

The Relationship between Inflation, Money Supply and Economic Growth in Ethiopia: Co integration and Causality Analysis

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Abstract- The Ethiopian Economy has the feature of low and stable inflation before the period 2002/03. However, in the post 2002/03 period continues rise in the prices level along with rapid economic growth has been emerged. On the basis of this situation, this study has examined the existing causal relationship between inflation and money supply and between inflation and economic growth in Ethiopia for the period 1970/71-2010/11. The Johansen co integration test indicates the presence of one co integrating vector and the VECM demonstrate that the existence of long run bi-directional causality between inflation and money supply and uni-directional causality from economic growth to inflation. In the short run one way causality were found from money supply and economic growth to inflation. Therefore, the key findings of the study are inflation is a monetary phenomenon in Ethiopia and inflation is negatively and significantly affected by economic growth. Thus, based on the results of the study, monetary policy should be planned to maintain price stability by controlling the growth of money supply in the economy. Also combined efforts should be made by policy maker to increase the supply of output so as to reduce the prices of goods and services and boost the growth of the economy.

Index Terms- Inflation, Money supply, Economic growth, Causality.

I. INTRODUCTION

After the downfall of the military government in 1990/91, the current government of Ethiopia implemented stabilization and structural adjustment program with the help of the IMF and the World Bank (ADB, 2000). The aim of the program was to abolish price distortions, improve market related incentives, encourage private enterprises and exports, and liberalize the economy and to reduce the role of the public sector in the economy. Then a private led competitive economy operating under a free market and prudent fiscal and monetary policy environments was expected to emerge from this program (Minale, 2002). With this stabilization and structural adjustment program, inflation remained low for most of the periods following the adjustment program as the inflation level of the past.

Following the expansionary economic policies (such as increased public expenditure and money supply) followed by the government and National Bank of Ethiopia (NBE), resulted in

improvements in various macroeconomic indicators including high economic growth (Alemayehu and Kibrom, 2008). Between the periods 2003/04-2010/11, the annual average real GDP growth rate was 11.5 percent (NBE, 2012). At the same time, sharp and persistence rise in the general price level in the economy has emerged as an important macroeconomic problem all over the country in the post 2002/3 period.

When we look at the developments in the monetary aggregate of Ethiopia, the broad money supply has been increased from birr 34.7 billion in 2002/03 to birr 145.4 billion in 2010/11 with annual average growth rate of around 22 percent ('Birr' is the official currency unit of Ethiopia). The share of broad money as a percentage of GDP has shown a marked increase from 42.7 percent in 2002/03 to 56.7 percent in 2006/07 and latter on declined to 29.1 percent in 2010/11 (NBE, 2012). In the fiscal front both the government revenue and expenditure has increased from birr 15.7 billion and 20.5 billion in 2002/03 and reached 85.6 billion and 93.8 billion birr respectively in 2010/11 (MoFED, NBE, 2012). As we observe here, there has been a huge increase in government expenditure and the money supply as well.

In order to understand the causal relationship between inflation, money supply and economic growth researchers have exert many effort. However, the existing empirical literatures are far from reaching conclusive agreement on the precise relationship between inflation and money supply and between inflation and economic growth. However, there is also controversy on the direction of causality between money supply and inflation despite the strong positive correlation between them. Thus, the purpose of this study is therefore to examine the causal relationship between inflation and money supply and between inflation and economic growth in Ethiopia.

Empirical studies on the possible sources of the inflationary situation in Ethiopia indicated that, the fast increase in broad money supply, the widening of public budget deficit and the mechanism of financing it, the rise in price of oil and food items and other as the causes of the price surge (ADB, 2011; Jema and Fekadu, 2012; Desta, 2009; Alemayehu and Kibrom, 2008). While the government on the other hand argues that structural factors that is, the hoarding of goods by traders (piling up stocks), rapid economic growth, the rise in oil and food prices are the possible sources of inflation in the country (Jema and Fekadu, 2012). In sum, there is no consensus on why Ethiopia is

currently facing varying food and non food inflation while the economy is registering rapid growth.

Therefore, in this situation it is interesting to understand the causal relationship between inflation and money supply on one hand and inflation and economic growth on the other hand. However, in the context of Ethiopia, the relationship between inflation and money supply as well as the repercussion of inflation on economic growth or vice versa is not well studied. To the best of the researcher knowledge, there have been little empirical studies done on the causal relationship between inflation, money supply and economic growth in the country. Wolde-Rufael, (2008) tried to investigate the causal link among inflation, money and budget deficits for the period 1964 to 2003 using the bounds test approach to co integration and a modified version of the Granger causality test. While, Fekadu, (2012) analyzed the relationship between inflation and economic growth for the period 1980-2011 using Vector Auto regression (VAR) model. Unlike these studies, in this paper the causal relationship between inflation and money supply and between inflation and economic growth is examined by using tri-variate Vector Error Correction Model (VECM) for the period 1970/71-2010/11.

Thus, the main objective of the study was to empirically analyze the causal relationship between inflation and money supply and between inflation and economic growth in Ethiopia for the period 1970/71-2010/11. Specifically this study tried to address: the long run relationship between inflation, money supply and economic growth; examine whether money supply and economic growth causes inflation; and whether inflation causes money supply and economic growth.

The rest of the paper is organized as follows. The next section provides review of empirical literature. This is followed model specification and methodology section. The penultimate section presents the empirical results. The concluding and policy implication section ends the paper.

II. A BRIEF REVIEW OF THE LITERATURE

For monetarists inflation is purely a monetary phenomenon. They argued that a sustained increase of aggregate prices in an economy is caused by the excessive rate of expansion of the supply of money. According to this argument the direction of causality should run from money supply to aggregate prices. On the other hand, other school of thought like structuralists' school challenged "inflation is purely a monetary phenomenon" and argued that the excessive money supply is a consequence rather than cause of inflation particularly in developing countries, i.e., the direction of causality runs from inflation to money supply (Tang, 2008). Similarly, there is also a debate on the relationship between inflation and economic growth. No conclusive theoretical argument for either a positive or a negative association and directional causal link between inflation and economic growth. To solve these controversies different research was conducted but there is no much empirical consensus on the relationships between inflation – money supply and inflation – economic growth.

Kesavarajah and Amirthalingam, (2012) examined the nexus between money supply and inflation in Sri Lanka over the period 1978 to 2010. They employed Johanson and Juselius multivariate cointegration test and Granger causality test to

estimate the long run equilibrium relationship among the variables. The result indicates the presence of long run relationship among the variables and the Granger causality test indicates there was a significant causality from money supply to inflation in Sri Lanka. While, Gunasinghe, (2007) analyzed the causal relationship between inflation and economic growth in this country using Granger causality. The result reveals that causality runs from inflation to economic growth for the period 1960-2005. Mallik and Chowdhury, (2001) analyzed the short-run and long-run dynamics of the link between inflation and economic growth for four South Asian economies: Bangladesh, India, Pakistan, and Sri Lanka by applying cointegration and error correction models by using annual data. The result revealed that, there is positive and statistically significant relationship between inflation and economic growth for all four countries and the sensitivity of growth to changes in inflation rates is lower than that of inflation to changes in growth rates.

Amin, (2011) studied "Quantity Theory of Money and its Applicability" in the case of Bangladesh using Johansen cointegration method; the empirical findings indicate the existence of long run cointegrating relationship between money supply and inflation. The Granger causality test, revealed a unidirectional causal relationship running from money supply to inflation which provides evidence in support for quantity theorist's view. Ahmed and Mortaza, (2005) empirically investigated the relationship between inflation and economic growth in this country, using annual data set on real GDP and CPI for the period of 1980 to 2005, and the co-integration and error correction models. The empirical evidence indicates that there exists a statistically significant long-run negative relationship between inflation and economic growth for the country as indicated by a statistically significant long-run negative relationship between CPI and real GDP.

Abbas and Husain, (2006) examined the causal relationship between money and income and between money and prices in Pakistan. Their cointegration analysis indicates that the existence of long run relationship among money, income and prices. The causal relationship between money and prices indicated a bi-directional causality that money expansion increases price level and inflation in turn increases the money supply in Pakistan.

Chuan-Yeh, (2012) investigated the causal relationship between inflation and economic growth using a broad cross-country data from 140 countries over the period 1970-2005. The results indicated that, inflation retards growth, whereas the effect from growth to inflation is beneficial. Moreover, he divided the cross national dataset in to low income, developing, and high income countries, and the results revealed that, the negative impact of inflation on growth in low income countries is greater than in developing and high income countries. On the other hand, he exploited the difference in effect of growth on inflation in different income level countries. Higher economic growth cannot result in improvement of inflation in high and low income countries. On the contrary, rapid economic growth induces higher inflation in low income sample countries.

In Africa, Chimobi and Uche, (2010) studied the relationship between Output, Money and Inflation in Nigeria by employing Cointegration and Granger-causality test analysis. Their findings revealed non-existence of a cointegrating vector in the series used. Money supply was found granger cause both output and

inflation. The result implies that monetary stability can contribute towards price stability in the Nigerian economy. However, Umaru and Abdulrahan, (2012) investigated the impact of inflation on economic growth and development in Nigeria between 1970-2010 through Granger causality test of causation between GDP and inflation. The results of Causality suggest that GDP causes inflation and not inflation causing GDP and it also revealed that inflation possessed a positive impact on economic growth through encouraging productivity and output level and on evolution of total factor productivity. Salami and Kelikume, (2010) estimated the inflation threshold for Nigeria and found 8 percent over the period 1980-2008, beyond this optimum point inflation becomes unfavorable to growth.

Tabi and Ondoa, (2011) analyzed the relationship between economic growth, inflation and money in circulation in Cameroon using a VAR model for the period 1960-2007. They found that increase in money supply increases growth and that growth causes inflation; however, an increase in money supply does not necessarily increase inflation.

In Tanzania Ailkaeli, (2007) studied Money and Inflation Dynamics in Tanzania. He used GARCH model on seasonally adjusted monthly data for the period 1994-2006 and the results of the study shows that, a current change in money supply would have impact on inflation rate significantly in the seventh month ahead. Additionally the effect of money supply on inflation is not a sort of one-time strike on inflation but a kind of persistent shock. Similarly Odhiambo, (2011) analyzed the short-run and long-run causal relationship between Economic growth, investment and inflation in Tanzania using the ARDL-bounds testing approach. The findings of the study indicate unidirectional causal flow from inflation to economic growth without any feedback response.

Empirical Studies in Ethiopia

Literature regarding inflation, money supply and economic growth in Ethiopia is scanty. Most of the studies focus on the sources and impacts of the current inflation level in the country. The methodologies of some of the studies are theoretical description and individual argumentations.

Teshome, (2011) studied the source of inflation and economic growth in Ethiopia using statistical analysis. According to him, between the year 2004 and 2008 the higher desires to spend and higher import price with slow growth of aggregate supply contributed to inflation in the country. He states that, inflation in Ethiopia is not a monetary phenomenon, and to him controlling money supply to reduce inflation will hinder growth of the economy. In addition to this, stopping the injection of money to the economy can't stop inflation due to high velocity of money caused by growth of financial institution and economic transaction in the economy. In part of the study he mentioned that, it is difficult to specify the exact relationship between inflation and growth and one must study the structure of government spending and the nature of economic growth.

Desti, (2009) stated that, there was an increase in broad money supply in Ethiopia and bank credit has been increased. From 2002 to 2006, Ethiopia's real GDP increased by 6.8 percent. Rather than adjusting the money stock with the change of GDP, the country's money supply grown by about 18 percent, contributing to an average 12 percent increase in the rate of

inflation. He also argues that if a nation achieves full employment, it is possible to assume that economic growth is likely to precipitate an inflationary situation. However, Jema and Fekadu, (2012) analyzed determinates of the recent soaring food inflation in Ethiopia and stated that, in Ethiopia food price accounts for the lion's share of the Consumer Price Index. This results in food price inflation necessitating general inflationary pressures in the economy both directly and indirectly. Moreover, food prices increased even faster than non-food items that made it the main contributor to high general inflation.

Wolde-Rufael, (2008) investigated the causal link among inflation, money and budget deficits for the period 1964 to 2003 using the bounds test approach to cointegration and a modified version of the Granger causality test. To check the robustness of the bounds test, he also used two additional long run tests: the dynamic ordinary least squares and the fully modified ordinary least squares (FMOLS). He found that, there was a long run cointegrating relationship among the series with a unidirectional Granger causality running from money supply to inflation and from budget deficits to inflation. He concluded that, the control of the money supply is essential policy tools for the long-run macroeconomic stability of Ethiopia. Fekadu, (2012) analyzed the relationship between inflation and economic growth in Ethiopia for the period 1980-2011. The Vector Auto regression (VAR) model showed that, an increase in economic growth decreases inflation whereas inflation does not have significant effect on economic growth in the short run. The Granger Causality test showed that, economic growth has forecasting power about inflation while inflation does not have predicting power about economic growth. The Cointegration test indicates that, there exist a long run relationship between economic growth and inflation in Ethiopia. Vector error correction estimates indicated that, economic growth significantly reduces inflation in short run while inflation does not have any significant effect on economic growth.

III. RESEARCH METHODOLOGY

Type and Sources of Data

This study entirely used secondary data sources covering the year ranged from 1970/71 to 2010/11. Data are collected from Ministry of Finance and Economic Development (MoFED) and National Bank of Ethiopia (NBE). The data set includes Real Gross Domestic Product (RGDP), Money Supply (M2 or broad money supply) and Consumer Price Index (CPI).

Consumer Price Index (CPI): is the Ethiopian consumer price index and it measures changes in the prices of basket of goods and services that households consume. Such changes have an effect on the real purchasing power of consumers' incomes and their welfare. When the prices of different goods and services vary by different rate, a price index can only reflect their average movement. A price index is usually given a value of unity, or 100, in some reference period and the values of the index for other periods of time are intended to show the average proportionate or percentage change in prices from this price reference period. CPI is expressed in averages of the year in the data.

Money Supply (M2): traditionally, money supply is defined from its narrow and broader sense. Narrow money (M1)

is a measure of money stock intended primarily for use in transactions. It consists of currency held by the public, traveler's checks, demand deposits and other checkable deposits. Broad money (M2) is a measure of the domestic money supply that includes M1 plus Quasi-money (savings and time deposits), overnight repurchase agreements, and personal balances in money market accounts. Mostly, M2 includes money that can be quickly converted to M1. The NBE takes the broader definition of money or M2 as money supply and in this study also this definition of money is used as money supply and measured in local currency.

Real Gross domestic product (RGDP)_t: is aggregate measure of the size of an economy adjusted for price changes. Gross domestic product (GDP) is the value of all final goods and services produced in the country for a given period of time measured in local currency. The market value of GDP depends on the actual quantity of goods and service produced, and their price. The actual quantity of goods produced some times is called the volume. Therefore, RGDP was used to capture the overall economic performance.

Model Specification

The quantity theory of money (QTM) relates a direct and proportional relationship between money supply and price level. The modern versions of this theory are often associated with Irving Fisher, (1911), it measures expenditures in two different ways and arise with these two identities (Alimi, 2010):

$$\begin{aligned}
 Y &= MV & [1] \\
 Y &= py & [2] \\
 \text{Hence} \quad MV &= py & [3]
 \end{aligned}$$

Where: y is real output (of commodities); P is price level (i.e. the average price of commodities); Y is nominal value of output (= nominal output); M is money supply; V is velocity of circulation of money

Fisher recognized equation (3) as an identity and he forward assumptions to transform the quantity of equation to the theory of prices determination. The quantity theory of equation (QTM) can be rewritten in terms of percentage rate of change (in terms of growth rates):

$$m_t + v_t = p_t + y_t \quad [4]$$

Where p is the logarithm of the price level, y is logarithm of real output, m is the logarithm of money supply, and v is the logarithm of the velocity of money.

Assuming the velocity of money is constant; the inflation equation can be specified by taking three variables in to account: consumer price index (CPI), Money supply (M2) and real GDP. Many works treat real output and the quantity of money (and their growth rates) as exogenous variables (see for example Alimi, (2010)).If the monetarist theory of inflation is true, the following relationship holds in the long run.

$$\begin{aligned}
 LCPI_t &= \alpha + \beta_1 LM2_t + \beta_2 LRGDP_t + \varepsilon_t \beta_1 \\
 &= 1 \quad \beta_2 = -1 \quad [5]
 \end{aligned}$$

Where α is the constant term, β_i 's are the coefficients of the respected variables to be estimated, LCPI is logarithm of consumer price index, LM2 is logarithm of money supply, LRGDP is logarithm of real GDP and t is the time period. The residual ε_t is assumed to be white noise.

The consumer price index (CPI) used as a proxy for inflation rate(INF), broad money(M2) used as a proxy for money supply and Real Gross Domestic Product(RGDP) used as a proxy for Economic growth. The three variables are transformed to logarithmic form to obtain LCPI, LM2 andLRGDP respectively over the period 1970/71-2010/11. Transforming data to logarithmic form have advantage of smoothing data distribution to some extent and makes data to have better goodness of fit for non-linearity. The most important is taking the difference of variables can obtain their respective change rate (Xiao, 2009). The above proxy for inflation, money supply and economic growth were used in the study of Alimi, (2010) and many others to determine the relationship between Inflation, Money supply and Economic growth.

IV. EMPIRICAL RESULTS

This paper employed tri-variate Granger causality test with Vector Error Correction Model (VECM) framework of the analysis on the causal relationship between inflation money supply and economic growth in Ethiopia. In this analysis the direction of causality between inflation and money supply; and between inflation and economic growth is determined.

The results in table 2 indicate that all the variables were non-stationary in levels. This can be seen by comparing the P-values of both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) test statistic with 1%, 5% and 10% level of significance. The results of this table show strong evidence of non-stationary in level and it is adequate to conclude that there is a unit root in the variables at level. Therefore, to make all the variables stationary all of them were differenced once and the ADF and PP test were conducted, and the result is given in table 3.

Table 1: Definition of Variables

Variable	Definition
Log of Consumer Price Index (LCPI)	It is a weighted average of the percentage price changes for a specified set (basket) of consumer products.
Log of Money Supply (LM2)	It includes Narrow Money (M1) ¹ plus Quasi-Money (Savings and Time deposits), overnight repurchase

Log of Real Gross Domestic product (LRGDP) agreements, and personal balances in money market accounts.
Real GDP is measured as Gross Domestic Product at market prices based on constant national currency.

This table provides the definition of the variables used in the analysis. ¹ Narrow money (M1) includes currency held by the public, traveler’s checks, demand deposits and other checkable deposits.

Table 2: Unit Root Test for Stationary at Level

ADF test		LCPI	LM2	LRGDP
None	Test statistic	5.0664	4.6178	4.1736
	P-Value	1.0000	1.0000	1.0000
Intercept	Test statistic	0.3493	1.1608	4.0781
	P-Value	0.9781	0.9973	1.0000
Intercept and trend	Test statistic	-1.4965	0.6450	1.5789
	P-value	0.8142	0.9994	1.0000
PP test				
None	Test statistic	4.2104	11.6824	3.8588
	P-Value	1.0000	1.0000	0.9999
Intercept	Test statistic	0.1714	1.3721	6.2798
	P-Value	0.9673	0.9986	1.0000
Intercept and trend	Test statistic	-2.0077	-0.1233	1.6095
	P-value	0.5795	0.9927	1.0000

Source: Authors Estimation using e-view 6.

Note:(*), (**) and (***) denotes rejection of the null hypothesis at 1%, 5% and 10% level of significance.

Table 3:Unit Root Test for Stationary at First Difference

ADF test		LCPI	LM2	LRGDP
None	Test statistic	-3.3477	0.0788	-1.0946
	P-Value	0.0014*	0.7018	0.2431
Intercept	Test statistic	-4.9047	-4.5305	-2.0642
	P-Value	0.0003*	0.0008*	0.2596
Intercept and trend	Test statistic	-4.8505	-4.6724	-6.6018
	P-value	0.0019*	0.0030*	0.0000*
PP test				
None	Test statistic	-3.4424	-0.2144	-3.6788
	P-Value	0.0010*	0.6026	0.0005*
Intercept	Test statistic	-4.9029	-4.9242	-4.7787
	P-Value	0.0003*	0.0003*	0.0004*
Intercept and trend	Test statistic	-4.8545	-5.0244	-6.0250
	P-value	0.0018*	0.0012*	0.0001*
Order of Integration		I(1)	I(1)	I(1)

Source: Authors Estimation using e-view 6 Software.

Note:(*), (**) and (***) denotes rejection of the null hypothesis at 1%, 5% and 10% level of significance.

Table 3 shows that all the variables were stationary at first difference. Therefore based on this result, the null hypothesis of unit root is rejected and it is safe to conclude that, all the variables become stationary at first difference and they are integrated of order one I(1).

Granger causality test, co integration and Vector Error correction Model (VECM) are usually preceded by a test of optimal lag length due to the estimated results are affected by the number of lag included. So, we must determine the maximum lag length before estimating the models and the standard Granger

causality test. In this study, the sequential modified LR test statistic (LR), Final Prediction Error (FPE), Akaike Information Criteria (AIC), Schwarz Information Criterion (SC) and the Hannan-Quinn Information Criterion (HQ) are employed to determine the optimal lag length. These lag length selection

criteria are given automatically by E-Views 6.0 econometrics software package to specify the maximum number of lags. Therefore, as Table 4 reveals that from lag length selection analysis lag length of 1 is optimal for series at level in all of the above types of criteria.

Table 4:Lag Order Selection Criterion

VAR Lag Order Selection Criteria						
Endogenous Variables: LCPI, LM2 and LRGDP						
Sample: 1970/71-2010/11						
Included Observations: 35						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-22.3533	NA	0.0007	1.3344	1.4637	1.3804
1	162.2821	330.4001*	7.39e-08*	-7.9096*	-7.3925*	-7.7256*
2	165.4720	5.2046	1.01e-07	-7.6038	-6.6988	-7.2818
3	175.0123	14.0593	1.01e-07	-7.6322	-6.3394	-7.1722
*indicates Lag order selected by the criterion						
LR: Sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike Information Criterion						
SC: Schwarz Information Criterion						
HQ: Hanna-Quinn Information Criterion						

Source: Authors Estimation using e-view 6 Software.

Granger causality test is undertaken here to have the idea about the causal relationship between inflation and money supply and between inflation and economic growth. Since all the variables are found to be I (1), the test is applied to the first differenced variables.

Table 5:Pair-wise Granger Causality Test between DLCPI, DLM2 and DLRGDP

Lags	Null Hypothesis	Obs.	F-stat.	Prob.
1	DLM2 does not granger cause DLCPI	39	4.5196	0.0404*
	DLCPI does not granger cause DLM2		0.3512	0.5570
1	DLRGDP does not granger cause DLCPI	39	4.2947	0.0455*
	DLCPI does not granger cause DLRGDP		1.0704	0.3545
1	DLRGDP does not granger cause DLM2	39	0.8356	0.3667
	DLM2 does not granger cause DLRGDP		1.8161	0.1862

Source:Authors Estimation using e-view 6 Software.

Note:(*) denotes rejection of the null hypothesis at 5% significant level

DLCPI: First Difference of Logarithm of Consumer Price Index, DLM2: First Difference of Logarithm of Money Supply, DLRGDP: First Difference of Logarithm of Real Gross Domestic Product

Granger causality test result presented in table 5 reveals money supply granger causes inflation that the null hypothesis money supply does not granger cause inflation is rejected at 5 percent level but inflation does not granger cause money supply. Therefore this result indicates that causality running from money supply to inflation. The implication of the result is that money

supply growth has valuable information in forecasting the values of inflation in the short run.

In table 5 the null hypotheses that economic growth does not granger causes inflation is rejected at 5 percent level of significance. However, the reverse is not rejected indicating that is economic growth which causes inflation and not the other way round. This implies that economic growth significantly suggest something about short run behavior of inflation rate while inflation rate does not predict anything about the short run properties of economic growth in Ethiopia.

Table 6: Co integration Test Result

Sample: 1970/71 to 2010/11 Sample (Adjusted): 1972/73 to 2010/11 Included Observations: 39 after adjustments Trend Assumption: Linear Deterministic Trend Series: LCPI LM2 LRGDP Lags Interval (in first differences): 1 to 1				
Unrestricted Co-integration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigen value	Trace statistic	0.05 critical value	Prob. **
None*	0.4321	37.2937	29.7971	0.0057
At most 1	0.2683	15.2255	15.4947	0.0549
At most 2	0.0750	3.0401	3.8415	0.0812
Trace test indicates 1 cointegrating equation(s) at the 0.05 level. (* denotes rejection of the hypothesis at the 0.05 level. (**) Mackinnon-Haug-Michelis (1999) p-values.				
Unrestricted Co-integration Rank Test (Maximum Eigen value)				
Hypothesized No. of CE(s)	Eigen value	Max-Eigen Static	0.05 critical value	Prob. **
None*	0.4321	22.0681	21.1316	0.0368
At most 1	0.2683	12.1855	14.2646	0.1039
At most 2	0.0750	3.0401	3.8415	0.0812
Max-Eigen value test indicates 1 cointegrating equation(s) at the 0.05 level. (* denotes rejection of the hypothesis at the 0.05 level (**) Mackinnon-Haug-Michelis (1999) p-values				

Source: Authors Estimation using e-view 6 Software.

Based on the results of Johansen cointegration test which is presented in table 6, the trace test reveals the existence of one cointegrating equation at 5 percent level of significance and the maximum Eigen value test also confirms the result. Therefore, it is safe to conclude that these two variables (LM2 and LRGDP) are individually cointegrated with aggregate price level. Thus, aggregate price, money supply and real output have long run equilibrium relationship between them. As the variables are cointegrated and the objective of this study is to examine the relationship of aggregate price to money supply and RGDP the cointegrating vectors are normalized by aggregate price (LCPI).

The normalized coefficients of long run relationship in table 7 show that long run effect of money supply on aggregate price is positive and statistically significant at 1 percent level. Inflation level will increase by 1% if money supply increases by 3.4734%, hence the direction of relation is positive. On the other hand, RGDP is negatively related to aggregate price in the long run and it is statistically significant at 1 percent level. The general price level decreases by one percent as far as economic growth increase by 12.8910%. Clearly this finding is consistent with the monetarist view that in the long run keeping output constant hence only change in money supply will lead to price change.

Table 7: Normalized Cointegration Coefficients: 1 Cointegrating Equation

LCPI	LM2	LRGDP
1.0000	3.4734* (0.6706) [5.1795]	-12.8910* (2.5378) [-5.0796]

Note: *denotes rejection of the null hypothesis at the 1 percent level of significance and Standard error in () and t-statistic in []

VECM Test Results

Since the cointegration test confirmed the existence of long run relationship among the variables, the vector error correction

model helps to estimate the short run relationship and the speed of adjustment towards long run equilibrium.

Table 8: Summary Results of Causality Test using VEC

Independent Variable	DLCPI	DLM2	DLRGDP
ECTcpi-1	-0.0157	-0.0857	-0.0086
t-value	1.8129	-4.5643	-0.105
t-prob.	0.0728**	0.0001*	0.9166
DLCPI-1	0.1333	-0.0079	0.0402
t-value	0.9372	-0.0896	0.728
t-prob.	0.3509	0.9288	0.4729
DLM2-1	0.2168	-0.0845	0.1789
t-value	2.1063	-0.5347	0.9644
t-prob.	0.0380**	0.594	0.3372
DLRGDP-1	-0.7729	-0.2383	0.1759
t-value	-3.1156	-1.5423	0.9696
t-prob.	0.0024*	0.1261	0.3345
Constant	0.0354	0.1594	-0.0101
t-value	0.9201	6.6486	-0.3588
t-prob.	0.3597	0.0001*	0.7205
R-Squared	0.4078	0.414	0.241
Adj. R-Squared	0.336	0.3451	0.1517
F-Statistics	5.6819	6.087	2.6999

Source: Authors Estimation using e-view 6 Software.

Note: (*) and (**) denotes significance of the p – value at 1% and 10% significance level

ECT: Error Correction Term

Based on the results of Vector Error correction Model (VECM) from the table 8, the error correction term in LCPI equation is weakly significant at 10 percent level and has a negative sign, implying that there exists a long run relationship running from money supply and economic growth to inflation. The speed of adjustment of any disequilibrium toward long run equilibrium is that about 1.57 percent of the disequilibrium in inflation is adjusted each year. The degree of adjustment mechanism is not powerful. The coefficient of error correction term with money supply as dependent variable is observed to be statistically significant at 1 percent level, indicating that there exists a strong long run relationship running from inflation and economic growth to money supply. Contrary the error correction term of RGDP as dependent variable was observed to be statistically insignificant, implying non existence of long run causality was observed from inflation and money supply to economic growth. Therefore from table 8 there exist bi-directional granger causal relationship between inflation and money supply and uni-directional granger causal relationship from economic growth to inflation in the long run.

V. CONCLUSION

This study has attempted to analyze the causal relationship between inflation and money supply and between inflation and economic growth in Ethiopia and the tri-variate Granger causality with VECM method of analysis was used. The

Johansen co integration test shows that aggregate price, money supply and real GDP are co integrated. This implies that the variables have long run equilibrium relationship. Following the co integration result, VECM is formed and the result indicates that there is bi-directional causal relationship between inflation and money supply and uni-directional granger causal relationship from economic growth to inflation in the long run.

In the short run the model indicates the presence of uni-directional causality from money supply to inflation. The finding that money supply causes inflation implies that the monetarist view exists in Ethiopian economy. The monetarist argued, to the extent that monetary expansion is not accompanied by expansion from production sector of the economy, the supply of money will have a direct effect on inflation. A number of recent studies that looked on inflation and money growth over long periods found strong relationship between growth rates of the money supply and of the price level for countries with high inflation rates. On the other hand, there is no reverse causation from inflation to money supply. In addition to inflationary way of financing different public investment by the government of Ethiopia has contributed to the current inflation.

The model also reveals economic growth has negative effect on inflation in the short run. If the basic sources of economic growth are noninflationary like increase in production and productivity, economic growth reduces inflation. However, if economic growth comes from sources which increase money supply above the real output, it creates problems of too much

money chasing too few goods which in turn results inflation. Economic growth must decrease inflation because the more goods are produced, the lower the prices of goods. This association between the level of production and the level of prices also holds for economic growth and inflation rate. If the growth rate of real GDP increases and the growth rates of money supply and velocity of money are kept constant, the growth rate of the price level must decline. But the growth rate of the price level is just another term for the inflation rate; therefore, inflation must decline. An increase in the rate of economic growth means more goods for money to chase, which puts downward pressure on the inflation rate. However, this can be hold if the underlying source of economic growth is productivity or supply growth.

Further there is no causation from inflation to economic growth and this finding is similar with Sidrauski's model. Nevertheless, Sidrauski's result seems to have little significance in explaining the current situation of the country. Furthermore, like many other developing economies, the economy of Ethiopia is a dual economy in which the traditional sector is the most dominate since majority of the population live in this sector. Therefore, due to this the increase in inflation rate does not seem to affect the output of the traditional sector which constitutes a large share in GDP. This is due to the fact that the economic activity of this sector is highly determined by exogenous factors. This might be another reason why no significant causation is found from inflation to economic growth at least in the short run.

Policy Implications

The results support monetarist view that is inflation is a monetary phenomenon and other similar results were found in Ethiopia. On the basis of the present study result, reduction of money supply can result in reduction of inflationary pressure in Ethiopia. Therefore, the National bank of Ethiopia needs to exercise tight monetary policy. Although the empirical evidence shows the change in money supply causes inflation, it does not mean that the implementation of tight monetary policy alone is effective anti-inflationary instrument. Because based on the negative causal effect of economic growth on inflation, supply-side policy can also be appropriate to contain inflation.

In Ethiopia, there is fast economic growth as well as high level of inflation at the same time. Hence it is essential to identify the possible sources of the country's current economic growth and inflation. If the sources of growth are dominated by inflationary way of financing different public investments, this exacerbates the problems of high inflation existing in the country by creating more money than real output in the economy. Therefore combined effort should be made by policy makers to increase the level of output and supply so as to reduce inflation in Ethiopia.

The robustness of the study result is delimited by the inter play of macro-economic factors such as interest rate, rate of saving, rate of investment, budget deficit, exchange rate, export and import. Here, in this study, the pure causal relationship between inflation, money supply and economic growth is analyzed without including any controlling variables. In addition to this limitation, CPI was used as proxy for inflation which mainly measures variation in prices at household level. Therefore, there is need for broader definition of inflation that will factor in change in price level in all the components of

aggregate demand. Hence, future studies will address these issues.

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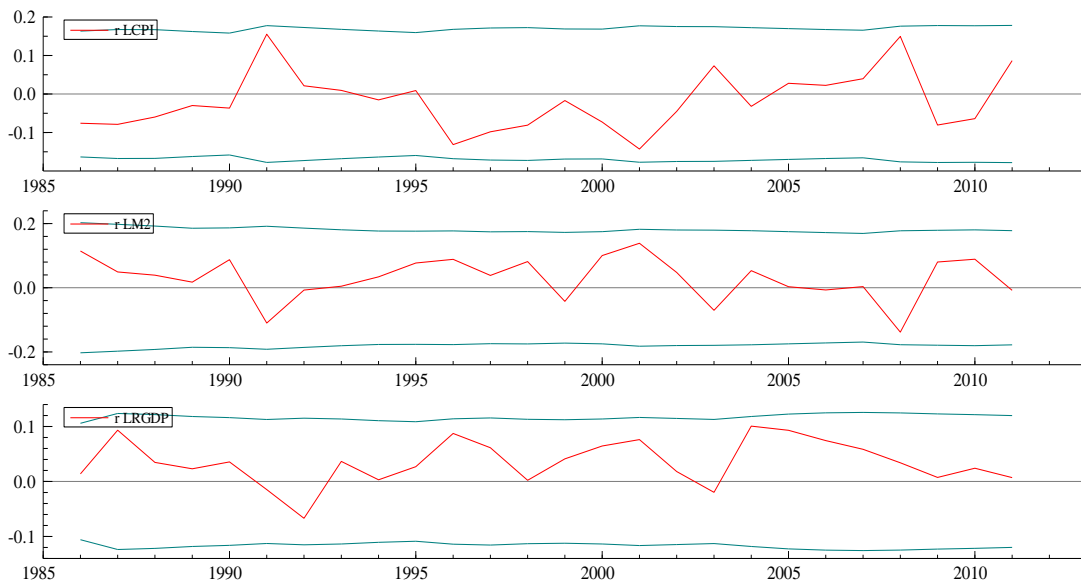
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Appendices

**Figure 1: Long Run Model Stability (1 –step residuals $\pm 2^{\text{nd}}$ SE)
(Plot of Recursive Graphs)**



**Figure 2: Short Run Model Stability (1 –step residuals $\pm 2^{\text{nd}}$ SE)
(Plot of Recursive Graph)**

