DETERMINANT AND IMPACTS OF DYNAMIC INFLATION IN ETHIOPIA

(A Granger causality model approach)

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Declaration

I, Temesgen Tezera Biresaw, do hereby declare the originality of my work, and wholeheartedly do acknowledge the use of all materials other than my own work. This work has not been submitted to any other university than Norwegian University of Life Sciences (UMB) for any type of academic degree or publication.

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Acknowledgement

TABLE OF CONTENT   **PAGE**

Acronyms

CPI   Consumer Price Index

PPI   Producers price index

CSA   Central Statistical Agency

DBE   Development Bank of Ethiopia

EDRI   Ethiopian Development Research Institute

EEA   Ethiopian economic association

GDP   Gross Domestic Product

IFS   International Financial Statistics

IMF   International Monetary Fund

MoFED   Ministry of Finance and Economic Development

NBE   National Bank of Ethiopia

LIST OF FIGURES:

LIST OF TABLES:

Abstract

This thesis uses quarterly data for the period 1998-2010 to investigate the determinant and impacts of dynamic inflation in Ethiopia. By using Granger causality model approach four testable hypotheses are investigated: (1) does the money supply growth Granger-cause inflation? (2) Does currency devaluation Granger cause inflation? (3) Does inflation affect economic growth? And (4) Does oil price Granger cause of inflation?

The empirical results suggest that there existed a bi-directional causality between broad money supply growth and inflation and unidirectional causality between currency devaluation and inflation as well as oil price and inflation. For the complete sample period, the causality running from inflation to broad money supply growth was stronger than that the other way round. This result is consistent with the view that in a high inflationary economy, inflation does have a feedback effect on money supply growth and this generates a self-sustaining inflationary process. On the other hand relationship between inflation and economic growth, the results shows that there was no short-run causality from inflation to economic growth for the complete sample period.

Key words: Inflation, Money Growth, Devaluation, Economic Growth, Granger-Causality, Ethiopi

1. INTRODUCTION

1.1 BACKGROUND

Inflation is defined as a continuous rise in price levels of goods and services leading to a fall in currency's purchasing power (Romer, 2012). A country is said to be under pressure of inflation when the prices of most goods and services continue to scale upward for long duration of time. Inflation reduces savings, pushes up nominal interest rates, dampens investment, and leads to depreciation of currency and in the extreme cases it can lead to the breakdown of a nation's monetary system.

Inflation occurs when the total demand for goods and services in an economy exceeds the supply of the same. When the supply is less, the prices of these goods and services would rise. Inflation affects everyone in the economy. When the price level rises, each unit of currency buys fewer goods and services; inflation is also erosion in the purchasing power of money, a loss of real value in the internal medium of exchange and unit of account in the economy (Walgenbach et al., 1973).

There are different types of inflation of which the main kinds are categorized as: **Demand Pull Inflation**: is an inflation which is caused by increase in demand due to increased private and government spending. **Cost Push Inflation**: Also referred to as supply shock inflation caused by reduced supplies due to increased prices of inputs, for example crude oil prices globally have gone up causing supply constraints which means higher costs of production. **Structural Inflation**: A type of inflation caused by deficiencies in certain conditions in the economy such as backward agricultural sector that is unable to respond to people's increased demand for food, inefficient distribution etc. (Ankit , 2011).

Various methods can be used to measure inflation. However, the common methods that are used to measure inflation are:

- ➢ Consumer Price Index (CPI): Take the change in the price of consumer goods and services.
- ➢ Producer Price Index (PPI): Take the change in price of raw material or produce used by the producers.
- ➢ GDP-Deflator: It is the ratio of nominal and real gross domestic product.

The types of inflation measurement provide different outcomes with their respective purpose (Joshua K., 2010). However, this particular research thesis uses consumer price index as a

measure of inflation because Inflation in Ethiopia is measured by using consumer price index (CPI), which is composed of food and non-food prices on monthly bases.

In Ethiopia the history and trend of inflation shows that, prior to 2002 inflation has remained more or less stable. The country has not suffered from high inflation and annual average inflation was only 5.2 percent during 1980-2003. However, in the post 2002/03 the situations have been dramatically changed. Inflation has increased. During the same period, the economy has recorded fast growth rate (On average 10.5% GDP growth) and continue growing consecutively for the last eight years according to reports (WB, 2010, NBE, 2010).

1.2 CPI AS A MEASURE OF INFLATION

In this study the change of consumer price index (CPI) is used to measure the rate of inflation in Ethiopia. Since it is published every month by the Ethiopian central statistical agency, the CPI is the most important inflation indicator in Ethiopia. The index is calculated in relation to a base period 2006 where it was set to 100.The following Laspeyres formula is used to calculate the current period t Ethiopian CPI.

$$CPI_t = \frac{\sum W_i \left(\frac{P_t}{P_o} \right)}{\sum W_i} \times 100$$

Where; **Pt** is the price of commodity i in the current period t, Po is the price of the commodity i in the reference period and **Wi** is the weight associated with commodity i. The reasons to use the CPI to measure the rate of inflation in this thesis are:

- It is simple for calculation
- It has large Population Coverage-it covers almost all areas of the country.
- It includes many products and services
- It is commonly used measure of inflation in Ethiopia

1.3 RESEARCH QUESTIONS

The Ethiopian economy has been highly dependent on agriculture and agriculture by its nature is weather dependent and characterized by fluctuation in output. Agriculture contributes over 40 percent of the national GDP of Ethiopia (NBE, 2012) and past histories showed that there exist a direct link between weather condition and agricultural production i.e. good weather conditions leads to good agricultural output With this systematic relationship between GDP (output) and rainfall there followed a systematic price variation i.e. Prices followed the inverse of output trend (Deressa and Hassan, 2009).

As historical experiences shows during years of good rainfall, output rises and most prices often dropped considerably. Even within any particular year prices have been lower during harvest periods. However, this trend appeared to have changed since the post 2002/03 period. Despite the significant increase in output, prices continued to rise. Every other year the inflation continues to gain momentum. This inflationary trend is mainly derived by food prices. For example out of 18.1% 0f annual inflation in 2010/11 about 14% of price hike is contributed by food price according to (NBE, 2011) reports whereas non-food items contributes only 1.2% of the inflation rate (see table 1 below).

Table1. Annual Average Inflation Rates (in percent)

Consumption Items	2009/10	2010/11	Change%	Change in Headline Inflation %
	A	B	B-A	C
General	2.8	18.1	15.3	15.3
Food	-5.4	15.7	21.1	14.1
Non food	18.2	21.8	3.6	1.2

Source: CSA and NBE Staff Computation

The agricultural sector has registered a marked growth over the past eight years. However this has failed to solve food price hikes. The food price inflation has reached over 36 percent in April 2008 (CSA, 2008). This seemingly contradictory situation has puzzled many and led many more to suspect the credibility of the stories of fast economic growth in Ethiopia over the past eight years.

Inflation affects the living standard of both urban and rural population by increasing living costs compare to the relatively low increments of income. It affects the life of the people by increasing the number of poor people in the county. Rise in food prices are causing many to be unable to feed themselves.

 In general the level of income in Ethiopia is very low. In addition this low income is hit by high inflation and this high inflationary condition proved unbearable for most. Hence, to solve the problem of high inflation it is essential that both government and non-governmental organizations participation to control the price hikes in the country. Therefore, in this research thesis it is try to apply an econometric technique of Granger-causality model in order to estimate specific causal relationship between inflation and its major determinants in Ethiopia.

1.4 RESEARCH OBJECTIVE

The main objective of this thesis is:

- To identify the most important determinants of inflation in Ethiopia.
- To see the impacts that inflation plays in the country both in the short run and the long run so as to design an alternative possible policy options.

1.5 HYPOTHESES

In order to sort out the major determinant of inflation in this research thesis four testable hypotheses will be investigating: (1) does the money supply growth Granger-cause inflation? (2) Does currency devaluation Granger cause inflation? (3) Does inflation affect economic growth? (4) Does international oil price fluctuations Granger cause inflation?

1.6 ORGANIZATION OF THE THESIS

This research thesis contains five parts. The introduction part is presented in part one, a review of literature will be discussed in part two. Both theoretical and empirical review about inflation will be briefly discussed. At the third part data and methodology will be presented. The trend of the various explanatory variables will be presented with that of inflation in order to see whether the trends have theoretically expected movements or not. In the fourth chapter analysis of the results of the econometric model will be presented. In addition model specification and estimation results will be forwarded. Finally, conclusion and recommendation will be presented.

2. LITRATURE REVIEW

2.1 THEORIES OF INFLATION

The study of causes of inflation has probably given rise to one of the most controversial debates in the field of economics. The debates differ in their hypotheses, mainly due to a range of conventional views about the appropriate measure to control inflation. For example, Neo-classical defined inflation as a rise in prices caused by excessive increase in the quantity of money. For Keynesians true inflation happens when money supply increases beyond full employment level (Jhingan, 1997). Though various economists define inflation in different ways a common general agreement is that inflation is a sustained increase in the general price level.

Different schools of thought emphasize one or a combination of the possible sources of inflation. for example For monetarists inflation is always and everywhere purely a monetary phenomenon whereas the proponents of the cost-push theory of inflation attribute inflation to a host of non-monetary, supply-oriented influences that alter the unit cost and profit markup components of the prices of individual goods (Humphrey, 1998).

It is specifically difficult to identify the reasons for or factors that contribute to inflation. In literature various schools of thought suggested different factors as the prime sources of inflation. However, important variables such as monetary and fiscal developments may be crucial in explaining inflationary processes. Yet, the sources of inflation in all countries need not be the same. In the review of theories of inflation the alternative theories are grouped in the following categories

2.1.1 DEMAND-PULL THEORIES OF INFLATION

According to demand- pull theorists there is identical or equal relationship between national income estimated at market prices and the velocity of circulation of the money supply. Based on this theory, there is a positive relationship between price levels and the money supply. This relationship is presented using the quantity equation.

MV = PY

Where: M is the stock of money in circulation, V is the velocity of circulation, P is the general price level, Y is the total income.

Accordingly there will be a proportionate positive relationship between the money supply and the price levels of a given economy by assuming velocity is constant. That is, when the money

supply increases by a certain percentage the price levels will also increase by an equal percentage.

According to this theory it is believed that inflation is caused by an expansion in the money supply of a given economy which is not supported by an increase in output levels of an economy (Auraro,2010).

2.1.2 MONETARIST THEORY OF INFLATION

Monetarists says that "*only money matters*", and as such monetary policy is a more important instrument than fiscal policy in economic stabilization. According to monetarists the money supply is the "*dominant, though not exclusive*" determinant of both the level of output and prices in the short run, and of the level of prices in the long run. The long- run level of output is not influenced by the money supply (Jalil Totonchi, 2011).

They further said that, when the money supply is increased in order to grow or increase production and full employment it creates an inflationary situation within an economy. Monetarist believes that increases in the money supply will only influence or increase production and employment levels in the short run and not in the long run. Accordingly, there will be a positive relationship between inflation levels and money supply. They further explain this relationship by using the theory of natural rate of unemployment.

The theory of natural rate of unemployment suggests that there will be a level of equilibrium output, employment, and corresponding level of unemployment naturally decided based on features such as resources employment, technology used and the number of firms in the country etc. the unemployment level decided in this manner will be identified as natural rate of unemployment. However, in the short run, expansionary monetary policies will result in the decline in the rate of unemployment and increase the production but the effectiveness of the expansionary policies will be limited in the long run and lead to an Inflationary situation.

2.1.3 COST-PUSH THEORIES OF INFLATION

For Cost-push inflation theorist's inflation is a phenomenon in which the general price levels rise due to increases in the cost of wages and raw materials (Jalil Totonchi, 2011). Cost-push inflation develops because the higher costs of production factors decrease in aggregate supply (the amount of total production) in the economy. Because there are fewer goods being produced (supply weakens) and demand for these goods remains consistent, the prices of finished goods increase (Investopedia, 2011).

One of the proponents of cost push theories is James Steuart (1767) in his '*Inquiry into the principles of Political Economy*,' argues that "*real forces derive individual and aggregate prices*

6

alike" (Humphrey 1998). Inflation is determined by forces that determine the prices of individual goods. The forces governing the prices of specific goods are competition and cost. Competition lowers prices as do falling costs.

According to (Jhingan, 1997) the cause of cost push inflation is an increase in the price of domestically produced or imported raw materials. The increase in raw material prices increases production cost of firms. This in turn results in higher prices because firms pass the cost increase to consumers.

2.1.4 KEYNESIAN THEORY OF INFLATION

J.A. Keynes (1940) is known as the father of modern economics in his theory of inflation he argues that an increase in general price levels or inflation is created by an increase in the aggregate demand which is over and above the increase in aggregate supply. If a given economy is at its full employment output level, an increase in government expenditure (G), an increase in private consumption (C) and an increase in private investment (I) will create an increase in aggregate demand; Leading towards an increase in general price levels. Such an inflationary situation is created due to the fact that at optimum or full employment of output (maximum utilization of scarce resources) in a given economy is unable to increase its output or aggregate supply in response to an increase in aggregate demand.

According to Keynes, unexpected increase in aggregate demand creates "inflationary gap" and leads to inflation under full employment conditions. This in turn creates unanticipated profits for firms while nominal wages remain temporarily constant. The rising profit creates excess demand in the goods market. The rise in profit compels firms to expand their production there by creating excess demand in the labor market. The competition for fully employed labor among firms pushes nominal wages until real wage is restored at its initial level. The increase in real wage in turn produces excess demand in the goods market and hence inflationary pressure. The interaction of the labor and goods market produces wage-price spiral that can only be reversed by checks to aggregate demand (Kibritçioğlu, 2002).

2.1.5 NEW NEOCLASSICAL SYNTHESIS (NNS) THEORY OF INFLATION
According to NNS monetary (Marvin Goodfriend, Robert King, 1997), or demand, factors are a key determinant of business cycles, because of the incorporated new Keynesian assumption of price stickiness in the short run. At the same time, however, the NNS assigns a potentially large function to supply shocks in explaining real economic activity, as suggested in the new classical real business cycle theory. The highly complex model of the new neoclassical synthesis allow that Keynesian and real business cycle mechanisms to operate through somewhat different channels. The so-called new IS-LM-PC version of the NNS makes the price level an endogenous

variable. In this model, IS refers to Investment and Saving .i.e. equilibrium equation of goods and services market, LM refers to demand for and supply of money .i.e. equilibrium equation of money market and PC refers to Philips Curve. The NNS also views expectations as critical to the inflation process, but accepts expectations as amenable to manage by a monetary policy rule.

2.1.6 NEW POLITICAL MACROECONOMICS THEORY OF INFLATION

The major important theories as mentioned above mainly focus on macroeconomic determinants of inflation and simply ignore the role of non- economic factors such as institutions, political process and culture in the process of inflation. Political forces, not the social planner, choose economic policy in the real world. Economic policy is the result of a decision process that balances conflicting interests so that a collective choice may emerge.

According to The new political economy theorist's literature (Alberto Alesina, 1988) provides fresh perspectives on the relations between timing of elections, performance of policy maker, political instability, policy credibility and reputation, and the inflation process itself. The case for Central Bank independence is usually framed in terms of the inflation bias (deviation) present in the conduct of monetary policies. However, the theoretical and empirical work suggests that monetary constitutions should be designed to ensure a high degree of Central Bank autonomy.

They also overlook the possibility that sustained government deficits, as a potential cause for inflation, may be partially or fully indigenized by considering the effects of the political process and possible lobbying activities on government budgets, and thus, on inflation.

2.2 EMPIRICAL LITERATURE REVIEW

Over the years, there have been a considerable number of empirical researches in the field of inflation. Most of the works were directed towards the establishment of the causal agents (determinants) of inflation and different methods were used in order to analyze the data. Some of the techniques are listed below as an example..

Ratnasiri (2006) to examine the main determinants of inflation in Sri Lanka over the period 1980 – 2005 he use Vector Autoregressive analysis the results presented in his paper indicate that money supply growth and rice price increases are the main determinants of inflation in Sri Lanka in the long run. In contrast, exchange rate depreciation and output gap have no statistically significant effect on inflation. On other hand Elbadawi (1990) conducted a research on the determinants of inflation in Uganda during the period 1988 to 89. His work revealed that rapid

monetary expansion and the depreciation of parallel exchange rate were the principal determinants of inflation in Uganda.

By applying cointegration analysis and error-correction modeling Leheyda (2005) investigate the determinants of inflation in Ukraine. And he concludes that in long run money demand, purchasing power parity and mark-up relationships were found, which may govern prices in the long run. In the short-run inflation inertia, money supply, wages, exchange rate and real output as well as some exogenous shocks influence inflation dynamics.

Laryea and Sumaila (2001) conducted a research to find out the determinants of inflation in Tanzania and their findings showed that in the short-run, output and monetary factors are the main determinants of inflation in Tanzania. They also pointed out that in the long-run, parallel exchange rate also influences inflation. In their conclusion, inflationary situation in Tanzania is basically a monetary phenomenon.

Arida and Frasicisco (2005) conducted an empirical research on "does political instability lead to higher inflation?" In their study, they combined generalized method of moment's system (GMM) estimation which was applied to dynamic panel data of 100 countries for the period (1960-99). Results of the study showed that a higher degree of political instability (which is measured by using several political and institutional variables) generates higher inflation rates and seignior age. They also pointed out that the propagative mechanism of political instability in causing higher inflation levels are more pervasive and stronger in developing countries than developed countries which have low inflation levels.

Based on the argument put up by structuralists in for example Fisher et al (2002) in their research pointed out that the relationship between fiscal deficit and inflation is only strong in high inflation countries but find no obvious relationship between fiscal deficit and inflation in low inflation countries.

Chaudhry and Navaray (2005) examined the determinants of inflation in Pakistan by using Vector Autoregressive analysis approach and they found that the growth rate of import prices is the most important determinant of inflation in Pakistan both in the short run and long run, which is followed by the growth rate of output in terms of importance. The effect of Money supply on inflation is negligible and statistically insignificant

On their study to investigated determinants of inflation in Tanzania Samuel and Ussif (2001) use OLS estimation and Error correction model.

$$\text{Log}\ (pt) = \alpha 0 + \alpha 1\ \text{log}\ (Mt) + \alpha 2\ \text{log}\ (GDPt) + \alpha 3\ \text{log}\ (EXRATEt) + Ut$$

In this model, the variables are price level (*pt*), money supply (*Mt*), GDP (*GDPt*) and exchange rate (*EXRATEt*). They found that in Tanzania, output and monetary factors are the main determinants of inflation. In addition, the exchange rate also becomes a significant variable in inflation in the long run.

Monetary developments also appear to be among the key determinants of the inflationary process in Africa. Edwards and Tabellini (1990), Chhibber (1991), and Barnichon and Peiris (2007) show that huge fiscal deficits led to inflationary pressures in Africa via monetization of the deficits and/or devaluation of domestic currencies. Isakova (2007) also indicates that money supply played role in inflationary process of Central Asia. But its effect was not direct, rather through money supply adjustments to interest rate variations by authorities.

Despite their importance in determining the inflationary processes in Africa, many argue targeting monetary aggregates to control inflation often doesn't produce success. Masson, Savastano and Sharma (1997), Özdemir, Kadioğlu and Yilmaz, (2000) and Barnichon and Peiris (2007) indicate that inflation targeting can be more effective in controlling inflation in developing countries than monetary and/or exchange rate targeting if there is high degree of monetary policy independence, freedom of fiscal dominance and absence of any firm commitment to particular levels of variables.

In Ethiopia There have been a few numbers of attempts to study the determinants of inflation and these studies came up with various econometrics methods and conclusions. For example Gebru (2009) identifies real GDP, expected inflation, and budget deficits as the main factors behind Ethiopian inflation. He found that monetary variables were not significant determinants of inflation by refuting the monetarist theory.

Other studies conducted by of The Ethiopian Development and Research Institute (EDRI, 2007) and FAO (2008) "point out that both domestic and external factors account for the recent inflation, among them increasing money supply; rising world commodity prices; continued good economic performance, housing shortages in urban areas, changes in farmers' behavior to supply products more uniformly over the year (improvements in access to credit, storage facilities, marketing information, etc.,); and increased local purchases by governmental food security institutions, agricultural cooperatives, and relief agencies" (Jiro H. and et al, 2008).

A study conducted by Getachew (2007) to determine the current inflationary condition in Ethiopia he apply a model of structural vector autoregressive (SVAR) and found that the effect of demand and supply shocks determine the inflationary conditions in Ethiopia. And he concluded that mainly demand factors determine recent inflationary conditions.

To investigate the impact of money supply on inflation in Ethiopia Mehari and Wondafrash (2008) used quarterly data from the first quarter of 1996/97 until the second quarter of 2006/07 to investigate the impact of money supply on inflation in Ethiopia. They used independent models for the narrow money supply and broad money supply. The result from their work reveals that money supply has a direct impact on inflation. The impact of narrow money supply which includes currency outside banks and net demand deposits was found to be greater than that of broad money supply which includes narrow money supply and quasi money.

Tadelle (2008) to investigated the nature of inflation in Ethiopia he constructed a model that can be used to forecast future values. The exponential smoothing model was employed and the forecasting performance of winter (additive) models was found to be better. Two alternative approaches for model identification were considered, namely, the Box-Jenkins methodology and Penalty function criteria. For Ethiopian monthly inflation data covering the period 1997 to 2006 ARMA model was fitted. Taddele suggests SARIMA (1, 0, 10)*(12, 0, 12) model using CPI for forecasting inflation in Ethiopia.

The last but not least Yohannes et al (2010) Using monthly data over the past decade January 2000 to December 2009, to identify the determinants of inflation in Ethiopia they applied general-to-specific modeling and estimate single equation error correction models (ECMs) for the Consumer Price Index (CPI) and three of its major components, and they concluded that the overall inflation in Ethiopia is closely associated with agriculture and food in the economy, and that the international food crisis had a strong impact on domestic inflation.

3. DATA SOURCE AND TREND

3.1 DATA SOURCES

In order to investigate and sort out the determinants and impact of inflation dynamics in Ethiopia a secondary quarterly data over the sample period of 1998 quarter1 through 2010 quarter4 is used. This data is collected mainly from three different governmental and non-governmental data sources namely national bank of Ethiopia, Ethiopian statistical agency and Ethiopian economic association.

- ➢ Quarterly data on CPI (general, food and nonfood) taken from Ethiopian statistical Agency(ESA)
- ➢ Quarterly data on GDP, Official exchange rate and Gas Oil price have been taken from National bank of Ethiopia (NBE).
- ➢ Quarterly data on broad money supply is taken from various Ethiopian Economic Association (EEA) quarterly macroeconomic reports and NBE.

This data set contains a total of 52 observation units. The most important variables includes in this data sets are consumer price index (CPI), real Growth domestic product (RGDP), nominal exchange rate (XER), broad money supply (M2) and gas oil prices (GP).

3.2 HISTORICAL OVERVIEW OF INFLATION IN ETHIOPIA.

Historically, Ethiopia has not suffered from high inflation. For example "The annual average was only 5.2 percent between the years 1981–2003, and major inflationary episodes have occurred only during conflict and drought" (kibrom, 2007). Annual average inflation reached a record of 18 percent during 1984/85 because of drought, 21 percent in 1991/92 at the peak of war with Eritrea, and again 16 percent during the 2003 drought (Dick D. et al, 2010).

Since 2003, onwards there has been occurred a general rise of price in most goods and services. In 2003, the inflation rate was increased to 15.1 percent. In 2004, the inflation rate declined by 60 percent as compared to 2003 due to the recovery of agriculture. However, after 2004 the inflation rate could not show any sign of declining till end of 2008. In 2008, the general inflation reached its climax in its history 36.4 percent. (Fig1) (NBE, 2010) the reason behind this highest climax of inflation in 2008 was associated to the worldwide economic and financial crises had been contributed a great impact on the Ethiopian inflation through imported inflation.

Figure1: Trends of country wide monthly price indexes (2006-2010).
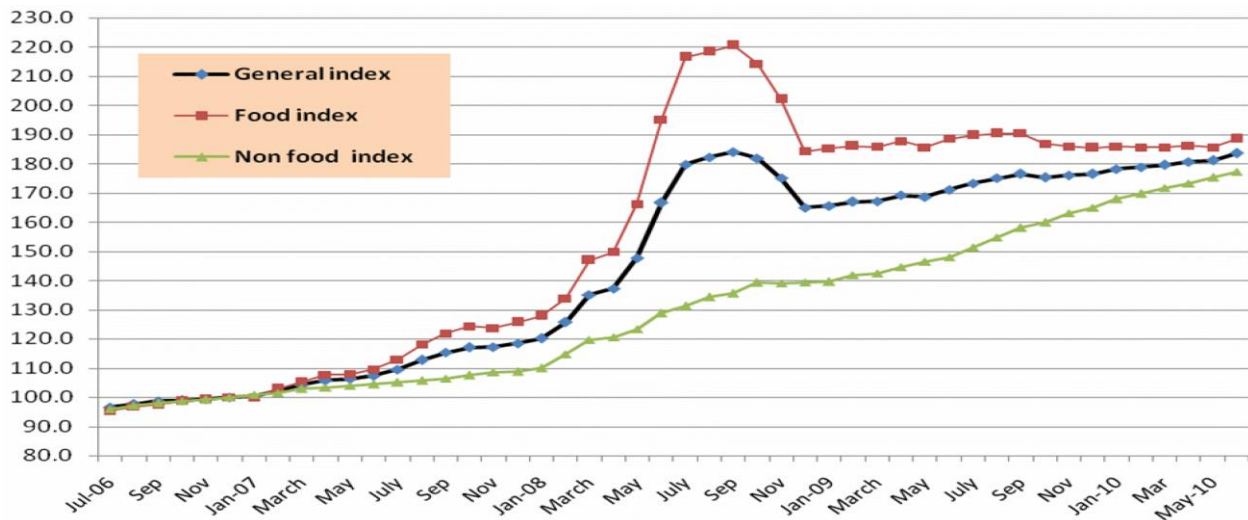
Source: Central Statistical Agency (2009/10)

As we understand from inflation theory the source of inflation can be categorized into two main broad parts: demand-pull and cost push inflation. The demand-pull inflation arises due to the higher demand for goods and services while the cost-push inflation is due to an increase in the cost of production of goods and services. Or some time inflation may arise due to both demand-pull and cost-push factors. Ethiopia's source of inflation is not out of these major sources of inflation. But the challenge is to locate exactly which source of inflation dominates or takes the higher share.

3.3.1 MONETERY POLICIES OF ETHIOPIA

As it is known that inflation is "monetary phenomenal" so, it is very important to discuss what the monetary policy says and how it works in Ethiopia. Like any other monetary policies the principal objective of the monetary policy of the National Bank of Ethiopia is to maintain price & exchange rate stability and support sustainable economic growth of Ethiopia. More specifically, the Ethiopia's monetary policy is design to:

- ✓ Foster monetary, credit and financial conditions conducive to orderly, balanced and sustained economic growth and development.
- ✓ Preserve the purchasing power of the national currency – ensuring that the level of money supply is generally consistent with developments in the macro- economy and intervening in the foreign exchange rate market for the purpose of stabilizing the rate when conditions necessitate.
- ✓ Encourage the mobilization of domestic and foreign savings and their efficient allocation for productive economic activities through the implementation of a prudent market driven interest rate policy.

13

✓ Facilitate the emergence of financial and capital markets that are capable of responding to the needs of the economy through appropriate policy measures. These measures would ensure the gradual introduction of trading instruments on a short-term basis (NBE,2010)

In achieving these objectives, the NBE sets both final and intermediate targets. The final targets of monetary policy in Ethiopia are to maintain price and exchange rate stability and support sustainable economic growth and as an intermediate target NBE uses money supply. NBE takes the broader definition of money or M2 as money supply. The current target is to ensure that the money supply growth is in line with nominal GDP growth rate.

The Ethiopia Monetary policy continued to focus on containing inflationary pressure and building international reserves of the country. Efforts were made to make the growth of broad money supply in line with nominal GDP growth. Accordingly, broad money to GDP ratio increased from 27.2 percent in 2009/10 to 29.1 percent in 2010/11 on account of remarkable growth in net foreign assets and domestic credit. Similarly, annual reserve money growth was 39.7 percent owing to same reason. As for interest rate, the NBE continued to set the minimum interest rate on saving and time deposits while leaving lending rates to be freely determined by banks. The minimum interest rate on deposits rate was set at 5 percent while lending rate ranged between 7.5 and 16.25 percent.

The introduction of a wide range of monetary instruments by central banks engenders competition, efficiency and transparency and broadens financial intermediation in the banking system. It also promotes liquidity management of commercial banks and gradually leads to the development of well-functioning money and financial markets which could serve as catalysts for economic growth and development. However, the use of such instruments has been extremely limited in Ethiopia due to the underdevelopment of the money market and the virtual non-existence of a financial market.

3.3.2 TRENDS OF AGGREGATE DEMAND AND AGGREGATE SUPPLY IN ETHIOPIA

In Ethiopia the amount of aggregate demand goods and services demanded by the consumer, investor, government and net foreign desire is greater than the aggregate output produced by the economy. Until 2004, the difference between aggregate demand and supply was narrow. For instance in 2000, the desire to buy goods and services in the economy was only 63 billion Birr[1] (NBE, 2001). In the same year the value of goods and services produced in the economy was 72 billion Birr. That means the value of output produced in the economy was higher by 14 percent as compared to the desire of the consumer ability to spend. However the studies

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[1] Birr is the official currency of Ethiopia has a value of 1NOK=3,30ETB at current exchange market.

conducted by national bank of Ethiopia showed that since 2003 onwards the gap between aggregate demand and aggregate supply widened. figure 2 below explains this fact.

Figure2: Aggregate demand and supply trend of selected years in Ethiopia.
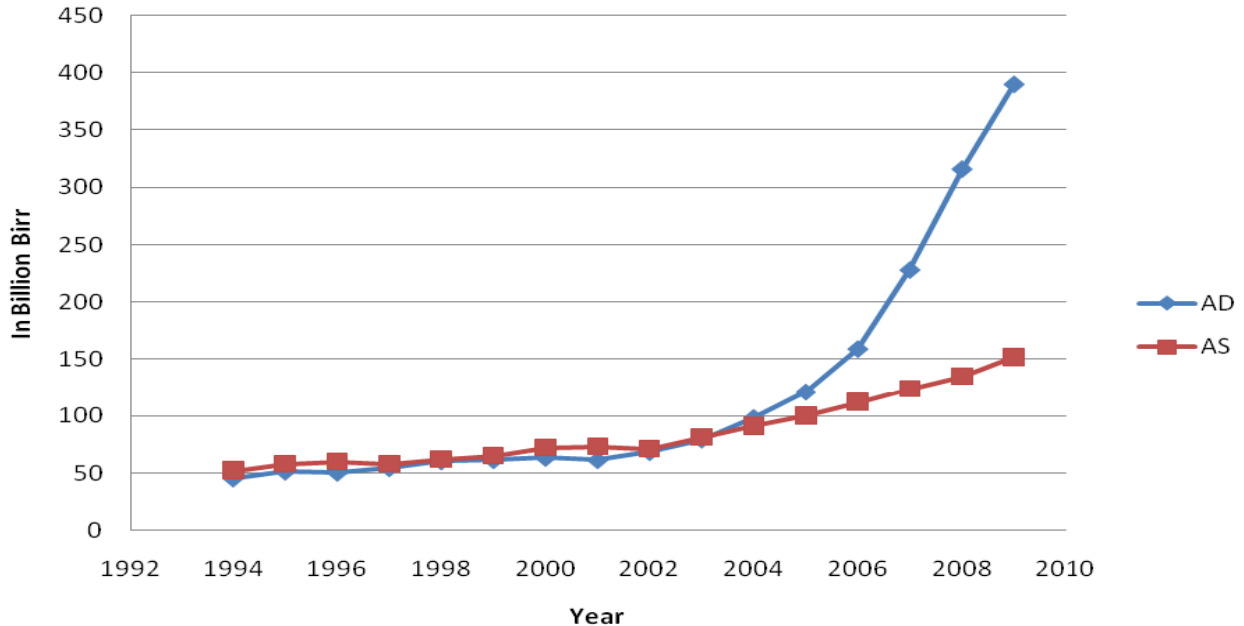
Source: Central Statistical Agency (1992-2010)

As we observe from (figure2) above 2003 onwards the gap between aggregate demand and supply is widened, and the aggregate demand exceed aggregate supply far away. For example in 2004 the gap between these two variables was 7.5 billion Ethiopian Birr and in 2006 it increases to 46 billion Birr. During these two years, the desire for goods and services increased by 58 billion Birr while the value of aggregate supply increased only by 21 billion Birr. In 2008 also, the aggregate demand exceeded the aggregate supply by 181 billion Birr. In other words, the economy produced only 42 percent of the national need (the desire to spend). Even if the above gaps between aggregate demand and supply shows a decline figure in the year 2010 by 22 billion Birr there is still a high supply constraint to satisfy the national need (NBE, 2011).

The average annual growth rate between the years 2004 and 2008 of aggregate demand and supply was 29.7 and 10 percent respectively (NBE, 2009). This real growth rate gap caused the price to increase at a higher rate than ever before so as to maintain aggregate demand equals aggregate supply. This can be justifies the source of inflation in Ethiopia is due to the higher demand growth in the economy. One of the conditions for economic growth is level of demand in the economy. The higher demand in the economy should be supported by the proper functioning market and national bank which enable us to manage the higher demand (Teshome, 2011).

3.3.2 DATA TRENDS

It is important to reproduce the inflation trends for analytical purposes by comparing them with the trends of the other inflation determinant variables.

3.3.2.1 INFLATION AND REAL GDP GROWTH RATE

Comparing inflation rate against the growth rate of real GDP as dictated by economic theory, one would expect a negative relationship i.e. when inflation rate is higher economic growth is slower or vice versa. However in Ethiopia a visual inspection of inflation rate plotted against real GDP for the quarters between 1998Q1 to 2010Q4 showed that there is the similar directional growth trend. Inflation rate seemed to be erratic and higher than real GDP growth in most quarters of the sample period of study. For the quarters between 2002Q1 to 2010Q4 GDP and inflation growth rate on average were 10.0 and 18.7 respectively.

Figure 3: Inflation and real GDP growth rates (1998Q1-2010Q4).
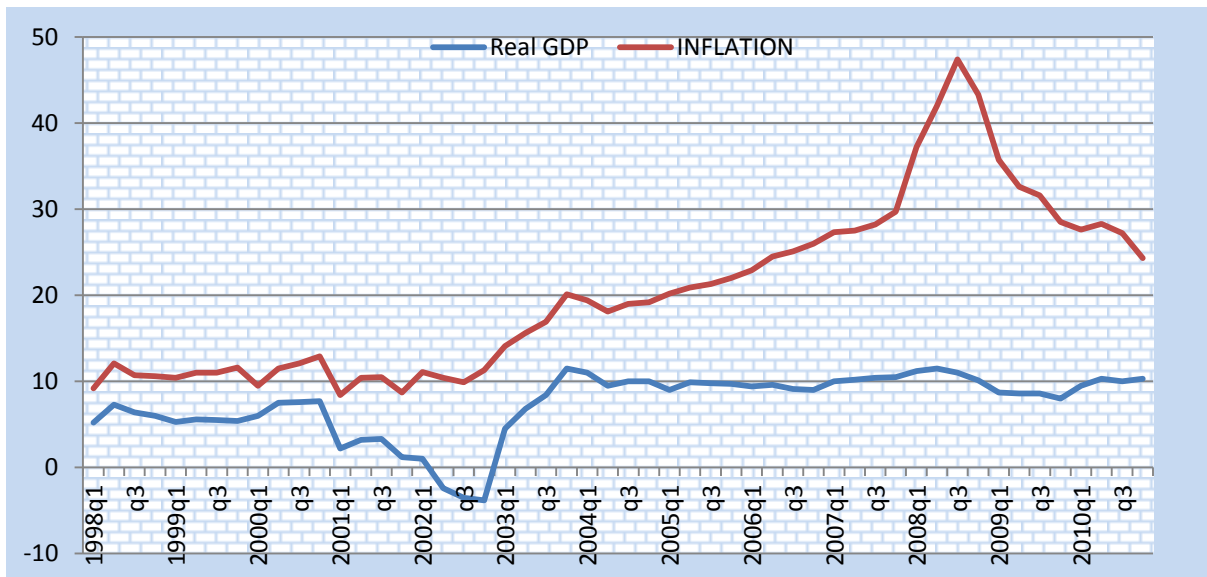
Source: own calculation based on data NBE

As can be observed from the data trend between inflation and real GDP growth rate (figure3) above a possible explanation would be that there is positive relationship between the inflation and real GDP growth rates. The inflation rate gradually increases through time under sample study period and reached its highest point between 2007Q2 and 2008Q4. Mainly associated to the global financial and economic crises occurred during this period throughout the world. And during the same period of time the global economic crisis had been also transmitted to the Ethiopian economy through imported inflation (such as the increase in the price of fuel, steel,

fertilizer and other capital goods) that raised the costs of both production inputs and outputs in Ethiopia. Beside of the world economic crisis during the same period of time, the action of the Ethiopian government unable to give further subsidy to the gasoil sector since 2007 onwards worsen the situation and puts the scale of inflationary problem much higher level.

However, parallel to inflation problem the good performance of Agriculture sector during the same period time due to improved productivity aided by favorable weather condition and conducive economic policy, agricultural Production had been increased on average about 8.8 percent while productivity rose from 15.7 quintal/hectare in 2004/05 to 16.3 quintal/hectare in 2010/11. In addition the growth of industrial (15%) and service sectors (12.5%) contributed the GDP to growth on average of 10.5% a year (NBE, 2005, 2011) throughout the sample period.

3.3.2.2 INFLATION AND BROAD MONEY SUPPLY (M2)

Most economic theories indicate there is a positive close directional relationship between changes in broad money supply (M2) and the rate of inflation. That is when broad money supply increase or decrease so does the same inflation rate. Figure4 below demonstrate in Ethiopia the trend of broad money supply growth rate relative to inflation growth rate reveals that both variables were moving in the same direction during the study sample period and broad money supply had been considerable expansion in the quarters between 1998Q1 to 2010Q4.

From (figure4 and Table2 below) it is observed that, even though inflation and M2 growth rate moving in the same positive direction M2 growth rate was greater than inflation growth rate in most of the quarters. This indicates the presence of expansionary monetary policy in the country. In addition it also proves the strong impact of M2 used by the government as an option of instrument to tackle inflationary problem in Ethiopia.

Table2. Components of broad money supply growth rate in (%) (2005-2011)

particular	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Narrow money supply	5.1	6.4	8.2	10.1	13.8	15.7	19.1	24.5	35.3	45.2
Quasi-money	10.0	12.1	13.5	14.0	17.1	20.5	23.0	28.7	26.0	54.4
Broad money supply	6.8	8.2	9.7	11.5	14.0	19.8	21.0	26.6	34.2	39.2

Source: national bank of Ethiopia

Figure 4: Inflation and broad money supply growth rate (1998Q1 to 2010Q4).
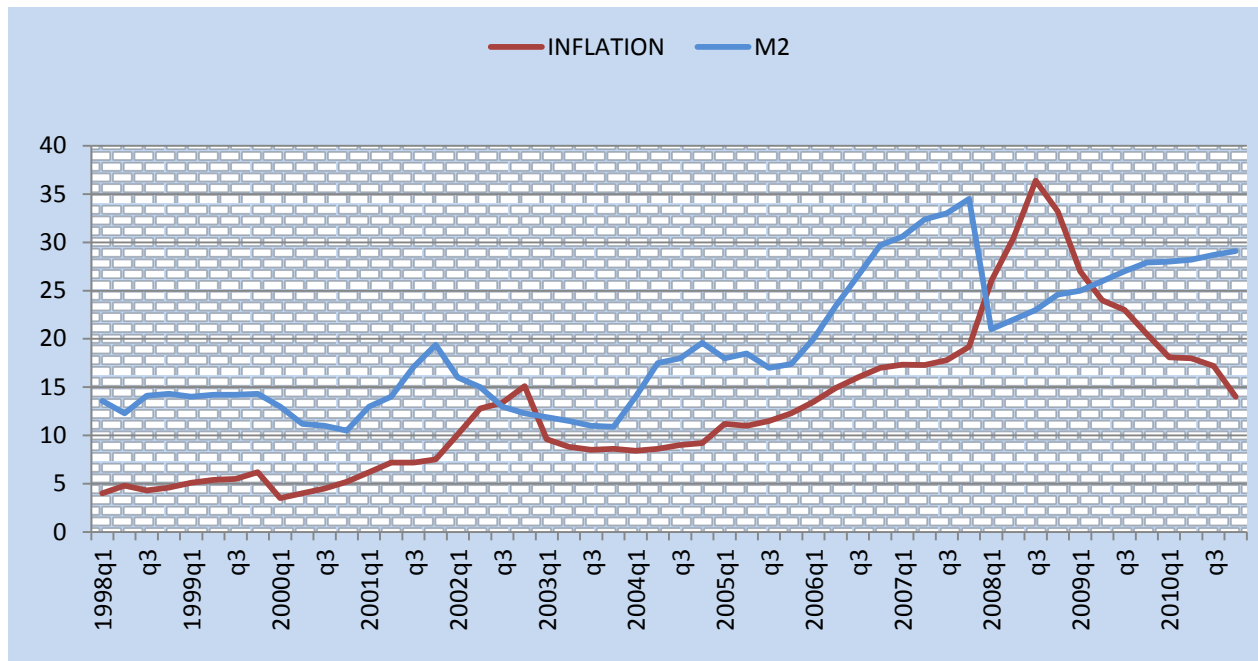
Source: Own computation based on data NBE and EEA.

3.3.2.3 INFLATION AND GASOIL PRICE

Oil is second commercial energy resource in Ethiopia next to hydroelectric power. And it contributes the second largest share of imported item (NBE, 2011). Due to the gradual devaluation of the Ethiopian currency against the USD since 1991[2] and the increase of petroleum price in the world commodity market the imported value increases year by year.

As can be observed from the (figure 5) below in Ethiopia Gas Oil price shows a gradual increment during the study period and its growth trend has a direct link with inflation growth rate as it is expected that is, the higher the price of oil per barrel leads to the higher the prices of goods and services. The subsidy given by the government had been reduced the impact of international oil price fluctuations on the domestic retail price before 2007. However, after 2007 onwards the government unable to subsidizing Gas oil price and domestic retail prices of petroleum products are adjusted monthly in line with the movements of oil prices in the world market.

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[2] Befor 1991 the Ethiopian currency was fixed under the rule of the socialist government[1USD=2.17 ETB), however since downfall of the socialist government in 1991 and replaced by relatively free market economic system government the Ethiopian currency depreciate gradually to make competitive in the international market (1USD=18.34ETB in 2013).

Figure5: Inflation and Gas oil price growth (1998Q1 to 2010Q4)
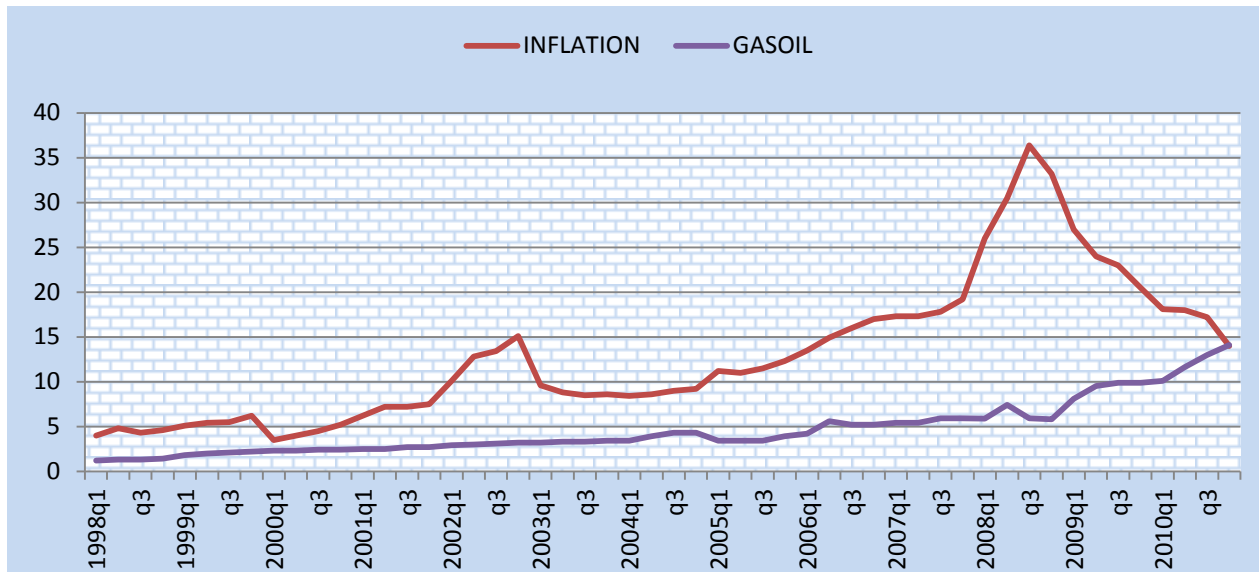
Source: Own computation based on NBE quarterly data.

As a result, the average domestic prices of all petroleum products increased with higher rate (59%) on average according to the Ethiopian petroleum enterprise reports during the study period. The increase in gas Oil prices has no doubt to contribute the higher prices of goods and services inside the country. In addition the average oil price increment the distance form port, poor quality of transport facilities, increase in tear and wear of vehicles contributes to the higher gas oil prices. In general, especially since 2007 onwards gasoil prices hike play a significant role for the general inflation level in Ethiopia.

3.3.2.4 INFLATION AND EXCHANGE RATE

From figure 6 below it is observed that the growth rate of nominal exchange rate shows a simple stable and gradual straight upward trend. This stable trend of exchange rate have resulted a lower impact of on the trend of inflation. However, in recent years in order to be competitive internationally and to promote the export sector the Ethiopian currency depreciated more and more. As the result imported capital goods and services become more expensive relative to the domestic prices which contribute to a higher cost of both capital and production inputs that contribute a general raise of prices in Ethiopia.

Figure6: Inflation and exchange growth rate (1998q1-2010q4)
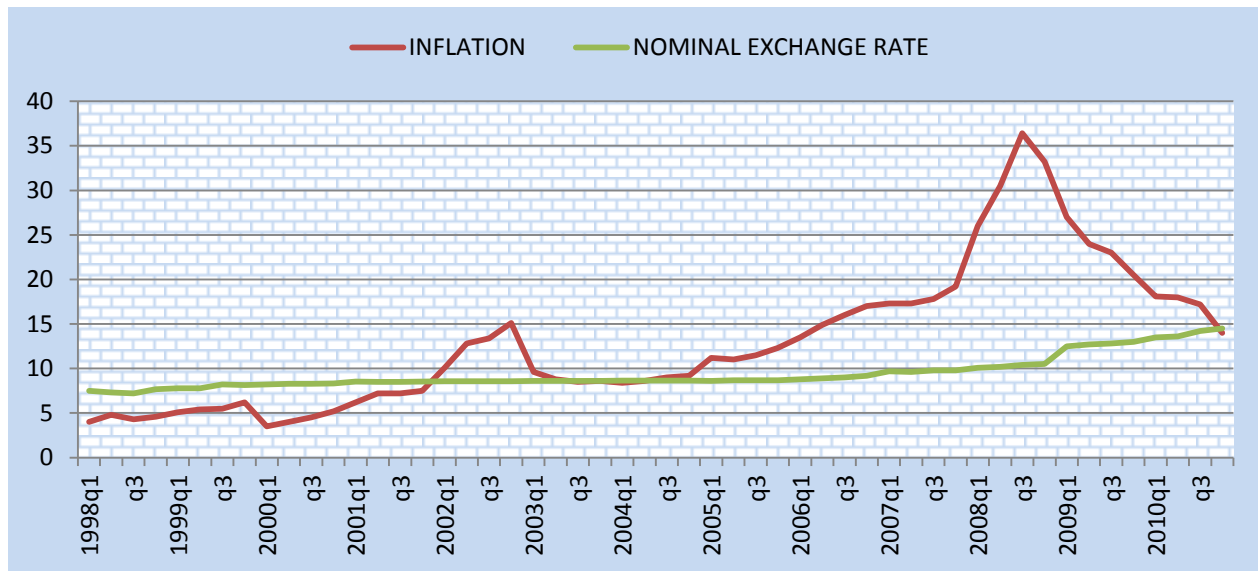
Source: own computation based on quarterly NBE data.

In general, the above data trend analysis reveals that inflation trend in Ethiopia is having theoretically expected trend with the trends of broad money supply (M2), exchange rate and Gas oil prices which have shown a direct positive link between these variables and inflation growth rate and it is in contrary with real GDP growth rate. That is, inflation and real GDP growth rate shows similar directional growth rate rather than opposite as it is expected and dictated by most theories.

4. Model specification and estimation

4.1. MODEL SPECIFICATION

From the above theoretical and empirical discussion, and by assuming all other things being constant the inflation function for Ethiopia can be specified in the following manner:-

$lnCPI_t = \alpha + \beta_1 \, lnRGDP_t + \beta_2 \, lnM2_t + \beta_4 \, lnXER_t + \beta_5 lnGP_t + \beta_6 \, LCPI + \beta_7 \, LM2 + \beta_8 LXER + \beta_9 LGP + \mu_t$ ....(1)

The above equation full definition is explained in the following table below which is obtained from data sources (Annex1 and table3).

Table3. Variables and definitions

Variables	Definition
RGDP	Real growth domestic product
M2	Broad money stock
XER	Nominal Exchange rate
GP	Gas oil price
LCPI	Lag consumer price index
LM2	Lag broad money supply
LXER	Lag exchange rate
LGP	Lag gas oil price

All the coefficients on the variables are expected to have a positive sign, except for RGDP. All variables in the equation are expressed in a log-linear form. GP, Gas Oil price, is incorporated in the model to analyze the impact of international oil price developments on the change Ethiopian consumer price index.

4.2 MODELLING STRATEGY

4.2.1 STATIONARY AND NON-STATIONARY

According to time series data analysis, a given regression like (equation 1) can explain the long-run relationship among the variables either if all the variables are stationary at level, i.e. I (o), or if they are cointegrated. Regression based on non-stationary time series leads to spurious (misleading) regression, very high R^2 but with no meaningful relationship among the variables.

To test the time series for stationarity, the Augmented Dickey-Fuller (ADF) test is used. The test has failed to reject the hypothesis of the presence of the unit root. All considered variables were found to be stationary in the first differences, i.e., integrated of order I(1). The lag structure in the ADF test was chosen on the basis of the Akaike information criterion (AIC) and further the residuals were tested for the higher order serial correlation using the Breusch-Godfrey test.

In order to avoid the spurious regression problem, with its related non-stationary pattern of the variables, differencing has become the common method of bringing non-stationary series to stationary. A variable is said to be integrated of order one, or I(1), if it is stationary after differencing once, or of order two, I(2) if differenced twice. If the variable is stationary without differencing, then it is integrated of order zero, I(0). The value of the mean of a stationary series is independent of time, and thus no matter at what point in its history the series was examined we would always recover the same information about its structure. In contrast, a non-stationary series contains a clear time trend and has a variance that is not constant overtime. If a series is non-stationary, it will display a high degree of persistence.

4.2.2 UNIT ROOT TEST

Since the data set that is used in this thesis is a time series data, stationary of the variables is important. First a regression based on non-stationary time series explains the relationship during the study period only. This means that it is impossible to infer about the long run relationship of the variables. In addition, regression of non-stationary time series on another non stationary time series may lead to spurious regression. In order to avoid these problems stationary test has been conducted on the variables using Augmented Dickey Fuller (ADF) test has been chosen to test for the existence of unit root because it accounts for correlation and in addition it is also widely used in unit root tests. The results of the tests and the relevant critical values, as well as the number of lags to get rid of serial correlation, are presented in Table 4 below

Table4. ADF Tests for Unit Roots (Order of Integration).

Variables	Test Statistics	Lag length	Order of integration
CPI	0.628	5	
DCPI	-2.615**	2	I(1)
RGDP	0.931	2	
DRGDP	-2.970 *	3	I(1)
M2	2.51	2	
DM2	-3.77**	3	I(1)
XER	1.51	2	

DXER	-5.05***	2	I(1)
OD	0.78	1	
DOD	-3.48*	2	I(1)
GP	-1.03	2	
DGP	-4.38**	3	I(1)

Notes: *Reject at 10% (*), 5% (**) or 1% (***) significance levels.*

D= difference

The results show that all variables have a unit root in their levels in the presence of structural breaks which indicating that the levels are non-stationary. However, the first differenced series of RGDP, M2, XER, and GP clearly rejects unit roots suggesting that the differenced variables are all stationary.

4.2.3 GRANGER-CAUSALITY MODEL

"*Granger causality is a statistical concept of causality that is based on prediction. According to this model, if a variable X Granger-causes Y, Y can be better predicted using the past values of both X and Y than it can using the past values of Y alone. Conceptually, the idea has several components*" (Kyle Beardsley, 2001).

• Only past values of X can cause Y.

• Exogeneity : a necessary condition for X to be exogenous of Y is that X fails to Granger-cause Y.

• Independence: variables X and Y are only independent if both fail to Granger-cause the other.

Hence, Granger causality is a powerful tool that it allows us to test for things that we might otherwise assume away or take for granted.

4.2.3.1 THE BIVARIATE GRANGER-CAUSALITY MODEL

A general specification of the granger causality test in a bivariate (X, Y) context can be expressed as:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \ldots\ldots\ldots\ldots \alpha_i Y_{t-i} + \beta_1 X_{t-1} + \ldots\ldots\ldots + \beta_i X_{t-i} + \mu_1 \quad \text{--------------------(2)}$$

$$X_t = \alpha_0 + \alpha_1 X_{t-1} + \ldots\ldots\ldots\ldots \alpha_i X_{t-i} + \beta_1 Y_{t-1} + \ldots\ldots\ldots + \beta_i Y_{t-i} + \mu_2 \quad \text{---------------------(3)}$$

The subscripts denotes time period, μ is a white noise error, α_0 is a constant parameter which represents a constant growth rate of X in the first equation and Y in the second equation. Thus

the trend in this model can be interpreted as a general movement of time series change in response to changes in economic variables. Hence, this specification is appropriate to show the existence of cointegration between X and Y that follows a unite root process, and it can be used for the data that is used for analysis in this thesis (Ekram gul, 2006).

With similar structure to the above model, by assuming that there exists a cointegral relationship between money, prices and output, a bivariate Granger-causality model of the following form can be specified for testing causality between broad money supply growth ($\Delta \ln M2_t$) and inflation ($\Delta \ln CPI_t$) as follows:

$\Delta \ln CPI_t = \alpha_0 + \rho 1 EC_{t-1} + \Sigma \alpha i \Delta \ln M2_{t-i} + \Sigma \delta i \; \Delta \ln CPI_{t-i} + \mu_t$ .... (4)

$\Delta \ln M2 = \alpha_0 + \rho 2 EC_{t-1} + \Sigma \beta i \; \Delta \ln CPI_{t-i} + \Sigma \gamma i \; \Delta \ln M2_{t-i} + \mu_t$ .... (5)

Where EC_{t-1} is one period lagged error-correction term in the cointegral relationship, α_0 is a constant term, M2 is the broad money stock, CPI is the consumer price index, and as per the Granger representation theorem (Tom.E and soren (1997) at least one of $\rho 1$ and $\rho 2$ is nonzero. A negative and significant coefficient $\rho 1$ or $\rho 2$ would indicate the presence of a long-run causal relationship between money supply growth and inflation. If, for example, only $\rho 1$ is significant, this would suggest a unidirectional causality from money to prices, implying that money supply drives prices toward equilibrium but not the other way around. If both $\rho 1$ and $\rho 2$ are significant, they would suggest a bi-directional causality between money supply growth and inflation.

According to Enders(1995), in a cointegrated system, x_t does not Granger cause y_t if lagged values Δx_{t-i} do not enter the Δy_t equation and if y_t does not respond to the deviation from long-run equilibrium, which is represented by the error-correction term in the short-run model. Similarly In the above model, the lagged terms of $\Delta \ln CPI_t$ and $\Delta \ln M2_t$ appear as explanatory variables, indicating the short-run cause and effect relationship between these two series. Thus if the lagged coefficients of $\Delta \ln M2_t$ are significant in the regression **of** $\Delta \ln CPI_t,$ this means that money growth causes inflation in the short run.

4.2.3.2 The Three variables Granger-Causality Model
Although the above bivariate specification is considered adequate, for the present study the Granger-causality model is specified in an expanded form for testing causality between money supply growth and inflation and between inflation and economic growth as follows (Hossain, 2005):

$\Delta \ln CPI_t = \alpha_0 + \rho 1 \; EC_{t-1} + \Sigma \alpha i \; \Delta \ln M2_{t-i} + \Sigma \delta i \; \Delta \ln CPI_{t-i} + \Sigma \eta I \; \Delta \ln RGDP_{t-i} + \mu_i$ ………………….. (6)

$$\Delta\ln M2_t = \alpha_0 + \rho 2 \ EC_{t-1} + \Sigma\beta i \ \Delta\ln CPI_{t-i} + \Sigma\gamma i \ \Delta\ln M2_{t-i} + \Sigma\nu I \ \Delta\ln RGDP_{t-i} + \mu_i \dots\dots\dots\dots\dots \ (7)$$

$$\Delta\ln RGDP_t = \alpha_0 + \rho 3 \ EC_{t-1} + \Sigma\varepsilon i \ \Delta\ln CPI_{t-i} + \Sigma\iota i \ \Delta\ln M2_{t-i} + \Sigma\vartheta i \ \Delta\ln RGDP_{t-i} + \mu_i \dots\dots\dots\dots \ (8)$$

Where RGDP is a measure of real GDP growth and other variables have been defined earlier. This expanded model is appropriate to examine the causal relationship between money supply growth and inflation conditional on the growth of real GDP growth. Any other causality like exchange rate variation and inflation or gasoil price and inflation can also be tested within this framework. Equation (8) in the above specification is used for testing the effect of inflation on economic growth.

In applying the above first model in to the Ethiopian case to test the Granger-causality between inflation and its determinants the lag length period of 1,2 and 3 years or 4 to 12 quarters will be considered because causal inference is usually sensitive to the choice of lag length. Given the relatively small sample size, the maximum lag length of 3 years (12 quarters) is considered long enough for the explanatory variables to have their impact realized on the dependent variable.

4.2.4 DATA ANALYSIS AND RESULT INTERPRETATIONS

4.2.4.1 THE GRANGER-CAUSALITY TEST BETWEEN MONEY SUPPLY GROWTH AND INFLATION

The Granger causality test between money supply growth and inflation in Ethiopia suggest that there is a strong causality running from inflation to M2 growth for the complete sample period (table5 and Annex2). This finding is consistent with the idea that high inflation generally has a pronounced impact on money supply growth. When inflation rate is high, the government attempts to extract resources from the private sector by printing money (and spending it) at a faster rate than the rate of inflation to cover rapid loss of real revenues. This gives a strong bi-directional relationship between money supply growth and inflation.

When the inflation rate is low, the impact of inflation on fiscal deficits is not pronounced; hence, any causality running from inflation to money supply growth may not be strong enough to be detected by a statistical test. As the rate of inflation in Ethiopia remained relatively high throughout the sample period, the impact of inflation on money supply growth was statistically significant. However, the causality running from money supply growth to inflation is weak and remains sensitive to the lag length. This indicates that the money supply growth is more an endogenous, rather than an exogenous policy, determined by factors in the money demand function, such as inflation, interest rates, exchange rates and real output.

To test the null hypothesis that whether "inflation" do not Granger cause "M2 growth "or "the change M2 does not granger cause inflation", first estimated the three variants (with different number of lags in the RHS equation) then carried out the F-test as follows:

Table5. Pair- wise Granger causality test between Money Supply Growth and Inflation.

Null hypothesis	NO. of lags	D.f	F-test	P-value	Decision
ΔM2 does not granger cause inflation	1	(1,48)	0.71	0.0544	accept
Inflation does not granger cause M2	1	(1, 48)	1.81	0.0042	reject
ΔM2 does not granger cause inflation	2	(2, 45)	0.08	0.7266	accept
Inflation does not granger cause ΔM2	2	(2, 45)	1.10	0.0022	reject
ΔM2 does not granger cause inflation	3	(3,41)	0.50	0.0129	reject
Inflation does not granger cause ΔM2	3	(3,41)	0.90	0.0799	accept

Source: own calculation based on stata output.

The pair wise F-test under the three lag periods of Granger causality test suggests that there is bi-directional Granger causal relationship between inflation and broad money supply (M2) that is the null hypothesis "inflation does not Granger cause ΔM2" is rejected at 0.05% level of significance at the first and second lag period and it becomes significant and strong. However, the reverse causality becomes true at the third lag that is money supply Granger cause inflation. Hence, from the above test result it can be concluded that the causality between inflation and broad money supply is a bidirectional lag dependent causal relationship and in a high inflationary economy like Ethiopia, inflation does have a feedback effect on money supply growth and this generates a self-sustaining inflationary process.

4.2.4.2 THE GRANGER-CAUSALITY TEST BETWEEN EXCHANGE RATE AND INFLATION

Before 1992 the exchange rate in Ethiopia had been fixed at 2.07 Birr against US Dollar for almost two decades. The rate was devalued by 140 percent to 5 Birr per 1 US Dollar in October 1992. Recently, in September 2010, the rate was devalued by 20 percent from 13.63 Birr/US Dollar to 16.35 Birr/US Dollar (NBE, 2011). Apart from these two massive devaluations, there have been changes in the nominal exchange rate of Birr since the abandonment of fixed exchange rate in 1991. Specifically, Ethiopia's currency has been depreciating from year to year when valued in terms of US Dollar. Of course, this change in nominal exchange rate should be translated into exchange rate in real terms to indicate export competitiveness.

Some empirical studies have shown that depreciation of currency improves the exports of a particular country through increasing their competitiveness while others reveal that may not be realistically achieved or leads to inflationary problem by making imports of capital goods more expensive relatively the depreciated domestic currency through imported inflation.

In Ethiopia Between the years (1998 to 2010) the official exchange rate was dynamically changing and the Ethiopian currency continues to depreciate relative to international exchange rate. This continuous currency depreciation might leads to imported inflation in Ethiopia. To test whether inflation Granger cause of exchange rate or vice versa the Granger-causality test is conducted and the output of the test (Table6 and Annex3) points out that there is a strong uni-directional causality running from the exchange rate to inflation under the three lag periods at 5% significance level. However, the Granger-causality running from inflation to exchanger rate becomes weak and insignificant. Therefore from the test result it can be concluded that the quick response of exchange rate changes to price growth shows that exchange rate plays an important role in price fluctuations of goods and services in Ethiopia or an important source of inflation in Ethiopia

Table6. Pair-wise Granger-Causality test between exchange rate and Inflation

Null hypothesis	NO. of lag	D.f	F-test	P-value	decision
ΔXER does not granger cause inflation	1	(1,47)	0.33	0.0372	reject
Inflation does not granger cause Δ XER	1	(1, 47)	1.33	0.2551	accept
ΔXER does not granger cause Inflation	2	(2,44)	0.19	0.00291	reject
Inflation does not granger cause Δ XER	2	(2,44)	0.75	0.4763	accept
ΔXER does not granger cause Inflation	3	(3,41)	0.10	0.0385	reject
Inflation does not granger cause Δ XER	3	(3,41)	0.56	0.6476	accept

Source: own computation based on stata output.

4.2.4.3 THE GRANGER-CAUSALITY BETWEEN INFLATION AND REAL GDP GROWTH

Most empirical studies, suggest that high or hyper-inflation retard economic growth, although there could be a positive relationship between inflation and economic growth when the inflation rate is low. The debate remains on the cut-off point at which inflation retards economic growth.

Sarel (1996) in his research locates the break-point at which annual inflation rate in East Asia affects economic growth is 8%. For inflation rates greater than 8%, the effect is negative, statistically significant and strong. Below that rate, inflation does not have a significant effect on growth or it may even exhibit a slightly positive effect. Ghosh and Phillips (1998), by using a larger sample data than Sarel's, find out that a substantially lower threshold effect at 2.5% annual inflation rate. They conclude that that inflation is an important statistical determinant of economic growth. Other researchers like Cristofferson and Doyle (1998) argue that the negative relationship between inflation and economic growth and they find no cross-sectional correlation between long-run averages of growth and inflation in the full-sample, but detect a negative effect of inflation and growth for inflation rates higher than 40 percent.

When we consider the sample data between (1998 -2010) even if it needs additional further study to detect the lower threshold level of inflation, Ethiopia experienced relatively high and double digit inflation for most of the period under consideration particularly since the period 2002/03 till present time. Such types of inflation may be originated from policy reasons, demand factors and supply/external shocks to a relatively open economy of Ethiopia. However, to test whether the growth rate of GDP cause the rise of inflation or the other way round the Granger- causality test result (Table 5) below shows that there was no significant and strong causal effect relationship inflation on economic growth for the complete or any sub-sample period at at 5% to 10% significant level .

Table 7: pair wise Granger causality between real GDP growth and inflation

Null hypothesis	NO. of lag	D.f	F-test	P-value	Decision
ΔRGDP does not granger cause inflation	1	(1,47)	3.54	0.0660	Accept
inflation does not granger cause ΔRGDP	1	(1, 47)	1.06	0.3086	Accept
ΔRGDP does not granger cause inflation	2	(2,44)	4.68	0.0144	Accept
Inflation does not granger cause ΔRGDP	2	(2,44)	0.78	0.4635	accept
ΔRGDP does not granger cause Inflation	3	(3,41)	2.95	0.0437	reject
Inflation does not granger cause ΔRGDP	3	(3,41)	0.47	0.7074	reject

Source: own computation based on stata output.

F-test in (Table 5) shows that the null hypothesis is accepted for "inflation does not Granger causes real GDP growth" at all lag period, which means that the growth rate of real GDP is not affected by inflation significantly. The same is true in the other way round .So according to the results of Granger causality test there is no direct Granger causal relationship between the real

GDP and inflation, that is, inflation does not Granger causes the real GDP growth or vice versa. The possible explanation for this result might be the dominance of agriculture in the Ethiopian economy. As it is mentioned earlier agriculture contributes over 40% of the total GDP and this sector performance had been well under the study period due to better agricultural policy and weather conditions so due to this fact the growth rate of real GDP exhibited growth on average under the sample period as opposed to the theories.

4.2.4.3 THE GRANGER-CAUSALITY BETWEEN INFLATION AND GASOIL PRICES

In Ethiopia the increase in Oil price has an impact on inflation through both direct and indirect channels.
1. Through Direct channel Oil and oil related products constitute important items in the consumption bundle of a typical household. An increase in oil price can cause inflation by directly raising the price of gasoline, but also by increasing the price of other energy related items such as electricity, household fuel, etc. Increased demand for substitutes such as natural gas associated with oil price increase, fuel their price increase too.
2. Through Indirect channel an Oil price increase also contributes indirectly to inflation by increasing production cost of commodities as far ranging from agricultural products to manufacturing and service sector products. Rising energy price can also increase commodity prices indirectly by raising costs of transportation, storage, and distribution of these goods. Further, rising energy costs can create higher expectation of inflation, and may lead to higher wage costs as workers demand and negotiate higher wage increases which are passed through rising consumer prices.

Granger causality tests were employed in this section to check for both unidirectional and bidirectional causality between the inflation and oil price index. The model uses 12 quarter lagged values of both the causal and the dependent variable. A null hypothesis of no causality is tested in a joint F-test that the coefficients of the lagged causal variables are significantly different from zero.

Table8: Pair wise Granger-Causality between gas oil price and Inflation

Null hypothesis	NO. of laggs	D.f	F-test	P-value	Decision
ΔGP does not granger cause inflation	1	(1,47)	1.44	0.2369	reject
inflation does not granger cause Δ GP	1	(1, 47)	0.56	0.4589	accept
ΔGP does not granger cause	2	(2,44)	1.62	0.2104	reject

inflation					
Inflation does not granger cause Δ GP	2	(2,44)	0.26	0.7717	accept
ΔGP does not granger cause inflation	3	(3,41)	1.20	0.3219	Reject
inflation does not granger cause Δ GP	3	(3,41)	0.54	0.6565	accept

Source: own computation based on stata output

The results of the causality tests, using F-statistic are reported in Annex 4 and table 8 In the traditional test, the high value of F-statistic indicates rejection of the null hypothesis that "oil price does not Granger cause inflation", implying that oil price does Granger cause inflation in Ethiopia. The low value of F-statistic in the other equation indicates that inflation does not Granger causes oil price. Thus from the above analysis we find evidence of unidirectional causality running from oil price to inflation.

5. CONCLUSION

5.1 CONCLUSION

In this thesis a quarterly data of the period between 1998Q1 to 2010Q4 is used to investigate the determinants of inflation in Ethiopia and for this purpose four testable hypotheses have been investigated: (1) does the money supply growth Granger-cause inflation? (2) Does currency devaluation Granger-cause inflation? (3) Does real GDP growth Granger-cause inflation? And (4) does oil price fluctuation granger cause of inflation? And According to Granger causal relationship between broad money growth, inflation, exchange rate growth, gasoil price and real GDP growth in Ethiopia the empirical results of the data analysis suggest that there existed a bi-directional causality between money supply growth and inflation and a unidirectional causality between currency devaluation, oil price volatility and inflation. However, the causality between inflation and economic growth in weak and insignificant this shows that inflation by itself does not directly significantly affect the real GDP growth in or economic growth does not Granger cause inflation.

For the complete sample period, the causality running from inflation to broad money supply growth was stronger than that from broad money supply growth to inflation. This result is consistent with the view that in a high inflationary economy, inflation does have a feedback effect on money supply growth and this generates a self-sustaining inflationary process. The unidirectional causality between currency devaluation and inflation is strong or is robust for the complete sample period. On the other hand similar to expectations, Gas oil prices have been found to have no significant influence on inflation between the years (1998 to 2007) due to this sector was subsidized by the government. However, 2007 onwards oil price has contributed a significant impact for the Ethiopian inflation.

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Annexes

Annex 1 data and description

```
Contains data from D:\TEMESGEN\THESIS\DATA\inflation.dta11.dta
  obs:            52                          lagged CPI
 vars:            11                          19 Mar 2013 09:40
 size:         2,288
```

───

```
              storage  display    value
variable name  type    format     label   variable label
```
───

```
CPI           float   %9.0g              consumer price index
RGDP          float   %9.0g              real GDP
M2            float   %9.0g              broad money supply
ALR           float   %9.0g              average lending rate
XER           float   %9.0g              exchange rate
OD            float   %9.0g              overall budget deficit
GP            float   %9.0g              Gas oil price
quarter       float   %tq                quarter
CPIl1         float   %9.0g              lagged CPI
M2l1          float   %9.0g              laggedM2
e             float   %9.0g              Residuals
```
───

```
Sorted by:  quarter
```

Summary of data

```
. sum CPI RGDP M2 ALR XER OD GP quarter CPIl1 M2l1 e LRGDP LXER LGP LM2 LCPI
```

Variable	Obs	Mean	Std. Dev.	Min	Max
CPI	52	99.11154	38.77801	62	180.1
RGDP	52	2.93e+08	7.90e+07	1.96e+08	4.91e+08
M2	52	4.57e+10	2.44e+10	1.73e+10	9.88e+10
ALR	52	11.38942	.8305052	10.5	12.75
XER	52	9.40554	1.782641	7.1529	13.6892
OD	52	1.73e+09	1.07e+09	6.29e+07	3.89e+09
GP	52	6.447308	3.372017	2.51	17.73
quarter	52	177.5	15.15476	152	203
CPIl1	51	97.52353	37.41729	62	177.2
M2l1	51	4.47e+10	2.34e+10	1.73e+10	9.53e+10
e	51	-6.57e-09	2.852201	-11.9107	7.464024
LRGDP	51	2.89e+08	7.46e+07	1.96e+08	4.77e+08
LXER	51	9.321547	1.693273	7.1529	13.44
LGP	51	6.226078	3.000334	2.51	14.45
LM2	51	4.47e+10	2.34e+10	1.73e+10	9.53e+10
LCPI	51	97.52353	37.41729	62	177.2

Annex 2 Granger-causality tests between M2 and inflation.

```
. reg M2 l1.M2 l2.M2 l3.M2 l1.CPI L2.CPI l3.CPI
```

Source	SS	df	MS		Number of obs =	49
					F(6, 42) =	5055.13
Model	2.7799e+22	6	4.6332e+21		Prob > F =	0.0000
Residual	3.8494e+19	42	9.1653e+17		R-squared =	0.9986
					Adj R-squared =	0.9984
Total	2.7838e+22	48	5.7995e+20		Root MSE =	9.6e+08

M2	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
M2						
L1.	.8142371	.1560118	5.22	0.000	.4993926	1.129082
L2.	.0365624	.2127339	0.17	0.864	-.3927521	.4658768
L3.	.2546447	.1696877	1.50	0.141	-.0877989	.5970883
CPI						
L1.	-1.99e+07	4.32e+07	-0.46	0.647	-1.07e+08	6.72e+07
L2.	-1690429	5.42e+07	-0.03	0.975	-1.11e+08	1.08e+08
L3.	-1.19e+07	4.18e+07	-0.28	0.778	-9.62e+07	7.24e+07
_cons	9.30e+08	6.23e+08	1.49	0.143	-3.28e+08	2.19e+09

```
. test l1.CPI l2.CPI l3.CPI

 ( 1)  L.CPI = 0
 ( 2)  L2.CPI = 0
 ( 3)  L3.CPI = 0

       F( 3,   42) =    0.90
           Prob > F =    0.4490
```

Annex 3 Granger causality test between exchange rate movement and inflation

```
. reg XER l1.XER l2.XER l3.XER l1.inflation l2.inflation l3.inflation
```

```
      Source |       SS           df       MS            Number of obs =      48
─────────────┼──────────────────────────────            F(  6,    41) =  265.12
       Model |  142.515191        6  23.7525319          Prob > F      =  0.0000
    Residual |  3.67322287       41  .089590802          R-squared     =  0.9749
─────────────┼──────────────────────────────            Adj R-squared =  0.9712
       Total |  146.188414       47  3.11039179          Root MSE      =  .29932
```

```
─────────────┬──────────────────────────────────────────────────────────────────
         XER |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
─────────────┼──────────────────────────────────────────────────────────────────
         XER |
         L1. |   .9086685   .1483314     6.13   0.000     .6091072    1.20823
         L2. |    .373845   .1964485     1.90   0.064    -.0228908   .7705809
         L3. |  -.2567623   .1554547    -1.65   0.106    -.5707094   .0571848
             |
   inflation |
         L1. |   .8899519   .8649623     1.03   0.310     -.856875   2.636779
         L2. |   .3758446    .886123     0.42   0.674    -1.413717   2.165406
         L3. |   .6128381   .8771891     0.70   0.489    -1.158681   2.384357
             |
       _cons |  -.1757817   .2769179    -0.63   0.529    -.7350287   .3834654
─────────────┴──────────────────────────────────────────────────────────────────
```

```
. test l1.inflation l2.inflation l3.inflation

 ( 1)  L.inflation = 0
 ( 2)  L2.inflation = 0
 ( 3)  L3.inflation = 0

       F(  3,    41) =    0.56
            Prob > F =    0.6476
```

Annex4 Granger causality test between real GDP growth and inflation

```
. reg RGDP l1.RGDP l2.RGDP l3.RGDP inflation l1.inflation l2.inflation l3.inflation
```

Source	SS	df	MS
Model	2.9181e+17	7	4.1688e+16
Residual	3.5623e+15	40	8.9058e+13
Total	2.9538e+17	47	6.2846e+15

```
Number of obs =       48
F(  7,    40) =   468.09
Prob > F      =   0.0000
R-squared     =   0.9879
Adj R-squared =   0.9858
Root MSE      =   9.4e+06
```

RGDP	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]
RGDP					
L1.	1.585641	.1580708	10.03	0.000	1.266168 1.905114
L2.	-.6653775	.2812679	-2.37	0.023	-1.233841 -.0969139
L3.	.0998002	.168659	0.59	0.557	-.2410725 .4406728
inflation					
--.	-1.86e+08	2.76e+07	-6.73	0.000	-2.42e+08 -1.30e+08
L1.	1.44e+08	3.99e+07	3.61	0.001	6.33e+07 2.25e+08
L2.	1.32e+07	4.22e+07	0.31	0.756	-7.20e+07 9.85e+07
L3.	2.45e+07	2.80e+07	0.87	0.387	-3.21e+07 8.11e+07
_cons	-2679607	6332503	-0.42	0.674	-1.55e+07 1.01e+07

```
. test l1.inflation l2.inflation l3.inflation

 ( 1)  L.inflation = 0
 ( 2)  L2.inflation = 0
 ( 3)  L3.inflation = 0

      F(  3,    40) =    5.98
           Prob > F =    0.0018
```

Annex 5 Granger causality test between oil price and inflation

```
. reg GP l1.GP l2.GP l3.GP inflation l1.inflation l2.inflation l3.inflation
```

Source	SS	df	MS		Number of obs =	48
					F(7, 40) =	116.33
Model	488.713051	7	69.8161501		Prob > F =	0.0000
Residual	24.0053152	40	.600132879		R-squared =	0.9532
					Adj R-squared =	0.9450
Total	512.718366	47	10.9089014		Root MSE =	.77468

GP	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
GP						
L1.	1.108687	.1813428	6.11	0.000	.7421798	1.475195
L2.	-.148092	.2538477	-0.58	0.563	-.6611373	.3649532
L3.	.159067	.1981171	0.80	0.427	-.2413427	.5594767
inflation						
--.	.5758662	2.327295	0.25	0.806	-4.127773	5.279505
L1.	-1.739391	2.355445	-0.74	0.465	-6.499923	3.02114
L2.	-.1362686	2.319997	-0.06	0.953	-4.825158	4.552621
L3.	-2.145872	2.29799	-0.93	0.356	-6.790282	2.498538
_cons	-.3534861	.2838889	-1.25	0.220	-.9272469	.2202747

```
. test l1.inflation l2.inflation l3.inflation

 ( 1)  L.inflation = 0
 ( 2)  L2.inflation = 0
 ( 3)  L3.inflation = 0

       F(  3,   40) =    0.50
            Prob > F =    0.6831

.
```