGDPG does not Granger Cause INF | | 0.19544 | 0.8230 |
| LNPLS does not Granger Cause RGDPG | 70 | 0.26146 | 0.7707 |
| RGDPG does not Granger Cause LNPLS | | 1.34406 | 0.2679 |
| LTOT does not Granger Cause RGDPG | 70 | 0.43071 | 0.6519 |
| RGDPG does not Granger Cause LTOT | | 0.01983 | 0.9804 |

| | | | |
|---|---|---|---|
| M2 does not Granger Cause RGDPG | 70 | 0.04611 | 0.9550 |
| RGDPG does not Granger Cause M2 | | 2.41390 | 0.0974 |
| LNPLS does not Granger Cause INF | 70 | 2.92711 | 0.0606 |
| INF does not Granger Cause LNPLS | | 0.55612 | 0.5761 |
| LTOT does not Granger Cause INF | 70 | 0.32437 | 0.7241 |
| INF does not Granger Cause LTOT | | 1.42475 | 0.2480 |
| M2 does not Granger Cause INF | 70 | 0.46768 | 0.6285 |
| INF does not Granger Cause M2 | | 0.50650 | 0.6050 |
| LTOT does not Granger Cause LNPLS | 70 | 4.82052 | 0.0112 |
| LNPLS does not Granger Cause LTOT | | 2.42129 | 0.0968 |
| M2 does not Granger Cause LNPLS | 70 | 0.91955 | 0.4038 |
| LNPLS does not Granger Cause M2 | | 13.5990 | 1.E-05 |
| M2 does not Granger Cause LTOT | 70 | 2.23589 | 0.1151 |
| LTOT does not Granger Cause M2 | | 17.3116 | 9.E-07 |

Source: Author's computation in Eviews

### 5.5. The Response of Non-performing loans (NPLs) to Macroeconomic shocks

In order to achieve the third objective, the study uses the variance decomposition factors (VDF) and Impose response functions (IRF). We shall be developing VDF and IRF under unrestricted VAR environment as proposed by koop et al (1996) & pesaran & shin (1998). This shows that the forecast error variances in one variable explained by its own innovation (shock) or innovation in other variables, and trace the directional response of one variable to a one standard-deviation in shocks in other variables. We tried to see the impulse responses and variance decomposition of the variable to each random innovation shocks in the unrestricted VAR model by employing sixteen quarter data.

First presents VDF results, which shows the extent of which the forecast error variance of one variable in the system is associated with the exogenous shock to other endogenous variables. In other words, the variance decomposition provides information about the relative importance of each orthogonalized random innovation in affecting the variation of the variables in each forecast error. The variance decomposition table 5.10 shows that, the period of sixteen quarter horizon. In the first horizon, the result shows that 100% of its forecast error variance is attributes to LNPLs

(own shock). However, by period 2 through to period 10, impulse (shock) contributed, 89.33%, 80.81%, 72.29%, 63.68%, 55.37%, 48.33%, 42.99%, 39.35%, & 37.06% respectively to its forecast error variance. By period 11 through to period 16 horizon the innovations from LNPLs contributed 35.71%, 34.99%, 34.61%, 34.69% and 34.82% respectively to its forecast error variance. To check the fluctuation non-performing loans in short-run we will take quarter 3. In the short run, that is quarter 3 shows, impulse or innovation or shock to LNPLs account for 80.81% variation of the fluctuation in LNPLs (own shock). Meaning that the shock in the LNPLs can cause 80.81% variation of fluctuation in LNPLs so I can call it own shock. To check the fluctuation non-performing loans in long-run we will take quarter 16 onwards. The shock to LNPLs can contribute 34.83% to LNPLs that means the long run contribute to LNPLs has gown down.

The result show that the first period innovation in real GDP growth rate 0.0% of the forecast error variance of non-performing loans. The explanatory power of real GDP growth rate increased from period 1 to period 10 but from period 11 to period 16 real GDP growth rate decreased. In the short-run, that is quarter three shows, impulse or shock to real GDP growth cause 0.14% fluctuation in LNPLs. In long-run we will take quarter 16 onwards. The shock to real GDP growth can contribute 1.82% fluctuation in LNPLs this means in short run and long run the story remains unchanged. This implies that in terms of the explanatory variables included in the study, the change in real GDP growth rate has the fourth major contributors regarding the variation of LNPLs over the sample period.

Shocks in inflation rate have no contribution to the forecast error variance of in the first period. From period 2 to period 5 inflation rates gradually increased. But from the 6 period to 16 periods innovations in money supply gradually decreased. In the short run, that means quarter three shows, impulse or shock to inflation rate cause 1.39% fluctuation in LNPLs. In the long run, that means quarter 16 shows, the shock to inflation rate can contribute 0.95% fluctuation in LNPLs that means over a period of time the story remain unchanged. There for, innovations from inflation rate had little and volatile effect on changes in LNPLs of Ethiopia commercial banks over the sample period.

Innovation from growth of broad money supply contributed to the forecast error variance of non-performing loans in the model has no contribution in the first period. But from period 2 to period 10 growth of broad money supply increases to the forecast error variance of non-performing loans. However there was a gradual decrease in innovation by inflation rate from the 11 to the 10 periods. In the short-run, that means quarter 3 shows, impulse or shock to growth of broad money supply rate cause 0.85% fluctuation in LNPLs. In the long run, that means quarter 16 shows; the shock to growth of broad money supply rate can contribute 1.13% fluctuation in LNPLs that means growth of broad money supply stable over a period of time.

The results show that first period innovations in terms of trade have no contribution of forecast error variance of non-performing loans. The explanatory power of terms of trade increased over increasing time horizons. In the short run, that means quarter three shows, impulse or shock to terms of trade index cause 4.16% fluctuation in LNPLs. In the long run, that means quarter 16 shows; the shock to terms of trade index can contribute 44.61% fluctuation in non-performing loans. This implies that in terms of explanatory variables included in the study, change in terms of trade has the most information regarding the variation of LNPLs.

From the above explanations, it is clear that the VDF substantiate the significant role played by real GDP growth rate, growth of broad money supply, inflation rate and terms of trade in accounting for fluctuation in forecast error variance of non-performing loans in loan portfolio of Ethiopian commercial banks. Among the variables in the system, the change in terms of trade has the most information regarding the variation of non-performing loans, and then equal important are Real GDP growth, Inflation rate and growth of broad money supply. But the other macroeconomic variables such as lending interest rate and unemployment rate found negative and statistically insignificance.

**Table 5. 10 Variance Decomposition Results**

| **Variance decomposition of LNPs** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Period** | **S.E.** | **LNPLS** | **RGDPG** | **INF** | **LIR** | **UNE** | **M2** | **LTOT** |
| 1 | 0.031938 | 100.0000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.058469 | 89.33801 | 0.104628 | 0.583967 | 4.785506 | 3.228372 | 0.564878 | 1.394642 |
| 3 | 0.082211 | 80.80981 | 0.145620 | 1.391503 | 6.497175 | 6.124564 | 0.863462 | 4.167866 |
| 4 | 0.102275 | 72.29640 | 0.329894 | 2.381746 | 7.960388 | 7.304758 | 0.558824 | 9.167987 |
| 5 | 0.120704 | 63.67974 | 0.687483 | 2.770100 | 8.531423 | 7.030552 | 0.540214 | 16.76049 |
| 6 | 0.138867 | 55.37335 | 1.166147 | 2.561737 | 8.619798 | 6.362637 | 0.638756 | 25.27758 |
| 7 | 0.156769 | 48.33447 | 1.665283 | 2.156826 | 8.382415 | 5.841044 | 0.904863 | 32.71510 |
| 8 | 0.174001 | 42.99689 | 2.062686 | 1.776798 | 7.967797 | 5.625480 | 1.215210 | 38.35514 |
| 9 | 0.189871 | 39.35306 | 2.269102 | 1.492198 | 7.517741 | 5.782091 | 1.369047 | 42.21676 |
| 10 | 0.203786 | 37.05950 | 2.298882 | 1.306139 | 7.103368 | 6.309534 | 1.404979 | 44.51759 |
| 11 | 0.215530 | 35.71375 | 2.225187 | 1.189689 | 6.732532 | 7.106011 | 1.391482 | 45.64135 |
| 12 | 0.225207 | 34.99978 | 2.114726 | 1.114956 | 6.406897 | 8.029890 | 1.342298 | 45.99145 |
| 13 | 0.233044 | 34.68793 | 2.008307 | 1.062744 | 6.131515 | 8.963845 | 1.277142 | 45.86852 |
| 14 | 0.239298 | 34.61901 | 1.923340 | 1.020801 | 5.905451 | 9.816770 | 1.217521 | 45.49711 |
| 15 | 0.244260 | 34.69043 | 1.863399 | 0.984535 | 5.722219 | 10.52477 | 1.169485 | 45.04516 |
| 16 | 0.248212 | 34.83262 | 1.828163 | 0.954036 | 5.573932 | 11.06439 | 1.132571 | 44.61429 |
| Cholesky Ordering: LNPLS RGDPG INF LIR UNE M2 LTOT | | | | | | | | |

*Source: Author's computation in Eviews*

Furthermore, the result of impulse response functions are presented as follow, the figure show plots of the generalized IRF of non-performing loans with respect to innovation in Real GDP growth rate, inflation rate, lending interest rate, growth of broad money supply, unemployment rate and terms of trade. This approach reveals insight into dynamic relationships between the variables as it portrays the response of a variable to unexpected shock in another variable over specified time horizon. The horizontal axis in each graph shows the number of quarters after the

impulse has been initialized while the vertical axis shows the responses of the appropriate variables.

According to the first plane of Figure 5.3, innovations from real GDP growth rate caused improvement to non-performing loans from period 1 to period 12, but start from period 13 to period 16 there is stable on non-performing loans. The result shows that, a negative innovation of real GDP growth rate cased a positive impact on non-performing loans or vice versa. The worsening economic growth rate causes of nonperforming loans in Ethiopia commercial banks. Conversely, the good economic conditions stimulate credit lending which then fuels the likelihood of loan defaults. Therefore, the result indicates in the short-run and long-run the impact of real GDP growth rate, though negative and significant.

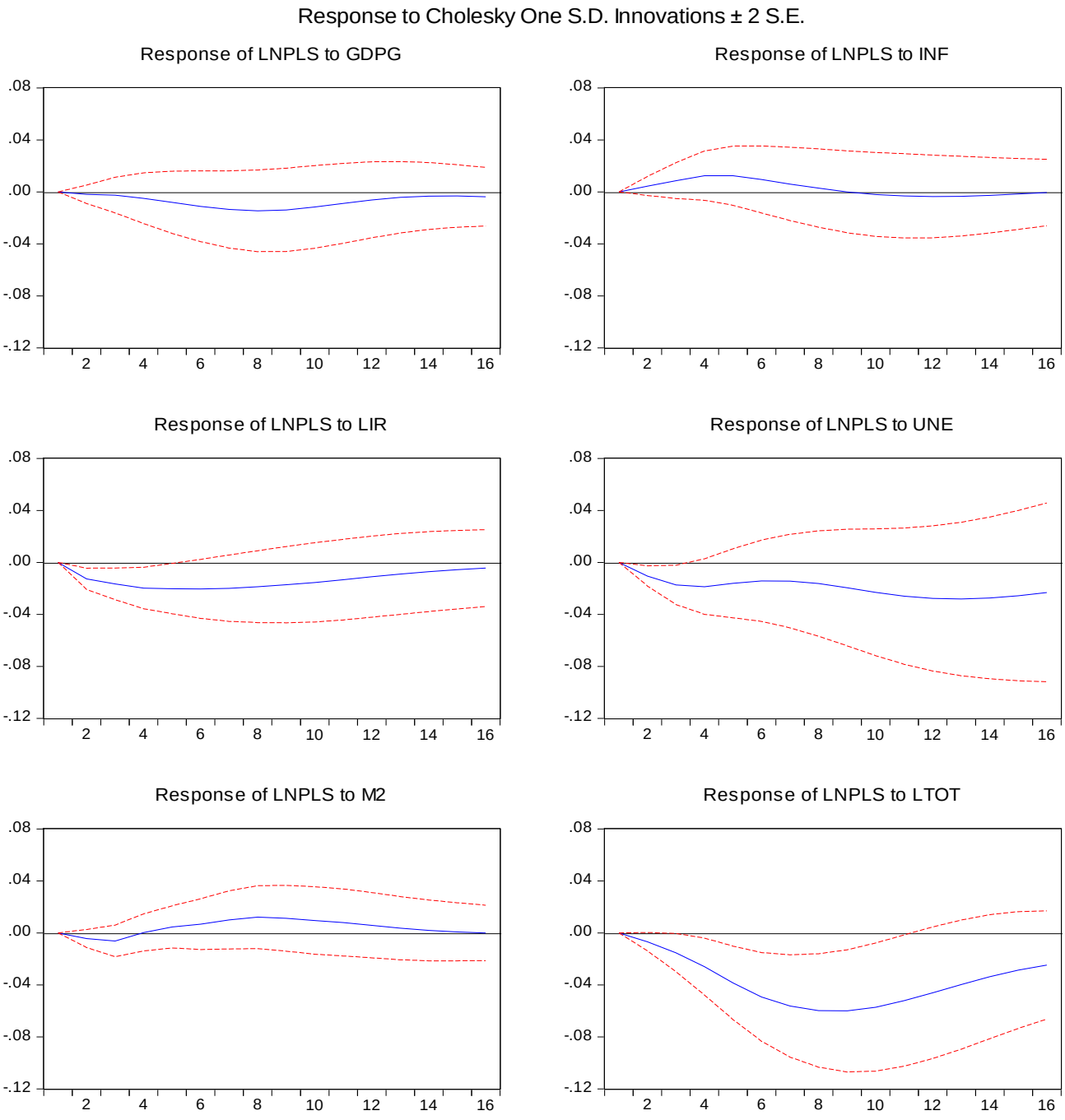
The response of non-performing loans to shocks inflation is shown in the second plane of Figure 5.3 below, from period 1 to 5 periods, innovation from inflation rate causes worsening non-performing loans. From period 5 to period 9 there is slight decline non-performing loans and from period 9 to period 16 there is inflation rate causes stable of non-performing loans in Ethiopia commercial banks. The result shows that, the contemporaneous response of non-performing loans to positive in the inflation rate is positive. On the other hand, rise inflation has a significant and positive on non-performing loans. Therefore, high inflation was found to lead to poor loan quality and increased NPLs for the financial sector.

The five planes in figure 5.3 shows the response of non-performing loans to innovation in growth of broad money supply. From period 1 to period 4, innovation caused improvement in non-performing loans and from period 4 to period 10 innovations caused worsening non-performing loans. But from period 10 to period 16 non-performing loans gradually become stable. The above result indicates growth of broad money supply innovations decrease the NPL ratio for about the first four quarters but thereafter lead to increase in the NPLs ratio which eventually dissipates. There for, a negative shock in growth of broad money supply increase non-performing loans and significant effect.

The response of non-performing loans to shock in terms of trade index is shown in the six plane of figure 5.3. From period 1 to period 10 innovations in terms of trade index caused decreased in the non-performing loans and from period 10 to period 16 there is stability in non-performing

loans position. The above results shows improve terms of trade were found to reduce the growth in the NPL ratio. Generally, the net effect of an expansion in real GDP growth, Broad money supply growth and terms of trade were found to improve the NPL ratio.

**Figure 5. 4 Impulse Response Function**




*Source: Author's computation in Eviews*

# CHAPTER SIX: CONCLUSION AND POLICY IMPLICATIONS

This preceding chapter presented results and discussion of the study, while this chapter will conclude the study. The chapter is organized in to two sections, the first section presents conclusion of the study and the second section presents the policy implication provide depend on the finding of the study & give highlight for the future research direction.

## 6.1. Conclusion

Several studies have focused their attention on the determinant of credit risk and have concluded that the macroeconomic environment has strong influence on banking credit risk. In this study, we investigate deeply the macroeconomic factors affecting credit risk in the Ethiopia commercial banks. To achieve the intended objective, the study employing Auto Regressive Distributed Lagged (ARDL) model to investigate the existence of short run and long run relationship between non-preforming loans and macroeconomic variables proposed by both theoretical and empirical literature. Additionally, the study employed the variance decomposition (VDC) and impulse response functions (IRF's) were used to test for the response of non-performing loans to innovations in macroeconomic variables. The model were estimated using quarterly data for the period ranging between 2001/01Q1 to 2018/19Q4. The study variables are included Real GDP growth rate (RGDPG), Inflation rate (INF), Lending interest rate (LIR), Broad Money supply growth (M2), Unemployment rate (UNE) and Terms of trade (TOT) as an explanatory variables and non-performing loans (NPLs) as dependent variable.

The macroeconomic variables model fulfills the features of good regression model. The diagnostic checking results revealed that the model successfully passed all tests of serial correlation, normality, conditional Heterosedasticity, and Ramsey RESET test. Robust results of the diagnostic test imply that the result the ARDL model can be trusted and relied upon for policy modeling. Hence, the result can be trusted for policy use. In addition to this diagnostic test, the long-run and short-run estimates are quite stable and there is no any structural break showing the result of the estimation are reliable and efficiency.

The result of the econometric analysis indicated that there is a long-run relationship between non-performing loans and Real GDP growth, Broad money supply growth and terms of trade.

However, other macroeconomic variables such as unemployment rate, inflation rate and lending interest rate found statistically insignificant in the long run. The long-run relationship between non-performing loans and Real GDP growth is negative and statistically significant. The negative coefficient of the real GDP growth rate indicates that the increase in economic growth results in the increase debt paying ability of individuals and firms because of the greater economic activities and earning of the individuals and firm, consequently resulting in the decline of NPLs. The long-run relationship between the non-performing loans and Broad money supply growth is negative, with a statistically significant coefficient. This result implying that the high growth of money supply leads to reduce the interest rate; as a result the borrower will have cheap fund, which contributes to an increase in their ability to repay their debt obligation, resulting in the decline of NPLs. The long run response of non-performing loans to changes in terms of trade is found to be negative and statistically significant implying that an improvement in terms of trade has effect in reducing non-performing loans.

Short-run analysis results reveal that the coefficient of difference of real GDP growth rate, difference of Broad money supply growth, and terms of trade affect nonperforming loans negatively and are statistically significant while the coefficient of difference of Inflation rate affect non-performing loans positively and statistically significant at 5% level of significance. However, other macroeconomic variables such as unemployment rate and lending interest rate found statistically insignificant in short-run. The short-run relationship between Inflation rates and non-performing loans is positive, with statistically significant coefficient. The positive coefficient of the inflation rate indicates that the high inflation rate is generally associate, with high loan interest rate. Thus, high interest rate increase cost of borrowing, which lead to an increase in the obligation of the borrowers resulting in an increase in NPLs. In addition to this, an increase in inflation would lead to reduced purchasing power, lower trade volumes and hence increased NPLs. The error correction coefficient (CointEq (-1)) that shows the speed of adjustment to the long run equilibrium is negative sign and statistically significant.

Finally from the estimated VAR model, the result of the VDF showed that the forecast error variances of non-performing loans highly attributed by its own shocks. In terms of explanatory power, innovations in terms of trade is highly contribute to the forecast error variance of non-performing loans as compared to real GDP growth rate, inflation rate and growth of broad money

supply. However innovations from growth of broad money supply contributed very little to the forecast error variance of the non-performing loans. In addition, the IRF further showed that innovations in growth of broad money supply had very little effect on non-performing loans.

## 6.2. Policy Implications

This study has the following useful implication for policy and future research in the area of macroeconomic factors affecting credit risk in loan portfolio of Ethiopia commercial banks. Given the empirical study of the macroeconomic variables have policy related implication for commercial banks.

- The major finding reveals that real GDP growth, inflation rate, broad money supply and terms of trade are influence non-performing loans of Ethiopian commercial banks means that these variables are good policy instrument. However, unemployment rate and lending interest rate do not influence credit risk means that these variables are not good policy instrument. Commercial banks can use the performance of the economy, inflation rate, terms of trade and growth of broad money supply while extending their lending or allocating loans.
- Real GDP growth is one of the important determinate factors in non-performing loans of Ethiopia commercial banks. The result of the study suggests that there is negative relationship, which implies that growth of real GDP can be minimizing non-performing loans. This can be done commercial banks can look for the growth in economy while extending their loans or at the time of extensive lending because during the downturn of economy the level of NPLs can increase.
- The negative relationship between terms of trade and non-performing loans has implies the terms of trade increase the purchasing power of the country's exports increase, resulting in the income growth of individuals and profit of investor. Thus, individuals and investors have the fund to repay the loans, resulting in decline of NPLs. Commercial bank can lend to the investors during the higher exports because of the high economic activities. This can be achieved by enhancing export competitiveness through product diversification, quality improvement and technological up grading in value-additional industries. In addition, government has doing special agreement with the neighboring country for free trades.

- The government can also play important role in improving the level of NPLs in the economy by influencing the macroeconomic variables. For instance, in order to increase the exports of the country government can provide incentives to the manufacturing sector by developing basic infrastructures, reducing taxes, providing low cost loans and can help exporters of exploring new international markets. In doing this, increase country economic activity, employment rate, production levels and exporters.
- Inflation rate is one of the short-run macroeconomic factors affecting non-performing loan of Ethiopian commercial banks. The result of the study reveals that there is positive relationship, which implies that High inflation rate is relatively good early warning macroeconomic signals of worsening loan quality. The result of this study more specifically indicates that the government should come up with strategies aimed at reducing the impact of inflation rate.
- The National Bank of Ethiopia should develop a framework which can include the macroeconomic variables such as real GDP growth, inflation rate, terms of trade and growth of broad money supply to monitory the stability and soundness of the banking sectors.
- Finally, the current study has used six macroeconomic variables to investigate the factors affecting on NPLs of the Ethiopian commercial banks, whereas the other macroeconomic factors not studied in this research has very significant contribution of banks credit risk. Therefore, require further research's to explore the other macroeconomic factors affecting credit risk. Few of the variables that can be used in the future studies are gross fixed capital formation, growth in investment, consumption, exchange rate and loan to GDP ratio.

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# Appendixes

## Appendix A: - Serial Correlation Test

Breusch-Godfrey Serial Correlation LM Test:

| | | | |
|---|---|---|---|
| F-statistic | 2.418889 | Prob. F(2,53) | 0.0988 |
| Obs*R-squared | 5.855075 | Prob. Chi-Square(2) | 0.0535 |

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 03/10/20 Time: 08:39
Sample: 2002Q3 2019Q4
Included observations: 70
Presample missing value lagged residuals set to zero.

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LNPLS(-1) | 0.220822 | 0.142976 | 1.544474 | 0.1284 |
| LNPLS(-2) | -0.193062 | 0.126658 | -1.524283 | 0.1334 |
| RGDPG | 0.000773 | 0.002171 | 0.355954 | 0.7233 |
| INF | 0.000330 | 0.000766 | 0.430318 | 0.6687 |
| INF(-1) | -0.000666 | 0.001062 | -0.626802 | 0.5335 |
| INF(-2) | 0.000240 | 0.000679 | 0.353039 | 0.7255 |
| LIR | -0.001534 | 0.007648 | -0.200549 | 0.8418 |
| UNE | 0.012938 | 0.160050 | 0.080834 | 0.9359 |
| UNE(-1) | -0.041491 | 0.268777 | -0.154369 | 0.8779 |
| UNE(-2) | 0.027770 | 0.161964 | 0.171458 | 0.8645 |
| M2 | 0.098421 | 0.174716 | 0.563324 | 0.5756 |
| M2(-1) | 0.107695 | 0.162145 | 0.664190 | 0.5094 |
| M2(-2) | 0.127820 | 0.176030 | 0.726122 | 0.4710 |
| LTOT | 0.100123 | 0.140559 | 0.712322 | 0.4794 |
| C | -0.525659 | 0.708629 | -0.741797 | 0.4615 |
| RESID(-1) | -0.436303 | 0.199280 | -2.189397 | 0.0330 |
| RESID(-2) | -0.166752 | 0.156610 | -1.064759 | 0.2918 |

| | | | |
|---|---|---|---|
| R-squared | 0.083644 | Mean dependent var | 2.18E-16 |
| Adjusted R-squared | -0.192992 | S.D. dependent var | 0.025134 |
| S.E. of regression | 0.027452 | Akaike info criterion | -4.145223 |
| Sum squared resid | 0.039942 | Schwarz criterion | -3.599160 |
| Log likelihood | 162.0828 | Hannan-Quinn criter. | -3.928320 |
| F-statistic | 0.302361 | Durbin-Watson stat | 1.991143 |
| Prob(F-statistic) | 0.994540 | | |

## Appendix B: - Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

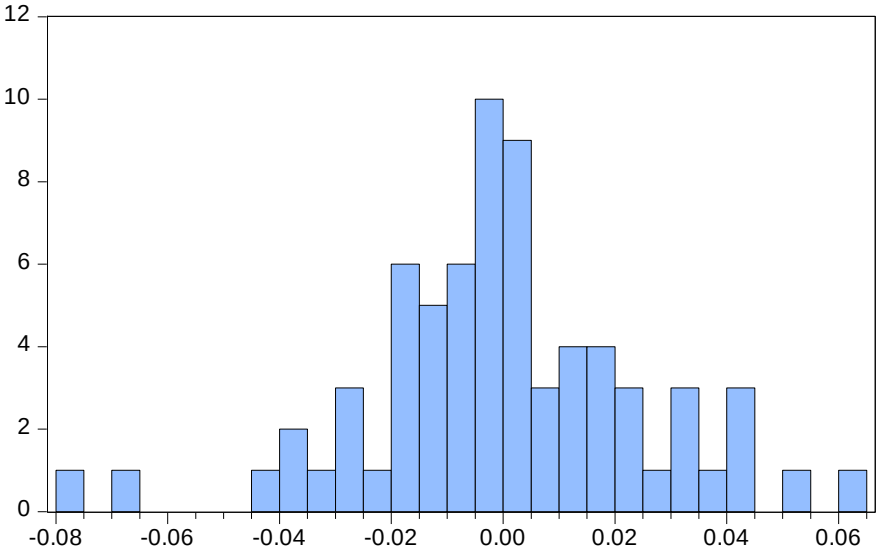
| | | | |
|---|---|---|---|
| F-statistic | 1.587767 | Prob. F(14,55) | 0.1122 |
| Obs*R-squared | 20.14809 | Prob. Chi-Square(14) | 0.1255 |
| Scaled explained SS | 19.45700 | Prob. Chi-Square(14) | 0.1482 |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 03/10/20 Time: 08:40
Sample: 2002Q3 2019Q4
Included observations: 70

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.000990 | 0.025324 | 0.039104 | 0.9689 |
| LNPLS(-1) | -0.006208 | 0.003878 | -1.600626 | 0.1152 |
| LNPLS(-2) | 0.006044 | 0.003483 | 1.735317 | 0.0883 |
| RGDPG | -0.000137 | 8.18E-05 | -1.676635 | 0.0993 |
| INF | 6.96E-05 | 2.80E-05 | 2.483628 | 0.0161 |
| INF(-1) | -4.63E-05 | 3.83E-05 | -1.209043 | 0.2318 |
| INF(-2) | 2.14E-05 | 2.55E-05 | 0.837063 | 0.4062 |
| LIR | 0.000290 | 0.000290 | 1.000412 | 0.3215 |
| UNE | -0.004323 | 0.006108 | -0.707681 | 0.4821 |
| UNE(-1) | 0.000297 | 0.010216 | 0.029101 | 0.9769 |
| UNE(-2) | 0.003617 | 0.006138 | 0.589350 | 0.5580 |
| M2 | -0.004750 | 0.006448 | -0.736630 | 0.4645 |
| M2(-1) | -0.004776 | 0.005853 | -0.816014 | 0.4180 |
| M2(-2) | 0.003052 | 0.006347 | 0.480963 | 0.6325 |
| LTOT | -0.000387 | 0.005053 | -0.076619 | 0.9392 |

| | | | |
|---|---|---|---|
| R-squared | 0.287830 | Mean dependent var | 0.000623 |
| Adjusted R-squared | 0.106550 | S.D. dependent var | 0.001109 |
| S.E. of regression | 0.001049 | Akaike info criterion | -10.69535 |
| Sum squared resid | 6.05E-05 | Schwarz criterion | -10.21353 |
| Log likelihood | 389.3373 | Hannan-Quinn criter. | -10.50397 |
| F-statistic | 1.587767 | Durbin-Watson stat | 1.804035 |
| Prob(F-statistic) | 0.112231 | | |

## Appendix C: - Normality Test




| | |
|---|---|
| Series: Residuals | |
| Sample 2002Q3 2019Q4 | |
| Observations 70 | |
| Mean | 2.18e-16 |
| Median | -0.001764 |
| Maximum | 0.064950 |
| Minimum | -0.079639 |
| Std. Dev. | 0.025134 |
| Skewness | -0.205923 |
| Kurtosis | 4.128547 |
| Jarque-Bera | 4.209435 |
| Probability | 0.121880 |

## Appendix D: - Ramsey RESET Test

Ramsey RESET Test
Equation: UNTITLED
Specification: LNPLS LNPLS(-1) LNPLS(-2) RGDPG INF INF(-1) INF(-2) LIR
UNE UNE(-1) UNE(-2) M2 M2(-1) M2(-2) LTOT C

Omitted Variables: Squares of fitted values

| | Value | Df | Probability |
|---|---|---|---|
| t-statistic | 1.904213 | 54 | 0.0622 |
| F-statistic | 3.626026 | (1, 54) | 0.0622 |

F-test summary:

| | Sum of Sq. | Df | Mean Squares |
|---|---|---|---|
| Test SSR | 0.002743 | 1 | 0.002743 |
| Restricted SSR | 0.043588 | 55 | 0.000793 |
| Unrestricted SSR | 0.040845 | 54 | 0.000756 |

Unrestricted Test Equation:
Dependent Variable: LNPLS
Method: ARDL
Date: 03/10/20 Time: 09:03
Sample: 2002Q3 2019Q4
Included observations: 70

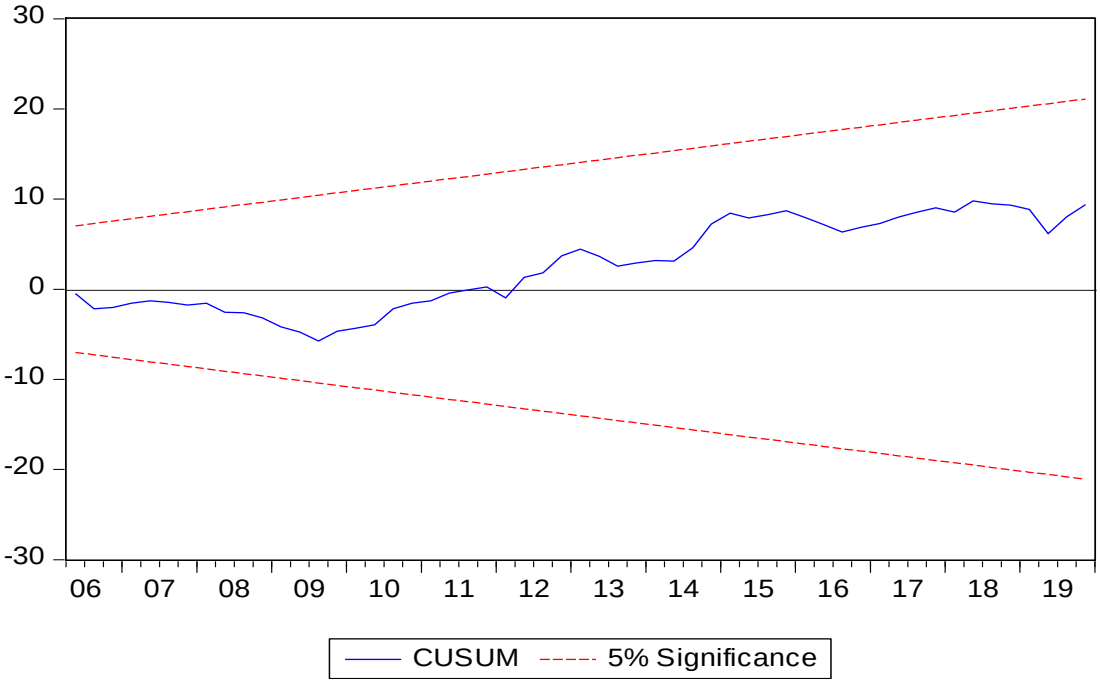
Maximum dependent lags: 2 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (2 lags, automatic):
Fixed regressors: C

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|---|---|---|---|---|
| LNPLS(-1) | 1.172690 | 0.165558 | 7.083278 | 0.0000 |
| LNPLS(-2) | -0.365162 | 0.118742 | -3.075250 | 0.0033 |
| RGDPG | -0.003834 | 0.002397 | -1.599746 | 0.1155 |
| INF | 0.002680 | 0.000818 | 3.277890 | 0.0018 |
| INF(-1) | -0.002394 | 0.001087 | -2.202176 | 0.0319 |
| INF(-2) | 0.001610 | 0.000669 | 2.406520 | 0.0196 |
| LIR | -0.008916 | 0.008875 | -1.004615 | 0.3196 |
| UNE | 0.180946 | 0.160849 | 1.124949 | 0.2656 |
| UNE(-1) | -0.707148 | 0.278825 | -2.536171 | 0.0141 |
| UNE(-2) | 0.465171 | 0.200861 | 2.315887 | 0.0244 |
| M2 | -0.332326 | 0.171850 | -1.933814 | 0.0584 |
| M2(-1) | -0.316722 | 0.155713 | -2.034017 | 0.0469 |
| M2(-2) | -0.325484 | 0.166508 | -1.954764 | 0.0558 |
| LTOT | -0.212727 | 0.138769 | -1.532961 | 0.1311 |
| C | 1.502075 | 0.667385 | 2.250687 | 0.0285 |
| FITTED^2 | 0.037688 | 0.019792 | 1.904213 | 0.0622 |

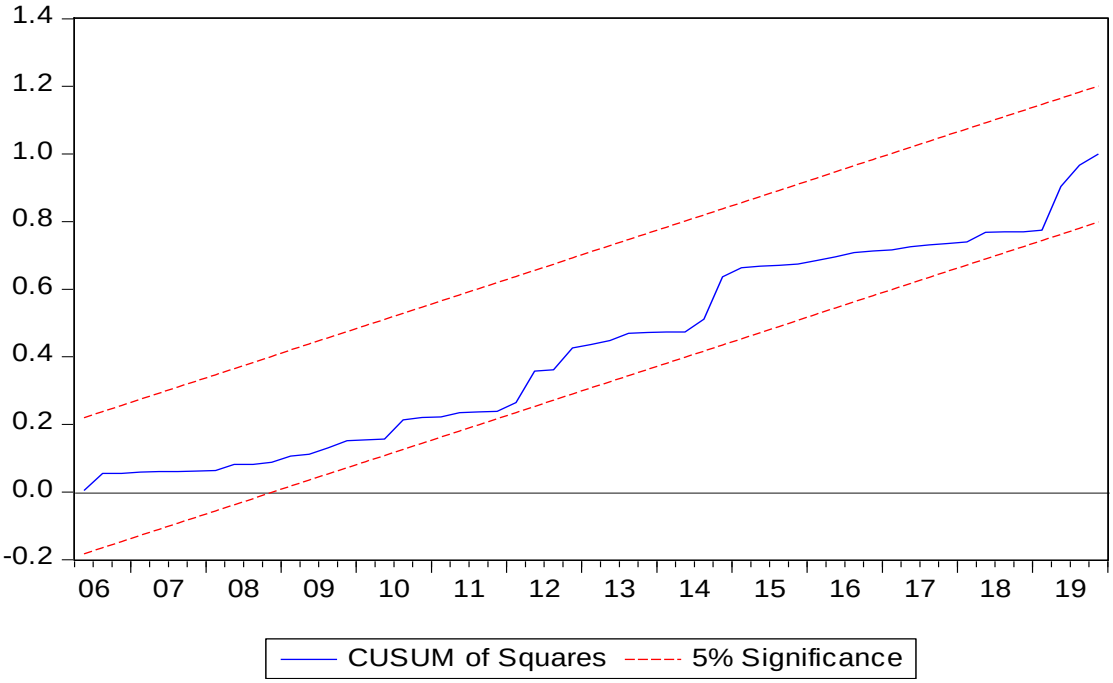
| | | | |
|---|---|---|---|
| R-squared | 0.998829 | Mean dependent var | 1.534594 |
| Adjusted R-squared | 0.998503 | S.D. dependent var | 0.710857 |
| S.E. of regression | 0.027503 | Akaike info criterion | -4.151435 |
| Sum squared resid | 0.040845 | Schwarz criterion | -3.637493 |
| Log likelihood | 161.3002 | Hannan-Quinn criter. | -3.947291 |
| F-statistic | 3069.466 | Durbin-Watson stat | 2.210502 |
| Prob(F-statistic) | 0.000000 | | |

*Note: p-values and any subsequent tests do not account for model Selection.

## Appendix E: - CUMSUM Result



## Appendix F: - CUMSUMSQ Result




## Appendix G: - ARDL Model Result

Dependent Variable: LNPLS
Method: ARDL
Date: 03/10/20 Time: 08:39
Sample (adjusted): 2002Q3 2019Q4
Included observations: 70 after adjustments
Maximum dependent lags: 2 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (2 lags, automatic): RGDPG INF LIR UNE M2 LTOT
Fixed regressors: C
Number of models evalulated: 1458
Selected Model: ARDL(2, 0, 2, 0, 2, 2, 0)

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|---|---|---|---|---|
| LNPLS(-1) | 1.421414 | 0.104127 | 13.65079 | 0.0000 |
| LNPLS(-2) | -0.509614 | 0.093507 | -5.450019 | 0.0000 |
| RGDPG | -0.005868 | 0.002196 | -2.671681 | 0.0099 |
| INF | 0.003362 | 0.000752 | 4.468007 | 0.0000 |
| INF(-1) | -0.003182 | 0.001029 | -3.092525 | 0.0031 |
| INF(-2) | 0.001591 | 0.000685 | 2.323491 | 0.0239 |
| LIR | -0.000227 | 0.007791 | -0.029096 | 0.9769 |
| UNE | 0.153751 | 0.163993 | 0.937545 | 0.3526 |
| UNE(-1) | -0.854021 | 0.274267 | -3.113833 | 0.0029 |

| | | | | |
|---|---|---|---|---|
| UNE(-2) | 0.693900 | 0.164786 | 4.210929 | 0.0001 |
| M2 | -0.390429 | 0.173110 | -2.255386 | 0.0281 |
| M2(-1) | -0.366265 | 0.157146 | -2.330731 | 0.0235 |
| M2(-2) | -0.332963 | 0.170389 | -1.954129 | 0.0558 |
| LTOT | -0.290975 | 0.135673 | -2.144681 | 0.0364 |
| C | 1.625758 | 0.679889 | 2.391213 | 0.0202 |

| | | | |
|---|---|---|---|
| R-squared | 0.998750 | Mean dependent var | 1.534594 |
| Adjusted R-squared | 0.998432 | S.D. dependent var | 0.710857 |
| S.E. of regression | 0.028152 | Akaike info criterion | -4.115016 |
| Sum squared resid | 0.043588 | Schwarz criterion | -3.633195 |
| Log likelihood | 159.0256 | Hannan-Quinn criter. | -3.923631 |
| F-statistic | 3138.599 | Durbin-Watson stat | 2.337130 |
| Prob(F-statistic) | 0.000000 | | |

*Note: p-values and any subsequent tests do not account for model Selection.

## Appendix H: - ARDL Bounds Test

ARDL Bounds Test
Date: 03/10/20 Time: 09:13
Sample: 2002Q3 2019Q4
Included observations: 70
Null Hypothesis: No long-run relationships exist

| Test Statistic | Value | k |
|---|---|---|
| F-statistic | 4.798795 | 6 |

Critical Value Bounds

| Significance | I0 Bound | I1 Bound |
|---|---|---|
| 10% | 2.12 | 3.23 |
| 5% | 2.45 | 3.61 |
| 2.5% | 2.75 | 3.99 |
| 1% | 3.15 | 4.43 |

Test Equation:
Dependent Variable: D(LNPLS)
Method: Least Squares
Date: 03/10/20 Time: 09:13
Sample: 2002Q3 2019Q4

Included observations: 70

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNPLS(-1)) | 0.528621 | 0.100086 | 5.281688 | 0.0000 |
| D(INF) | 0.001546 | 0.000703 | 2.199603 | 0.0320 |
| D(UNE) | 0.287105 | 0.168301 | 1.705904 | 0.0936 |
| D(UNE(-1)) | -0.632343 | 0.170658 | -3.705324 | 0.0005 |
| D(M2) | -0.352194 | 0.184231 | -1.911700 | 0.0610 |
| D(M2(-1)) | 0.336510 | 0.167958 | 2.003538 | 0.0500 |
| C | 1.923326 | 0.777445 | 2.473906 | 0.0164 |
| RGDPG(-1) | -0.003240 | 0.002115 | -1.531879 | 0.1312 |
| INF | 0.000759 | 0.000496 | 1.531636 | 0.1312 |
| LIR(-1) | 0.000793 | 0.007638 | 0.103879 | 0.9176 |
| UNE(-1) | 0.014933 | 0.029201 | 0.511403 | 0.6111 |
| M2(-1) | -1.050463 | 0.373812 | -2.810136 | 0.0068 |
| LTOT(-1) | -0.360153 | 0.153995 | -2.338735 | 0.0229 |
| LNPLS(-1) | -0.111049 | 0.036619 | -3.032511 | 0.0037 |

| | | | |
|---|---|---|---|
| R-squared | 0.754264 | Mean dependent var | -0.028828 |
| Adjusted R-squared | 0.697218 | S.D. dependent var | 0.054687 |
| S.E. of regression | 0.030092 | Akaike info criterion | -3.992270 |
| Sum squared resid | 0.050709 | Schwarz criterion | -3.542571 |
| Log likelihood | 153.7295 | Hannan-Quinn criter. | -3.813644 |
| F-statistic | 13.22208 | Durbin-Watson stat | 2.220430 |
| Prob(F-statistic) | 0.000000 | | |

## Appendix I: - ARDL Cointegrating and Long Run Estimation

ARDL Cointegrating And Long Run Form
Dependent Variable: LNPLS
Selected Model: ARDL(2, 0, 2, 0, 2, 2, 0)
Date: 03/10/20 Time: 09:16
Sample: 2002Q1 2019Q4
Included observations: 70

Cointegrating Form

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNPLS(-1)) | 0.509614 | 0.093507 | 5.450019 | 0.0000 |
| D(RGDPG) | -0.005868 | 0.002196 | -2.671681 | 0.0099 |
| D(INF) | 0.003362 | 0.000752 | 4.468007 | 0.0000 |
| D(INF) | -0.001591 | 0.000685 | -2.323491 | 0.0239 |

| | | | | |
|---|---|---|---|---|
| D(LIR) | -0.000227 | 0.007791 | -0.029096 | 0.9769 |
| D(UNE) | 0.153751 | 0.163993 | 0.937545 | 0.3526 |
| D(UNE(-1)) | -0.693900 | 0.164786 | -4.210929 | 0.0001 |
| D(M2) | -0.390429 | 0.173110 | -2.255386 | 0.0281 |
| D(M2(-1)) | 0.332963 | 0.170389 | 1.954129 | 0.0558 |
| D(LTOT) | -0.290975 | 0.135673 | -2.144681 | 0.0364 |
| CointEq(-1) | -0.088199 | 0.033519 | -2.631353 | 0.0110 |

Cointeq = LNPLS - (-0.0665*RGDPG + 0.0201*INF -0.0026*LIR - 0.0722
*UNE -12.3545*M2 -3.2991*LTOT + 18.4328 )

Long Run Coefficients

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| RGDPG | -0.066534 | 0.039523 | -1.683430 | 0.0980 |
| INF | 0.020078 | 0.012129 | 1.655383 | 0.1035 |
| LIR | -0.002570 | 0.088262 | -0.029121 | 0.9769 |
| UNE | -0.072220 | 0.345413 | -0.209082 | 0.8352 |
| M2 | -12.354492 | 3.957066 | -3.122134 | 0.0029 |
| LTOT | -3.299064 | 0.679009 | -4.858645 | 0.0000 |
| C | 18.432796 | 3.123957 | 5.900464 | 0.0000 |

## Appendix J: - Lag Order selection Criteria

VAR Lag Order Selection Criteria
Endogenous variables: LNPLS
Exogenous variables: C RGDPG INF LIR LTOT M2
UNE
Date: 03/10/20 Time: 09:24
Sample: 2002Q1 2019Q4
Included observations: 64

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | 42.40179 | NA | 0.019384 | -1.106306 | -0.870178 | -1.013283 |
| 1 | 120.9475 | 137.4550 | 0.001719 | -3.529609 | -3.259749 | -3.423297 |
| 2 | 134.2183 | 22.80920* | 0.001172* | -3.913072* | -3.609479* | -3.793471* |
| 3 | 134.3673 | 0.251439 | 0.001204 | -3.886478 | -3.549153 | -3.753588 |
| 4 | 134.6586 | 0.482537 | 0.001232 | -3.864332 | -3.493274 | -3.718154 |
| 5 | 134.7734 | 0.186424 | 0.001268 | -3.836668 | -3.431877 | -3.677200 |
| 6 | 137.1527 | 3.792141 | 0.001216 | -3.879773 | -3.441250 | -3.707017 |
| 7 | 137.3433 | 0.297667 | 0.001249 | -3.854477 | -3.382221 | -3.668431 |
| 8 | 137.4501 | 0.163576 | 0.001287 | -3.826565 | -3.320577 | -3.627231 |

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error

AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

## Appendix K:-Variance decomposition of LNPLs

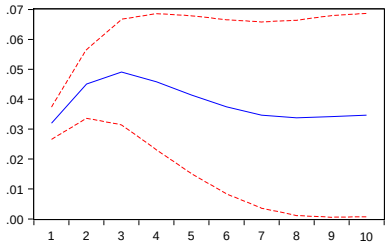
| Period | S.E. | LNPLS | RGDPG | INF | LIR | UNE | M2 | LTOT |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.031938 | 100.0000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.058469 | 89.33801 | 0.104628 | 0.583967 | 4.785506 | 3.228372 | 0.564878 | 1.394642 |
| 3 | 0.082211 | 80.80981 | 0.145620 | 1.391503 | 6.497175 | 6.124564 | 0.863462 | 4.167866 |
| 4 | 0.102275 | 72.29640 | 0.329894 | 2.381746 | 7.960388 | 7.304758 | 0.558824 | 9.167987 |
| 5 | 0.120704 | 63.67974 | 0.687483 | 2.770100 | 8.531423 | 7.030552 | 0.540214 | 16.76049 |
| 6 | 0.138867 | 55.37335 | 1.166147 | 2.561737 | 8.619798 | 6.362637 | 0.638756 | 25.27758 |
| 7 | 0.156769 | 48.33447 | 1.665283 | 2.156826 | 8.382415 | 5.841044 | 0.904863 | 32.71510 |
| 8 | 0.174001 | 42.99689 | 2.062686 | 1.776798 | 7.967797 | 5.625480 | 1.215210 | 38.35514 |
| 9 | 0.189871 | 39.35306 | 2.269102 | 1.492198 | 7.517741 | 5.782091 | 1.369047 | 42.21676 |
| 10 | 0.203786 | 37.05950 | 2.298882 | 1.306139 | 7.103368 | 6.309534 | 1.404979 | 44.51759 |
| 11 | 0.215530 | 35.71375 | 2.225187 | 1.189689 | 6.732532 | 7.106011 | 1.391482 | 45.64135 |
| 12 | 0.225207 | 34.99978 | 2.114726 | 1.114956 | 6.406897 | 8.029890 | 1.342298 | 45.99145 |
| 13 | 0.233044 | 34.68793 | 2.008307 | 1.062744 | 6.131515 | 8.963845 | 1.277142 | 45.86852 |
| 14 | 0.239298 | 34.61901 | 1.923340 | 1.020801 | 5.905451 | 9.816770 | 1.217521 | 45.49711 |
| 15 | 0.244260 | 34.69043 | 1.863399 | 0.984535 | 5.722219 | 10.52477 | 1.169485 | 45.04516 |
| 16 | 0.248212 | 34.83262 | 1.828163 | 0.954036 | 5.573932 | 11.06439 | 1.132571 | 44.61429 |

Cholesky Ordering: LNPLS RGDPG INF LIR UNE M2 LTOT

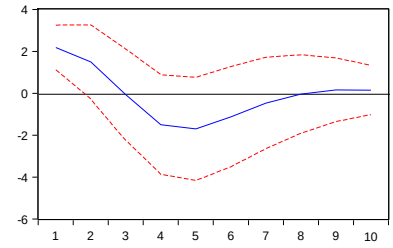
# Appendix L: - Impulse Response results

Response to Cholesky One S.D. Innovations ± 2 S.E.

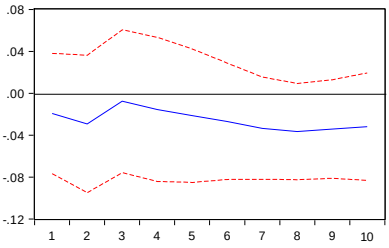
Response of LNPLS to LNPLS



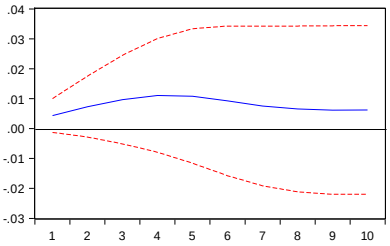

Response of INF to LNPLS



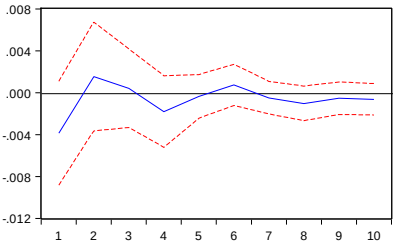

Response of LIR to LNPLS



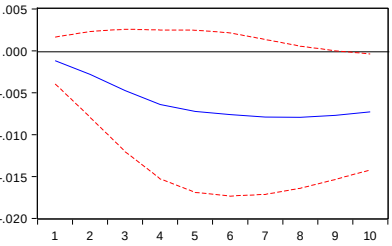

Response of UNE to LNPLS




Response of M2 to LNPLS




Response of LTOT to LNPLS




Response of GDPG to LNPLS