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IMPACTS OF MONETARY POLICY SHOCKS ON THE ETTHIOPIAN ECONOMY:

By:

Temesgen Benti

June, 2014

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A Thesis Submitted to School of Graduate Studies in Partial Fulfillment of the Requirements for the Degree of Masters of Science in Economics
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DECLARATION

I, the undersigned, declare that this thesis is my original work and has never been presented for a degree in any other university and that all sources of materials used for this thesis have been duly acknowledged. The advisors and examiners' comments have been duly taken in to account.

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ACRONYMS

ADF	Augmented Dicky Fuller
AIC	Akaike Information Criteria
CPI	Consumer Price Index
CSA	Central Statistics Authority
DF	Dicky Fuller
DR	Discount Rate
ECM	Error Correction Model
FEVD	Forecast Error Variance Decomposition
GDP	Gross Domestic Product
GDPD	Gross Domestic Product Deflator
GNP	Gross National Product
HIC	Hannan-Quinn Information Criteria
IMF	International Monetary Fund
Ir	Interest Rate
LDCs	Least Developed Countries
MoFED	Minstry of Finance and Economic Development
NBE	National Bank of Ethiopia
OECD	Organization for Economic Cooperation and Development
OMO	Open Market Operation
PP	Philips Perron
RR	Reserve Requirement
VAR	Vector Autoregressive
VECM	Vector Error Correction Model

Abstract

This thesis analyses the impacts of monetary policy shocks on Ethiopian macro economy, and the channels through which these shocks will be transmitted to the overall economy using annual data running from 1981/82-2011/12.In order to achieve this objective; unit roots (ADF and PP), cointegration (Johansen procedure), Vector Autoregressive (VAR), Error correction model and Granger Causality (Wald Coefficient restriction test, X2 and F-statistics) are carried out. The results of the unit root tests show that the series of interest are stationary in first differences. Cointegretion and causality between the variables are tested and compared using tri-variate vector Autoregressive model (VAR). The results of co-integration tests on the tri-variate models show that two Granger-causality alternative models (VAR in first difference and Error Correction Models) fit for this study. In both types of models, Granger-causality (unidirectional or bidirectional causations) between monetary policy instrument on one side and price and economic growth on the other side are tested using Chi – square and F – statistics from Wald coefficient restriction test. The results of cointegration test shows that there is a long run equilibrium relation between the variables. The error correction model and the Wald Granger causality indicates the existence of short run bidirectional causality between money supply and price level, and unidirectional causation running from output to price level that shows that price level is a monetary phenomenon in the short run. Based on the short run causation results, all the foregoing discussion leads to put exchange rate as an important channel of monetary policy instrument to be considered as a supplementary, through which shocks in monetary policy transmits to the real economy.

CHAPTER ONE:

INTRODUCTION

1.1 Background of the Study

One of the most celebrated hypothesis in economics is the impacts of monetary shocks on real output concomitant by change in price level equivalent to monetary shocks. A general agreement among economists regarding co- movement of money, output and inflation is attributed to the work of Milton Friedman (1994). According to the Monetarists, an increase in money supply first will lead to increase in output, that dies out soon and will result in higher prices that live long i.e. monetary shocks will have short-run output effect, but long-run inflationary effect.

Ample of both theoretical and empirical research have emerged to support this consensus. Walsh (2003) demonstrates that in the short-run exogenous monetary policy shocks produce hump-shaped movements in real economic activity. The peak effects occur after a lag of several quarters (as much as two or three years in some of the estimates) and then die out, Chow and Yan (2004). Blanchard and Fischer (1989) also show that nominal interest rate innovations are positively correlated with current and lagged GNP innovations but negatively correlated with GNP two to five quarters later. Friedman and Schwartz (1963) argued that money leads output movements could be reinterpreted as output innovations lead to changes in money growth, as monetary authorities react to the state of the economy. This is a demonstration of the. Boschen and Mills (1995) display that for the United States, permanent monetary shocks do not contribute to permanent shifts in real output. McCandless and Weber (1995) reveal that in the long run there exist: high correlation between the rate of growth of the money supply and the rate of inflation, blurred evidence of relation between the growth rates of money and real output; no correlation for some countries and positive correlation in a subsample of countries in the Organization for Economic Cooperation and Development (OECD), and there is no correlation between inflation and real output growth. The quantity-theoretic argument that the growth of money supply leads to an equal rise in the price level is supported by Walsh (2003). King (2002) shows that the strong correlation between monetary shocks and price level appears as the time horizon lengthens, which indicates that the effects of money growth should emerge in the changes in real variables first followed by changes in prices later on.

Romer (2006) also confirms this view: "when it comes to understanding inflation over the longer term, economists typically emphasize just one factor: growth of the money supply" (p.497). From monetary facts explained above, the fact that monetary policy could only affect the nominal variables in the long run, does not rule out the fact it could also have real effects in the short-run. And the long run effect of money on inflation suggests that long-run inflation can be adjusted by adjusting the growth rate of money (Romer, 2006).

1.2 Statement of the problems

Ethiopian economy has been growing at a robust pace over the last nine years. In its 2012 report, International Monetary Fund (IMF) reveals that poverty is falling as well. However, there is growing concern that, high rate of inflation if sustained for any period of time length could be contractionary. When a country's inflation rate remains extremely high for any sustained period of time, the growth of money supply is extremely high as well, Mishkin (1992) and Visokavičienė(2010). Such a tendency may cause hyperinflation, if the central bank fails to take timely actions to stop it by regulating the money stock in circulation (Visokavičienė, 2010). From the perspective of quantity theory of money, if money supply increases faster than does the domestic real output, it will turnout in equal increase of prices and a depreciation of the domestic currency. This law of inflation was developed by Irving Fisher (Fisher, 1911) and later by Victoria Chick (Chick, 1973).
This scenario seems to be evidenced in the Ethiopian economy as well. IMF projected economic growth rate of 7% and inflation rate of about 22% for the year 2011/12. Which means price level (money stock) grows about three times faster than real sector's growth.

High Inflation is problematic all over the world and its impacts on the economy are such which urges the policy makers to contour it (Mohammed, 2012). High and persistent inflation is a regressive tax and adversely impacts the poor and economic development as it erodes the savings of poor (Fisher and Modigliani, 1978). Although economists dissent on the impacts of inflation on economic growth, there are emerging consensuses that high and persistent inflation is detrimental to growth. Moderate or low inflation may be desirable but when it crosses the limit it becomes equally undesirable; inflation of more than 8% has high negative impacts on growth, below that level inflation instead has some positive effects on growth (Sarel, 1995).

In Ethiopia inflation has crossed the desired level and hence there is a need to take appropriate action to contain it within the limits. This will impel to a policy dilemma of sustaining economic growth and stabilizing economy which could be hard to achieve both at the same time. Any remedial measure without the understanding of the reasons might not be appropriate as Burton and Fisher (1997) states; "inflation does not happen out of a clear blue sky. It is serving some political economy purpose in each country where it continues. In seeking to end inflation, it is useful to try to understand what purpose its continuation serves in each particular case."
Besides, if real sector and inflation are hypothesized as monetary phenomena for Ethiopia's case; though from different perspectives, it will be a compelling fact that this study should investigate the channels through which monetary shocks impact the real sector and prices. Identification of such channels will have paramount importance to appreciate the relevancy of the predictions of different theories involving monetary theories. The most known main channels through which monetary policy affects many economies are the interest rate channel, asset price channel, credit channel and exchange rate channel.

1.3 Objectives of the study

The main objective of this study is to investigate the impacts of monetary policy on major macroeconomic variables as GDP and price level of Ethiopia over the period covering 1981/82-2011/12. The specific objectives are:

- To investigate whether economic growth and inflation are impacted by monetary policy shocks in Ethiopia through transmission channels.
- To identify those different channels through which monetary policy shocks affect the Ethiopia's economy.

1.4 Significance of the Study

This study will help to know the country specific impact of monetary policy shocks on different real macroeconomic variables by using time series approach specifically of the country.

Moreover, it will contribute to the existing literature by extending the works of others. Furthermore, the results of study could help the concerned policy makers with suggesting the appropriate ways of intervention, appropriate policy set up and good macroeconomic environment that favors the effectiveness policy in promoting economic growth and reducing poverty.

1.5 Scope and Limitation of the Study

The study explores the impact of monetary policy shocks on different macroeconomic variables. To achieve this objective, the periods 1981/82 to 2011/12 are chosen based on availability of data for variables used in the study.

The result of the study is confounded by quality of data. This limitation arises from the inconsistency of data reported by different institutions and even by different departments in the same institution. Additionally, because of lack of data, the study has been unable to use a long time period for the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Literature Review

The Quantity Theory of Money is one of the oldest doctrines in monetary economics literature and is very important in the formulation of monetary policy. The relationship of money with real variables is built on the premises that, over the long run, permanent increase in money supply will produce equiproportionate permanent in increase in price level but nothing else. This is an identity usually known as the equation of exchange and written as;

$$MV = PY$$

M is quantity of money in circulation may be represented by any monetary aggregate such as M0, M1 or M2; V = velocity that a unit of money is transacted; P = price level usually measured by GDP deflator or CPI (consumer price index); Y = real value of aggregate output (GDP). The amount of money multiplied by the number of times that money is used for making purchases of new goods and services in a given period should be equivalent to the value of production in that economy. Surprisingly enough, yet to date, it has been debated which direction the causation runs: whether MV causes PY or, whether PY causes MV ; whether velocity (V) and output (Y) are fixed (constant) or not, and whether money supply (M) is fixed by the central bank or not. In the classical model, output is taken as determined by availability of capital and labor. Velocity is assumed fixed therefore any exogenous change in money supply leads to change in price level.

Money in this case does not have any impact on the real variables and is said to be a 'veil over the real workings of the economy. Money growth rate + velocity growth rate = Price level growth rate + output growth rate. The intuition for this equation is the same as for the quantity equation in levels. The left hand side is a measure of how fast the amount of money used for transactions is growing (it increases both because the stock of money is increasing, and because a given amount of money is being used for more transactions). The right hand side is a measure of how fast the value of production is growing (it is increasing both because the quantity of goods being produced is rising and because the price of those goods are rising). The two sides have to be equal by definition since the money being used for transactions is purchasing the goods that are being produced. In the long run, it is assumed that economy will be at equilibrium with full employment such that real GDP growth is equal to potential GDP growth. This implies that the long run growth rate is independent of changes in the growth rate of the money supply. If we could change the growth path simply by printing money then growth would be a challenge, so that seems to be a reasonable assumption.

If we assume velocity is constant, which of course means that the growth rate of velocity is zero. Also assume that money growth and that actual GDP growth are equal then, the growth of price level is also zero or there will be no inflation. However, if the rate of money growth higher by some amount, for the exchange equation equality to be maintained, the price level has to rise by equiproportionate rate of growth i.e., the inflation rate will rise by the same percentage by which money growth exceeds the long run growth of output. Conversely, if money growth is reduced to a rate below the potential growth rate of output, then price level growth rate will be reduced by equi- proportionate rate, which of course means that the money used for transaction is purchasing less than the value of goods produced, which is a situation of deflation.

In summary, we have a one-to-one correspondence between money and inflation: if the growth rate of money is equal to the growth rate of production (for example 3% each), then inflation will be zero. If, on the other hand, money growth exceeds the growth rate of output (if money growth rate is 5% now), then we have inflation of 2%. Intuitively, this is because there is proportionally more money chasing goods, and thus prices will rise, i.e. we will experience inflation. Conversely, if money growth (1%) is less than the growth rate of output (3%), then we have proportionally less money chasing goods, and thus prices will fall, i.e. we will experience deflation of 2% this time.

If we now relax our earlier assumption of constant velocity of money, and consider the possibility that velocity can change (i.e. that the growth rate of velocity is not zero), then the relationship between money growth and inflation becomes more complicated.

If we leave money supply growth rate intact and allow growth in velocity of money, we will have such relationship; increases in the growth rate of velocity leads to increases in inflation and decreases in the growth rate of velocity lead to decreases in inflation, all else equal. This can be easily demonstrated using the previous example again. Given the growth rates of money and output at 3% each, if the growth rate of velocity of money increases by 2%; the inflation rate will be 2% as well. Conversely, if growth in velocity of money falls by 2%, all else equal, there will be deflation of 2%. However, if both money and velocity change together, all else equal, price level will change by equiproportionate change of the sum of the two changes in the same direction. When the collective growth rate exceeds real GDP growth, inflation rises. If, on the other hand, the collective growth rate falls below real GDP growth, the economy experiences deflation. Zero inflation requires that the growth rate of money used for transactions exactly equal the growth rate of potential GDP.

This can be intuitively understood as follows: when velocity also changes, the growth in the amount of money being used to purchase goods and services depends on both on how much the growth of the money supply but also on the how fast the number of times that money supply is being used for transactions is growing, i.e. on velocity growth. They reinforce each other in determining how fast the amount of money used for transactions is growing. With an unchanging growth rate of output, either an increase in money growth or an increase in velocity growth can cause inflation to rise. This analysis comes up with interesting conclusion that inflation is not solely determined by how much the money stock grows but also how fast money changes hands as well. This could happen because of the fact that the rapid money growth would be accompanied by a rapid increase in velocity.

The power of monetary policy over an economy lies on whether the celebrated hypothesis of Quantity Theory of Money holds or not in empirical works. The hypothesis sparked substantial debate among economists regarding potency of monetary policy and concerning the appropriate policy that needs to be pursued.

Classical economists state that money is the main tool to bring change in status of economy, for price level of goods and services proportionally rises due to increase in the money supply. But real incomes, real interest rate (real economic activities) remain unchanged, consequently economy remains at full employment.

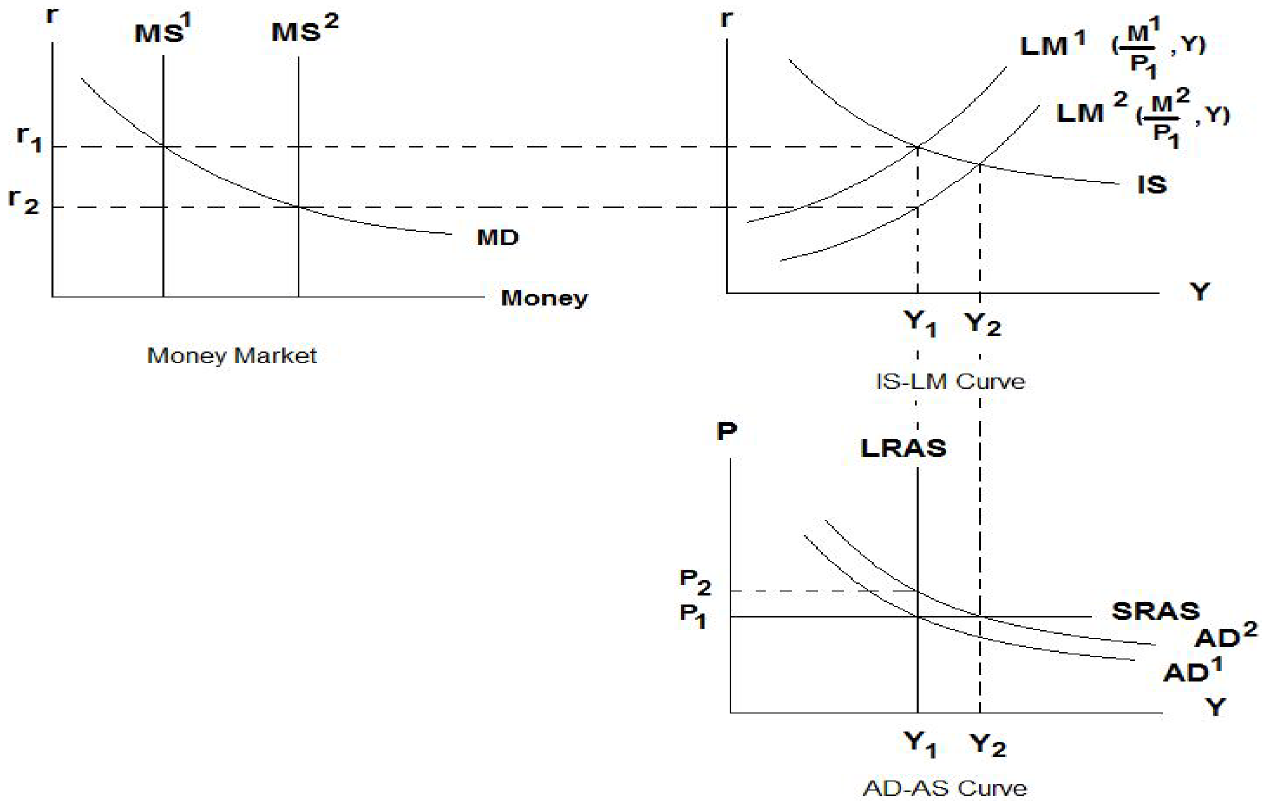
According to Keynesians when there is under unemployment in the economy, an increase in the money supply leads to an increase in aggregate demand, output and employment in short-run but in long -run there is no effect of money on these real variables. If the money supply increases beyond the full employment level, output causes to rise and prices rise in proportion with the money supply. Keynes also argues that it is the costs of such a recession that likely cause governments and central banks to allow a supply shock to result in inflation (Jhingan 2003).

Neo-Classicists consider that output effect of monetary policy is short run and the excessive increase in money supply results in inflation in the long run. Monetarists view money supply as the only factor creating inflation through the demand channel and they give more importance to monetary policy to stabilize the economy. Milton claims price as monetary phenomenon against the perception of inflation, which is raised due to increase in cost of some goods and services that reduces the money available for other goods which consequently rises the prices of those goods and services whose prices raised that leads to inflation (Majumder 2006).

Therefore, this part consists of theoretical relation of money supply to GDP and inflation.
Interest rate channel effect of monetary policy (OMO, RR, and DR) works through the expectations that by adjusting the money supply in the economy, the economic activities will consequently alter toward particular directions. Therefore, the influence to the economy triggered by the change in money supply can be analyzed by adopting the Keynesian structural IS-LM and AD-AS framework from the very basic aspect of macroeconomics.

In a two sector model, an increase in money supply, in the money market with a constant price level, will lead to a drop in interest rate. The fall in interest rate will in turn induce disturbances in the goods market that trigger more increment in output via expansion of investment activities in the short run as price level remains sticky. In the long run, however, price is flexible and output will ultimately return to the assumed-full-employment level. As output returns back and rise in price, there will be disturbances in the money market that clears through increment of interest rate back to the original level.. In summary, increase in money supply will decrease interest rate and increase output in the short run. In the long run, it has no effect on the interest rate or output, but results in inflations. On the other hand, the influence on the economy of decreasing money supply is the opposite, which will increase the short run interest rate, decrease the output, but lower the price in the long term. These effects can be shown in the figure below, taken from (Fang and Weiya 2011, pp-8).

Figure 2.1 Keynesian IS-LM and AD-AS Model



According to Frederic (2007, p.603-607), the traditional Keynesian structural model examines the channels of interest rate effects through which the monetary policy eventually has impact on aggregate demand. An expansionary monetary policy (M) leads to a fall in real interest rates (ir), which in turn lowers the cost of capital, causing a rise in investment spending(I), thereby leading to an increase in aggregate demand and a rise in output(Y).

$M\uparrow \rightarrow ir\downarrow \rightarrow I\uparrow \rightarrow Y\uparrow$

This channel of monetary transmission also applies equally as well to consumer spending on durable items following the latter developments.

An important feature of the interest-rate transmission mechanism is not only its emphasis on the real interest rate, but also the impact on the long run real interest rate on spending. In the short run, a fall in nominal interest rate induced by expansionary monetary policy will induce a corresponding fall in real interest rate due to the fact that the price level is sticky in short run. Long run interest rate is an average of expected future short term interest rates. However, because of expectations only the lower real short-term interest rate leads to a fall in the real long-term interest rate. Because nominal interest rates hit a floor of zero during a deflationary episode (or by the monetary authorities), an expansion in the money supply (M) can raise the expected price level (P_e) and hence expected inflation (Πe) there by lowering the real interest rate (Ir) even when the nominal interest rate is fixed at zero and stimulating spending through the interest-rate channel:

$M\uparrow \rightarrow P\ e\uparrow \rightarrow \Pi e\uparrow \rightarrow ir\downarrow \rightarrow I\uparrow \rightarrow Y\uparrow$

For monetarists, this mechanism is key element in discussions why the U.S. economy was not stuck in a liquidity trap during the Great Depression and why expansionary monetary policy could have prevented the sharp decline in output during that period. Some economists, such as John Taylor of Stanford University, take the position that there is strong empirical evidence for substantial interest-rate effects on consumer and investment spending through the cost of capital, making the interest-rate monetary transmission mechanism a strong one. His position is highly controversial, and many researchers, including Ben Bernanke of Princeton University and Mark Gertler of New York University, believe that the empirical evidence does not support strong interest-rate effects operating through the cost of capital. Indeed, these researchers see the empirical failure of traditional interest-rate monetary transmission mechanisms as having provided the stimulus for the search for other transmission mechanisms of monetary policy.

These other transmission mechanisms fall into two basic categories: those operating through asset prices other than interest rates and those operating through asymmetric information effects on credit markets (the so-called credit view). As a key objection to the Keynesian analysis of monetary policy effects on the economy, that focuses on only one asset price, the interest rate, monetarists envision a transmission mechanism in which other relative asset prices and real wealth transmit monetary effects onto the economy. In addition to bond prices, two other asset prices receive substantial attention as channels for monetary policy effects: foreign exchange and equities (stocks). With the growing internationalization of economies throughout the world and the advent of flexible exchange rates, more attention has been paid to how monetary policy affects exchange rates, which in turn affect net exports and aggregate output. This channel also involves interest-rate effects as well. An expansionary monetary policy lowers both short term nominal and short term real exchange rates simultaneously. Lower short-term real interests rates imply that dollar denominated assets are less attractive than foreign assets leading to a decrease in demand for dollars. The subsequent depreciation of the dollar makes domestic goods cheaper than foreign goods and leads to an increase in Net Exports, and therefore in GDP as well.

For small open economies with flexible exchange rates, this can be a particularly important channel of transmission. The reason why some small open economies choose to adopt fixed exchange rates can also be understood from this equation. When the exchange rate is not allowed to change then domestic interest rates must be equal to world interest rates, thus the monetary policymaker is rendered toothless.

Mishkin emphasizes two equity price channels: Tobin's Q and wealth effects. Tobin's Q is a widely used theory of investment, which states that; When Q is high, 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. Firms can then issue stock and get a high price for it relative to the cost of the facilities and equipment they are buying. Thus, firms will invest more either because adding capital is cheap or because the value of installed capital is high. Investment spending will rise, because firms can buy a lot of new investment goods with only a small issue of stock.

Conversely when Q is low, firms will not purchase new investment goods because the market value of firms is low relative to the cost of capital. If companies want to acquire capital when q is low, they can buy another firm cheaply and acquire old capital instead. Investment spending, the purchase of new investment goods, will then be very low.

Expansionary monetary policy can lead to a higher Q - either because market interest rates are falling leaving people with less attractive alternatives or because they have more money than they want to spend, therefore they buy more stocks to get rid of it. This result in higher stock prices (a higher market value) that lead to a higher Q and more investment. The schematic for the monetary transmission mechanism that operates through the channel is:

M↑ => P_s ↑ => q↑ => I↑ => Y↑

Life cycle hypothesis of consumption by Franco Modigliani states that people smooth out their consumption patterns over life time. An important component of consumers' lifetime resources is their financial wealth, a major component of which is common stocks. The increase in the price of stocks that follows a monetary expansion raises household wealth and leads individuals to spend more money. It could also be the case that higher demand for stocks increases the value of companies and enables companies to borrow and spend more freely as well. This will result in monetary expansion mechanism that affects output through wealth effect.

M↑ => P_s ↑ => wealth↑ => consumption↑ => Y↑

The credit channel arises from a credit market failure related to information asymmetries between borrowers and lenders. Intuitively borrowers and lenders have a hard time matching up because information about each other is very costly to verify. In particular lenders have a very hard time evaluating the viability of an investment project run by a borrower about whom they know very little. Similarly, borrowers may have a hard time finding lenders who are looking for projects similar to their own to invest in.Thus, in such scenario, banks become valuable financial intermediaries: bringing together borrowers and lenders. Lenders only need to have information about the viability of the bank because that is where they are putting their money, and banks have more resources and better ability to screen borrowers, some of whom are repeated customers. This channel becomes especially vital for small firms, which are unable to offer shares on the stock market or issue their own bonds to raise money.

An expansionary monetary policy leads to more reserves and deposits at the bank, which in turn makes more loans available. The increased supply of loans implies that many smaller firms can get access to loans and therefore undertake more investment projects leading to more investment and higher GDP. Schematically, the monetary policy effect is:

M↑ => bank deposits ↑ => bank loans ↑ => I↑ => Y↑

The presence of asymmetric information problems in credit markets gives rise, besides bank loan channel just discussed above, to another credit channel called balance sheet channel. The balance sheet channel is similar to the bank lending channel in that it is related to information asymmetries of moral hazard and adverse selection in financial markets.

The basic gist of the argument is as follows: lenders are always concerned that borrowers may be unable to repay their loans. This problem is most acute for firms with low net worth. The lender has to wonder if the reason that a low net-worth borrower is coming to him is because no one else is willing to lend to a borrower who may go under at any time (the adverse selection problem). The lender also has to wonder whether giving an increased loan to a low net-worth firm may make that firm pursue risky investment projects, thus, increasing the likelihood of project failure since the owner of the firm has little to lose if the firm goes under (the moral hazard problem). 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: lower interest rates which increase cash flow, higher equity prices, inflation that reduces value of liabilities, higher aggregate demand which raises business revenues and profits etc. Expansionary monetary policy (M↑), which causes a rise in stock prices (Ps↑) raises the net worth of firms and so leads to higher investment spending (I↑) and aggregate demand (Y↑) because of the decrease in adverse selection and moral hazard problems. This leads to the situation shown in the following schematic framework for one balance sheet channel of monetary transmission:

M↑ => P_S ↑ => adverse selection ↓, moral hazard↓ => lending ↑ => I↑ => Y↑

The myriad of different channels through which monetary expansion affects the real economy pose questions on relative importance of these channels for the economy under investigation. Some authors believe in a strong interest rate channel but other authors do not believe this to be the case. Some have argued that the right way to think about this question is that the credit and asset channels magnify and propagate the interest rate channels. For example, Mishkin believes that the credit channel is very important in propagating monetary policy decisions into the real economy. So, as a researcher, I believe that accepting or refuting any of these channels are open to empirical questions to be answered by carrying out a careful investigation.

2.2 Empirical Literature Review

Chow, Gregory and Yan (2004) analyze the changes in output and price level following the change in money stock for Chinese Economy over the period 1952- 2004. The objective of their study is to test empirical validity of Friedman Empirical Proportion (1994). Their work consists of three components:

The first one is they used ECM to explain inflation stability of Chinese economy over the period under investigation. This updates the work of Chow (1987) to explain the change in log P by its lagged value, the change in log(M/Y) and an error-correction term, where M denotes money supply and Y denotes real output. There are two steps in it, first long run relation between log(P) and log(M2/Y) is estimated by regressing log(P) on log(M2/Y) and a constant. Then following Chow (1987; 2002, p. 124), the lagged value of the residual t 1 u − of the above regression is used as an independent variable representing the error correction term in estimating the equation that explains the inflation rate Δlog(P).

The second is they estimate VAR model to test for the existence of co-integrating relationship among the three variables by the maximum likelihood method of Johansen (1991) to find the rank of the coefficient matrix. The co-integrating equation is then estimated by regressing log (P) on log (M2/Y), as suggested by Engle and Granger (1987) under the assumption that the coefficients of log (M2) and log(Y) are opposite in sign and equal in magnitude.

Finally, using this VAR they compute the impulse responses of log P and log Y to unexpected changes in M2. The dynamic effects are found to be consistent with the major propositions of Milton Friedman stated above on the effects of money supply on price and output, and as recently summarized in Bernanke (2003). Then, they compare the impulse responses estimated by using US and Chinese data with M1replacing M2, and finds that the general patterns are quite similar in spite of the institutional differences between these two countries.

Their work concluded finding out how the price level and real output respond to monetary shocks in the Chinese economy. According to Friedman (1994, p.48), because of price rigidity, the effects of monetary shock will first show up for log output over two to three quarters. Such effects tend to dissipate over time. "The effect on prices, like that on income and output, is distributed over time, but it comes some twelve to eighteen months later, so that the total delay between a change in monetary growth and a change in the rate of inflation averages something like two years".

Husain & Abbas (2002), investigate the co-relationship between money and income and between money and prices in Pakistan through the tri-variate VAR approach using annual data from 1949–50 to 1998–99.They used Error Correction Model (ECM) conditional on the presence of third variable,(Zt); GDP equation is estimated conditional on the presence of prices and output is, in turn, conditional variable while estimating inflation equation.

Whereas the lags capturing short run ΔYt, ΔXt and error term represent short and long run relations respectively. They found long run relationship between money and prices. Whereas no impacts of money on GDP are found in both short run and long run.

Zahoor et al,(2001) examine the impact of monetary on GDP Deflator in Pakistan's Economy using the technique of Ordinary Least Square using annual data for the period from 1971-72 to 2006-07.

After testing for serial correlation in the data using The Breusch-Godfrey test, they come up with the finding that there exists positive relationship between narrow money supply and GDP deflator.

CHAPTER THREE
MODEL SPECIFICATION AND RESEARCH METHODOLOGY

3.1 Econometric model specification.

As this thesis perches on the theoretical framework of an age old quantity theory of money, which Professionals call "a theory that has taken many different forms and traces back to the very beginning of systematic thinking about economic matters''. The theory has been a continual bone of contention among economists and is one of the most empirically tested propositions in wisdom of economics. Yet, it has been rejected by many economists in the past and has leased life once again recently and has got adherence of many professional economists.

So, the thesis tries to explain dynamic responses of GDP and Price level to disturbances in the money market. In order to capture the impacts of monetary shocks on the two variables, the quantity theory of money as expressed by a weak form of quantity equation, MV=PY is used. It is called so because the functional form of the quantity equation MV=PY may not be correct empirically (Chow, Gregory C. and Yan S. (2004). The rationality to use this functional form stems from the work of Milton Friedman (1994) that assumes the Neoclassical Synthesis of short run price rigidity and long run vertical aggregate supply curve. Accordingly, in the short run, changes in output is attributed to only proportional changes in money supply; with M and V held constant, Y will decrease only if P rises. In the long run price level tends to increase as Money increases; with M and V kept constant, and P changes in opposite directions to the change in Y to maintain the equality of the quantity equation. However, these assumptions or specification may not be empirically valid for various reasons and spark a number of questions:-

(a) Velocity (V) may change in response to interest rate changes;

(b) It is yet debatable which side of the equation cause the other (MV causes PY or PY causes MV);

(c) Unitary elastic money demand equation (M/P = Y/V) is another inherent assumption which may not be empirically correct.

The simple model of interest to start with is the quantity theory equation written as:

MV=PY…………………………………………………………………………...(3.4)

M is money that circulates in an economy, V is the velocity of money, P is price level and Y is income or output. Log transformation of equation (3.4) will give out estimation of the following cointegration regressions:

$$\mathrm{LogY_t} = \alpha_1 + \alpha_2 \log \mathrm{M_t} + \mathrm{u_t} \text{……………………..…………………………...… } (3.5a)$$

$$\mathrm{LogP_t} = \beta_1 + \beta_2 \log \mathrm{M_t} + \beta_3 \log \mathrm{Y_t} + \mathrm{v_t} \text{ …………………………………….…..…...} (3.5b)$$

Here Y_t, P_t and M_t are respectively GDP, price level and monetary policy instrument at time t. While u_t and v_t are the corresponding error terms. The coefficients of monetary shocks on Y and P are expected to be positive whereas, the coefficients of P and Y on each other are expected to be indeterminate since nonlinear relationship is expected between Y and P. While testing the long-run dynamic relationship among the variables of interests, the assumptions involving endogenity and exogenity of variables can be avoided by use of Vector Auto-regressive Models (VARs).

3.2 Sources of Data

As the achievement of any econometric analysis ultimately depends on the availability and accuracy of data, it is, therefore, essential to discuss about the source and nature of data. Regarding the type of data, the study used a sufficient length of secondary data ranging from 1981/82-2011/12. The data were collected from different sources. The major data sources for the research problem under investigation were publications of National Bank of Ethiopia (NBE), Central statistics Authority (CSA), Ministry of Finance and Economic Development (MoFED) and Statistical data base of Ethiopian Economic Association (EEA) and statistical data base of International Monetary Fund (IMF).

3.3 Method of Data Analysis and Estimation Techinques

The data collected were analyzed quantitavely. The study was undertaken through the analysis of the time series property of the data (test of the unit root on each variable), test of co integration to assess long run relationship between the variables of interest and their determinants, and vector error correction model (VECM) have been used to estimate the short run dynamics. All estimations were carried out using econometric software packages i.e, Stata for econometric analysis.

3.3.1 Vector Error Correction Model (VECM)

If two variables are not cointegrated or proved to have no long run relationship, the testing procedure will stop there and one will not go for the construction of an error correction model. But if they are cointegrated or proved to have a long run relationship one needs to go for an error correction mechanism. The error correction mechanism (ECM) is a mechanism used to correct any short run deviation of the variables from their long run equilibrium.

If two variables Y and X are cointegrated, then the long term or equilibrium relationship that exists between the two can be expressed as ECM (Gujarati 2004).

This means one shall go for the construction of an error correction model if and only if the variables are cointegrated. For this study the ECM can be given by:

$$\mathrm{dlogY_t} = b_{10} + \delta_1 \varepsilon_{t-1} + \sum_{i=1}^{n} \partial_{1i} \mathrm{dlogY}_{t-1} + \sum_{j=1}^{n} b_{1j} \mathrm{dlogP}_{t-1} + \sum_{k=1}^{n} \lambda_{1k}\, \mathrm{dlogM}_{t-1} + \sum_{m=1}^{n} \Omega_{1m} \mathrm{dlogZ}_{t-1} + u_{1t} \ldots \ldots \ldots \ldots (3.12a)$$

$$\mathrm{dlogP_t} = b_{20} + \delta_2 \varepsilon_{t-1} + \sum_{i=1}^{n} \partial_{2i} \mathrm{dlogY}_{t-1} + \sum_{j=1}^{n} b_{2j} \mathrm{dlogP}_{t-1} + \sum_{k=1}^{n} \lambda_{2k}\, \mathrm{dlogM}_{t-1} + \sum_{m=1}^{n} \Omega_{2m} \mathrm{dlogZ}_{t-1} + u_{2t} \ldots \ldots \ldots \ldots (3.12b)$$

$$\mathrm{dlogM_t} = b_{30} + \delta_{3O} \varepsilon_{t-1} + \sum_{i=1}^{n} \partial_{3i} \mathrm{dlogY}_{t-1} + \sum_{j=1}^{n} b_{3j} \mathrm{dlogP}_{t-1} + \sum_{k=1}^{n} \lambda_{3k}\, \mathrm{dlogM}_{t-1} + \sum_{m=1}^{n} \Omega_{3m} \mathrm{dlogZ}_{t-1} + u_{3t} \ldots \ldots \ldots \ldots (3.12c)$$

Where

Y_t is Gross Domestic Product at base year 2012

P_t is a measure Inflation at base year 2012

M_t is Monetary policy Instruments (Money Supply M2,Exchange rate, Interest Rate and Credit Balance)

If co-integration has been detected between series, it means that there is a long-term equilibrium relationship between them such that Vector Error Correction Model (VECM) will be applied in order to evaluate the short run properties of the co integrated series. In case of no cointegration, however, VECM is no longer required and VAR in levels or in difference will be applied to test the significance of Monetary channels for the respective GDP and P equations.

In VECM the co-integration rank shows the number of cointegrating vectors. For instance, a rank of two indicates that two linearly independent combinations of the non-stationary variables will be stationary. A negative and significant coefficient of the ECM (i.e. ε_{t-1} in the above equations) indicates that any short-term fluctuations between the independent variables and the dependant variable will give rise to a stable long run relationship between the variables (Karrar, 2009). If all coefficients (of ε_{t-1}) are significant it implies bidirectional causality among the variables conditional on the presence of M, i.e., significant impact of the regressors in the context of this thesis.

In case the coefficient does not fulfill the property of being negative and significant; we conclude that no stable long run relationship exists between the variables (Karrar 2009). Moreover, the magnitude of the error term coefficient indicates the speed of adjustment with which the variables converge overtime (Gujarati 2004).

The coefficients of the lagged terms of Y_t , M_t and P_t will be looked at in order to evaluate the short-term behavior between the series,. For instance, if the lagged coefficients of $M2_t$ turn out to be significant in the regression of Y_t ,then M2 impacts or causes Y.

Omitting the error correction term from the above two equations gives us the Granger causality equations, required to investigate the causal links in case of no co integration among series

3.3.2 Unit Root

A stochastic process is said to be stationary if its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed. If a time series is not stationary in the sense just defined, it is called a nonstationary time series. In other words, a nonstationary time series will have a time varying mean or a time varying variance or both (Gujarati, 2004).

In general, if a (nonstationary) time series has to be differenced d times to make it stationary, that time series is said to be integrated of order d. A time series Yt integrated of order d is denoted as Yt ~I (d). If a time series Y_t is stationary to begin with (i.e. it does not require any differencing), it is said to be integrated of order zero, denoted by Yt ~I (0). Most economic time series are generally I (1); that is, they generally become stationary after taking their first differences (Gujarati, 2004).

Testing the stationarity of variables is relevant for the reason that it incorporates important behavior for these variables and making analysis with nonstationary variables may result in spurious correlation. A stationary time series is superior or more important than a nonstationary in economic analysis as it makes easier the study of the behavior of variables in the long run (Gujarati, 2004).

Stationarity test will be done on all time series properties of data employing the unit root test by Augmented Dickey- Fuller (ADF) and the Phillips Perron (PP) test to avoid possible spurious regression.

If it is assumed that the error term, u_t, is uncorrelated, the DF test may be used. But in case the u_t are correlated, Dickey and Fuller have developed a test known as the Augmented Dickey Fuller (ADF) test. The ADF test is used in this study as most tests of the DF type have low power. That is, they tend to accept the null of unit root more frequently than is warranted.

The ADF unit root test requires the estimation of the following regression

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} (\alpha_i \Delta Y_{t-i}) + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots.. (3.7)$$

Where ε_t is a pure white noise error term and $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc are consecutive lagged differences augmented, β_1 is intercept, β_2 is trend coefficient, t is time or trend variable, m the number of lag terms chosen.

The hypotheses of this test will be:

H_0 : $\delta = 0$, i.e., there is a unit root – the time series is non-stationary.

H_1 : $\delta < 0$, i.e., there is no unit root – the time series is stationary

If the computed absolute value of the t statistic exceeds the ADF critical values, we do not accept the hypothesis that $\delta = 0$, in which case the time series is stationary and vice versa.

Phillips and Perron, on the other hand, proposed a nonparametric method of controlling for serial correlation when testing for a unit root. The PP method estimates the non-augmented DF test equation and modifies the t-ratio of the α coefficient so that serial correlation does not affect the asymptotic distribution of the test statistic. A test of unit root using the Phillips-Perron approach does not require a lag length determination (Waheed et al, 2006).

The test regression for the PP tests is given by the following equation (Phillips 1998):

$$\Delta Y_t = c + \alpha Y_{t-1} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.8)$$

Where $\boldsymbol{u}_t$ is I (0) and may be heteroskedastic. The PP tests correct for any serial correlation and hetroskedasticity in the errors $\boldsymbol{u}_t$ of the test regression by directly modifying the test statistics. These tests are known as Phillips Z_α and Z_t tests. The Z -tests allow for a wide class of time series with heterogeneously and serially correlated errors.

3.3.3 Johansen Cointegration Test

There are two possibilities to deal with nonstationary variables in a given model after the stationarity test. One is, to difference the series so as to obtain stationary variables and if so, then continue with the analysis. This is used only for the analysis of a short run relationship.

If not, the second is, to test if the linear combination of the nonstationary variables is stationary by using cointegration test. If they are cointegrated, then proceed the analysis with nonstationary variables.

According to Engle and Granger (1987), for X_t and Y_t both I (1) to be cointegrated there should exist α such that $Y_t - \alpha X_t$ is I (0) (i.e. $Y_t - \alpha X_t$ is stationary). (Xt, Yt) is denoted as CI (1, 1). Granger noted (cited in Gujarati 2004) that “A test for cointegration can be thought as a pre-test to avoid ‘spurious regression’ situations”. A regression of one nonstationary variable over another nonstationary variable may yield a stationary series and if so, it is known as cointegrating regression and the slope parameter in such a regression is known as cointegrating parameter. The concept of cointegration can be extended to a regression model containing k regressors. In this case, one will have k-1 cointegrating parameters.

Johansen method of cointegration applies the maximum likelihood procedure to determine the presence of cointegrating vectors in a vector autoregressive system. Johansen’s methodology is given by the following vector autoregressive (VAR) of order p form,

$$Y_t = \mu + A_1 Y_{t-1} --- +A_P Y_{t-p} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (3.9)$$

Where is*Y* an nx1 vector of variables that are integrated of order one [I (1)], μ is a vector of constant, εt is an nx1 vector and A1, A2 . . . A_p are PxP matrices of estimable parameters.

In the original work of Johansen and Juselius (1990), the model incorporates a vector of nonstochastic variables (Dt) orthogonal to the constant term such as seasonal dummies, ‘dummy type’ variables and/or stochastic ‘weakly exogenous’ variables. Thus, the model can also be given as:

$$Y_t = \mu + A_1 Y_{t-1} + --- + A_P Y_{t-P} + \partial D_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.10)$$

In general, economic time series are non-stationary processes and the above VAR model is expressed in its first differenced form given as follows;

$$\Delta Y_t = \mu + \amalg Y_{t-1} + \sum_{i=0}^{P-1} \theta \Delta Y_{t-1} + \partial D_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (3.11)$$

Where

$$\amalg = \sum_{i=1}^{P} [A_t - I]$$

$$\emptyset = \sum_{j=i+1}^{P} [A_j]$$

ϕ and Ⅲ represent short run adjustment and long run relationship among the Y_t variables respectively. The rank of Ⅲ shows the number of linear combinations of the Y_t variables that are stationary.

CHAPTER FOUR

ESTIMATION AND DISCUSSION OF RESULTS

4.1 Unit roots tests

Before any meaningful regression is performed with the time series variables, it is essential to test the existence of unit roots in the variables and hence to establish their order of integration. The variables used in the analysis need to be stationary and should be co-integrated in order to deduce a meaningful relationship from the regression.

Working with non-stationary variables gives rise to spurious regression (seemingly related variables) results, from which further inference is no more meaningful. Appropriate tests of stationarity should be employed on variables of interest in order to avoid problems of spurious correlation normally associated with the inclusion of non-stationary series in regression models. Two types of formal tests are conducted to examine whether the data series is stationary or not. These tests are the conventional Augmented Dickey-Fuller test (ADF) and the Phillips-Perron test (PP). These two tests allow for three options while conducting the tests; i.e., without intercept and trend, with only intercept and with both intercept and trend. The null hypothesis for the test claims that the data series under investigation has unit root. Conversely, the alternative hypothesis claims that the series is stationary. In addition, the result of the test for the variables at level and at their first difference is presented in the following table 4.1

Unit root tests are done on log of each series. Conventionally, it is believed that log of series are less hetroskedastic and are less likely to result in spurious regressions. All variables are first differenced and are turned out in to stationary process. Both ADF and PP tests do not accept the null hypothesis such that the series in first difference contain unit roots at @1% and 5% percent significance level for all variables except dlnRE. The results are shown in the table below.

Table 4.1: The Result for the Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) Unit Root Tests at First Difference.($RGDP_{2012,}$ CPI_{2012} AND $M_{2012)}$

Variable	Augmented Dickey Fuller Test			Phillips Perron Test		
	Constant (C), Trend, Lag	Test statistic, Z(t)	Order of integration	Constant(C), Trend, Lag	Test statistic, Z(t)	Order of Integration
dLNCPI	C, T ,0	-4.561***	I(1)	C, T ,3	-4.565***	I(1)
Dlngdpd	C, T ,0	-4.600***	I(1)	C, T ,3	-4.659***	I(1)
dLNRGDP	C, T ,0	-4.837***	I(1)	C, T ,3	-4.844***	I(1)
dLNM2LC	C, T ,0	-4.490***	I(1)	C, T ,3	-4.576***	I(1)
dLNM2RR	C, T ,0	-4.490***	I(1)	C, T ,3	-4.022***	I(1)
dLNRE	C, T ,0	-3.231*	I(1)	C, T ,3	-3.251*	I(1)
dLNIAO	C, T ,0	-5.369***	I(1)	C, T ,3	-5.445***	I(1)
dLNIAP	C, T ,0	-5.423***	I(1)	C, T ,3	-5.444***	I(1)
dLNDCB	C, T ,0	-4.852***	I(1)	C, T ,3	-4.852***	I(1)
dLNDCP	C, T ,0	-4.666***	I(1)	C, T ,3	-4.660***	I(1)

The critical values in bracket at respective significance levels for both tests are 1%(-4.343), 5%(-3.584)

4.2 Lag Length Selection

Cointegration test is usually preceded by a test of optimal (appropriate) lag length selection because of the test is affected by the number of lags included in the VAR model. There are many tests that can be used to choose appropriate lag length. These are the Log Likelihood (LL), the Akaike information criteria (AIC), the Schwarz information criteria (SIC) and the Hannan-Quinn information criteria (HIC). The optimal lag length for this study is determined by using the Akaike Information Criteria (AIC) as this method has been proven in most empirical papers to be superior to other tests. According to the Akaike Information Criteria, the VAR estimate with the lowest AIC in absolute value is the most efficient one. In addition, the optimal lag length that is obtained from the AIC is also confirmed by the VAR estimates considering successive lags. Accordingly, Johensen co- integration test starts with choosing the optimum lags length to test for co-integration, in the case of this thesis, among GDP, price level and monetary policy instruments. All the lags length selection criteria selects lags length of (p) zero or Var(0) for tri-variate vector autoregressive models without exogenous variables.

Table 4.2: VAR Lag Order Selection Criteria
($RGDP_{2012}$, CPI_{2012} AND $M_{2012)}$)

Endogenous Variables	V(p)	Criteria @ 5%
dlnCPI,dlnRGDP, dlnM2LCc	**0**	**All**
dlnCPI,dlnRGDP, dlnM2RR	**1**	**AIC**
dlnCPI,dlnRGDP,dlnRE	**0**	**All**
dlnCPI,dlnRGDP,dlnIAO	**2**	**AIC**
dlnCPI,dlnRGDP,dlnIAP	**2**	**AIC**
DlnGDPD,dlnRGDP, dlnM2LC	**3**	**AIC**
DlnGDPD,dlnRGDPD, dlnM2RR	**1**	**AIC**
DlnGDPD,dlnRGDP, dlnRE	**0**	**All**
DlnGDPD,dlnRGDP, dlnIAO	**2**	**AIC**
DlnGDP,dlnRGDP, dlnMIAP	**2**	**AIC**

4.3 Johansen Cointegration Tests (Estimation of long run Relationship)

In section 4.1, the unit root tests show that all the variables are stationary at first difference except for dlnRE. Theories state that econometric analysis with non stationary variables makes no sense. The only exception is if their linear combination results in a stationary series. The test of cointegration in this section, tests for the existence of such a relationship among the nonstationary variables considered in this study.

Once all the variables entered the monetary equation are integrated of similar order (I (1)) as seen from the above Table 4.1, the next step is to check for cointegration. To test the number of cointegrating relationships among variables real GDP,real exchange rate,interest rate and price,Johansen cointegration test is considered. To determine the number of cointegrating vectors two test statistics called the maximum eigenvalue (λmax) and trace statistics (λtrace) are computed.

For k-endogenous variables each with a single unit root, there is a possibility to find from zero to k-1 linearly independent cointegrating relations. Two types of test statistics are used to determine the rank of the model in this study; namely the trace test and the maximum eigen/likelihood ratio test. The trace test (λtrace) tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of k cointegrating vectors, where k is the number of endogenous variables, for r=0,1,2…,k-1. The maximum eigen-value test, on the other hand, tests the null hypothesis of **r** cointegrating vectors against the alternative hypothesis of **r+1** cointegrating vectors. Both the trace statistics and the maximum eigen/likelihood ratio test results in one cointegrating equations at 1% level of significance for this study. The trace test shows that the null hypothesis of r=0 cointegrating relation is rejected and the alternative r≥0 cointegrating equations is accepted. This means that there is one cointegrating equations because the null hypothesis of r≤ 1 could not be rejected in the next step. The maximum eigen/likelihood ratio test confirms the same result. It shows that the null hypothesis of r=0 cointegrating relation is rejected in favour of the alternative r=1.

Thus, both the trace and the maximal eigen value test conclude that there is one cointegrating vector among the variables and there is only one eigen value significant at 1% level and this outcome determines that the rank of the cointegration is unity. This means among the variables real GDP, exchange rate, interest rate, and CPI there is one long run relationships. The test statistics are summarized in Table 4.3.

Table 4.3: Results of the Johansen Cointegration Test (.(RGDP$_{2012}$, CPI$_{2012}$ AND M$_{2012)}$)

Endogenous Variables	H_0:Rank= r	Trace statistic	Eigen Value/max statistic	Rank
dlncpi ,dlnrgdp, dlnm2lc	0	43.9798	20.3448	2
	1	**23.6350**	**17.4002**	
	2	6.2349**	6.2349**	
dlncpi,dlnrgdp, dlnm2rr	0	47.0509	33.8692	2
	1	13.1817	8.2646	
	2	4.9171**	4.9171**	
dlncpi,dlnrgdp,dlnre	0	37.0373	19.4909	1
	1	17.5464**	9.7684**	
	2	7.7780	7.7780	
dlncpi,dlnrgdp,dlniao	0	39.5209	32.5456	1
	1	6.9753’	4.5472’	
	2	2.4281	2.4281	
dlncpi,dlnrgdp,dlniap	0	45.9842	36.0136	1
	1	9.9706’	7.4963’	
	2	2.4743	2.4743	
dlncpi,dlnrgdp, dlnre	0	39.9348	22.0601	1
	1	17.8746**	10.0291	
	2	7.8455	7.8455	

dlncpi,dlnrgdp, dlniao	0	33.8405	26.9876	1

Note: H_0 for both tests is rank=r; alternative hypotheses: trace: H_1:rank>r; max eigenvalue H_1: rank=r+1. At 1% critical value: Trace: for r=0 is 35.65; for r=1 is 20.04; r= 2 is 6.65 Max : for r=0 is 25.52, for r=1 is 18.63; for r= 2 is 6.65.and similarly
---- (**) means rejection of the null hypothesis at the 1% and r denotes the rank of the long-run matrix. It identifies the number of cointegating vectors

4.4 Vector Error correction Models

The error correction models of each model are presented as two sub-sections: the first part contains estimation of Error Correction terms of the ECMs. These are the tests for short run dynamics of respective variables of the models that show how fast the long run equilibriums are restored following the short run disequilibrium. In the second part, the VAR in first difference of the estimated ECMs, reports the coefficients of regression of the each variable on its own lags and lags of other variables in the system. The VARMs explain the vector composed of the differences of natural logarithms of respective variables of the model under explanation. The motive here is to find out how output and price levels respond to different monetary policy shocks for Ethiopian Economy. Taking the advantage of the tri-variate VARMs allows to investigating causality among variables of the model with the null hypotheses of no causations. Therefore, the significance of the joint coefficients of the variables indicates rejections of the null hypotheses.

4.5 M2 Channel of Monetary Policy (Model1)

This Vector Error Correction Model (VECM) framework consists of the variables real GDP, CPI and money supply measured by local currency as monetary policy instrument. The first step in estimation of a VECM is selection of an appropriate lag length. The number of lags in the model was determined according to Akaike Information Criterion (AIC). The lag length that minimizes the AIC is 2. The estimated model 1 with p- values of regression coefficients in parenthesis is presented in table 4.4.

The coefficients of error-correction terms EC_{t-1}, are given interpretations as follows: the coefficient in dlnRGDP equation is statistically significant and has a negative sign. It means the error term does contribute in explaining the changes in general money to real GDP. In dlnCPI equation, the speed of adjustment of any disequilibrium towards a long-run equilibrium is such that about 75% of the disequilibrium in CPI is corrected each year. In the third equation, at 1%, the estimated coefficient of the error correction term is statically significant and has a negative sign. It shows that real money supply converges to its long run equilibrium state each year at the rate of (.0086988) after own and other variables shocks in the system. These altogether confirm the existence of one co-integrating relationship between the endogenous variables.

Furthermore, the existence of Co-integration, in turn, implies the existence of Granger causality at least in one direction (Granger, 1988). The negative and statistically significant value of error correction coefficient indicates the existence of a long-run causality between the variables money supply and price level. This is a result that classical macroeconomists believe to hold with regard to money neutrality; i.e, inflation as monetary phenomenon. It implies that in Ethiopia an increase in money supply does not affect the real macroeconomic variables, instead, would be offset by a proportional rise in prices. In views of Monetarists, because, prices are rigid in short run, the effects of monetary shock will first show up for output whose effects tend to dissipate over two to three quarters. The effect on prices, like that on income and output, is distributed over time, but it comes some twelve to eighteen months later Chow (2009).

Table 4.4 ECM estimates results for model 1:p (z) values are in parenthesis:
(.(RGDP$_{2012}$, CPI$_{2012}$ AND M$_2$)

Variables	Dlnrgdp	Dlngdpd	Dlnm2lc
EC_{t-1}	**-.0035704** **(0.017)**	**-.757296** **(0.033)**	**.0086988** **(0.001)**
$dlnrgdp_{t-1}$	**.1601831** **(0.453)**	**82.2077** **(0.005)**	**.2955442** **(0.163)**
$dlnrgdp_{t-2}$	**-.2939575** **(0.219)**	**34.21204** **(0.291)**	**.1524936** **(0.520)**

$dlncpi_{t-1}$	**-.0000429** **(0.987)**	**-.5293783** **(0.149)**	**-.0079257** **(0.003)**
$dlncpi_{t-2}$	**-.0014385** **(0.490)**	**-.2725092** **(0.336)**	**-.0039664** **(0.055)**
$dlnm2lc_{t-1}$	**.5780458** **(0.177)**	**100.5375** **(0.083)**	**-.7876207** **(0.063)**
$dlnm2lc_{t-2}$	**.3581912** **(0.256)**	**75.66128** **(0.077)**	**-.5171516** **(0.098)**
Constant	**-.008636** **(0.548)**	**.0000327** **(1.000)**	**-.000678** **(0.962)**
R- sq	**0.5601**	**0.6959**	**0.6744**
Chi^2	**22.91697**	**41.18288**	**37.28685**
P>chi^2	**0.0064**	**0.0000**	**0.0000**

In addition, the coefficients on lagged independent variables indicate short run bidirectional causality between CPI and M2lc; and real GDP causes CPI. The difference of the natural logarithms of the real GDP, CPI and M2 at local currency indicates the rates of changes (percentage change) of the respective variables between the adjacent years. For instance, the estimated equation of dlnGDP can be implied as percentage change in CPI caused by the percentage changes in CPI as well as the percentage changes in real GDP and M2 1 to 2 years ago.

So as to prove the short run causal and feedback effects based on VECM estimates, standard Granger causality is performed in first difference VAR based on F- statistics. The results also show; uni- directional causation from real GDP to CPI; bi-directional causality between CPI and money supply and no causation is found between real GDP and money supply.

The interpretation is that with other variables remain constant 1 percent increment in real GDP one year ago will increase inflation by 82 percent over the short run. Theoretically, there will be expected negative association between real GDP and inflation but, in the long run they are independent of each other. The mechanics of the response is such that an increment in output in the short runs resulting from stimulus would result in decline in output and higher price.

On the other hand, all other things remaining constant, if there were a rise in money supply by one percents one and two years before, inflation would rise by 100% and 75% respectively in the current year i.e. in short run.

Alternatively, it can be implicated as that the previous years' money supply and inflationary conditions determine the target growth rate of money supply by National Bank of Ethiopia. It is that all else held constant, if money supply are higher by one percent in the last one and two years, the growth of money supply will be less respectively by 0.78 and 0.51 percent. And all other things remaining unchanged, if inflation were one percent high in the past one and two years before, the growth rate of money supply will be less respectively by 0.007 and 0.004 percents over the current years.

From the foregoing results and discussion, it is to be concluded that Friedman's hypothesis is refuted in Ethiopian case. That is, price level is monetary caused both in short and long runs.
To further strengthen the results of the ECM estimation, also they are reported in terms of impulse response functions. The IRF results support what have been discussed so far. Only when it comes to the response of GDP deflator to shocks in real GDP and M2; inflation responds positively in response to the shocks in real GDP, negatively to the shocks in money supply and it diverges to its own shock .i.e., this shows a tendency of inflation to adjust to the equilibrium. Real GDP is independent of all shocks including own shocks but gives stable relation with regard to all. Money supply is affected by its own past history of disturbances only for short while but give stable relation to all.

In order to examine the extent of effect relationships among the variables involved, Forecast Error Variance Decomposition (FEVD) is carried out. The FEVD measures the proportion of the total variance in the volatility of one variable explained by innovations in the volatility of itself and the other variables. Figure in appendix depicts the results of the variance decomposition analysis. These results supplement the impact relationships examined by ECM. Shocks in real GDP explain the variability in CPI and the variability in CPI, explains the variability in M2. All three variables move due to the shocks in their own over time horizon of 30 years.

4.6 Exchange Rate Channel (Model 2)

This model is constructed of the variables real GDP, CPI as measure of inflation and real exchange as monetary policy instrument variable. The VECM proceeds after selecting the optimal lag length of 3 according to SIC. This had been followed by test for co-integrating relations and one co-integrating equation is found according to Johansen co-integration test. The results of the VECM estimates are provided in table 4.5.

The error correction terms of the coefficients are statistically significant with expected signs. It does indicate not only adjustment speed of the variables towards equilibrium after short run disturbances but also there exist long run relations between the variables of the system. The error correction coefficients of the VECM estimates show that the short run disequilibrium each year is corrected by changes in real GDP, CPI and real exchange rate at rates of 28%, 12100% and 124% respectively. Furthermore, these coefficients confirm the existence of one co-integral equation found by Johansen Co-integration test which together show long run causal relationships at least among real GDP, CPI and real exchange rate.

The short run impact relationships among the variables are explored in the VAR part of the same VECM estimates adjustment parameters derived. In the system each variable considered as endogenous variable is regressed on the lagged values of the other variables and its own lagged values as exogenous variables. For instance, in CPI equation, CPI as dependant variable is regressed on the past three years values of real GDP, real exchange rate and CPI. Thus, from table 4.5 below, it is observed that all coefficients on lagged real GDP and the first and the second coefficients of real exchange rate and CPI are statistically significant.

Table 4.5 VECM estimates results for exchange channel(.(RGDP$_{2012}$, CPI$_{2012}$ AND Exchange Rate$_{)}$)

Variables	Dlnrgdp	Dlncpi	Dlnrr
EC_{t-1}	-.2851548 (0.024)	-121.8383 (0.008)	-1.245042 (0.017)
$dlnrgdp_{t-1}$	.0938722 (0.793)	149.9062 (0.026)	.7146686 (0.348)
$dlnrgdp_{t-2}$	-.3022527 (0.291)	114.8845 (0.032)	.7207182 (0.237)
$dlnrgdp_{t-3}$	.0196824 (0.942)	107.8403 (0.035)	-.0252389 (0.965)
$dlncpi_{t-1}$	.0008256 (0.531)	-.5330032 (0.031)	.0025658 (0.360)
$dlncpi_{t-2}$	-.0011096 (0.475)	-.7184028 (0.014)	.0012687 (0.701)
$dlncpi_{t-3}$	.0010402 (0.571)	-.3622459 (0.293)	-.000701 (0.857)
$dlnrr_{t-1}$	.183145 (0.101)	37.32173 (0.075)	.3268898 (0.168)
$dlnrr_{t-2}$	.1439395 (0.184)	40.33571 (0.047)	-.0155291 (0.946)
$dlnrr_{t-3}$	.1029945 (0.300)	.0002109 (0.181)	.1287358 (0.542)
Constant	-.014891 (0.278)	-.082068 (1.000)	-.0172196 (0.555)
R- sq	0.6429	0.6472	0.6429
Chi2	26.9998	27.51213	26.9998
P>chi2	0.0046	0.0038	0.3001

To rely on the results of VECM estimates above as robust one, they must be confirmed by Granger causality test in first difference . This involves three steps of which the first one is selecting the appropriate lag length and 5 lag is chosen by SIC. The next step is to run VAR estimation in first differenced variables and test the statistical significance of the joint coefficients of five lagged values of the variable in the system. The results of Granger causality test in appendix table 10 shows strong feedback effects between inflation and output; and direction of causation runs from exchange rate to CPI, real GDP but no other way round.

The explanation is that all else remain equal, 1 percent increase in real GDP in 1,2 and 3 years from the present will be inflationary by 149%, 114% and 107% respectively. This impact may not dissipate as time passes by however as time length is three years. The implication is that, no matter how big or small the figures are, the reality for Ethiopia is that the development in economic environments in the past recent years are fueling inflation due to inflationary expectation that follows expected economic booms. One percent surge of inflationary scenarios in the past one and two years found to lower inflation respectively by 0.50 and 0.70 percents, meager figures in fact.

Moreover, in CPI equation of the estimated VECM it turns out that inflation is caused by exchange rate. The interpretation of the coefficients is that ceteris paribus, one percent real exchange rate depreciation one and two years before will result in higher inflation of 37% and 40% respectively. This will put exchange rate as important channel of monetary policy instrument in Ethiopia to be considered a supplementary, if not an independent, source of inflation.

On the other hand, the association between inflation and economic growth had origin in the Phillips curve relationships between inflation and unemployment. Friedman (1977) argues that inflation-unemployment trade off attributes to inflation uncertainty which has adverse effect on economic growth. Ball (1992) dragged on Friedman's views formally in an asymmetric repeated information game where the public faces uncertainty about the monetary authority. Following his foot step most empirical studies, such as Fischer (1993), De Gregorio (1993) and Bruno and Easterly (1995), suggest non linear association between the two; that high or hyper-inflation retard economic growth, although there could be a positive relationship between inflation and economic growth when the inflation rate is low. Yet, there remains a debate over what thresh hold level of inflation would be the cut-off point? Some like Sarel (1996) locates annual inflation rate of 8 percent as the break-point beyond which the effect on output is negative. Below that rate, inflation does not have a significant effect on growth or it may even exhibit a slightly positive effect. Bruno and Easterly (1998) suggest that the annual inflation rate above 40 percent is likely to lead to a growth crisis. Fischer, Sahay and Vegh (1996) argue that, in the case of transition economies, this cut-off point occurs when the annual inflation rate is about 50 percent.

Real exchange rate has knock- on- effect on economic activities through its impact on investment both through accelerator effect and user cost of capital. When real exchange rate depreciates, it increases the price of foreign goods relative to domestic goods. Due to increased import prices and production costs, spending from foreign to domestic goods increases thus causing increase in prices and aggregate demand. On the other hand, real exchange rate depreciation lowers export prices. This causes the net exports to decrease leading to a fall in private sector real wealth and expenditure. This may lead firms to revise their expectations of future demand and thus, lower investment and therefore, results in fall in real income in the economy. Thus the combined effects that occur through the demand and supply channels determine the net results of exchange rate fluctuations on real output and price. Therefore, besides, its inflationary effect, exchange rate is important channel to affect economic activities in Ethiopian case as supplementary, if not independent variable.

Thus, the strength of the exchange rate channel depends on the responsiveness of the exchange rate to monetary shocks, the degree of openness of the economy, and the sensitivity of net exports to exchange rate variations. A nominal depreciation brought on by monetary easing, combined with sticky prices results in a depreciation of the real exchange rate in the short-run whose the effects are likely to be subdued as prices adjust slowly in the long run.

Nevertheless, the fact that Ethiopia went from a fixed exchange rate to a dirty floating regime during the sample period does not alter the analysis of the results. A move from a fixed exchange rate to floating regime only further enhances the importance of the exchange rate channel since nominal exchange rates are not allowed to fluctuate under the former case. Real exchange rates, however, can vary under a fixed or crawling peg regime so there is scope for monetary policy to affect real activity through this channel.

The impulse response functions and forecast error variance decomposition analysis are carried out substantiate the VECM and Granger Causality estimates. Table 4.5 confirms the result from VECM estimates such that shocks in inflation are explained past history of its own shocks.

GDP and real exchange rate; that is inflation responds positively and negatively in response to the shocks in its own, real GDP and money supply and where it diverges to shock in real GDP i.e., this shows intendancy of inflation to adjust to the equilibrium.

4.7 Interest rate channel

The VECM framework of interest rate channel, also referred to as traditional channel, consists of the variables real GDP, CPI and interest rate as instrument of monetary policy. As usual, the same procedure is followed and the impact relationships between any two variables are investigated in the presence of the third variable. As a result, the VEC estimation is run on lag length of one and one co-integral equation.

It is observed from the error correction part, that the variables of the model get back to its long run stable condition that is caused by short run disturbances of own and other variables. The coefficients of adjustment parameters with significant negative signs shows not only speed of adjustment toward long run stability condition but also percentage change in the variables by which they converge themselves towards long run equilibrium condition following disturbances caused by each year via their own and the other variables. Accordingly, CPI adjusts at the rate of (-138.2406) followed by real GDP adjusting at rate of (-.8675308). However, the coefficient in dlnIAO equation is not statistically significant but has a negative sign. It means the error term does not contribute in explaining the changes in real interest rate. Furthermore, this is a manifestation of the long run co-integrating relation which in turn is implication of long run causal effects between price level and output.

Table 4.6 VECM estimate of interest rate channel (.(RGDP$_{2012}$, CPI$_{2012}$ AND Interest Rate)

Variables	Dlnrgdp	Dlncpi	Dlniao
EC_{t-1}	**-.8675308** **(0.000)**	**-138.2406** **(0.000)**	**-.7919192** **(0.730)**
$dlnrgdp_{t-1}$	**.0988169** **(0.549)**	**67.03662** **(0.041)**	**1.508369** **(0.556)**
$dlncpi_{t-1}$	**.0032159** **(0.000)**	**-.0908215** **(0.606)**	**.0025988** **(0.850)**
$dlniao_{t-1}$	**-.0299029** **(0.005)**	**6.451968** **(0.002)**	**-.6655395** **(0.000)**

Constant	**-.00828** **(0.434)**	**.0000302** **(1.000)**	**.003797** **(0.982)**
R- sq	**0.6438**	**0.5729**	**0.5052**
Chi2	**41.57377**	**30.84625**	**23.48351**
P>chi2	**0.0000**	**0.0000**	**0.0003**

(The values in parenthesis are p- values)

The ECM results of interest channel show bidirectional impacts between real GDP and CPI; and unidirectional causation running from interest rate to output and price level. These all are confirmed by Wald Granger causality derived from independent first difference VAR model of lag length two.

The interest rate channel is often considered as primary mechanism at work in conventional macroeconomic models. It works through traditional IS-LM and AD-AS framework and Fisher equation effect relation of inter temporal consumption; the change of nominal interest rate that follows suit of shocks in money market translates into an increase in the real rate of interest and the user cost of capital and will lead to a shift of LM curve. In the goods market, these changes in interest rates may lead to changes in consumption or investment spending. Consequently, the new intersect of IS and LM curves indicates the new equilibrium of output. In the goods market, this change in output results in a shift of AD curve which changes the price level in the long term, but the price stays constant in the short run due to its stickiness in the short term. Therefore, the short run dynamics among interest rate, price level and output indicates that monetary policy that is executed via buying and selling of government treasuries by selecting target interest rate can have control over economy.

Lastly, the graphs generated by the impulse response functions confirm that inflation responds a little bit to shocks in real GDP and gives a little bit more diverging responses to shocks in interest rate as shown Appendix A, graph 3). And those graphs generated by forecast error variance decomposition show the scenario where all variables vary proportionately due to their own shocks. Likewise inflation responds to variation real GDP and interest rate; output responds to shocks in inflation and interest rate; and interest rate is unresponsive to shocks in real GDP and price level as presented in figure 7 appendix B).

4.8 Credit Channel

Credit channel operates through bank reserves and leads to changes in the supply of loanable funds by the banks including the availability or the terms of new loans. First, this implying that the bank lending is influenced by the structure of the financial system and its regulation such as ; the degree to which the central bank has allowed banks to extend loans, monetary policy stance; and the dependence of borrowers on bank loans. Therefore, this channel is important since almost all of businesses in Ethiopia are of small and medium-sized firms, facing informational frictions in financial markets, rely primarily on bank loans for external finance because it is not possible for these borrowers to issue securities in the open market.

In second place, however, the credit channel is an enhancement mechanism to the interest rate channel and does not operate independently on its own. The key point here is that the real effects of interest rates will be amplified through the lending channel, beyond what would be predicted to be transmitted only through the traditional interest rate channel. For instance, a rise in interest rates subsequent to monetary tightening reduces business investment only because cost of capital is high but also due to supply of bank loans mostly to small and medium sized firms is reduced. Hence, such association between the two channels reduces the importance of credit channel as independent channel of monetary policy tool to target it solely, but provide comprehensive framework of systems in which the two could operate and give out results expected them of.

Table 4.7 Difference VAR estimates results for Credit channel (($RGDP_{2012}$, CPI_{2012} AND Credit Balance)

Variables	Dlnrgdp	Dlncpi	Dlndcb
$dlnrgdp_{t-1}$	**.308981** **(1.67)**	**-30.95889** **(-0.87)**	**.2814415** **(1.09)**
$dlnrgdp_{t-2}$	**-.1520854** **(-0.83)**	**-13.80963** **(-0.39)**	**-.6321172** **(-2.47)**

$\mathrm{dlnrgdp}_{t-3}$	**.0254486** **(0.14)**	**-87.70072** **(-2.59)**	**.4754324** **(1.94)**
dlncpi_{t-1}	**.0007128** **(0.68)**	**.3607378** **(1.77)**	**.0002392** **(0.16)**
dlncpi_{t-2}	**-.0028816** **(-2.67)**	**-.3240745** **(-1.56)**	**.0041603** **(2.77)**
dlncpi_{t-3}	**.0024768** **(2.24)**	**.7330916** **(3.44)**	**.0004239** **(0.28)**
dlndcb_{t-1}	**-.2422677** **(-1.91)**	**-45.70014** **(-1.87)**	**.1758311** **(1.00)**
dlndcb_{t-2}	**.0060513** **(0.05)**	**31.73798** **(1.29)**	**-.0444373** **(-0.25)**
dlndcb_{t-3}	**-.1785273** **(-1.40)**	**-60.13132** **(-2.45)**	**-.3019613** **(-1.70)**
Constant	**-.0490364** **(-2.25)**	**-3.717229** **(-0.88)**	**-.0498047** **(-1.64)**
R- sq	**0.5210**	**0.4585**	**0.4256**
Chi2	**29.37117**	**22.86114**	**20.00672**
P>chi2	**0.0006**	**0.0065**	**0.0179**

4.9 Granger Causality Test

The final step in this section is to determine the direction of causations (either unidirectional or bidirectional) between the series on VAR models. The joint null hypotheses of Granger- non causality (there is neither unidirectional nor bidirectional causation between the variables under investigation are tested by Wald X^2 and F- statistics obtained from Wald Coefficients restriction.

4.9.1 Granger Causality Test in VAR- M2 channel of monetary Policy

The estimates of Error Correction Model and the Wald Granger causality indicate the existence of short run bidirectional causality between money supply and price level and unidirectional causation running from output to price level. The evidence of short-run bidirectional causality between money supply and general price level indicates that price level is affected by hocks in the monetary policy in the short-run.

The results of the co-integration test based on Johansen's procedure for M2 channel of monetary policy indicate the existence of the co-integration between variables. Therefore, the variables have a long-run equilibrium relationship between them; despite there may be disequilibrium in the short-run. The evidence of long-run bidirectional causality between money supply and price level shown by co-integrating equation and adjustment parameters of GDP deflator and money supply infers that in the short run money is neutral in its effect and thus, refutes the Keynesian belief and supports the monetarists view.

The evidence of co integrating relationships between money supply and price level implies that causal impacts if there is any long run. Thus, under such scenario the joint hypotheses would be there are neither long run bi-directional causations between money supply and general price level nor short run causal relationship between money supply and real output.

The Chi- square independent variables from Wald coefficient restrictions test show that the joint null hypothesis of no long run impact of money supply on general price level(inflation) and no short run impact of money supply on output, and the reverse side impact could be rejected at 5% and 10% critical values .

Table 4.8 Granger Causality Wald Tests of M2 (Null hypotheses: Real GDP, CPI, M2lc, M2rr do not impact each other in both short run and Long Run With .($RGDP_{2012}$, CPI_{2012} AND $M_{2012)}$)

Models	Null Hypothesis		Chi-Square	Df	Pro> Chi2	Conclusion
M2 channel	DlnRGDP does not Granger cause dlnCPI	LR	4.56	2	0.121	No
		SR	7.6814	3	0.053	Yes
	DlnRGDP does not Granger cause dlnM2lc	LR	5.4377	2	0.142	No
		SR	8.28	3	0.132	No
	DlnCPI does not Granger cause dlnRGDP	LR	4.1184	2	0.249	No
		SR	5.35	3	0.211	No

	DlnCPI does not Granger cause dlnM2lc	LR	9.4225	2	0.024	Yes
		SR	11.34	3	0.102	Yes
	DlnM2lc does not Granger cause dlnRGDP	LR	5.4320	2	0.154	No
		SR	8.13	3	0.043	Yes
	DlnM2lc does not Granger cause dlnCPI	LR	7.832	2	0.050	Yes
		SR	4.674	3	0.092	No

4.9.2 Granger Causality Test of Exchange Rate Channel

From the same procedure of the Johansen co-integration test as confirmed by error correction term, one co-integrating relationship is found between real GDP, CPI and real exchange rate. With regards to short run dynamic adjustment of the variables, inflation and output exhibit feedback effects; the causation runs from real exchange rate to real GDP and price level.

The results of Error Correction Model and the Wald Granger causality in the presence of exchange rate indicate the existence of short run bidirectional causality between output and price level.

The Chi- square independent variables from Wald coefficient restrictions test show that the joint null hypothesis of neither long run nor short run impact of real exchange rate on general price level(inflation) output, and the reverse side impact could be rejected at 5% and 10% critical values .

Table 4.9 Granger Causality Wald Tests in VAR of Exchange Rate (Null hypotheses: Real GDP, cpi, M2lc, M2rr do not impact each other in both short run and long run with .($RGDP_{2012}$, CPI_{2012} AND M_{2012}))

Models	Null Hypothesis		Chi-Square	Df	Pro> Chi2	Conclusion
Exchange rate channel	Dlnrgdp does not Granger cause dlncpi	SR	7.356	5	0.072	Yes
		LR	21.378	4	0.001	Yes
	Dlnrgdp does not Granger cause dlnrer	SR	6.401	5	0.423	No
		LR	2.1496	4	0.828	No
	Dlncpi does not Granger	SR	7.879	5	0.047	Yes

	cause dlnrgdp	LR	14.669	4	0.012	Yes
	Dlncpi does not Granger cause dlnrer	SR	2.243	5	0.198	No
		LR	6.8365	4	0.233	No
	Dlnrer does not Granger cause dlnrgdp	SR	3.978	5	0.008	Yes
		LR	16.836	4	0.033	Yes
	Dlnrer does not Granger cause dlncpi	SR	4.983	5	0.034	Yes
		LR	10.289	4	0.067	No

4.9.3 Granger Causality Test In VAR- Interest Rate Channel

Employing the same procedure of the Johansen co-integration test as followed by error correction term, it is to be concluded that long run relationships exist among output, price level and interest rate. In the short run, bidirectional causality is found between output and price level and one way impact runs from interest rate to output and price level.

Table 4.10 Granger Causality Wald Tests in VAR of Interest Rate (Null hypotheses: Real GDP, GDP Deflator, M2lc, M2rr and do not impact each other in short run with ($RGDP_{2012}$, CPI_{2012} AND M_{2012})

Models	Null Hypothesis		Chi-Square	df	Pro> Chi2	Conclusion
Interest Rate Channel	DlnRGDP does not Granger cause dlnCPI	LR	2.526	2	0.113	No
		SR	8.7135	3	0.013	Yes
	DlnRGDP does not Granger cause dlnIAO	LR	.13889	2	0.933	No
		SR	1.478	3	0.219	No
	DlnCPI does not Granger cause dlnRGDP	LR	12.263	2	0.002	Yes
		SR	3.543	3	0.0097	Yes
	DlnCPI does not Granger cause dlnIAO	LR	.0128	2	0.994	No
		SR	2.897	3	0.598	No
	DlnIAO does not	LR	7.9908	2	0.018	Yes

	Granger cause dlnRGDP	SR	11.032	3	0.041	Yes
	Dlnaio does not Granger cause dlncpi	LR	8.4195	2	0.015	Yes
		SR	11.432	3	0.029	Yes

4.9.4 Granger Causality Test in of Credit Channel

The results of the co-integration test based on Johansen's procedure for credit channel channel of monetary policy indicate the absence of the co-integration between variables. Therefore, the variables have a no long-run equilibrium relationship between them but short run. The evidence of short run bidirectional causality is between credit channel, real GDP and price level. Therefore, there would be only short run dynamics which in fact detects evidence of bidirectional causation between real GDP and price level; between price level and domestic credit by banks; reverse causation running from real GDP to domestic credit.

Table 4.11 Granger Causality Wald Tests in VAR of Credit Channel (Null hypotheses: Real GDP, CPI, M2lc, M2rr do not impact each other in both short run and long run with (RGDP$_{2012}$, CPI$_{2012}$ AND M$_{2012}$)

Models	**Null Hypothesis**	**Chi- Square**	**Df**	**Pro> Chi2**	**Conclusion**
Credit channel	Dlnrgdp does not Granger cause dlncpi	9.3874	3	0.025	Yes
	Dlnrgdp does not Granger cause dlndcb	7.7147	3	0.052	Yes
	Dlncpi does not Granger cause dlnrgdp	9.5009	3	0.023	Yes
	Dlncpi does not Granger cause dlndcb	10.033	3	0.018	Yes
	Dlndcb does not Granger cause	5.5717	3	0.104	Yes

	dlnrgdp				
	Dlndcb does not Granger cause dlncpi	9.9557	3	0.019	Yes

4.10 Impulse Response Functions (IRFs)

In this analysis, a one-unit shock to the monetary policy tools of M2,exchange rate ,interest and credit balance estimate the Impulse Response Functions over a period of 30years. IRFs on GDP and CPI as endogenous variables are generated when these channels were used as the monetary policy instrument and the results are shown graphically on Appendix A.

Accordingly When M2 is employed as a monetary policy instrument in analyzing the impacts of monetary policy shocks ,CPI responds positively to shocks in real GDP and M2 and it diverges to its own shock .i.e., this shows a tendency of inflation to adjust to the equilibrium. Real GDP is independent of all shocks including own shocks but gives stable relation with regard to all. Money supply is affected by its own past history of disturbances only for short while but give stable relation to all.

The impulse response functions in exchange rate equation shows that shocks in inflation are explained by past history of its own shocks, real GDP shocks and real exchange rate; that is inflation responds positively to shocks in both lagged RGDP and monetary policy shock via exchange rate and negatively in response to the shocks in its own.

The graphs generated by the impulse response functions confirm that inflation responds to shocks in real GDP and gives a little bit more diverging responses to shocks in interest rate as shown Appendix A, graph 3). And those graphs generated by forecast error variance decomposition show the scenario where all variables vary proportionately due to their own shocks. Likewise inflation responds to variation real GDP and interest rate; output responds to shocks in inflation and interest rate; and interest rate is unresponsive to shocks in real GDP and price level as presented in figure 7 appendix B).

CHAPTER FIVE
CONCLUSION AND POLICY RECOMMENDATION

5.1 Conclusion

This thesis is an attempt to investigate impact of monetary policy on GDP, price level from different time perspectives, i.e., the hypotheses tested are output is monetary policy effect in the short run and price level is monetary policy effect in the long run. Also it probes the relevancy of various channels of monetary policy transmission mechanism both in the short run and the long run for the economy of Ethiopia. Moreover, it has been investigated the relation between inflation and output under all cases.

Tri-variate Vector Autoregressive Models had been developed and four Error Correction Models were estimated. The data properties are analyzed to determine the stationarity of time series using the Augmented Dickey-Fuller and Phillip Perron unit root tests which indicate that all the series are I(1). Either the variable CPI or GDPD was included or chosen in each model on the basis of their statistical significances in the model of interest.

The results of the co-integration test based on Johansen's procedure for M2 channel of monetary policy indicate the existence of the co-integration between variables. Therefore, the variables have a long-run equilibrium relationship between them; despite there may be disequilibrium in the short-run. The evidence of long-run bidirectional causality between money supply and price level shown by co-integrating equation and adjustment parameters of GDP deflator and money supply infers that money is neutral in its effect and thus, refutes the Keynesian belief and supports the monetarists view.

Also the estimates of Error Correction Model and the Wald Granger causality indicate the existence of short run bidirectional causality between money supply and price level and unidirectional causation running from output to price level. The evidence of short-run bidirectional causality between money supply and general price level indicates that price level is a monetary phenomenon in the short-run. This short-run dynamic adjustment between money supply and price level in turn indicates that active monetary policy to stabilize short-run fluctuation in prices must be handled with caution, as it would intensify rather than moderate price fluctuations in the long-run. On the other hand, this result means, in a high-or hyperinflationary economy like Ethiopia's, inflation does have a feedback effect on money supply growth and this generates a self-sustaining inflationary process.

Regarding the short-run dynamic adjustment relationship between inflation and economic growth, the results suggest that if there is any policy that stimulates economic growth, would intensify inflationary process in Ethiopian case.

Following the same procedure, the Johansen co-integration test also confirmed by error correction term one co-integrating relationship is found between real GDP, CPI and real exchange rate and the second ECM of exchange rate channel was estimated. The proof of long run relation among variable indicates long run causation and hence, either price level or output or both are monetary phenomena. This can be implicated as real exchange rate depreciation has stagflationary effect in the long run i.e., slowing down income and rising inflation and unemployment.

With regards to short run dynamic adjustment of the variables, inflation and output exhibit feedback effects; the causation runs from real exchange rate to real GDP and price level. This evidence regarding the short-run bidirectional causation among economic growth and price level implicates that any attempt to devaluate domestic currency as monetary policy instrument to stabilize short-run fluctuation in prices and boost output must be handled with caution, as it would intensify rather than moderate price fluctuations and reduce output in the long-run following the non linear relationships between inflation and output. Furthermore, the evidence regarding the short-run dynamic responses of output and price level to the shocks in real exchange rate indicates that a short-term ease in monetary policy following devaluation is also likely to fuel inflation and reduce speed of the long-run economic growth since price level and output are found to Granger cause each other.

In summary, all the foregoing discussions leads to put exchange rate as important channel of monetary policy instrument in Ethiopia to be considered a supplementary, if not an independent, source of inflation and economic slowdown.

Interest rate channel is the third VECM estimated with one co-integral equation. From the same results, it is to be concluded that long run relationships exist among output, price level and interest rate. In the short run, bidirectional causality is found between output and price level and one way impact runs from interest rate to output and price level. Thus, both output and inflation are interest rate driven putting interest rate channel as another important supplementary channel of monetary policy instrument in Ethiopia. It follows that tight and loose monetary policies executed via open market operations with target interest rates can be effective; however, the word of caution is that any move to affect either price or output independently must be exercised with caution owing to feedback effects between the later two.

Credit channel is the fourth monetary policy instrument and the only first difference VAR estimation of this following absence of co-integrating relation among the variables of the model. Therefore, there would be only short run dynamics which in fact detects evidence of bidirectional causation between real GDP and price level; between price level and domestic credit by banks; reverse causation running from real GDP to domestic credit.
This channel has importance since almost all business firms in Ethiopia rely on bank lending for their external financing. The fact that it works only in collaboration with interest rate channel may reduce its importance however. Therefore, it has to be treated along with the later to achieve target objective.

5.2 Policy Recommendations

In spite of the fact that complete models of economic growth and inflationary process needs to be formulated independent, still there will be the ground on which it is possible to formulate the hypotheses within the framework of the thesis for Ethiopian case. In result, those first sets of hypothesis which established causation between monetary policy shocks and prices movements in the long run, are proved to be existing and constitutes a satisfactory framework for the discussion of anti-inflationary policies in the Ethiopia.

Ethiopia is a dual economy characterized by coexistence of traditional sector and a modern sector. However, the traditional sector is the most dominant since almost 85 per cent of the populations live in this sector which constitutes a large share in the GDP. Consequential upon that monetary policy is less likely to affect the output of the sector since the economic activity of this sector is exclusively determined by exogenous forces. This might be one reason why not most of those set of hypotheses that established causation between money supply and monetary policy instruments in one side and real GDP in the other side holding in the short run. This implies either the need to transform the economy from traditional agricultural sector to modern industrial sector or look other policy options available other than monetary policy.

The other interesting outcome of the thesis is the confirmation of bidirectional causation between real GDP and output which should be taken seriously with all the short coming at its disposal; that the tradeoffs must be made either to push for sustained economic growth at expense of higher inflation or to vote for stable prices at expense of lower economic growth rate. In fact this work is not the attempt to determine the cutoff threshold level of inflation below or beyond where the relation between the two would be positive or negative. So, it leaves the scope for furthermore detailed investigation to be free of doubt.

In the attempted to probe the strength of channels through which monetary policy shocks propagate, this paper found that the exchange rate is the most important channel followed by interest rate and credit channels. This may be because the effect of exchange rate could be hard to accurately dissociate from inflation owing to supply side effects of exchange rate. In that case, any real exchange rate depreciation could lead to adverse supply shock given that the country is heavily dependent on imports of all types. The subsequent high import bills will result in rise of domestic prices and reduce domestic productions through their on aggregate demand and supply channels. The extent of inflationary process and output contract that results from adverse supply shocks should not be ignored easily. Therefore, exchange rate should occupy primary spot over the others

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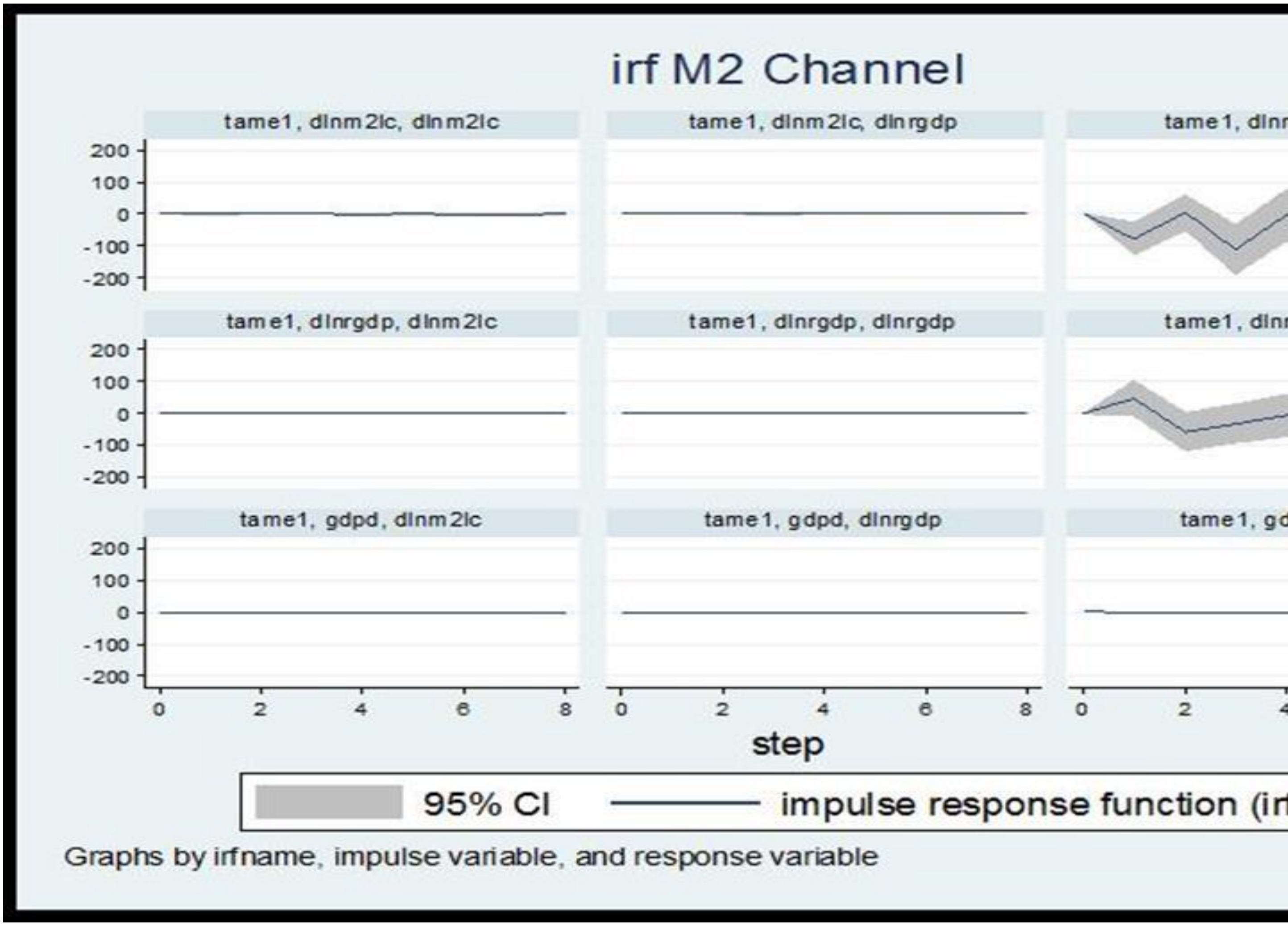
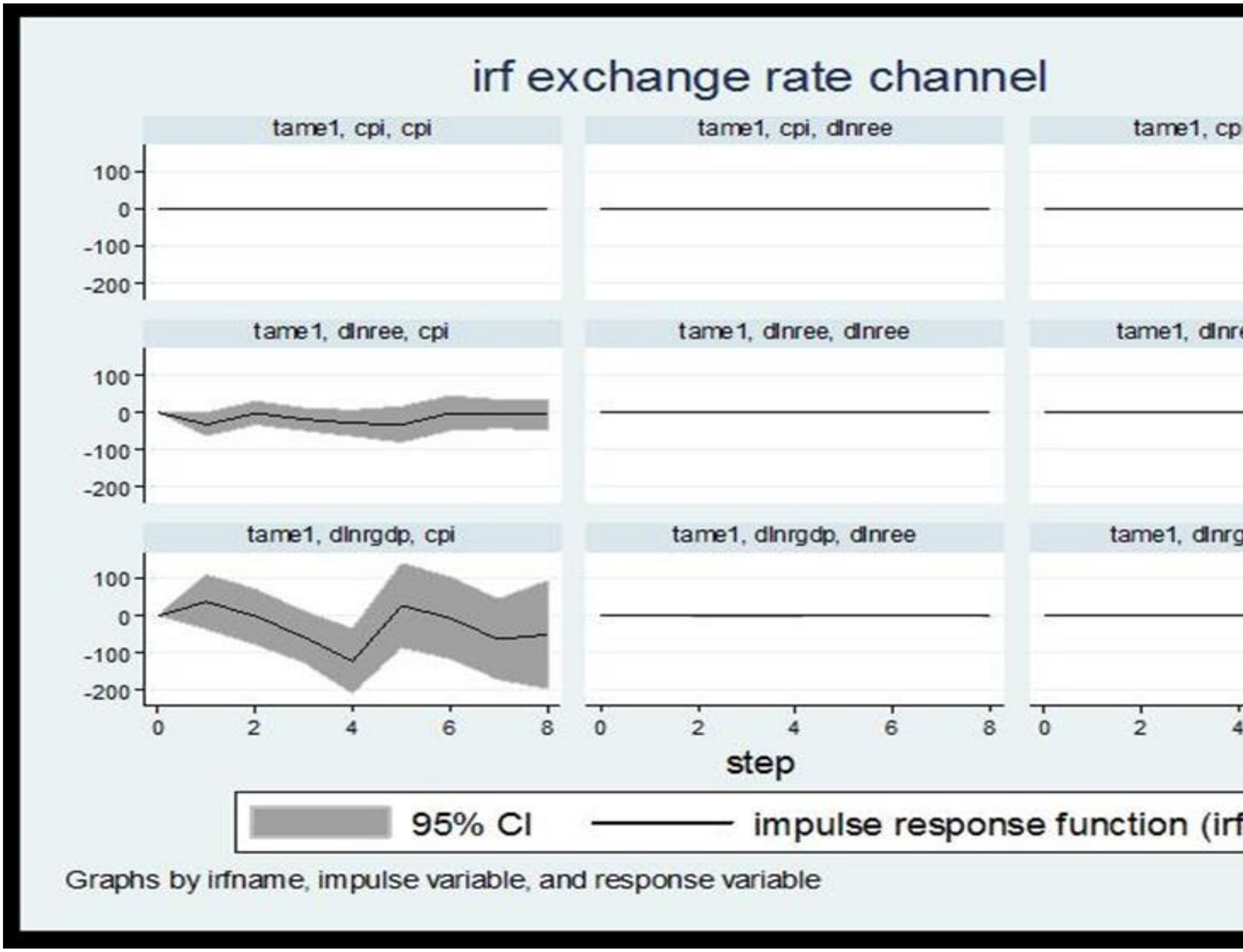
APPENDICES

Appendix A: Impulse Response Function of Each Variable

Graph 1: Graphical Representation of Imulse Response Function of M2 channel

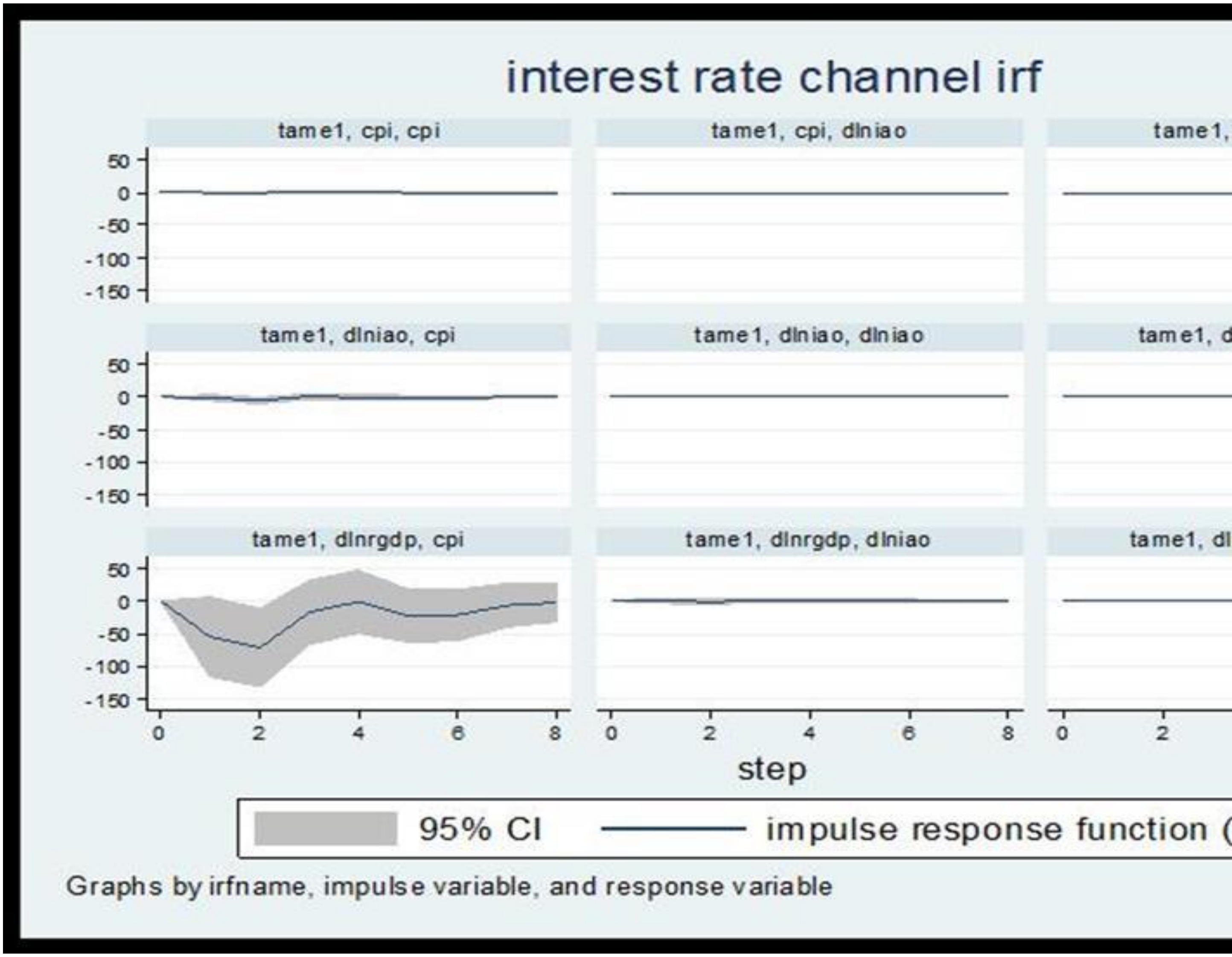


Graph 2: Graphical Representation of Impulse Response Function of Exchange Rate channel

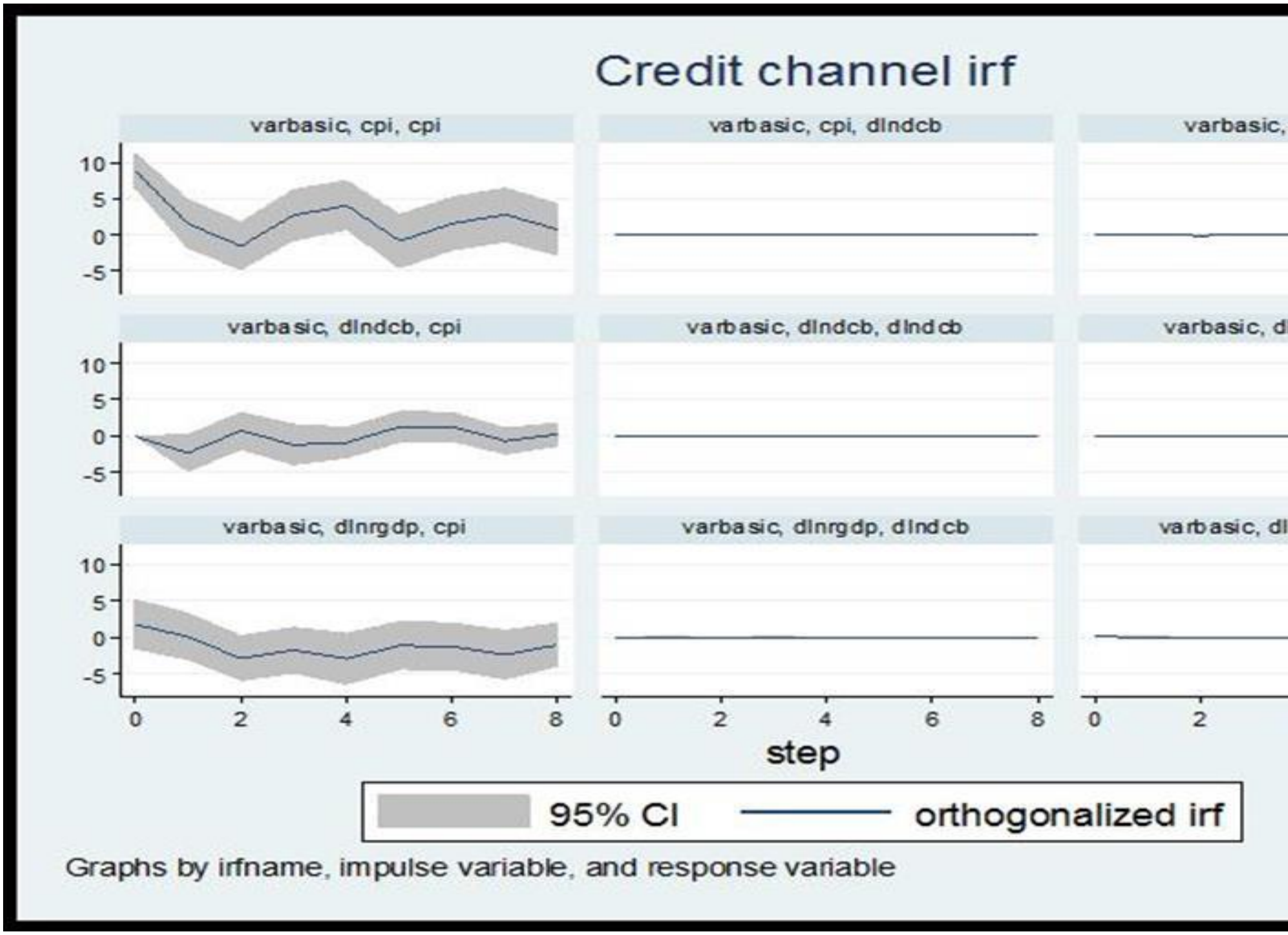


irf exchange rate channel
tame1, cpi, cpi
tame1, cpi, dlnree
tame1, dlnree, cpi
tame1, dlnree, dlnree
tame1, dlnrgdp, cpi
tame1, dlnrgdp, dlnree
100
0
-100
-200
0
2
4
6
8
step
95% CI
Graphs by irfname, impulse variable, and response variable

Graph 3: Graphical Representation of Impulse Response Function of Interest Rate channel



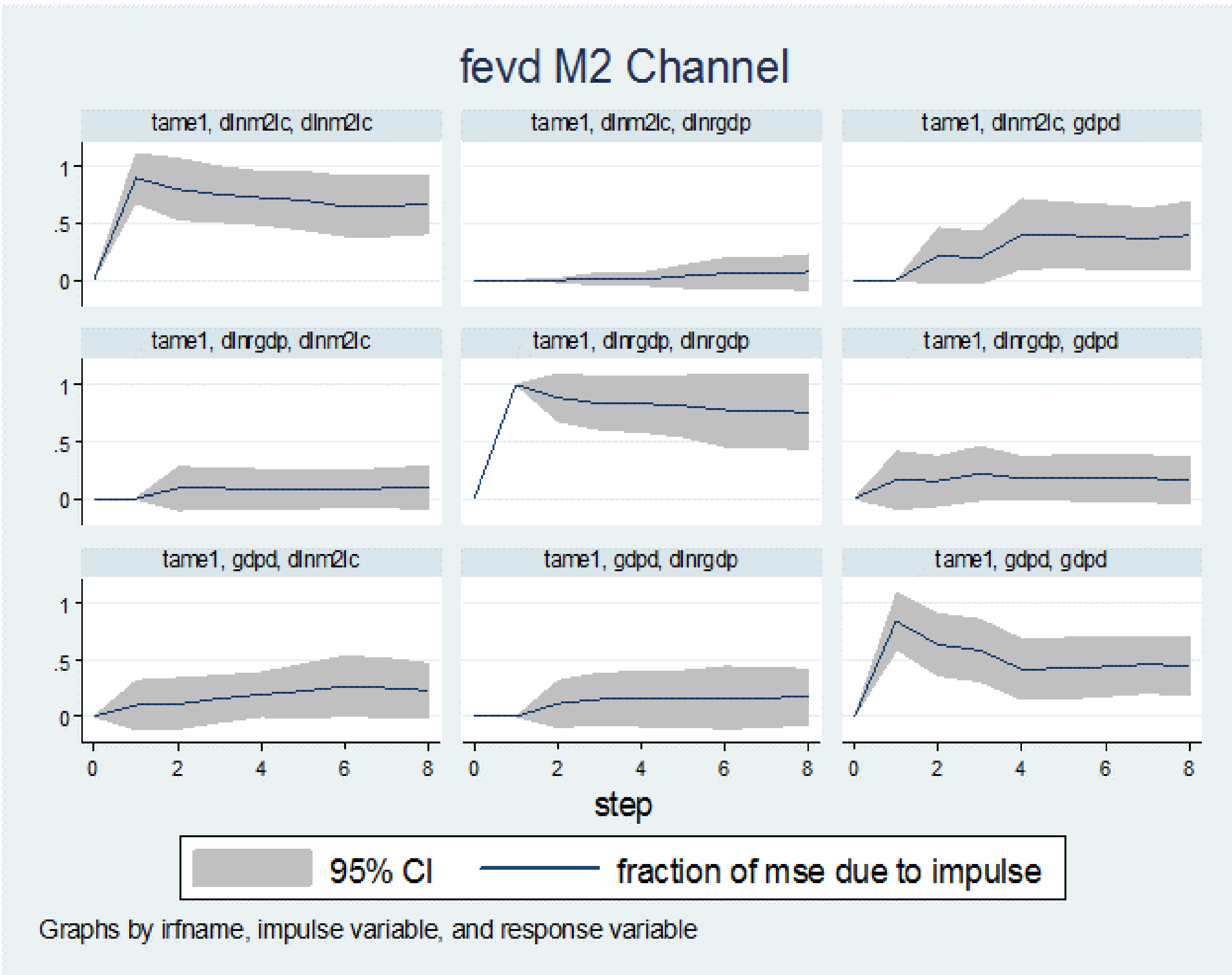
Graph 4: Graphical Representation of Impulse Response Function of Credit Channel



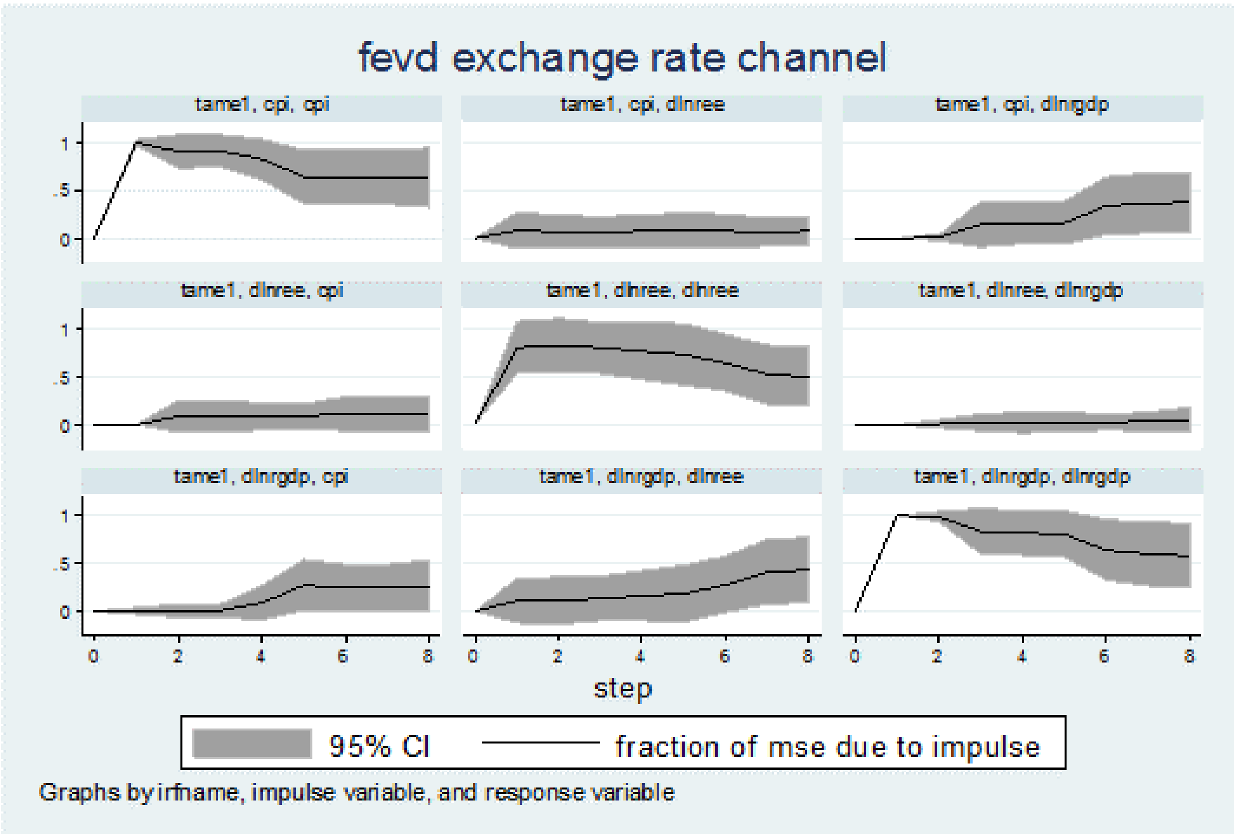
APPENDIX B

FORECAST ERROR VARIANCE DECOMPOSITION OFVARIABLES (RESPONSE TO OWN SHOCKS)

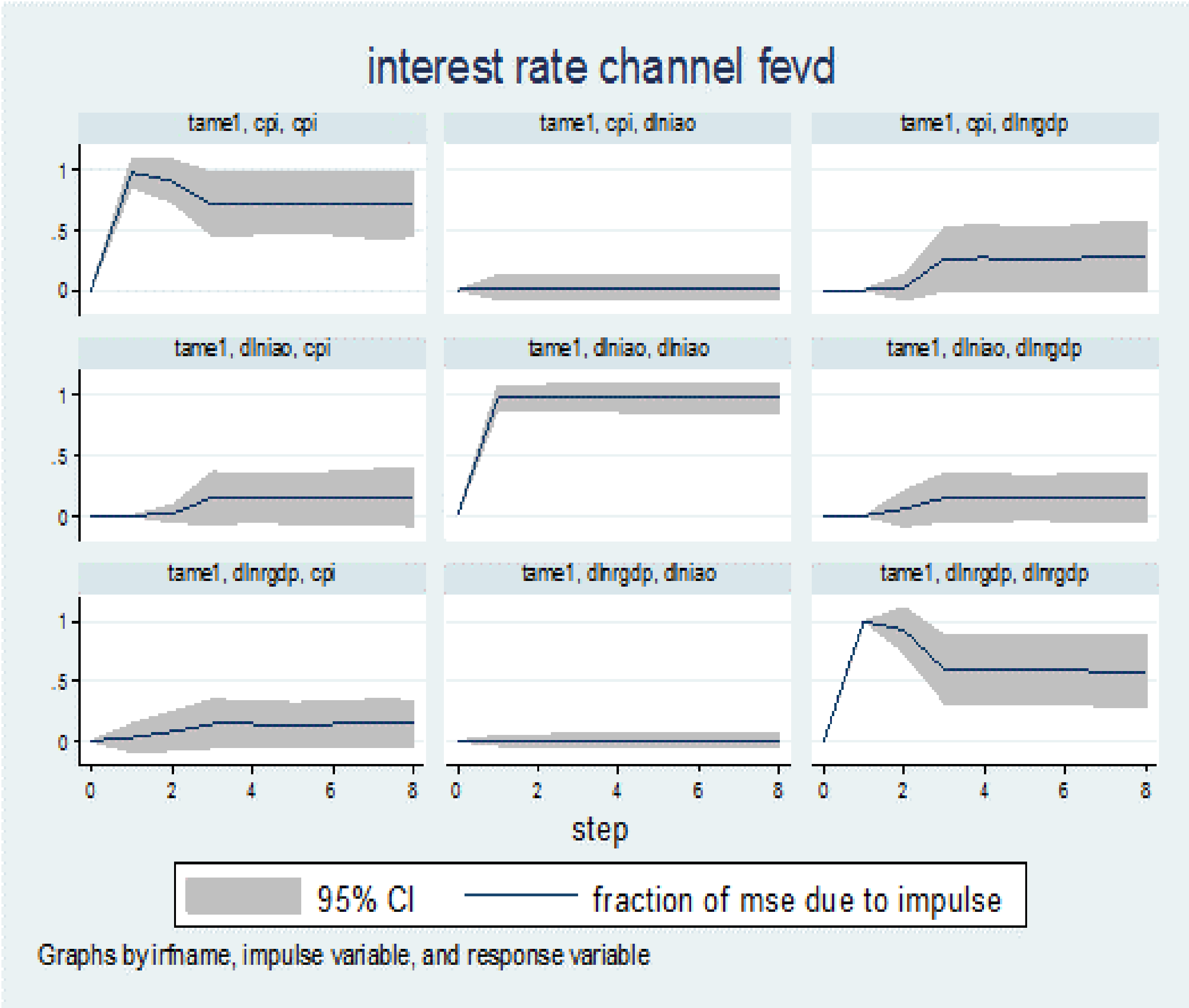
Graph 5: FEVD OF M2 CHANNEL



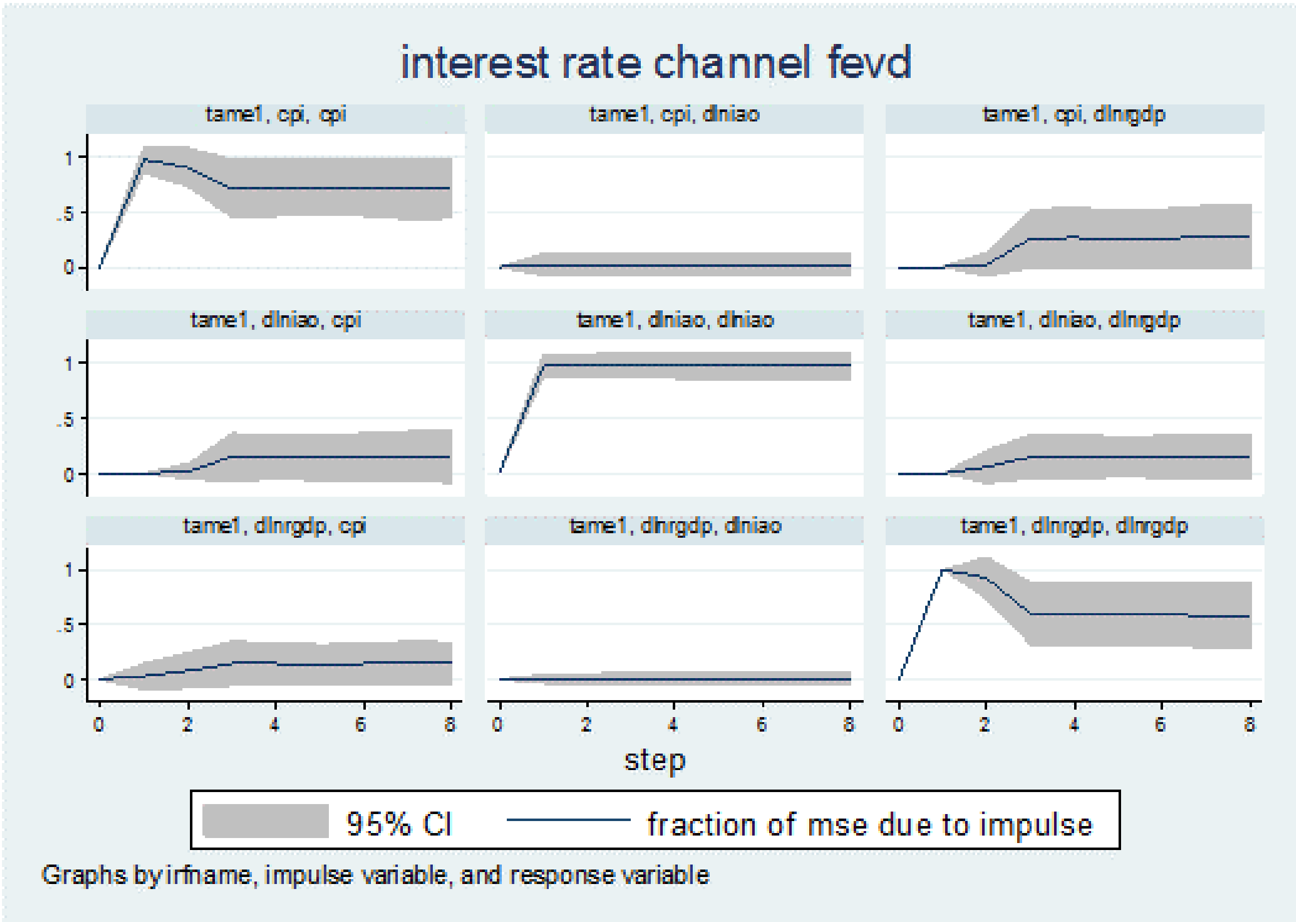
Graph 6: FEVD OF EXCHANGE RATE CHANNEL



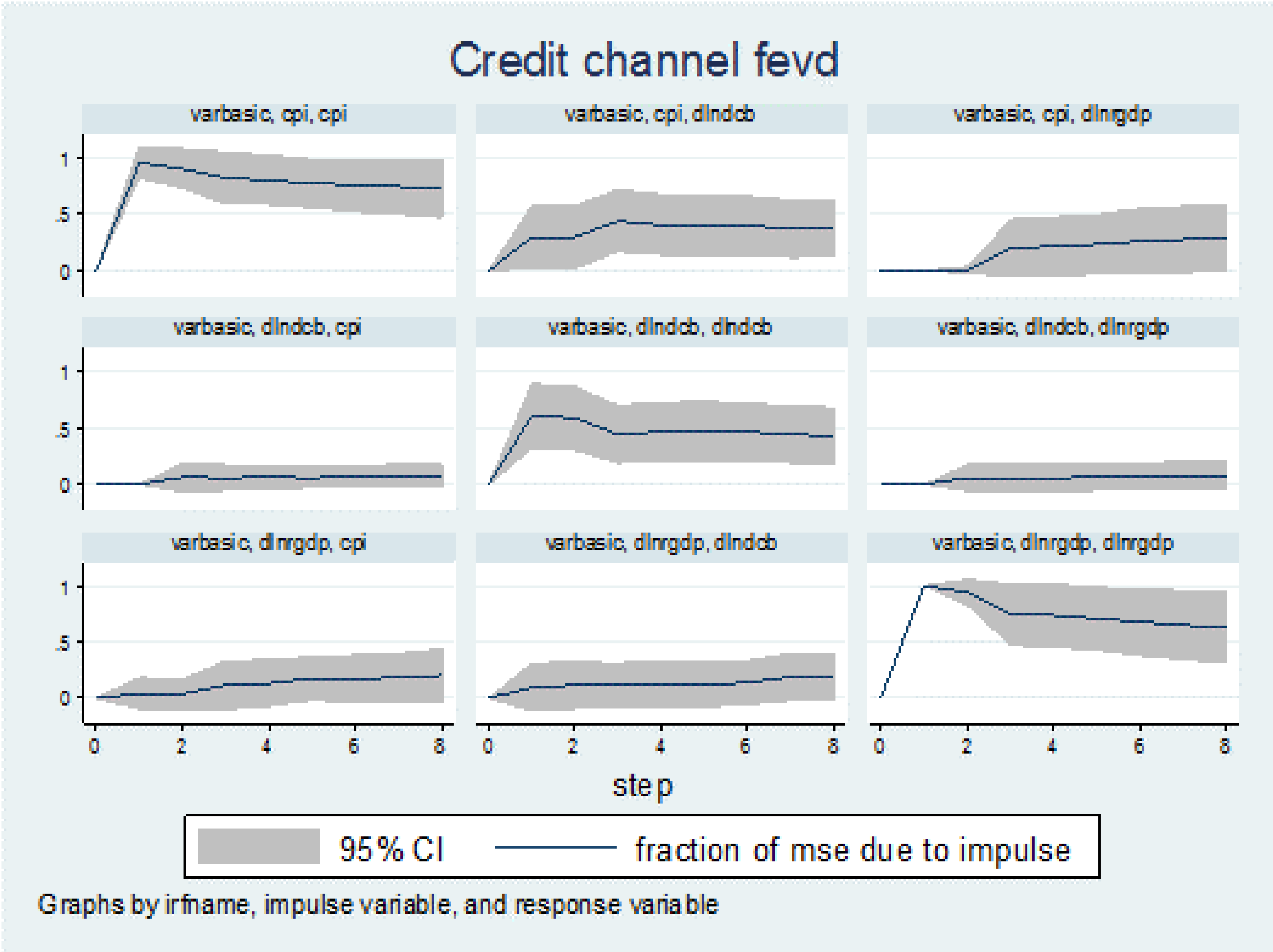
Graph 7: FEVD OF INTEREST RATE CHANNEL



Graph 8: FEVD OF INTEREST RATE CHANNEL



Graph 9: FEVD OF CREDIT RATE CHANNEL


Credit channel fevd
varbasic, cpi, cpi
varbasic, cpi, dlndcb
varbasic, cpi, dlnrgdp
varbasic, dlndcb, cpi
varbasic, dlndcb, dlndcb
varbasic, dlndcb, dlnrgdp
varbasic, dlnrgdp, cpi
varbasic, dlnrgdp, dlndcb
varbasic, dlnrgdp, dlnrgdp
1
.5
0
0
2
4
6
8
step
95% CI
fraction of mse due to impulse
Graphs by irfname, impulse variable, and response variable

APPENDIX C

VECTOR ERROR CORRECTION MODEL ESTIMATIONS

Table 1 Vector Error Correction Model for M2 Channel

Variables	Dlnrgdp	Dlngdpd	Dlnm2lc
EC_{t-1}	**-.0035704** **(0.017)**	**-.757296** **(0.033)**	**.0086988** **(0.001)**
$dlnrgdp_{t-1}$	**.1601831** **(0.453)**	**82.2077** **(0.005)**	**.2955442** **(0.163)**
$dlnrgdp_{t-2}$	**-.2939575** **(0.219)**	**34.21204** **(0.291)**	**.1524936** **(0.520)**
$dlngdpd_{t-1}$	**-.0000429** **(0.987)**	**-.5293783** **(0.149)**	**-.0079257** **(0.003)**
$dlngdpd_{t-2}$	**-.0014385** **(0.490)**	**-.2725092** **(0.336)**	**-.0039664** **(0.055)**
$dlnm2lc_{t-1}$	**.5780458** **(0.177)**	**100.5375** **(0.083)**	**-.7876207** **(0.063)**
$dlnm2lc_{t-2}$	**.3581912** **(0.256)**	**75.66128** **(0.077)**	**-.5171516** **(0.098)**
Constant	**-.008636** **(0.548)**	**.0000327** **(1.000)**	**-.000678** **(0.962)**
R- sq	**0.5601**	**0.6959**	**0.6744**
Chi^2	**22.91697**	**41.18288**	**37.28685**
$P>chi^2$	**0.0064**	**0.0000**	**0.0000**

Table 2: Vector Error Correction Model for Exchange Rate Channel

Variables	**Dlnrgdp**	**Dlncpi**	**Dlnrr**
EC_{t-1}	**-.2851548** **(0.024)**	**-121.8383** **(0.008)**	**-1.245042** **(0.017)**
$dlnrgdp_{t-1}$	**.0938722** **(0.793)**	**149.9062** **(0.026)**	**.7146686** **(0.348)**
$dlnrgdp_{t-2}$	**-.3022527** **(0.291)**	**114.8845** **(0.032)**	**.7207182** **(0.237)**
$dlnrgdp_{t-3}$	**.0196824** **(0.942)**	**107.8403** **(0.035)**	**-.0252389** **(0.965)**
$dlncpi_{t-1}$	**.0008256** **(0.531)**	**-.5330032** **(0.031)**	**.0025658** **(0.360)**
$dlncpi_{t-2}$	**-.0011096** **(0.475)**	**-.7184028** **(0.014)**	**.0012687** **(0.701)**
$dlncpi_{t-3}$	**.0010402** **(0.571)**	**-.3622459** **(0.293)**	**-.000701** **(0.857)**
$dlnrr_{t-1}$	**.183145** **(0.101)**	**37.32173** **(0.075)**	**.3268898** **(0.168)**
$dlnrr_{t-2}$	**.1439395** **(0.184)**	**40.33571** **(0.047)**	**-.0155291** **(0.946)**
$dlnrr_{t-3}$	**.1029945** **(0.300)**	**.0002109** **(0.181)**	**.1287358** **(0.542)**
Constant	**-.014891** **(0.278)**	**-.082068** **(1.000)**	**-.0172196** **(0.555)**
R- sq	**0.6429**	**0.6472**	**0.6429**
Chi2	**26.9998**	**27.51213**	**26.9998**
P>chi2	**0.0046**	**0.0038**	**0.3001**

Table 3 Vector Error Correction Model for Interest Rate Channel

Variables	Dlnrgdp	Dlncpi	Dlniao
EC_{t-1}	**-.8675308** **(0.000)**	**-138.2406** **(0.000)**	**-.7919192** **(0.730)**
$dlnrgdp_{t-1}$	**.0988169** **(0.549)**	**67.03662** **(0.041)**	**1.508369** **(0.556)**
$dlncpi_{t-1}$	**.0032159** **(0.000)**	**-.0908215** **(0.606)**	**.0025988** **(0.850)**
$dlniao_{t-1}$	**-.0299029** **(0.005)**	**6.451968** **(0.002)**	**-.6655395** **(0.000)**
Constant	**-.00828** **(0.434)**	**.0000302** **(1.000)**	**.003797** **(0.982)**
R- sq	**0.6438**	**0.5729**	**0.5052**
Chi2	**41.57377**	**30.84625**	**23.48351**
P>chi2	**0.0000**	**0.0000**	**0.0003**

Table 4: Vector Error Correction Model for Credit Channel

Variables	Dlnrgdp	Dlncpi	Dlndcb
$dlnrgdp_{t-1}$	**.308981** **(1.67)**	**-30.95889** **(-0.87)**	**.2814415** **(1.09)**
$dlnrgdp_{t-2}$	**-.1520854** **(-0.83)**	**-13.80963** **(-0.39)**	**-.6321172** **(-2.47)**
$dlnrgdp_{t-3}$	**.0254486** **(0.14)**	**-87.70072** **(-2.59)**	**.4754324** **(1.94)**
$dlncpi_{t-1}$	**.0007128** **(0.68)**	**.3607378** **(1.77)**	**.0002392** **(0.16)**
$dlncpi_{t-2}$	**-.0028816** **(-2.67)**	**-.3240745** **(-1.56)**	**.0041603** **(2.77)**
$dlncpi_{t-3}$	**.0024768** **(2.24)**	**.7330916** **(3.44)**	**.0004239** **(0.28)**
$dlndcb_{t-1}$	**-.2422677** **(-1.91)**	**-45.70014** **(-1.87)**	**.1758311** **(1.00)**
$dlndcb_{t-2}$	**.0060513** **(0.05)**	**31.73798** **(1.29)**	**-.0444373** **(-0.25)**
$dlndcb_{t-3}$	**-.1785273** **(-1.40)**	**-60.13132** **(-2.45)**	**-.3019613** **(-1.70)**
Constant	**-.0490364** **(-2.25)**	**-3.717229** **(-0.88)**	**-.0498047** **(-1.64)**
R- sq	**0.5210**	**0.4585**	**0.4256**
Chi2	**29.37117**	**22.86114**	**20.00672**
P>chi2	**0.0006**	**0.0065**	**0.0179**