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# **Analysis of Equilibrium Relationship among Government Budget Deficit, Money Supply and Inflation in Ethiopia: Co-integrated VAR Analysis Approach**

**Negash Haile Dedeho<sup>1</sup>**

## *Abstract*

*This study attempted to provide empirical evidences for causal long-term relationship between budget deficit, broad money supply and inflation in Ethiopia. For this purpose, the study employed co-integrated VAR or vector error correction (VEC) model approach by using annual time series data over 1975-2012. The study also investigated direction of causality by using Granger causality test. Parameters of the system were estimated by using Johansen estimation approach. The results show that positive causal relationship between money supply and inflation both in the short and long run. It also shows that budget deficit affects both money supply and inflation in the long run. However, this is not conclusive by taking into account granger causality test. But both money supply and inflation do not Granger cause government budget deficit.*

**Key words:** Budget Deficit, Money Supply, Inflation, Hypothesis testing.

**JEL Classification:** H62, E51, E31, C12

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<sup>1</sup> Dilla University, College of Business and Economics, Department of Economics  
E-mail: [negh2009@gmail.com](mailto:negh2009@gmail.com); Cell phone: +251932251788/+251913557158

## **1. Introduction**

The objectives of monetary and fiscal policies are either economic growth or macroeconomic stability or both. Although, the concern of policy-makers in developing countries like Ethiopia is to attain rapid growth and structural change, inflation takes a remarkable place in development process of a given *economy* (Hossain and Chowdhury, 1996). Inflation is persistence and appreciable rise in the general price level in the economy. The rise in general price level may be attributable to expansionary monetary policy and persistent fiscal imbalances. Thus it can be argued that the objectives of a stable price level, the optimal level of government budget deficit and monetary balance are intertwined and needs to be considered jointly.

The relationship between budget deficit, money growth and inflation has acquired a prominent place in macroeconomic economic literature overtime. The two traditional approaches which have been used to explain the link between these macroeconomic variables are monetarist hypothesis (MH) and the fiscal theory of the price level (FTPL). Another alternative theory, based on dynamic general macroeconomic models with imperfect competition is the new Keynesian (NK) theory. According to monetarist view “inflation is always and everywhere a monetary phenomenon” and hence, it helps to explain the dynamics of inflation. But, according to FTPL, “price is the result of fiscal activities”.

Sustained increase in money growth ultimately translated into increased inflation in the long run when all adjustments have been taken place (Dornbusch and Fisher, 1992). But this still leaves the question of what determines the money supply growth in the economy. A frequent argument says money supply growth is a consequence of government budget deficits. Monetization of budget deficit leads to increase in money supply and hence, produces inflation and macroeconomic instability. As Lozano (2008) stated, high inflation in developing countries emerges a fiscal driven monetary phenomenon. This occurs when the governments finance large and persistent budget deficits through money creation. On other hand, high inflation puts

pressure on government budget and leads to high fiscal imbalance (Dornbusch and Fisher, 1994). When the economy experiences high inflation real revenue collected from taxation would fall while government expenditure adjusts to inflation quickly and hence, leads to fiscal imbalance. Another channel through inflation affects budget deficit is increasing nominal interest payment made by the government on national debt.

Extensive number of papers have empirically investigated and evaluated the relationship between money supply, budget deficit and inflation in different countries and ended with mixed results. Significant number of empirical studies show that the existence of significant relationship between money supplies, budget deficit and inflation (Ignacio, 2008; Kanhaya and Gupta, 1992; Olalere, 2012; Mathias, 2015; Parida, 2000; Anwar, 2012). Contrary to this, some other studies found insignificant relationship between inflation and budget deficit (Vincent *et al.* 2012; Tahir and Muhammad, 2010; Hoang, 2014).

For Ethiopia, a remarkable number of papers have investigated the relationship between money supply and inflation. Using VECM, Jema and Fekadu (2012) examined the determinants of food price. Their result revealed that positive impact of money expansion on food price. Dick and Bo (2012) evaluated the driving forces of inflation through single equation error correction model and identified money expansion as short to medium term factor of inflation. Contrary to these, Josef et al (2009) estimated single equation error correction model of inflation and identified insignificant long run relationship between monetary expansion and inflation. Loening *et al.* (2008) examined short-run dynamics of inflation in Ethiopia by using a parsimonious error correction model and found significant short run impact of money supply on inflation. However, there is no studies explicitly cited fiscal deficit as a long run cause of money supply growth and inflation in Ethiopia. None of previous empirical studies also used co-integrated VAR model approach to investigate the dynamic long run relationship among money supply, budget deficit and inflation in Ethiopia. Therefore, this paper attempts to provide empirical evidence on the dynamic long run relationship

among monetary expansion, budget deficit and inflation in Ethiopia by using vector error correction model (VECM). The result of this study is relevant for policy makers in Ethiopia, particularly when the government wants to set long run and short run macroeconomic stability. By providing the direction of causal relationship among these variables, it helps the government to effectively implement fiscal and monetary policies and hence to control inflation.

The paper is organized as follows: The next section contains brief review of related theoretical and empirical literature. Section 3 presents descriptive analysis of data trend while Section 4 outlines the methodological approach. Section 5 carries out the empirical analysis and the last section concludes the paper.

## **2. Review of Related Literatures**

### **2.1 Theoretical Literature Review**

The issue of fiscal policy and persistent fiscal imbalances in the economy is controversial and debating issue among different scholars. On the one hand, some argue that budget deficits do not matter but On the other hand, many others have been overly concerned about the existence of huge and persistent fiscal imbalances in many countries (Siamack, 1999).

Some researchers (Auerbach *et al.*, 1991) have attempted to provide measure and computational methodology of budget deficit based on the intergenerational distribution of the burden of financing government budget deficits. According to this approach, members of each generation receive payments and make contributions to the government budget at different times. The generational accounting system computes the net present value of these cash flows based on a given fiscal policy regime. Changes in the fiscal policy that alter the current budget deficit will affect the intergenerational fiscal burden (Siamack, 1999).

Budget deficit affects the supply of money in the economy. The determination of which components of money supply are to be included in the measurement of money supply is related to the level of financial liberalization, or sophistication in a country (Mishkin, 2004). As an economy advances, there evolves an increasing range of monetary and other financial instruments and it becomes increasingly difficult to establish a distinction between them. Recall that a main purpose for measuring the money supply is to facilitate analysis of its growth relative to other macroeconomic targets including inflation and economic growth. In Ethiopia broad money (M2) is used as a measurement of money supply and in this research the analysis will be based on it.

Another important concept which should be concerned in the monetary and fiscal policy analysis is inflation. In economics, the term inflation is usually used to indicate a rise in the general level of prices of goods and services in an economy over a period of time. It has impact on the well being of the economy, macroeconomic stability, standard of living, fiscal and current account balance and etc.

### **Monetarist hypothesis of money supply-inflation relationship**

There are many potential factors that can significantly affect inflation in a given economy. However, when one thinks over the long period of time, monetary economists just focus only on one factor, growth of money supply. The reason for this is that there are no other factors likely to lead to persistent increase in the price level (Romer, 1996). Persistent increase in price level requires persistent fall in aggregate supply or persistent increase in aggregate demand. But these are unlikely and most of the factors are limited in their scope given technology. The money supply, in contrast, can grow at almost any rate; there may be huge variation in money supply during deflations and hyperinflations. Higher growth rate of money causes prices to increase, because higher money growth lowers the value of money or it deteriorates the purchasing power of currency.

In examining the link between money growth and inflation, it is convenient to use monetarist quantity theory of money (Dornbush and Fischer, 1992). That relation between money supply growth and increase in price level is historically associated with the quantity theory of money. The quantity theory relates the level of nominal income (PY), where P is prices and Y is outputs, with the total amount of money stock in the economy (M) and transaction velocity of money (V). As monetarists assume that V and Y are determined, in the long run, by real variables, such as the productive capacity of the economy, there is a direct relationship between the growth of the money supply and inflation. In its modern form, the quantity theory of money builds upon the following definitional relationship.

$$MV = \sum_t (P_t Y_t) \quad (1)$$

Where,

$P_t$  and  $Y_t$  are the price and quantity of the  $i^{th}$  transaction. However, the above formula associated with the difficulty of calculation because there is no data available for each transaction in the economy. Due to this, economists work with the more simplified form of the equation based on final product transaction. The simplified model can be expressed as:

$$MV = PY \quad (2)$$

This can also be written in terms of natural logarithm and percentage changes over time for the variables.

$$\ln M + \ln V = \ln P + \ln Y \quad (3)$$

$$m + v = \pi + y \quad (4)$$

Where, m is money supply growth, v is percentage change in velocity of money,  $\pi$  is the inflation rate and y is the growth rate of output. According to monetarist proposition inflation is predominantly a monetary phenomenon

implies that changes in velocities are small and they assume output at its natural level. From quantity theory of money one can infer that there is proportionality between money growth and inflation rate. So, there is clear and strong connection between money stock and price growth.

According to quantity theory hypothesis changes in the money supply have no long run real effects. By considering equilibrium condition for the money market in which equality holds between money supply and money demand and by adding two more assumptions such as national output fixed at equilibrium and money stock is not affected by nominal income we can note that the raise in money supply leads to increase in price level to maintain new equilibrium level (Levai and Rebmann, 1982). Given that the equilibrium value of output ( $Y$ ) and velocity of money ( $V$ ) are fixed, the only way equilibrium can be restored is raise in price level. Here the crucial assumption is that price is assumed to be flexible and adjusts the equilibrium if imbalances occurred in the economy. The models here obey what is known as the “classical dichotomy”- they will have the property that real variables are determined by other real variables, and not by nominal variables. Most of economists believe that the classical dichotomy holds in the long run.

Thus, the quantity theory of money states that the central bank has ultimate control over the rate of inflation by manipulating money supply. If the central bank keeps the money supply stable, the price level will be stable. If the central bank increases the money supply rapidly, the price level will rise rapidly. Hence according to monetarist view Inflation is always and everywhere a monetary phenomenon. Monetary policy has no effect on real variables in the long run but it only affects nominal variables such as price level in the economy.

However, according to Keynesian view monetary expansion affects both real output and inflation in the short run but in the long run they agree with the classical economists (Snowdon and Vane, 2005). A further assumption Keynes introduced is that the theory of liquidity preference, the possibility



that the demand for money function might shift about unpredictably, causing velocity of money to vary, implies that changes in Money supply may be offset by changes in velocity in the opposite direction. With output and velocity no longer assumed to be constant in the equation of quantity of money. it is clear that changes in the quantity of money may cause velocity (V), price (P) or output (Y) to vary. According to this view the neutrality of money is no longer guaranteed in the short run.

### **Fiscal theory of the price level**

The fiscal theory of the price level is the idea that fiscal factors replace the money supply as the key determinant of the price level. Stable price level requires sustainable government finances meaning that they must run a balanced budget over the course of the business cycle. It is a contrary to widely accepted economic theories of the price level, which states that the price level is primarily or exclusively determined by the growth of stock of money in the long-run.

Walsh (2010) point out that fiscal theory of the price level raises some important issues for both monetary theory and monetary policy. There are two ways fiscal policy might matter for the price level. First, equilibrium requires that the real quantity of money equal the real demand for money. If fiscal variables affect the real demand for money, the equilibrium price level will also depend on fiscal factors. This, however, is not the channel emphasized in fiscal theories of the price level. Instead, these theories focus on a second aspect of monetary models - there may be multiple price levels consistent with a given nominal quantity of money and equality between money supply and money demand. Fiscal policy may then determine one of these equilibrium price levels and in some cases, the equilibrium price level picked out by fiscal factors may be independent of the nominal supply of money.

In contrast to the standard monetary theories of the price level, the fiscal theory assumes that the government's intertemporal budget equation

represents an equilibrium condition rather than a constraint that must hold for all price levels. A price level at which intertemporal government budget constraint hold is consistent with equilibrium. Given the stock of nominal debt, the equilibrium price level must ensure that the government's intertemporal budget is balanced (Walsh, 2010). The fiscal theory of the price level implies that a government could exogenously fix its real spending, revenue and seigniorage plans, and that the general price level would adjust the real value of its contractual nominal debt obligations so as to ensure government solvency (Buiter, 1999).

This means that at price levels not equal to equilibrium price, the government is planning to run surpluses/deficit (including seigniorage) whose real value, in present discounted terms, is not equal to the government's outstanding real liabilities. Similarly, it means that the government could cut current taxes, leaving current and future government expenditures and seigniorage unchanged, and not simultaneously plans to raise future taxes. If prices are deviated from its equilibrium level the government run deficit or surplus.

Developing countries have four different ways to finance their high budget deficit which are printing money, running down foreign exchange reserves, borrowing from abroad and domestic markets (Sahan and Bektasoglu, 2008). Inflation has raising effect on budget deficit through nominal interest rate. According to Fischer Effect; nominal interest rate consist of real interest rate and expected inflation rate. If the inflation expectation increases, it causes to rising nominal interest rate which leads to the public debt to go up, since interest payment covers the big part of public payment in developing countries. If interest rate increases because of inflation, it leads to raise interest payment as well as budget deficit by causing the Debt/ GDP ratio to go up. Thus, high interest rate and interest payment lead to instability between budget and public deficit acceleration and tax revenue acceleration. Public expenditure always increases faster than public revenue so as budget deficit increase as well.

The reverse effect of budget deficit on inflation is analyzed by using government intertemporal budget constraint. The intertemporal budget constraint implies that any government with a current outstanding debt must run in present value terms, of future surpluses. One way to generate a surplus is to increase revenues from seigniorage, and for that reason, economists have been interested in the implications of budget deficits for future money growth.

However, (Bektasoglu and Sahan.2008) stated that in spite of the positive relationship between inflation and budget deficit, in some cases inflation and budget deficit move in reverse direction. If inflation tax is higher than normal level, as inflation increase people avoid holding money because the cost of holding money is high. Thus, real monetary base tends to decrease as inflation tax correspondingly. Holding money would be a costly activity. Inflation tax would be a type of tax revenue which makes the budget deficit decline. If borrowing is not indexed to the inflation, as the inflation rise the real value of public borrowing stocks would decline. As the public borrowing stock fall, budget deficit is expected to decrease.

Therefore, monetary expansion, fiscal deficit and inflation in a given economy are interlinked. Budget deficit affects money supply, money supply affects inflation and inflation in turn affects fiscal imbalances. There is vicious circle like relationship between these macroeconomic variables.

## **2.2 Empirical Literature Review**

Extensive number of papers have empirically investigated and evaluated the relationship between money supply, budget deficit and inflation with mixed results. Some of them found no significant relationship among these macroeconomic variables and the results of several others papers are on the contrary.

Using post-1999 period data from Brazil, Chile, Colombia and Mexico Luiz (2008) estimated simultaneously a monetary reaction function and the

determinants of expected inflation by using VEC model. The revealed result shows the existence of long term relationship among the interest rate, expected inflation and inflation target, which suggests that the importance of monetary policy in tackling inflation. The finding of the same study also showed that greater volatility in the monetary stance leads to higher volatility in expected inflation.

Ignacio (2008) examined the causal long term relationship between budget deficit, money supply and inflation in Colombian by using VEC model. He used two sets of data, quarterly data over the period of 1982Q1 to 2007Q4 and annual data from 1955 to 2007. In the first case the study has found close relationship between inflation and money supply one hand and between budget deficit and money growth on the other. But, in the second case the study didn't find significant relationship between budget deficit and money growth.

Using Nigerian data over the period of (2000Q1-2013Q4), Mathias (2015) evaluated the relationship between money supply, inflation, interest rate and exchange rate by employing recursive vector auto regression (VAR) model. The result of the study revealed that inflation in Nigeria is monetary phenomena. Using annual data from 1980-2009 Abel and Olalere (2012) examined the relationship between budget deficit and inflation in the same country by employing VEC model mechanism and found causal long term relationship among them. As they stated budget deficit transmitted to inflation through money supply growth. Ibrahim et al (2014) investigated the long run relationship between money supply, budget deficit (percentage of GDP), inflation and growth of external debt/GDP in Nigeria over the period of 1975 and 2012. Through error correction model (ECM) of single equation the study provided support for the existence of long run relationship between inflation, money supply and budget deficit. Using data over 1970-2006 similar study (Vincent et al. 2012) revealed insignificant relationship between inflation and budget deficit on one hand and significant positive relationship between money growth and inflation on the other hand.

For Pakistan, using quarterly observations over the period 1960-2007 and applying Johansen co-integration approach Tahir and Muhammad (2010) examined the long run relationship between money supply, budget deficit and inflation. The result provided that the impact of fiscal deficit on inflation is not significant and contrary to this money supply significantly affects inflation in the long run.

Among empirical studies with mixed results, Petraq (2012) evaluated the relationship between budget deficit, money supply and inflation in three transition economies of Albania, Bulgaria, and Romania over first quarter of 1991 to last quarter of 1997. Through OLS method, he found that public finance imbalance is the main cause of money creation and inflation in these countries. Kivilcim (2011) examined the relationship between Inflation and Budget Deficit in Turkey over 1950-1987 annual observation. Using multivariate cointegration analysis technique of single equation he found budget deficit, income growth and debit monetization have affected inflation. Using Tanzanian data over 2000 to 2011 and examining through OLS, ECM and VAR mechanism, James *et al.*, (2014) found similar result. VECM result estimated from Iranian quarterly data over 1988Q1 to 2005Q4 indicated, inflation in the long run induced by monetary expansion but this result is not holds in the short run (Mehdi and Seyyed. 2013). Using Vietnam's monthly data set from January 1995 to December 2012 Hoang (2014) examined the relationship between budget deficit, money supply and inflation through Structural VAR model. The result of the study found positive impact of money growth on inflation while, budget deficit has no impact on both money growth and inflation.

Gupta (1992) analyzed the effects of budget deficit on money supply growth by using reduced form equation models for selected Asian countries by using annual data. The results of his estimation shows that budget deficits do not have a strong influence on the growth of money supply. He also examined the effect of budget deficit on inflation by using annual data through structural and non-structural approaches. Based on structural approach employing error-correction model, budget deficits seem to exercise direct

effects on inflation in Malaysia, Pakistan, the Philippines, Sri Lanka, Taiwan, and Thailand. But there is no evidence of such direct effects in India, Indonesia, South Korea, and Singapore. The indirect effects of budget deficits on inflation exist in India, Indonesia, Malaysia, the Philippines, Singapore, Sri Lanka, Taiwan, and Thailand. The result from non-structural approach has also supported strong causal relationship between budget deficit and inflation.

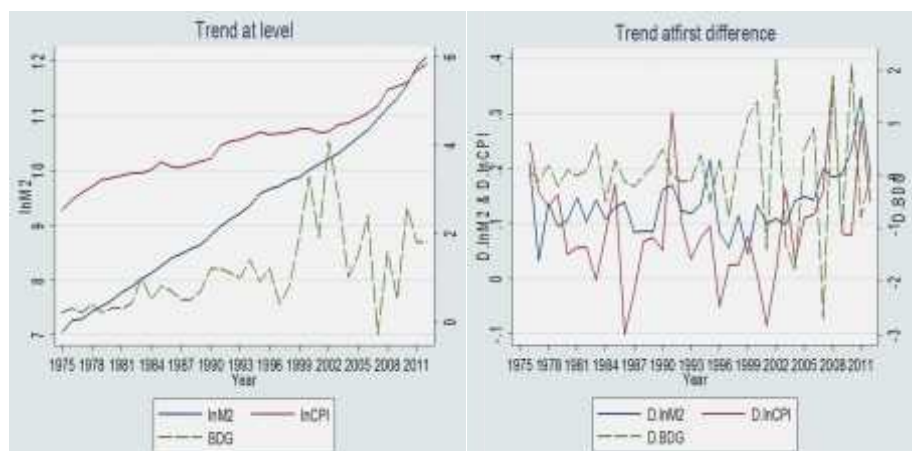
With reference to Ethiopia, there are remarkable number of papers assessing the relationship between inflation and its determinants. Using quarterly data over (1996/97 Q1– 200/08Q3), Kibrom (2008) empirically identified the determinants of inflation in Ethiopia. Through vector autoregressive (VAR) and single equation error correction model, he has found positive and significant relationship between inflation and money supply in the long run. Yemane (2008), examined the causal link among inflation, money and budget deficits in Ethiopia over (1964 - 2003) by using the bounds test approach to co-integration and Granger causality test. The result shows that money supply Granger causes inflation and also budget deficits Granger causes inflation. Contrary to this, Asayehgn (2008) evaluated contributing factors of inflation in Ethiopia over (1991M2-2006M7) through OLS method and found positive but insignificant relationship between money supply and inflation and between budget deficit and inflation. There are no previous studies that empirically evaluate the long run relationship between budget deficit, money growth and inflation by using vector error correction model (VECM), as proposed in this paper.

### **3. Descriptive Analysis**

As a preliminary to the econometric analysis, descriptive analysis of data trend is discussed in this section. The variables are broad money supply (M2), general consumer price index (CPI) and percentage share of budget deficit to GDP ratio (BDG). Both M2 and CPI are in natural logarithm form and BDG is in positive number because it is a form of percentage share from 1975 to 2012. From Figure 1, one can notice that upward trending of each

variable at level but at first difference they become stable. The graphs also displays that the variables involved in the system have common stochastic trends. In other words, they have common tendency to move together over time.

**Figure.1: Trends of broad money supply. CPI and BDG from 1975 to 2012**



Budget deficit to GDP ratio has shown some fluctuations over the sample period. Different factors may be contributed to these. For example, increase in defense expenditure from 3.5% of GDP in 1997 to 10.2% of GDP in 1999 and hence, contributed to the increase of federal government expenditure from 19.6% to 26.3% as percentage of GDP over the same period, while, revenue decreased from 17.2% to 17% as percentage of GDP over these periods. Since, 2000 the government highly increased its expenditure (road construction (from 1.9% in 2000 to 5.2% in 2012), education (from 0.9% to 2.5%), agriculture (from 0.9% to 1.4%) and natural resource (from 0.5% to 1.7%)) as a percentage of GDP from 2000 to 2012. But revenue to GDP has not been shown significant change over these periods. The government deficit has been financed from domestic banking system over 1975 to 1993 and 1999. This has further influenced money supply and hence inflation in Ethiopia during the sample period.

Even though, Ethiopian economy has achieved high economic growth (average rate of 10.4%) compared to Sub-Saharan Africa average of 5.3% from 2004 to 2014 (IMF Regional Economic Outlook. 2015). inflation was remaining its great challenges over these periods (JOSEF *et al.*, 2009). However, the government claimed that inflation has been maintained at single digit by taking robust monetary and fiscal policies (MoFED, 2013). Different authors outlined different reasons for the existence of high inflation in Ethiopia as discussed in introduction section. But, Figure 1 shows that natural log of CPI moves with natural log of broad money supply and budget deficit to GDP ratio. From this one can understand that money supply and budget deficit are possible cause of inflation in Ethiopia. Therefore, the objective of this study is empirically investigating causal long term relationship among M2, CPI and BDG in Ethiopian by using VECM.

#### **4. Econometric Methodology and the Data**

##### **4.1 Methodology**

As Lütkepohl and Krätzig (2004) stated, including many variables in the single equation may not capture the dynamic, inter-temporal relationship among the variables and may not lead to better result. In this case, formulating the interrelations among economic variables as a system provides sufficient information about the variables (Anindya *et al.* 2003). Vector autoregressive (VAR) process based on Gaussian errors is a robust and suitable model class for describing dynamics of macroeconomic time series data. Other reasons for the frequent choice of VAR model are: Its flexibility, easiness to estimate, and its good fit to macroeconomic data. It also used for structural inference, forecasting and policy analysis. The possibility of combining long-run and short-run information in the data by exploiting the co-integration property is probably another important reason why the VAR model continues to receive the interest of both econometricians and applied economists. Making inference based on VAR formulation is consistent than making inference based on isolated single equation (Juselius, 2006).



Despite these, VAR model has its own limitations, for example, it does not based on standard set theories and may produce different result from theory based models. Restrictions are usually imposed with statistical techniques instead of prior beliefs based on uncertain theoretical considerations (Lütkepohl and Krätzig, 2004). However, if it is empirically well defined, it produces robust result which better fits macroeconomic data and hence addresses the limitation of theory based models. Theory based models are over simplified by the assumption of ceteris paribus and may explain little about the real economic situations. In this case VAR model is useful to develop new hypothesis or to modify the very narrow theories (Johansen, 1995; Juselius, 2006 and Watson, 1994). But, VAR produces valid estimate/forecasts only when covariance stationarity or no unit root assumptions are fulfilled. Another shortcoming of VAR model is that it fails to spilt short term causality and long term relationships among economic variables.

When we are thinking about long run relationship among variables, it is necessary to consider the underling properties of data generating process i.e. series stationarity and co-integration relations. Since failure to do so can lead to a problem of spurious regression meaning that invalid inference (Harris, 1995). These are the task testing order of integration and order of co-integration. VAR model produces valid result when the underlying data generating process is covariance stationary and the order of co-integration is zero. But most of economic time series variables don't exhibit stationarity at their level and they may show common tendency to move together for some extent. Hence it is necessary to have models that accommodate these features of data generating process. One possible technique is performing VAR analysis after differencing integrated individual components involved in the system if it doesn't distorts important features of variables. But, this may be inadequate in deriving inferences and forecasting (Lütkepohl, 2005). Another robust and more appropriate technique is to analyze data within a co-integration framework.

Co-integration refers to equilibrium relationship which characterized by having common stochastic trend among a set of variables. It naturally arises in economic variables and most often associated with economic theories that imply equilibrium relationship among the variables. The appropriate model which accommodates these issues is known as vector error correction models (VECM) or co-integrated VAR (CVAR) model or vector equilibrium correction model (Lütkepohl & Krätzig, 2004) which has extensively used in modeling economic equilibrium relationship (Hubrich, 2005). This methodology is a growing approach in econometrics application of analyzing the dynamic long run equilibrium relationship and short term causality among integrated variables and has been playing an explicit role in econometric modeling of economic time series data. Juselius (2006) described several advantages of VECM formulation among others: first, the autocorrelation and multicollinearity problem which typically arises in time-series data would be significantly reduced in the error-correction form. Second, all information about long-run effects are summarized in the levels matrix (subsequently denoted by  $\alpha$ ). Third, the interpretation of the estimates is more intuitive, as the coefficients can be naturally classified into short-run and long-run effects. Fourth, the VECM formulation gives a direct answer to the question ‘why a given variable changes from time to time as a result of changes in the chosen information set.

VEC model which captures both long run dynamic relationship and short run causality among macroeconomic variables can be specified in the form of:

$$Y_t = \alpha Y_{t-1} + \beta_1 Y_{t-1} + \dots + \beta_{p-1} \Delta Y_{t-p+1} + \mu + U_t \quad [5]$$

Where, rank of  $(\alpha I)$  =  $r$  with  $0 < r < K$ . then reduced rank matrix  $\alpha$  is not unique can be decomposed as  $\alpha I = \alpha \beta'$ . The parameters  $\alpha$  and  $\beta$  are  $(k \times r)$  matrices with  $\text{rk}(\alpha) = \text{rk}(\beta) = r$ ; where,  $k$  indicates number of variables in the system;  $\alpha$  is adjustment coefficient; and  $\beta$  represents long run coefficients of the model which is called co-integrating vector. The short run components of the model is captured by  $X_j (j = 1, \dots, p - 1)$  which are  $(K \times K)$  parameter matrices. The error term component of the model is assumed to be

Gaussian white noise i.e.  $u_t \sim (0, u)$  while  $Y_{t-1}$  contains I(1) variables. Due to its clear separation between the long-run parameter ( $\alpha$ ) and the short-run effects ( $\beta$ ) VECM formulation has become attractive.

The co-integration hypothesis can be formulated as a reduced rank restriction on the  $\alpha$  matrix. The choice; 2 of  $\alpha$  and  $\beta$  in addition to reproducing the matrix, should ideally describe an interpretable economic structure and provide empirical insight on the appropriateness of the underlying economic model (Juselius, 2006). The co-integrating rank  $r$  shows the number of linearly independent co-integrating relations of the system. In other words  $r$  measures the number of stationary linearly independent relations available in the system. Johansen methodology is commonly applied to test the existence long run relationship (co-integration relations) among the variables.

Moreover, the VECM specification is not particularly useful in the cases of zero co-integrating vector and full rank co-integrating vector. The former indicates the absence of co-integrating relationship among the variables, while the later shows all variables involved in the system are stationary. In both case VAR model with first-differenced variables and at level can be used to analyze the relationship among the variables in the system (Lütkepohl and Krätzig, 2004 and Lütkepohl, 2005). Nonetheless, a unit root is often a convenient statistical approximation, which enables us to utilize a much richer framework (VECM) that distinguishes between the longer and shorter term dynamic effects. It is therefore useful to consider unit roots for the empirical analysis of macroeconomic relationships since neglecting it invalidate our analysis. Among the test procedures Augmented Dickey Fuller (ADF) test procedures will be applied to determine the order of integration (existence of unit root) in the endogenous variables such as budget deficit, money supply and CPI.

The most usual estimation method for the VECM presented above is the maximum likelihood estimator (MLE) proposed by Johansen (1995), which uses the reduced rank regression (RRR). In Johansen's approach, the parameter estimator is made unique by normalizing eigenvectors, and

adjusting accordingly (Lütkepohl and Krätzig, 2004). Therefore, appropriate identification restrictions needed to be imposed on co-integrating vector but we should be careful with the order of the variables and our interpretation.

Another important point must be considered before fitting unrestricted model with  $p$  lags is checking whether the underlying assumptions of the model are satisfied or not, otherwise the procedures derived may not be valid (Johansen, 1995). In particular it is important to determine the optimal lag length, check absence of autocorrelation problem, Gaussian white noise process.

The optimal lag length for the VAR or VEC model can be determined by using information criteria procedures such as Akaike's Information Criterion (AIC), final prediction error (FPE), Hannan-Quinn criterion (HQ), and Schwarz criterion (SC). The strategy for determining the optimal lag length is choosing the lag that minimizes the information criterion. An important criterion for the choice of lag length is that the residuals are uncorrelated. To test residual autocorrelations Portmanteau test and Lagrange multiplier test can be used. However, it is important to avoid too many lags (Johansen, 1995). Once the lag length of VAR model determined it is straightforward to determine the lag length of VECM. In addition to these, structural analysis: granger causality test and impulse response analysis and structural change i.e. VECM parameter stability test would be carried out as tool for diagnostic checking to validate VEC model results and supplement long run analysis (Lütkepohl, 2005).

## **4.2 Data**

This study is based on annual fiscal and monetary data from 1975 to 2012. The variables are percentage of budget deficit to GDP ratio (BDG), broad money supply (M2) and consumer price index (CPI) as endogenous variables. BDG is calculated by subtracting government revenue from government cost and take it as percentage of GDP and hence it is positive number. Broad money supply (M2) contains money at circulation, demand deposits, savings deposits and time deposits. Budget deficit and GDP are obtained from MoFED while money supply and consumer price index are

obtained from National Bank. Even though, it is recommended to use time series data from the same source, the reason why the author relies on two data sources is that lack of long term data on all variables from one source. Due to the lack of long term quarterly data, the researcher forced to use annual data.

## 5. Econometrics Results and Discussion

### 5.1 Properties of the System

Augmented Dickey-Fuller test (ADF) procedure is commonly applied in determining unit root properties of economic time series data. The results of ADF tests both at level and first difference for each series are presented in Table 1. Test results, indicate that all variables are integrated of order one i.e.  $I(1)$  at 5 percent level. In other words, non-stationarity hypothesis can be rejected at first difference of the series.

According to AIC and FPE tests, chosen lag length for the VAR model is two (Table 2). Because for small sample size time series AIC and FPE are preferable than SC and HQ criterion (Lüptkepohl, 2005). The order of VEC model automatically set one less than the order of VAR model.

**Table 1: ADF (2) Unit root test**

Variables	Test statistics		Critical value		
	At level	At first difference	1%	5%	10%
$\Delta$ $Y_{t-1}$	1.6099	-3.2137			
$\Delta$ $M_{t-1}$	0.3512	-3.9988			
$\Delta$ $B_{t-1}$	-1.8191	-6.4025	-3.43	-2.86	-2.57

**Table 2: VAR model lag order selection criterion**

Lag	FPE	AIC	SC	HQ
0	.018311	4.51331	4.55908	4.64935
1	.000015	-2.79689	-2.61378**	-2.2527**
2	.000012**	-2.92371**	-2.30328	-1.67138
3	.000023	-2.20815	-1.7504	-.847692
4	.000019	-2.49169	-1.89661	-.723087

\*\* Shows VAR Order which minimizes information criteria

Table 3 presents the results of the Lagrange Multiplier (LM) test which was proposed by Breusch (1978) and Godfrey (1978) and LMF test (with standard F-approximation) tests for VAR model residual serial autocorrelation. According to these tests we fail to reject the null hypothesis of absence of systematic serial autocorrelation up to lag two even at 10% level.

**Table 3: Test for residual autocorrelation up to lag two (LM-type test)**

Lags	LM-Stat		LMF-Stat	
	Statistic	p-value	Statistic	p-value
1	8.4019	0.9720	0.7495	0.6840
2	9.0500	0.43268	1.1820	0.3573

**Table 4: Test for normality**

Equation	Jarque-Bera test		Skewness test		Kurtosis test	
	chi2	Prob > chi2	chi2	Prob > chi2	chi2	Prob > chi2
lnM2	0.498	0.77941	0.386	0.53443	0.112	0.73735
CPI	0.055	0.97275	0.004	0.95137	0.052	0.82043
BDG	6.826	0.03294	1.541	0.21449	5.286	0.02150
Joint	7.380	0.28712	1.931	0.58694	5.450	0.14169

**Table 5: Johansen co-integration test**

Maximum Cointegrating Vector	Eigenvalue	5% critical Value	5% critical Value	5% critical Value	P-value of S&L test	
r = 0	0.50228	114.3554	34.91	88.3910	22.00	0.0015
r 1	0.90827	25.9644	19.96	22.5901	15.67	0.0650
r 2	0.45694	3.3743**	9.42	3.3743**	9.24	0.5045*

\*\* indicates acceptance of null hypothesis at 5% significant level

Normality test based on multivariate version of Jarque Bera tests, skewness test and excess kurtosis test are presented in Table 4. The results shows that the null hypothesis of normality cannot be rejected for M2 and CPI at 5% level while, for BDG we can accept normality assumption only at 1%. In the presence of outlier in the model, failure of Jarque-Bera test is a common

phenomenon, which will not crucially distort final results. But they are jointly normally distributed based on all tests.

Johansen (1995) lambda trace and lambda maximum, Eigen value. and Saikkonen and Lütkepohl (S&L) co-integration tests procedures are applied to determine the number of co-integrating vector. S&L and Johansen test proceeding sequentially from the first hypothesis of zero co-integrating vectors to an increasing number of co-integrating vectors. The results of trace,  $\lambda_{Max}$  and S&L Co-integration test statistics are reported in Table 5. All test statistics indicate that the existence of two co-integrating vector ( $r=2$ ) in the system at 95 percent confidence level.

## 5.2 Vector Error Correction (VEC) Model Specification and Results

In VECM we assume that changes in variables at period  $t$  depends on deviations from equilibrium relationship at period  $t-1$ . Moreover, the model assumes that changes in the variables at time  $t$  depends not only on deviations from the equilibrium relationship, but also on changes in each of the variables at period  $t-1$ .

Since two co-integrating relations are present among money supply, consumer price index and budget deficit to GDP ratio, vector error correction models (VECM) allows us to incorporate the co-integration structure in the model. The VEC model is useful to establish equilibrium relationship among a set of economic variables under consideration. In addition, when there is short term deviation from the long run equilibrium path, the model is also helpful to evaluate the dynamic adjustment towards its equilibrium in the system. The model can be specified as:

$$Y_t = \Pi Y_{t-1} + \alpha_1 Y_{t-1} + \mu + U_t \quad [6]$$

Where,  $Y_t = [ \ln M2_t \quad \ln CPI_t \quad BDG_t ]$ ;  $U_t = [ u_{1t} \quad u_{2t} \quad u_{3t} ]$ ;  $\mu = \text{con}$ ;  $\Pi$  is the long term parameter and  $\alpha_1$  is short term parameter of (3x3) matrix. The long run equilibrium relationship between the variables could be given by:

$$Y_{t-1} = \alpha + \gamma Y_{t-1} = \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{21} & \beta_{31} \\ \beta_{12} & \beta_{22} & \beta_{32} \end{bmatrix} \begin{bmatrix} \ln M2_{t-1} \\ \ln CPI_{t-1} \\ BDG_{t-1} \end{bmatrix}$$

Where,  $\alpha$  is vector of adjustment parameters and  $\gamma$  is cointegrating vector, if  $\alpha \neq 0$ , the co-integrating equation  $Y_t$  is stable and, thus, represents a co-integration relation. To uniquely estimate co-integrating parameters Johansen normalization methodology of identification would be applied.

The matrix  $\alpha$  is adjustment parameter which is sometimes called the loading matrix and it contains the weights attached to the co-integrating relations in the individual equations of the model. In other words it measures the speed of adjustment of the variable towards its long run equilibrium in response to short term deviations. It has an important implication in equilibrium analysis. If all  $\alpha$  coefficients are zero in the equation of a particular variable, that variable is considered as weakly exogenous to the system and hence, doesn't enter in to co-integrating relations. But,  $\gamma$  matrix contains the co-integrating relations or linear transformations of them. For a particular period, the long-term relationship could be expressed as  $Y_{t-1} = \mu + \varepsilon_t$  where  $\varepsilon_t$  is white noise process which represents short term deviations from the equilibrium level. If the equilibrium relationship actually exists, it is reasonable to assume that  $Y_t$  variables move together over time and  $\varepsilon_t$  is stable. Given two co-integrating relations in the system, the long-term relationships among money supply ( $\ln M2$ ), consumer price index ( $\ln CPI$ ) and government budget deficit to GDP ratio (BDG) can be specified as:

$$\begin{bmatrix} \beta_{11} & \beta_{21} & \beta_{31} \\ \beta_{12} & \beta_{22} & \beta_{32} \end{bmatrix} \begin{bmatrix} \ln M2_t \\ \ln CPI_t \\ BDG_t \end{bmatrix} = \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

Without further restriction on co-integrating vectors the long run parameters cannot be identified (Lütkepohl, 2005; Lütkepohl and Krätzig, 2004; Juselius, 2006 and Johansen, 1995). In practice, the estimation of the parameters of a VECM requires at least  $r^2$  identification restrictions. Since



we have two co-integrating vector conventional Johansen restriction methodology require four identification restrictions to be imposed. After normalizing on money supply and consumer price index the long run equations can be expressed as:

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} \beta_{31} \\ \beta_{32} \end{bmatrix} \begin{bmatrix} \ln M2_t \\ \ln CPI_t \\ BDG_t \end{bmatrix} = \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \quad [7]$$

From this the long term equilibrium relationship between money supply and government budget deficit and between inflation and government budget deficit can be expressed as follows:

$$\ln M2_t = -\hat{\beta}_{31} BDG_t + \hat{\varepsilon}_{1t} \quad [8]$$

$$\ln CPI_t = -\hat{\beta}_{32} BDG_t + \hat{\varepsilon}_{2t} \quad [9]$$

Where,  $\hat{\varepsilon}_{1t}$  and  $\hat{\varepsilon}_{2t}$  are stationary disturbance terms and being represents the short term deviations of a particular variable from its long run equilibrium path. If we change the order of variables and impose restriction on consumer price index and budget deficit to GDP ratio the long run equilibrium equation can be expressed as:

$$\ln CPI_t = -\hat{\beta}_{11} \ln M2_t + \hat{\varepsilon}_{1t} \quad [10]$$

$$BDG_t = -\hat{\beta}_{12} \ln M2_t + \hat{\varepsilon}_{1t} \quad [11]$$

The results of estimated VEC model based on Johansen methodology for natural log of broad money ( $\ln M2$ ), natural log of consumer price index ( $\ln CPI$ ) and percentage of budget deficit to GDP ratio ( $BDG$ ) are presented in Table 6 and Table 7 below. In the first case co-integrating vectors are normalized on  $\ln M2$  and  $\ln CPI$  to measure the effect of fiscal deficit on them and hence to obtain their long term equilibrium equations.

**Table 6: VECM result: Johansen normalization restrictions imposed on lnM2 & lnCPI**

	Eigenvectors ( )		
	lnM2	lnCPI	BDG (z-value)
_ec1	1	0	-1.558 (-5.114)
_ec2	0	1	-0.730 (-4.566)
Standardized Adjustment parameters ( )			
	lnM2 (z-value)	lnCPI (z-value)	BDG (z-value)
	-0.090 (-2.443)	0.189 (2.762)	0.864 (1.433)
	0.198 (2.975)	-0.325 (-2.612)	-0.849 (-0.776)
Deterministic term ( )			
	lnM2 (z-value)	lnCPI (z-value)	BDG (z-value)
Constant	0.163 (1.944)	-0.404 [-2.578]	-3.330 [-2.415]
Short term parameters ( )			
	lnM2	lnCPI	BDG
	0.056	0.735**	-1.758
	-0.008	0.132	-1.699
	0.006	0.028	-0.160

**Table 7: VECM result: Johansen normalization restrictions imposed on lnCPI & BDG**

	Standardized Eigenvectors ( )		
	lnCPI	BDG	lnM2 (t-value)
_ec1	1	0	-0.619 [-20.224]
_ec2	0	1	-0.426 [-6.695]
Standardized Adjustment parameters ( )			
	lnCPI (t-value)	BDG (t-value)	lnM2 (t-value)
	-0.199 [-2.594]	-0.637 (-1.266)	-0.132 [-2.749]
	-0.037 [-1.443]	-0.847 [-5.031]	-0.009 [-0.557]
Deterministic term ( )			
	lnCPI (t-value)	BDG (t-value)	lnM2 (t-value)
Constant	-0.575 [-2.688]	-3.514 [-2.509]	-0.232 [-1.742]

\* Indicates statistically significant at 0.1 level & \*\* Indicates significant at 0.05 level

Adjustment coefficient ( $\alpha$  vectors) measures how the variable adjusts towards its equilibrium to correct short term imbalances. In other words, it indicates that whether the variables entered as explanatory variable is weakly exogenous to the system or not and the variable chosen to be explained is endogenous to the system. In the case of first normalization, we fail to reject the weak exogeneity hypothesis for BDG. In other words, there is no feedback effect onto BDG from disequilibrium in both co-integrating relations in the in previous period. But, both money supply growth and inflation are endogenous to the system. This further confirms the existence of at most two co-integration relations in the system. However, in the case of second normalization we fail to accept the weakly exogeneity assumption for all variables.

By normalizing co-integrating vectors on both broad money supply and CPI and taking into account the significance level of long term parameters we can write the long-term equations for  $\ln M2$  and  $\ln CPI$  as follows:

$$\widehat{\ln M2}_t = 1.56 \text{BDG}_t + \hat{\varepsilon}_{1t} \quad [12]$$

$$\widehat{\ln CPI}_t = 0.730 \text{BDG}_t + \hat{\varepsilon}_{2t} \quad [13]$$

The VECM result shows that in the long run government budget deficit to GDP ratio has positive and significant impact on the growth of broad money supply. The sign of the coefficient on budget deficit is as expected and can be interpreted as a unit increase in percentage of budget deficit to GDP ratio on average leads to 1.56 percent per annum increase in broad money supply in the long run. This result is consistent with theoretical framework and the empirical results obtained from other studies. For example, Ignacio (2008) investigated long run relationship among budget deficit; money growth and inflation by using Colombian quarterly data and has found positive relationship between budget deficit and money supply. Petraq (2012) explored the impact of budget deficit on money supply growth and inflation in three transition economies: Albania, Bulgaria and Romania, and has found positive and significant effect of budget deficit on both variables. But in the short run coefficient of budget deficit in money supply equation is not

statistically significant. The fiscal deficit can be financed from domestic and foreign sources. The former includes borrowing from banking and non-banking sectors and direct printing of money. All these have both direct and indirect influences on money supply growth. Government's repayment of both principal and interest on debts in the long run further deteriorates fiscal deficit and hence, increases money supply in the economy. The  $\alpha$  coefficients -0.09 and 0.198 shows that feedback effect of co-integrating relations on money supply. In other words, money supply adjusts itself to correct short term imbalances at rate of 9% and 20% per year for the first and second co-integrating relations.

Budget deficit also has positive and significant long run effect on inflation (Table 6 and Equation 8). Its sign is as expected and compatible with fiscal theory of price level and empirical evidences from other countries (see; Musa, 2014; William and Klaus, 2010; Furrukh, *et al.* 2011; Kivilcim, 2011; Petraq, 2012). The coefficient in inflation equation (13) can be interpreted as 1 percent rise in budget deficit to GDP ratio on average leads to 0.75 percent raise in CPI in the long run. The effect of fiscal deficit on inflation is depends on the interaction of budget deficit and GDP growth. In other words, it has no effect on inflation in the long run, if GDP and fiscal imbalances grow at the same rate. But BDG has null effect on inflation in the short run. The standardized adjustment coefficients ( $\alpha s$ ) on inflation equation show that both co-integrating equations have feedback effect on inflation and hence inflation converges at the rate of 32.5% for the second co-integrating relation and 19% for the first equation.

By reversing the order of variables and imposing Johansen identification restriction on CPI and Budget deficit to GDP ratio we can find long run equations of CPI and BDG as a function of broad money supply. Here our interest is to investigate the impact of broad money supply growth on inflation and government budget deficit to GDP ratio.

The estimated  $\beta$  coefficient (Table 7) shows that money supply growth significantly affects general price level and its sign is as expected. Its value

can be interpreted as on average; one percent rise in money supply induces inflation by 0.62 in the long run, holding other factors constant. This result is compatible with monetarist hypothesis and empirical evidences obtained from other countries (Kivilcim, 2011; Petraq, 2012; Furrukh, *et al.* 2011; Ignacio, 2008; Hoang, 2014; Mehdi and Seyyed, 2013; James *et al.* 2014). For example, Furrukh *et al.* (2011) obtained long run broad money supply coefficient of 0.61 in inflation equation by using Pakistan data; and Mehdi and Seyyed (2013) obtained 0.785, coefficient of money supply in the long run inflation equation from Iran data. The standard adjustment parameters (Table 7) show that inflation fairly converges for the deviant nature of money supply from long run equilibrium. Money supply growth has also positive and significant effect on inflation. The magnitude of short run coefficient is 0.735, which is quite greater than that of long run coefficient.

Budget deficit to GDP ratio increases with broad money supply growth in the long run (Table 7). The coefficient of 0.426 on BDG equation has the expected sign which intuitively seems realistic and it is statistically and economically significant. In particular, 1% rises in money supply on average stimulates percentage of budget deficit to GDP ratio to increase by 0.43 in the long run but its effect in the short run is nil. The adjustment parameters ( $\alpha$ 's) shows that budget deficit is not sensitive for imbalances in the first co-integrating relation but for the second (see Table 7).

### **5.3 Structural Analysis and Model Checking**

#### **Pair wise Granger-Causality**

The term Granger-causality refers to cause and effect relationship between two pairs of variables in the system while, instantaneous-causality only shows none-zero correlation relation between two sets of variables. The result of pair wise Granger and instantaneous -causality tests show that BDG jointly Granger cause money supply and inflation (Table 8). Money supply in turn jointly Granger causes inflation and fiscal deficit to GDP ratio. Budget deficit with money supply also Granger causes inflation. Money supply growth individually Granger causes inflation but not vice versa.

Instantaneous Causality test also supports bi-directional causality between “inflation, BDG” and “money supply growth”; between “BDG. money supply” and “inflation”, and between “money supply growth” and “inflation”, Starting from the highly significant causality test, impulse in money supply helps to improve forecasting of inflation and in turn inflation instantaneous cause money supply growth.

**Table 8: Granger-Causality and Instantaneous Causality test**

Pair Variables	Granger-Causality direction		Instantaneous Causality
	First $\Rightarrow$	$\Leftarrow$ second	$\Leftrightarrow$
"lnM2". "lnCPI" & "BDG"	1.0342	2.0743*	0.0431
"lnCPI". "BDG" & "lnM2"	0.8137	3.2334**	8.2905**
"BDG". "lnM2" & "lnCPI"	3.9987**	0.5914	8.2837**
"lnCPI". "BDG"	1.5221	0.5565	0.0505
"lnCPI". "lnM2"	1.6509	4.1547**	7.8995**
"BDG". "lnM2"	0.6996	1.0984	0.1915

\*\*denotes significance at a 5% level

\*denotes significance at a 10% level

**Table 9: VAR model lag exclusion test**

lag	lnM2-equation		lnCPI-equation		BDG-equation		Jointly	
	chi2	Prob.	chi2	Prob.	chi2	Prob.	chi2	Prob.
1	66.8308	0.000	68.62443	0.000	11.9241	0.008	99.97763	0.000
2	.4874088	0.922	10.99398	0.012	7.5124	0.047	18.37293	0.031

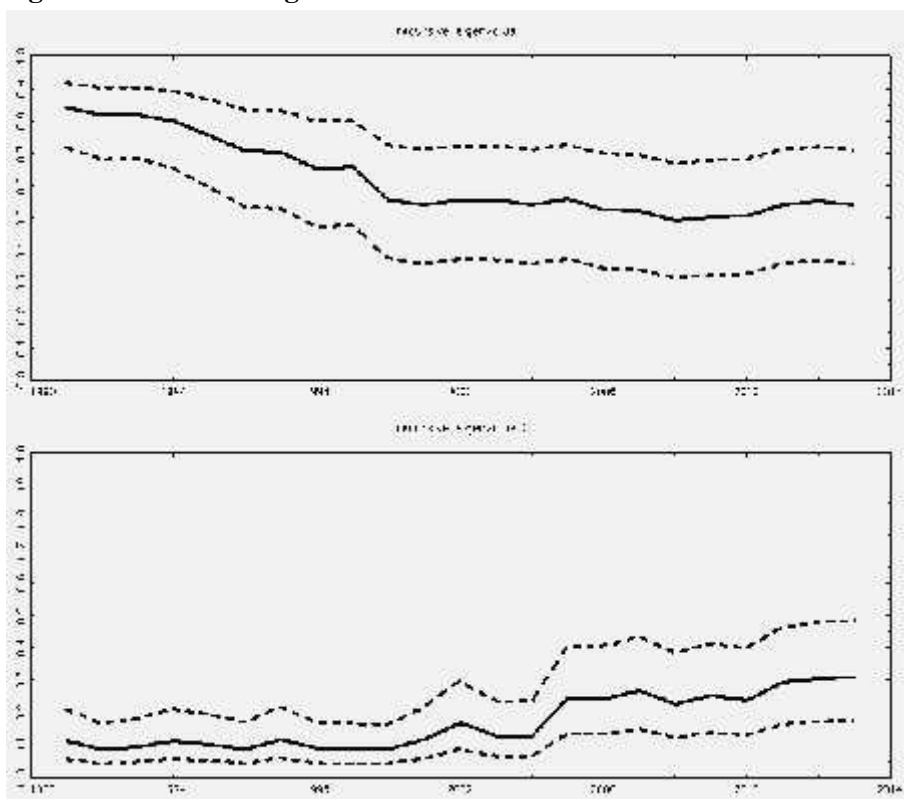
Combined with long run equation, this supports monetarist hypothesis (MH) of ‘inflation is monetary phenomena’. Impulse in budget deficit aids us in predicting money supply growth and inflation jointly but not individually. It is not clear whether budget deficit to GDP ratio directly affects inflation or not. However, budget deficit jointly with money supply aids to improve forecasting of inflation. The shock in budget deficit may transmit to inflation through money supply channel.

### Lag exclusion test

According to Wald lag exclusion test procedure all coefficients of endogenous variables at lag two for all equations are jointly different from zero at 5% level of significance (Table 9). In other words, the lag order of all equations in the system is jointly two.

### Model Stability Analysis

**Figure 2: Recursive eigenvalues with 95% confidence band**



Recursively estimated eigenvalues from VECM model reported with its 95% confidence band (Figure 1) show that the absence of parameter instability over time. Because of both eigenvalues lie within 95 % confidence bands, one can see that the absence of system instability. This diagnostic test shows

that, our econometric model is correctly specified and the results can be used for further analysis.

## **6. Conclusion**

This paper attempted to investigate the causal long-term relationship between broad money supply growth, inflation and budget deficit to GDP ratio in Ethiopia. All the variables are integrated of order one and the system consists of two co-integrating relations. Under such circumstances, vector error correction model (VECM) is appropriate model, since it offers better information compared to other data generating processes. The lag length for VEC model has been chosen at one based on AIC and FPE. Furthermore, the system contains normally and independently distributed random variables and its recursively estimated Eigen values appeared to be stable over time. Ethiopian annual data on broad money supply, consumer price index and budget deficit to GDP ratio from 1975 to 2012 were used in this study.

The results shows that the existence of long-term relationship between money supply and budget deficit in Ethiopia. On average 1% point increase in BDG leads to 1.56 % point raises in broad money supply keeping other factors constant. This is consistent with theoretical framework and it is also compatible with the empirical evidences found from other countries (Ignacio, 2008; Petraq, 2012). However, there is no evidence for its short run effect on money supply. Deficit financing through credit expansion obviously results in increasing money supply. Ethiopian government has been financing its deficit from domestic and foreign borrowing. Both are potentially affects money supply growth in the long run. Direct Advance from National Bank of Ethiopia takes the lion share of domestic borrowing (for example. 67.2% in 2011 and 58.5% in 2012) which has been directly contributed to money supply growth and it accounts 32% and 25% of broad money supply in 2011 and 2012 respectively (see MoFED. 2012). But. Granger causality analysis shows that the effect of budget deficit on money supply growth is only marginally significant at 90% confidence level.



On the other hand, in the long run budget deficit also significantly affects inflation. On average one point rises in percentage of budget deficit to GDP ratio induces inflation by 0.73 point in the long run keeping other things remain constant. This result is in line with the hypothesis of fiscal theory of price level. However, in the short run its effect on inflation is not significant. Granger causality analysis also shows that budget deficit not individually directly causes inflation but jointly with money supply it causes inflation in the economy. This indicates budget deficit affects inflation through money supply Channel. Therefore, the direct effect of budget deficit on inflation Ethiopia is not conclusive and needs further investigation.

In the long run growth of broad money supply significantly influences inflation. On average one percentage point rise in broad money supply leads to 0.62 percent rise in consumer price index in Ethiopia, keeping other factors constant. In the short run, inflation also influenced by monetary expansion (on average a percent rise in money supply induces 0.735 percent in inflation). This result is also supported by granger and instantaneous causality analysis. From these results, one can conclude that inflation in Ethiopia is more of monetary phenomenon. Since, there is instantaneous causality between inflation and money supply; increase in money supply induces inflation and this in turn further increases money supply and so on. Broad money supply has also positive effect on budget deficit in the long run. However, structural granger causality analysis doesn't support this statement. In the long run expansionary monetary policy aggravates fiscal imbalances and hence responsible for macroeconomic instability in Ethiopia.

As reviewed earlier, fiscal deficit, money supply and inflation in Ethiopia are interlinked in the long run. Budget deficit has contributed to money supply growth, monetary expansion has exerted inflationary pressure in the economy, and inflation in turn has been putting pressure on fiscal deficit. Hence, it is to be suggested that budget deficit in Ethiopia should be properly managed; ensuring transparency and accountability in fiscal operation; improving domestic resource mobilization, proper planning of government budget, reducing government expenditure on non productive activities and

improving domestic revenue collection, administration system, broadening tax bases and prioritizing projects and activities. These may reduce inflationary pressure of fiscal deficit in the country. The most important to combat inflation in Ethiopia is monetary policy operation. The effectiveness of monetary policy in controlling inflation requires National Bank Ethiopian to possess some degree of autonomy. In addition to this, monetary authorities required to tightening monetary policy without affecting economic growth; adjusting money supply growth with GDP; ensuring fiscal and monetary policy coordination; improving the capacity of National Bank to properly manage financial sectors operation, increase reserve requirement, improving credit market operation.

The magnitude of causal long-term relationship among budget deficit, money supply growth and inflation could vary depending on the type of fiscal and monetary-policy regime, monetization and openness of the economy, as it has been explored in other studies. However, these issues are not covered in this study and open to further research in Ethiopia.

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