MONETARY POLICY AND INFLATION DYNAMICS IN ETHIOPIA

A Thesis Submitted to School of Graduate Studies of Jimma University in Partial Fulfillments for the Award of the Degree of Master of Science in Economics

(Economic Policy Analysis)

By:

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CERTIFICATE

This is to certify that the thesis entitled ***"Monetary Policy and Inflation Dynamics in Ethiopia"****, Submitted to Graduate School of Jimma University for the award of Degree of Master of Science in Economics (Msc in Economic Policy Analysis) complies with the rules and regulations of the university and is carried out by Mr. Minyahil Alemu Haile under our guidance and Supervision.*

Therefore, we hereby declare that no part of this thesis have been submitted to any other university or institutions for the award of any degree or diploma.

Main Adviser's Name	Signature	Date
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Mr. Yilkal Wassie	_____	_____

DECLARATION

I, Minyahil Alemu Haile, proclaim the originality of this Msc Thesis in Economics entitled ***'MONETARY POLICY AND INFLATION DYNAMICS IN ETHIOPIA'*** and contains no material that has been presented in any other institution for the award of any academic qualification; or any other events. Hence and that, except where otherwise indicated throughout the body of the paper, this research project belongs to me and is my original work.

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Name: Minyahil Alemu Haile

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Date: 30 May, 2016.

Place and Date of Submission: At the Research and Post Graduate Program Coordinating office of the Business and Economics College on 30 may, 2016.

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Board of Thesis Examination;

We, members of the thesis examination board, hereby approved the originality of this thesis entitled "Monetary Policy and Inflation Dynamics in Ethiopia" thereby critically examining it and evaluating the final open defense by the undersigned researcher. Therefore, we certify that this paper meets the required standards with respect to quality and originality.

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ACRONYMS

ADFT:	Augmented Dickey-Fuller Test
AfDB:	African Development Bank
AIC:	Akaike Information Criteria
CPI:	Consumer Price Index
CSA:	Central Statistics Agency
FPE:	Final Prediction Error
HIC:	Hannan-Quinn Information Criteria
IMF:	International Monetary Fund
LL:	Log Likelihood
NBE:	National Bank of Ethiopia
PP:	Phillips Perron Unit Root Test
QTM:	Quantity Theory of Money
RGDP:	Real Gross Domestic Product
UNDP:	United National Development Programme
VAR:	Vector Auto Regressive
VECM:	Vector Error Correction Model

ABSTRACT

While inflationary sources have been linked with various issues, its attachment to money supply had especial consideration in Economic theories. The Classical version of Quantity Theory holds for inflation as being 'always and everywhere a monetary phenomenon'. On the other side, Keynes's version departed by claiming neutrality of money in an economy where idle resources exist. Motivated basically by these theoretical departures on the link between the two variables, and the limited availability of literatures particularly in the spirit of the subject it is concerned with, the present study aimed to empirically examine the share of money supply in explaining the dynamics of inflation in Ethiopia, using the Vector Error Correction Model by employing the data series for the period ranging from 1974/75 to 2014/15. The Johnson's Maximum likelihood approach for cointegration has indicated the existence of long run relationships amongst variables entered the inflation model. Moreover, the ADF and PP Unit Root tests confirmed that the time series in the model are all integrated of order one (I(1)). VECM regression suggest that money supply, real Gross Domestic Product, trade openness, real exchange rate, budget deficit and the nominal deposit interest rate variables have together been important in explaining the long run dynamics of inflation. Except real Gross Domestic Product and nominal deposit interest rates, the effects of the remaining ones persist also in the short run. Moreover, money supply was estimated to impose the dominant effect towards validating the classical version of QTM in the context of Ethiopian economy. Besides, monetary policy is found to be more important in the dynamics of Ethiopia's inflation compared to fiscal policy. Furthermore, VAR Granger Causality test suggests the causation running from budget deficit to money supply; and, from money supply to inflation, but no causality was suggested in reverse. This also reveals partly the applicability of Sargent and Wallace (1981) aspect of the so called 'fiscal dominance' in Ethiopia. Finally, the study suggests for the enhancement of effectively designed and implemented network of both monetary and fiscal policies considering the power of money supply on inflation. Moreover, investments in food and agricultural sectors could considerably support the process of ensuring price stability.

***Keywords*: Inflation, Money Supply, Vector Error Correction Model**

CHAPTER ONE

INTRODUCTION

1.1. Back ground of the Study

Despite its difference in structure and performance, every economy to the end has a common vision of realizing economic development; which could only be assisted by real and sustained economic growth. For instance, China's largest economy is due to an annual average growth rate of 9.8% for over three decades, particularly from 1978 to 2009 (Song, 2010). Growth, on the other hand, highly necessitates stability in key macroeconomic variables. Martin cited by Mankiw (2008) and Friedman (1971), equally appreciate the role of stabilized macroeconomic variables in determining the behavior of general economic environment; though they view ways of stabilization otherwise. For Friedman, an economy is naturally stable, in that any stabilizing policy will have a futile role. But, Martin calls for any shock correcting reaction of either monetary or fiscal policy measures. General Price level (measure of inflation variable) is therefore, among the key macroeconomic variables with the largest concern in monetary theory as well as modern economic literatures. Inflation beyond the optimum level is ruthless in general. Degrading the real value of money balance, inflation retards economic growth via its adverse effect on the domestic private saving. Moreover, it destructively impacts welfare of the public; more harshly the poor section (Yamaguchi, 2015). Even though it is of the most focused issues in economic researches, the problem of inflation remained a monotonous headache to monetary policy makers. Regardless of the empirical discoveries on various possible roots of inflation, macroeconomic theories reveal the inflationary effect of money supply to be the dominant one. Furthermore, in support of their argument, theories maintain the inflationary effect of other factors to be induced by prior monetary shocks (Mbutor, 2014). This theoretical attachment of money to inflation being the motivation to this particular study raises a need to highlight a little.

Monetary association of inflation was central in early classical economics; of which the Quantity Theory of Money is primarily mentioning. Via Fisher's quantity equation ($MV = PY$), the *QTM* reveals for the existence of equi-proportional link between money supply (M) and price (P) (Dornbusch and Fischer, 1970). In the model, monetary growth accounts for the whole variation

in the growth rate of inflation. Aggregate demand is the proposed channel through which monetary impulse transmits directly to the general price. That means when money supply increases, aggregate demand increases and hence price equally moves in the same direction. The inference bases on prior assumption of the economy operating at its natural state, and invariant velocity (V) of money income. Milton Friedman and his students in Chicago University were among the allies of the quantity theorists in viewing inflation as being *'always and everywhere a monetary phenomenon'* (Hua and Ting, 2006).

Ali and Abdull (2014) noted that successful monetary policy necessitates properly identified systematic behavior of macroeconomic variables of which it exercises. Unlike conventional *QTM*, empirical studies have confirmed various forms of interactions between money supply and inflation thereby suggesting the relationship rather complex and depend on the channel of inflationary experiences. Money induced aggregate demand is the immediate channel through which inflation responds to any monetary shock in the model of the *QTM.* The central question here could be that, what if the prevailing inflation is not explained by the demand side of the economy? With supply side shocks, studies have confirmed inverse relationship between the two variables. For instance, studies by Akinbobola (2012) in Nigeria and Turan (2014) in the economy of USA have confirmed inverse correlations with similar reason as the case above. More importantly, Romer (1996) has confirmed the importance of other factors like; technology and labor supply conditions (among others) in explaining inflation unlike the postulate of *QTM;* though, money is still the chief item in his model. A little overview of empirical works above obligates us to acknowledge the possibility for various forms of interactions between money supply and inflation; rather than relying on the postulate of the *QTM* alone. Besides, one has to have the fact that, roots of inflation varies across economies based on their respective economic, social, political and other conditions governing them.

Finally, thereby simultaneously considering the views of conventional *QTM* and various empirical evidences on the relationships between money supply and inflation, it would be safe at least to assume that, part of the inflationary experiences in Ethiopia is explained by monetary growth; having considered also the role of other factors and the importance of theoretical debates against the classical monetary economists. While developing such a point, this study is not

intended to determine whether money has a space in the room of inflation in Ethiopia, but rather to investigate how large its space is, relative to other factors in the model. Hence, broad money supply being the focus variable, this study examined the share of money supply both in the short and long run dynamics of Ethiopian Inflation by controlling budget deficit, real exchange rate, real *GDP*, nominal deposit interest rate and international trade openness variables for the time period serially ranging from 1974/75 to 2014/15.

1.2. Problem Statement

It is the general argument for inflation to be the public enemy. By degrading the real value of money balance; inflation retards economic growth and public welfare thereby shrinking the intensity of domestic saving (Wood, 1998). Citrus paribus, in countries of like ours, where the wage rate remains stiff for long compared to the price level, the growth rate of inflation above the moderate level would elevate living costs. Having only barely said about the cons of inflation, the study argues that it needs be controlled since doing so would mean saving the economy from all its adverse effects. Therefore, the best way to control inflation begins from critical examination of its sources.

Inflation in Ethiopia is still an issue to deal with. When the country achieves success in recording single digit growth rate for one or two years, it has immediately been followed by even three folds higher rate of the previous level. For example in 2004, it was registered at a rate of 2.38%, but has mounted to an annual average of 22.98% from 2005 to 2008, with a double digit rate for each individual year. Furthermore, it is after this single digit growth rate that Ethiopia has experienced an ever higher inflation rate of more than 56% in 2008 (NBE, 2012/13). As usual with prudent monetary and fiscal policy efforts, single digit growth rates of 2.71% and 7.32% were respectively revealed in 2009 and 2010; yet, jumped to 38.04% in 2011, and 20.81% in 2012. However, in the latter two successive years of 2013 and 2014, the annual growth rates of inflation have been registered to be 7.39% and 8.45%. For the reason that it has been exhibiting cyclical and highly unstable pattern for a long, inflation in Ethiopia is highly volatile; and hence, the single digit growth rates recorded in the last two years doesn't pledge its sustainability. Despite the availability of various justifications for the causes of inflation in Ethiopia, it continued to exhibit highly volatile trend which being a threat to the future of the general

economy. Therefore, inflation is still an issue in Ethiopia; despite the existence of numerous justifications on its causes, it has been exhibiting similar and highly volatile trend. It implies that none of the previous justifications were effective and hence, it is crucial to investigate its dynamics in a relation to other macroeconomic variables in enhancing the monetary policy target of maintaining stable price.

Besides, it would be very difficult to deny the existence of other non-monetary forces equally (or even dominantly) governing prices in any economy, in contrast to the claims of monetarists who hold for direct and equi-proportional correlations between money supply and inflation, with a later being an effect. There have been theoretical as well as empirical challenges against this postulate. Of the immediate theoretical challenges were the Keynes's version of *QTM*, and the Banking school of thoughts who particularly reversed the direction of causation from inflation to money supply (Humphrey, 1974). For Keynes, money is not inflationary where idle resources are available and, it is highly inflationary in the long run even with greater magnitude (being provoked by inflation expectation) than in Classical version. Moreover, studies confirm various forms (even negative) of relationships between the two series; see Akinbobola (2012); Joseph and Musa (2015); Holod (2000). Hence, these empirical and theoretical departures from the classical version of *QTM* on the relationship between the two series were the primary motivations to this particular study. Hence, the study has examined the applicability of the classicals' version of *QTM* in the context of Ethiopian economy. As far as the researcher's knowledge is concerned, no previous work has been done in current spirit in the country.

Moreover, previous studies in Ethiopia have been focusing more on the general cause-effect aspects of inflation with no particular attention to money supply and inflation as opposed to their share in inflation and monetary theories. Even though, a little work has been done, they all commonly share serious limitations: variables employed as well as the number of observations were of limited size. Besides, not a little of them were concerned with food inflation alone. For example, a study by Josef et al (2008) had considered only with the short run issues. Demirew (1998) for example used only agricultural and money supply variables in a relation to inflation as cited by Kibrom (2008); and Josef et al (2008) controlled only money supply, exchange rate, agricultural production shocks and foreign price. The study is limited basically on three grounds;

by employing small number of variables, observations and considering the short run issue only. Other recent studies are also not out of this limitation: study by (Tsegay, 2014; Meseret, 2014) might exemplify it. Moreover, majority of them used only small size of observations. For instance; Kibrom (2008), Jema and Fekadu (2012); Josef et al (2008); Habtamu (2013) and Temesgen (2013) are mentioned among others. Carrying out analysis in such a way leads to defective conclusions. The present study differs from the previous once on a number of grounds. First, both the size of observations and variables are extended as appropriate as the econometric models employed. As per my knowledge, no previous work has been done in the spirit of the present study. Moreover, the present study has considered both the long and short run dynamics of inflation. Uncommon with the previous studies, the relative importance of fiscal and monetary policy in the dynamics of inflation in Ethiopia were simultaneously analyzed. Hence, motivated primarily with the theoretical as well as empirical departures from the traditional version of *QTM*, the study aimed to verify which suits more to the Ethiopian context. Limited literatures on the particular subject of this study complemented with the already raised shortcomings of previous studies and other special considerations discussed in this section have provided further impetus for this study.

1.3. Objectives of the Study

The study has primarily intended to empirically examine the power of money supply in explaining the dynamics of inflation in Ethiopia by employing the time series data for the period ranging from 1974/75 to 2014/15.

The following specific objectives are also considered towards accomplishing the set broad objective of this particular study.

- Identifying the potential sources of inflation in Ethiopia;
- Evaluating the relative share of each determinant in the dynamics of inflation in Ethiopia;
- Assessing the trends of inflation and broad money supply during the study period;
- Analyzing the possible causality amongst the broad money supply, budget deficit and inflation variables in the model, and;

- Determining the comparative importance of monetary and fiscal policies in the dynamics of Ethiopian inflation at large.

1.4. Hypothesis of the Study

Based on its objectives, the study has formed the following basic hypotheses to be tested using any appropriate econometric testing procedures;

- There exists positive correlation between money supply and inflation in Ethiopia.
- Money supply granger causes inflation.
- There is positive relationship between budget deficit and money supply.

1.5. Significance of the Study

Though a lot has been done regarding the causes and effects of inflation throughout the world, Ethiopia's share in the literature is low; particularly an empirical investigation on the relationship between money and price is limited too in our country. Moreover, since inflation is dynamic (as it is subject to various internal as well as external dynamic shocks) the past conclusions and findings might not be as such effective in the current policy decision making; as a result assessing its timely behavior would have a considerable role in monetary policy effectiveness. Moreover, this study has extended both the study period and number of variables so that, it reasonably filled the statistical limitations of previous studies. Most previous cause effect analyses on inflation were undertaken without instantaneous consideration of possible causation between inflation and other independent variables; and were addressed in this study. As of Gujarati (2004), the existence of relationships doesn't necessarily imply causation.

When we highly restrict the number of explanatory variables, the predicting power of the model becomes weak and in that case the major determinant variable will simply be reported as stochastic term, so that, the problem still remains being unidentified. In an attempt to avoid possibility of committing such an error, the explanatory variables used in this study will be large enough and are also expected to be smart enough to explain the inflationary dynamics of the country based on their theoretical and empirical back ground in a relation to price movement.

1.6. Scope and Limitations of the Study

In this study, the effect of money supply on the Ethiopian inflation dynamics was analyzed by using the time series data ranging from 1974/75 to 2014/2015. The reason for the specification of the time period is based on several grounds. First, to reasonably test the relationships over a reasonably lengthy time horizon in an attempt to overcome the limitations arising from low time span observations. Moreover, the time series data set in Ethiopia are relatively available since the overthrow of the imperial regime. Money supply being the focus variable, other variables like real Exchange Rate, real Gross Domestic Product, government fiscal deficit, nominal interest rate and the country's trade openness were controlled in the model.

Absence of sufficient literatures on the particular relationship between money supply and inflation in Ethiopia has constrained the process of this study. Alternatively previous inflation models in the country controlling money supply were referred.

1.7. Organization of the Paper

This paper is partitioned in to six separate chapters. The first chapter introduces the study in general; and, the topic related issues were briefly reviewed and contained in chapter two. Chapter three presents the overview of price and monetary developments during the study period covered. Chapter four briefs the type and source of data employed, the general methodologies and econometric models adopted for various statistical conditions in time series analysis. After examining all the necessary econometric model diagnosis tests, the inflation model adopted was estimated and discussed in chapter five of this paper. After all, chapter six concludes the study by summarizing the main findings and forwarding important policy directions.

CHAPTER TWO
REVIEW OF RELATED LITERATURES

The capacity of an economy in dealing with macroeconomic shocks considerably determines its position in gaining international competitive advantage. Exploiting the competitive advantage, therefore, heavenly rests on the stability of key macroeconomic indicators. Issues related with unemployment, general price level, national real income, Balance of Payment *(BOP)* and the exchange rates have been subjects of most economic literatures over the globe; of which inflation is the particular focus of this study. High and persistent inflationary pressure could yield distortive effect on the general network of economic system thereby shocking the agent's consumption-saving decision, the Terms of Trade via the exchange rate channel of monetary policy, and since that, the workings of macroeconomic elements are not independent; its link with other indicators could even aggravate the initial impact of inflation. Hence, all these adversely cost to the public welfare, functioning and credibility of the general government running with such scenarios within its vicinity.

Economics is relatively rich in theories regarding the causes of inflation; of which, the earliest monetary explanation has remained an important point of macroeconomic debates. Referring to various empirical studies and theoretical considerations of inflation over the global economy, in none of them is the monetarist's view of inflation left at least unconsidered. Hence, this study is also motivated by the special role the classical theorist's money plays with inflation. Here under, details of the monetary explanations of inflation together with its contra-arguments, and the role of expectations and structural factors in a relation to inflation are briefed.

2.1. Theoretical Literature Review

2.1.1. The Quantity Theory of Money (the Classical Version)

The *QTM* appointed central bankers as being the critical administrators of the general price level since money growth accounts for majority of the variations in the level of prices. According to their assertions, it is only to the will of the central bankers that the fate of inflation in any economy could be determined. Milton Friedman (1976) confirmed this hypothesis by claiming inflation to be lonely a monetary phenomenon (Hetzel, 2007). The Fisher's (1911) quantity

equation, given by *(MV = PY)* was a key for the analysis of the classical economists. Where *Y* is real output, V (the average number of times a unit of currency is spent per year), P (the general price level) and M is the amount of money supply in an economy. Assuming no rigidities in the economy (in prices and wages), they claim for any monetary change to proportionally change the price level. Hence, Money is simply a veil and no more influential in their model. The hypothesis of direct and proportional transmission of any monetary shock to price level was based on the prior assumption of fixed velocity and real output (Nelson, 2007).

The classical economists were highly monetarists and their inflationary analysis was very straight forward. They divided the general economy in to two as the real and nominal component, and further suggest both sectors to be determined by the real and nominal factors respectively. That is, given the quantity equation *(MV = PY)*, the Y variable *(real GDP)* is affected only by real variables with monetary impulse nothing force over it. Moreover, they argued for velocity to be exogenous variable, which only is to be influenced by the customs and institutional arrangements of the society, but not of monetary growth. With the two variables fixed in the model $(M\bar{V} = P\bar{Y})$, the *QTM* assert that any shock in money supply would be reflected by proportional variation in general price level (Ley and Cate, 2001; Ray and Anderson, 2011)

More precisely, the above argument could be represented by $(\%\Delta M + \%\Delta V = \%\Delta P + \%\Delta Y)$; and since $\%\Delta V = 0$ and $\%\Delta Y = 0$, the relationship between the remaining two nominal terms would be, $\%\Delta M = \%\Delta P$: the impact of monetary shock on general price is complete. Where, Δ is (the difference operator). Real income (Y) could not be affected by money supply in that it only is influenced by the real factors. The symbol $\%\Delta P$ represents the rate of change in aggregate price level which we call inflation rate, and $\%\Delta M$ represents the rate by which money grows. So, in equation above, letting $\%\Delta V$ zero and $\%\Delta Y$ being governed by other exogenous factors, we remain with the equation $\%\Delta M = \%\Delta P$. A fundamental implication here is that a given change in growth of money induces exactly similar growth in the inflation rate, which provokes Milton Friedman to hold for inflation as being *"always and every where a monetary phenomenon"*.

In conclusion, in the classical model real variables are invariant of the quantity of money: the quantity of money only determines the level of price. A mere rise in money supply with unresponsive production would only result in persistent increase in aggregate price which is known to be inflation, but there would be no other resultant effect. Hence the optimum policy is to cut unreasonable monetary growth: money growth rate beyond the real income growth rate is hence unproductive. Milton Friedman (1976) advised for a given percentage change in money supply to be matched exactly by equal and proportional growth of real GDP.

2.1.2. Keynes's Version of Quantity Theory of Money

Though debatable, the classical version of *QTM* remained a dominant macroeconomic ideology since 1930s. Since then, an immediate attack emerged from the Great Britain economist John Maynard Keynes following a Great Depression. We noted in the classical model that a monetary impulse has no real effect on the economy. For classical economists, changes in money supply impact only the nominal variables but not the real variables (Hoover, 2012). Keynes rejected this hypothesis and analyzed the money-price spirals differently. His attack takes the following forms. To the beginning, he didn't believe in the fallacy of direct causal links between money and price. The classicalists' analysis was based on the prior implicit assumption of the economy operating at full employment. This assumption was an important stepping point for Keynes in his critics against the *QTM.* He hence maintained that, in the presence of idle labor and other material resources; forming such an implicit assumption could be of a futile task (Dutt and Skott, 2005). Continuing his justification, he identified three basic reasons why an economic agents demand money balance; the transaction demand (in line with the traditional economists), the precautionary demand *(for emergency cases)* and the speculative demand *(money even as store of value);* with the latter being the key tool in his attack against the *QTM* (Krusell, 2004). He contained these three motives together in his money demand function given by ($\frac{Md}{P}$ = f(-i, +Y)), and related money demand positively to income and negatively to the level of interest rates: thereby recognizing the role of interest rate in affecting the demand for money.

Price being determined by the demand and supply for money, Keynes formulated his own quantity equation given by $P = \frac{M}{D}$, or $\frac{M}{P}$ = D. Where; M is the nominal stock of exogenously

determined money supply; D, the demand for money and P is the general price level (Keynes, 1936).

Keynes has made an important macroeconomic revolution in monetary economics while recognizing the role of interest rate in economic decision thereby identifying the role many plays in the economic system. With the nominal interest rate included in his money demand function, Keynes stressed that, changes in the quantity of money affect price level only after impacting the level of interest rate, and hence investment, output and employment (Humphrey, 1971). So that, the transmission mechanism between money and the price level is indirect. The immediate impact of change in the quantity of money rests on the interest rate but not on price. It implies that when interest rate decreases *(following positive shock in the quantity of money)*, the level of investment responds by increasing. Hence, the levels of output, income and employment increase also as well. The additional level of employment, in fact, imposes additional pressure on aggregate demand, and that the rising wage and other costs together induce the price level to rise. Here, the transmission of monetary impact on price is not only indirect, but the effect is not complete, since part of the money balance is held by the speculators, see (Nelson, 2007; Krusell, 2004)

Both versions of *QTM* are similar after the economy attains its full employment level by recognizing the full impact of money growth on the general price level. The Keynes's version reveals that the elasticity of price with respect to any monetary shock be equal to zero ($e_p = 0$) in an economy with idle resources to utilize. According to him, in such an economy, monetary injections would enable utilize idle resources and employment which increases output in a proportion to changing aggregate demand, hence there would be no impact on prices in the short run (Dutt and Skott, 2005). The elasticity becomes one, given the level of output and employment fixed at full capacity and is '*True inflation'* for Keynes. Any monetary growth while the economy is operating at full capacity induces proportional change on price.

Secondly*,* the constant assumption of velocity was no more guaranteed in Keynes's version of *QTM.* In his *Tract*, he claimed that velocity of money is rather pro-cyclical *(subjected to shocks)* by considering the impact of interest rate on demand for money. Capturing velocity by *(V*

$= \frac{PY}{f(i,Y)}$), Keynes argued that velocity is a positive function of interest rate. It works like this; when interest rate increases, money demand decreases and, as a result velocity of money increases. The implication is that, increased interest rate induces cash holders to save more to gain extra benefit from rising rates. So that, they put more of their balance at bank and remain with few and since the amount of balance available in the economy is now less, it frequently changes hands to serve the remaining unsatisfied motives for money. With unstable velocity, no way for money to directly transmit to price and vice versa; i.e. any change in price or income would also be absorbed by the same process as a result no increasing response from money supply (see Snowdon and Vane, 2005).

The traditional aggregate demand and aggregate supply curve frame works are also used to analyze the transmission of money through interest rate to other real variables. With a perfectly elastic supply curve, the additional money supply induces aggregate demand and the overall effect would be added employment and output: money with neutral effect on price (i.e. no inflation) until full employment level is attained. But in a normal condition, an induced effective demand (because of additional money supply) would result in increased price level and employment given that the output is at its potential level (Andolfatto, 2000).

Humphrey (1998); Minsky (2008); Laurentiu and Teodora (2009) insist that the long run inflationary effects of expectations were considered in the Keynes's Version of *QTM*. In his reformulated quantity equation $\frac{M}{P}$ = D, Keynes set money demand as a function of wealth, public habit, interest rate and the future inflation expectation. He argued that, when money supply increases continuously, agents may expect higher future rate of inflation thereby reducing the demand for money. Since the price level adjusts to equate the demand for and supply of money, price level must increase to deflate the real money balance (*following the fall in the real demand for money).* Therefore, a given monetary injection in the long run, together with higher inflationary expectation might create even a more than proportionate change in the price level ($e_p > 1$).

Besides, the resultant higher velocity of money even creates additional pressure on price, it in turn, multiplies the impact of initial monetary growth on inflation leading to faster inflationary growth than the change in money supply (Teodora and Laurentiu, 2009; Friedman, 1971),

To the end, the money demand function in a relation to real economy seems well defined by Keynes. Actually money is demanded not only for transaction purpose as the case with classical economists: all the functions described by Keynes are certainly practical. Unlike the traditional economists, money demand for Keynes is not independent of interest rate considerations. Financial asset markets *(like bonds)* are today among the common financial capital holding alternatives that everyone can access. With the exception of what Keynes called *'liquidity trap situation'*, people prefer to hold their wealth in the form of financial assets expecting the future gain. According to him, it is only in a situation of liquidity trap that people hold their balance in the form of cash, and he called it absolute liquidity preference (Keynes, 1936; Minsky, 2008)

Post-Keynesians had one concern in a relation to the velocity of money. They maintained that, with volatile velocity, it is hardly possible to predict the influence of any monetary expansion on the price level. The other form of criticism against the classical QTM was from the Real Bills Doctrine. For them, money supply is an endogenous variable; it responds to its demand which is completely against the money supply explanation of the classical economists. The logic behind their argument is that; price increase being determined by any autonomous factor causes fall in the real power of the existing money stock and hence increases the demand for money. Therefore, banks respond by increasing money supply (Humphrey, 1974 and 1998). Here we found that money, unlike the traditional *QTM* is passive. Besides, the direction of causation between these two variables was hypothesized in reverse as opposed to the classicals.

2.1.3. The Demand-Pull Theory of Inflation

Keynes and his followers (Keynesian economists) identified another source of inflation which they called the demand pull inflation (the name takes its origin). From Baumol and Blinder (2010), in a closed economy we have a Keynes' national income identity comprising three components as consumption (C), investment (I) and government expenditure (G) and in sum their total becomes aggregate demand. Hence, Keynesians hold for inflation to take place when

this sum tops the full employment level of aggregate supply in an economy. Any factor causing aggregate demand to increase above its potential level would result in inflation. However, in the long run, aggregate demand can be held above the potential level of output only by increasing the quantity of money in circulation higher than the real growth rate of output. With the larger being aggregate demand, they described that the positive difference between these two variable as 'inflationary gap'. They further claim inflation to take place even before reaching the full employment level of output because of various prevailing constraints in the economy and at the time of prosperity, it is natural for inflation to occur.

According to Olsson (2010), Keynesians' had a simple and direct tool to deal with this type of inflation. Their advice is to absorb money back from the public sufficient enough in reducing the extra effective demand imposing unwanted pressure on the level of price. Accordingly, any effective demand beyond the full employment level of aggregate supply should be eliminated. A national target to reduce any one of the components could be effective in reducing aggregate demand and hence inflation. An example of such a measure may be either increasing the amount of tax or reducing the level of government expenditure in that both instruments become effective in reducing currency in the hands of the public. An alternative approach may be legally restricted private investment either in sectors or volume. Legally set flexible consumption to income proportion *(however difficult to implement)* may be an alternative mechanism in an attempt to reduce effective demand.

2.1.4. The Cost-Push Fallacy

Curtis and Irvine (2015) maintain that the supply side of the economy to explain output, inflation and the economy's adjustment to equilibrium at the potential level of output. The argument here is that, any factors contributing negatively to the production side of the economy are all inflationary. For example, increasing raw material costs, rising labor costs, indirect taxes could direct reflect in the form of increased prices or induce price to increase thereby lowering production levels. Of course, it would be certain for price level to increase following decline in the supply of any item; and more importantly for necessary product supplying sectors. It means when supply is insufficient to satisfy the prevailing demand in the market, it will create

competition in the demand side and hence suppliers respond by increasing the prices. This argument is consistent with the conventional aggregate demand and supply interaction in clearing out the market.

Totonchi (2013) further insisted that the simultaneous rise in price and wages in an economy operating with output gap to push the economy to its natural state only at higher constant rate of inflation. In the framework of aggregate demand and supply diagrams, the aggregate supply curve shifts back to higher price level when there are higher production costs in the general economy. The moment is what we call 'cost–push inflation'. This type of inflation is often regarded 'self-sustaining', as it induces cost and price to rise continuously in its course of action. When prices are rising because of inadequate supply (may be due to various natural or other disturbances in the production sector), the aggregate supply dampens; creating pressure on aggregate demand and this finally manifests itself in the form of increased prices.

It is frequently stated in theoretical literatures like, Batten (1987); Humphrey (1974) for this type of inflation to take place in the following manner: to cope up with the rising living costs in a condition of rising aggregate prices, employees may bargain and form a union demanding additional wage income; rising wages in turn can help drive inflation. This type of price surge also is regarded to spread in other sectors of the economy. It implies that, if a given production sector involves the input use of goods and services produced in another sector for which the production costs are increasing; then the prices of the goods produced in the first sector also increases (Ibid)

In his *Treatise,* Keynes also identified other form of inflation, 'profit inflation'. He insisted that, with a relatively autonomous power in own price determination; firms in a markets with imperfect competition *(mostly monopolists and Oligopolists)* tend to rise the price of their products to compensate for the rising production costs and hence earn higher profit (Minsky, 2008; Totonchi, 2013; Keynes, 1936). Our knowledge of Microeconomic theory gives power, of course, to monopolists in their marketing decision. So that, they are relatively free in determining prices and output combination. As a result, when input prices are rising, they tend to shift the additional cost burden to consumers in the form of increased prices. However, their profit level depends on the type of demand curve for their products: in doing so, they will be more successful

with perfectly inelastic demand curve, which further could be determined by the nature of items to be supplied. Here, a firm operating in a monopolistically competitive market would be less effective *(compared to one in a pure monopoly)* due to the availability of related substitutes from other sources.

2.1.5. The Structuralist's Explanation

Monetary variable is not as such an important issue to deal with this theory of inflation; it rather is mostly a theory to explain inflation in developing economies based on structural considerations. According to the structuralists' point of view, the structural constraints prevailing in the social, political and economic aspects of the developing countries are primarily responsible to explain price *(Wikipedia, the free encyclopedia: http://www.businessdictionary.com).* Hence, the extent of inflation here is based on the structural composition and level of economic advancement. Accordingly, the cost and extent of this type of inflation falls as the economy grows and achieves transformation.

Wachter (1979) has identified three basic factors commonly explaining these structural rigidities and hence inflation in most of the developing economies; these being, inelastic supply of agricultural products, insufficient national resource (government budget constraint) and foreign exchange bottlenecks. According to him, factors which are responsible in creating sartorial imbalances are inflationary in developing economies. The implication with the first case is that, the unbalanced growth trends in agricultural sector and urbanization could result in higher rate of inflation in most LDCs. That means agricultural productivity is insufficient to meet its growing demand as urbanization is going ahead.

Besides, LDCs are characterized by monetization of their deficits. This is not different from increasing the quantity of money supply, which is inflationary in line with the classical *QTM.* While linking this to the structural factors, Donath and Dima (2000) and, Jaime (1989) further insisted that, monetization of deficits in *LDCs* is induced by other factors; especially of weak internal financing alternatives and hence loss of confidence by external lenders. Hence, these factors forcing monetization account for the resultant inflation, but not the forced supply of money. Foreign exchange limitations and huge price differentials in the international trade are

also among the main headaches of underdeveloped economies. The implication follows that higher import prices cause domestic prices to increase via being external impact on domestic price level. Finally, structuralists' have a message to *LDCs* at least to minimize the effect of inflation resulting from structural rigidities. That is to develop any optimum measure as well as capable institutions enough to avoid structural rigidness and imbalances in various sectors of the developing economies and bring these changes in the economy.

The analysis of structural economists seems interesting in that all the issues discussed above in a relation to their influence on economies of *LDCs* are all convincing and more of logical. In modern economic literatures, agricultural supply shocks have important role in explaining inflation too, mostly in Africa and some Asian economies, see Kabundi (2012); Rebecca (2014). The explanations on the foreign exchange limitations and low domestic source of revenue in a relation to price are also subjects of modern literatures in *LDCs*. Probably, the uncommon thing would be the way money is regarded in a relation to price (i.e. the monetary contiguous description). Whatever is the case, inflation followed monetization, so is inflationary itself; in a way it is described to be created in less developed countries.

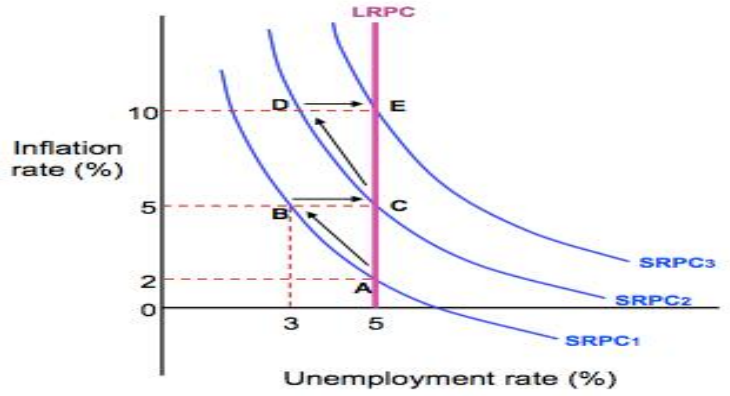
2.1.6. Expectations and Inflation

Expectations might play important role in determining the actual value of economic variables. Particularly, expectations have been linked to the level of inflation via their effect on output and unemployment. Based on Fuhrer and Olivei (2010), we do have basically two types of expectations considered in a relation to inflation: adaptive and rational expectations.

In the theory of adaptive expectation, future expectations are made based on what happened in the past. That means if the trend of a variable assumes a given constant movement, agents will expect similar trend in the future. Related with inflation, if the last year's inflation rate was below than is expected, the lower rate of inflation is anticipated this year and the next year's period (Galati, Heemeijer and Moessner, 2011). Here only past information is important. According to Baumol and Blinder (2010) rational expectations, on the other hand, are not necessarily actual forecasts, but made best as possible given available multi-sourced information. The RET claim economic agents as rational actors in that they are fore ward looking; in making

economic decisions they act rationally, so that, utilize any available information including the past, current and the future in forming predictions, unlike the postulate of adaptive expectations; claiming expectations depend only on past experiences (Romer, 1996). With sufficient availability of all related information, the predicted values will as possibly be as near to the market equilibrium. Moreover, both types of expectation theories can better be explained by using the Phillips Curve frame work.

Figure 2.1: Expectations and the Phillips Curve



Source: Boundless Economics, "Inflation-expectation Nexus"

Where, LRPC: represents Long Run Phillips Curve; and, SRPC: represents Short run Phillips Curve

Given that point *'A'* is the stepping point for this economy where the rate of inflation is given by *2%*, both expectations could be explained in relation to inflation in the following manner. Recall that an adaptive predictor reacts after realizing events. From where we assumed the economy to be, now the government with the intension of reducing unemployment rate has undertaken huge public investment activities in line with (Bruin et al, 2011). Hence the resulted higher aggregate demand from higher employment places the economy to point *'B'*, where inflation is higher at *5%*. At this stage the Phillips curve frame work is in effect. Workers realize higher rate of inflation in spite of rising employment rates so that impose additional wage pressure to compensate for lost real wage incomes. With rational expectations no movement to point *'B'* could be realized, since prior smart decisions on the government's action are possible. Hence, rational predictor directly jumps to point *'C'* at higher rate of inflation thereby rejecting the Phillips curve hypothesis at all.

Turning back to point *'B'*, following higher wage demands by adaptive predictors, companies fire part of the labor force thereby failing the initial government's objective of reducing unemployment in the economy. Hence, the economy could end up with increased unemployment in the long run and moves to point *'C'*, where inflation rate exceeds its original level. The implication with both expectations follows, the Phillips curve hypothesis *(reducing unemployment at a cost of higher inflation)* no longer holds while expectations have a considerable role in the workings of the economy; except to temporary evidence with only adaptive prediction. Further application of other policy as with the case above in our analysis would affect the public expectations and hence the economy temporarily moves back to point *'D'* and, hence point *'E'* for all with adaptive predictions. For exactly the same reason described above, the rational predictor could move directly to point *'E'* with no need of transiting through point *'D'*. Note in both of the cases above that the overall impact would be higher inflation with a natural rate of unemployment level.

The advocators of *RET* (*like Thomas Sargent*) stress much on the credibility and commitment status of the government policy makers in affecting the agents expectations. Heijdra (2002) and Snowdon and Vane (2005) pointed out that, credible and committed policy makers in lowering inflation would make rational expectations adjust towards it. The implication is that rational expectations are always consistent with the announcement and policy of credible and committed policy makers. Moreover, it has been argued with the early policy target announcement and credibility, both objectives with the Phillips curve framework could simultaneously be attained.

2.1.7. Theoretical Link between Deficits and Inflation

Budget deficit is the second important variable in this study *(next to money supply variable)* because of its theoretical link to monetary growth. Via the *QTM* approach, the monetarists argue that monetization of budget deficit is inflationary. There are three ways to finance the public expenditures; borrowing from the public, borrowing from the central bank (Segniorage) and external borrowing (Sargent and Wallace, 1976; Rebecca, 2014). Relative to the other two methods, the central bank financed deficits impose higher inflationary pressures. That is when money is created to fill deficits, the quantity of money in the economy increases and could result in inflation. Budget deficit affects price only after affecting the level of nominal money growth

in an economy. It means, as long as the deficit is not monetized, no link exists between deficits and the price level. Sargent and Wallace (1981) postulate that, following exogenous government spending and taxes, monetization of the deficits would lead to monetary variable induced inflation in the long run. According to them, deficit cause money growth and which in turn causes inflation. Besides, they argue in such a condition, for the existence of feedback effect from inflation to budget deficits in the manner that inflation reduces the value of real revenue to the government, leading to fiscal deficit in the long run. Sargent and Wallace maintain that if monetization of deficits could result in growth of money supply and hence inflation, the situation would be termed as 'fiscal dominance,' due to the fact that the whole process is forced by the initial shocks in the fiscal policy. Lags in the collection of government's tax revenue adversely affect the government's fiscal position thereby reducing the real value of the public's tax revenue; this might further induce monetary creation.

2.2. Empirical Evidences

We do have sufficient literature on the relationship between inflation and money supply, starting from early classicals to the present. Friedman and Schwartz at around 1970 have found the positive but not proportional relationship between the two variables in the economy of the United States (Mankiw, 2008). This empirical fact from the economy of USA was strong evidence for Friedman, to claim inflationary pressures as more of monetary factors. Moreover, the panel data from IFS evidenced the positive correlation between the two variables in many countries at around 1980s (Romer, 1996). Romer further insisted that, these strong relationships between the two variables were not due to the special role money has in inflation determination, but because money accounts for majority of the variations in the growth of aggregate demand. At the times both of these observations were evidences for the quantity theorists postulate of money to take a lion's share in explaining inflation.

Kenneth and Anthony (2015) examined the dynamic impact of money supply on inflation using the panel data for Economic Commission for Western African States (ECOWAS) member states by applying the OLS regression. Their study found the positive and statistically significant impact of the current value of money supply on inflation for Cote D' Ivore, Senegal and Togo, and insignificant impact for Burkina-Faso, Gambia, Ghana and Niger. Moreover, they found

positive and significant impact of the first period money supply on inflation only for Gambia and Ghana, but insignificant impact for Burkina-Faso, Cote D' Ivore, Niger and Nigeria. The impact in the first period was found to be negative, but insignificant in the case of Senegal and Togo.

Mehrizi et al (2011) applied a VAR model to investigate the impact of *GDP*, domestic deposit rate, foreign interest rate, nominal exchange rate and money supply on inflation in Iran, using the times series data from 1973 - 2008. The study confirmed the positive and significant impact of money supply, domestic deposit rate and foreign interest rate on inflation; whereas *GDP* and nominal exchange rates were suggested to have negative influence on inflation in Iran.

Strano (2004) estimated OLS for 11 countries of Iceland over the period 1972-2002 to analyze the relationship between money supply and inflation. In both the high and low inflation periods, monetary growth remained to be the main determinant of inflation with a long run elasticity of more than 0.9. Despite, the estimates have confirmed the claim of *QTM* in all cases.

Oludele et al (2015) also found that shocks in money supply and inflation are closely related and are moving in the same direction in the economy of South Africa in the long run. The association, however, is not suggested to be proportional in contrast to the case with the monetarists. It implies that there is still free space for other factors in their inflation model for South Africa; the negative and significant impact of nominal interest rate on inflation was estimated, and that real GDP was found to positively contribute to the long run dynamics of inflation. The implication with this finding could be that the hypothesis of proportional link between money supply and price level is not welcomed in the economy of South Africa.

Furthermore, there were cases in which money and price relate inversely. An important indicator of this fact would be the study by T.O. Akinbobola (2012) on the money supply, price and exchange interactions in Nigerian economy. His *VECM* approach analysis confirmed the significantly inverse relationship between money supply and inflation in Nigeria. The case was attached to the delays in both the domestic and foreign supply chain outlets. According to his analysis inflation in Nigeria, to the most part, was not explained by aggregate demand and, was his main justification for the inverse movement in both series in Nigerian economy: rather supply related issues were highly responsible in explaining inflation there.

Gull (2011) revealed that monetization of deficits as being the main determinant of inflation in Pakistan. His reasoning follows that, the then heavy rains and floods disrupting the transportation system forced the government to spend more, which in turn, forced it to monetization of the deficits and further resulted in inflationary pressures. Other factors complementing money to explain inflation in Pakistan, according to him, were supply shocks of essential items, frequent devaluation of domestic currency *(the rupee)* and heavy reliance on indirect tax as a means to mobilize domestic resources. His findings could be consistent with the monetarist's view, regarding only the positive correlation between money supply and inflation variables; however, the full and sole inflationary impact of money supply hasn't been confirmed. More importantly, concerning the tax case, it also is attributable to the structuralist's view of inflation; and, the supply shock aspect sides the cost-push inflation analysis. Hence, the classical economists claim that *'inflation is always and every where a monetary phenomenon'* has not been guaranteed given that other factors were important in the process of inflation in Tanzania.

Laryea and Sumaila (2012) applied the OLS estimates to determine the factors explaining price in Tanzanian economy and found that output and money supply govern inflation in the short run, and the parallel exchange rate works together with the first two in the long run. According to his estimates, the long run elasticity of money was found to be 0.77, implying that 77% of the variation in general price level was explained by the variations in money supply. This result was consistent to the monetarist's argument of monetary power in determining inflation. However, money alone is not still the only issue to deal with the concept of inflation: the rest 23% of inflation in the long run would be explained by output, exchange rate and other elements subject to shocks.

A VAR model approach analysis of Holod (2000) shows that the price level in Ukraine was mainly subject to shocks in exchange rate. The result of his analysis concluded that in Ukraine, majority of the variations in the level of inflation was the result of variations in exchange rates significantly: exchange rate depreciation leads to a permanent increase in the price level manifesting itself in increased price of imported goods. From this, we do have fairly sufficient evidence to question the Friedman's postulate of attaching inflation solely to money supply. Regarding causality, the study found weak forward and strong negative backward influences.

The negative, but strong influence running back from inflation to money growth was thought to be a sign of the Ukrainian monetary authority to target inflation. The increase in the price level was followed by reduced money supply which can be the Bank's direct intervention in the process.

Even though, literatures are scant on the particular relationship between monetary aggregates and inflation in Ethiopia, considerable number of studies exist on its causes; though inconclusive results were obtained. For instance, Habtamu (2013) investigated into the causes and dynamics of price inflation in Ethiopia using a time series data of CPI, agricultural supply shocks, monetary growth, cost of capital, exchange rate and others, ranging from (1980-2012) by applying the *VEC* and Multi-factor Single Equation Models. His findings suggest that, money supply was an important factor in determining the dynamics of price level in Ethiopia, both in short and the long run. Moreover, the agricultural supply shocks and the external market conditions (particularly, the exchange rate depreciation, oil price and the intermediate goods import) were found to have considerable significant positive impact on domestic inflation in the long run and the short run. The cost of capital was found to have a positive inflationary pressure only in the short run. Regarding the relative impact of each of the explanatory variables on inflation, indexation (inflationary expectations) and the money supply were suggested to have the highest magnitude; with inflationary expectations being the outcome of increasing monetary aggregates.

Josef et al (2008) analyzed the short run dynamics of inflation in Ethiopia, using a parsimonious ECM fitted with monthly observations ranging from (1995M01-2006M12) using the time series data of money supply, nominal exchange rate and agricultural out puts (proxied by a cereal–weighted agricultural production index). The results of their study confirmed that, inflation in Ethiopia is strongly of past inflation determined, with money supply being the second deriver of inflation in the short term. They revealed further that, inflationary expectations explain more than half of it, even after three years of a shock; while in the medium-run, the nominal exchange rate and the output factors were found to have the positive and a greater than money supply impact on inflationary dynamics. The study argued hence that, with prevailing structural factors causing rigidities in price formation, tightening of monetary policy alone to contain inflation

would become ineffective, and claimed rather to make policy reforms bringing flexible price formation, together with the credible and transparent central bank in curbing inflationary expectations and enhancing the effectiveness of monetary policy in Ethiopia. Here, we found that, money supply variable had only a limited role in explaining inflation for the period exceeding the short run; but rather, the exchange rate (the external influence) and the output shocks together with inflationary expectations were found to be important both in short and the medium-term periods.

Durevall et al (2009) estimated the ECM to determine the short and long run importance of various factors on food and non-food inflation in Ethiopia, using monthly time series data set ranging from 1999 to 2008. The results confirmed the importance of external factors (the exchange rate and international foods and goods prices) in explaining the domestic food and non-food prices in the long run; while the agricultural supply shocks and inflation inertia being important in the short run. Moreover, the exchange rate depreciation and international prices were found to have the biggest share in Ethiopia's inflation in the long run; excess money growth with insignificant role on inflation. They had three possible arguments for the insignificant role of money in the long run; first, the lower number of observations (with only ten years monthly data); second, the involuntary excess reserve holding by banks could affect banks behavior thereby causing unstable demand for money; and finally that instability in demand for money following non-monetization of large part of Ethiopian economy, mostly, in rural section of the country.

Evidences by Durevall et al (2009) were strongly against the monetarist's fallacy of monetary attachment to inflation. It is well argued that, money could have full effect on price level in the monetarist's model of price; which is completely in contrast to the above analysis. However that, in modern economy in which all most all part of the economy is monetized, it would seem unlikely to expect the neutral impact of money on price. Concerning the researcher's reasoning on the insignificant impact of money, we could draw at least two likely reactions. First, the study was undertaken during the period at which money supply has been rapidly growing at a maximum rate, due to domestic credit expansions. Moreover, other explanatory variables controlled in the model were consistent to their expected influence and regarded irrespective of

the time span. Hence, since the time consideration includes all other variables and that, the development in monetary aggregate during the study period was very large; we could expect, at least, little influence of money supply on inflation. Second, it would also be unlikely to think of the significant impact of non-monetized activity on general modern monetized economic system; of which, Ethiopian economy is also mentioning.

Yemane (2008) investigated the causal link amongst the time series of money supply, budget deficits and inflation in Ethiopia, applying the Granger causality test to detect the short run causality, and the bounds test approach to the long run issues, for the period ranging from 1964 to 2003. The results of the study confirmed the existence of long run cointegrating relationships among the series and only uni-directional [for ward Granger Causality running from M → P]. Furthermore, budget deficits were found to have no impact on the growth of money supply; and that both money supply and budget deficits impose positive and statistically significant impact on inflation, with the largest pressure sourcing from money supply while confirming the dominancy of money in the dynamics of inflation. He recommended finally that, since both the fiscal and monetary variables were important in determining inflation, the simultaneous exercising of proper fiscal and monetary policies would be effective to achieve the national objective of maintaining low inflation in Ethiopia.

Moreover, Rao and Abate (2015) analyzed the causality effect between money supply and price level in Ethiopia by applying the Granger causality and Cointegration tests, respectively for the short and long run issues; for the period covering from 1975 to 2012. Accordingly, the granger causality test suggested the existence of uni-directional causality running from money supply to inflation only, and all the variables were found to have cointegrated over the long term. They found positive but insignificant impact of money supply on inflation in the long run and suggested that it may be attributed to the offsetting effect of aggregate demand and output in the long run. In other words, the increase in money supply induces aggregate demand and causes price to rise in the short run following lags in production; but latter, the additional aggregate demand induces production and hence output increases and leads to reduction of prices in the long run. In their study, inflation expectation and imported (pass through) inflation were primarily important in driving domestic price in short and the long run. Moreover, interest rate

was suggested to have negative and significant impact on inflation and fiscal variable (budget deficit) was found to be insignificant in determining inflation in Ethiopia.

Abate and Rao (2015) has justified two possibilities for the insignificant impact of budget deficit; the first being, inclusion of monetary variable in the sense that both are ways of deficit financing; and secondly, not all budget deficits are inflationary. However, owing to the fact that, deficits are mostly monetized in Ethiopia; the first case was strongly supposed be the most likely reason. The negative impact of interest rate on inflation was also explained in two ways in the study; the increase in interest rate leads to increased cost of borrowing and result in reduced aggregate demand (given that investment demands are negative functions of interest rates) and finally lowers inflation. Alternatively, the resultant less appetite for holding money balance encourage saving and reduce aggregate demand and further ease pressure on price level.

African Bank of Development (2011) analyzed the dynamics of inflation in some selected East African Countries, such as; Ethiopia, Tanzania, Kenya and Uganda and found different results on the main causes of inflation in each case. Their analysis revealed money supply as the main deriver of inflation in Ethiopia and Uganda in the short run, whereas shocks in oil prices, to the large extent explain inflation in Tanzania and Kenya. Moreover, their justification for monetary expansion in Ethiopia was attributed to monetization of fiscal deficit; and, growth in private sector credit was reflected in monetary expansion in Uganda and Kenya. Their findings also reveal that almost one third of inflation dynamics in Tanzania was explained by shocks in domestic cereal production.

Analyzing the impact of causality among macroeconomic variables would be of important task in economic studies. Since, the workings of economic systems are interrelated; it would be nice to argue for the existence of possible feedback effect within the system. Following the initial influence of x on y, the second variable (y) might exhibit either a positive, negative or nothing backward impact on the first variable (x) or other components of the economic system. Examination of such causation could enhance easily control the variable with a bad shock thereby facilitating the stabilization process. Considerable studies have been done on the causality network between money supply and inflation variables. Bhalchandra and Dattubhai (2008) confirmed the existence of reverse Granger causality (from price to money) in Indian

economy. The test showed that money supply in India is partly endogenous as it is also determined by price level. Simply expressed, according to the findings, inflation in India induces further monetary growth which is against the doctrine of quantity theorists.

Empirical studies confirm the existence of uni-directional causation in some countries and also bi-directional causation in some others. It means, in some economies, money causes price only and in some others price, in turn causes money supply. In an economy where price causes money supply, to rely on money supply control alone as monetary policy instrument in an attempt to control inflation is of limited importance. Benbouziane & Benamar (2004) applied a Granger causality test to analyze the money-price relationship in Maghreb countries (Algeria, Tunisia and Morocco). The results showed that, in the case of Tunisian and Moroccan economies, the direction of influence runs from money to price but, their analysis did not found any meaningful relationship between money and prices in Algeria. Their justification for this case was the miss treatment of CPI in spite of the difference in prices paid in the consumer goods market and the amount recorded.

Empirical findings reveal inconclusive results on the relationship between budget deficit and inflation. VECM approach analysis of Lozano (2008) using the quarterly time series data over 25 year's period for the budget deficit, money growth and inflation variables in the case of Colombian economy found significant positive correlations between the two series. His study confirmed further the granger causality running from budget deficit to money supply, and hence from money supply to inflation in line with Sargent and Wallace (1981) hypothesis. But, they also found that the whole deficit is not monetized; parts of it were being financed by other alternatives.

Rebecca (2014) applied the ARDL Model to investigate the behaviors of fiscal deficit, money supply and inflation both in short and the long run time horizon in the economy of Ghana. Her analysis revealed the existence of positive relationship between fiscal deficits and inflation only in the short run. However, a significant positive relationship was observed among money supply and inflation both in short and the long run. Furthermore, money supply was estimated to primarily drive inflation in Ghanaian economy in the study, which is consistent with the postulate of the quantity theory of money. VAR Granger Causality examination by Rebecca

(2014) showed also the existence of unidirectional causality running from deficit to money supply and inflation; and bidirectional causality between money supply and inflation. The implication for Ghana is that, the government fiscal deficit has caused money supply and in turn, leads to inflation.

From all the above empirical discussions, we could draw two possible conclusions regarding inflation-money spirals at this stage, just for our purposes. First, inflation is not only guided by a single variable, rather it is a result of combined pressures from different events. Second, the source of inflation varies from time to time as well as economy to economy. Therefore, no single theory fully explains inflation in a particular economy. Having discussed, the forms of money-price relationship in particular and inflation in general both theoretically and empirically, we found inconclusive results on the forms interactions among money supply and inflation. The present study has gone through investing how inflation in Ethiopia behaves for the monetary policy action of changing the quantity of money supply to targeting certain variables.

2.3. Overview of Monetary Policy Framework in Ethiopia

Ethiopian economy had passed through different regimes and, hence economic policies. As a result, national economic policies were set in line with the respective regime's political ideology as policies are directed to achieve the stated goals of the general government. Monetary Policy is commonly understood as, "the deliberate application of monetary variables by the government *(Central banks in most cases)* to influence the general economic environment" (Ayubu, 2013). Despite the difference in the way they are applied, monetary policies are mainly targeted to reduce unemployment, enhance price and exchange rate stability, and attain maximum output.

During the era of command economy in Ethiopia, the financial sector was governed by the then socialistic ideology; and as a result, interest rates were set at levels to discourage private ownership in the sector in particular and the economy in general. Limited Credits were channeled only at the will of the central government to the selected target sectors. However, with the introduction of developmental state after the overthrow of Derge regime in 1991, the sector has undergone with some relief and as a result private banks and insurance companies were evolved following the enactment of the Banking and Monetary proclamation in 1990's. Hence,

in line with the adopted free market approach, monetary policy instruments were shifted to the market mechanism from direct government control (Alemayehu, 2001; Berhane, 2002).

I. Objectives of Monetary policy in Ethiopia

Currently, the National Bank of Ethiopia (NBE) is the banker of the government responsible to set and regulate the overall monetary policy actions on behalf of the government. According to Nuru (2013) and IMF (2013), Ethiopia's National Bank has the following basic objectives under its monetary policy framework;

- Nurturing issues related with money supply and demand, credit and other financial aspects conducive in realizing balanced and sustainable economic growth and development;
- Checking whether the periodic growth of money supply is consistent with the national macroeconomic dynamisms; especially with the growth rate of nominal GDP.
- Intervening in foreign exchange markets (forex) to ensure stability in these rates when demanded;
- Enhancing developments of financial and capital markets able to satisfy the dynamic needs of the general economy;
- Enhancing growth in domestic and international savings and reallocating them at productive activities, given market based interest rate mechanism.

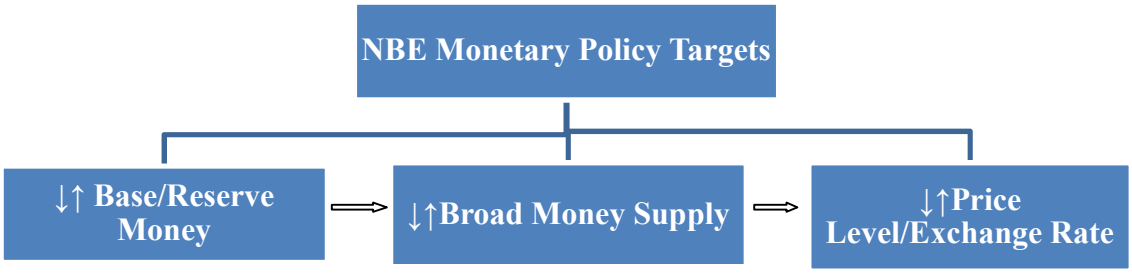
II. Monetary Policy Targets of NBE

The operating strategies of NBE are guided by its major objectives. Accordingly, the monetary policy frame work in Ethiopia has three major operating targets; the ultimate or final, the intermediate and the operating targets. Ensuring price and exchange rate stabilities are the final targets in the monetary policy framework of NBE. In achieving its final target, the NBE uses money supply (M2) as the intermediate target. NBE defines money in two ways; the narrow (M1) and broad money (M2) supplies. The first definition encompasses; currency under circulation, traveler's check, demand deposits and other checkable deposits. On the other hand, the broad definition (M2) adds the Quasi-money component, overnight

repurchase agreements and others quickly converted in to M1 (NBE, 2009). Currently, the M2 component is what comprises for the operational definition of money supply in Ethiopia. The present intermediate target of NBE is hence, ensuring whether the developments of money supply (M2) and nominal GDP are consistent (IMF, 2013; Nuru, 2013). Therefore, it is this definition of money supply adopted for the analysis in the inflation model of the present study.

On the other hand, controlling the growth of base (reserve) money is the existing operational target of NBE. It includes currency with the public and deposits of commercial banks at national bank. While targeting base (reserve) money, the monetary policy assumes stability in money demand function in the economy. But, when the money demand function continues to be unstable, the bank resorts to targeting of other indicators; like interest rate. Moreover, the bank shall use the international reserves adequate for international transactions (NBE, 2009)

Figure 2.2: Flow of the Monetary Policy Targets of NBE



Source: Self manipulation based on NBE (2009)

III. Monetary Policy Instruments of NBE

The policy instruments are meant to achieve the desired operating targets. Currently, NBE is employing various monetary policy instruments in combination. The policy instruments are similar in most cases to those in other economies elsewhere. Basically, these monetary policy instruments of NBE include; Open Market Operation (OMO), Standing central bank credit facility, reserve requirements, setting floor deposit rates, direct inter-bank borrowing or lending mechanism, credit control and moral suasion (NBE, 2001 and 2009). The bank uses

these instruments either separately or in combination based on its policy target to be achieved. Within the framework of NBE, the Monetary Policy Committee (MPC) periodically reviews developments in key national economic variables and proposes appropriate policy stance to the Board of Director on a regular basis (NBE, 2009). The committee, being appointed by the General Governor of the Bank also performs the following major tasks among others;

- Assessing international economic performances; including prices of exports, external loans and grants, FDI flows and so on;
- Assessing and proposing circumstances of domestic macroeconomic policies of like; fiscal policy, monetary growth, exchange rate conditions and policies, inflation, unemployment and so on;
- Designing and proposing monetary policy; which includes assessing headline and core inflation (current and future), evaluating current growth rates of monetary targets, evaluating current and forecasted GDP growth rates and etc.

CHAPTER THREE

OVERVIEW OF MONETARY AND PRICE DEVELOPMENTS IN ETHIOPIA

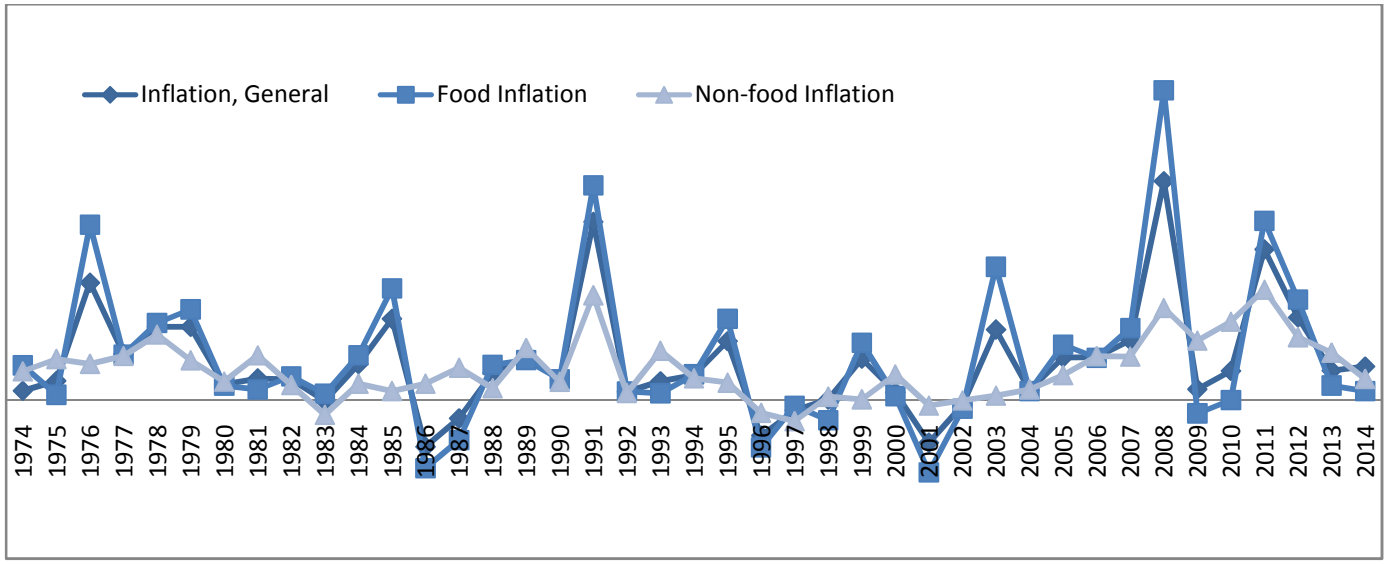
3.1. Price Development

Generally in the inflationary episodes of Ethiopia, the period 2002/03 marked the beginning of sustainable mounts in the growth rate of inflation. A grouping of inflationary episodes in Ethiopia by NBE (2012) reveals that, prior to 2002/03, the issue of inflation was not considerable thereby exhibiting the average annual rate of less than 5%. However, things changed and the rate has mounted to 17.77% in 2003/04; and that the food and non-food inflations in the same period were recorded at the annual growth rates of 33.68% and 1.06% respectively; while confirming the fact that food inflation takes the dominant share. Droughts together with the peaked Ethio-Eritrean Wars were accounted for higher price surges at around 1980's and the early stages of 1990's (Durevall et al, 2009). Besides, the lower rate of inflation prior to 2002/03, as indicated by Alemayehu and Kibrom (2008) was mainly due to the conservative monetary and economic policies of the then socialist government.

Between 2003/04–2007/08, the general CPI inflation continued to register at annual average double digit growth rate being 13.21%. The rates for food and non-food inflation were registered to be 15.75% and 6.38%, respectively, while showing still the larger pressure on general price level as emanating from food inflation. As of IMF (2008), since the mid of 2005/06, monetary growth (though not alone) remained to be the main deriver of food inflation in Ethiopia. In the report, external factors as international oil prices and heavy import of other industrial goods also added pressure on the non-food inflation. NBE (2012) revealed that, in most of the recent years of Ethiopian economic episodes, the non-food inflation has been registering a double digit parallel to the rate in food sector. For example, for the years between 2006/07 to 2014/15, the annual average growth rate of inflation in non-food sector has recorded sequentially by 11.05%, 10.94%, 23.23%, 14.97%, 19.76%, 27.84%, 15.84%, 11.94% and 5.31%, in respective years. During 2004/05-2008/09, food inflation continued mounting and remained an important contributor to CPI inflation, and Cereal price inflation explained the largest part of food inflation

during the period. Figure below presents the trends of general consumer price inflation, food-inflation and non-food inflation with their respective time series values ranging from 1974/75 to 2014/15.

Figure 3.1: Trends of Inflation in Ethiopia (1974-2014)



Source: Self computation based on NBE (1974/75-2014/15).

As evidenced in the figure above, the food inflation is an important element in determining the general consumer price inflation compared to the one in the non-food sector. The increase in food inflation was mainly attributable to the shocks in the agricultural outputs.

An ever higher inflation rate of 55% was recorded during 2008/09. The case was primarily attributed mainly to the cereal and oil price hikes (Durevall et al, 2010). WB (2013) also attached this price hikes to the then increasing food and fuel prices, deficient foreign exchanges, higher import dependence and agricultural supply shocks. The general inflation rates for the years 2011/12 and 2012/13 were 38.04% and 20.81% respectively. But it is only for the last two years that, the consumer price indexed inflation was reported to exhibit the annual rates of 7.39% in 2013/14 and 8.45% in 2014/15. However, it lacks credibility on its sustainability owing to the previous similar trends in the price development dynamics in Ethiopia. There were periods in which inflation was continuously stable at a single digit, but immediately followed by the highest one, which could distort all the previous benefits of lower inflation. For instance, the years

2009/10 and 2010/11 registered the single digit annual inflation rates of 2.71% and 7.32% respectively, but immediately followed by the double digit annual growth rates of 38.04% and 20.81% in the subsequent years of 2011/12 and 2012/13. According to WB (2013), annual average headline inflation at the end of the fiscal year 2011/2012 was 34.1%, which is 16% higher than the previous year. The main factor responsible for this, as stated by the NBE (2012/13) was the food price hike, in addition to higher money growth.

3.2. Monetary Developments

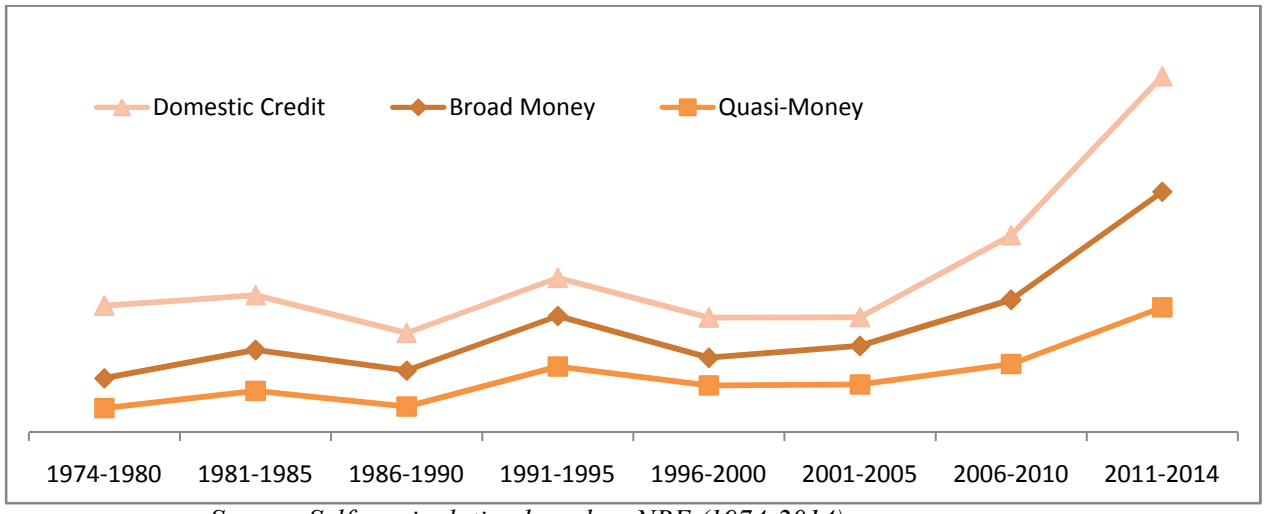
Before 1991/92, the average annual growth rate of domestic liquidity as measured by broad money supply (M2) was estimated at about 11.86%. Broad money encompasses both the quasi-money (time and saving deposits) and narrow money categories. Prior to 1991/92, the average annual growth rates of narrow money and the quasi-money components were figured at 14.10% and 9.6% respectively, suggesting the largest share of narrow money in explaining the growth of money supply in Ethiopia. The expansion of domestic credit to both the private and government sectors was the main reason for the expansion of narrow money. The quantity of broad money supply in the year 1974/75 was Birr 1,109.40 million and rose to Birr 1150.90 million in 1975/76, which is about 3.74% larger than the previous year's.

Broad money supply (M2) has continued to increase at the annual average rate of 15.8% and reached Birr 2,377.60 million in 1981/82, owing to the dramatic jump in domestic credit by the rate of 38.35% in the same period. The credit expansion was attributed to the higher demand from the government to finance its deficits. Between the years (1981/82-1997/98), the expansion in domestic credit was rated only at 13.42%, and similarly the quasi-money component registered the annual average growth rate of 15.33%. In the same period specified, the broad money supply has registered the annually rated average growth of 15.33%, which was largely explained by the quasi-money component, it in turn was achieved by expanding the banking destinations in the country sides and as a result, the national saving deposit level in both the saving and time deposit accounts have significantly surged. Before 2004/05, the average annual growth rate of broad money supply was only 9.7%. Unfortunately, its growth rate reached the annual average of 18.47% between (2005/06-2008/09) years period. According to IMF (2009), this event was mainly due to increasing volume of monetized budget deficits. The trend

continued and the annual average rate of 33.16% was registered between 2009/10-2014/15. During this period, the domestic credit has grown by 33.95% and the quasi-money grew at a rate of 26.59%. The share of quasi-money has shown considerable improvements following the government's higher involvement in selling more bonds. This according to IMF (2014) was due to the expansion of domestic credits and increasing transactions money demand following some economic advancement.

The average annual growth rate of broad money supply for the last five years has shown the highest surge being 35.60% between (2010/11-2014/2015) years period, with the respective individual annual growth rates of 26.57%, 39.21%, 30.28%, 24.24% and 24.72%. This stage of monetary growth was mainly explained by the fastest growth of the quasi-money component of the broad money supply. Similarly, the quasi-money has been growing at the annual average rate of 38.60%, where as 36.84% was the annual average growth rate of the domestic credit. Larger proportions of these credits were advanced to the public sectors. Of course, the two determinants of broad money supply components registered the highest rates between the time periods specified, and hence equally have been explaining the dynamics money supply. Generally, the relative impact of the two determinants of broad money supply is reflected in the following figure;

Figure 3.2: Growth of Broad Money Supply, Quasi-Money and Domestic Credit (In averages)

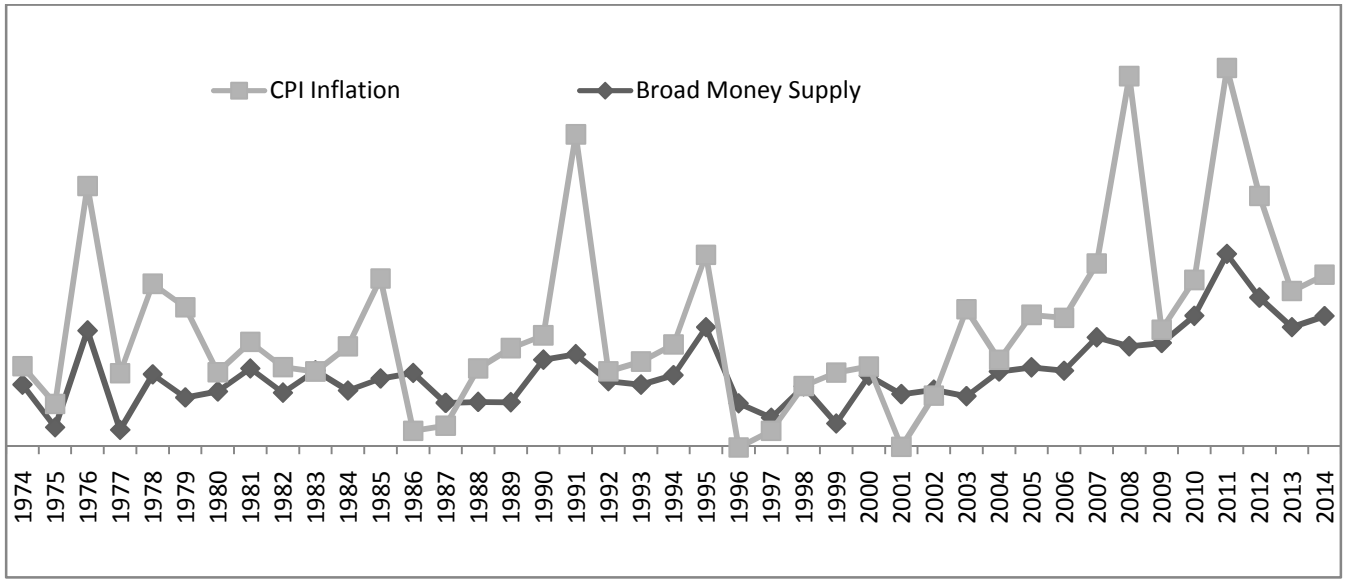


Source: Self manipulation based on NBE (1974-2014)

The behavior of broad money supply relative to two of its components is owing to the existence of other determinants of broad money supply; as for instance demand deposits and other ways by which the narrow money widens. Monetary development has registered a unique progress in the last five years (2011-2014/015) in both its components, i.e. the domestic credit (part of currency in circulation under narrower definition) and the quasi-money. The period is characterized by huge investment undertakings especially in construction sector both in private and the public sector; and hence might explain the rush in monetary dynamics during the period.

Expansions in money supply could impose higher pressure on inflation both directly (by increasing aggregate demand) and indirectly through inflationary expectations. Higher surges in the growth of money supply and inflation could reduce the real interest rate thereby by reducing the credibility of money acting as a store of value. Hence, the account holders can switch either to spend on consumption or other alternative asset holding positions; thereby both methods rising the amount of currency in circulation and would result in further inflationary pressures. Monetary growth either by seigniorage or credit expansions, has also been among the important factors in the dynamics of inflation. The movements in money supply (M2) and consumer price indexed inflation in Ethiopia from the fiscal years (1974/75–2014/15) are indicated in the following table;

Figure 3.3: Developments in Broad Money Supply and Inflation in Ethiopia (1974-2014)



Source: Self Computation based on NBE (1974-2014)

In the last two years, the growth rate of inflation in Ethiopia has been reported to be contained in a single digit, being 7.39% in 2013/14 and 8.45% in 2014/15. In contrast, the two periods have experienced with the highest growth rates in broad money supply being 24.24% in 2013/14, and 26.53% in the following fiscal period. Comparing the two macroeconomic cycles in the same period, monetary growth has been more than a double of inflationary growth rates. The favorable harvest and cost conditions in Ethiopia's trading partners as noted by UNDP (2014) were important in maintaining these lower rates. Moreover, both the monetary and fiscal operations during the period were successfully targeted towards achieving the single digit rates. According to Alemayehu and Kibrom (2008), the trends of price deflations and very lower inflation rates were explained to the larger extent by the nice weather and hence harvest conditions as agricultural supplies in Ethiopia are sensitive to these factors. Besides, a significant volume of food aids at different times were also important to considerably lower domestic inflation.

CHAPTER FOUR

DATA SOURCE, TYPE AND METHODOLOGY

4.1. Data Source and Type

The quality and significance of output is highly reliant on the quality and availability of its inputs. Therefore, the quality of any macroeconomic analysis can be determined by the accuracy, consistency and availability of any macroeconomic variables in question. The problem in Ethiopian case is the inconsistency of macroeconomic data from different sources: to cope up with such problem, money sources have been referred as possible. The study uses secondary time series data for all the variables under consideration from 1974/75 to 2014/15, which is for about 41 years. The data were sourced from both the domestic and external organizations. The main domestic sources include; Ministry of Finance and Economic Cooperation (MoFEC), National Bank of Ethiopia (NBE), Central Statistics Agency (CSA) and the Ethiopian Economic Association (EEA). External sources include; World Bank (WB) data base, International Monetary Fund (IMF) and the African Development Bank (AfDB).

4.2. Econometric Model Specification

We do have different measures of inflation (a positive change in general price level, which is persistent for a sufficiently long time period). The most commonly used measures are described as follows.

- → GDP-Deflator: - computed as the ratio of nominal to real GDP. This ratio at any time (t) indicates the development in general price level.
- → Producer Price Index (PPI):- It measures the positive change in the average price of inputs or raw materials used by producers. Its delinquency is that it considers only raw materials, not finished goods and services.
- → Consumer Price Index (CPI):- It is the change in the average price of consumable goods and services. It measures the positive net change in the average price of consumer goods and services.

Each of this measure has its own drawbacks. CPI is superior to GDP- deflator and, in the context of Ethiopian Economy, to PPI. Thus, in this study, CPI will be taken as a proxy to inflation variable and is the dependent variable whose behavior in a relation to other variables has been investigated. No doubt, higher proportion of income in Ethiopia is spent on consumption of final goods and services. According to the Ethiopian 2014/2015 third quarter economic report of UNDP, more than 56% of households' expenditure was made on food, beverages and other final consumable goods and services. Therefore, to use CPI is more appropriate and contextual in the case of Ethiopian economy. GDP-Deflator is inappropriate because it excludes the impact of imported inflation on domestic price owing to the definition of Gross Domestic Product. On the other hand, Producer Price Index (PPI) is not suitable to represent inflation in Ethiopia compared to CPI, since the proportion of income spent on the purchase of raw material is low in the country. Therefore, CPI is the dependent variable in the inflation of model this paper.

The guide line to the present study is the classical Quantity Theory of Money; provoking the direct and exact relationship between money supply and general price level. The relationship is expressed by the identity given by;

$$MV = PY \quad \text{(4.1)}$$

Where; **M, V, P** and **Y** are respectively, the nominal stock of money supply, Velocity of money, general price level (measure of inflation) and the real output variables. In the model, **V** and **Y** are assumed to be constant. Since the intention is to determine the impact of M on P in the model, equation (4.1) can be expressed in terms of price as follows;

$$P = \frac{MV}{Y} \quad \text{(4.2)}$$

The natural log of equation (4.2) becomes,

$$lnP = lnM + lnV - lnY \quad \text{(4.3)}$$

However, once appreciated the importance of other factors in explaining inflation, it is important to include other potential variables in the model to also investigate their impact on inflation along with money supply. The variables included in the model are considered so that they could

reflect the structural effects, demand-side effects, the cost or supply side effects as well as external effects on home side price level. Accordingly, the deterministic relationship between the dependent and all the independent variables employed can be expressed as;

$$CPI_t = f\,(M2_t, NDIR_t, FD_t, RER_t, RGDP_t, OT_t) \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.\; (4.4)$$

Where, CPI_t (proxy to P) = the value of Consumer Price Index at any time t, $M2_t$ = the nominal quantity of broad money supply at any time t, FD_t = the government fiscal deficit at any time t. RER_t = real exchange rate at any time t, $RGDP_t$ = measure of Real Gross Domestic Product at time t, $NDIR_t$ = the Nominal Deposit Rate of Interest and OT_t = the country's openness to trade at any time t. Trade openness is measured by dividing the sum of import and export trades by nominal GDP, all measured at current prices and current exchange rates. For the reason that it stands for the definition of money supply in Ethiopia, the broadest component (M2) of money supply is employed for analysis. Because not everything is controllable, the model has made to consider the effect of other shocks (the error terms) from various sources. Hence, based on (Ayubu, 2013; Abate and Rao, 2015; Akinbobola, 2012; Alemayehu and Kibrom, 2008), the basic econometric model (which considers the importance of other stochastic factors) adopted in the present study is set as follows;

$$lnCPI_t = \beta_0 + \beta_1 lnM2_t + \beta_2 lnFD_t + \beta_3 lnRER_t + \beta_4 lnRGDP_t + \beta_5 lnOT_t + \beta_6 lnNDIR_t + \varepsilon_t \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\; (4.5)$$

Where; ln represents the logarithmic expressions of all the variables in the model already defined under equation (4.4) above. ε_t, is the white noise error term as usual, and the parameters β_1, β_2….. β_6, are the long run elasticities of the independent variables; and the constant term β_0, is a value that the dependent variable assumes when values of all the independent variables are zero or near zero.

4.3. Expected Impacts of Independent variables on CPI Inflation.

Among the explanatory variable is the country's openness to trade. It is defined as the ratio of the country's trade to its GDP, with all imports, exports and GDP measured at current prices and exchange rates. It measures the degree of the economy's exposure to international trade. Trade

has been thought to be essential towards attaining successful economy, thereby increasing the country's competitiveness resulting from broaden market access, the domestic firms exposure to foreign skills and knowledge (Obstfeld and Rogoff, 1996). This variable is influenced mainly by the trade policy of the country. Furthermore, since it is all about the international interaction, the world state of economy also impacts the country's trade to GDP ratio. For instance, the report of the department of BIS revealed that, the financial crisis of 2008 reduced global trade and difficulties in Euro zone impacted the trade at large. Integration in the world economy also represents the share of domestic producers (exports) and the share of domestic demand in foreign supply (imports).

It is a common celebration in international economics that trade openness negatively impacts domestic inflation through its direct impact on tariffs and indirect on output. It is certain that lower or removed tariffs would have reducing impact on domestic prices. Adam Smith's teaching was that international trade enhances specialization, accelerates the spread of skills and transfer of knowledge, all with a potential of increasing output thereby decreasing production costs from economies of scale and advanced production techniques. It looks also nice in analyzing the production cost impact of trade integration. Moreover, it is important to consider (low or no) import and export tariff promotes trade, hence increases the trade to GDP ratio. Therefore, following the above analysis, we expected the negative relationship between trade openness ratio and inflation in this study.

The government's fiscal imbalance is another indicator, expected to explain inflation of Ethiopia. In theory and practice, the relationship between inflation and budget deficit has been inconclusive. But majority argue for fiscal imbalances to exert positive influence on inflation, especially in less developed economies, see Sargent and Wallace (1981). The logic behind their argument is that, with lower tax base and income and inadequate access to external borrowing, the governments of less developed economies resort to monetization of the deficits; which is about to increase the country's monetary base. The fiscal aspect of inflation is associated with the monetary doctrine as long as fiscal gaps are largely filled by seigniorage in LDCs, a rising from structural rigidities in domestic economy. According to Mankiw (2010), when the central banks print additional money, the price level responds by increasing. To the end of WWI,

Germany used to finance its budget deficit, resulted from its reparation payments to the Allied powers in an attempt to compensate the losses in the war; but, ended up with what was called, hyperinflation. Therefore, the study assumed that domestic borrowing is not inflationary rather it is domestic spending with changed hands. The government by taking money from the private sector is making expenditure. Here the problem is that, it creates the crowding out effect. Finally, budget deficit has been expected to move positively with inflation in Ethiopia. The other is the so called the broad money supply. The M2 component of money supply in Ethiopia encompasses; currency in circulation, demand deposits, saving deposits and time deposits. Considering the macroeconomic effect of the Quasi-money, the broad money supply has been examined in a relation to inflation in this study. Currency in circulation, together with demand deposits forms the narrow money (M1) component of money supply in Ethiopia. It is straight foreword to expect the positive influence of money supply on inflation via the aggregate demand channel. Another candidate considered important in this study is the output variable (proxied by real GDP in this study). Other things constant, the study assumed, the output variable produces negative influence on inflation. It is apparent from microeconomic theories that output and prices possess the negative relationships. It has been also assumed in this study that, higher production levels relate negatively to the inflation rate, thereby reducing competition in the demand side of the economy.

Real depreciation is followed by increased exports and decreased imports. With depreciation, imports are being made with less valued currency and therefore resulted in increased domestic prices, and vice versa. Following the price increase, especially for the imported items, domestic inflation rate rises certainly. Then it is expectable for positive relationship to exist between real exchange rate and inflation. The last but not the least, is the domestic deposit interest rate. Increased deposit rate induces higher saving thereby reducing spending level, and this scenario is expected to decrease price level because of dampened consumption demand.

4.4. Model Estimation Procedures

4.4.1. The Unit Root Test

With spurious regression, variables with no theoretical ground might exhibit higher values of R^2: falsely inferring strong relationships. It would be so, if one regress a non-stationary time series

on one or more of other non-stationary series. Any policy inference based on such analysis would lead to futile implications. Hence, stationarity of variables is a priori statistical condition so as to deal with subsequent econometric procedures in analyzing the behavior of economic variables; otherwise nothing would be accomplished.

For a time series to be stationary, as of Gujarati (2004); it should possess time invariant mean, variance and auto covariance (at possibly various lags). With non-stationary variables, we would only be able to examine the behavior of variables for the study period covered. However, the core task in any econometric analysis is to forecast the future trend and behavior of the economic and financial variables, so as to enable design any appropriate economic policy. Most of the time series variables become stationary only at their first differences, i.e. $y_t \sim I(1)$; indicates a variable 'y' integrated of order one. If it is already stationary at level, it could be represented by $y_t \sim I(0)$.

The Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) unit root tests have been applied in order to examine the stationarity property of each variable entered the inflation model of the present study. The traditional Dickey-Fuller (DF) stationarity tests are of limited practicability in empirical analysis due to its implicit assumption of no co-linearity in stationary variables. ADF version was introduced to overcome this limitation with the traditional DF methodology. Besides, Phillips and Perron (1988) proposed the non-parametric transformations of τ-statistics from the traditional DF unit root regressions, and hence solve the problem with DF test (Harry, 2012; Lahari, 2011). ADF procedure relies on a parametric auto regression to approximate an ARMA structure of residuals in the regression. It is conducted by extending all the equations under consideration by adding the lagged terms of the dependent variables, and requires estimation of the following regression;

$$\Delta y_t = \beta' D_t + \phi Y_{t-1} + \sum_{j=1}^{s} \Pi j \Delta y_{t-j} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textit{(4.6)}$$

Where, ε_t, is the usual pure white noise error term; D_t is vector of deterministic terms of the constant term. The S lagged difference terms, Δy_{t-j} are used to approximate the ARMA structure of the error terms. The value of s is set so that the error terms (ε_t) are serially uncorrelated.

Alternatively, the more general and robust ADF regression, considering both the trend and drift terms can be given as follows;

$$\Delta \boldsymbol{Y_t = \beta_0 + \gamma_1 t + \delta \Delta Y_{t-1} + \sum_{j=1}^{s} \Pi j \Delta y_{t-j} + \epsilon_t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textbf{(4.7)}$$

Where, $\delta = \phi - 1$ and $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, and the like. $\boldsymbol{\beta_0}$ is the intercept term, γ_1 is the trend coefficient, t – the time/trend variable and where; s, are the lag terms. For this test, the hypothesis would be;

Where, H_0: $\delta = 0$; there is unit root→ (implying the time series is non-stationary).

H_1: $\delta < 0$; No unit root → the time series is stationary

Decision: reject the null hypothesis of ($\delta = 0$), hence the time series is stationary; if the computed t-statistic (in absolute terms) exceed the ADF critical values; the variable under consideration is stationary.

On the other hand, the test regression for the Phillips-Perron (1988) unit root approach looks;

$$\Delta \boldsymbol{y_t = \beta L_t + \delta y_{t-i} + u_t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textbf{(4.8)}$$

But, the error term (u_t) is stationary at level, and may be heterosckedastic and serially correlated. However, the problems will be corrected in PP (1988) test by modifying the test statistics of $t_{\delta = 0}$ and $T\hat{\delta}$ in the first regression. Based on Harry (2012); Sjo (2008), the new test statistics would be represented by Z_t and Z_δ as;

$$Z_t = \left[\left(\frac{\widehat{\sigma 2}}{\widehat{\rho} 2}\right)^{1/2} * t_{\delta = 0} - \frac{1}{2}\left(\frac{\widehat{\rho} 2 - \widehat{\sigma} 2}{\widehat{\rho} 2}\right) * \left(\frac{T * SE\,(\widehat{\delta})}{\widehat{\sigma} 2}\right)\right] \text{ and; } Z_\delta = \left[T\hat{\delta} - \frac{1}{2}\frac{T2 * SE\,(\widehat{\delta})}{\widehat{\sigma} 2}\left(\hat{\rho}^{\,2} - \hat{\sigma}^2\right)\right]$$

Where, $\hat{\sigma}^2$ and $\hat{\rho}^{\,2}$ are the consistent variance estimates of the following respectively;

$$\sigma^2 = \lim_{T\to\infty} T^{-1}\left(1 + \frac{1}{n}\right)^n \sum_{t=1}^{T} E[u_t]^2; \text{ and } \rho^2 = \lim_{T\to\infty} \sum_{t=1}^{T} E\left(T^{-1} \sum_{t=1}^{T} u_t\right).$$

Under the null of $\delta = 0$ (i.e. unit root exists), the Z_t and Z_δ statistics in the Phillips-Perron (PP) procedure above, assume similar asymptotic distribution as with the conventional DF t-statistic. The PP procedure is advantageous over the ADF mechanism on at least two grounds; 1st, the PP

are robust to general forms of heteroskedasticity in the error term; and, 2nd, it does not need specification of lag length for regression as it is adjusted at length three by default in econometric and statistical soft ware.

4.4.2. The Cointegration Test

Certain linear transformation of variables already integrated of order (n) may also be stationary and is what we call cointegration (Gujarati, 2004). Generally, any two variables are said to be cointegrated, whenever they exhibit long term equilibrium relationship. In the absence of cointegration among variables, it is impossible to model the long run relationships among them. Theories reveal most economic variables to move together in the long run. One of it would be the subject of this study; the QTM: which holds that a long term stable equilibrium relationship exists between money supply and inflation. Once variables have suggested to have cointegrated (or jointly stationary), one can construct these long run relationships.

Johnson's test for cointegration has been employed in order to examine the existence of long run relationship among variables considered in this study. Though many more other methods exist also, the superior test for cointegration is the Johnson's approach, since it satisfies all the desirable statistical properties. Other methods have been criticized of being less powerful and unreliable; and hence, are not popular in econometric analysis. For instance, due to its heavy reliance on the residual of static model already suspected of being spurious, and its implicit assumption of only one cointegrating vector in ECM, the Engel-Granger (Two-step) Procedure is of limited value in applied econometrics. Moreover, the practical applicability of Durbin-Watson Statistic (the DW-test) is extremely limited as the critical values of the test statistic are inconsistent as the number of regressors (p) increases over the sample size (Gujarati, 2004; Lahari, 2011; Harry, 2012). The Johnson's maximum likelihood procedure addresses all these limitations, and builds cointegrated variables directly on maximum likelihood estimation instead of relying on OLS estimation. This procedure relies heavily on the relationship between the rank of a matrix and its characteristic roots. Johansen derived the maximum likelihood estimation using sequential tests for determining the number of cointegrating vectors. His procedure steps from estimation of Vector Auto Regression (VAR) of order 'p' given by;

$$y_t = \mu + A_1 y_{t-1} + \ldots\ldots + A_p y_{t-p} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.9)$$

Where, y_t is an nx1 vector of variables integrated of order one and ε_t is an nx1 vector of originations. This VAR can also be written as;

$$\Delta y_t = \mu + \Pi y_{t-1} + \sum_i^p = 1\Gamma_i \Delta y_{t-i} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.10)$$

Where $\Pi = \sum_i^p = 1A_i - I$ and $\Gamma_i = -\sum_j^p = I + 1^{Aj}$

If the coefficient matrix (Π) has reduced rank ($r < n$), then there exist an (n x r) matrices 'α' and 'β' each with rank (r) such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is stationary. Hence, 'r' and 'α' indicate the number of cointegrating equations and the speed of adjustment parameters in *ECM* respectively. And that each column of 'β' represent the cointegrating equation. Based on equation 4.10, here is the VAR Model representation of the variables entered the inflation model of the present study;

$$\begin{pmatrix} \Delta lnCPI_t \\ \Delta lnM2_t \\ \Delta lnFD_t \\ \Delta lnRER_t \\ \Delta lnRGDP_t \\ \Delta lnOT_t \\ \Delta lnDIR_t \end{pmatrix} = \Gamma_i \begin{vmatrix} \Delta lnCPI_{t-i} \\ \Delta lnM2_{t-i} \\ \Delta lnFD_{t-i} \\ \Delta lnRER_{t-i} \\ \Delta lnRGDP_{t-i} \\ \Delta lnOT_{t-i} \\ \Delta lnDIR_{t-i} \end{vmatrix} + \alpha\beta' \begin{pmatrix} lnCPI_{t-i} \\ lnM2_{t-i} \\ lnFD_{t-i} \\ lnRER_{t-i} \\ lnRGDP_{t-i} \\ lnOT_{t-i} \\ lnDIR_{t-i} \end{pmatrix} \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.11)$$

The Johnson's maximum likelihood approach for cointegration basically uses two test statistics. These are the trace and maximum eigenvalues. While the maximum eigenvalue examines the null of **'r'** cointegrating vectors against its alternative of **'r+1'**, the trace test examines the null of **'r'** cointegrating vectors against the alternative of **'k'** cointegrating relations. Where **'k'** represents the number of variables in the model adopted; and (r = 0, 1, 2, 3… k-1); i.e. in a model containing **'k'** endogenous variables, possibly the cointegrating rank might assume the value ranging from zero to **'k-1'**, see (Harry, 2012; Nurmadihah and Jusoff et al, 2011).

Following Nurmadihah and Jusoff et al (2011) the maximum eigenvalue and trace test statistics respectively, are generated by the formula given by;

$$\lambda_{max}\left(r/r+1\right) = -T*log\,(1-\hat{\lambda}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.12)$$

Where, λ are the maximum eigenvalues and T is the sample size in the model and,

$$\lambda_{trace}\left(r/k\right) = -T*\sum_{i=r+1}^{n} log(1-\hat{\lambda}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.13)$$

And where the notations in the equation are similarly defined earlier

4.4.3. Vector Error Correction Model (VECM)

After applying the cointegration test, VECM has been estimated to capture the short and long run dynamics of inflation in a relation to other variables considered in the model of this study. The beauty of VECM is that it simultaneously yields both the short and the long run elasticities. In the above procedure, if the economic variables do not exhibit equilibrium in the long run, no need for error correction mechanism instead VAR model could be applied either in difference or in level. As Gujarati (2004) noted, existence of cointegration doesn't guarantee the short term relationships. Therefore, after proving the existence of cointegration, the ECM has been estimated to also deal with the short run issues. Assuming two variables y and x (to be dependent and independent series respectively), *ECM* in this study requires estimating the following regression;

$$\Delta y_t = d_1 + \alpha_1\varepsilon_{t-i} + \sum_{i=0}^{n}\beta_i\Delta y_{t-i} + \sum_{i=0}^{n}\delta_i\Delta x_{t-i} + \sum_{i=0}^{n}\Omega_i Z_{t-i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.14a)$$

$$\Delta x_t = d_2 + \alpha_2\varepsilon_{t-i} + \sum_{i=0}^{n}\delta_i y_{t-i} + \sum_{i=0}^{n}\beta_i\Delta x_{t-i} + \sum_{i=0}^{n}\Omega_i Z_{t-i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.14b)$$

The rank of cointegration gives us the amount of cointegrating vectors in the model as described above in the section for cointegration. The coefficients of the lagged variables, in accordance to their placement in the equations above reveal the short run impact of the independent variables on dependent ones; for instance, (δ_i) in equation *(4.14a)* measures the short run impact of the variable x on y. on the other hand, the significant and negative coefficient of the error correction term (the α parameters in equations *4.14a* and *4.14b*) show the economy's convergence to its

long run equilibrium. Any short run deviation from the long term equilibrium can be adjusted back at a periodic speed rate of that coefficient, and is said to be the adjustment parameter. If the coefficient of error term is not significant and negative, there will not be any long run causality amongst the variables of interest. Following equations (4.14), the VEC short run model representation of the series entered the inflation model of this study could be set as follows;

$$\Delta lnCPI_t = d_1 + \alpha_1\varepsilon_{t-i} + \sum_{i=1}^{n} \phi_{1i}\Delta lnCPI_{t-i} + \sum_{h=1}^{n} \delta_{1h}\Delta lnRGDP_{t-i} + \sum_{x=1}^{n} \Omega_{1x}\Delta lnRER_{t-i} + \sum_{m=1}^{n} \lambda_{1m}\Delta lnNIR_{t-i} + \sum_{k=1}^{n} \Pi_{1k}\Delta lnOT_{t-i} + \sum_{v=1}^{n} \Phi_{1v}\Delta lnBD_{t-i} + \sum_{q=1}^{n} \Psi_{1q}\Delta lnM2_{t-i} + u_{1t-i} \ldots. \quad (4.15a)$$

$$\Delta lnRGDP_t = d_2 + \alpha_2\varepsilon_{t-i} + \sum_{i=1}^{n} \phi_{2i}\Delta lnCPI_{t-i} + \sum_{h=1}^{n} \delta_{2h}\Delta lnRGDP_{t-i} + \sum_{x=1}^{n} \Omega_{2x}\Delta lnRER_{t-i} + \sum_{m=1}^{n} \lambda_{2m}\Delta lnNIR_{t-i} + \sum_{k=1}^{n} \Pi_{2k}\Delta lnOT_{t-i} + \sum_{v=1}^{n} \Phi_{2v}\Delta lnBD_{t-i} + \sum_{q=1}^{n} \Psi_{2q}\Delta lnM2_{t-i} + u_{2t-i} \ldots \quad (4.15b)$$

$$\Delta lnRER_t = d_3 + \alpha_3\varepsilon_{t-i} + \sum_{i=1}^{n} \phi_{3i}\Delta lnCPI_{t-i} + \sum_{h=1}^{n} \delta_{3h}\Delta lnRGDP_{t-i} + \sum_{x=1}^{n} \Omega_{3x}\Delta lnRER_{t-i} + \sum_{m=1}^{n} \lambda_{3m}\Delta lnNIR_{t-i} + \sum_{k=1}^{n} \Pi_{3k}\Delta lnOT_{t-i} + \sum_{v=1}^{n} \Phi_{3v}\Delta lnBD_{t-i} + \sum_{q=1}^{n} \Psi_{3q}\Delta lnM2_{t-i} + u_{3t-i} \ldots. \quad (4.15c)$$

$$\Delta lnOT_t = d_4 + \alpha_4\varepsilon_{t-i} + \sum_{i=1}^{n} \phi_{4i}\Delta lnCPI_{t-i} + \sum_{h=1}^{n} \delta_{4h}\Delta lnRGDP_{t-i} + \sum_{x=1}^{n} \Omega_{4x}\Delta lnRER_{t-i} + \sum_{m=1}^{n} \lambda_{4m}\Delta lnNIR_{t-i} + \sum_{k=1}^{n} \Pi_{4k}\Delta lnOT_{t-i} + \sum_{v=1}^{n} \Phi_{4v}\Delta lnBD_{t-i} + \sum_{q=1}^{n} \Psi_{4q}\Delta lnM2_{t-i} + u_{4t-i} \ldots \quad (4.15d)$$

$$\Delta lnBD_t = d_5 + \alpha_5\varepsilon_{t-i} + \sum_{i=1}^{n} \phi_{5i}\Delta lnCPI_{t-i} + \sum_{h=1}^{n} \delta_{5h}\Delta lnRGDP_{t-i} + \sum_{x=1}^{n} \Omega_{5x}\Delta lnRER_{t-i} + \sum_{m=1}^{n} \lambda_{5m}\Delta lnNIR_{t-i} + \sum_{k=1}^{n} \Pi_{5k}\Delta lnOT_{t-i} + \sum_{v=1}^{n} \Phi_{5v}\Delta lnBD_{t-i} + \sum_{q=1}^{n} \Psi_{5q}\Delta lnM2_{t-i} + u_{5t-i} \ldots \quad (4.15e)$$

$$\Delta lnM2t = d_6 + \alpha_6\varepsilon_{t-i} + \sum_{i=1}^{n} \phi_{6i}\Delta lnCPI_{t-i} + \sum_{h=1}^{n} \delta_{6h}\Delta lnRGDP_{t-i} + \sum_{x=1}^{n} \Omega_{6x}\Delta lnRER_{t-i} + \sum_{m=1}^{n} \lambda_{6m}\Delta lnNIR_{t-i} + \sum_{k=1}^{n} \Pi_{6k}\Delta lnOT_{t-i} + \sum_{v=1}^{n} \Phi_{6v}\Delta lnBD_{t-i} + \sum_{q=1}^{n} \Psi_{6q}\Delta lnM2_{t-i} + u_{6t-i} \ldots \quad (4.15f)$$

$$\Delta lnNDIR_t = d_7 + \alpha_7\varepsilon_{t-i} + \sum_{i=1}^{n} \phi_{7i}\Delta lnCPI_{t-i} + \sum_{h=1}^{n} \delta_{7h}\Delta lnRGDP_{t-i} + \sum_{x=1}^{n} \Omega_{7x}\Delta lnRER_{t-i} + \sum_{m=1}^{n} \lambda_{7m}\Delta lnNDIR_{t-i} + \sum_{k=1}^{n} \Pi_{7k}\Delta lnOT_{t-i} + \sum_{v=1}^{n} \Phi_{7v}\Delta lnBD_{t-i} + \sum_{q=1}^{n} \Psi_{7q}\Delta lnM2_{t-i} + u_{4t-i} \quad (4.15g)$$

The speed of adjustment to the long run equilibrium for each endogenous variable in the equations above would be given by the negative and significant coefficients of the error correction terms. Along with the short run estimates, the cointegrating equations (the long run coefficients) are also computed simultaneously in VEC model regressions. Besides, a properly determined cointegrating rank makes the predicted cointegrated equation exhibit a property of

stationarity. Equation *(4.15a)* where the inflation variable is related to other determinant variables is the target model in the present study.

4.4.4. The Granger Causality Test

It is also critical to identify the direction of influence among variables since it helps to easily control variables causing adverse shocks at macro level. Keynes, the Real Bills Doctrine and the monetary economists viewed the direction of causality among money supply and inflation variables (refer the respective sections back in chapter two). Towards validating either of the cases in the context of Ethiopian economy, the Granger Causality approach has been applied to detect the direction of causality among the three dominant variables in the model. They are considered dominant as long as the study is primarily motivated to identify the nature of relationship between monetary and inflation growth dynamics. For that matter, money supply (M2) and the proxy to inflation variable (CPI) reflect the direct dominancy. The Government's fiscal imbalance is also grouped under dominant variables based on the assumption that only if it is monetized that it would result in inflationary outcomes. So that, the Central Bank (National Bank in our case) financed budget deficit is not different from increase in money supply.

Basically, two causality tests were focused; the first being the causality test between money supply and CPI inflation and, the second is between budget deficits and money supply. The test needs all the variables be stationary; which of course has been solved in the section for Unit Root Tests above. Moreover, as usual, the error terms in the testing procedure need serially uncorrelated. Following Wooldridge (2013), the Granger causality test examines the following two focus paired regressions sequentially from the inflation model;

$$\Delta lnm2_t = \sum_{i=1}^{n} \alpha_i \Delta lncpi_{t-i} + \sum_{j=1}^{n} \beta_j \Delta lnm2_{t-j} + u_{1t} \quad \text{..... (4.16a)}$$

$$\Delta lncpi_t = \sum_{i=1}^{n} \delta_i \Delta lncpi_{t-i} + \sum_{j=1}^{n} \lambda_j \Delta lnm2_{t-j} + u_{2t} \quad \text{..... (4.16b)}$$

Where, the lower case letters represent the growth rates of corresponding variables, and that u_{1t} and u_{2t} are assumed to be uncorrelated; Δ are difference operators. From equation *(4.16a)*, currently money supply is determined by its i^{th} lagged value and the previous level of inflation.

Hence, the current value of money supply is regressed on all of its lagged terms and all other variables in question (but with no lagged terms of CPI). Next, the same regression could be applied including the lagged terms of CPI. From the first regression, due to the restricted lagged terms of the inflation variable, we get the Restricted Residual sum of Squares *(RSS_R)*, and from the second regression, we do have unrestricted Residual Sum of Squares (*RSS_{UR}),* see Gujarati (2004). Finally, using the two residual square terms, the general F-test to be examined can be built as follows;

$$F = \frac{(RSS_R - RSS_{UR})/h}{RSS_{UR}/(n-k)} \quad \text{..... (4.17).}$$

Where, **'h'** represents the number of M2 lagged terms, & **'k'** is the number of parameters estimated in the unrestricted regression, which follows F-distribution with **'n-k'** degree of freedom. The test requires estimation of the VAR model discussed earlier in the section for cointegration.

The null hypothesis is: H_0: $\sum \alpha_i = 0 \rightarrow$ the lagged *M2* values do not belong in the regression. If the calculated F value exceeds the critical value at chosen level of significance, we reject the null hypothesis; so that the lagged M2 values belong in the regression: which is to mean M2 causes CPI. Exactly the same procedure is followed to test whether the influence runs in reverse.

The second one is the causality between budget deficit and money supply variables. From macroeconomics, we do have basically three ways to fill fiscal gap: borrowing (either domestic or external) and Segniorage. The latter is thought to have inflationary effect in practice. Examining budget deficit in a relation to inflation, one could easily detect the extent of seigniorage in the economy. It is a common argument for monetary base financing of deficits to be inflationary. The point is that; monetization of deficits $\rightarrow \uparrow$money supply $\rightarrow \uparrow$inflation. To detect whether budget deficit causes money supply, or whether the influence flow in reverse or moves in both directions (bi-directional causality), the Granger causality test has been applied between *ln*BD and *ln*M2; following exactly similar procedure as with the case in *ln*M2 and *ln*CPI variables above.

CHAPTER FIVE

ESTIMATION RESULTS AND DISCUSSION

The study has analyzed the short and long run dynamics of inflation by estimating Vector Error Correction Model as proposed. A beauty of VECM is that, it enables us to simultaneously capture both the short run and long run estimates. Besides, the inflation model's adjustment to the long run equilibrium can be determined by the estimated coefficient of the error term. Before regressing VECM, all of the series were subjected to pre and post-VECM estimation diagnostic tests, which are important to ensure the reliability of the model and inferences made based on it. Pre- estimation tests are important so as determine which econometric model is suitable given the underlying properties of the variables employed. Unit Root and Cointegration properties are of the essential pre-estimation tests; which has been sequentially conducted and, hence allowed estimation of the proposed VECM in this study. The post-diagnosis test results are presented under the appendix section of this paper.

5.1. Unit Root Properties of Individual Variables

For the sake of convenience, the stationarity properties of the variables have been examined by employing both the ADF and PP unit root tests. An interesting thing here has been that, stationarity properties of the series were consistent with both cases. Table 5.1 below reports the test statistics of both methods with all variables examined at level;

Table 5.1: Augmented Dickey Fuller (ADF) and Philips-Perron (PP) Unit Root Tests at Level

	Augmented Dickey Fuller (ADF)		Philips-Perron (PP) Test		
Variable	Constant	Constant & Trend	Constant	Constant &Trend	Inference
ln*CPI*	0.265*[0.9757]*	-1.129*[0.9242]*	0.174*[0.9708]*	-1.452*[0.8450]*	*NS*
ln*M2*	2.198*[0.9989]*	1.300*[1.0000]*	1.544*[0.9977]*	0.484*[0.9968]*	*NS*
ln*RGDP*	4.518*[1.0000]*	0.720*[1.0000]*	3.541*[1.0000]*	0.250*[0.9960]*	*NS*

ln*BD*	-0.905*[0.7865]*	-2.587*[0.0611]*	-0.812*[0.8155]*	-2.583*[0.0651]*	*NS*
ln*OT*	1.380*[0.9970]*	-1.410*[0.8579]*	1.307*[0.9966]*	-1.484*[0.8346]*	*NS*
ln*RER*	-1.572*[0.4975]*	-1.656*[0.7696]*	-1.709*[0.4264]*	-1.851*[0.6796]*	*NS*
ln*DIR*	-1.758*[0.4013]*	0.7696*[0.3398]*	-1.870*[0.3461]*	-2.557*[0.3000]*	*NS*

***Note**: NS implies the series are all non-stationary at level: [ ] are p-values; ln — represents the logarithmic forms of the time series defined as; RER: Real Exchange Rate ; OT: Openness to Trade; BD: Government Budget Deficit; M2: Broad Money Supply; CPI: Consumer Price Index; RGDP: Real Gross Domestic Product; DIR: Deposit Interest Rate*

Source: STATA Model output

The decision as to whether accept or reject the null hypothesis was based on the Mackinnon critical values @ 1%, @ 5% and @ 10% level of significances. The null hypothesis in each case state, variable contains a unit root. Accordingly, both tests fail to reject the null hypothesis, implying that all variables are non-stationary at level. Since, the t-statistics of both ADF and PP unit root tests are insignificant for all the series entered the inflation model, the existence of unit root has been detected; i.e. they are non-stationary at level. Once the series were identified to contain unit root at level, the next option would be to difference once and then apply the test procedures again.

Table 5.2: ADF and PP Unit Root Tests with all Variables Differenced Once;

Augmented Dickey Fuller Unit Root (ADF) Test			Philips-Perron (PP) Unit Root Test		
Variables	Constant	Constant & Trend	Constant	Constant &Trend	Infer/e
D.ln*CPI*	-5.560**[0.0000]*	-5.516**[0.0000]*	-5.582**[0.0000]*	-5.530**[0.0000]*	*I(1)*
D.ln*M2*	-3.833**[0.0026]*	-4.709**[0.0007]*	-3.928**[0.0018]*	-4.709**[0.0007]*	*I(1)*
D.ln*RGDP*	-3.490***[0.0083]*	-4.608***[0.0010]*	-3.537***[0.0071]*	-4.720***[0.0006]*	*I(1)*
D.ln*BD*	-9.279**[0.0000]*	-9.189**[0.0000]*	-5.855**[0.0000]*	-10.074**[0.0000]*	*I(1)*
D.ln*OT*	-5.782**[0.0000]*	-6.277**[0.0000]*	-10.164**[0.0000]*	-6.286**[0.0000]*	*I(1)*
D.ln*RER*	-5.117**[0.0000]*	-5.066**[0.0002]*	-5.041**[0.0000]*	-4.981**[0.0002]*	*I(1)*
D.ln*DIR*	-6.573**[0.0000]*	-6.433**[0.0000]*	-6.590**[0.0000]*	-6.444**[0.0000]*	*I(1)*

***Note:** * and ** implies rejection of the null hypotheses @1% and @5% critical values respectively in both cases; I(1)-*

shows order of integration;[ ]are the P-values; and other notations are as defined earlier.

Source: STATA Model output

Table 5.2, above reports the ADF and PP unit root estimates on the first differences of the series under consideration. As with a priori theoretical expectations, all the variables become stationary only after taking their first differences. Similar to the case in table 5.1, both test statistics are also consistent for the first differences; while guarantying efficiency in both estimates. Besides, the variables are all stationary at their first differences; i.e. $y_t \sim I(1)$. Except for the *RGDP* variable, the unit root test statistics for all other variables are significant @1%. Besides, both the ADF and PP unit root tests have confirmed stationarity in *ln*RGDP at 5 percent. Inclusion of the trend term did not improve efficiency of the unit root estimates. Hence, consideration of either the constant term alone, or inclusion of trend term together with the constant doesn't have differences in the estimation of the general inflation model of this study. So that, only the constant term is considered while regressing VEC model latter in this chapter.

5.2. Lag Length Determination

It is well understood that, the Johnson's approach for cointegration is highly sensitive to the number of lags included in the VAR model. Perhaps, there is no sharp rule on what optimum lags size to use; but, given the respective practical limitations of all the lag length selection criteria, researchers would enjoy some degree of freedom to arbitrarily determine the number of lags, conceptually geared to be reasonable. Based on Hollod (2000) and Mbutor (2013), sufficiently large size could be used in a model with large number of real variables, since real effects persist sufficiently for a longer time horizon. However, unfortunately most of the variables in our model are of monetary and nominal aspects; hence, based on the notation above, limiting the lags to a reasonably minimum size has been considered important.

We do have various ways of determining the appropriate lag length in applied econometrics. The Final Prediction Error (FPE), Akaike Information Criteria (AIC), Schewarz Information Criteria (SIC), Log Likelihood (LL), Sequential Modified Likelihood Ratio Test (LR) and Hannan-Quinn Information Criteria (HIC) are mentioning (Wooldridge, 2013). In empirical studies, the popular approach would be to determine the lag length where the AIC is minimized

Table 5.3: Lags Order Suggested by each Criterion

Lag Order	LL	LR	P-Value	FPE	AIC	HQIC	SBIC
0	208.098	-	-	6.0e-14	-10.5841	-10.4768	-10.2824
1	470.968	525.74	0.000	8.1e-19	-21.8404	-20.9818	-19.4271*
2	536.755	131.57	0.000	4.4e-19	-22.7239	-21.114	-18.199
3	614.727	155.94*	0.000	2.2e-19*	-24.2488*	-21.8876*	-17.6123

** reflects the appropriate lag length suggested by each of the criteria; and where, LL: the Log Likelihood; FPE: Final Prediction Error; AIC: Akaike Information Criteria; LR: Sequential Modified Likelihood Ratio Test (LR); HQIC: Hannan-Quinn Information Criteria; and SBIC: Schewarz Information Criteria*

Source: STATA Model output

As indicated in table 5.3, the lag length selected for subsequent analysis in this study was three. The selection was based mainly on two basic grounds; the first being majority vote, i.e. except the *SBIC*, all others have suggested the lag length of three. Referring to most of the studies in economics, the most popular candidate in lags size determination, which has been revealed to be optimum and relatively efficient, is where the AIC is minimized; which has also been satisfied at an optimum lag order of three in this study.

5.3. Johnson's Cointegration Test Results

Once variables entered the inflation model have been revealed to be integrated of the same order (I(1)), the next task could be to apply the Johnson's methodology to detect the existence of long run relationships among these individually integrated variables. With mixed order of integration, the Johnson's methodology would be no longer practical in econometric analysis. But, since the series considered here are all integrated of order one (the same order), the Johnson's approach has been employed. Accordingly, the trace (λ_{trace}) and maximum eigenvalue test (λ_{max}) statistics have rejected the null of no-cointegration amongst the series of interest: while confirming the existence of long run relationships among them. The summary statistics of both tests have been reflected in the table below;

Table 5.4: *Results for Unrestricted Cointegration Rank Test*

Maximum Rank	λ_{max}	Critical @ 5%	λ_{trace}	Critical @ 5%
0	49.2117	48.45	144.3689	136.61
1	35.7802*	42.48	95.1572*	104.94
2	26.7732	36.41	59.3770	77.74
3	14.7638	30.33	32.6038	54.64
4	11.7084	23.78	17.8399	34.55
5	5.0027	16.87	6.1315	18.17
6	1.1288	3.74	1.1288	3.74

*Where *, represents the maximum cointegrating rank determined by both test statistics*

Source: STATA Model Output

From table 5.4, it is clearly indicative that the two test statistics have confirmed the existence of one cointegrating relation among the variables entered the inflation model of the present study. The λ_{trace} statistics rejected the null of ($r = 0$) while favoring its alternative hypothesis of ($r \geq 0$). At this stage the existence of at least one cointegrating rank within the adopted model of inflation is detected based on the trace test. At ($r = 0$), the λ_{trace} statistic (144.3689) is greater than the 5% critical value, which is 136.61. Hence, we can reject the null hypothesis of no cointegration. Similarly, the maximum eigenvalue test rejected the null of ($r = 0$), and accepted the alternative hypothesis of ($r = 1$), because the λ_{max} test statistics (49.2117) exceeds the corresponding value at 5% critical (48.45). Besides, the λ_{max} test has also confirmed the existence of at least one cointegrating relations in the model at the initial stage of the test procedure. After now on, the issue wouldn't be about investigating the existence of cointegration, but rather the level of that long run relationship, once cointegration is confirmed at the first stage. However at the next step, both tests have failed to reject the null hypothesis thereby both conforming the existence of one cointegrating rank among the variables entered in the inflation model. That means the λ_{trace} test accepted the null of ($r = 1$) and rejected the alternative hypothesis of ($r \geq 1$), because there, the trace test statistic (95.1572) is less than the value at 5% critical (104.94)**.** The maximum eigenvalue test has also accepted the null hypothesis of ($r = 1$) and rejected its alternative of ($r = 2$), since the corresponding λ_{max} test statistic (35.7802) is lower than the 5% critical value given

by 42.48. Therefore, both test statistics has confirmed the existence of one cointegrating equation in the inflation model.

5.4. Vector Error Correction Model Estimation

5.4.1. The Long Run Elasticities [β Coefficients]

At this stage, VECM was estimated and, hence both the short and long run elasticities have already been captured. Long run elasticities (the β's) were exactly identified and the Johnson normalization restrictions were imposed too. Table 5.5, below presents these long run elasticities of all the explanatory variables in the inflation model adopted. The estimates revealed that, all of the variables considered have been important and highly significant in determining the long run dynamics of inflation. Moreover, internal factors were more important than the external factors.

Table 5.5: *VECM Long Run Elasticities of the Explanatory Variables*

Variables	Coefficients	Standard Errors	t-statistic	P- value
ln*RER*	0.30	0.0422	7.04	0.000
ln*RGDP*	-1.34	0.1581	-8.46	0.000
ln*DIR*	-0.06	0.0267	-2.20	0.028
ln*M2*	1.45	0.1712	8.46	0.000
ln*OT*	0.91	0.084	10.74	0.000
ln*BD*	1.38	0.105	13.13	0.000
CON	-7.88	-	-	-
$R^2 = 0.98$	$\bar{R}^2 = 0.98$	F(6, 34) = 534.61[0.0000]	RSS = 0.061071746	DW(7, 41) = 1.83

Diagnostic Test:

- *Heteroskedasticity Test: Chi^2(1) = 2.42[0.1198]*
- *RESET Test: (3, 31)= 2.28[0.0990]*
- *ARCH= 0.745[0.3879]*
- *Model Normality Condition;*
  Jarque-Bera test: Chi^2(14) = 4.493[0.99170]
  Skewness test: Chi^2(7) = 1.571[0.97976]
  Kurtosis test: Chi^2(7) = 2.922[0.89211]
- *Residual Autocorrelation Test at lags;*
  (1). Chi^2 (49) = 53.5123[0.30522]
  (2). Chi^2 (49) = 62.6017[0.09174]
  (3). Chi^2 (49) = 58.0539[0.17617]

Source: STATA Model output

Where: ln = Logarithmic forms of: M2; Broad Money Supply: RGDP; Real Gross Domestic Product: OT; Openness to Trade: BD; Budget Deficit: RER; Real Exchange Rate: DIR; Nominal Rate of Deposit: and CON is the Constant term.

From the Johnson's procedure for cointegration under section 5.3, the number of cointegrating equation among variables entered the inflation model of the present study has been suggested to be one. Therefore, that cointegrating equation in the long run inflation model adopted in this study could be set as follows;

$$\ln CPI = -7.88 + 0.30\ln RER - 1.34\ln RGDP + 1.45\ln M2 + 0.91\ln OT - 0.06\ln DIR + 1.38\ln BD \quad \ldots\ldots\ldots (5.1)$$

$$(7.04) \qquad (-8.46) \qquad (8.46) \qquad (10.74) \qquad (-2.20) \qquad (13.13)$$

Where ( ) are the t-values.

Table 5.5 presents the long term influence of each explanatory variable on the inflation variable. As has been clearly displayed in the table, all of the considered series were found to impose a considerable long run impact on inflation. The long run elasticity of money supply was estimated to be 1.45, exhibiting a more than unit elastic effect ($e_p > 1$). It can be understood as, other things being constant; a percentage change in money supply causes the long run growth rate of inflation to change by about 1.45%. Concerning the suggested strong inflationary impact of money supply, this finding is consistent with the classical version of *QTM*. Besides, it also supports the works of Habtamu (2013) and Yemane (2008) in Ethiopia; Mehrizi et al (2011) in Iran; Oludele et al (2015) in South Africa. More importantly, the suggested higher than unit long run elasticity of money supply is strongly in line with the Keynes's version of *QTM.* For Keynes, monetary impact being aggravated by inflationary expectations could result even in a more than unitary effect on inflation in the long run; and the elasticity assumes zero value in the short run (Teodora and Laurentiu, 2009). Hence that, there is no guarantee for the estimated higher elasticity of money supply here is not because of the same reason as with the case in the reformulated version of *QTM.*

Being of the important monetary policy operational instruments of the National Bank of Ethiopia, the role of deposit interest rate in the long run dynamics of inflation was revealed to be very low, though significant. With all other factors kept unchanged, a percentage surge in domestic deposit rate would result in a down move of inflation rate only by 0.06%; while

exhibiting inverse relationship with inflation. The implication might be that, the interest rate channel of monetary policy in dealing with the long run issue of inflation in Ethiopia is less effective. Normally, the rise in deposit rate induces saving and discourages consumption. As a result, aggregate demand drops thereby easing pressure on price, assuming stability in the investment function. This fragility in deposit rate can be viewed from different angles in the context of Ethiopian economy;

First: owing to the customary lower bank rates, economic agents may resort to other asset holding decisions. Even at small house hold level, the return from small scale farm or investment may exceed bank return. In this case, extra balance will be spent for the purchase of investment and consumable goods and services; and would further result in increased aggregate demand and hence price level.

Second: another possible justification may be that, associated with higher surge in money growth and past inflationary experiences, the public's future inflationary expectation may increase. This further reduces the expected real rate of bank return, and discourages voluntary saving and induces consumption. Once again, other wealth holding methods become preferable, leading to increased spending, aggregate demand and price.

Third: poor habitual tendency to save in Ethiopia may be leading the volume of saving to be interest inelastic. Irrespective of changes in bank deposit rate, agents may engage in other wealth holding decision, or either consumes all what they have. It might further be accredited to the inadequate personal disposable income in Ethiopia and, even inadequate information to the public on periodic levels of these rates by the public together with the potential benefits of keeping wealth at bank. Of course, these factors are the manifestations of under developed financial sectors and the general economy. With improper information on the timely set bank rates, achieving the ultimate monetary policy target of maintaining sustainable price, via its interest rate instrument could hardly be possible. .

On the other hand, production sector has also been significantly explaining the long run dynamics of inflation in Ethiopia. It being proxied by ln*RGDP* was found to have strongly significant and negative effect on inflation as with prior expectation. Its estimated long run

elasticity is 1.34; suggesting, with all other factors held constant, a 1% increase in the level of real output reduces the growth rate of inflation by about 1.34% in the long run. This effect is strong as nearly equal as the long run effect of money supply on inflation. Empirically, it also is consistent with, among others, works of Laryea and Sumaila (2012) in Tanzania; Habtamu (2013) in Ethiopia.

It is straight to argue the negative impact of output on Ethiopian inflation based on economic interpretations. Since Ethiopian economy is predominantly agrarian; improvements in agricultural productivity and output will have considerably reducing effect on food inflation; which, in turn, has been explaining more than half of the general *CPI* inflation in Ethiopia (UNDP, 2014/15). Besides, it is an interesting fact to consider the case in Ethiopia that, seasons with drought and unfavorable weather conditions (*either less abundant or excessive rain fall*) has been followed by price hikes. This, in one or the other way, could be endorsed to the fall in agricultural supplies; given that the sector's yield is more of nature guided, and is based mainly on traditional practices.

Unlike the claims in 'New Growth Theory', trade openness is found to move significantly positively with inflation in the long run. Its long run elasticity was estimated at 0.91; implying that, a percentage improvement in country's exposure to international trade would result in growth of domestic inflation by about 0.91%. Of course, it is not that much impressing to estimate the positive correlation between openness and inflation in countries of like ours; where a bulk of manufactured and industrial goods and inputs are made in huge volume. Before developing arguments for this positive relationship, let's first highlight the explanations of New Growth Theories on the link between the two variables. The theory argued for higher degree of openness to reduce domestic price level directly by reduced tariff rate, and indirectly by boosting domestic production (Mukhtar, 2010). The hypothesis follows that, an opened up economy will have special economic advantages in the form of; production efficiency, enlarged market opportunities for home products, better utilization of excess capacity, better international resource flows, following smoothed cross boundary trade policies and decreased or removed trade barriers. It would therefore result in enhanced productivity and production level, and will have indirect negative effect on price (via output-price frameworks). Besides, as a measure for

freeing international trades, the on port import and export duties would be removed, or at least minimized, hence suggested to be directly reflected in the form of lowered domestic prices.

However, the 'Cost-Push' sides viewed contrarily to the case with New Growth Theory. They hold for inflation to move positively with openness (Mayer, 2003). The argument is that, an opened up economy is highly subject to imported inflation and weekend domestic macroeconomic policies (particularly of monetary and fiscal policies) with the introduction of external shocks (like exchange rate conditions and other unfavorable happenings in trading partners), see Aron and Muellbaur (2007). Heavy reliance on import of manufactured and industrial goods and intermediate inputs by emerging economies will have higher possibility of importing foreign inflation simultaneously, which can be reflected directly on domestic prices. Hence, given all these possibilities, the 'Cost-Push' advocators claimed that, it is the net effect that determines the level of output and, hence price level; but not only the justified benefits of trade openness. The implication follows that since openness has both costs and benefits, whenever the suspected benefits of openness are sufficient enough to offset these costs, and left with extra capacity to boost domestic productions, the hypothesis of 'New Growth Theory' holds; otherwise, the correlation remains positive. Therefore, the present study sides the 'Cost-push' analysis to partly explain the positive correlation among the two series. It also is consistent with many empirical studies over the world, and to mention only few; Sanginabadi et al (2011) in Iran; Zakaria (2010) in Pakistan. In both cases positive and significant relationship between openness and inflation was confirmed.

To sum, 'New Growth Theory' may be missing in failing to consider other country specific factors operating against the suspected benefits of openness. Internal political unrest, frequent conflicts and civil wars, drought and famine and unstable macroeconomic environment will potentially harm the inflow of FDI, which is the principal benefit from larger international exposure. In this case, inflow of capital would be limited too, and higher imports in spite of low exports could badly harm the general economy. Besides, bad history of famine and drought, the discouraging and aggressive economic policies in the past regimes, internal conflicts and that of frequent Ethio- Eritrean Wars and internal civil wars, among others, might have been shadowing the international image of Ethiopia. The study period covered here is sufficiently large *(about*

forty one years), hence have been experienced with majority of these problems and, it is during this period that, especially economic and political instabilities were serious headaches of the country. Therefore, it might partly explain the estimated positive relationship between the two series in this study. Recent negative relationships between openness and inflation *(if it exists owing to some improvements in internal conditions)* may be offset by the larger earlier positive relationships. Possibly, another personal justification for the case would be that, the government may resort to increasing the domestic tax rate as well as tax base, to compensate for the lost tariff and other trade liberalization related revenues.

Another external factor considered is the real exchange rate. Its long run elasticity is 0.30, with strongly significant and expected sign (positive). In other words, a percentage real depreciation in domestic currency increases the growth rate of domestic inflation by about 0.3%. Real depreciation makes exports cheap and, imports become expensive; so that, higher foreign prices would be reflected in domestic economy in the form of higher inflation. It is consistent with the international trade hypothesis, like Obstfeld and Rogoff (1996). It also is consistent with the works of Durevall et al (2009) in Ethiopia; Holod (2000) in Ukraine; and Gull (2011) in Pakistan.

The Government's budget deficit variable is among the revealed long run determinants of inflation in this study. Following its macroeconomic link to money supply *(especially in LDCs)*, the deficit variable has given due attention in this study. Due to its monetary dimension, the long run impact of budget deficit on inflation is positive as expected and significant too. A 1% rise in financing deficits would result in rise of long run inflation rate by 1.35%; while exhibiting also a more than unit effect. This result further supports the strong long run impact of money supply on inflation thereby both exhibiting a greater than one elasticity. From macroeconomic theories (including the traditional QTM), any positive effect of budget deficit on inflation reflects seigniorage. Therefore, though made in fiscal aspects the effect of budget deficit could be viewed indirectly as being the effect of money supply. This analysis is highly consistent with the study of Gull (2011) in Pakistan; and Yemane (2008) in Ethiopia. Therefore, monetization of fiscal deficits has been among the important long run drivers of inflation, and that budget deficit has also been an important source of monetary growth in Ethiopia.

5.4.2. VEC Model Short Run Estimates

The long and short run estimates of VECM are related by the error correction term EC_{t-i}. A negative and significant coefficient of the error term reveals the economy's convergence back to the long run equilibrium. Any short run deviations will be adjusted towards the long run equilibrium by the periodic rate of that coefficient in VECM. Moreover, the existence of long run causality from the independent to dependent variable is indicated by the significant and negative coefficient of EC_{t-i} term in the model.

In the short run, most of the variables were found to be important. Money supply remained still dominant as with the case in the long run, thereby exhibiting a more than full effect. The detail is reflected in the following table;

Table 5.6: *VECM Short- Run Elasticities*

Dependent variable: Dln*CPI* [Proxy to Inflation Variable]			
[D_ln*cpi* _ce1], Speed of Adjustment	-0.40 (-3.44) [0.001]	Speed of adjustment is the α-parameter in *VECM*	
Independent Variables	Short run elasticities at various lag length		
	y_{t-1}	y_{t-2}	y_{t-3}
Dln*CPI*	-0.09 (-0.47) [0.641]	-0.35 (-1.83) [0.068]	-0.10 (-0.58) [0.565]
Dln*M2*	1.07 (2.32) [0.020]	1.01 (2.68) [0.007]	0.34 (1.17) [0.241]
Dln*RGDP*	-0.06 (-0.25) [0.800]	0.06 (0.24) [0.807]	0.81 (2.98) [0.003]
Dln*OT*	0.44 (3.26) [0.001]	-0.24 (-2.31) [0.021]	-0.35 (-2.54) [0.011]
Dln*BD*	0.64 (3.94) [0.000]	0.52 (4.07) [0.000]	0.02 (0.27) [0.786]
Dln*RER*	0.64 (4.28) [0.000]	0.21 (1.30) [0.194]	0.14 (1.17) [0.244]

Dln*DIR*	-0.13 (-1.72) [0.085]	0.04 (0.43) [0.666]	0.15 (1.89) [0.058]
CONS	0.05 (2.15) [0.031]		
$R^2 = 0.98$ $\bar{R}^2 = 0.98$ *F(6, 34) = 534.61[0.0000]* *RSS = 0.061071746* *DW(7, 41) = 1.83*			
Diagnostic Test: • *Heteroskedasticity Test: Chi^2(1) = 2.42[0.1198]* • *RESET Test: (3, 31)= 2.28[0.0990]* • *ARCH= 0.745[0.3879]* • *Model Normality Condition;* *Jarque-Bera test: Chi^2(14) = 4.493[0.99170]* *Skewness test: Chi^2(7) = 1.571[0.97976]* *Kurtosis test: Chi^2(7) = 2.922[0.89211]* • *Residual Autocorrelation Test at lags;* *(1). Chi^2 (49) = 53.5123[0.30522]* *(2). Chi^2 (49) = 62.6017[0.09174]* *(3). Chi^2 (49) = 58.0539[0.17617]*			

Source: STATA Model output

Note: Numbers without brackets are the short run elasticities of corresponding Series; ( ) are t-values and; [ ] are the P-Values; and D, represents the Difference Term: $y_{t-i,}$ represents the lag length.

As long as the short run elasticities were of *VECM* estimates, the post diagnostic tests are consistently defined as with the long run cointegrating coefficients above.

The most important thing in VEC model is the sign and significance status the error term. It measures the speed by which the short term deviations in the inflation model can converge back to, or diverge from its long run equilibrium. In our case, it is negative and highly significant implying that any short term distortions in the inflation model could be corrected; and the short term deviations could converge towards the long run equilibrium at the annual speed rate of 40%. Hence, it takes a model about $2\frac{1}{2}$ years to reach the long run equilibrium point.

As indicative in table 5.6, except the real output and the domestic deposit interest rate variables, all others have been important in the short run. The short run elasticity of money supply is 1.07 and 1.01, in the first and second lags respectively; but, it is insignificant at the third lag. Besides, the short run elasticities are strong, being more than unity in the first lag, and equal to unity at the second lag. Therefore, money supply remained dominant even in the short run. It is highly consistent with the hypothesis of the traditional Quantity Theory of Money.

The short run elasticity of openness in the first year is positive and significant being 0.44. It means a percentage improvement in a country's exposure to international trade increases the growth rate of inflation by 0.44%. But, in the second and third lags, it exhibited the negative and significant coefficient in line with Romer's hypothesis. On the other hand, the real output sector was not important in the short run. However, in the third lag, it becomes significant with a short run positive elasticity of 0.81. Even though insignificant, the positive and negative short run elasticities in the first and second lag respectively might be explained as follows; in the initial stages of harvesting period, some agricultural products become fashion of the season and consumed in large quantities even at higher prices. Later on, agricultural supplies begin to rise from other sources thereby easing pressure on price level. The positive effect at the third lag may be because of rising rural demand for manufactured and other industrial goods due to the initial agricultural income.

Possibly due to the factors mentioned earlier, the interest rate channel of monetary policy has been found to be ineffective (insignificant) in the short run. The short run elasticities of budget deficit have been estimated to be significant for the first two lag periods, being 0.64 and 0.52 respectively. This finding is in line with the hypothesis of traditional *QTM,* thereby suggesting that, monetization of fiscal deficit has been important in explaining inflation both in short and the long run.

Finally, real exchange rate has also been found to have a positive and statistically significant short run impact on inflation, having a coefficient of 0.64 in the first lag. The import trade root accounts for the positive influence of real exchange rate on the process of inflation.

5.5. Monetary versus Fiscal Policy: *Which is more important?*

Consideration of all the major variables of monetary policy (money supply, real exchange rate and deposit interest rate) with the adopted inflation model enables to fully capture the role of monetary policy regarding the process of inflation. On the other hand, the sole candidate to fiscal policy in our model is the budget deficit variable. In comparing these two policies, and to avoid bias and moreover based on the main subject of this study, monetary policy was represented only by money supply variable and that, fiscal policy was examined with consideration of budget

deficit variable. Accordingly, the computed long run elasticity of broad money supply is 1.45 and, of that of budget deficit variable is equal to 1.38. For a 1% additional money supply, inflation responds by 1.45% increment; while, a 1% rise in deficit financing results in a growth of inflation by 1.38% in the long run. The coefficients are almost equal revealing the strength in both policies in explaining the long run dynamics of inflation in Ethiopia. The reason may be that, the measures in both policies have resulted in the expansion of money supply within the general economy. Though policies differ, measures in both cases are meant to increase the quantity of money under circulation.

But, the inflationary effect of money supply under monetary policy only slightly exceeds its effect through fiscal policy. That means the long run inflationary impact of monetary policy is a little bit greater than the effect of fiscal policy only by 0.07%. For comparison matters however, monetary policy is more important in the long run process of inflation in Ethiopia. This finding is consistent with the works of AfDB (2011) in Ethiopia; Rebecca (2014) in Ghana and Lozano (2008) in Colombia. The finding also rejected the government's claim that, inflation in Ethiopia is of neither monetary nor fiscal factors, but rather of a growth factor. Even though, the pressure from production side has been estimated to be strong in the long run, its short run importance is not considerable.

The share of money supply is dominant also in the short run. In the first lag, money supply and budget deficit variables exhibited the short run elasticities 1.07 and 0.64 respectively. Their effects persisted even up to the second lag with the respective elasticities of 1.01 and 0.52. The short run effect of money supply was twice of the budget deficit variable. The classical *QTM* has a truth in regarding money as the powerful item in a relation to the dynamics of inflation. Generally, money supply has found to be the strongest of all, both in short and the long run dynamics of inflation with a more than full effect. Inflationary expectations, in line with Keynes's version of *QTM* might partly explain this higher effect of money supply on inflation. Moreover, a 1% increase in government's deficit financing would result in a rise of inflation rate by 0.64% in the first lag and, by 0.52% in the second lag. Relative to the power of monetary policy, fiscal policy is less powerful in the short run also. Over all, monetary policy has been found to be more inflationary than fiscal policy both in short and the long run periods.

More importantly, by allowing all the factors to change simultaneously, we can also evaluate the relative importance of all the variables entered in the inflation model. It can be achieved by computing the ratios of each coefficient of the corresponding series to the sum of overall coefficients with significant impact on long run process of inflation.

Table 5.7: *The Comparative Long Run Importance of Explanatory Variables (with all variables changing simultaneously);*

Variables	Comparative Ratios	Percentages	Sign
ln*M2*	0.267	26.7	+
ln*DIR*	0.011	1.1	_
ln*RER*	0.055	5.5	+
ln*RGDP*	0.246	24.6	_
ln*OT*	0.167	16.7	+
ln*BD*	0.254	25.4	+
Total	1.00	100.0	

Source: Self Computation using Model Output

Assuming all variables in the model are moving instantaneously, money supply remains the most strongest of all; while the budget deficit variable being the intimate follower. The share of money supply in the overall long run dynamics of inflation is 0.267 (26.7%), and that of budget deficit variable is given by 0.254 (25.4%). In line with the previous analysis, the two values are nearly, but not exactly equal. Therefore, the effect of money supply is slightly more than budget deficit, suggesting the importance of monetary policy over fiscal policy once again. Note also however that, the long run inflationary effect of real output has been found to be as strong as money supply and budget deficit variables. Its comparative share is computed to be -0.246 (24.6%), which is almost equal to the first two variables discussed. Hence, one can deduce that the long run inflationary dynamics in Ethiopia has been equally and strongly responsive to the internal factors considered.

Compared to others, the share of deposit interest rate is very small and its comparative ratio has been given by -0.011 (1.1%). It implies that, given the instantaneous movement in the model, the

monetary policy action of increasing the deposit rate of interest by 1% scales down the rate of inflation by 0.011% (which explains only 1.1% of the variation in inflation). Hence, the interest rate instrument of monetary policy has been imposing a little higher than insignificant effect on the long run dynamics of inflation.

The two considered external factors are real exchange rate and the trade openness variables. The relative coefficients of the two variables are 0.055 and 0.167 respectively. Assuming one time change in the model, real exchange rate explains 5.5% of the variation in inflation, while openness accounts for 16.7% of the long run dynamics of domestic inflation in Ethiopia. Being component of monetary policy, the power of real depreciation has been found to be less important in the long run. Moreover, compared to internal factors, the role of external factors in explaining the long run dynamics of inflation has been suggested to be less. They both jointly explain 22.22% of the long run inflation, while the remaining 77.78% belongs to the internal factors considered. Therefore we can infer that, the long run dynamics of inflation in Ethiopia has been more of internal phenomenon.

5.6. Granger Causality Test Results

The short run causalities among variables entered the model of inflation have been examined by employing the VAR model Granger causality test approach, of which due attention has been paid on three of the principal variables in this analysis. The principality of broad money supply and CPI inflation in this study is certain. Due to its macroeconomic link with money supply, the budget deficit variable has also been regarded principal. Knowing the responsiveness of a variable to shocks from other source is help full to easily control the effect of one on the other. The test results have been presented here under;

Table 5.8*: Granger Causality Wald Test Results*

Null Hypothesis:	*F-Statistic*	*P-value*	*Decision*
Inflation does not Granger cause Money Supply	3.2183	0.0833	*Accept*
Money Supply does not Granger Cause Inflation	4.3417	0.0461	*Reject*
Inflation does not Granger cause Budget Deficit	1.8481	0.1845	*Accept*

Budget Deficit does not Granger Cause Inflation	0.5860	0.4502	*Accept*
Money Supply does not Granger cause Budget Deficit	0.4135	0.5253	*Accept*
Budget Deficit does not Granger Cause Money Supply	24.288	0.0000	*Reject*

Source: STATA VAR Model output

The bench mark to decide on as to whether accept or reject the null hypothesis was based on the 5% critical value. Accordingly, from table 5.8, the null of 'no Granger causality' has been accepted in most of the cases. Besides, no causal influence has been detected between inflation and budget deficit variables in either direction; but, forward uni-directional causality was suggested from money supply to inflation. It means money supply Granger causes inflation but no influence runs in reverse. This is in line with the traditional *QTM*. It is also consistent with the works of (Benbouziane and Benamar, 2004, in Tunisia and Morocco; Rao and Abate, 2015, and Yemane, 2008, in Ethiopia). Moreover, the revealed uni-directional causality from budget deficit to money supply is in line with the doctrine of the classical Quantity Theory of Money. This finding strongly supports the macroeconomic treatment of budget deficit to cause money supply and hence inflation in LDCs. Generally, the Granger Causality test has estimated the causal influence running from budget deficit to money supply and from money supply to inflation ($BD \rightarrow M^s \rightarrow CPI$). This is also consistent with the study of (Lozano, 2008, in Colombia; Rebecca, 2014, in Ghana; Benbouziane & Benamar, 2004 in Tunisia and Morocco). Hence, the inflationary effect of deficit financing is indirect via its initial positive effect on the quantity of currency in circulation. It further evidenced the claim in Ethiopia that, monetization of fiscal deficit has been the main reason for the rapid growth of money supply and, hence inflation; see (Benbouziane and Benamar, 2004; Yemane, 2008) in Ethiopia.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

The belief that inflation is a public enemy has remained subject of numerous empirical studies in economics. Though being such a focus variable, inflation has been a threat to most economies over the world, mainly to underdeveloped once. Thereby degrading the real value of money balance, it harshly penalizes poor section of the society. Despite the availability of numerous literatures on the subject, the findings on its causes were inconclusive too. Moreover, the sources of inflation have been argued otherwise in macroeconomic theories; and this difference has remained an important subject to most policy discussions and economic researches. The competing views by the classical and Keynes's version of *QTM* on the nature of interactions between money supply and inflation, complemented with the varying empirical discoveries on the causes of inflation were of the prominent motivators for considerable quantities of economic researches. Besides, these deviate on the relationship between the two series, in addition to the deficiency of economic literatures on inflation in a manner it is captured in the spirit of this paper, were also the primary motivations of this particular study. Thus, the study has gone through examining the applicability of classical QTM in the context of Ethiopian Economy.

Inspired basically by the hypothesis of the classical version of *QTM*, the study has mainly intended to empirically investigate the share of money supply in explaining the dynamics of inflation in Ethiopia by employing the time series data set ranging from 1974/75 to 2014/15. To achieve this objective, VEC econometric model was estimated after confirming all the pre and post statistical qualities in individual variables as well as, their joint behavior in the model. Based on its objectives, the major findings of this study were summarized as follows;

Towards validating the claims in traditional *QTM*, money supply has found to account for the dominant role in the process of inflation in Ethiopia with a more than unit effect. Especially its dominant role is highly considerable in the short run. The long run case puts it only a little over other domestic factors of fiscal deficit and real output. Besides, the Keynes's version of *QTM*

might partly explain a more than unit effect inflationary effect of money supply. Moreover, the uni-directional causality from budget deficit to money supply; and from money supply to inflation has been confirmed by VAR Granger causality tests. The implication is that, budget deficit has been an important source of monetary growth and; hence, inflation in Ethiopia. This result is also consistent with hypothesis of traditional macroeconomists in *QTM*; and, with most empirical studies claiming for government budget deficit to cause money supply especially in developing economies as they rely more on monetization of these deficits.

Besides; budget deficit, real output, trade openness and real exchange rate variables were estimated to be an important sources of inflation in the long run. Domestic deposit interest rate is also suggested to have only a minor role in the long run dynamics of inflation. As with the case in broad money supply, both real *GDP* and budget deficit variables have exhibited a more than unit long run elasticities, suggesting their strongest role in the process of Ethiopia's inflation. The strong impact of budget deficit is, because it explains part of the growth of money supply in the long run. Besides, the study has estimated the positive correlation between openness and inflation in contrast to the hypothesis of New Growth Theory.

Moreover; money supply, budget deficit, real exchange rate and trade openness are found to be important in the short run. The short run impacts of real *GDP* and domestic deposit interest rate variables have been found to be insignificant. Money supply still remained the dominant one with a more than unit effect in line with the classical version of *QTM*, but in contrast to Keynes.

Regarding the share of each variable in the model of Ethiopian inflation, the long run elasticities of money supply, real *GDP* and budget deficit variables were suggested to be nearly equal. However, for comparison matters and considering both the short and long run cases, money supply revealed the highest magnitude. Therefore, we can infer that monetary sector is more important than fiscal as well as production sectors. Additionally, the effect in monetary policy is much larger than the external factors.

6.2. Recommendations

Taking note of the points below would support the process of maintaining stable price; and hence, well being of general macroeconomic environment in Ethiopia;

- Both the monetary and fiscal policy makers should consider the higher sensitivity of inflation to changes in monetary growth. Controlling money supply growth thereby situational tightening of monetary policy can be an important solution. Besides, it is better for the government to rely more on other methods (rather than seigniorage) to finance its deficits. Enhancing domestic capacity and utilizing resources at home could have considerably stabilizing effect in the long run.
- Based on Keynes's version of *QTM,* the estimated higher than unit elasticity of money supply may have been explained by higher inflationary expectations. Hence, the effect of expectations can be tackled by ensuring credibility in targeting and announcement of key economic and general policy variables.
- Price shocks associated with the real production sector necessitate for larger investments in agriculture (as more of output is sourced from agricultural sector) and other food sectors. Therefore, enhanced domestic and foreign investment undertakings in these sectors could support the process of price stabilization and growth in general; parallel to the government's effort of expanding manufacturing industries in Ethiopia.
- To divert the positive effect of openness, the inflow of *FDI* should be encouraged and be provided with various promotional incentives in order to boost domestic production. Promoting *FDI* in manufacturing industries will reduce the sill of imported inflation in the long run.
- Furthermore, efforts to improve saving habits, moderate upward revision of deposit rates together with the credible policy for expectation issues will improve the effectiveness of monetary policy in controlling inflation via its interest rate channel. Measures related to interest rate should also consider their impact on investment undertakings.
- Finally, the inflation model of this study suggests that, inflation in Ethiopia has been more of internal factor. As a result, especial consideration should be given to home side factors.

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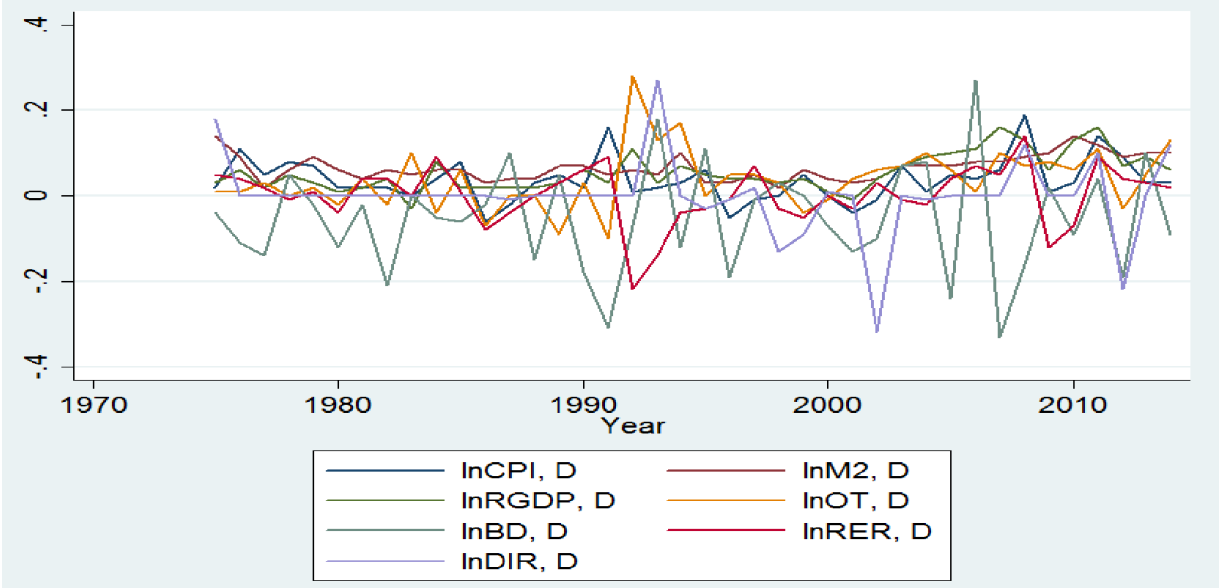
APPENDICES

Appendix 1: Pre- Estimation Tests

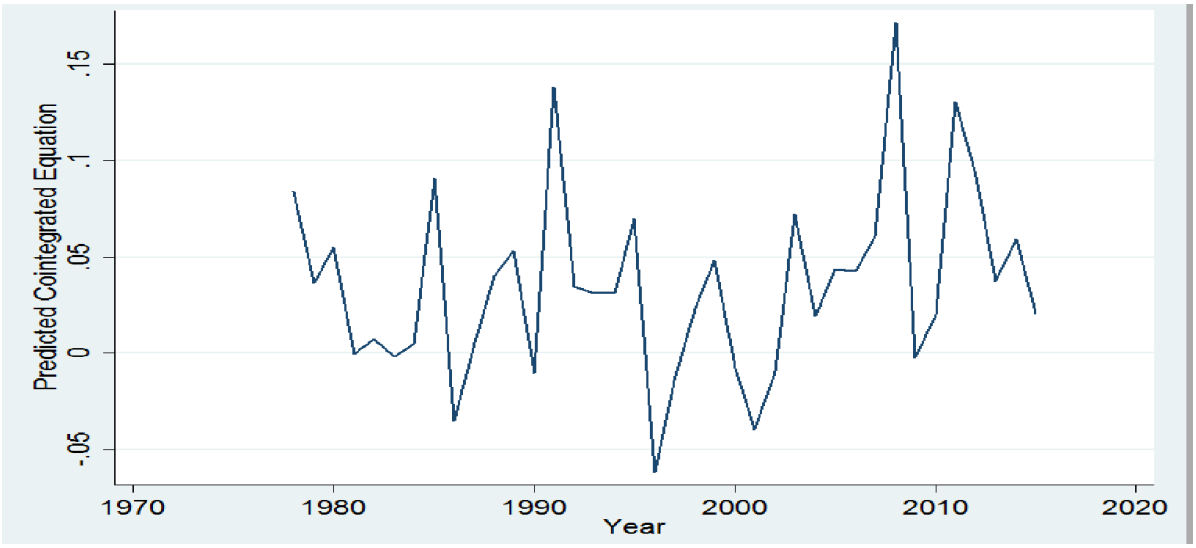
Figure 6: Plots of all Series in the Model at first Differences (all in one)



Source: STATA Inflation Model Output

The plot of each of the concerned series confirms that, all are stationary at their first differenced terms. It is of the essential preconditions for any econometric analysis.

Figure 7: Plots of the Predicted Cointegrating Equation for the 'Inflation Model'



Source: *STATA Inflation Model Output*

Figure 2 above reveals that apart from individual stationarity, the identified cointegrating equation is also stationary, and it provides further impetus to efficiency of the model estimated.

Appendix 2: Johnson Cointegration Test Results

```
. vecrank logcpi logm2 logrgdp logot logbd logrer ldir, trend(constant) lags(3) max

                        Johansen tests for cointegration
Trend: constant                                         Number of obs =       38
Sample:  1977 - 2014                                          Lags =       3
```

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	14	418.57899	.	144.3689	136.61
1	27	443.18485	0.72611	95.1572+	104.94
2	38	461.07493	0.60999	59.3770	77.74
3	47	474.46155	0.50567	32.6038	54.64
4	54	481.84346	0.32194	17.8399	34.55
5	59	487.69767	0.26517	6.1315	18.17
6	62	490.19904	0.12335	1.1288	3.74
7	63	490.76343	0.02927		

maximum rank	parms	LL	eigenvalue	max statistic	5% critical value
0	14	418.57899	.	49.2117	48.45
1	27	443.18485	0.72611	35.7802	42.48
2	38	461.07493	0.60999	26.7732	36.41
3	47	474.46155	0.50567	14.7638	30.33
4	54	481.84346	0.32194	11.7084	23.78
5	59	487.69767	0.26517	5.0027	16.87
6	62	490.19904	0.12335	1.1288	3.74
7	63	490.76343	0.02927		

Source: STATA Model Outputs

Appendix 3: VEC Model Estimation

1. Output of VECM Short Run Estimates (target model only)

```
Vector error-correction model

Sample:  1978 - 2014                            No. of obs      =         37
                                                AIC             = -25.67912
Log likelihood =  642.0637                      HQIC            = -23.11579
Det(Sigma_ml)  =  2.00e-24                      SBIC            = -18.40822

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
D_lncpi               23   .027726   0.9258   174.6213   0.0000
D_lnm2                23   .019063   0.9722   489.0378   0.0000
D_lnrgdp              23   .040984   0.8749   97.92516   0.0000
D_lnot                23   .063206   0.7805   49.77919   0.0010
D_lnbd                23   .118854   0.7195    35.9144   0.0421
D_lnrer               23   .061466   0.6958   32.02943   0.0995
D_lndir               23   .087335   0.6308    23.9157   0.4085
------------------------------------------------------------------
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_lncpi						
_ce1						
L1.	-.4048633	.117853	-3.44	0.001	-.6358509	-.1738757
lncpi						
LD.	-.0909255	.1949146	-0.47	0.641	-.4729511	.2911002
L2D.	-.3532432	.193329	-1.83	0.068	-.7321611	.0256748
L3D.	-.097701	.1698209	-0.58	0.565	-.4305438	.2351418
lnm2						
LD.	1.067683	.4606128	2.32	0.020	.1648981	1.970467
L2D.	1.008728	.3766157	2.68	0.007	.2705748	1.746881
L3D.	.341047	.2910511	1.17	0.241	-.2294027	.9114967
lnrgdp						
LD.	-.0599173	.2369287	-0.25	0.800	-.5242889	.4044544
L2D.	.0562132	.2302452	0.24	0.807	-.3950591	.5074856
L3D.	.8099321	.271511	2.98	0.003	.2777802	1.342084
lnot						
LD.	.4426698	.1356672	3.26	0.001	.176767	.7085726
L2D.	-.2406591	.1042739	-2.31	0.021	-.4450322	-.0362859
L3D.	-.3451543	.1358723	-2.54	0.011	-.6114592	-.0788494
lnbd						
LD.	.6422221	.1630805	3.94	0.000	.3225902	.9618541
L2D.	.5216047	.1282936	4.07	0.000	.270154	.7730555
L3D.	.0229189	.0843711	0.27	0.786	-.1424454	.1882832

lnrer						
LD.	.6434911	.1503862	4.28	0.000	.3487395	.9382426
L2D.	.2126057	.1637243	1.30	0.194	-.108288	.5334995
L3D.	.1356002	.116292	1.17	0.244	-.0923279	.3635282
lndir						
LD.	-.1343977	.0779521	-1.72	0.085	-.2871811	.0183857
L2D.	.0358797	.0831769	0.43	0.666	-.1271442	.1989035
L3D.	.1480243	.0782168	1.89	0.058	-.0052778	.3013265
_cons	.0543436	.0252502	2.15	0.031	.0048542	.1038331

Source: STATA VEC Model Output

For the purpose of saving space, only the short run coefficients of the target model in VECM estimates (where lnCPI is the regressand) is displayed together with the coefficient of the error term.

Appendix 4: Output of Cointegrating Coefficients for the Inflation Model

Cointegrating equations

Equation	Parms	chi2	P>chi2
_ce1	6	4627.088	0.0000

Identification: beta is exactly identified

Johansen normalization restriction imposed

beta	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_ce1						
lncpi	1	.	.	.	.	.
lnm2	1.448846	.1712708	8.46	0.000	1.113161	1.78453
lnrgdp	-1.337181	.1581383	-8.46	0.000	-1.647126	-1.027236
lnot	.9059746	.0843232	10.74	0.000	.7407042	1.071245
lnbd	1.380441	.1049782	13.15	0.000	1.174687	1.586194
lnrer	.2968703	.0421548	7.04	0.000	.2142484	.3794923
lndir	-.0586541	.0266842	-2.20	0.028	-.1109542	-.006354
_cons	-7.877614	.	.	.	.	.

Source: STATA Model Output

Note: The Cointegrating equation involves the long run elasticities of individual variables in the model.

Appendix 5: Model Post- Diagnostic Tests

Vector Error Correction Model involves basically three common post estimation tests. These are LM test for serial autocorrelation, normality and parameter stability tests. Each of the test results are displayed in the section below;

1. Results of LM Test for Residual Autocorrelation

```
. veclmar, mlag(3)
```

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	53.5123	49	0.30522
2	62.6017	49	0.09174
3	58.0539	49	0.17617

H0: no autocorrelation at lag order

Source: STATA Model Output.

2. Results for Normally Distributed Disturbances

```
. vecnorm, jbera skewness kurtosis
```

Jarque-Bera test

Equation	chi2	df	Prob > chi2
D_lncpi	0.154	2	0.92599
D_lnm2	2.593	2	0.27354
D_lnrgdp	0.269	2	0.87410
D_lnot	0.055	2	0.97304
D_lnbd	0.402	2	0.81780
D_lnrer	0.165	2	0.92063
D_lndir	0.855	2	0.65219
ALL	4.493	14	0.99170

Source: STATA Model Estimate

Skewness test

Equation	Skewness	chi2	df	Prob > chi2
D_lncpi	-.03985	0.010	1	0.92117
D_lnm2	-.14434	0.128	1	0.72001
D_lnrgdp	.19587	0.237	1	0.62668
D_lnot	.07131	0.031	1	0.85944
D_lnbd	-.2496	0.384	1	0.53538
D_lnrer	.03176	0.006	1	0.93713
D_lndir	-.35427	0.774	1	0.37899
ALL		1.571	7	0.97976

Source: STATA Model Estimate

Kurtosis test

Equation	Kurtosis	chi2	df	Prob > chi2
D_lncpi	2.6944	0.144	1	0.70434
D_lnm2	4.2643	2.464	1	0.11647
D_lnrgdp	2.8547	0.033	1	0.85685
D_lnot	2.8771	0.023	1	0.87868
D_lnbd	2.8916	0.018	1	0.89296
D_lnrer	2.6787	0.159	1	0.68992
D_lndir	3.229	0.081	1	0.77612
ALL		2.922	7	0.89211

Source: STATA Model Estimate

Normality test in the residuals of the inflation model has been examined in three separate tests of Kurtosis, skewness and the Jarque-Bera tests. Accordingly, all the three cases have confirmed normality in the general model.

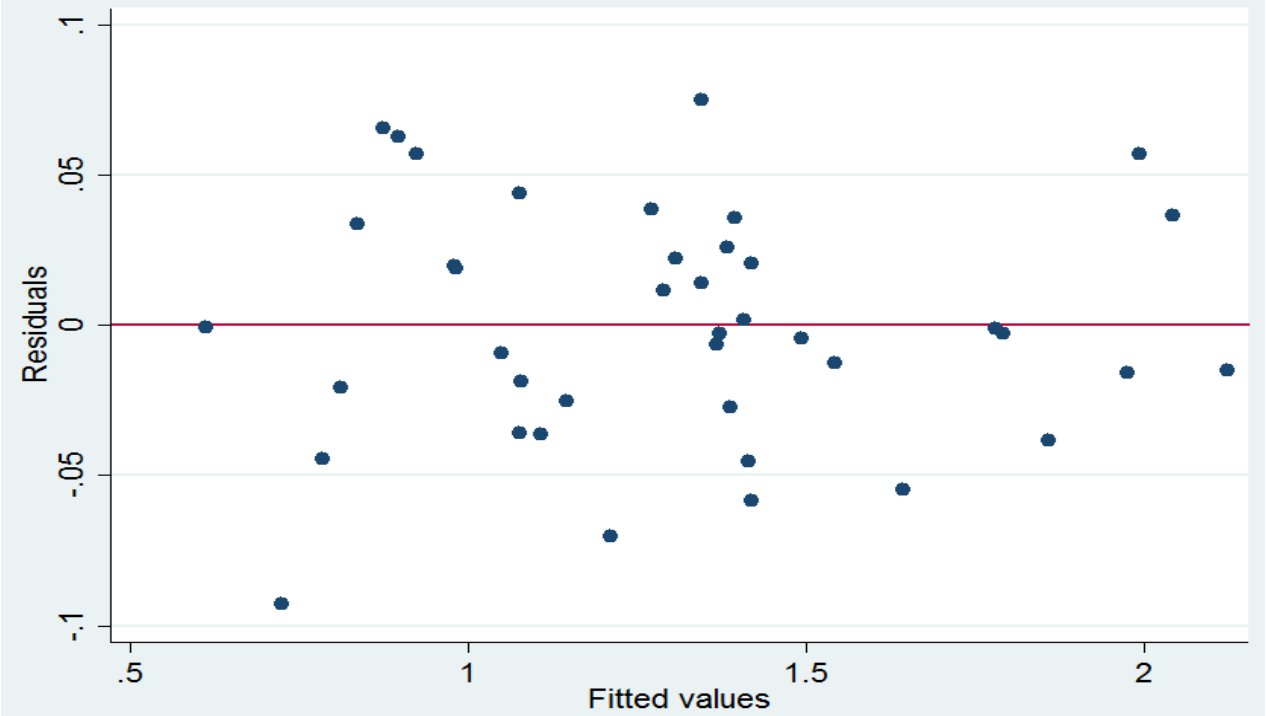
3. Heteroskedasticity Diagnosis

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

         chi2(1)      =     1.87
         Prob > chi2  =   0.1714
```

The test statistics is significantly different from zero suggesting that the residuals in the inflation model are not heterosckedastic. Similarly, heteroskedasticity can be detected by plotting graph for residual distribution as follows;

Figure 8: Plot of Heteroskedasticity Diagnosis



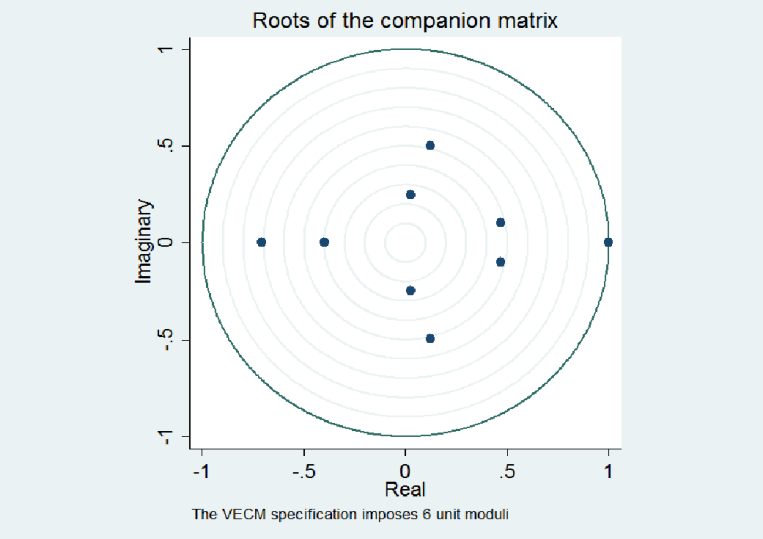
Source: STATA model output

Residuals do not exhibit any pattern so that the null of constant variance in the distribution of residuals for the inflation model was accepted against the alternative hypothesis of varying variances.

4. Parameter Stability Condition

To check the stability condition in the model, the Companion matrix for the imposed eigen-roots has been examined. There rule is that if VECM contains *(k)* endogenous variables and *(r)* cointegration vectors, there should be *(k-r)* unit moduli in the companion matrix. Accordingly, the inflation model of this study contains seven endogenous variables and that the identified cointegrating equation was one; and in line with rule, six unit moduli were imposed in companion matrix of the inflation model as displayed below;

Figure 9: Roots of Companion Matrix for the 'Inflation Model'



Source: STATA Model Output

For the process to be stable, the remaining eigenvalues should strictly be less than one. Accordingly, the graph above implies that none of the remaining eigenvalue appears close to the unit circle. Moreover, none of them appears outside of the unit circle, so that stability of the parameters of the inflation model is confirmed.

Finally, all of the diagnosis tests suggest that the inflation model adopted in the presented study is well specified. Therefore, it supports the credibility of all the inferences made by estimating this model fulfilling all the necessary econometric qualifications.