

**An Empirical Investigation on
Monetary Policy Transmission
Mechanism in Ethiopia**

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ABSTRACT

An Empirical Investigation on Monetary Policy transmission Mechanism in Ethiopia

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This study investigates empirically the monetary transmission mechanism in Ethiopia to better inform monetary policy, which is currently dedicated to price and exchange rate stability.

The study analyses long-run equilibrium relationships, adjustment mechanisms and short-run influences between the output, price level and transmission channels: namely, the exchange rate; the interest rate; money supply; and credit channel.

In order to analyze the transmission mechanisms of monetary policy, the study uses vector autoregression and vector error correction mechanism (VECM). In addition, impulse response functions (IRF) and variance decompositions (VDC) techniques are employed to assess the relative strength of each channel.

The results of econometric analysis suggest that monetary policy in Ethiopia had a relatively significant influence on the real activity through the direct monetary transmission and exchange rate channel. Besides, the results of statistical tests suggest that the interest rate channel is not active. Although the cointegration analysis showed that domestic credit have significant impact in the long run, both the VDC and IRFs implies weak existence of the credit channel.

In order to strengthen the monetary transmission mechanisms that exist in the country a continued effort need to be made to develop the domestic financial sector and to adjust exchange rate to maintain external competitiveness. .

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Abbreviations and Acronyms

ADF: Augmented Dickey Fuller

AIC: Akaike Information Criteria

CBE: Commercial Bank of Ethiopia

ECM: Error Correction Mechanism

EDRI: Ethiopian Development Research Institute

HQ: Hannan Quinn information criteria

IRFs: Impulse Response Functions

LR: Likelihood Ratio

MoFED: Ministry of Finance and Economic Development

NBE: National Bank of Ethiopia

OLS: Ordinary Least Square

PNG: Papa New Guiana

SC: Schwartz-Bayesian criteria

SYS: System

USD: United States Dollar

VAR: Vector Autoregression

VDCs: Variance Decompositions

VECM: Vector Error Correction Model

Chapter One:

Introduction

1.1 Background of the study

Issues concerning the impact of money on real economy have always been an area of great interest for economists and policymakers. This is due to the fact that monetary policy is one of the most powerful instruments for monetary authorities to influence such important macroeconomic variables as output and inflation. In this regard, the study of transmission mechanism seems to be a subject of greater interest. The monetary transmission mechanism is a process through which monetary decisions are transmitted into changes in output and inflation (Taylor, 1995).

In a simplistic approach, we could say that an increase in money supply leads eventually to an increase in the aggregated demand and thus, via various channels, an increase in GDP. One aspect on which most economists agree is the fact that movement is produced at certain time lags that are, regularly, long and variable. In order to fulfill monetary policy objectives, it is very crucial to have a deep understanding of channels through which monetary policy transmitted, so that the monetary authority could make the best decisions.

Like other countries, Monetary Policy in Ethiopia is geared at containing inflation and rebuilding of international reserve at levels that ensure that economic activity takes place in a low inflationary environment (IMF, 2010). The objective of monetary policy is, thus, price stability, reflected in low and non-volatile rates of inflation.

The conduct of monetary policy in Ethiopia has gone through two distinct phases, before 1991 and after 1991, reflecting major shifts in broad macroeconomic policies. From 1974 to 1991, since the country is under the regime of Derg, military power, the monetary policy was designed to target of central plan. So, the country inherited a structurally weak economy characterized by extensive regulations in the financial, production and international trade. Under this environment, monetary policy was relatively inactive.

In 1990/91 following the fall of the autocratic government, EPRDF came to power with the idea of market oriented economy up on the adjustment programs of the international monetary fund and the world bank. The inception of economic reforms in the 1990s, however, saw the economy transform to a market-based system where free market forces had a significant role in promoting economic growth and employment generation.

The shift from a highly regulated economy before 1991, to a market-based system in the 1990s, widened the scope for the conduct of monetary policy. This saw the national bank of Ethiopia adapting its operating procedures to the changing financial environment and monetary policy assumed a more active role. The national bank of Ethiopia has progressively introduced indirect monetary instruments including adjusting interest rates, undertaking open market operation, setting the minimum deposit and maximum lending rate, sales of Treasury bill and rediscount window facility. The bank is considering enhancing the effectiveness of the instruments and introducing new one (NBE, 2003). It is undeniable fact that the effectiveness of monetary policy depends on the financial sector development and close supervision. In spite of the global financial crises, Ethiopian banking system remain sound partly due to the prudent financial sector policies of government, which allow the close regulation of the central bank (NBE, 2009).

The central bank of Ethiopia has been made an effort to maintain single digit inflation and to reduce the excess liquidity in the banking system. Recently following the implementation of the base money nominal anchor policy (the contractionary base money policy), the inflation level reduced to 21 percent. The reduction of NBE financing to the government and significant sales of foreign exchange were deployed to reduce the inflation though it requires much effort to achieve single digit inflation (IMF, 2012).

As the National Bank of Ethiopia continues to reform its monetary policy framework, a deeper understanding of the empirical implications of conducting active monetary policy is crucial, in particular regarding the relationship between the central bank's instruments and economic variables such as output and inflation. The transmission mechanism of monetary policy has been an area of abundant economic research in many countries. A prominent recent trend in this field has been the empirical analysis of how a monetary policy shock, usually defined as a temporary and exogenous rise in a short-term interest rate, affects output, prices, exchange rates, as well as other key economic variables.

1.2 Statement of the problem

It is generally accepted that monetary policy has an important role in the real sector of the economy. The mechanism through which monetary policy influences the economy- through which monetary policy impulses are transmitted to the real sector, however, is still disputable.

The channels through which monetary policy works are complex and changing over time, especially when new instruments emerge and financial markets are rapidly evolving (Kamin, Turner and van't dack, 1998).

Mishkin (1996) underscore the importance of understanding the channels through which monetary policy transmitted to the real economy for successful conduct of monetary policy, which help the monetary authorities to have an accurate assessment of the timing and effect of their policies on the economy. As we all know from theory, an increase in the money supply should lead to an increasing price level and may potentially increase real output. However, it may occur through a variety of channels including the interest rate channel, the credit channel, the exchange rate channel, and the asset price channel (Mishkin, 2004).

The traditional and most known transmission mechanism of monetary policy is the interest rate channel (Taylor, 1995). According to Mishkin, this channel works through the traditional Keynesian view of how monetary tightening is transmitted to the real economy. A contractionary monetary policy raises the real interest rate which raises the cost of capital and thus leads to a decrease in investment. Thereby, lead to a decline in aggregate demand and output.

The other channel is the so called credit channel. This channel mainly involves agency problems arising from asymmetric information and costly enforcement of contracts in the financial market (Bernanke and Gertler, 1995). Mishkin (1996) indicate that the credit channel operates via two main components, including the bank lending channel and the balance-sheet channel. In developing economies where most of the projects are financed by bank loans, the bank lending channel is more effective in explaining the variation in output.

“The view that monetary policy affects output through the bank credit channel is increasingly accepted. Recent developments in the global economy have shown emphatically that the freezing up of bank credit has large negative effects on GDP. Therefore, focusing on bank credit appears to be the right way to look at the monetary transmission mechanism.” (Khan, 2010)

The exchange rates channel also another important transmission channel. The higher the value of domestic currency, the cheaper the foreign good and the more expensive will be the domestic good. As a result, there will be a fall in net export and then output (Taylor, 1995).

In addition to interest rates and exchange rates, asset price channels may also play a vital role. Important among these is the role of stock prices, which may affect the economy in accordance with Tobin’s q theory of investment and through the effects of stock market wealth on consumption (Mishkin, 1995). However, we do not describe these channels further, because the stock market in Ethiopia is in its infancy. Consequently, it is too early to investigate this channel. Moreover, Mishkin (2006) add the expectation channel to the transmission mechanisms, a mechanism that relates to the transparency and credibility of the monetary policy objective and strategy.

One motivation for this study is the 2008s Ethiopia’s inflation –the highest inflation that the country experience in its history. For subsequent years the government put much effort to tackle the problem, at least to reduce the inflation. It is also witnessed that the country doing well in reducing the galloping inflation in to single digit (IMF, 2010). At the beginning of 2009 saw the imposition of unusually tight credit policies by the central bank, justified by the need to reduce inflation (Ethiopia Macroeconomic Handbook,

2010). From this one can suspect that the credit channel may have something to do with inflation.

Although there are several studies available including those dealing with monetary policy and balance of payment (Haile, 2001), the behavior of money supply (Yimeserach, 2005) and how central bank respond to macroeconomic shock(Zerayehu, 2006),as far as my knowledge, there is no specific study that investigate in detail the transmission mechanisms of monetary policy in Ethiopia .

Thus far, the monetary transmission mechanism in Ethiopia has not been studied quantitatively. This creates difficulties in formulating and implementing monetary policy, as the significance, effect and timing of each transmission channel is not quantified. Therefore, an empirical study of the monetary transmission mechanism is timely and useful; revealing many important policy implications for Ethiopia, such as whether monetary policy should target output or inflation, which channels of transmission is more effective in Ethiopia's context. This paper seeks to fill the gap by undertaking an empirical study of Ethiopia's monetary policy transmission mechanism from 1998 to 2010.

1.3 Objectives of the Study

The main aim of this study is to empirically analyze the monetary transmission channels for Ethiopian economy. The specific objectives are;

- To identify the active transmission channels exist in Ethiopia. In essence, the study attempted to produce some empirical results and policy outcomes that would guide a Monetary Policy Framework for Ethiopia.

- To evaluate the relative strengths of different instruments and intermediate target variables, which include interest rate, monetary aggregate, credit and exchange rate.

These can be addressed by the following questions;

- How relevant is the interest and credit channel in the achievement of price stability and economic growth in Ethiopia?
- Which transmission channel is more important in transmitting monetary impulses to Ethiopia's real sector?
- How relevance is the internal channels (interest, credit, direct) and external channel (notably exchange rate) in attaining price stability.
- Does price (interest rate, exchange rate) or monetary aggregates (quantities) give a better indication of the thrust of monetary policy?

1.4 Hypothesis of the study

In this study the relative impact of monetary transmission mechanisms on output and price level was empirically investigated. The testable hypothesis was that:

- Direct Money and Exchange rate channels are more effective than the credit and Interest rate channels in transmitting monetary impulses into the real sector of the Ethiopian Economy.

1.5 Significance of the Study

Though the monetary transmission has been subject of much debate over a number of years, for instance the study by Taylor (1995), Bernanke and Gertler (1995), in developing countries, especially in Sub-Saharan Africa, very little is known about issues

essential to monetary policy .In particular, how the economy responds to monetary shocks, the relative importance of various transmission channels, the magnitude and timing on monetary policy effects and the effectiveness of various policy instruments are less understood.

The better knowledge about the transmission mechanism could lead to better choices of policy instruments and targets, which in turn would improve the effectiveness of policy. This enables monetary authorities to understand the distribution consequences of their monetary policy decisions. Knowledge of the disparities in the effects of the monetary shocks on the real sectoral activities is important not only to enable the central bank to monitor the consequences of its actions, also for the design of appropriate monetary policies.

Moreover, investigating the relative importance of various channels of monetary transmission is useful to identify the relevant financial variables to improve our understanding of the links between the financial and real sector of the economy which in turn would help policy makers to interpret movements in financial variables more precisely. Finally, more information about the transmission mechanism might lead to a better choice of targets; for example, if the credit channel is an important part of the transmission mechanism, bank portfolios should be the focus of more attention. On the other hand, if the interest rate channel is crucial, then the central bank may need to focus on an interest rate target.

Therefore, the main preoccupation of this study is to identify active transmission mechanisms in Ethiopia and to compare their relative importance in transmitting monetary impulses in to the real economy.

1.6 Scope and Limitation of the study

The scope of the study is confined to the investigation of monetary policy transmission mechanisms in Ethiopia by using vector autoregressive technique and decomposition procedure will be used to evaluate the relative strengths of different transmission channels. The study employed quarterly data which cover a period of 12 years (1998-2010).

The analysis of monetary transmission mechanisms usually requires availability of many years' data. However, in Ethiopia, the data on most of monetary variables only found after the rise of EPRDF. As a result, the study compelled to use Quarterly data.

1.7 Organization of the study

The rest of the dissertation organized as follows, chapter two presents a review of theoretical and empirical literature on monetary transmission, and chapter three then discusses the overall monetary framework of the country.

Section four presents the model and econometric methodology used to estimate the transmission channels relevant to Ethiopian economy whereas chapter five presents estimation result of the study and interpretation of the result. At last, chapter six concludes and outlines policy implications and possible areas for future research.

Chapter Two:

Review of Literatures

2.1 Theoretical literature

A substantial body of recent literature has focused on issues looking at the transmission mechanisms and sectoral effects of monetary policy for developed and emerging economies. However, less attention has been given to developing countries. While the consensus seems to be that monetary policy matters, especially in developed economies, the same cannot be said about the way it exerts its influence. Different observers weigh in different ways the various specific channels through which monetary policy works. From analytic point of view, it is widely acknowledged that significant gaps remain with regard to the precise nature of the channels monetary impulse transmitted through economies. This lack of consensus is evidenced by the many studies that have emphasized the importance of different channels through which policy shocks are propagated through the economy.

2.1.1 The Interest rate Channel

The interest channel of transmission of monetary policy was clearly defined in Keynes's General Theory. The present value of capital and durable consumption goods is negatively related to the real interest rate (marginal efficiency of capital function). The traditional Keynesian approach to the monetary transmission mechanism works directly through the interest rate. The proposition is based on the belief that monetary policy (e.g. a change in the short-term official interest rate) has an impact on (short and long term) nominal as well as real interest rates that in turn affect consumer and investment spending, aggregate demand and output (Mishkin, 1996).

Mishkin (2004) analyze this traditional mechanism based on the Keynesians view by assuming expansionary monetary policy. An increase in money supply lead to a fall in real interest rate which in turn lower the cost of capital which is a source for expansion in investment spending(including residential housing and durable expenditure), thereby, causing to a rise in aggregate demand and a rise in output.

An important feature of the traditional transmission mechanism is its focus on the real rather than the nominal interest rate as the rate that affects consumer and business decisions. This happen because of the slow adjustment of goods prices over time, meaning that expansionary monetary policy, which lowers the short-term nominal interest rate, also lowers the short-term real interest rate. Hence, a change in the nominal interest rate results in a change in real interest rate along the period where prices and expectation are adjusting.

In addition, it is often the real long-term interest rate and not the short-term interest rate that is viewed as having the major impact on spending. The expectations hypothesis mentioned in Mishikin (2004) referred the long-term interest rate as an average of expected future short term interest rates. They suggests that the lower real short-term interest rate leads to a fall in the real long-term interest rate which in turn lower real interest rates then lead to rises in business fixed investment, residential housing investment, inventory investment, and consumer durable expenditure, all of which produce the rise in aggregate output.

The fact that it is the real interest rate rather than the nominal rate that affects spending provides an important mechanism for how monetary policy can stimulate the economy,

even when nominal interest rates have already been driven down to zero by the monetary authorities (Mishikin, 2004).

According to Mishikin (2004), with nominal interest rates hit a floor of zero, an expansion in the money supply can raise the expected price level and hence expected inflation, which in turn decrease the real interest rate. This means that spending will stimulate through interest rate channel even when the nominal interest rate is fixed at zero.

Although, the conventional approach to the interest channel does not explicitly take the role of expectations into account, a change in interest rates as a result of a policy change may quite well have an impact on the economy through expectations and confidence about the future outlook of the economy (Bank of England, 2001). However, the direction in which such effects work is hard to predict and can vary from time to time.

Agenor and Montiel (2008) highlighted the importance of studying the extent to which changes in short-term official rates affect market interest rates:

“If the pass-through of policy rates to short-term market interest rates is complete and rapid, then a representative market rate (for instance, the overnight interbank rate, the money market rate, or the three-month Treasury bill rate) can be regarded as the policy instrument itself. In developing countries, however, due to various types of market imperfections, the pass-through is not always complete and may not occur very quickly.”

In the most conventional model of monetary transmission, a shift in policy leads to a change in the money supply that, for a given money demand, leads to a change in money-market interest rates. Changes in policy and interbank rates lead, in turn, to changes in bank loan rates for borrowers, which may affect investment decisions, and in deposit

rates, which may affect the choice between timing of consumption (Kamin, Turner and Van't Dack, 1998).

According to their study, a key issue in this channel of transmission is the extent to which a policy-induced change in the interest rate most directly under the central bank's control (usually an overnight interbank rate) affects all short-term money market interest rates, and in turn reaches to the entire range of interest rates.

2.1.2 Asset price channel

The other transmission mechanism pointed out by Mishkin (2004) is the asset price channel which relies on Tobin's q theory. This theory explains how monetary policy can affect the economy through its effect on the valuation of equities or stocks.

Tobin (1969) as mentioned by Mishkin (2004) defines q as the market value of firms divided by the replacement cost of capital. The market price of firms is high relative to the replacement cost of capital and new plant and equipment capital is cheap relative to the market value of firms, if Tobin's q is high. Companies can then issue stock and get a high price for it relative to the cost of the facilities and equipment they are buying. Since firms can buy a lot of new investment goods with only a small issue of stock, investment spending will rise.

The idea of this mechanism is an increase in money supply leads to an increase in household spending and demand for assets. That means the price of assets rises relative to the real cost of replacement capital. Consequently, Tobin's q increases and firms acquire more capital by issuing low equities. The higher Tobin's q induces a higher real investment spending and an increase in real output.

In addition, the asset price mechanism also produces a wealth effect that increase consumption and aggregate demand (Mishkin, 2004). Modigliani, in his famous life cycle hypothesis, was the pioneer to look the effect of consumer's balance sheet on their spending decision. The basic argument of Modigliani's theory is that consumers smooth out their consumption over time. Therefore, their consumption spending is determined by lifetime resources of consumers rather than their income today. An important component of consumers' lifetime resources is their financial wealth, a major component of which is common stocks. When stock prices raise, the value of financial wealth increases, thereby increasing the lifetime resources of consumers, and consumption should rise.

The wealth and Tobin's q channels allow for a general definition of equity, so the Tobin q framework can also be applied to the housing market, where housing is equity. An increase in house price, which raises their prices relative to replacement cost, leads to a rise in Tobin's q for housing, thereby stimulating its production. Similarly, housing and land prices are extremely important components of wealth, and so rise in these prices increase wealth, thereby raising consumption. Monetary expansion, which raises land and housing prices through the Tobin's q and wealth mechanisms described here, thus leads to a rise in aggregate demand (Mishkin, 2004).

The effect of the change in real estate prices is very similar to the effect of the change in equity prices on firms and consumers. There is a wealth effect working in two ways. On the one hand changes in the value of housing wealth affect consumption and on the other hand they change the value of collateral, which influences investment spending (Bank of England 2001). Finally, there is the direct effect of the price change on housing expenditure (Mishkin , 2001).

2.1.3 Exchange Rate Channel

The effect of monetary policy on the exchange rate works conventionally through uncovered interest rate parity that relates interest rate differentials to expected exchange rate movements. Although in the end the exchange rate is determined by factors such as purchasing power parity, its short run behavior is the result of asset equilibrium. In many developing countries those with only undeveloped markets for bonds, equities and real estate, the exchange rate is probably the most important asset price affected by monetary policy (Agenor and Montiel, 2008).

When the exchange rate is floating, a tightening of monetary policy increases interest rates, raises the demand for domestic assets, and hence leads to an appreciation of the nominal and the real exchange rate (Agenor and Montiel, 2008).

According to Mishkin (2004), after monetary contraction when domestic real interest increase, depositing domestic currency become more attractive than depositing foreign denomination currencies, which in turn leading to the appreciation of the domestic currency (a rise in the value of domestic currency relative to other currencies). The higher the value of domestic currency means the more expensive will be the domestic good compared to foreign good, thereby, leading to a decline in net export which in turn causing a fall in aggregate output. This is what we call the relative price effect.

The change in the exchange rate affects the price competitiveness of the country thereby affecting net exports (Kuttner and Mosser, 2002). However, the degree and direction of the exchange rate channel depend on many conditions such as the elasticity of demand for exports and imports, openness of the economy and exchange rate pass-through.

Mishkin (2001) points out that the exchange rate channel also works through the balance sheet effect. It is the case when a substantial amount of domestic debt is denominated in

foreign currency, resulting in a change in the debt burden through the change in the exchange rate.

It is important to note that the relative price and balance sheet effects are not working in the same direction (Kamin, Turner and Van't dack 1998). According to this paper, the appreciation of the domestic currency tends to increase the demand for imported goods worsening net exports while the balance sheet effect may lead to a rise in domestic demand and hence balancing or even dominating the relative price effect.

Khan (2010) argued that the exchange rate channel is likely to be particularly important in small open (developing) economies with flexible exchange rates. Unlike the other channels, the exchange rate channel does not only affect aggregate demand but also aggregate supply through the import cost structure. For instance, monetary policy loosening may lead to depreciation of domestic currency which in turn increases the cost of import. As a result, without any visible expansion of aggregate demand, firms induced to raise domestic producer price. Note also that in the case of a fixed or heavily managed exchange rate the effectiveness of monetary policy is reduced but not entirely eliminated. In the case of fixed nominal exchange rates, monetary policy may well affect the real exchange rate by acting on the price level (Kamin ,Turner and Van't dack, 1998).

In a country with fixed exchange rate or crawling peg arrangement, the exchange rate channel is not that much active, because domestic interest rates adjust in such a way as to leave the exchange rate unchanged. In other words, there is self-imposed restriction on the use of monetary policy since the domestic interest rates are determined by the interest rates in currency of the country to which the domestic currency is pegged.

Agenor and Montiel (2008) argue the macroeconomic effect of exchange rate channel by identifying three different effects:

The first one is a direct effect on inflation through the cost of imported goods which is the most rapid transmission channel from monetary policy to inflation in an open economy. An appreciation of the real exchange rate, for instance, lowers the domestic price of imports and has a direct downward effect on the price of import-competing goods. The pass-through of lower import prices to final demand prices, by contrast, may be spread over time.

Second, there is an indirect effect on inflation via changes in aggregate demand and expenditure themselves resulting from movements in the relative prices of tradable and non tradable goods. This is an intra temporal substitution effect. For instance, an increase in the relative price of non tradable goods (a real appreciation) would tend to lower demand for these goods and put downward pressure on inflation. However, in countries which are net importers of capital goods (as is often the case in the developing world), the real appreciation may also stimulate private investment by lowering the domestic price of investment goods. This transmission channel may eventually have an impact on inflation and economic activity, although it may occur more gradually.

The last but not list that Agenor and Montiel (2008) mentioned is a direct supply-side effect resulting from the impact of changes in the domestic-currency price of imported inputs (such as oil) on the production of tradables and non tradables. A depreciation of the nominal exchange rate, for instance, raises the domestic-currency price of imported commodities.

2.1.4 The Credit Channel

Relatively more recent channel discussed in the literature is the credit channel. It focuses on financial market imperfections, namely asymmetric information phenomena, as an essential factor of propagation and amplification of initial monetary policy shocks.

Bernanke and Gertler (1995), as advocator of this mechanism, points out the basic premise of their conception about the channel. The premise states that wherever there is a problem of information asymmetry and costly enforcement of contracts which interrupt the smooth functioning of financial market, there will be imperfect substitutability between different sources of financing (the cost of external funds and opportunity cost of internal funds). This cost spread between self-financing and credit, called the external finance premium. The difference between the two funds reflects the dead weight cost associated with principal agent problem that exist between lenders and borrowers. Lenders expected cost of evaluation, monitoring and collection; the information advantage of the borrower than the lender about its prospect; cost of distortion in the behavior of borrowers that arise from moral hazard-are some of the factors reflected in the external finance premium (Bernanke and Gertler, 1995). The higher the external finance premium (cost due to financial imperfection), the lower will be the investment and consumption spending.

According to Bernanke and Gertler (1995), monetary policy affects not only general level of interest rates, but also the size of external finance premium. There are two transmission mechanisms under the credit view which arise as a result of credit market imperfection: the bank lending channel and the balance sheet (net-worth) channel.

Bank lending channel supposes that monetary tightening which drains deposits from the banking system has a direct effect on banks' loan supply. The bank lending channel is

based on the idea that banks play a special role in the financial system since they are especially well suited to solve asymmetric information problems in credit markets. The special role of banks allows certain borrowers who do not have access to the credit markets to get loan from banks. According to Mishikin (2004) as long as there is no perfect substitutability of retail bank deposits with other sources of funds, the bank lending channel of monetary transmission operates as follows. Expansionary monetary policy, which increases bank reserves and bank deposits, increases the availability of bank loans .since many borrowers finance their activities by using bank loan, this increase in loans will cause investment (and possibly consumer spending) to rise.

An important implication of the credit view is that monetary policy will have a greater effect on expenditure by smaller firms, which are more dependent on bank loans, than it will on large firms, which can access the credit markets directly through stock and bond markets (and not only through banks). Apart from being forced to cut their loans supply, banks generally increase their lending rate which in turn raises external finance premium and lower output. In this case, increase in lending rates is a way in which banks try to compensate for borrowers inclination to exhibit stronger adverse selection and moral hazard behavior during monetary contraction.

Balance sheet channel looks at credit channel of monetary transmission from a borrowers' perspective. Monetary policy expansion for example, strengthens borrowers' net worth by a rise in equity, house and land prices or by a rise in firms' cash flow caused by a decline in nominal interest rates. External finance premium declines at this point because higher net worth reduces opportunistic behavior by borrowers so that banks are willing to lower lending rates, thus affecting aggregate spending decisions.

The study by Bernanke and Gertler (1995) shows that the lower the net worth of business firms, the more severe will be the adverse selection and moral hazard problems in providing loan to these firms. Lower net worth means that lenders in effect have less collateral for their loans, and so potential losses from adverse selection are higher. A decline in net worth, which raises the adverse selection problem, thus leads to decreased lending to finance investment spending.

Bernanke and Gertler (1995) mentioned also that the lower net worth of businesses also increases the moral hazard problem because it means that owners have a lower equity stake in their firms, giving them more incentive to engage in risky investment projects. Since taking on riskier investment projects makes it more likely that lenders will not be paid back, a decrease in businesses' net worth leads to a decrease in lending and hence in investment spending. Monetary policy can affect firms' balance sheets in several ways. Expansionary monetary policy, which causes a rise in stock prices, raises the net worth of firms and so leads to higher investment spending and aggregate demand because of the decrease in adverse selection and moral hazard problems (Mishkin, 2004).

As emphasized by Benanke and Gertler (1995), the credit channel is not really an independent alternative to the traditional interest channel but rather an amplifying mechanism. Mishkin (2004) cited three reasons to believe that credit channel are an important part of monetary transmission mechanism. First, it finds that there is a large body of cross-sectional evidence which supports the view that credit market imperfections of the type crucial to the credit channels do indeed affect firms' employment and spending decisions. Second, there is evidence found in Gertler and Gilchrist (1994), showing that small firms, which are more likely to be credit constrained,

are hurt more by tight monetary policy than large firms which are unlikely to be credit constrained .

Third, and perhaps most compelling, the asymmetric information view of credit market imperfections at the core of the credit channel analysis is a theoretical construct that has proved to be highly useful in explaining many other important phenomena.

2.1.5 Expectation channel

The last monetary transmission channel discussed by some literatures is the expectation channel. According to Mishkin (2004) the shock of monetary policy depends on the degree to which they have been anticipated by economic agents. Since unanticipated changes will have relatively strong effects, monetary authorities' control over monetary conditions is determined by their ability to influence inflationary expectations. The formation of expectations crucially depends on policy credibility, which takes a long time to build.

In recent years there has been a growing recognition of the importance of expectations about the future stance of monetary policy in improving monetary policy effectiveness in stabilizing inflation and output. Since there are costs in changing prices and renegotiating contracts, agents show forward-looking behavior in their setting of prices and wages (Mishkin, 2004).

2.2 Empirical literatures

There have been a growing number of studies done on the monetary transmission mechanism, especially dealing with the developed world transmission mechanism. Empirical studies in this area mainly used the VAR approach and focused primarily on the reduced-form relationships between monetary policy and output using a small number of variables such as, real output, inflation(consumer price index), interest rate, credit , exchange rate and stock index. It is important to examine some of the studies both from the developed and developing nations in greater detail to obtain a better idea about their methods and findings, even though only little done in most of the underdeveloped world. Reyes (2002) analyzes the monetary transmission mechanism in USA by employing VAR approach. He found empirical evidence that support the four channels of transmission mechanism surveyed by Mishikin (1996). The result of his study showed that real interest rate, asset price, real expenditure and money are the major variables affecting the dynamic of output. However, real exchange rate, real net export, real bank loans, real deposit have a weak influence on output. Based on the results, the author suggested that policies that induce to stimulate the US economy at the study period by expanding credit or improving the exchange rate might have lower probability of being succeeded.

Loayza (2002) provides an overview of empirical studies concerning monetary transmission channels in Australia, Canada and the United Kingdom. By using the VAR approach, he found that the interest rate and exchange rate channels are important in all of the mentioned countries. Asset price and credit channels on the other hand are not important in any of the countries.

In regards of the euro countries, Angeloni et al. (2002) made an attempt to examine the monetary transmission mechanisms in euro area countries. By using the aggregate euro countries data they ensured that the monetary policy has a significant effect on output and price. They also found that a temporary reduction on output for increases in short term interest rate while the response of price is slow. By employing a country specific data of countries like Austria, Germany, France, Italy, Belgium, Spain, Portugal, they showed that interest rate and credit channels are the most significant transmission channels in the area.

Morsink and Bayoumi (2003) employed VAR models with quarterly, seasonally-adjusted data from 1980Q1 to 1998Q3, to analyze the effect of monetary shock on the Japanese economy. In their basic model, they used output, prices, interest rates, and broad money. They found that both interest rate and broad money significantly affect output. Then, after examining the basic model, they extended the VAR to examine different channels of the monetary transmission mechanism and concluded that both monetary policy and banks' balance sheets are important sources of shocks to output, that banks play a crucial role in transmitting monetary shocks to economic activity, and that business investment is especially sensitive to monetary shocks.

In addition to those economically advanced countries the study attempted to review empirical works on monetary transmission mechanisms in some small and open economies of Central and Eastern European countries that are characterized by a developed bank system and an underdeveloped financial market.

Lyziak (2001) presents a vast survey of the relative importance of different monetary policy transmission mechanisms in Poland. The result of the study showed that the

exchange rate channel is the quickest way to affect inflation, though its effects on inflation are not very strong. Although the use of the exchange rate channel was constrained by the objective to maintain the international competitiveness, the study argues that the real appreciation of the exchange rate played a vital role in the Polish disinflationary process.

Moreover, the study in Poland showed that the effectiveness of the interest rate channel appears to be restricted in Poland economy. Even if the output gap is moderately sensitive to changes in the interest rate, but its response is delayed and the link between inflation and the output gap is very weak.

Vizek (2006) explored the characteristics and functioning of monetary transmission in Croatia by using monthly data from January 1995 to April 2006. He used VAR approach to estimate the influence of exchange rate, interest rate and narrow money on the real economic activity. The results of econometric analysis suggest that monetary policy in Croatia had a significant influence on the real activity through the direct monetary transmission and exchange rate channel. Moreover, the result suggests that the interest rate channel is not active.

Samkharadze (2008) employed VAR approach to investigate the role of the different channels of the monetary transmission mechanism in Georgia by using monthly data for the period from June 2002 to May 2007. The result of the study showed that the exchange rate channel is important in determining the inflation level in Georgia. He also found the significant interest rate pass-through to the real GDP and inflation and the existence of significance bank lending channel. Finally, monetary aggregates were found to have positive and highly significant effect on the real output and inflation.

The studies in central and Eastern European countries demonstrated the monetary transmission mechanism in these countries highly depend on the exchange rate channel unlike the other euro zone European countries. Since the euro area countries use common currency the exchange rate channel is more or less insignificant rather the traditional interest rate channel has a dominant role in explaining the impact of monetary policy on the real economy.

Regarding the empirical literatures on the developing countries, Disyatat and Vongsinsirikul (2003) used the VAR approach with quarterly, seasonally-adjusted data from 1993Q1 to 2001Q4 with two lags to analyze the monetary transmission mechanism in Thailand. Their basic model included real output, price level, and the fourteen-day repurchase rate, which they assumed to be the measure of monetary policy since they used short term interest rates as monetary policy stance for Thailand. They found that tightening monetary policy led to a decrease in output and the aggregate price level initially responded very little, but ultimately started to decline after about a year. Moreover, investment appeared to be the most sensitive component of gross domestic product (GDP) to monetary policy shocks.

Agha et al. (2005) examined the monetary transmission mechanism in Pakistan through vector autoregressions, with seasonally adjusted monthly data from July-1996 to March-2004. The study indicate that monetary tightening leads first to a fall in domestic demand, primarily investment demand financed by bank lending, which translates into a gradual reduction in price pressures that eventually reduces the overall price level with a significant lag. In addition to the traditional interest rate channel, the results point to a transmission mechanism in which banks play an important role. He also found an active

asset price channel even if the exchange rate channel has been less significant by comparison.

The study include variables like industrial production index, as a proxy for GDP, price, real effective exchange rate, six-month Treasury bill rate, stock exchange rate index and credit. The reason mentioned by the author to use six month Treasury bill rate is its capacity to explain recent financial sector development.

The study made in Jordan showed different result as Poddar, Sab, and Khatrachyan (2006) used VAR by employing quarterly data from 1996 Q1 to 2005 Q1 to investigate the monetary transmission process in Jordan. They found no evidence of monetary policy affecting output. However, Jordan's monetary policy, which is measured by the spread between the three-month currency deposit rate and the US Federal Funds rate, was effective in influencing foreign reserves. Other channels, like equity prices and exchange rate, were not significant channels for transmitting monetary policy to economic activity. The effect of monetary policy on the stock market also seemed insignificant.

Ahmed (2008) also tried to analyze various channels of monetary policy transmission in the two small pacific economies, i.e., Fiji and Papua New Guinea. He uses quarterly data which ranges from 1974Q1 to 2003Q4 for PNG and from 1971Q1 to 2003Q4 for Fiji. Ahmed interpolated annual real GDP figures into quarterly figures to tackle the problem of lack of quarterly GDP data. In his VAR analysis, he found that the monetary channel is more important in explaining the output variation in Fiji than the credit channel especially in the long run. While in PNG the credit channel plays significant role compared to money channel supporting the fact that in less developed financial sector economies, the bank lending channel is more important which reflects the restricted

portfolio choice to the investors. From the empirical result he conclude that in less developed financial markets monetary policy influence economic activity by varying the availability of quantity of credit than its price.

Jayaraman and Choong (2008) undertook a study of monetary policy transmission mechanism in Fiji by utilizing annual observations ranging from 1970 to 2006. Their VAR model contains three policy variables namely, monetary aggregate, exchange rate, and interest rate represented by money market rate; and two monetary goal variables which are output and price level.

By applying the procedures of variance decomposition and impulse response functions, their study examined the impact of a shock in monetary aggregate, exchange rate and interest rate on output and price level in Fiji. They concluded that the money channel is the most effective channel of transmission mechanism since the money channel has had a larger impact on output than the interest rate channel. In regard to the price level, the money channel exhibited far greater influence than the interest rate.

The two studies in Fiji confirmed the importance of the money channel in affecting output and price more than the other transmission channels. Although Jayaraman and Choong (2008) used annual figures their result is almost consistent with that of Ahmed (2008) who use quarterly figure.

Ahmed and Islam (2006) attempted to empirically investigate whether bank lending and exchange rate channels exist in the Bangladesh economy through which monetary policy changes can influence aggregate output and prices. The study employed the unrestricted vector autoregressions (VARs) approach using quarterly data for the period of July-

September 1979 to April-June 2005. The results of the empirical analysis showed weak existence of both bank lending and exchange rate channels in the Bangladesh economy for the sample period. Ahmed and Islam (2006) generalize their study by showing the importance of identifying the distinct active channels of monetary transmission in the economy which guide the monetary authority in formulating and conducting monetary policy pursuant to its objectives under the regime of floating exchange rate and market based monetary policy instruments.

In Egypt, Al-Mashat and Billmeier (2008) studied the monetary transmission mechanism by using VAR model which consists of output, the price level, a measure of the monetary stance, and the exchange rate. They attempted to describe the changing transmission channels over the last decade by employing seasonally adjusted monthly data. They found that the exchange rate channel plays a strong role in propagating monetary shocks to output and prices rather than the other channels (bank lending and asset price).

Although the interest rate channel provides correct signs, the significance and amplitude of the results are not satisfactory, particularly in light of the planned move toward inflation targeting in Egypt. The role of the asset price channel is generally unresponsive, but explicit modeling of this channel intensifies the response of prices to exchange rate shocks. Moreover, they got evidence on the bank lending channel that points to a stronger transmission of the monetary policy stance on output through credit (loans and securities) to the public sector compared to private sector lending.

Regarding sub-Saharan Africa, some papers have studied the monetary transmission mechanism in the region. For example, Saxegaard (2006) uses a threshold vector autoregression model for a number of sub-Saharan African countries and finds that

excess liquidity in the region weakens the monetary transmission mechanism and thus the ability of monetary authorities to influence demand conditions in the economy. Durevall and Ndung'u (1997), using Kenyan data during 1974–1996, found that exchange rates have long-term effects on prices, while interest rates and money supply have short-term effects.

Recently, Cheng (2006) also studied the impact of a monetary policy shock on output, prices, and the nominal effective exchange rate for Kenya using monthly data during 1997–2005.

As he uses VAR approach, the main results suggest that an exogenous increase in the short-term interest rate tends to be followed by a decline in prices and appreciation in the nominal exchange rate, but has insignificant impact on output. Furthermore, the paper finds that variations in the short-term interest rate account for significant fluctuations in the nominal exchange rate and prices, while accounting little for output fluctuations. Finally he concluded that he found a weak transmission mechanism from monetary policy stance to real variables and a strong link between monetary policy and nominal variables. Even if the study by Cheng (2006) uses monthly data which is adjusted seasonally, the time span of the sample period is very short. As a result, it will be difficult to believe that the study give a precise analysis of the long-run behavior of the economy.

To sum up, the study attempted to overview of empirical evidence on different transmission channels in developed and less developed countries. The evidence concerning monetary transmission mechanism in euro area countries reveals that the interest rate channel emerges as clearly and exclusively dominant but a weak existence of the exchange rate channel due to the implementation of common currency in the region.

The empirical studies of other advanced countries like USA, UK, Australia and Canada suggest that the Interest rate channel and exchange rate channel, rather than the Credit channel and asset price channel, have a prominent role in monetary transmission in open advanced economies.

In contrast to the other advanced countries, in Japan the credit channel (bank loan) play a vital role together with interest rate and asset price channels as a monetary transmission mechanism.

Empirical evidence from the group of less developed countries provides no clear-cut implications. On the one hand there are some countries (e.g. Japan, Pakistan, Georgia) where the interest rate channel seems to play an important role in the transmission process of monetary policy. On the other hand there exists a second group of countries (e.g. Fiji, Croatia, Poland, Kenya) where the role of the Interest rate channel tends to be rather limited. The same pattern of mixed evidence across different countries also applies to the Credit channel and exchange rate channel. For instance the exchange rate channel is highly significant in countries like Poland, Croatia, Georgia, Kenya and Egypt however its impact is less significant in Bangladesh and Jordan. Regarding the credit channel it has a large influence on transmission mechanism of some countries such as PNG, Egypt and Pakistan. In contrary, the studies in Bangladesh and Fiji explained a weak existence of this channel. Some studies in Fiji and Croatia also witnessed the importance of monetary aggregates as a useful transmission mechanism.

Moreover; the rationales why certain channels are present or not in a particular country vary from country to country, which sheds some light on the link between a specific channel and the economic structure of the country.

Generally, the above studies indicated that not only one particular channel does matter to the monetary policy transmission mechanism in one country, but also many channels may be simultaneously play a vital role. Furthermore, the review also showed that it is very hard to find any empirical evidence in the context of developing countries. This is not a surprise since there is no apparent implementation of monetary policy among the developing countries.

In Ethiopia, almost no empirical study undertook in the area of monetary transmission mechanisms in the country, at least which is published. As a result this paper will be a good motivation in investigating empirically the monetary transmission mechanism in Ethiopia.

Chapter Three:

Monetary Policy and Financial Sector Development in Ethiopia

3.1 Monetary Policy Development

3.1.1 Evolution of Monetary Policy Framework

Similar to other sub Saharan African countries, the monetary framework of Ethiopia are highly shaped by the type of government regime that came to power. The history of monetary policy dates back to 1943 when the State Bank of Ethiopia was established, with two departments performing the separate functions of an issuing bank and a commercial bank before they formally separated in 1963.

As the countries monetary authority, The National bank of Ethiopia was established in 1963 by proclamation no 206/1963 and granted broad administrative autonomy and juridical personality. In addition to the responsibility of issuing paper money and coins, NBE was entrusted to regulate the supply availability and cost of money and credit, to manage and administer the country's international reserves, to license and supervise banks and hold commercial banks reserve s and lend money to them, to supervise loans of commercial banks and regulate interest rates, to fix and control the foreign exchange rates.

However, monetary and banking proclamation no.99 of 1976 came into action to shape the bank's role according to the socialist economic principles that the country adopted. As part of the national planning, NBE's supervisory area increased to include other financial institutions such as insurance institutions, credit cooperatives. Moreover the government introduced the new Ethiopian birr in place of the former Ethiopian dollar.

The 1976 proclamation also revised the banks relationship with the government by raising the legal limits of outstanding government domestic borrowing to 25% of the actual ordinary revenue of the government during the preceding three budget years as against the proclamation of 1963 which set it to be 15%. Generally, in that period financial markets were abolished, the exchange rate was fixed, capital controls were absolute and price regulation was pursued.

After the down fall of the socialist regime, in 1994 a new proclamation issued to reorganize the bank according to the market based economic policy so that it could foster monetary stability, a sound financial system and such other credit and exchange conditions as are conducive to the balanced growth of the economy of the country. The proclamation 83/1994 vested the bank to regulate the supply and availability of money and credit and applicable interest rates, to set limits on the net foreign exchange position and on the terms and amount of external indebtedness of banks and other financial institutions and to make short and long term refinancing facilities available .

In 2008 the government amends the Establishment National Bank of Ethiopia with the Proclamation No. 591/2008. According to this proclamation the bank granted to perform the following functions:

- ✓ Coins, prints and issues the legal tender currency and Acts as banker, fiscal agent and financial advisor to the Government
- ✓ Regulates and determine the supply and availability of money and credit as well as the applicable interest rate and other cost of money charges
- ✓ Formulating implements and follow up the country's exchange rate policy, and manages and administers the international reserves of the country

- ✓ Licenses, supervises and regulates the operations of banks, insurance companies and other financial institutions
- ✓ Sets limits on gold and foreign exchange assets, which banks, and other financial institutions authorized to deal in foreign exchange and hold in deposits
- ✓ Sets limits on the net foreign exchange positions and terms, and the amount of external indebtedness of banks and other financial institutions
- ✓ Provides short and long term refinancing facilities to banks and other financial institutions
- ✓ Accepts deposit of any kind from foreign sources
- ✓ Promotes and encourages the dissemination of banking and insurance services throughout the country
- ✓ prepares periodic economic studies, together with forecasts of the balance of payments, money supply, prices and other relevant statistical indicators of the Ethiopian economy useful for analysis and for the formulation and determination by the Bank of monetary, saving and exchange policies
- ✓ represents the country in international monetary institutions and acts consistently with international monetary and banking agreements to which Ethiopia is a party
- ✓ Exercises and performs such other powers and activities as central banks customarily perform

3.1.2 Monetary policy Instruments

Monetary policy guides the Central Bank's supply of money in order to achieve the objectives of price stability (low inflation), full employment, and growth in aggregate income. In recent years, many countries place greater emphasis on achieving the

objective of low inflation since there is a strong empirical evidence that indicate high inflation (and its associated high variability) distorts the decision making of private agents with regard to investment, savings, and production, and ultimately leads to slower economic growth (Khan,2010).

Monetary policy targets, as distinct from objectives, are proximate goals. They are not objectives in and of themselves, but if attained will work directly toward achieving the longer-term objectives of policy.

Monetary policy targets are classified as either operating targets or intermediate targets. Intermediate targets are variables that affect the ultimate objectives of monetary policy, but are not controlled directly by the central bank. They include various monetary aggregates and long-term interest rates. In contrast, operating targets are tactical goals that the central bank can influence in the short run. Although central banks cannot use monetary policy instruments directly to affect intermediate targets, they can use them to affect operating targets, such as reserve money and short-term interest rates, which influence the intermediate targets.

Monetary instruments that affect operating targets are generally classified as either direct or indirect instruments. Direct instruments function according to regulations that directly affect either the interest rate or the volume of credit, for example, administratively set interest rate ceilings, individual bank credit ceilings, and directed lending.

Direct instruments become increasingly ineffective as money and financial markets develop; besides, they create distortions, including financial repression, and promote financial disintermediation, and fiscal dominance.

Indirect instruments usually termed as market-based instruments, since their use affects the market determined price of bank reserves as the central bank engages in transactions with both financial and nonfinancial institutions. There are three main types of indirect instruments—open-market operations, central bank lending policies, and reserve requirements—that are used to inject and absorb liquidity (khan, 2010).

In case of National Bank of Ethiopia, they use a number of monetary policy and accommodation instruments with which to regulate market liquidity and influence reserve money. The commonly used instruments are discussed below.

3.1.2.1 Reserve Requirement

The Central Bank may require Deposit Money Banks to hold a fraction (or a combination) of their deposit liabilities (reserves) as vault cash and or deposits with it. Fractional reserve limits the amount of loans banks can make to the domestic economy and thus limit the supply of money. By this, the central bank can control the amount of liquidity in the economy. The assumption is that Deposit Money Banks generally maintain a stable relationship between their reserve holdings and the amount of credit they extend to the public. Reserve requirements are set and changed according to regulation and thus contain an element of direct control. However, since the effect of changes in reserve requirements is a function of the demand for reserve money, they can be classified as an indirect policy instrument (NBE,2009).

Reserve requirement in Ethiopia is computed by netting out un cleared checks paid and un cleared effect foreign from the total deposits. The requirement is currently 5 percent of the net deposit and failing to comply with this requirement will be penalized. The National Bank of Ethiopia uses this instrument to control the liquidity of banks by

varying the rate according with the targeted level. The higher Reserve Requirement leads to contracts the liquidity as well as credit expansion power of commercial banks and the opposite will increase liquidity and credit expansion power of banks. This has to be undertaken consistently with macroeconomic conditions (Gazena: 2001 cited in Zerayehu 2006).

3.1.2.2 Open Market Operations

Open Market Operation has generally been used by countries as one of the main instruments for the development of money markets. It is an activity of selling and purchasing bonds or securities issued by governments. Trading in these instruments smooth the financial system in particular and the national economy in general and increases financial intermediation among market participants. One such security is Treasury Bills. When the Central Bank sells securities, it reduces the supply of reserves and when it buys securities-by redeeming them-it increases the supply of reserves to the Deposit Money Banks, thus affecting the supply of money.

In light of this, the NBE will use open market operations as one of its monetary policy instruments. In the absence of its own securities, certain amount of government treasury bills needs to be allocated to NBE by the government for its monetary policy purpose (NBE, 2009). To prepare the ground for enhanced open market operations, the yield on government securities should be at least close to the minimum interest rate. As a next step, secondary market for government securities needs to be established.

In the condition of under developed financial market, the treasury bills market is the first step for grown open market operation. Hence the bi-monthly auction market is introduced in 1995 with the objectives of financing government deficit from non-bank sources. In

addition it has an intention of creating a base for the establishment of secondary market and to boost the NBE's controlling power on money stock and interest rate.

To get private sectors participations, the minimum denomination was trim down and interest proceed was tax exempted in t bills market. However the market failed to attract private bidders as expected, and it is dominated by public organization. This is because high competition among liquid banks and other financial institution make bill interest rate low, which is lower than three percent on average. So private sectors prefer bank deposits. In effect, liquid commercial banks willing to lend to government by a lower rate than the deposit rate they are paying to their deposit liability (Zerayehu, 2006).

As a result, the T-bill market not serving most of its pre designed objectives as a first attempt to develop secondary market except utilized as a source of fund for government. NBE has allowed inter-bank money market but still it is at rudimentary level largely and ironically because of the treasury bills market which cast a shadow on it development as the excessively liquid use treasury bills market that provides them with maximum security and lower cost as well as higher return (in absolute term) than inter-bank lending they give fund seeking banks lesser attention and even turndown their request (Gazena 2001cited in Zerayehu 2006).

NBE carry out its open market operation actively through Treasury bills market to manipulate variables like liquidity level and net domestic assets of the banking system and money supply in the economy and monitor whether they are consistent with the targeted level (NBE Birritu, No.78).

3.1.2.3 Standing central bank credit facility

It is another instrument used to enhance the financial capacity of commercial banks and to promote financial intermediation and efficiency.

The main benefits of such standing credit facility are transparency and predictability of accessing central banks' resources to cover short-term needs. This credit facility gives banks an assurance that, when confronted with problems of shortfall in the clearing and a lack of alternatives for raising immediate funds in the inter-bank market, they can settle the clearing with the central bank's funds at a reasonable interest rate which has a clear relationship with short term market interest rates. The NBE will use this facility as one of its monetary policy instrument (NBE, 2009).

The instruments of monetary policy used by the Central Bank depend on the level of development of the economy, especially its financial sector. The introduction of a wide range of monetary instruments by central banks provokes competition, efficiency and transparency and broadens financial intermediation in the banking system. It also promotes liquidity management of commercial banks and gradually leads to the development of well functioning money and financial markets which could serve as a means for economic growth and development.

Hitherto, the use of such instruments has been extremely limited in Ethiopia due to the underdevelopment of the money market and the virtual non-existence of a financial market (NBE, 2009). Thus, it is envisaged to use a mix of diversified monetary policy instruments so as to effectively perform the monetary management function of the NBE.

3.1.3 Monetary Aggregates

3.1.3.1 Determinants of Broad Money Supply

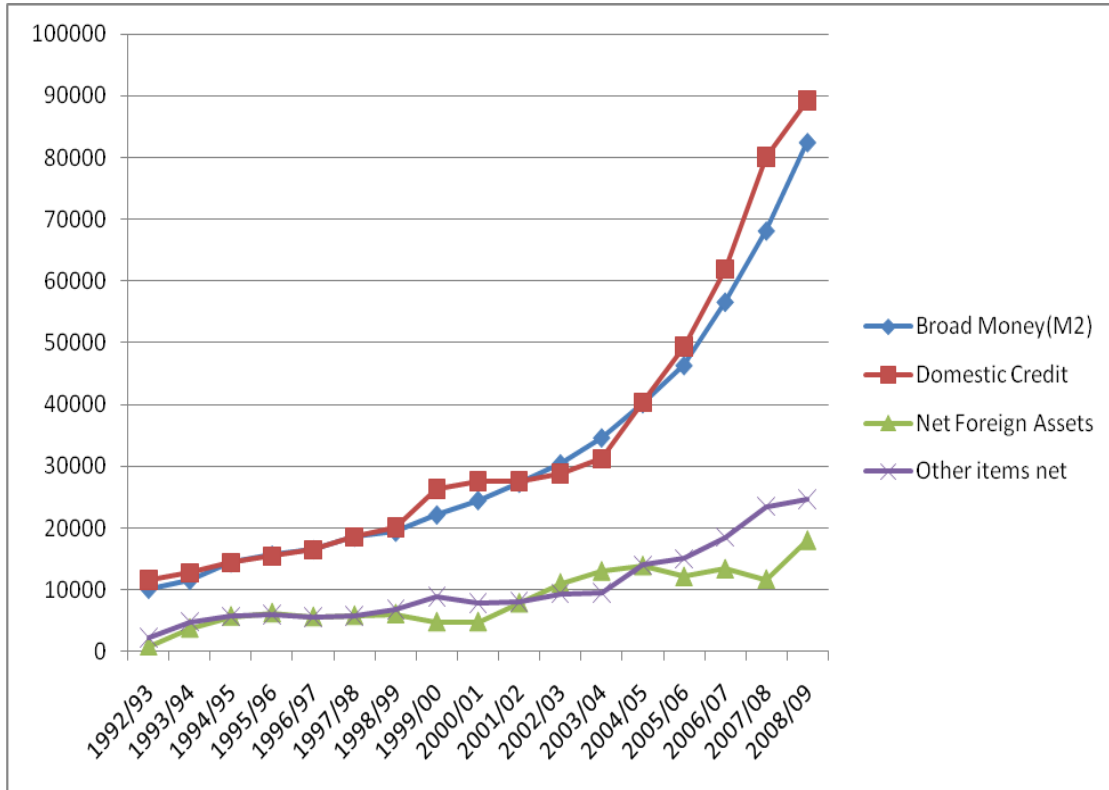
For the last two decades before 1963 money supply was explained by balance of payments and domestic credit. The impact of domestic credit on money supply was enhanced in response to growing economic activities such as the expansion of trade, manufacturing and housing industries which demanded a huge amount of private credit. Accordingly, domestic credit came to play vital role in determining the growth rate of money supply in the 1950s and early 1960s.

Money supply increased from eth.\$259.6 in 1963 to eth. \$694.3 million 1974. Broad money (M_2) also increased from eth. \$306.6 million in 1963 to eth.\$1,075 million in 1974. Money supply's share to GDP, on average, also increased from 12.3 % for 1965-1974 to 25.9% for 1974-1990. The main factor behind the expansion of money supply during that period was again the expansion of domestic credit to both the private sector and the government. The domestic deficit financing through discretionary bank borrowing also contributed for the huge increase in broad money supply (Derrese, 2001).

Broad Money can be determined by net foreign assets, domestic credit and net other items where domestic credit consists of claims on central government and other financial institutions in the review period. The significant share of claims on central government over on other financial institutions emphasized the significant role of domestic credit in the determination of Broad money comparing with net foreign assets. Through the review period, all the determinants are increased overtime but the increase in domestic credit overwhelm the other determinant. This implies a revival in the private sectors' appetite for bank credit comparing with the preceding year. The considerable growth in net

foreign assets also was partly attributed to improved performance in export, and foreign aid (Zerayehu, 2006).

Figure 3.1: Determinants of Broad Money supply



Source: National Bank Annual Report (1992/93-2008/09)

Broad money supply (M2), the annual growth rate of domestic liquidity, grew by 20.4 percent and reached Birr 68.1 billion by the end of 2007/08, compared with the same period of 2005/06, wholly driven by the expansion of domestic credit, which more than offset the 12.6 percent decline in net foreign assets. Throughout the review period, the domestic credit stays to be the main and significant determinant of broad money supply.

3.1.3.2 Monetary Aggregate Ratios and Growth Rates

The Ratio of Broad Money to GDP (M2/GDP) measures the degree of monetization in the economy and used as proxy of financial development/deepening. It indicates the real size of the financial sector of a growing economy in which money provides payment and saving services. Between 1993 and 2010 the average broad money to GDP ratio fluctuate between 40 and 25% on average and stood at 26 percent in 2010 (NBE, Birritu No.110).

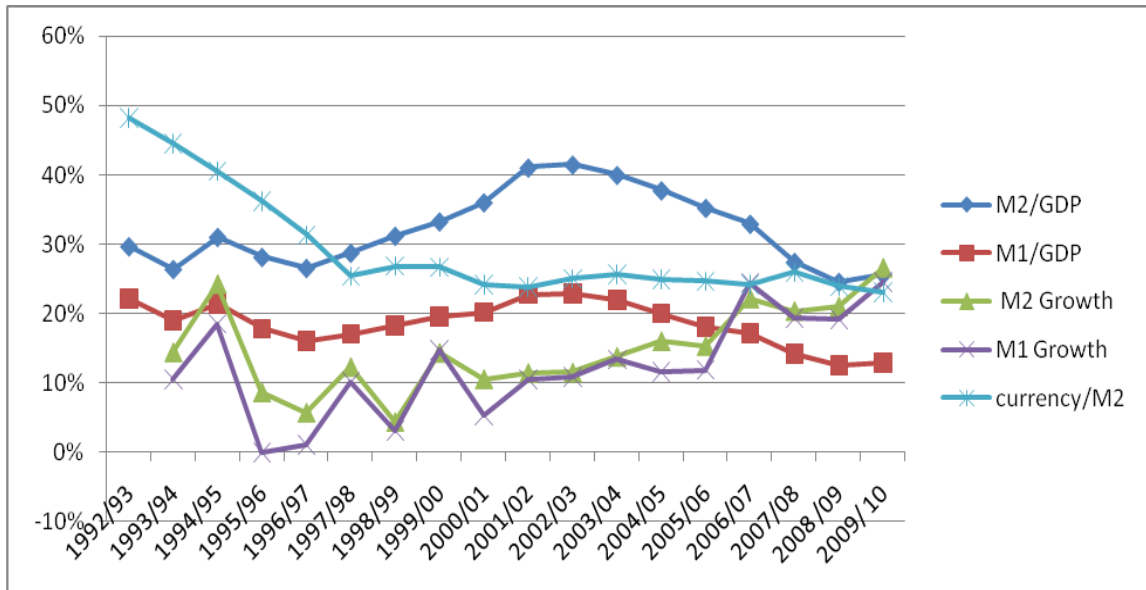
The Figure below implies that the ratio of M2/GDP increased from 1997 onwards and reach its maximum level (41%) around 2003/2004 which indicate the gradual monetization process followed by the government. However after 2003/04, the financial system could not keep its good record of monetization and decline over time and reached to 26 percent in 2010. This decline in M2/GDP ratio might be reflected the tight monetary policy measures taken by the government in order to mitigate the inflationary pressures witnessed in the review period.

In addition to the ratio of M2 to GDP, the decline in the ratio of currency in circulation to broad money supply implies financial deepening (development). Figure 3.2 clearly shows that the ratio of C/M2 decline to 23% in 2009/10 from 48% in 1993/94 which reflect the increase in degree of financial deepening in the economy.

Although the figure below shows almost analogous pattern between narrow (M1, the sum of demand deposits and currency outsides banks) and broad money (M2, the sum of demand deposits, currency outside banks, and saving and time deposits), they may deviate one to another in some years.

The M1 diverges from M2 growth in some years, chiefly due to the growth of both demand deposit and currency in circulation in 1995-97 and 2001/02, and growth of demand deposit in 2006/07.

Figure 3.2 Monetary ratios and growth rates



Source: Own computation based on NBE annual reports

3.1.4 Exchange Rate Development

Before the 1992 economic reform, the exchange rate of Ethiopian currency against its reference or reserve currency (US dollar) was determined by government decree.

According to currency Proclamation of 1945, the exchange rate of Ethiopian currency with US dollar was created with the official exchange rate of 2.48 birr per US Dollar. After almost two decades, in 1964, the Ethiopian birr was slightly devalued to 2.50 birr per US dollar but it was revalued to 2.30 birr per US dollar on 1971 after the collapse of Bretton Woods. The subsequent 10% devaluation of the US dollar had temporarily

brought about undervaluation of the birr. To realign the Ethiopian birr, it was again revalued to 2.07 birr per USD in February 1973.

From then on for nearly two decades until the 1992 reform, the Ethiopian currency was pegged to the US dollar at a fixed rate of 2.07 birr per US dollar. At the beginning of the reform period a massive devaluation took place and the currency devalued to 5 birr per US dollar since the birr was overvalued for the pre reform period. Before this reform, all foreign exchange earnings were capitulated to the National Bank of Ethiopia (NBE), which rationed this limited supply of foreign exchange to socialized sectors than private sector based on priority in the national plan.

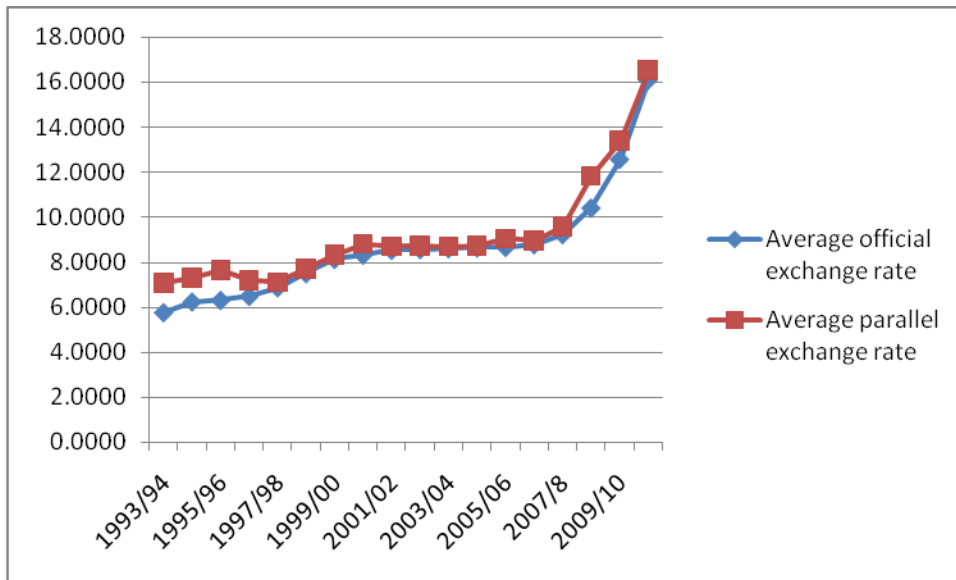
Consequently, auction-based exchange rate was introduced in 1993, which conducted on a biweekly basis as a Dutch auction, where the marginal rate, which clears the market, is taken as the ruling rate for the subsequent two weeks. Prior to the 1995 unification of the two rates, both the auction based exchange rate system and the official exchange rate utilized together. As said by Alemayehu (2005) the supply of funds for the Foreign exchange market comes from export earnings, loans, and external grants.

The NBE has also replaced the retail auction system with a wholesale auction system in 1998 where banks are taken as wholesale bidders. Currently, the exchange rate is determined through an interbank foreign exchange market on a daily basis, which is a clear indication of the government's policy of gradualism toward liberalizing the exchange rate market. However, the government's extensive controls on foreign exchange limit the accessibility of foreign exchange demanders to the official market, and then it leads to the emergence and development of an illegal foreign parallel exchange market.

Looking in to the development of Foreign Exchange Market, one can investigate how far the parallel exchange rate deviates from the official exchange rate and the real effective exchange rate indices from their nominal effective exchange rates. Conversely since the devaluation of domestic currency made the deviation started to narrow down and, in some cases, even the real effective exchange rate indicating that the overvaluation of the Birr has been reduced and the parallel market exchange rate premium has declined significantly. The ongoing foreign exchange liberalization should be strengthened until the exchange rate is set by solely market forces so as to eliminate the undesirable impact of the exchange rate premium on the economy (Zerayehu, 2006).

Throughout the period from 1993 to 1997 the parallel exchange rate showed a significant divergence from the official rate. Both rates start to move together in 1998 and continue till 2007, at this time the exchange rate premium between the parallel and the official rate narrowed down. However, the average official exchange rate of birr 10.42/USD in 2008/09 indicate annual depreciation of 12.7%. The rate of depreciation is relatively higher than the previous period; this is because of NBE's intervention in interbank foreign exchange market to reverse the appreciation of real exchange rate in order to improve the external competitiveness of the country. The parallel exchange rate also highly depreciated and reached birr 11.8/USD. As a result the exchange rate widened again till 2009/2010. After 2009/10 both the official and parallel rate are depreciated to birr 16.11/USD and 16.52/USD respectively, these in turn narrow the premium between the official and the parallel exchange rate.

Figure 3.3: Official and Parallel exchange rates (1992-2011)



Source: National Bank of Ethiopia annual reports

3.1.5 Interest rate development

The pre-reform period was characterized by discriminatory interest rates, foreign exchange as well as credit allocation policies. The interest rate was deliberately set at a very low level and depending on the degree of socialization; different sectors did face different interest rates.

However, after 1998 reform interest rates assumed to be determined by the inter-play of the market forces. Consequently, the interest rate is fairly liberalized and the NBE has set only a floor for deposit rate, leaving all other rates to be determined by market forces. Moreover, pursuant to the strategy of gradualism, the NBE has implemented this policy step by step.

Accordingly the average interest rate on time and saving became 6.0 & 6.29 percent while the nominal lending rate by the Banks ranged between 10.5% and 13%, with some private Banks charging more. The development in differentiated interest rates, associated with the expansion of private banks, indicated the slow but growing competition among banks. During the period between 2002 and 2005, no significant changes have been observed in the interest rate structure of the banking system. This was mainly due to the prevalence of excess liquidity in commercial banks. As a result, the simple average savings deposits rate remained at 3.08 percent per annum just 0.08 percentage points above the 3 percent minimum set by the NBE. Interest rate on time deposits, however, ranged between 3.62 percent for a maturity period of less than one year to 3.71 percent for those loans extending above two years.

In 2010/11, the saving deposit rate and time deposit grow to 5.4 and 5.49 respectively while the nominal lending rate by the Banks ranged between 7.5% and 16%.

Table 3.1 Interest Rate Structure of Commercial Banks: (1998-2011)

Rates		1998/99	2000/01	2002/03	2004/05	2006/07	2008/09	2010/11
	Saving deposit(average)	6	6	3.01	3.08	3.075	4.50	5.40
	Time deposit (average)	6.29	6.51	3.62	3.71	4.080	5.260	5.49
	Demand deposit(average)	NA	0.85	0.93	0.05	0.062	0.057	0.06
Lending rate	Minimum	10.5	10.5	7	7	7	8	7.5
	Maximum	13	15	14	14	14	16.5	16.25
	Average	11.75	12.75	10.5	10.5	10.5	12.25	11.88
T-bill (nominal)	4.88	0.61	0.62	0.05	0.495	0.802	1.31	

Source: National Bank Annual Reports

It is true that in a market economy interest rates could play a significant role in serving as a transmission mechanism of monetary policy. In Ethiopia, NBE refrained from changing interest rate to counter the negative real rate of interest in deposits and/ or yields of Treasury bills because such an intervention was regarded to have no desirable effect on output and imported inflation(NBE,2011)

3.2 Financial Sector Development in Ethiopia

In Ethiopia the financial system is highly dominated by the banking system. In 1963 the commercial bank of Ethiopia established along with the National bank of Ethiopia. After the 1963 law, some other banks also established which was owned by foreigners.

Before 1992 the financial sector was dominated entirely by the government. Although there were few banks owned by foreigners before 1975, all privately owned banks were nationalized and concentrated into Commercial Bank of Ethiopia. Afterward, the main financial sector reform was to direct the government banks to finance greatly increased public sector

In terms of the financial sector, the 1992 reform brought in private sector players. The government not only began to serve the private sector, which previously had been demonized, but it also allowed the establishment of new private financial institutions. Equally, the role of Ethiopia's central bank needed to be reformulated. In undertaking this task, after 1992 the government adopted a strategy which allow gradual opening up of private banks and insurance companies alongside public ones and gradual liberalization of the foreign exchange market. In contrast, it follows a strategy that restricts the sector to Ethiopian nationals in order to strength domestic competitive capacity before full liberalization (Alemayehu, 2005).

The main financial institutions operating in Ethiopia are banks, insurance companies and microfinance institutions although banking sector dominates the financial system. The number of banks operating in the country during the fiscal year reached 17 in 2011. In terms of ownership, fourteen were private commercial banks and the remaining three state-owned. Unlike their number the privately owned commercial banks have a very small size compared to the public banks, especially the commercial bank of Ethiopia

(CBE). In addition, all the private banks are domestically owned. There is a gradual but encouraging entry of private banks to the system though the larger share of the banking market still goes to CBE.

In terms of capital ownership, in 2003/04 the public banks had 2.17 billion birr which is 66.6 % of the total banking capital while the private had only 33.2% share which is 1.04 billion birr. In 2010, from the total capital of the banking system, the share of private banks rose to 43.6 percent (7.23 billion birr) from 33.2 percent seven years ago.

In terms of disbursement of loans, the share of private banks has increased from 17 percent in 1997/98 to 48 percent in 2010/11. The available data also shows that the share of credit extended to the private sector has jumped to 73 percent between 1997/98 and 2002/03, while that of the public sector has declined from 15 to 5.5 percent during the same period. This implies the effectiveness of financial liberalization policy pursued by the government. In spite of this; the banking sector in general has excess liquidity. This may relate to the problems of access to credit that may relate to risky avert nature of the banking sector in the face of the growing level of nonperforming loans.

Beside the banking sector, the role of insurance companies and micro finance institutions become an important mix of the financial sector. By the end of 2010/11, the number of microfinance institutions operating in the country reached 31. Their total capital increased by 24 percent to Birr 2.9 billion and their assets rose by 27.6 percent to Birr 10.2 billion mirroring their ever growing rose in the economy. Meanwhile, the number of insurance companies reached to 14 and registered a total capital of Birr 955.7 million. Private insurance companies accounted for 69.5 percent of the total capital, while the

remaining share was taken up by the single public owned enterprise, the Ethiopian Insurance Corporation (NBE, 2011).

3.3 Limitations of applicability of transmission channels

Ethiopia's under-developed money and capital markets with limited financial assets, limit the effectiveness of monetary policy transmission mechanism acting through various channels. Commercial banks in Ethiopia (both CBE and other private banks) dominate the financial sector, since the non-bank financial sector is still in its infancy. This kind of financial sector (bank dominated) with only a few participants is not deep enough to absorb debt instruments and equities.

Besides, the secondary market, in which these financial assets could be traded with ease and speed, did not exist. Thus, there are obvious limitations to the efficient functioning of the interest rate channel.

The balance sheet approach assumes that financial assets are important constituents of firms or consumers portfolios and the existence of convertibility between illiquid (consumer durables) and liquid (financial) assets. However, Ethiopia's money and capital markets have not attained such a degree of sophistication that would enable it to function as an efficient conduit for monetary policy.

As regards the asset price channel mechanism and its variants of Tobin's q theory (valuation of equities) and Modigliani's wealth and consumption model, an important precondition, namely presence of financial assets constituting a key component of borrowers' and wealth holders' portfolios does not exist in Ethiopia.

The exchange rate channel transmission mechanism for its full efficiency presupposes a floating regime as well as the condition that financial assets are perfectly substitutable

and desirable from the point of view of foreigners. Since Ethiopia follows managed float exchange rate regime with adjustable pegs from time to time, together with imperfect substitutable nature of Ethiopia's financial assets, the role of exchange rate transmission mechanism may be diminished.

Chapter Four:

Model specification and Methodology

The transmission mechanism of monetary policy has been area of abundant economic research in many countries. A prominent recent trend in this field has been the empirical analysis of how a monetary policy shock or changes in monetary policy variables affect monetary goal variables, as well as other key economic variables. Typically, this strand of research has been conducted in the context of a vector autoregression (VAR) framework pioneered by Sims (1980).

A review of relevant literature indicates that a large majority of recent studies on the effects of monetary policy use vector autoregression (VAR) as their econometric tool of choice. Although VAR models are useful tools for describing stylized facts about the data, this methodology has been subject to some criticism, on the grounds that it lacks a sufficient theoretical basis and on the grounds that its identification procedure is questionable. With respect to the criticisms, it is arguably a matter of personal preference, since none of the econometric methodologies currently in use is totally immune from criticism on this score. Although economic theory does establish certain relationships between variables, it seldom provides accurate predictions of the dynamics of those relationships or distinguishes between endogenous and exogenous variables. In order to overcome some of the weakness of the methodology this thesis employs the cointegrated vector autoregressive approach by looking the long run relationship among the variables fitted in the model.

VARs are dynamic systems of equations used to capture the dynamics and interaction between multiple time series in which the current level of each variable in the system

depends on past movements in that variable and all other variables in the system. In VAR approach all the variables are treated symmetrically, and the dependent variable in each equation is explained by lags of all of the variables in the model, including the dependent variable itself. The VAR was developed in response to Sims' (1980) argument that there is no a priori guide or substantial economic reasoning to justify treating particular variables as exogenous in the modeling process, and therefore all variables should be treated as endogenous. This is reflected in the fact that the dynamics of VAR models are driven by unanticipated changes, or shocks, in the endogenous variables.

One merit of this methodology is, it allows us to place minimal restrictions on how monetary shocks affect the economy. In addition, this approach recognizes explicitly the simultaneity between monetary policy and macroeconomic developments, that is, the dependence of monetary policy on other economic variables, as well as the dependence of economic variables on monetary policy.

The choice of a VAR approach is also motivated by the existence of a large empirical literature using VARs to examine the monetary transmission mechanism in various countries, which focuses primarily on reduced-form relationships between monetary policy and output using a small number of variables.

The set of the core explanatory variables to use in this study will be chosen on the basis of the relevance in the existing literature. The selected variables are important macroeconomic indicators whose association with monetary transmission cannot be ruled out. They can also be influenced by monetary authorities through monetary policy tools and so they are important to this study. The variables selected include GDP (to represent

economic activity), Exchange rate, interest rate, monetary aggregate, domestic credit and consumer price index.

4.1 Theoretical Framework

4.1.1 The Direct Money view

The model was developed from the Fisher's Quantity theory of money; The Classical (particularly pigou) suggests money is just a veil; on which the real variables are concealed (Mishkin 2004). Therefore, monetary changes are transmitted directly into price movements. In this respect, monetary policy should not be therefore geared to control real variables but its goal should be price stability as suggested by the Classics.

4.1.2 The Classical Model

The quantity theory of money implies that aggregate spending is determined solely by movements in the quantity of money since they assume a constant velocity of money.

$$MV = PY \tag{4.1}$$

Where V, Y, P and M represented velocity of circulation of money, aggregate output, price level and quantity of money respectively. V and Y are constant, there is linear relationship between quantity of money and price.

According to classical if velocity of money is assumed to be constant and the constant Y assumption relaxed, a change in the quantity of money (M) must cause a proportionate change in nominal GDP (PY). In other word, if velocity is fixed, the quantity of money determines the dollar value of the economy's output (Mishkin, 2004).

The monetary aggregate chosen in this study is Broad money (M2) rather than narrow money¹. Even if a recent study on Fiji (Jayaraman and Choong,2008) indicate, holding of liquid assets in a developing country plays a much larger role in the transmission of monetary policy, this study uses broad money to extend the scope by acknowledging the role of saving deposit. However, this study and so many others (Jayaraman ,Choong and Budhoo,2012) find similar result irrespective of using broad and/or narrow money.

4.1.3 The Money view (Keynesian Model)

The money view proposed by the traditional Keynesians places emphasis on the change in monetary aggregate affecting output (y) through interest rate channel. The mechanism can be traced by using the following systematic mechanism (Mishkin, 1996).

$$M \downarrow \Rightarrow r \uparrow \Rightarrow I \downarrow \Rightarrow Y \downarrow$$

The mechanism states that a contractionary monetary policy (m) leads to a rise in real interest rates(r), which raises the cost of capital, thereby causing a decline in investment goods (I). Further, this leads to a decline in aggregate demand and hence, fall in output.

According to this view, in the long-run the relationship between inflation and money growth depends on the demand for money and money supply. The most important factor affecting the demand for money is real income (output) and the forgone interest income from holding money instead of other assets.

¹ The study tried M1 instead of M2 ,but the results are similar

This relationship can be written as:

$$\frac{M}{P} = f(r, y) \quad (4.2)$$

Where M is money supply, P is domestic price r is interest rate and y is growth rate of output

To incorporate the impact of the interest rate many empirical researches in different countries use different types of interest rates. Some studies use the Treasury bill rate and some others work with the interbank money market rate. However, in Ethiopia it is unreliable to use such rates because in most cases the Treasury bill is issued to provide finance for temporary shortfalls in government revenue rather than as monetary policy instrument. The inter-bank money market transaction also not conducted for most of the review periods since the banking sector have huge excess liquidity. As a result this study compelled to use the average lending rate to represent the interest rate.

4.1.4 The Credit view (Bank lending channel)

Bernanke and Gertler (1995) introduced a credit channel and gave a new insight to the conventional transmission mechanisms. A decrease in money supply leads to a decrease in bank deposits, which further decreases the volume of money that banks have to loan out. This, in turn, decreases investment and aggregate demand. This channel allows monetary policy to operate without interest rate, meaning that decreasing interest rates may not be sufficient to increase investment. The schematic for the bank lending channel is as follows:

$$M \downarrow \implies \text{bank deposits (D)} \downarrow \implies \text{bank loans (L)} \downarrow \implies I \downarrow \implies Y \downarrow$$

Consequently=f (M, D, L, I)

In order to capture the credit channel the study employed the total domestic credit data which consist credits provided to the government as well as to the private sectors.

4.1.5 The Exchange Rate Channel

Both the Taylor paper (1995) and the study by Obstfeld and Rogoff (1995) emphasize the importance of the exchange rate channel of monetary policy. In the context of the Managed float exchange rate regime, the study decided to consider exchange rate as one of variables, which is the nominal one. The exchange rate (E) refers to the domestic currency (Ethiopian Birr) units per unit of foreign currency (US dollar).

The relationship between the nominal exchange rate and the real sector can be seen through Mundell-Fleming model which describes the market for goods and services by incorporating net exports. In particular, the goods market is represented with the following equation:

$$Y = C + I(r^*) + G + NX(E(p/p^*)) \quad (4.3)$$

This equation states that aggregate income Y is the sum of consumption C , investment I , government purchases G , and net exports NX . Investment depends negatively on the interest rate, which equals the world interest rate r^* . Net exports depend negatively on the exchange rate E . when the nominal exchange rate appreciates, foreign goods become cheaper compared to domestic goods, and this causes exports to fall and imports to rise.

The exchange rate channel established from a fall in domestic interest rate following an expansionary monetary policy, domestic dollar deposits become less attractive relative to deposits denominated in foreign currencies. As a result, the value of birr deposits relative to other currency deposits falls, and the birr depreciates ($E \downarrow$). The lower value of the

domestic currency makes domestic goods cheaper than foreign goods, thereby causing a rise in net exports ($NX \uparrow$) and hence in aggregate output ($Y \uparrow$).

$$M \uparrow \implies r \downarrow \implies E \downarrow \implies NX \uparrow \implies Y \uparrow$$

Therefore $Y = f(M, E, r, NX)$

The argument for using the nominal exchange rate over the real one is that we can isolate changes in the nominal exchange rate on real economic activity separately from changes in prices, since the real exchange rate is already adjusted for changes in prices and using this variable would make it stiff to isolate price changes (inflation) from exchange rate changes (Jayaraman and Choong, 2008).

In most of empirical analysis which include exchange rate as a variable arguments arise whether to use the official rate or the parallel market rate. Based on the information from Ethiopian macroeconomic Hand book (2010) the clearest and most readily observable indication of the near to proper value of an exchange rate is its going rate in the parallel market, especially in a setting such as Ethiopia where banks do not have full flexibility to move their rates.

Generally, the three theorists (classicals, Keynes, monetarists) and Taylor and Rogoff's empirical evidence produce the following model;

$$Y_t = f(M_t, DC_t, R_t, E_t, P_t) \tag{4.4}$$

Where: Y , M , DC , R , E and P represent Output, monetary aggregate, domestic credit interest rate, nominal exchange rate and consumer price index (price) respectively.

4.2 Model specification

The econometric model of monetary policy transmission mechanism used in this study is based on Jayaraman and Dahalan (2000). The model is rewrite by converting all variables (in equation 4.4) in to natural logarithmic form as follows;

$$LRGDP_t = \alpha_1 + \alpha_2 LM2_t + \alpha_3 LDC_t + \alpha_4 LR_t + \alpha_5 LE_t + \alpha_6 LP_t + \varepsilon_t \quad (4.5)$$

Where $LRGDP$, $LM2$, LDC , LR , LE and LP represents the logarithm of real gross domestic, broad money, domestic credit, interest rate represented by average lending rate , nominal exchange rate and consumer price index at time t.

After identifying the variables that can enter into the VAR model and converting into logarithmic form, it is possible to rewrite the above model in terms of reduced form VAR .In which, we can expresses each variable as a linear function of its own past values, the past values of all other variables being considered, and a serially uncorrelated error term.

$$LRGDP_t = \alpha_1 + \alpha_2 \sum_{j=1}^n LM2_{t-j} + \alpha_3 \sum_{j=1}^n LDC_{t-j} + \alpha_4 \sum_{j=1}^n LR_{t-j} + \alpha_5 \sum_{j=1}^n LE_{t-j} + \alpha_6 \sum_{j=1}^n LP_{t-j} + \alpha_7 \sum_{j=1}^n LRGDP_{t-j} + e_t \quad (4.6)$$

Where $LRGDP$, $LM2$, LDC , LR , LE and LP represents the logarithm of real gross domestic, broad money, domestic credit, interest rate represented by average lending rate , nominal exchange rate and consumer price index at time t and lagged time. e_t are the random disturbance term at time t, and j and n are the number of lag lengths.

Analogous equations also specified for the current values of broad money (M2), domestic credit (DC), interest rate (R), nominal exchange rate (E) and output (RGDP)

4.3 Data source and constraints

This study uses six different macro variables in order to study the transmission mechanisms of monetary policy in Ethiopia namely real gross domestic product, consumer price index, domestic credit, broad money supply, nominal exchange rate and average lending rate.

The data for broad money supply (M2), domestic credit (DC), consumer price index (P), average lending rate (R) and nominal exchange rate (E) are collected from various issues of annual and quarterly bulletins of National bank of Ethiopia. The Quarterly real gross domestic product (RGDP) data is constructed by EDRI.

The study employed a quarterly data which covers a period from 1998 Q3 to 2010Q2 since the work on transmission mechanisms need a high frequency data's. The period chosen for this study influenced by the availability of quarterly data and government proclamation of 1994 to reorganize the National bank of Ethiopia according to the market based economic policy.

In most developing countries including Ethiopia, it is difficult to find a quarterly data on gross domestic product. In order to overcome this problem different researcher uses different method to obtain quarterly estimates of GDP through interpolating annual GDP data by various available procedures including cubic spline and Chow-Lin methodology (Abeyasinghe and Lee, 1998; Jayaraman, 2010).

In case of Ethiopia Haile (2001) and Zerayehu (2006) both tried to generate quarterly figure of GDP by studying the behavior of seasonality function of each sector in its contribution to annual GDP based on seasonality adjustment coefficients.

Regarding this study, I prefer to use recently generated RGDP series by industrial classification at EDRI in 2010.

The study will employ a quarterly data which covers a period from 1998Q3 to 2010Q2. The period chosen for this study influenced by the availability of quarterly data from EDRI and government proclamation of 1994 to reorganize the National bank of Ethiopia according to the market based economic policy.

4.4 Methodology

4.4.1 Econometric framework

The econometric framework applied is a cointegrated vector autoregressive (VAR) model which allows us to model for the impact of monetary shocks on the economy while taking care of the feedback between the variables. The cointegrated VAR model used in this study is to estimate the monetary policy transmission mechanism where we assume a system of equations describing the time path of each variable. This time path depends on both on its interrelations with the other variables and on the shocks.

Each co integrated relationship can be interpreted statistically as a steady-state path to which in the presence of any shocks it would converge to this path. Therefore in any particular period of the time the equilibrium relationship may not be totally satisfied, but there is a stationary description of such equilibrium. Thus, in the presence of deviations we can infer how they can return to the equilibrium or the steady state path of the variable.

The basic idea of the cointegration analysis is to find linear combinations between non stationary variables that are stationary. Such interpretation holds because the cointegrated vector is represented by a stochastic variable expressed through deviations from the

equilibrium. We can say that they have a common stochastic trend on the extent that such variables wander extensively or are integrated individually but there exists a linear combination of them which is stationary. The starting point in this procedure is formulation of unrestricted vector autoregressive (VAR) model in the following form;²

The basic representation is the p-dimensional vector autoregressive model with Gaussian errors ($\epsilon_{it} \sim \text{iidN}(0, \Omega)$):

$$X_t = A_1 X_{t-1} + A_2 X_{t-2} + \dots + A_k X_{t-k} + \Phi D_t + \epsilon_t \quad t=1, \dots, T \quad (4.7)$$

Where X_t are the variables of interest in the system namely: *M2, DC, R, E, P and RGDP* where D_t is a vector of deterministic variables, containing the constant of the model and dummy variables and the trend and ϵ is an p dimensional vector of multivariate random errors with zero mean and covariance matrix Ω .

An important issue in econometrics is the need to integrate short run dynamics with long run equilibria. The analysis of short run dynamics is often done by eliminating trends in the variables usually by differencing. Reformulating the model in an error correction form allows distinguishing between stationarity that is created by linear combinations of the variables and stationarity created by first differencing:

$$\Delta X_t = \Pi X_{t-1} + \Gamma_1 \Delta X_{t-1} + \dots + \Gamma_{k-1} \Delta X_{t-k+1} + \Phi D_t + \epsilon_t \quad t=1, \dots, T \quad (4.8)$$

The VECM representation of the VAR model provides a favorable transformation. Combining levels and differences, the multicollinearity often present in macroeconomic data is reduced. In addition the VECM form of the model gives an intuitive explanation of the data, categorizing the effects in long (Π) and short (Γ_1) run information.

² The discussion on the methodology part of this chapter is taken from Juselius (2007) and Enders (1996)

The logical inconsistency with $X_t \sim I(1)$ is resolved by transforming the multivariate model and reducing the rank of Π to $r < p$, with p being the number of variables. The reduced rank matrix can be factorized into two $p \times r$ matrices α and β ($\Pi = \alpha\beta'$). The factorization provides r stationary linear combinations of the variables (cointegrating vectors) and $p - r$ common stochastic trends of the system. Formulating the cointegration hypothesis as a reduced rank condition on the matrix $\Pi = \alpha\beta'$ implies that the processes ΔX_t and $\beta'X_t$ are stationary, while the levels of the variables X_t are nonstationary.

4.4.2 Stationarity and Non-stationarity

Although the classical regression model assumes that both the dependent and independent variables to be stationary over time, most economic variables exhibit long-run trend movement and only become stationary after they are differenced (Alemayehu, Daniel and Ndung'u, 2009). Thus, empirical literature for unit root shows that almost all macro variables are non-stationary in level while their difference is stationary. Applying the standard regression techniques to the levels of variables leads to a spurious correlation, which may give very high R^2 value and significant t-ratio even without true relationship among the variables.

Therefore, Ordinary Least Squares (OLS) may lead to inconsistent and less efficient parameters as they may show that there is a strong relationship whilst in actual fact there is no relationship at all and hence the results obtained from such regressions will not have a meaningful economic interpretation. Hence, prior to estimation of the long run models the time series properties of the variables, unit root test, should be conducted.

4.4.3 The unit root test

Several tests are usually employed to test whether time series variables are stationary or non-stationary; the Dick-Fuller (DF), the Augmented Dick-Fuller (ADF) test, Ng peron test and Phillips-Peron test (PP). In this study the researcher is going to employ the ADF test to determine the existence of a unit root. By incorporating the autoregressive process of order p, this model becomes superior to DF. Basically this test has been chosen for its consistency, accuracy and resourcefulness. The general form of the ADF equation where only an intercept is included is as follows:

$$\Delta Y_t = A_o + \rho Y_{t-1} + \sum_{i=2}^p \beta_i \Delta Y_{t-i+1} + \varepsilon_t \quad (4.9)$$

For the case where the auto regression includes the intercept and a trend, the equation is of the following form:

$$\Delta Y_t = A_o + A_1 t + \rho Y_{t-1} + \sum_{i=2}^p \beta_i \Delta Y_{t-i+1} + \varepsilon_t \quad (4.10)$$

Where, Y_t is any variable in the model to be tested for stationary, A_1 is coefficient of a trend, ε_t is an error term, Δ is the first difference operator and A_0 is a constant.

The null hypothesis of ADF is $\rho = 0$ against alternative hypothesis that $\rho < 0$. A rejection of this hypothesis means that the time series is stationary or it does not contains a unit root while not rejecting means that the time series is non-stationary (Enders, 1996).

We have to be care full also in determining p of the lagged variables because too few lags will leave autocorrelation in the errors and distort the test and too many lags will reduce the power of the test. Economists suggest the use of information criteria such as akaike

information criteria, schwarz bayesian criteria and recursive t-statistics procedure to determine the optimal lag length. A time series is said to be integrated of order zero, $I(0)$, if it is stationary in levels. Some series needs to be differenced several times before becoming stationary. The number of times a series needs to be differenced before being stationary is the order of integration. So if a time series is said to be integrated of order n , $I(n)$, it means that it has to be differenced n times before the series become stationary.

4.4.4 Cointegration Test

One possible means of avoiding spurious regression is the use of cointegration technique which allows the estimation of non spurious regression with non stationary data. Any equilibrium relationship among a set of non stationary variables implies that their stochastic trends must be linked. After all, the equilibrium relationship means that the variables can't move independently of each other. This linkage among the stochastic trends necessitates that the variables be cointegrated (Brooks, 2002).

The co integration technique is based on the assumption of an equilibrium relationship among the variables, which implies that two or more variables that are individually non-stationary but are integrated of the same order possess a linear combination of a one-degree lower order of integration. Therefore, if all the variables are $I(1)$ and are cointegrated, then their c integrating equation would yield a composite variable of order $I(0)$, i.e. it would be stationary (Handa, 2009). Thus, Cointegration among the variables reflects the presence of long run relationship in the system.

Consequently, there is a need to test for Cointegration because differencing the variables to attain stationarity generates a model that does not show the long run behavior of the variables. It gives only the short run dynamics, in which case valuable information

concerning the long run equilibrium properties of the data could be lost (Kennedy, 1992). Hence, testing for Cointegration is the same as testing for long-run relationship. In general, if variables that are integrated of order ' n ' produce a linear combination which is integrated of order less than ' n ' then the variables are cointegrated and hence have stable long run equilibrium relationship (Gujarati, 1995).

There are two ways of testing the existence of cointegration between variables of interest and estimating the co-integrating vector. They are: The Engel-Granger (E-G) Approach and the Johanson Approach.

4.4.4.1 Engle-Granger (E-G) Approach

The Engle-Granger (E-G) method requires that for co-integration to exist, all the variables must be integrated of the same order. Hence, once the variables are found to have the same order of integration, estimates of the long-run equilibrium equation are made. Then an ADF test on the residual of the long-run equation, which is equal to the linear combination of the variables of interest, is conducted to determine if the variables in question are cointegrated or not—i.e, whether the error term follows a stationary Process. If the residuals are found to be stationary it implies that the variables are cointegrated. This in turn ensures that the deviation from the long run equilibrium relationship dies out with time (Enders, 1996).

Hence if the variables are cointegrated we could combine the error term with the first difference of the variables to estimate the final model. This last model is called an Error Correction Model (ECM). This formulation helps to show the deviation from the equilibrium position and how an adjustment towards the equilibrium is made by

combining both the long and short run versions of the model in one regression (Enders, 1996)

Although the Engle-Granger (EG) procedure is easily implemented, it is subject to the following important limitations (Enders, 1996). In tests using three or more variables, there may be more than one cointegrating vector. In fact, if there are n variables in a model there may be $n-1$ cointegrating vector. This method has no systematic procedure for separate estimation of the multiple cointegrating vectors. This method makes also the implicit assumption that the cointegrating vector is unique, which means that we are bound to end with a model that is a linear combination of independent cointegrating vectors. The other shortcoming of the EG approach is that it relies on a two-step estimator. The first step is to generate the error series and the second step uses these generated errors for estimation, thereby carrying over errors obtained from regression using the residuals (Enders, 1996). Hence, any error introduced in the first step is carried to the second step.

Moreover, it is very sensitive to the choice of left hand side variable. Therefore, it may be invalid if the chosen left hand side variable does not belong to the cointegrating relationship. As a result of the above and other limitation of the EG approach, this study employ the Johansen maximum Likelihood Procedure (1988) since it addresses the above stated weakness of the E-G method and it has more desirable features.

4.4.4.2 Johansen Maximum Likelihood Approach

The Johansen (1990) method is a multivariate autoregressive approach. It enables estimating and testing for the presence of multiple cointegration relationships, in a single step procedure. Moreover, it allows testing restricted version of cointegrating vectors and

the speed of adjustment parameter. The Johansen approach considers a model where we have a vector of variables (Y_t) which are endogenous. In this case, we can generalize the specification of unrestricted vector autoregressive estimation as follows:

Considering K-lags of Y_t ,

$$Y_t = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \dots + \beta_k Y_{t-k} + \mu + \varepsilon_t \quad (4.11)$$

Where Y_t is a $(n \times 1)$ vector of stochastic $I(1)$ variables, β_i ($i=1, \dots, k$) is $(n \times n)$ matrix of parameters, μ is a vector of deterministic component (i.e., a constant and trend), and ε_t is a vector of error term and $t = 1, \dots, T$ (T is the number of observation). This type of unrestricted VAR can be used to estimate dynamic relationship among jointly endogenous variables.

The above model can be reformulated to a vector error correction model (VECM) specified as :

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \dots + \Gamma_{k-1} \Delta Y_{t-k+1} + \Pi Y_{t-k} + \varepsilon_t \quad (4.12)$$

Simplifying equation (4.12) gives

$$\Delta Y_t = \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \Pi Y_{t-1} + \mu + \varepsilon_t \quad (4.13)$$

Where, $\Gamma_i = - \left(\sum_{j=1}^i \beta_j \right)$ containing information of the short run adjustment to change in

Y_t and ($i=1, 2, \dots, k-1$).

$\Pi = \left(\sum_{i=1}^k \beta_i \right) - I_n$ Containing information of the short run adjustment to

change in Y_t

The long run relationship among the variables is captured by the term ΠY_{t-1} . In the Johansen (1988) procedure, determining the rank of Π provides the number of cointegrating vector between the elements in Y . In this connection, there are three cases worth mentioning. First, if the rank of Π is zero, it points that the matrix is null which means that the variables are not cointegrated. In such case the above model is used in first difference, void of long run information. Second, if the rank of Π equals the number of variables in the system (say n), then Π has full rank which implies that the vector process is stationary. Therefore, the VAR can be tested in levels. Finally, if Π has a reduced rank [i.e., $0 < r(\Pi) < n$] it suggests that there exists $r \leq (n-1)$ cointegrating vector where r is the number of cointegrating vectors in the system.

Therefore, the matrix Π equals to $-\alpha\beta'$ where α and β are $n \times r$ matrices, β represents the cointegration parameters with α showing their corresponding feedback or adjustment mechanism to equilibrium (i.e., it shows the speed with which disequilibrium from the long run path is adjusted). In identifying the number of cointegrating vectors, the Johansen procedure provides n eigenvalues denoted by λ (also called characteristics roots) whose magnitude measures the extent of correlation of the cointegration relations with the stationery elements in the model.

In making inferences about the number of cointegrating relations, two statistics known the trace statistic and the maximal eigen value statistic are used.

The trace static is determined using the following formula:

$$\lambda_{trace} = -T \sum_{i=r_0+1}^n \ln(1 - \hat{\lambda}_i) \quad r_0 = 0, 1, 2, \dots, n-1 \quad (4.14)$$

Where T is the number of observation and $\hat{\lambda}_i$ is estimated i^{th} eigenvalue.

The maximal eigen value static is determined using the following formula:

$$\lambda_{max} = -T \ln(1 - \hat{\lambda}_{r_0+1}) \quad r_0 = 0, 1, 2, \dots, n-1 \quad (4.15)$$

The null hypothesis of less than or equal to (r_0) cointegrating vectors against the alternative hypothesis of $(r_0 < r \leq n)$ is tested by trace statistics. The null hypothesis of less than or equal to (r_0) cointegrating vector against the alternative of r_0+1 cointegrating vector is tested by maximal eigenvalue statistic.

Although both trace test and maximal eigenvalue test are actually likelihood ratio tests , they do not have the usual Chi-squared distributions. Instead, the appropriate distributions are multivariate extensions of the Dickey–Fuller distributions (Verbeek, 2004).

Helmut and Pentti (2001) found that there is a difference between the two tests when the sample size is small. They compare trace test statistics with max-eigenvalues statistics by applying the Monte Carlo experiment. The result shows the power of trace tests is superior to that of the maximum eigenvalues tests. Thus, when there is clear contradiction in two tests for cointegration rank, the trace test is much more reliable.

4.4.5 Vector Error Correction Model (VECM): Short Run Model

According to Granger's representation theorem, if there is cointegration there must exist Granger causality in at least one direction and therefore one can reformulate the VAR into a VECM in which error correction terms are included (Brooks, 2002). The VECM framework restricts the long run behavior of the endogenous variables to converge to their co integrating relationships, while allowing for short run adjustment dynamics. Therefore, VECM depicts both the short run and long run behavior of a system.

After identification of the number of co integrating vectors in the model, a Vector Error Correction Model (VECM) can be estimated by specifying the number of co integrating vectors.

This means if there are long run relationships that exist in the model, we can rewrite equation (4.7) to come up with the following VECM specification.

$$\Delta X_t = \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-1} + \alpha (\hat{\beta}'_1 X_{t-1} + \hat{\beta}'_2 X_{t-1} + \dots + \hat{\beta}'_r X_{t-1}) + \phi D_t + \varepsilon_t \quad (4.16)$$

Where, α is error correction parameter and measures the speed of adjustment, β_i are coefficients of the long run relationship in the system and D_t is vector of deterministic variables.

If there is only one cointegrating vector and if the endogenous and exogenous variables are identified in the long run analysis, one can develop the VECM by conditioning on the exogenous variables.

To achieve parsimony in the model, insignificant regressors from the general model are removed. In the process the adequacy of the model must be checked to support the reduction approach.

It should be noted that Granger-causality really represents only a correlation between the current value of one variable and the previous values of others. It doesn't mean that movements of one variable cause movements of another (Brooks, 2002). Moreover, although causality in VAR examines whether the current value of variable X can be explained by the past values of variable Y, it still does not explain the sign of the relationship or how long these effects last. However, further information will be given by impulse responses and variance decomposition analysis.

4.4.6 Impulse Response and Variance Decomposition

Impulse response is a method of assessing the interaction among the variables in the VAR. This method can be used either to assess the dynamic behavior of the VAR or to investigate the policy impact of the variables that constitute the VAR (Alemayehu, Daneil and Ndung'u 2009). The coefficients of VAR models only reveal the direct and ceteris paribus effect without taking in to account the fact that the lagged explanatory variables in each equation are inter linked. That is both with a lag and contemporaneously and therefore do not reflect the full impact of one variable on another.

As a result, the analysis relies to a great extent on impulse response functions to estimate the total short and long run impacts of an increase in one variable on another variable. Fundamentally impulse response demonstrates how one variable, say price level, responds over time to a shock in another variable (exchange rate, interest rate, etc) and compares this response to shocks from other variables.

Impulse response function just traces out time path of the effects of shocks of other variables contained in the VAR model on a particular variable. In other words, this

approach is designed to determine how each variable responds over time to an earlier shock in that variable and to shocks in other variables. (Lutkepohl and Kratzig, 2004)

While impulse response functions trace the effects of a shock to one endogenous variable on to the other variables in the VAR, variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR.

The variance decomposition helps in identifying the degree to which one variable influences the other. According to Brooks (2002), Variance decompositions trace out the proportion of the movements in the dependent variables that are due to their own shocks versus shocks to the other variables. It shows the components of variances of dependent variables clearly.

This study is going to use variance decomposition to break down and ascertain the degree to which change in one policy variable influence target variables in the system and vice versa. Variables in a system will have a forecast error and the error in forecasting can be attributed to the present and past values of the variable in question and the past and present values of all other variables in the system.

So by breaking down this forecast error it is possible to determine the degree to which the variable in question is being influenced by its past and present values and to the other variables in the system (Handa, 2009). The variance decomposition determines how much of the n-step ahead forecast error variance of a given variable is explained by innovations (shocks) to each explanatory variable.

Chapter five:

Estimated Results and Interpretation

5.1 Unit Root Test

Non-stationarity of time series data has often been regarded as a problem in empirical analysis. Sometimes working with non-stationary variables may lead to spurious regression results, from which further inference is meaningless. Hence, the first step in time series econometric analysis is to carry out unit root test on the variables of interest. The test examines whether the data series is stationary or not.

To conduct the test, the conventional Augmented Dickey – Fuller (ADF) test were employed with and without a trend. The null hypothesis in this test is the presence of a unit root against the stationary alternative hypothesis, we check for the stationarity condition of our variables and compares the estimated ADF statistics with the simulated MacKinnon (1991, 1996) critical values, which employ a set of simulations to derive asymptotic results and to simulate critical values for arbitrary sample sizes.

The results of the test for the variables at level and first difference are presented in Table 5.1. As reported in table 5.1 all variables at level are non-stationary at 5% level of significance. However, the series in first differences are stationary as Augmented Dickey-Fuller (ADF) tests indicate that *logM2*, *logDC*, *log R*, *logE*, *logP* and *logRGDP* are integrated of order one.

Table 5.1: Unit Root Tests of the Variables at Level and First difference

Variables	Augmented Dickey Fuller (ADF)			
	With Intercept		With Intercept and trend	
	Level	First difference	Level	First difference
LRGDP	-2.31	-2.98**	-0.04	-4.03**
LM2	8.21	-3.21**	3.42	-3.84**
LDC	4.27	-4.10**	0.69	-5.58**
LR	3.73	-6.74**	-2.7	-7.06**
LE	-1.42	-5.34**	-0.39	-4.61**
LP	2.32	-4.89**	0.40	-5.93**

Note,

** denotes rejection of the null hypothesis at 5% significance level.

The ADF critical value at 5% level is -2.9640 and -3.5629 for Intercept without trend and Intercept with trend regressions, respectively.

The optimal lag length for each of autoregressive process of ADF test is determined by AIC.

5.2 Lag Length Determination

Lag length determination is an important issue in modeling VAR, because choosing wrong lag length has strong implications for subsequent modeling choices. If too few lags are chosen, then systematic variation will show up in the residuals and hence the

autocorrelation may have failed, but the penalty if too many lags are chosen is drastically fewer degrees of freedom that means loss of power.

A lag length of two is generally encouraged especially in employing quarterly data (Reade, 2006). This is for a number of reasons. Firstly in macroeconomic data it is hard to imagine agents using information much further back than two quarters in making decisions. Secondly, as mentioned, adding extra lags is costly in degrees of freedom, so it is at the second lag that it becomes less costly to include an additional variable rather than another lag. Hence, so far the model estimated with lag length of two.

However, there are some tests that we can use to specify the appropriate lag or to compare between models with different lags. One of such tests is the Likelihood ratio test (LR) is given by;

$$-2\ln Q(H_K/H_{K+1}) = T(\ln |\hat{\Omega}_k| - \ln |\hat{\Omega}_{k+1}|) \quad (5.1)$$

where H_k is the null hypothesis that k lags are sufficient and H_{k+1} is the alternative hypothesis that the VAR model needs $k + 1$ lags.

Because the LR test is testing a $p \times p$ matrix to be zero, the test statistic $-2\ln Q$ is asymptotically distributed as χ^2 with p^2 degrees of freedom.

There are also other various test procedures for the determination of the lag length such as, the Akaike, the Schwartz and the Hannan-Quinn information criteria. They are defined by:

$$AIC = \ln |\hat{\Omega}| + (p^2 k) / 2T \quad (5.2)$$

$$SC = \ln |\hat{\Omega}| + (p^2 k) \ln T / T \quad (5.3)$$

$$HQ = \ln |\hat{\Omega}| + (p^2 k) 2 \ln \ln T / T \quad (5.4)$$

All the criteria's are based on the maximal value of the likelihood function with an additional penalizing factor related to the number of estimated parameters. The suggested criteria differ regarding the strength of the penalty associated with the increase in model parameters as a result of adding more lags.

The idea is to calculate the test criteria for different values of k and then choose the value of k that corresponds to the smallest value. When using these criteria for the choice of lag length it is important to remember that they are valid under the assumption of a correctly specified model (Juslius, 2007).

Table 5.2: lag length tests

Progress to date							
Model	T	p		log-likelihood	SC	HQ	AIC
SYS (2)	46	40	OLS	352.75465	-12.008	-13.002	-13.598
SYS (1)	46	70	OLS	464.67409	-14.377	-16.117	-17.160
Tests of model reduction (please ensure models are nested for test validity)							
SYS(1) --> SYS(2): F(30,114)= 9.0265 [0.0000]**							

Where: SC=*Schwarz criterion* HQ=*Hannan-Quinn criterion* AIC=*Akai information criterion*

** indicate level of significance at 5%

Based on the information criteria and likelihood ratio test pc give undertake the lag reduction test. First, we estimate the model with five lags and then we reduce to lag four after eliminating the insignificant lags in the first model in order to check the significance of the additional lag. By repeating this procedure, we continue to reduce the model till the reduced model is rejected by F-test. The result that reported in table 5.2 shows that reducing the model from VAR (2) to VAR (1)-i.e. SYS(1) to SYS (2), is rejected based on the overall F-test at 5% level of significance. That is, modeling with one lag possibly result in losing much information. Consequently, the study chooses lag of two throughout the VAR analysis.

5.3 Cointegration Test

After determining the optimal lag length ,the study proceed to investigate the existence of any long-run relationship between the variables by checking whether the variables are cointegrated; that is, if there exists a linear combination of them that is stationary.

The results of the multivariate cointegration analysis following Johansen and Juselius (1990) are shown in Table 5.3.

Table 5.3: Johansen Cointegration Test

H₀:r =P	Trace Statistics	Eigen Value	P - value
P=0	124.32	0.724	[0.000] **
P≤1	70.98	0.686	[0.138]
P≤2	40.23	0.487	[0.216]
P≤3	23.54	0.304	[0.227]
P≤4	9.387	0.264	[0.337]
P≤5	3.521	0.119	[0.061]

***indicate statistical significance at 5 %*

As reported in table 5.3, the trace statistics adjusted for degrees of freedom confirms that the null hypothesis of at most one co integrating vector is not rejected at 5% significance level. On the basis of the trace statistics it's possible to see that there is only one cointegrating vector since the trace statistic associated with the null hypothesis of $r \leq 1$ is not rejected. Furthermore, the cointegration test reports the eigen value, beta and alpha coefficients.

Table 5.4 and Table 5.5 report the standardize beta and alpha coefficients respectively. The existence of one cointegrating vector suggests that only the first row of β and first column of α matrices are important for further analysis. .

While the first row of table 5.4 shows the long run coefficients on co integrated vector, the first column of table 5.5 shows the speed of adjustments towards the long run steady state equilibrium for all variables. For example, -0.412 , -0.225, -0.097 indicates the speed of adjustment of real GDP , money supply and domestic credit towards the long run

steady state path, respectively. That is, the speed of adjustment of LRGDP, LM2 and LDC adjusts to their long run equilibrium by 41.2, 22.5 and 9.7 percent respectively. However, α coefficient of LR is positive, which indicates the extent to which these variable deviate from its long run steady state path after a certain shock.

Table 5.4: Standardized Beta β Coefficient

LRGDP	LM2	LDC	LR	LE	LP
1.0000	-0.64386	-0.32923	0.03606	1.0426	0.00165
1.1478	1.0000	-0.52958	-1.1344	0.1258	-3.3270
0.020851	-0.13890	1.0000	0.56231	0.3932	-0.3594
-0.43245	1.6275	-0.1868	1.0000	-0.01857	-2.3478
3.1008	-7.2077	-2.4466	12.345	1.0000	4.3423
0.51065	1.5147	2.6739	2.3319	-2.275	1.0000

Table 5.5: Standardized Alpha α Coefficients

LRGDP	-0.4128	-0.078537	-0.10355	-0.10701	-0.072395	-0.004350
LM2	-0.22560	0.032398	0.089880	-0.004414	0.063293	0.13513
LDC	-0.09734	-0.067650	-0.10097	0.12006	-0.094169	0.012099
LR	0.07456	-0.071001	0.068212	-0.020522	-0.063585	0.033108
LE	-0.01434	0.000512	0.013747	0.0010381	-0.000494	-0.007836
LP	-0.01773	-0.013116	-0.00207	0.000294	0.014098	-0.013068

However, since the Johansen procedure only determines the number of stationary vectors that span the cointegration space, and any linear combination of stationary vectors is also stationary vector, the estimated β coefficients are not unique.

Table 5.6: Test of Zero restriction on the Long – run β Parameters

β-Coefficients	LR test of restrictions: Chi²(1)	P Value
LRGDP	6.4386	[0.0112]*
LM2	17.117	[0.0000]**
LDC	7.0703	[0.0078]**
LR	17.355	[0.0000]**
LE	15.789	[0.0001]**
LP	11.712	[0.0006]**

*** and * denotes rejection of the null hypothesis at 1% and 5% significance level respectively*

Consequently, once the cointegration rank is determined and the cointegrating relations are induced based on some theory, it is possible to impose a rank restriction in the cointegration space to obtain a unique relationship (Alemayehu, Daniel & Ndung'u 2009).

This process (test on significance of long run coefficients) imposes zero restriction on each variable and estimate the reduced form cointegrating relationship with the rest non zero variables. Then, it generates a likelihood ratio based test on the validity of the restriction. As the test shows, if the zero restriction on one variable is rejected implying that it is an important variable spanning the co integration space. From table 5.6, the test on the long run coefficients results depict that all explanatory variables for LRGDP were

found to be significant from zero. That is, the result rejects the null hypothesis that the β coefficients are jointly significant at 1% level of significance.

The test results suggest that our cointegrating vector is unique and in terms of the structural long run relationship including money supply, domestic credit, interest rate ,exchange rate and price ,which are significant variables in explaining real output. In other word, the test on the long run coefficients results depict that all explanatory variables for LRGDP were found to be significant from zero.

After identification of the unique vector, to identify the variables that are endogenously determined and conditional on other variables in the VAR, the test for weak exogeneity is conducted. Weak exogeneity necessitates the validity of zero restrictions on the α coefficients corresponding with the variables of interest (Alemayehu, Daniel & Ndung'u 2009). In other way, it requires imposing zero restriction on the first column of α coefficients. The results, using the likelihood ratio test as shown in the Table 5.7 confirm that only the dependant variable rejects the null at 5% while all the explanatory variables did not reject. Therefore, other than real GDP all the explanatory variables showed weak exogeneity property; i.e we can put LRGDP on the left hand side and the others on the right hand side.

Table 5.7: Test of Weak Exogeneity (Test for Zero Restriction on α Coefficients)

α -Coefficients	LR test of restrictions: $\text{Chi}^2(1)$	Probability Value
LRGDP	6.2083	[0.0124]**
LM2	2.7612	[0.1015]
LDC	1.9453	[0.1426]
LR	0.8012	[0.3718]
LE	0.4239	[0.4588]
LP	4.0125	[0.0657]

***denotes rejection of the null hypothesis of weak exogeneity at 5% significance level.*

Now after establishing the weak exogeneity conditions, one can explain the long run equilibrium relationship between variables in the form of the following equation.

$$LRGDP = 1.74 + 0.643LM2^{**} + 0.33LDC^{**} - 0.036LR - 1.04LE^{**} - 0.001LP \quad (5.1)$$

$$t = (3.079) \quad (4.2078) \quad (-0.284) \quad (-6.893) \quad (-0.008)$$

*** denote significance at 5 % levels.*

Vector Normality test: $\text{Chi}^2(12) = 127.57 [0.0000]^$*

Vector hetero test: $\text{Chi}^2(504) = 857.89 [0.1283]$

**denotes rejection at 1% level of significance*

The estimates of the long-run parameters have the theoretically expected and correct signs. While the coefficients of logM2, logDC and logE are found statistically significant at the 5% level, the coefficients of both logR and logP are not significant. The

magnitudes of long-run elasticities range from 0.001 (in regard to LP) to 1.04 (in regard to LE).

The result of the diagnostic test confirms the adequacy of the model. That is, the null of no serial correlation and homoscedasticity are not rejected at any conventional significant level. The null hypothesis of normality, however, is rejected at 1% level of significance. Nonetheless, the Johansen result still holds.

In line with the standard monetary theory, the regression result shows that, both money supply and domestic credit produced significant and positive influence on real gross domestic product. The result implies that money supply and domestic credit variables play major role in transmitting the monetary policy in to the real output sector. The long run elasticity of LRGDP with respect to LM2 is 0.643, implying one percent increase in money supply produces 0.6 percent increment in real output. In addition the result indicates that nominal exchange rate and the average lending rate have negative relationship with real GDP. Depreciation (a decrease on nominal exchange rate) would make the country's exports more attractive to foreigners; it will lead to an increase in net exports which would result in greater aggregate demand leading to rise in output.

However, interest rate has an insignificant effect on output. Probably the reason is due to underdeveloped money and financial market which is a common feature for developing countries economy in general and Ethiopian economy in particular. The results matched with the findings of Jayaraman and Choong (2008) for the case of Fiji.

5.4 The Vector Error Correction Model

While economic theory proposes relatively richer long-run hypothetical relations that can be tested empirically, it is much less so for the short-run. Unlike the long run relationship, the short-run dynamics remains relatively unknown. Hence, identification of the short run structure aims at identifying a parsimonious parameterization rather than testing a well-specified economic hypothesis.

The short-run dynamic model (vector error correction mechanism) includes simultaneous current effects, short-run adjustment effects to lagged changes to the variable and previous equilibrium errors in the system. Identification of the short-run structural equations often requires that the residuals are uncorrelated, or at least not significantly correlated since residual covariance matrix plays an important role in the identification of the short-run structure. When the residuals of a short-run structural model are approximately uncorrelated, it might be possible to label them as estimated shocks. In contrast, if the residuals are correlated it will not be easy to make impulse response analysis since it is not clear which shocks leads to which effect (Reade, 2006).

Therefore, in order to undertake variance decomposition and impulse response analysis we should have to estimate a vector error correction model (VECM).

Furthermore, the VECM procedure can be used to check Granger causality among the variables both in the short run and long run. Thus, it is vital to search for a parsimonious specification by using the variable deletion tests and by deleting the variables with insignificant coefficients to get the final short-run dynamic equations. Since the main interest of the study is to find out impact of monetary policy changes on output and price level, it present the results of the parsimonious VECM equation results in regard to both logRGDP and logPrice.

The existence of stationarity and co integration in the long run equation permits to develop the following error correction model for real output.

The results of parsimonious vector error correction model for log RGDP reported in table 5.8 by employing the Hendry's general to specific model.

The lagged error correction term (ECT₋₁) included in the model to capture the long run dynamics between the cointegrating series is correctly signed (-0.05) and statistically significant. The coefficient of ECT, which measures the speed of adjustment at which RGDP would adjust to changes in M2, domestic credit, interest rate, exchange rate and price before converging to their equilibrium level, has the correct sign, implying that the series is non explosive and that long-run equilibrium is attainable. The estimated coefficient of ECT (-0.051) for RGDP, indicates speed of adjustment to reach the equilibrium following a shock. In other words, about 20.4% of disequilibrium of the current year's shock converges and is eliminated within a year and the economy returns to long-run equilibrium within 5 years. In the short run dynamics equation, monetary aggregate and price has a positive and significant impact which explain that their effect on real output become important after three quarter and one year respectively. The short term effect of price suggests that inflation may increase the volatility of output. Among the short-run determinants of changes in output, first-lagged exchange rate changes exert a strongly significant effect. But in contrast to theory, it has a positive sign. It implies that depreciation of the domestic currency may not contribute positively to output growth of a country in the short run.

Table 5.8 Results of parsimonious vector error correction model for real output (logRGDP)

Variable	Coefficient	t-value
Constant	0.0501	3.21**
DLRGDP_2	0.277	2.26
DLM2	0.043	1.55
DLM2_3	0.479	3.45**
DLDC	0.0366	0.370
DLDC_4	0.0535	1.94
DLR-1	-0.033	-1.38
DLR_2	-0.0769	-2.27
DLE_1	0.316	3.33**
DLE_4	-0.179	-2.01
DLP_4	0.341	2.97**
ECT_1	-0.0512	-2.28
DIAGNOSTIC TESTS		
<i>R² = 0.5206</i>		
<i>DW = 1.88</i>		
<i>F(11,28) = 2.904 [0.009]**</i>		
<i>AR 1-3 test: F(3,25) = 0.094025 [0.9105]</i>		
<i>ARCH 1-3 test: F(3,22) = 0.44880 [0.5080]</i>		
<i>Normality test: Chi²(2) = 4.1178 [0.1276]</i>		
<i>hetero test: F(22,5) = 0.72452 [0.7447]</i>		
<i>RESET test: F(1,27) = 0.21264 [0.6609]</i>		

*** denote significance at 5 % levels.*

In addition, first and second-lagged changes in interest rate have a negative relationship with output growth but its impact is insignificant. Regarding domestic credit, even though it has the expected sign in short run, its impact on the change in output is insignificant. Various diagnostic tests of the model show no problem regarding the regression analysis.

That is, there is no an indication of serial autocorrelation as shown by the Breusch Godfrey LM test for serial correlation.

The white test for heterocedasticity also does not reject the null hypothesis of homocedasticity errors. Furthermore, the ARCH test indicates the absence of autoregressive conditional, hetrocedasticity errors. Similarly, the general test for misspecification as provided by Ramsey's RESET test failed to reject the null hypothesis of no functional misspecification in the estimated equations. And finally, the Jacques Bera test for normality indicates that the null hypothesis of normality distributed error terms is not rejected. The goodness of fit of the above models (R^2) shows that (52%) of the total variation in the dependent variable is explained by the independent variables in the model. In addition, the reported F-statistics rejects the null hypothesis that the coefficients of all explanatory variables except the constant term are jointly zero. Hence, in general, the estimated model is statistically acceptable.

Since the abovementioned long run analysis confirms that the price variable determined endogenously in the system. Hence, one can develop VEC model for price.

Following the general to specific model for the price model, the parsimonious specification for a change in log price is reported in Table 5.9.

The adjustment coefficient in the error correction model of the change in the log of the price level has the hypothesized negative sign and is statistically significant. This theoretically plausible negative sign indicates that inflation adjusts the price level so as to move the variables towards their long-run equilibrium.

The coefficient measures the speed of adjustment suggesting that if the price level is temporarily deviate from its long-run equilibrium level then such deviations are offset by the change in the rate of inflation such that four percent of the total adjustment required is accomplished in each consecutive quarter. The speed of adjustment further indicates that it takes almost six years for the deviation to be fully adjusted.

Regarding the estimated coefficients, all of the short run coefficients of the inflation model have the appropriate signs but they are not significant with the exception of the second lag of the exchange rate and third lag of output. The significant negative effect from the Second lag of the exchange rate indicates that a one-percent depreciation of the birr against the dollar will be followed by increased inflation of 0.36 percent. This point outs the importance of the pass-through effect of exchange rate changes into domestic prices. Moreover, the past price levels have a significant effect on the change in the inflation .

Overall, the regression results in table 5.9 are acceptable, as they pass the diagnostic tests against serial correlation, heteroscedasticity, Constant variance, functional form misspecification (RESET) and non-normal errors.

Table 5.9 Results of parsimonious vector error correction model for Price (logP)

Variable	Coefficient	t-value
Constant	-0.034	-1.30
DLRGDP_3	0.092	2.77**
DLM2_1	0.346	1.43
DLM2_2	0.257	1.64
DLDC_2	0.077	1.77
DLR	-0.027	-0.61
DLE_2	-0.366	-3.02**
DLP	0.573	3.06**
DLP_2	0.189	2.51**
ECT_1	-0.042	-2.90**
DIAGNOSTIC TESTS		
$R^2 = 0.6254$		
$DW = 2.11$		
$F(12,25) 3.478 [0.004]**$		
$AR\ 1-2\ test: F(3,22) = 1.3235 [0.2921]$		
$ARCH\ 1-1\ test: F(3,19) = 1.7813 [0.1849]$		
$Normality\ test: Chi^2(2) = 2.7405 [0.2540]$		
$hetero\ test: F(13,25) = 1.6042 [0.1502]$		
$RESET\ test: F(1,24) = 1.7153 [0.1982]$		

*** denote significance at 5 % levels.*

5.5 Impulse Response and Variance Decomposition Analysis

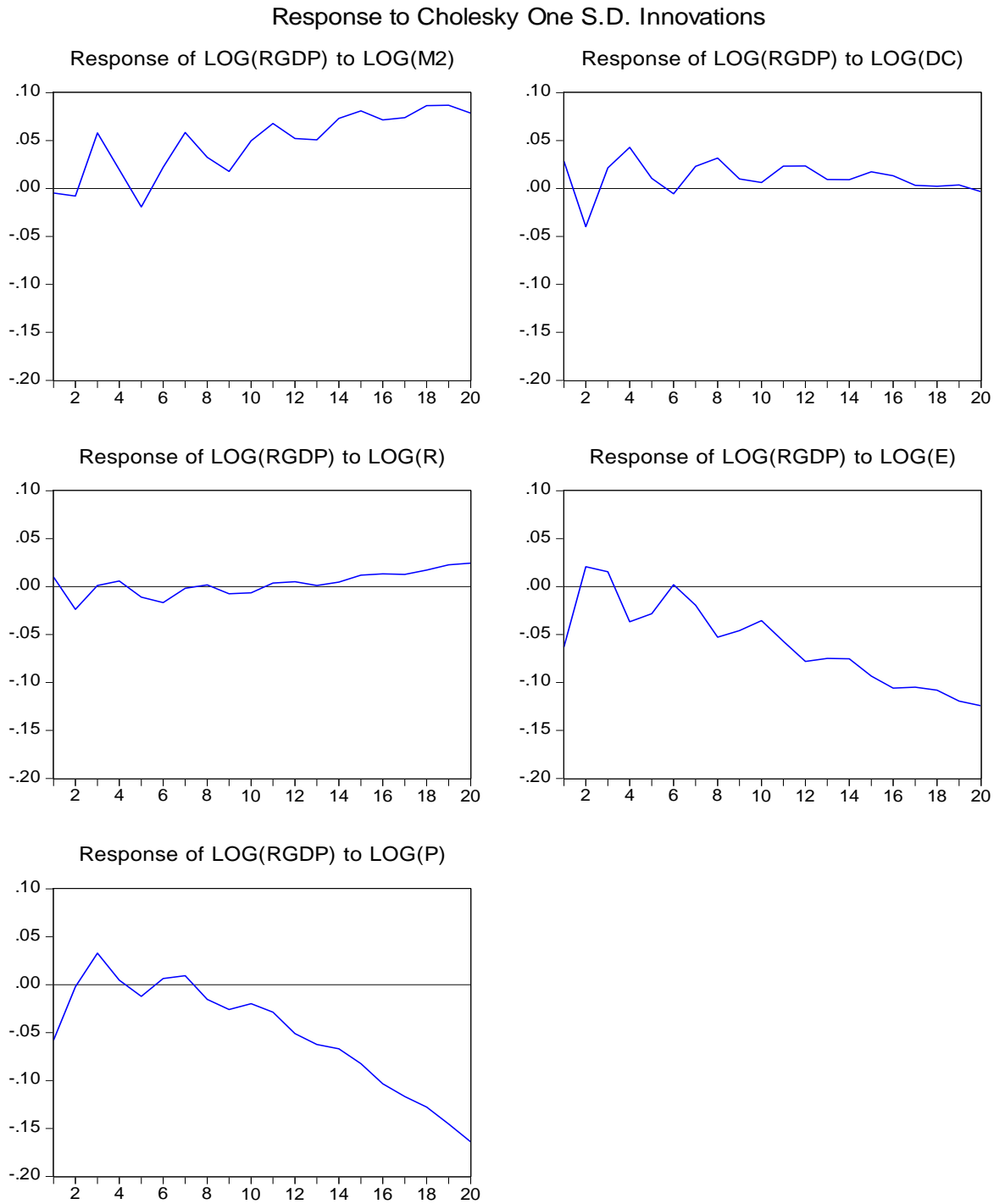
To investigate the impulse response and variance decomposition, the first step is to check the stability of the VAR model. The CUSUM stability test (presented in appendix B) shows that the both output and price models are stable. Hence it is possible to undertake impulse response and variance decomposition analysis.

5.5.1 Impulse Response Analysis

The impulse response analysis is an important method of understanding how policies or shocks affect the variable that the study is interested in. The impulse response function shows the increment to each variable due to one standard error shock of the other variable taking account all interactions between the variables. The impulse responses are eventually expected to converge to a level that is consistent with the estimated long run co-integrating relationship.

Impulse response function, reported for a horizon of five years (Figures 5.1 and 5.2) enables us to trace out the response of output and price to a shock in policy variables. It allows us to see the monetary transmission mechanism unfolding by illustrating the response of the system to a shock in our measure of monetary policy. The shock is represented by one standard deviation of the error term in the underlying structural model for the variable. Since all variables are measured in logs, the impulse response functions trace out a growth rate relative to the base period when the shock occurred (Jayaraman, 2010).

Fig 5.1 Results of Impulse Response Function Analysis (Response of LRGDP)



The horizontal axis in the impulse response graphs shows the passage of time: in this case 20 quarters (5 years) are displayed. In each graph, point estimates of the function are represented by a solid line while the dotted lines indicate a two standard deviation band around the point estimates (see Appendix C). A shock is said to be significant when the lower standard deviation is above the zero line (Jayaraman and Choong, 2010).

The first graph in Figure 5.1 shows the response of output to shock in monetary policy represented by one standard deviation of monetary aggregate. A one-standard deviation shock to the money has a positive effect on the output with some fluctuation and reaches its peak on the 18th quarter. Especially for the first three years the impact has been significant and most of the fluctuations are evident during this period. The shock to credit has positive impact on real GDP. The positive effect takes place only after the third quarter. A shock to domestic credit has an initial negative impact on real GDP but after the third quarter it remains positive and reaches its peak after 1 year where it becomes significant. The fluctuations occur during the first four year after which the response stabilizes around zero.

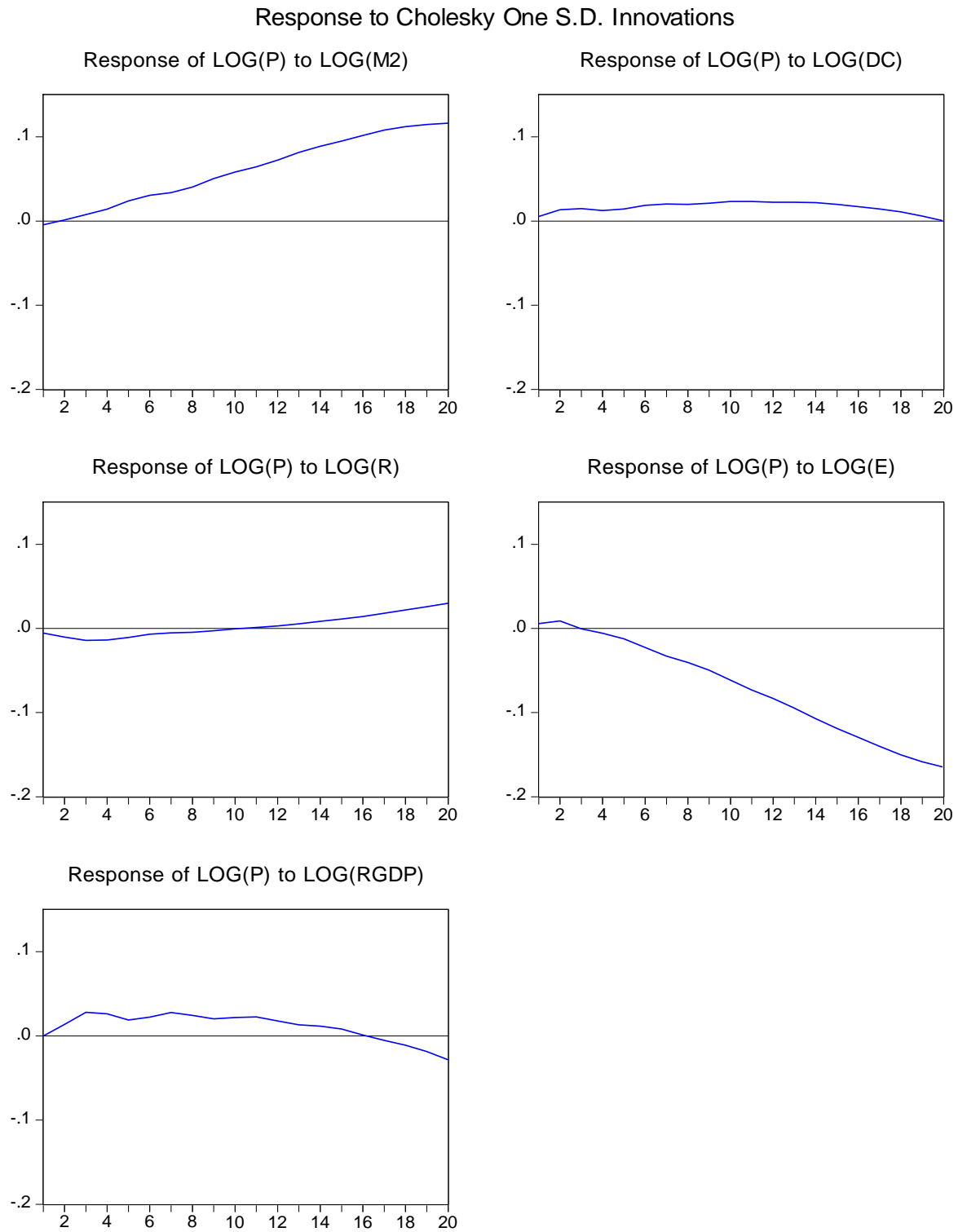
A shock to average lending rate (R) has an initial negative impact on real GDP up to the third quarter then, it die out after a year. For the entire forecasting time the average lending rate has insignificant effect on the real output. This result can explain the underdeveloped financial market exist in developing countries like Ethiopia. A shock to nominal exchange rate (E) also produces negative impact on real GDP entirely with the exception of the second and third quarters. The initial positive effect shows that depreciation in domestic currency against foreign currency may contribute negatively for output growth in short run. Finally, a response of RGDP for a shock in price has negative

effect for most of the period .It is clear from the result of impulse response function that innovations on monetary aggregate and exchange rate, amongst all the policy variables, have the largest impact on output followed by shocks to credit and interest rate.

In regard to price (in Fig 5.2), it is seen that price responds to monetary aggregate (logM2) shock in a positive and steady manner in the short-term, increasing both in the medium and long terms. The effect becomes highly significant after the first one year and remains substantial throughout the 20 quarters or 5 years. This indicates that shocks to monetary aggregate have a relatively long-run impact on prices. Likewise, the impact of a shock to credit on prices remains positive for the entire period. The impact is significant for the first 3 years and in steady manner and stabilizes afterwards. In contrast, a shock to average lending rate (R) has a small and insignificant negative impact on prices in initially, which however, turn to have a positive impact after three year. The response of prices to monetary tightening seems a bit contradictory, but it is not very strange and is described in the literature of Sims (1982) as price puzzle. A possible explanation is the failure to include a rich enough specification of the information available and those variables that contain useful information about future inflation are left out of the information set of central banks while setting up their policy instrument.

A shock to exchange rate (E) on the other hand, produces a positive effect on prices initially. Then, the effect gradually increases negatively and it brings a huge long run impact on price. this result suggest that in short run ,depreciation of birr may have unintended effect of rising the domestic price since Ethiopia ,like other developing countries ,heavily rely on imported goods. The impulse response of price, for a shock in real output, is positive and significant throughout the five year period.

Fig 5.2 Results of Impulse Response Function Analysis (Response of LP)



5.5.2 Variance Decomposition

Variance decomposition represents the proportion of movements in one variable that are due to errors in own shocks and to each other variables in the system. Fundamentally it provides information on how important is each variable in explaining variations in the variable in question in the system. For undertaking variance decomposition analysis, we enter the variables with policy variables first followed by target variables: monetary aggregate (LM2), domestic credit (LDC), interest rate (LR), exchange rate (LE), prices (LP) and real output (LRGDP)

Table 5.10 and Table 5.11 present the variance decomposition for log RGDP and for log P respectively.

Table 5.10: Variance decomposition of output (LRGDP)

Period	S.E.	LOG(M2)	LOG(DC)	LOG(R)	LOG(E)	LOG(P)	LOG(RGDP)
4	0.116903	7.539141	9.229449	1.372840	11.77305	8.784199	61.30132
8	0.172381	12.82752	8.931173	1.550436	13.98172	6.981207	55.72795
12	0.297489	18.69501	7.385061	1.206139	22.04160	9.212625	41.45956
16	0.516158	21.41068	4.554207	0.872269	29.73171	19.53527	23.89586
20	0.814629	19.16703	2.428780	0.927189	31.12468	33.25080	13.10152

Cholesky ordering: LOG(M2)LOG(DC)LOG(R)LOG(E)LOG(P)LOG(RGDP)

The results of Variance decomposition test (Table 5.10) indicate that the exchange rate channel is the most important amongst the four channels both in the short run and long run. Next in importance are monetary aggregates, credit and interest channels.

According to the decomposition test, after one year exchange rate shocks account for around 12 % of the fluctuations in output followed by the shock in credit which account 9% of the variation. Impact of credit shocks is dampened and they account for 3% fluctuation in output after five year, while the shock in broad money rose and account for 19% fluctuations in output after five year, with own shocks of output accounting for only 13% by reducing its more than 50 % share in the first two years.

Moreover, the test result indicates that price has a significant explanatory power of predicting the movement in real output, it accounts almost 33 % of the variation after 5 year. The interest rate channel's role amongst all the channels is the least important, as it accounted for less than two percent of output variability throughout the time horizon.

Table 5.11: Variance decomposition of output (LP)

Period	S.E.	LOG(M2)	LOG(DC)	LOG(R)	LOG(E)	LOG(P)	LOG(RGDP)
4	0.116903	2.879805	5.974931	5.344457	1.518973	67.37140	16.91044
8	0.172381	20.01546	8.513890	3.231028	15.51952	35.67085	17.04926
12	0.297489	31.09132	6.190593	1.176987	34.51633	18.27204	8.752728
16	0.516158	28.89085	3.012581	0.638831	39.45870	24.79220	3.206836
20	0.814629	22.90008	1.305149	0.777789	36.74425	36.68006	1.592666

Cholesky ordering: LOG(M2)LOG(DC)LOG(R)LOG(E)LOG(P)LOG(RGDP)

Regarding the variance decomposition of log price, the result reveals that exchange rate channel is the dominant one amongst all the channels throughout the five year period. The effect of Exchange rate on price is relatively small within first two years-ahead of the forecast horizon. For example, exchange rate explains only less than 2 percent of variability in output growth for the first year-ahead of the forecast period. However, the effect accumulates over time. By 5 years ahead, exchange rate accounts for about 37 percent of the variability in output growth.

Similarly, Shocks in monetary aggregate after one year account only for 2.8 percent of variability in prices. However, its importance grows over the medium term to 31 percent within three years period and diminished again after five year to 22%.

Innovations in credit are equally important over the time horizon. Initially, shocks in domestic credit account for 1.9 percent of variability in prices. However, over the medium term, the influence of exchange rate increases to reach about 8 percent and thereafter remains steady in the long run. In addition, Variance decomposition of price level shows that interest rate shocks have no significant impact on price level though they account 5% of price variability one year ahead. After five year they account for only 1% fluctuations in prices while the impact of shock in price to its own future values is around 22 percent(see Appendix D to observe VDC of all variables)

Table 5.12 Correlation Matrix for the Reduced Form VAR residuals

	LOG(M2)	LOG(DC)	LOG(R)	LOG(E)	LOG(P)	LOG(RGDP)
LOG(M2)	1.000000	0.269571	-0.280019	-0.083443	-0.116344	-0.027513
LOG(DC)		1.000000	0.070303	-0.011565	0.104153	0.154800
LOG(R)			1.000000	-0.471826	-0.084608	0.089484
LOG(E)				1.000000	0.218253	-0.343074
LOG(P)					1.000000	-0.368633
LOG(RGDP)						1.000000

With view to testing the robustness of the VAR results which vary, based on different orderings of the variables, the study resorted to testing the correlation of reduced-form VAR residuals. Table 5.12 shows the correlation matrix of the reduced-form VAR residuals based on the ordering employed in the study. The elements of the correlation matrix between the policy variable and the rest of the system are very low, which indicates that contemporaneous feedback is not a problem. Hence, these correlations suggest that the ordering of the variables in Choleski decomposition is not a major concern.

Chapter Six:

Conclusion and Policy Implications

6.1 Conclusion

Since 1992 economic reform through implementation of various reforms in public finances and fiscal adjustment measures, Ethiopia has emerged in recent years to be good economic performer in East Africa. Although there is a growing body of literature on Ethiopia dealing with its fiscal performance, there have been only few studies on monetary policy and its transmission to the real sector in Ethiopia. This paper is an attempt to fill the gap. Accordingly, this paper undertook an empirical investigation of monetary policy transmission mechanism in Ethiopia. The study, which used quarterly data, covered a period of 12 years (1998-2010) and adopted a VAR approach. The study employed six variables, four of them were policy variables namely, monetary aggregate represented by Broad money supply, domestic credit, nominal exchange rate, and interest rate represented by average lending rate; and the rest two(output and price) were monetary goal variables.

Results from the cointegration analysis reveal a long-run relationship between the price level, output, the exchange rate, money supply, the interest rate and credit. In the only one co integrating vector with output as dependent variable, three of the four monetary policy variables were found to be statistically significant in the long-term relationship. Monetary aggregate, credit and exchange rate are found to be significant in influencing real output while interest rate was not significant.

Since the variables were cointegrated, a vector error correction model was constructed to examine the short-run relationships. The vector error correction model shows that it takes a relatively long time for changes in output and change in the rate of inflation to return to

their respective level of long-run equilibrium after a disequilibrating shock.

The results of short run model for output revealed that domestic credit and exchange rate have a positive and significant effect on output growth. Unlike the negative long run effect, the short run positive impact of exchange rate suggests that the devaluation strategy in Ethiopia would not be effective in stimulating economic growth in the short run. Since most of the developing countries in general and Ethiopia in particular are net importers of capital goods depreciation may hinder private investment by raising the domestic price of private investment, this in turn leads to a contraction in domestic output.

In line with the long run model, Money supplies and domestic credit have a positive and significant influence on output growth while the impact of interest rate is insignificant. In contrast, there is no significant effect on current inflation from past changes in the interest rate, domestic credit and money supply while the significant effect from the third lag of the exchange rate indicates that a given depreciation of the birr against the foreign currency will be followed by increased inflation. This indicates the importance of the pass-through effect of exchange rate changes into domestic prices.

Although the long run and short run analysis explain the relationship between monetary policy variables and goal variables, the relative impact of change in monetary variables on real sector is better assessed by variance decomposition and impulse response analyses. Both results of the IRF and VDC analysis indicates that in Ethiopia, the money supply and exchange rate channels are strong channels than the credit and interest rate channels in transmitting monetary impulses to the real sector. This is also consistent with evidence that the interest rate in Ethiopia has not been driven solely by market forces and

has not been an effective monetary policy instrument.

These findings are similar to the findings arrived at by various studies (Jayraman and Choong, 2010; Cheng, 2006; Vizek, 2006) on developing economies where money and capital markets are at nascent stages of development that the interest rate and credit channel has been found to be less effective.

6.2 Policy Implication

The empirical findings of the study have essential implications with respect to the operation of monetary policy. Specifically, identifying the distinct active channels of monetary transmission in the economy would steer the monetary authority in formulating and conducting monetary policy in accordance with its objectives under the current regime, i.e., managed float exchange rate and market based monetary policy instruments.

Despite the managed floating exchange rate regime (NBE, 2009) or crawling peg regime (IMF, 2012) adopted in Ethiopia, exchange rate policy can still play a useful role in macroeconomic adjustment. Thus, the monetary authorities need to focus on adjusting exchange rate in order to preserve external competitiveness which in turn leads to macroeconomic stability of the country.

Since money and capital markets are still at rudimentary stages with very few securities and given the lack of short-term money markets, interest rate policies are almost unused in the conduct of monetary policy in Ethiopia. It is, therefore, recommended that monetary authorities target monetary aggregate as a policy variable for effective monetary policy implementation. In addition, Monetary authorities should be put much effort to move towards more market based monetary and financial sector policies.

In general, continued efforts to develop domestic financial markets should be the main focus in strengthening monetary policy transmission in Ethiopia since a developed financial market would build up monetary policy transmission not only through interest rate and credit channels, but also other channels that does not exist at present—such as those through asset prices and balance sheets that are effective only in deep and sophisticated financial markets.

At last, a number of caveats need to be taken in account while interpreting the results. First, the short sample period of the data rule out any strong statements about long-run relationships between variables. Therefore, the findings may only pertain to idiosyncratic economic developments during the sample period, while not necessarily serving as a best guide as to how the Ethiopian economy would work in the future. Second, poor output data quality. Since the study use the quarterly estimates of annual GDP obtained through interpolating annual GDP data, inferences based on such quarterly estimates of GDP may not likely to be robust enough for policy making purposes (Jayaraman and Choong, 2008).

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APPENDICES

APPENDIX A: DIAGNOSTIC TESTS

LM2	: AR 1-4 test:	$F(4,26)$	=	1.2047	[0.3326]
LDC	: AR 1-4 test:	$F(4,26)$	=	1.3511	[0.2779]
LR	: AR 1-4 test:	$F(4,26)$	=	0.99940	[0.4257]
LE	: AR 1-4 test:	$F(4,26)$	=	0.16215	[0.9556]
LCPI	: AR 1-4 test:	$F(4,26)$	=	0.98405	[0.4335]
LGDP	: AR 1-4 test:	$F(4,26)$	=	2.3818	[0.0775]
LM2	: Normality test:	$\text{Chi}^2(2)$	=	2.0182	[0.3646]
LDC	: Normality test:	$\text{Chi}^2(2)$	=	2.1702	[0.3379]
LR	: Normality test:	$\text{Chi}^2(2)$	=	11.419	[0.0033]**
LE	: Normality test:	$\text{Chi}^2(2)$	=	1.0364	[0.5956]
LCPI	: Normality test:	$\text{Chi}^2(2)$	=	4.1685	[0.1244]
LGDP	: Normality test:	$\text{Chi}^2(2)$	=	0.56059	[0.7556]
LM2	: ARCH 1-4 test:	$F(4,22)$	=	1.0261	[0.4158]
LDC	: ARCH 1-4 test:	$F(4,22)$	=	0.22020	[0.9243]
LR	: ARCH 1-4 test:	$F(4,22)$	=	0.61674	[0.6552]
LE	: ARCH 1-4 test:	$F(4,22)$	=	0.23971	[0.9128]
LCPI	: ARCH 1-4 test:	$F(4,22)$	=	1.6999	[0.1859]
LGDP	: ARCH 1-4 test:	$F(4,22)$	=	1.6368	[0.2006]
LM2	: hetero test:	$F(24,5)$	=	0.47078	[0.9028]
LDC	: hetero test:	$F(24,5)$	=	0.34314	[0.9659]
LR	: hetero test:	$F(24,5)$	=	0.64441	[0.7884]
LE	: hetero test:	$F(24,5)$	=	1.1001	[0.5083]
LCPI	: hetero test:	$F(24,5)$	=	1.0465	[0.5359]
LGDP	: hetero test:	$F(24,5)$	=	0.42844	[0.9268]
<u>Diagnostic Tests</u>					
Vector AR 1-4 test: $F(144,13)=$ 1.4018 [0.2521]					
Vector Normality test: $\text{Chi}^2(12)=$ 22.937 [0.0283]*					
Vector hetero test: $\text{Chi}^2(504)=$ 555.51 [0.0558]					
Not enough observations for hetero-X test					

APPENDIX B: VAR STABILITY TEST

Fig. 1: CUSUM stability test for LR GDP model

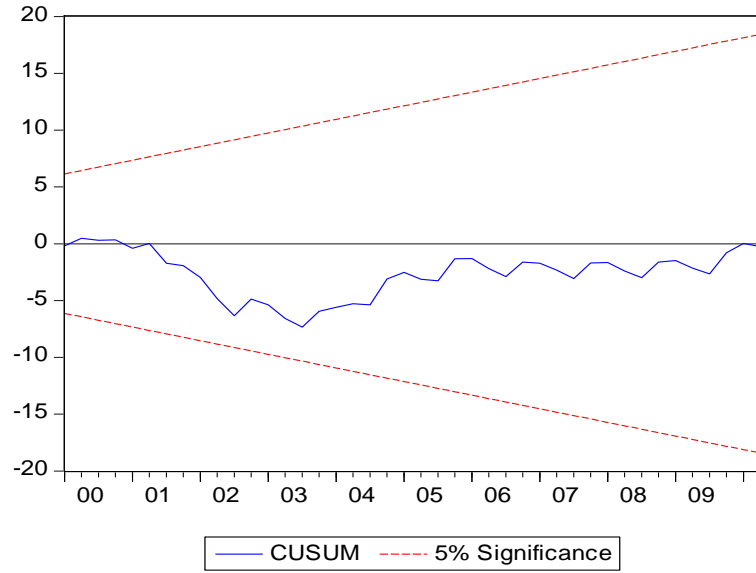
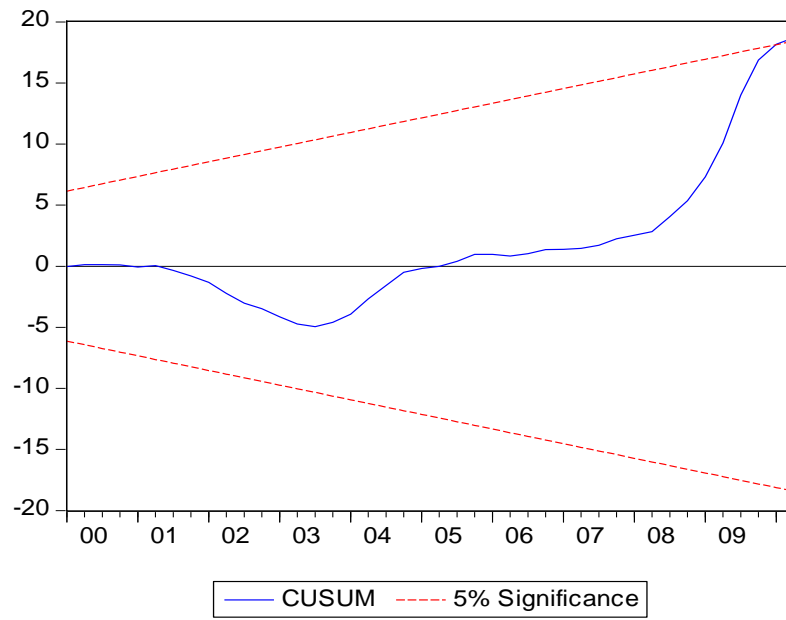


Fig. 2: CUSUM stability test for LP model



**APPENDIX C: GRAPHICAL REPRESENTATION OF IMPULSE
RESPONSE FUNCTIONS**

Fig.1: Results of Impulse Response Function Analysis for Ethiopia (response of LRGDP)

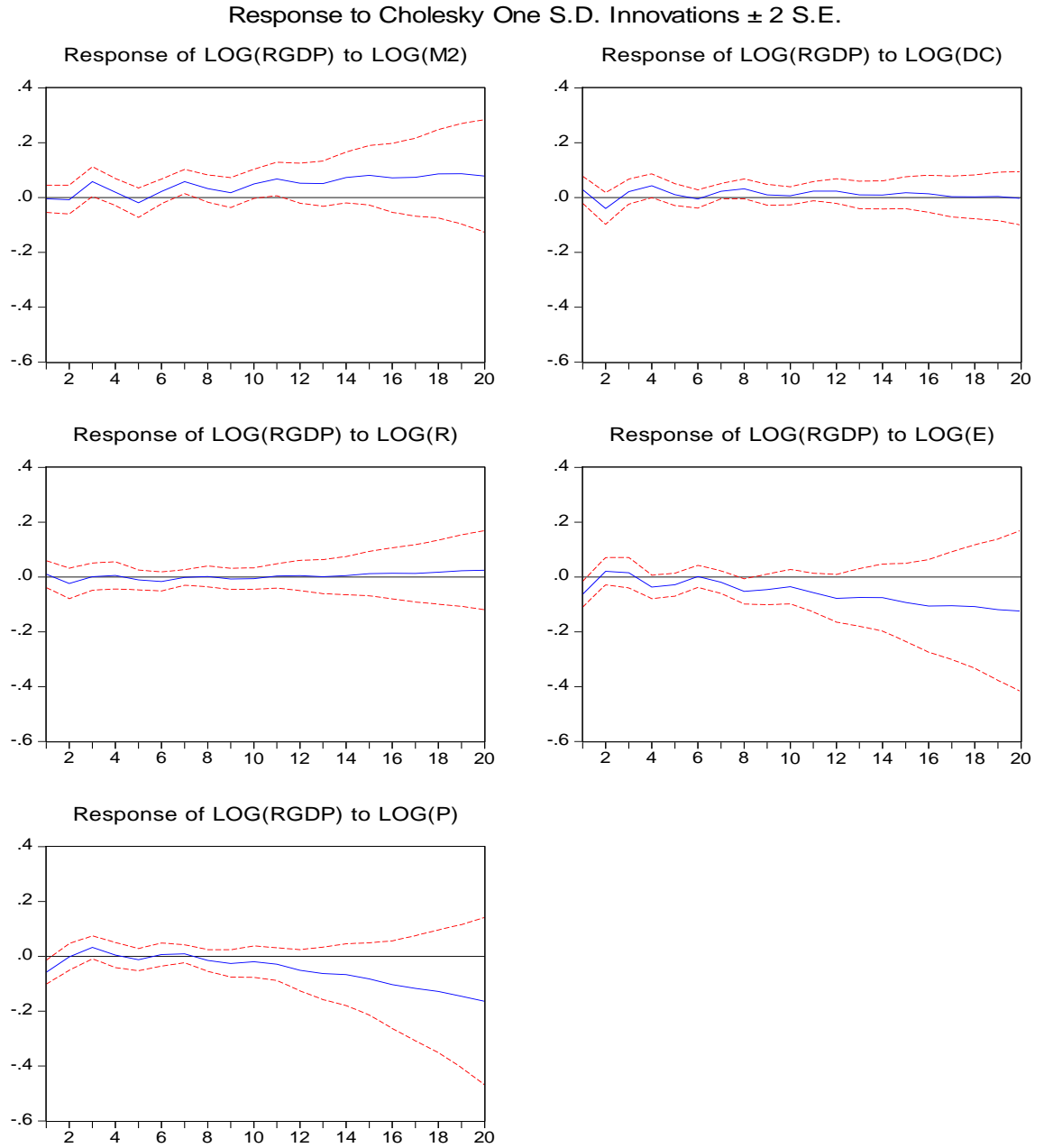


Fig.2: Results of Impulse Response Function Analysis for Ethiopia (response of LP)

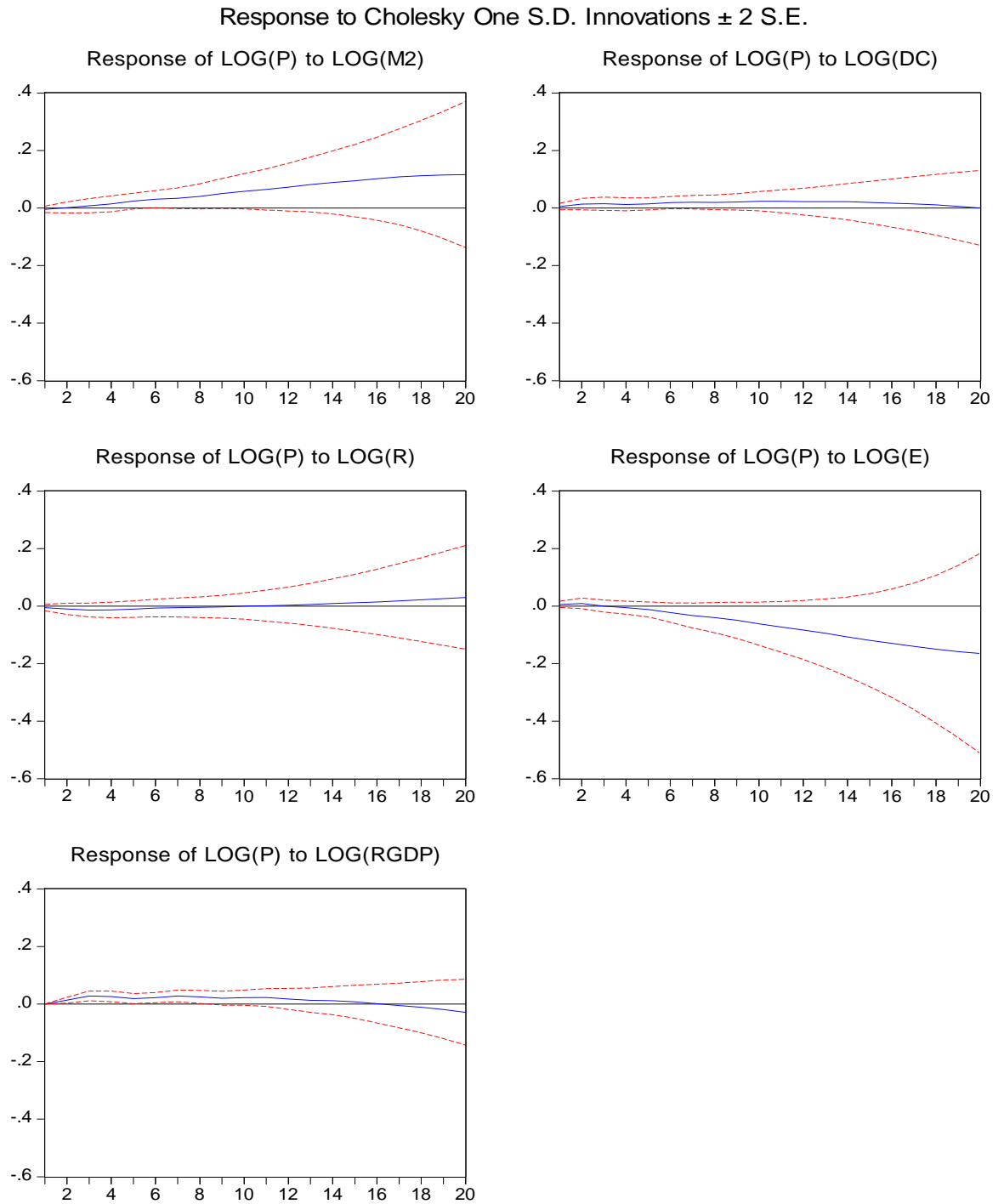


Fig.3: Results of Impulse Response Function Analysis for Ethiopia (response of LM2)

Response to Cholesky One S.D. Innovations

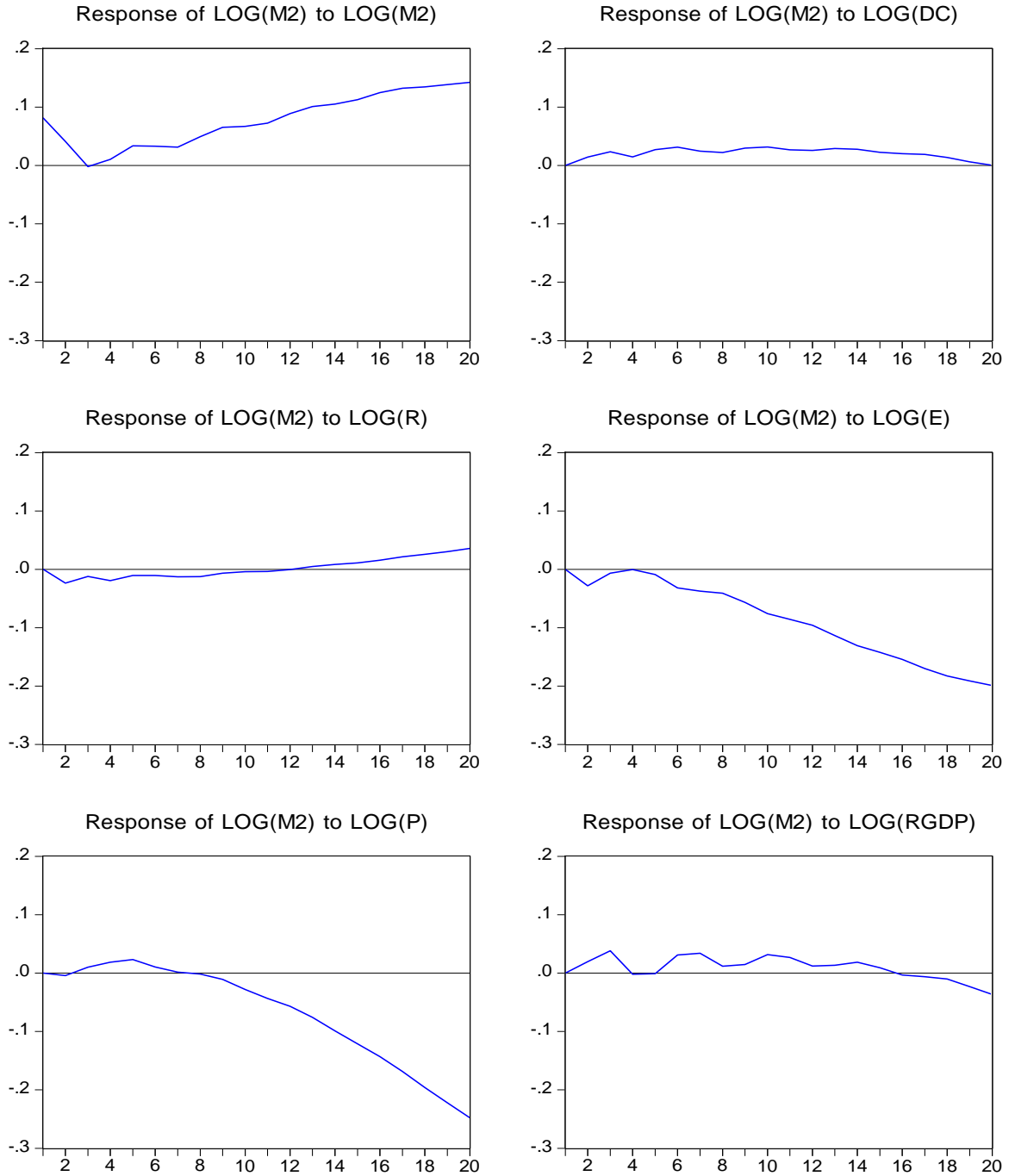


Fig.4: Results of Impulse Response Function Analysis for Ethiopia (response of LDC)

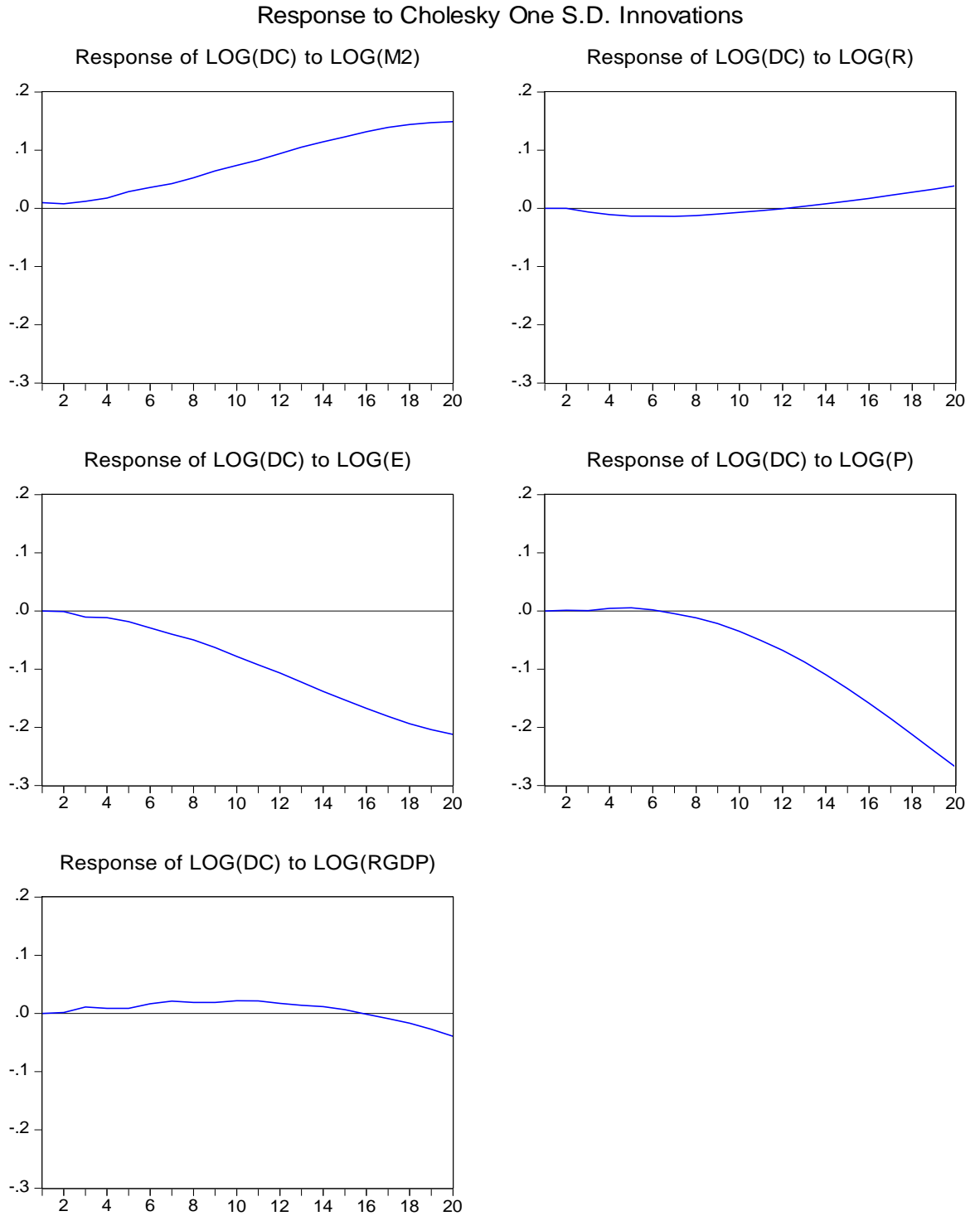


Fig.5: Results of Impulse Response Function Analysis for Ethiopia (response of LR)

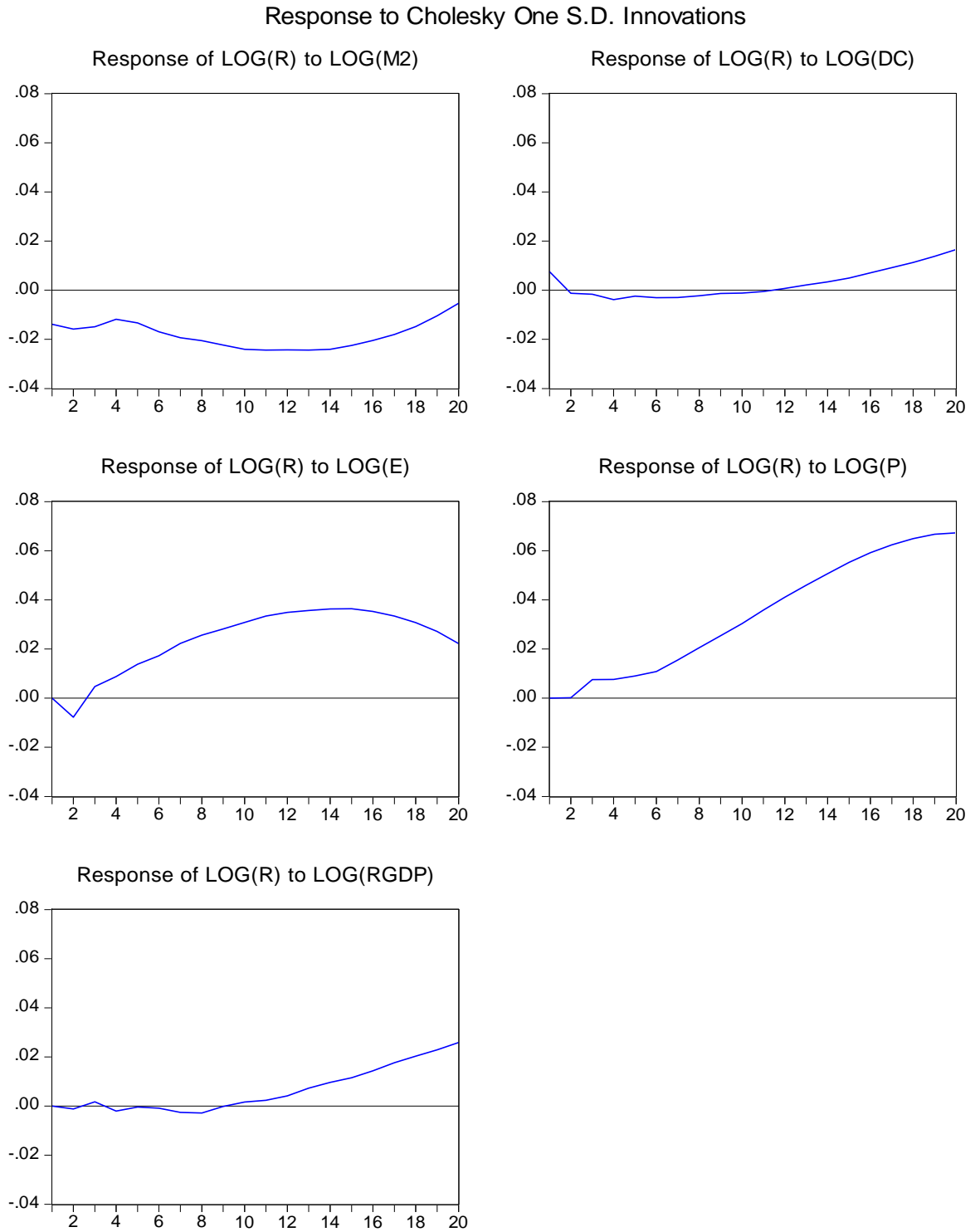
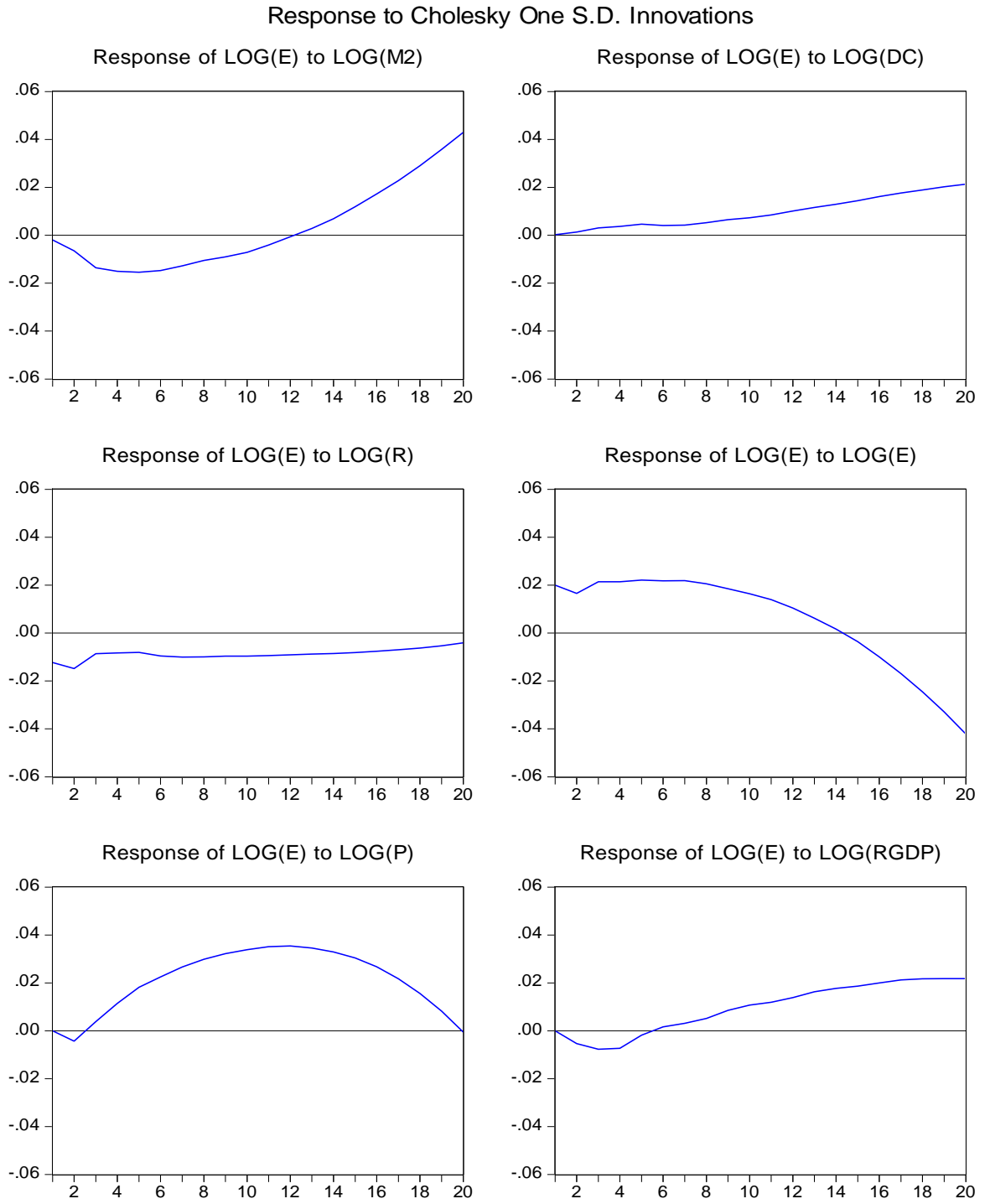


Fig.6: Results of Impulse Response Function Analysis for Ethiopia (response of LE)



APPENDIX D: VARIANCE DECOMPOSITION OF VARIABLES

Table 1: Variance decomposition of output (LM2)

Period	S.E.	LOG(M2)	LOG(DC)	LOG(R)	LOG(E)	LOG(P)	LOG(RGDP)
1	0.081635	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.101504	81.00355	1.979834	5.385896	7.673722	0.181606	3.775387
3	0.112354	66.14645	5.977477	5.580437	6.618696	0.955792	14.72115
4	0.116903	61.88781	7.067023	7.935398	6.115231	3.366832	13.62770
5	0.127478	58.93909	10.48658	7.369084	5.629031	6.111214	11.46500
6	0.143196	51.97576	13.11613	6.388178	9.427195	5.364110	13.72863
7	0.157560	46.90657	13.25767	5.934058	13.44441	4.440736	16.01655
8	0.172381	47.36889	12.70879	5.492520	16.86165	3.719342	13.84881
9	0.196082	47.65182	12.11630	4.366656	21.42374	3.171870	11.26962
10	0.226915	44.30848	10.99563	3.292775	27.16338	3.887252	10.35248

Cholesky ordering: LOG(M2)LOG(DC)LOG(R)LOG(E)LOG(P)LOG(RGDP)

Table 2 : Variance decomposition of output (LDC)

Period	S.E.	LOG(M2)	LOG(DC)	LOG(R)	LOG(E)	LOG(P)	LOG(RGDP)
1	0.081635	7.266878	92.73312	0.000000	0.000000	0.000000	0.000000
2	0.101504	6.858245	92.92623	0.000669	0.070371	0.054588	0.089893
3	0.112354	8.320890	84.06756	1.039683	3.119279	0.039955	3.412630
4	0.116903	12.31216	75.10404	3.114582	4.961780	0.440897	4.066538
5	0.127478	19.85119	62.68275	4.657371	8.188489	0.717043	3.903150
6	0.143196	25.41675	50.57000	4.832352	13.43003	0.513940	5.236928
7	0.157560	28.94084	40.23951	4.516280	19.36725	0.490173	6.445952
8	0.172381	32.56556	31.86560	3.858799	24.63819	0.958745	6.113098
9	0.196082	35.31832	24.94004	2.978127	29.34066	2.099668	5.323187
10	0.226915	36.13774	19.42072	2.168644	33.45299	4.094013	4.725896

Cholesky ordering: LOG(M2)LOG(DC)LOG(R)LOG(E)LOG(P)LOG(RGDP)

Table 3: Variance decomposition of output (LR)

Period	S.E.	LOG(M2)	LOG(DC)	LOG(R)	LOG(E)	LOG(P)	LOG(RGDP)
1	0.081635	7.841087	2.291985	89.86693	0.000000	0.000000	0.000000
2	0.101504	11.11984	1.451874	85.88084	1.508982	0.000795	0.037666
3	0.112354	13.34227	1.217508	82.54788	1.658745	1.145342	0.088249
4	0.116903	14.72298	1.381634	78.68716	2.934192	2.114214	0.159823
5	0.127478	16.34524	1.355939	73.01431	5.853451	3.282611	0.148440
6	0.143196	18.82342	1.348512	65.38731	9.626633	4.670067	0.144051
7	0.157560	20.85836	1.264973	56.05119	14.55320	7.062974	0.209301
8	0.172381	21.98052	1.115406	47.01417	19.20045	10.42703	0.262425
9	0.196082	22.62297	0.939870	38.97333	22.91230	14.33378	0.217754
10	0.226915	22.77027	0.781247	32.11651	25.69237	18.44169	0.197924

Cholesky ordering: LOG(M2)LOG(DC)LOG(R)LOG(E)LOG(P)LOG(RGDP)

Table 4: Variance decomposition of output (LE)

Period	S.E.	LOG(M2)	LOG(DC)	LOG(R)	LOG(E)	LOG(P)	LOG(RGDP)
1	0.081635	0.696266	0.012879	27.47606	71.81480	0.000000	0.000000
2	0.101504	4.088174	0.170957	32.65528	58.90480	1.677894	2.502888
3	0.112354	11.84064	0.583082	23.05868	58.22411	1.729459	4.564034
4	0.116903	15.76906	0.860545	17.84750	54.91957	5.690360	4.912960
5	0.127478	17.19242	1.149959	14.38198	51.46181	12.21444	3.599383
6	0.143196	17.04332	1.178529	12.58618	47.75138	18.67107	2.769516
7	0.157560	15.73186	1.186687	11.32534	44.42071	25.02777	2.307636
8	0.172381	14.09906	1.291563	10.38571	41.09186	30.94529	2.186521
9	0.196082	12.57756	1.493963	9.597044	37.69104	36.09995	2.540445
10	0.226915	11.17084	1.727850	8.977566	34.45610	40.53333	3.134321

Cholesky ordering: LOG(M2)LOG(DC)LOG(R)LOG(E)LOG(P)LOG(RGDP)

Declaration

I, the undersigned, declare that this thesis is my own work and that all sources of materials used for the thesis have been duly acknowledged.

Nuru Hussien Mohammed

Signature