

What Causes Inflation in a Post Communist Economy? Evidence from Ethiopia

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This paper examines the determinants of inflation for a post communist economy, in the long run as well as in the short run, using time series evidence from Ethiopia and applying the Johnson co integration and Error Correction Mechanisms. A vivid observation of the results shows that the short run determinants of inflation are broad money supply, growth of domestic gross product, real interest rate, budget deficit, Exchange rate, inflation expectation and world price movements. The result of the long run model after co integration is proved using the residual based ducky fuller test and the Johnson co integration tests revealed that broad money supply, government budget deficit, exchange rate and inflation expectation are found to be the major determinants of inflation. The result shows that domestic gross product growth rate has no effect on inflation. To curb inflation, therefore, policy makers need to implement prudential fiscal and monetary policy tools. Inflation expectations need to be tackled by way of transparent and well informed government policies to change consumer perception. Concerning this, it is important to consider targeting monetary and fiscal policy variables and appropriately implanting the set targets.

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Introduction:

Inflation is among the major indicators of macroeconomic stability along with, unemployment rate, balance of payment and output growth (Payne, 2009; Jiranyakul and Opiela, 2010; Robert Leesoned., 2000; Aporale et al., 2010; Phillips, Sussman, 2007; Svensson, L.E.O., 2000; Ruge-Murcia, 2003; and Olivera, 1964). In economic theory inflation is defined as a sustained increase in the general level of prices for goods and services in an economy. Sustained general increase in the price level indicates the net change in the price of all baskets of commodity produced and services provided in the economy. The net change may be a rise or fall in the price of basket of some representative commodities in the economy. The net effect gives us the general rise in the price level or decrease in the price level. If the net change is a rise in the price level, economists call it inflation otherwise deflation. For monetary policy purpose inflation is measured in two ways: headline inflation and core inflation.

Headline inflation measures the rate at which the household cost of living is rising on individual basis (Girijasankar M. and Anis C., 2001). It is a measure of aggregate rise in price of commodities including food and energy prices. It is headline inflation relative to income growth that determines whether a house hold's standard of living is rising or falling. Core rate of inflation is the total inflation excluding food and energy prices based on the assumption of stable price of food and energy items. Monetary policy focuses on core rate of inflation intently because the core is less volatile and a better reflection of the interplay of supply and demand in domestic product

markets (Sussman, 2007; Muscatelli et al., 2002; Friedman, 1994; Catao and Terrones, 2003). Thus, the core usually is considered as better gauge of the underlying rate of inflation that will tend to emerge in the absence of supply shocks. When food and energy prices are extremely volatile due to temporary supply disruptions related to weather or to political crises, the headline rate of inflation, which includes the volatile food and energy price components, tends to be less representative of the underlying rate of inflation. Kibrom (2008) argued that the surge in global market prices of food and energy over the last decade has increased the importance of headline inflation rate for policy purposes.

Economic literature on causes of inflation (Kibritçioğlu, 2002; Friedman, 1994; Payne, 2009; Caporale et al., 2010; Jiranyakul and Opiela, 2010) has been concerned with the monetary and fiscal policy instruments. Economic literature provides abundant evidence of a strong link between inflation and economic variables such as prices in world economy, money supply, and depreciation of domestic currency, inflation expectation, supply bottlenecks, inflation uncertainty, and government deficit (Komain Jiranyakul and Timothy P. Opiela, 2011; Daal et al., 2005; Payne, 2009; Friedman 1970; Streeten, 1962; Olivera, 1964; Scheibe J. and D.Vines, 2005).

The inflationary experience in Ethiopia since recent past proved to lead to deteriorating living condition in the short run on top of its expected long run adverse consequences to the economy. Ethiopia as a post communist economy started transition to market economy in 1991 with landmark reforms introduced in 1991. Since then, (Solomon Woldemeskel, 2008), the government has made a broad range of policy reforms, including liberalization of foreign trade regime, decentralization of economic & political power, deregulation of the financial sector and deregulation of domestic price and devaluation of the national currency.

Since the recent past, the Ethiopian economy has been registering remarkable growth in terms of output. However, there have been repeated shocks as the agricultural system which is dominant contributor to the GDP is rain fed system. There has been a reported continuous growth in GDP averaging around 11 percent per annum for ten consecutive years since 2003/2004 (World Bank, 2013). In spite of the significant growth in GDP level, price spiral has been the challenge encountered by policy makers during recent years. There is no consensus on why Ethiopia is experiencing such rapid price rises. Inflation growth has recently coincided with high economic growth rates, whereas in the past inflation was traditionally associated with large agricultural supply shocks due to drought. Every other year the inflation continues to gain momentum (*see: Table-1 and Figure-1 in the appendix*). According to Kibrom (2010) the inflationary trend in Ethiopia is mainly derived by food prices. Food price inflation is 37.5% in 2008 and 45.5% in September 2011. The growth in agricultural sector for ten years in a row failed to keep food price hikes under control. This paradoxical condition has puzzled economists and policy experts and led many more to suspect the validity of the stories of fast economic growth over ten years.

Understanding the sources of the current inflationary trend should be the foremost business to react to challenge for stabilization purposes. The analysis of the macro economic developments of the recent post may provide certain clue about the current inflationary problem though locating the specific cause demands detailed investigation of facts related inflation according to empirical economic literature. Monetary developments show that broad money supply has grown from 30.5 billion Birr in 2002/03 to 76.7 billion in 2009/2010. The share of broad money as a percentage of GDP has also shown a marked increase jumping from 42.7 percent in 2002/03 to 60 percent in 2009/2010 (NBE, 2009/2010). The fiscal development has been

driven by increase in government expenditure as the government embarked on huge social and capital projects investment. The government's budget deficit, however, (including grants) as a percentage of GDP has fallen considerably. The means of financing the budget deficit has shifted from external to domestic bank and nonbank sources. This has led to the monetization of the deficits. The use of domestic means of deficit financing as percentage of budget deficit has grown from 34.4 percent in 2002/03 to 78.8 percent in 2009/2010 (MoFED, 2009/2010). The domestic revenue has been significantly increasing following the comprehensive tax system reform which introduced value added tax in to the tax system of the nation in 2003. Gains from export have also improved and attributed to the diversification of exports and recovery of international prices of commodities.

The inflationary problem observed in Ethiopia has led into intervention of the government through different mechanisms including price controls introduced from 2008 through 2010. Such interventions, however, require appropriate policies drawn from careful investigation of the factors driving price hikes. Though literature on Ethiopian inflationary experience is miniature, there have been efforts to study inflation in Ethiopia (Getachew, 1996; Mehari and Wondafrash, 2008; Muche, 2007; Demirew, 1998; Yohannes, 2007). All of these studies focused on the role of demand factors or supply factors as drivers of inflation except Yohannes (2007). Yohannes (2007) has used broader framework by incorporating factors from both supply side and demand side of the market that may have played role in price process. His study estimated a general equilibrium econometric model to show the possible functional relationships between output, prices and various inputs. The current paper examines the sources of inflation in Ethiopia using time series data from 1979 to 2013. This study uses broad framework that

includes demand side factors, supply side factors and policy variables. The model adopts a disaggregated approach to study the contributions of Prices in world economy, depreciation of domestic currency, inflation expectation, supply side growth, real interest rates and money supply to the inflationary process in a view to address the following basic questions:

What factors are instrumental in determining head Headline inflation in the short run for post communist economy like Ethiopia?

What are the fundamental determinants of head Headline inflation in the long run for post communist economy like Ethiopia?

Literature Review

Plethora of economic literature have attributed inflationary phenomenon to various factors. Essential prime sources of inflation identified in literature comprise variables such as monetary and fiscal policy developments (Debelle, G., 2001; Boschen and Weise, 2003; Isabel Vansteenkiste, 2009). The quantity theory of money is one of the fundamental theoretical frameworks employed to explain the most important and long run determinants of inflation rate and price level (Kibritçioğlu, 2002). Loungani P. and P. Swagel(2001) stresses the primary importance of the money supply in determining nominal GDP and the price level based on original monetary theories of Friedman(Friedman, M. (1968[1994]. The quantity theory of money represented by Fisher's equation of exchange is expressed as indicated below (Fischer, S. etal., 2002; Barenjee, 1975).

$$M.V = P.T-----(1)$$

Where, M, V, P and T represent money supply, velocity of money movement, general price level and real volume of transactions.

The theory is built based on two pillar assumptions: constant velocity of money and full employment of resources. The full employment assumption leads to constant volume of transactions (T). That is, the aggregate supply in quantity theory of money is (T) and the aggregate demand (AD) at goods market equilibrium is given by:

$$AD = T \text{ ----- (2)}$$

$$AD = MV / P = T \text{ ----- (3)}$$

By rearranging equation (3) the price level (P) is:

$$P = MV / T \text{ ----- (4)}$$

The logs of the variables differentiated with respect to time will result in determination of inflation equation of the quantity theory of money framework as:

$$\lambda = (v - \tau) + \mu \text{ (5)}$$

Where λ is the annual rate of inflation, v is the growth rate of velocity, τ is the growth rate of the volume of transactions and μ is the growth rate of money supply. The fundamental assumptions of the model imply that V and T are constant and therefore, the rates of growth of V and T must be zero. Frankel (2006) and Krichene (2008) claim that the most important factor in inflationary process is

expansionary monetary policy in key industrial countries, which led to low interest rates and a sharp fall in the value of the US dollar. From this we can conclude that the model dictates that any increase in money supply translates into proportionate increase in the aggregate price level (Mishkin, 2008; Payne, 2009; Caporale et al., 2010; Jiranyakul and Opiela, 2010). Generally, the quantity theory of money which provides equation of money supply emphasizes on the role of excess money supply in explaining inflation (Cukierman, A, and S Gerlach, 2003). Inflationary process is also attributed to the institutional problems of people increasing their price levels (Muscatelli, V.A. et al., 2002; Desai, R. M., 2003; Lipsey, 1960; Samuelson and Solow, 1960). Many others (Robert Leeson, 2000; Gutierrez, E., 2003) are concerned with analysis of the trade off between inflation and unemployment presenting a model with the idea of negative 'trade-off' between inflation and unemployment. But, for Scheibe J. and D.Vines (2005), the modern extensions and interpretations of the 'trade-off' between inflation and unemployment suggest a positive relationship between inflation and the output gap, exchange rate and inflation expectations.

Inflationary phenomenon could also be explained by cost push or demand pull models. That is, forces of competition and cost are important determinants of inflation (Humphrey 1998). Dotsey and Sarte (2000) argued that when monetary excess happens to spill over into goods market, there will be matching shift in demand and supply. This shift would lead into the output response to monetary excess which will leave prices intact (Aslund, A., et al., 1996; Khan and Senhadji; 2000). According to theory of antecedent pricing, since price setting precedes sales, instead of the predetermined prices adjusting to monetary fluctuations, money supply adjusts to ensure the existing supply is just sufficient for transaction (Daal et al. 2005; Payne, 2009; Caporale et al., 2010; Jiranyakul and Opiela, 2010). Shortage of raw

materials, due to for example crop failures, will contribute to rise in price of specific products and thus the general price level. There are two explanatory routes through which such shortages contribute to price rise: directly via rise in the price of raw materials and indirectly via a feedback effect into higher wage demands (Mohanty and Klau, 2001).

Economic literature identified supply-side factors, such as food prices, administered prices, wages and import prices as determinants of inflation (Kibrom Tafere, 2010; Leigh and Rossi, 2002). For the supply side theory, inflation in the long run can be explained by the differential rates in productivity growth, wages and elasticity of income and prices between the industrial and services sectors. The recent and more complex issues of general price level that have emerged with the erosion of trade and other barriers call for more dynamic and pragmatic answers to the causes of inflation which none of the above explained important theories alone fail to address this question in a developing and post socialist country's volatile economic environment. However, recent investigations about inflationary problem in developing and emerging markets (Hasan et al., 1995; Callen and Chang, 1999; Leigh and Rossi, 2002; Simone, 2000) have some answers to this problem. These studies on inflation provide models that incorporate both demand side and supply side factors along with policy variables and adaptive expectations. The literature identifies the main determinants of inflation such as: monetary shocks, inflation expectations, nominal exchange rate, and price of imports, exogenous supply shocks and fiscal policy shocks (Chang and Velasco, 2000; Catão and Terrones, 2001; Ho and McCauley, 2003; Goldfajn and Olivares, 2001).

Empirical investigations on sources of inflation in developing economies identified various variables. Kibrom Tafere (2010), using quarterly data for the period 1994/95 to 2007/08 for Ethiopia and

estimating the synthesis of monetarist and structuralist model of inflation identified that sharp rise in food demand triggered by an alarming rise in money supply/credit expansion, inflation expectation and international food price hike are the most important forces behind food inflation in the long run. His estimation result shows that the long run determinants of non-food inflation, on the other hand, are money supply, interest rate and inflation expectations. In the short run model, wages, international prices, exchange rates, cost marking-up and constraints in food supply are found to be prime sources of inflation.

Using data from the 1972-73 to 2005-06 period in Pakistan (Abdul A. Khan, Syed K. Bukhari and etl., 2007) and applying ordinary least square method found that the most important determinants of inflation in were adaptive expectations, private sector credit and rising import prices while the fiscal policy's contribution to inflation was found to be minimal. Girijasankar Mallik and Anis Chowdhury (2001) found evidence of long-run positive relationship between GDP growth rate and inflation using data from four South Asian countries (Bangladesh, India, Pakistan and Sri Lanka). However, there exists plethora of evidence from cross country studies, which found inflation affecting economic growth negatively (Komain Jiranyakul and Timothy P. Opiela, 2011; Fischer, 1993; Barro, 1996; Bruno and Easterly, 1998). Barro reports a significantly negative correlation between inflation and GDP growth for average inflation rates above ten percent and preferred price stability because he believed it to be appropriate for economic growth. Fischer (1993) found a very small negative impact of inflation on economic growth. Though the evidence is not plausible enough Fischer concluded that inflation is not good for longer-term growth.

Maliszewski (2003) used monthly data from January 1996 to February 2003 in Georgia and applying a short run ECM and a long run co integration models found that changes in exchange rate and imported oil prices are the causes of inflation in the short run while the long run determinants include money supply, exchange rate and output; the exchange rate variable is found to be the dominant factor in explaining inflation. Hammermann and Flangan (2007) in their studies of persistent inflation differentials across 19 transition economies used annual data from 1995-2004 and concluded that central banks incentive towards higher short run inflation, unanticipated shocks to supply and demand, high government debt and low financial market development are key reason for the observed inflation differentials.

Ghosh et al (1996) in their analysis of the influence of the various exchanges rate regimes on inflation and growth using data of all IMF members' states from 1960-90 identified that countries with pegged exchange rates had an average annual inflation of 8% compared with 14% for intermediate regimes, and 16% for floating regimes. The difference in inflation rate is attributed lower rate of growth in money supply for countries with pegged exchange rates and the high public confidence in pegged regimes, for a given growth rate of money supply thereby leading into higher demand for money which in turn leads to low in inflation.

Catao and Terrones (2003) analyzed the relations between fiscal deficit and inflation for 107 countries using an annual data from 1960-2001 and modeling inflation as non linearly related to fiscal deficit through the inflation tax base using dynamic panel techniques that explicitly distinguish between short- run and long-run effects of fiscal deficits, concluded that budget deficit is significant deriver of inflation in most groups with the exception of low inflation economies and advanced countries. Mwase (2006) used quarterly data from Q1:1990

up to Q1:2005 in his study of inflation in Tanzania based structural vector auto regression (VAR) model to capture the relationship between short term movements in exchange rate and inflation found that currency appreciation is associated with a decrease in inflation rate, with one quarter lag. Egwaikhede, et al (1994) also found that official exchange rate, output and money supply are the main causes of inflation in Nigeria using annual data from 1973 to 1989 while they concluded that inflation expectations showed insignificant result. Yahyak (1989) in his study of inflation in Nigeria with the use of basic macroeconomics accounting frame work for annual data from 1970-1976 found that money supply is the main determinant of inflation.

A study on determinants of inflation in Uganda by (Barung, 1997) using Error Correction Model generated strong evidence that monetary expansion and supply shocks are found to be significant in explaining the variations in price level while the real exchange rate has been found to be with negative sign and insignificant. Barung argued that negative sign of the real exchange rate comes from the financing of large volume of imports through import support grants which may have offset the inflationary impact of the real deviation. Using on annual data from 1962 up to 1989 (Sowa and kwakye, 1993) found that supply constraint, exchange rate devaluations and monetary constraint are sources of inflationary pressure though the monetary effect is dominant. Acute, et al (2001) used annual data form 1974 to 2000 to identify the determinants of inflation in Swaziland and identified that the impact of money supply on inflation was found to be insignificant, suggesting that money supply growth in Swaziland does not accord with normal behavioral expectations towards inflation. Exchange rates and wage rates have been found to have significant long run influence on the level of prices in Swaziland.

Getachew (1996) in his study of inflation in Ethiopia concluded that in the short run money stock is significant determinant of

inflation in Ethiopia while his long run inflation model estimation shows that supply bottleneck is the driving force behind inflation in the long run. Yohannes (2000) in this study of inflation in Ethiopia used quarterly data from 1967/68 to 1998/99 also confirmed that money supply is a cause of inflation in the short run. Moreover, Yohannes identified that inflation inertia and actual world inflation affect Ethiopian inflation condition in the short run. Mehari and Wondafrash (2008), in their investigation of the impact of money supply on inflation in Ethiopia using quarterly data from the first quarter of 1996/97 until the second quarter of 2006/07 concluded that money supply has a direct impact on inflation. Ahmed (2007) also lists various other domestic and external factors matter, including money supply and world commodity prices. Ayalew Birru (2007) using annual data from 1970 to 2006 claimed that supply shocks, inertia, and the consumer prices of major trading partners appear to be among the most important determinants of inflation in Ethiopia.

Methodology

The model

The model employed is based on prime considerations of incorporation of all essential demand-side, supply-side and policy variables explained in the literature section of the paper and keep it straight and effective in explaining the causes of inflation in Ethiopia. Under these considerations, the following variables are used to develop inflation model: Prices in world economy, depreciation of domestic currency, inflation expectation, supply bottlenecks, money supply. This research employed a modified version of the model developed by Abdul A. Khan and etal. (2007). accordingly, the following model was developed and estimated:

$$\ln(HCPI) = \theta + \ln \alpha_1(WPI) + \ln \alpha_2(EX) + \ln \alpha_3(IE) + \ln \alpha_4(GDP) + \ln \alpha_5(GBD) + \ln \alpha_6(RIR) + \ln \alpha_7(BM) \dots \dots \dots (2)$$

In the equation, world price inflation (*WPI*), official exchange rate (*EX*), inflation expectation (*IE*), gross domestic product growth rate (*GDP*), government budget deficit (*GBD*), real interest rate (*RIR*) and broad money supply (*BM*) are used to explain consumer prices as measured by headline CPI (*HCPI*).

To capture the external price shock independent of movement in exchange rate, the researcher has taken the index of import prices in dollars. Increase in prices of goods, such as petrol and raw material makes our imports costlier and hence increases the cost of production. The variable thus is expected to have a positive coefficient. African Development Bank Group (2010), Ethiopia's economy is highly vulnerable to exogenous shocks by virtue of its dependence on primary commodities and rain fed agriculture. The report further asserted that, Ethiopia has experienced major exogenous shocks notably droughts and adverse terms of trade (e.g., prices of coffee and fuel) during the past five to seven years.

Annual growth rate of GDP is used as proxy to the supply side of the market (Cecchetti, S. and M. Ehrmann, 1999). In line with D. J. Elder and S. Fountas (2009) and Komain J. and Timothy P. Opiela (2011) the priori expectation is that economic growth is negatively related to price instability in the economy.

Exchange rate was expressed as Birr per dollar, which means that a depreciation of the Ethiopian Birr would mean more Birr for a dollar and hence increase in the number. More Birr for a dollar mean increasing cost of imports. The variable again is assumed to have a positive sign, indicating that the depreciation of the domestic currency

would have an inflationary effect on prices (Brenner M. and M. Sokoler, 2010; Campa et al, 2002; Campa and Goldberg, 2006).

Rising prices create expectations for future inflation. The role of expectations is critical in the determination of future prices. People expect higher salaries to compensate for expected increase in prices, speculation in asset prices increases, credit meant for manufacturing sector diverts to real estate and stock markets, and hoarders, profit seekers and rentiers become active in expectation of higher prices in the future. All this can have a devastating effect on prices. To incorporate these elements, the researcher has included the variable 'inflation expectation to be measured by one period lag of (*HCPI*)' in the model. This variable is ought to have a positive correlation with current consumer prices.

Two main categories of the assets side of money supply are government sector borrowing and private sector borrowing [alternatively, Non-Government Sector Borrowing (NGSB)]. Instead of taking money supply as a whole (*M2*), it is good to take the break-up to see a clearer picture of the role of government and private borrowing in explaining inflation. However, because of the lack of data for the study period the researcher is compelled to use broad money supply (*M2*) as a whole (Shan, 2005; Masih, 2007). The variable is found to have a positive coefficient since an increase in government and private borrowing can have an inflationary nature.

Fiscal policy can be an important determinant of inflation. Deficit financing is used as a proxy for fiscal policy (Ogunmuyiwa, 2008). Deficit financing creates inflationary pressure (Oladipo and Akinbobola, 2011; Chimobi and Igwe, 2010). On the other hand, direct taxes reduce the take-home income and thus have an anti-inflationary effect. If both taken together, coefficient's sign can partially depict which kind of tax has a more dominant role to play.

In a time series data, the major concern of researchers is that if non stationary data series persists then it could possibly lead to spurious relationship. To deal with this problem it is crucial to study the long run relationship of the variables. This is often done by checking if the variables are co integrated. The first step in co integration analysis is studying the order of integration of the variables under consideration. The order of integration of the variables in this study will determine using unit root tests of the Augmented Dikey-Fuller (ADF). Accordingly, the determination of the co integrating relationships in the model shall be done using the residual based Dickey-Fuller approach. That is the Engle-Granger procedure will be applied to test for co-integration. The first step is to estimate a long-run equation using ordinary least squares (OLS) with variables, which are integrated of Order one, $I(1)$, in their levels. In order to avoid spurious regression, residual based co integration test can be used, where the stationarity of the residual implies a co integrating relationship among the variables in the long run equation. The second step of the Engel-Granger procedure is to estimate the corresponding error correction model (ECM), based on the long run co integrating relationship to observe the short run dynamics (Engel and Granger, 1987). If the variables prove non stationary and co integrated, the variables have to be differenced of higher order. Therefore, the final model for estimation is:

$$\ln \Delta(HCPI) = \theta + \ln \alpha_1 \Delta(WPI) + \ln \alpha_2 \Delta(EX) + \ln \alpha_3 \Delta(IE) + \Delta \ln \alpha_4 \Delta(GDP) + \ln \alpha_5 \Delta(GBD) + \ln \alpha_6 \Delta(RIR) + \ln \alpha_7 \Delta(BM) \dots \dots \dots \dots \dots \dots \dots \dots \dots (2)$$

The data and empirical Results

The data consist of annual series of all the variables in the model. The variable series cover the annual period of 1979 to 2013. These data will be from the IMF's *International Financial Statistics* and the

National Bank of Ethiopia *Bulletin*. Data for all variables shall be taken in logarithmic form. In order to identify the problem of serial correlation, the Breusch-Godfrey Serial Correlation LM tests were applied. Further, residual series shall be examined by using Augmented Dickey Fuller Test. The unit root test proved that the variables have unit roots at their levels (See: Table-2a and 2b).

Table 2a

Unit-Root Tests on Variables (Phillip Peron Tests)

<i>Variables</i>	<i>Levels</i>		<i>First difference</i>		<i>Order of co-integration</i>
	<i>Without trend</i>	<i>With trend</i>	<i>Without trend</i>	<i>With trend</i>	
INFL	4.6639(2.983)	4.829(3.576)	-4.582(2.986)	-4.778(-3.580)	I (0)
BM	17.517(2.983)	10.272(3.57)	16.327(-2.986)	14.590(-3.580)	I (0)
RIR	3.549(2.983)	3.739(3.576)	-2.331(-2.986)	-2.391(-3.580)	I (0)
GDP	4.133(2.983)	4.982(3.576)	4.177(-2.986)	-4.902(-3.580)	I (0)
WPI	0.917(2.983)	2.630(3.576)	-3.795(-2.986)	-3.582(-3.580)	I (1)
GBD	3.632(2.983)	3.799(3.576)	-3.468(-2.986)	-3.529(-3.580)	I (0)
EX	1.224(2.983)	1.517(3.576)	3.813 (-2.986)	-4.852(-3.580)	I (1)
INFLlag	4.582(2.986)	4.778(3.580)	-3.298(-2.986)	-3.652(-3.580)	I (0)

***95 percent critical values in parenthesis

Table 2b

Unit-Root Tests on Variables (Augmented Dickey Fuller Tests)

<i>Variables</i>	<i>Levels</i>		<i>First difference</i>		<i>Order of co-integration</i>
	<i>Without trend</i>	<i>With trend</i>	<i>Without trend</i>	<i>With trend</i>	
INFL	4.652(2.983)	4.841(3.576)	-4.571(-2.986)	-4.780(-3.580)	I (0)
BM	0.000(2.983)	0.000(3.576)	-3.262(-2.986)	-3.699(-3.580)	I (1)
RIR	3.513(2.983)	3.727(3.576)	-2.262(-2.986)	-3.799(-3.580)	I (0)
GDP	4.186(2.983)	4.986(3.576)	-3.716(-2.986)	-4.334(-3.580)	I (0)
WPI	0.939(2.983)	2.559(3.576)	-5.499(-2.986)	-5.330(-3.580)	I (1)

<i>GBD</i>	3.593(2.983)	3.782(3.576)	-2.387(-2.986)	-2.518(-3.580)	<i>I</i> (0)
<i>EX</i>	2.010(2.983)	0.969(3.576)	1.274(-2.986)	-1.611(-3.580)	<i>I</i> (1)
<i>INFLlag</i>	4.571(2.986)	4.780(3.580)	-3.235 (-2.986)	-3.339(-3.580)	<i>I</i> (0)

***95 percent critical values in parenthesis

The unit root tests conducted revealed all variables have no unit root in their level, except WPI and EX and hence they are stationary. Even then, the variables have to be differenced to achieve stationary so that the regression does not suffer from mixed order of integration. The researcher then conducted the Augmented Dickey-Fuller (ADF) tests on the first difference of the time series data. From the test results on the first difference given in Tables 2a and 2b, the null hypothesis has been rejected because of the fact that all variables become stationary at their first difference. The result is confirmed using Augmented Dickey-Fuller (ADF) and Phillip Peron tests. The three exceptions, however, are broad money (BM), world price inflation (WPI) and exchange rate (EX). Broad money (BM) is stationary in level under the Phillip Peron test, while ADF test indicated that it is non-stationary. World price inflation (WPI) and exchange rate (EX) are found to be stationary in their first difference under the Phillip Peron test, while ADF test indicated that they are non-stationary. One possible explanation for these contradicting results could be strong autocorrelation and structural breaks in the variables series. In such cases ADF test has low power and indicates the presence of unit roots (Harris, 1995). Perron (1989) cited in Harris (1995) notes that the usual ADF unit root test mistakes a permanent shift in a series that is stationary around a deterministic trend during the period under consideration as a persistent innovation to a non-stationary trend and leads to under-rejection of the null of unit roots. The Phillip Peron test, however, takes accounts of such structural breaks. It is, therefore, a better test in the presence of structural

breaks. The existence of a significant break in these variables can be observed from figures -2& 3 in the appendix. The Unit root tests revealed that all variables used in this study are stationary at their first difference. Thus, the determination of co integrating relationships doesn't suffer from mixed order of integration. The existence of co integrating vectors in the model will now be tested using the Engle-Granger two step procedure.

Co Integration Analysis

As noted above the determination of the co integrating relationships in the model is done using the residual based Dickey-Fuller approach and Johansen tests for co integration. That is the Engle-Granger procedure was applied to test for co-integration. The first step is to estimate a long-run equation using ordinary least squares (OLS) with variables, which are integrated of Order one, $I(1)$, in their levels. In order to avoid spurious regression, residual based co integration test can be used, where the stationarity of the residual implies a co integrating relationship among the variables in the long run equation. The second step of the Engle-Granger procedure is to estimate the corresponding error correction model (ECM), based on the long run co integrating relationship to observe the short run dynamics (Engel and Granger, 1987). The ducky fuller tests were applied on the error terms and the results of Augmented Dikey-Fuller (ADF) unit root tests on residuals are given in table-4 below.

Table 3

Unit-Root Test results on Residuals

	<i>Phillip Peron tests</i>		<i>Augmented</i>	<i>Dickey-Fuller</i>
	<i>Levels</i>	<i>First difference</i>	<i>(ADF) test</i>	
			<i>Levels</i>	<i>First difference</i>
<i>Without trend</i>	-4.410(-3.00)	-6.805(-2.989)	-6.382(-2.986)	-6.273(-2.989)
<i>With trend</i>	-4.456(-3.60)	-7.195(-3.584)	-6.332(-3.580)	-6.321(-3.584)

*** 95 percent critical values in parenthesis

In determining the number of co integrating relationships the lag length used is 3 as determined using various information criteria(see:Table-4) shows the results from various lag length selection criteria used in determining the lag length of the model. As can be seen from the table below LR, FPE, AIC, SC and HQ criteria indicate that the appropriate lag length is three. The Johansen procedure test results for co integration with three lags in the system indicates that there are at most three co integrating relationships. Both trace and maximum eigenvalue tests fail to reject the null of at most three co integrating equations in the system. The trace and maximum eigenvalue test statistics are given in table-5. Based on the result it could be inferred that long-run relationship or co-integration exists among inflation rate (INFL), broad money(BM), real interest rate (RIR), Exchange rate (EX), world Inflation rate (WPI), GDP growth rate (GDP),government budget deficit(GBD) and inflation expectation(INFLlag). This is because the critical value at 5% is less

than the likelihood ratio in row 1, 2 and 3. Therefore, the hypothesis of no co-integration has been rejected at 5% significance level.

The Long Run Co Integrating Equation Model

The result of the Johansen co-integration shows the existence of long run relationship among the variables. That means even though the OLS result in Table-2C is acceptable as the long run model, a more interpretable long run could be determined from the co integrating equations. The co-integrating equation is chosen based on log likelihood ratio. If the log likelihood ratio is positively signed, we chose the equation with the lowest log likelihood ratio and if negative signed, we chose the highest log likelihood ratio at absolute term. From the Johansen co-integration result, all the three log likelihood ratios of the respective co-integrating equations are negatively signed. Therefore, the highest log likelihood ratio is chosen. The lowest log likelihood ratio is -996.1145 and its corresponding co-integrating equation is stated below.

Table 6

**Long Run Co Integrating Equation; Dependent Variable:
Inflation**

t-ratio [p-value]	Regressors	Coefficients
BM	(8.32e-14) 5.94e-13***	7.14 [0.000]
RIR	(0.0016231) -0.0023829	-1.47[0.142]
GDP	(0.0001306) 0.0001017	0.78 [0.436]
WPI	(0.0001893) -0.0002566	-1.36[0.175]
GBD	(0.0016166) 0.0032885**	2.03 [0.042]
EX	(0.0005319) -0.0033084***	-6.22 [0.000]
INFLlag	(0.0000695) -0.9995741***	-5.46[0.000]

_cons	(000) 1237.453***	000 [0.000]
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$R^2 = 0.8323$; $F = 21.26$; ($Prob > F = 0.00$) ***

Adjusted $R^2 = 0.8059$

$N =$

31

(***) (**), shows significance at 1% and 5 % significance level and the number in the brackets refers standard error

From the equation, if all independent variables are held constant, inflation will rise by 1237.453 units in the long run. The coefficient of broad money implies a positive relationship between broad money and inflation rate in the long run and significant at 1%. As expected money supply has been a key determinant factor of inflation inertia. That is increase in broad money will cause a rise in inflation. The result is consistent with the economic theory of money supply, demand for goods and services and inflation. Increase in money supply leads to excess money circulating over the economy generating induced demand for goods and services. This situation will lead to price hikes for a given supply of goods and services according to the law of demand.

The coefficient of exchange rate is negative and significant at 1%. The coefficient is negatively signed showing that in the long run, EX and INFL are inversely related. Exchange rate is found to be one of the driving forces of inflation in the long run. Inflation will decrease in the long run if exchange rate increases. The possible explanation for this result is that domestic currency depreciation will lead to substitution of domestic products by consumers for imported products which in turn lead to reduction of the effect of imported inflation on domestic prices.

World price inflation has a negative coefficient and insignificant at 5%. It can be deduced that in the long run, if world price inflation should increase by a unit; it will cause domestic inflation rate to decrease. This result may be explained by substitution of domestic products by consumers for imported goods and services when prices of goods in international markets make them unaffordable in the domestic market.

The coefficient of real interest rate is negative and insignificant at 5%. The negatively signed coefficient signifies that real interest rate and inflation rate have a negative long run relationship. An increase in real interest rate means that inflation would decline. Increase in real interest rate alters the consumption behavior of the public because consumers have the incentive to save when the real interest rate is growing. This will result in fall in demand for goods and services and sellers are compelled to reduce prices. Inflation expectation is found to be inversely related to inflation in the long run with negative coefficient and significant at 1%. This result implies that in the long run consumers react to inflation by reducing their level of consumption based on the learning effect of the market structure.

GDP growth rate has direct relationship with inflation in the long run because of the positive sign attached to its coefficient but insignificant at 5%. This implies that as GDP growth increases, inflation will also increase. GDP influences inflation from two sides (Kibrom, 2008): first directly as a determinant of demand and second, as a component of excess money supply. In the first case, as income rises, demand for goods rises, for a given supply of goods, driving price up. In the second case, rise in income results in rise in demand for real money balances and, thus, reduces the excess supply of money, for a given stock of money supply, and drives price down. The positive relationship between GDP growth and inflation obtained in

the co integration equation indicates the former effect outweighs the later effect.

Government budget deficit is found to be one of the determinants of inflation in the long run with positive coefficient and significant at 5%. This reveals that increase in government budget deficit leads to hike in general price levels. The result is consistent with monetary financing theory of budget deficit which involves governments resorting to central bank's resources; means issuing of money so as to finance public expenditures generating budget deficits. Through this process (Fillip 2002), governments offer on the market stock of money that excels the amount objectively justified to be in circulation taking in to account the proportion and nature of the economy in terms of supply of goods and services. To the extent of the mismatch between money supply and supply of goods and services it drives general prices up.

Table 7

Co-integration in $I(1)$: Error Correction Model (ECM)

t-ratio [p-value]	Regressors	Coefficients
dRIR	(.2905464)9.634411***	33.16[0.000]
dGDP	(0.013157)-0.2313254***	-17.58[0.000]
dGBD	(0.2888173)10.3468***	35.82[0.000]
dEX	(.1847737)-1.454559***	-7.87[0.000]
dINFLlag	(.0154141) -.3851597***	-24.99[0.000]
dBMLag2	(3.05e-11)3.84e-10***	12.60 [0.000]
dRIRlag	(.2997128)0.7339548**	2.45[0.031]
dRIRlag3	(.2727829)1.427483***	5.23[0.000]
dGDPlag3	(.0159233)0.0468762**	2.94[0.012]
dWPIlag2	(.0376788) -0.1173461***	-3.11[0.009]

dGBDlag	(.3040725)-.7640265**	-2.51[0.027]
dGBDlag3	(.2682174) 1.463586***	5.46[0.000]
dEXlag3	(.204163)-1.024874***	-5.02[0.000]
ECM	(.0162504)1.01000***	63.98 [0.000]
ECM(-1)	(.0249285)-.9417202**	-37.78[0.031]
_cons	(.1234112).3749499***	3.04[0.010]

$R^2 = 0.9997$; $F = 21.26$; ($Prob > F = 0.00$) ***

Adjusted $R^2 = 0.9994$

$N =$

28

(***) (**), shows significance at 1% and 5 % significance level and the number in the brackets refers standard error

The results in table 7 appear to suggest that both consumption and supply factors play role in the dynamics of prices in the short run. The short run determinants of inflation are found to be gross domestic product growth rate, real interest rate, inflation expectations, exchange rate, world price inflation and government budget deficit. Growth in real money supply and interest rate fuel the demand leading to rising prices for a given level of output while the growth in gross domestic product eases inflation. .

Broad money (BM) doesn't have a direct positive effect on short run price variations. It affects short run price fluctuations through two period lagged values. This result is consistent with the view that in the absence of a well developed financial markets monetary transmission might take longer than would be with well developed secondary financial markets as the intermediation process is only through banking institutions in Ethiopia. There is no well developed secondary financial market in this economy to facilitate the intermediation process. Thus, the effect of monetary expansion may not be reflected

in the short run economic growth. This result is also supported by the negative correlation between lagged value of broad money and economic growth shown in table-7 above. A rise in broad money with two periods lag results in inflation responding with its positive coefficient.

Government fiscal deficit up to three periods lag is found to be one of the key determining factors of price movements in the short run model. The reaction of inflation to increase in government budget deficit with three periods lag is significant at 5%. The current period response of inflation to government budget deficit is also strong at 5%. This result implies that deficit spending poses inflationary problems. The results of the short run model also appears to suggest that increase in real interest rate with three period lag leads to inflation responding with strong evidence of being significant at 5%. Similarly, the current period response of inflation to change in real interest rate is also found to be positive and significant. This implies that there is fast transmission of interest to prices of goods and services. Interest rate gets into the price fluctuation process from two directions. First, by increasing aggregate demand as and second by raising the production costs may be reflected via mark-up pricing.

World price inflation affects domestic price fluctuations through two period lags. Accordingly domestic prices respond negatively to rise in world prices of goods and services. This implies that world price inflation has passes to the domestic prices slowly and there is no strong evidence for direct transmission. The result also shows that domestic prices respond to variation in exchange rates up to three periods lag. Inflation reacts to changes in exchange rate with three periods lag with negative coefficient. The negative coefficient could be explained by domestic currency depreciation leading to substitution of domestic products by consumers for imported products which in turn lead to reduction of the effect of imported inflation on domestic

prices. Inflation expectation is also found to be one of the role payers in short run price variations in the economy.

The coefficients of the error correction terms are interpreted as speed of adjustment to long run equilibrium or the disequilibrium periodically transmitted to inflation from the explanatory variables. The coefficient of the error correction term of the model is negative and less than one. This means the speed of adjustment of the error to its own long run equilibrium is shown by the adjustment coefficient of -0.9417202 implying that every year 94.17202 percent of the disequilibrium in inflation is adjusted. The negative adjustment coefficient implies that any disequilibrium in inflation converges every year.

Conclusions and Implication of the findings

The hub of the study is to examine the determinants of inflation in a post communist economy using evidence from Ethiopia. A vivid observation of the results shows that the short run determinants of inflation are broad money supply, real interest rate government budget deficit and inflation expectation. In the short run GDP growth rate, exchange rate and world price inflation are found to be non contributing factors to inflation in Ethiopian economy though their coefficients are in consonance with the priori expectation. The result of the long run model after co integration is proved using the residual based ducky fuller test and the Johnson co integration tests revealed that broad money supply, government budget deficit, exchange rate and inflation expectation are found to be the major determinants of inflation. The implication of the positivity of broad money which is in consonance with the a priori expectation means that broad money supply is one of the sources of inflation. This result is similar to the findings of Maliszewski (2003); IsabelVansteenkiste (2009); Loungani P. and P. Swagel (2001); Payne (2009); Caporale et al., (2010)

pinpointing that it is essential to align the money growth and monetary policy to the productive capacity of the economy. Therefore, in order to be able to curb the price instability challenges, it is essential to adopt conservative monetary growth. This may, however, restrict policy makers' in fiscal front engendering problem of slower growth. Finding the appropriate balance in line with the macroeconomic policy objectives and prioritization would be the responsibility of the policy makers. In conformity with the a priori expectation, real interest rate is having a direct relationship with inflation. As argued by Brenner, M. and M. Sokoler (2010), this implies that the variability of the real interest rate determines inflation.

Government budget deficit is significant with a positive coefficient in the long run implying that fiscal deficit is among the drivers of inflation. The result is consistent with the analysis by Catao and Terrones (2003), Oladipo and Akinbobola (2011); Chimobi and Igwe (2010). The policy implication of this fact is that sound fiscal policy which enables the government to finance its deficit from non inflationary sources could be opted for. It is known that contractionary fiscal policy hampers the growth ambition of post communist economies as it amounts to cutting the investment in to infrastructure development, health care services and educations which are key factors for long term success and transformation of the economy. That is to mean cutting government expenditure is undesirable policy option for the obvious reason that it is detrimental to economic growth and development. Therefore, policy makers should look for mechanisms of financing deficit which are noninflationary (i.e. borrowing from commercial banks and financial markets) or least inflationary by their nature instead of relying on the national bank assets. That is, borrowing from commercial banks and financial markets; governments must accept the adverse effect of sluggish private sector development and economic growth in the short

run. To compensate for such undesirable short run outcomes policy makers should focus on long term productive investment on economic sectors such as health, education and infrastructure development. The development of these economic sectors has great potential to create a favorable environment for private sector development in the long run.

Adaptive Inflation expectation is also found to be one of the fundamental factors that induced inflationary problem. The outcome is analogous to the findings by Abdul A. Khan, Syed K. Bukhari and etl. (2007); Kibrom (2010); Rossi (2002) and Simone (2000). The negative coefficient may be explained by reaction of the consumers to upward movements of prices through consumption cuts. This leads to the market structure adjusting itself to the social and economic realities. The result brilliantly shows that strong inflation expectations appear to be serving as effective inflation inertia and fueling continuous price instability on the economy. Though inflation expectation seems rational as in the rational expectation theory, it seems aggravated by the market structure problem. The market structure in Ethiopia is not exposed to competition even in cases of provision of basic goods which are price inelastic. Hence, government intervention with policies and publicities that can alter the perception of the consumer about inflation is essential in the effort to curb the inflationary problem that challenges the economy. In the process of implementation of such policies transparency is very important because of the agency principal relationship problem between the government and the electorate which could hamper success because of lost credibility. Specific monetary and fiscal policy targets should be well informed to the public and properly pursued by the government. Altering the non competitive market structure may also be used by the government to reduce inflation expectation by offering incentives to those willing to invest in the provision of basic consumer goods or

through direct provision of basic goods by the public sector hand in hand with the private sector.

Consistent with the result by Mwase (2006); M. and M. Sokoler (2010); Campa and Goldberg (2006) exchange rate bears negative coefficient but significant leading one to deduce that it is a determining factor of inflation in the long run. In the short run model exchange rate was insignificant but found to be among the major factors that induce inflation in the long run. This result is not surprising as the effect of exchange rate can not be immediately transformed to the market transactions affecting domestic prices. The implication of this is that though the exchange rate of a key currency (U.S. dollar) to the Ethiopian Birr might be on the high side, it has not in anyway adversely affected the economy through generating price instability; instead it has yielded positive results which may be attributed to substitution of imported goods by domestic produces. Theoretically, policy of exchange rate depreciation would make imported goods unaffordable there by shifting consumption to domestic goods and services. The macroeconomic policy implication for a post communist economy that hardly allow for import of commodities due to excessive depreciation or undervaluation of domestic currency is that it creates an environment which support domestic producers while improving the competitiveness of the economy in international markets.

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Appendix:

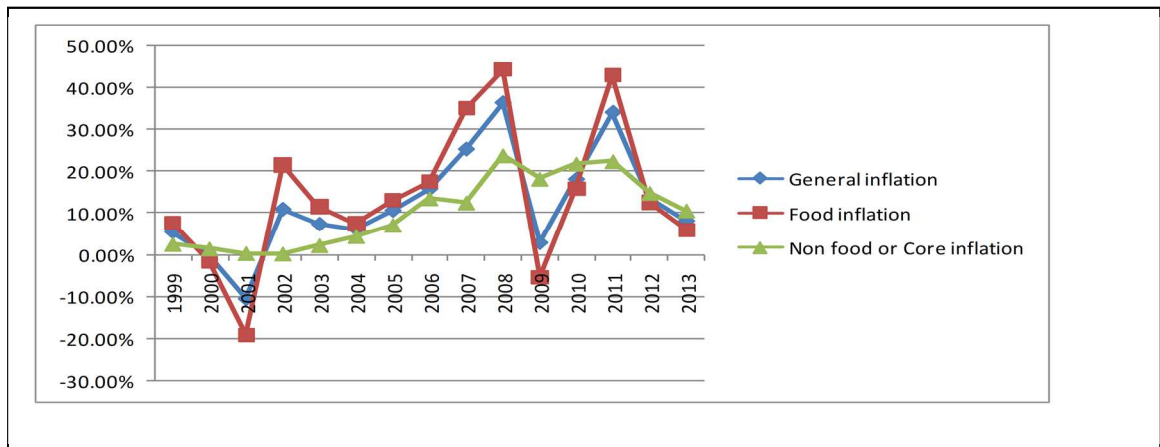
Table 1

Macroeconomic Indicators of Ethiopia

Year	Exchange Rate (Birr per USD)	GDP at Market Price (USD)	GDP Deflator (% change)	Real GDP Growth Rate	Private Consumption Expenditure	Government Consumption Exp.	Investment	Exports	Imports
1999	8.14	8,106.40	6.9	3.4	5,603.32	1549.754	1799.386	984.0295	1959.803
2000	8.33	8,085.40	-5.8	7.4	5,760.02	1265.666	1905.246	977.9112	1933.782
2001	8.54	7,716.00	-3.6	1.6	5,775.06	1223.419	2036.885	982.3185	2073.396
2002	8.58	8,473.50	12.8	-2.1	6,615.97	1214.685	2059.324	1139.7436	2346.305
2003	8.63	9,942.10	3.9	11.7	7,052.84	1387.37	2885.516	1496.3614	3171.124
2004	8.6518	12,184.2	9.9	12.6	9,413.65	1614.808	3168.011	1858.2145	4366.294
2005	8.6817	15,013.7	11.6	11.5	11,811.66	1960.143	4141.458	2097.1547	5539.961
2006	8.7943	19,362.7	17.2	11.8	14,795.72	2174.477	4687.923	2485.0415	6264.137
2007	9.24	26,605.6	30.3	11.2	21,370.24	2790.26	6510.39	3064.6104	8286.147
2008	10.42	31,867.6	24.2	10	25,719.96	3027.255	7923.225	3381.286	9240.403
2009	12.89	29,413.1	1.7	10.6	23,982.31	2699.845	7944.375	4047.1684	9799.767
2010	16.1	31,957.1	20.1	11.4	23,173.20	3301.062	10272.05	5338.4969	10092.35
2011	17.3	43,314.2	33.5	8.7	31,302.68	3586.387	16025.65	5947.2254	13663.86
2012	18.3	47,305.7	4.7	9.8	34,249.95	3918.257	16914.02	5899.9563	13732.27
2013	19.1	54,909.8	10.2	10.3	38,134.70	4361.508	22083.04	6420.518	16162.45

Source: National Bank of Ethiopia Annual Report (2014)

Figure 1
Recent trends of different types of inflation in Ethiopia



Source: National Bank of Ethiopia Annual Report (2014)

Table 2C
Summary of OLS Results; Dependent Variable: Inflation

	Regressors	Coefficients
	t-ratio [p-value]	
BM	(1.32e-10)2.76e-10**	2.10[0.047]
RIR	(3.125135)9.907881***	3.17[0.004]
GDP	(0.2316979)-0.2347423	-1.01[0.322]
WPI	(0.3444213) 0.2035904	0.59 [0.560]
GBD	(3.075849)10.62026***	-3.45[0.002]
EX	(1.053531)-0.7494241	-0.71[0.484]
INFLlag	(0.1350232)0.3535783**	-2.62[0.015]
_cons	(10.70609) 70.34709***	000 [0.000]

$R^2 = 0.7523$; $F = 9.980$; ($Prob > F$ 0.00) ***

*Adjusted R*² = 0.6769

N =

31

*) (**), (*) shows significance at 1% (5 %) and 10% significance level and the number in the brackets refers standard error

Figure 2

The trends of broad money and world price inflation

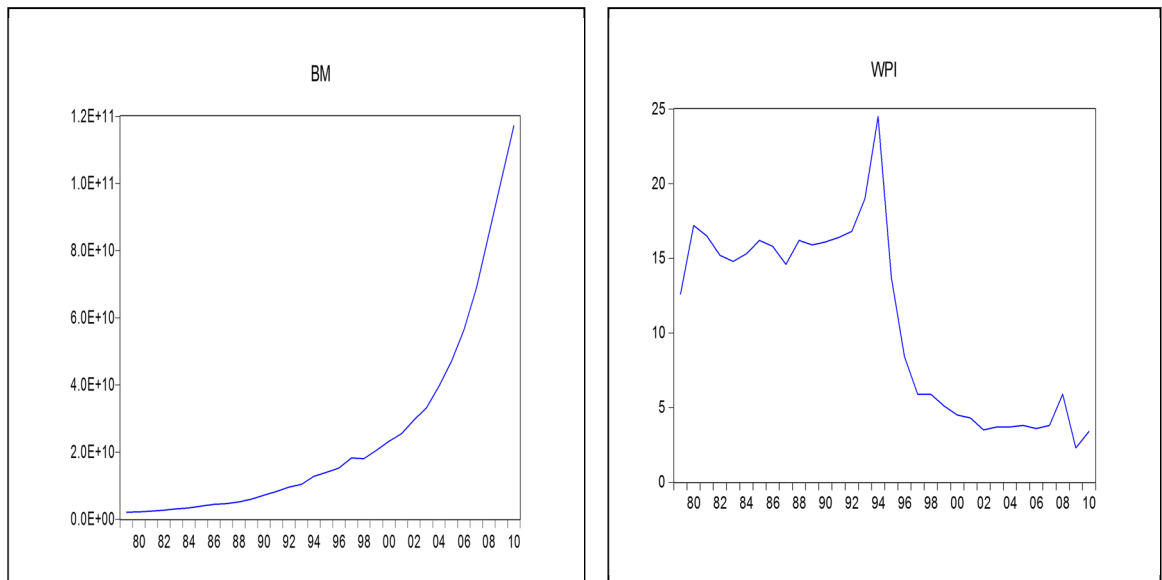


Figure 3

The trends of exchange rate

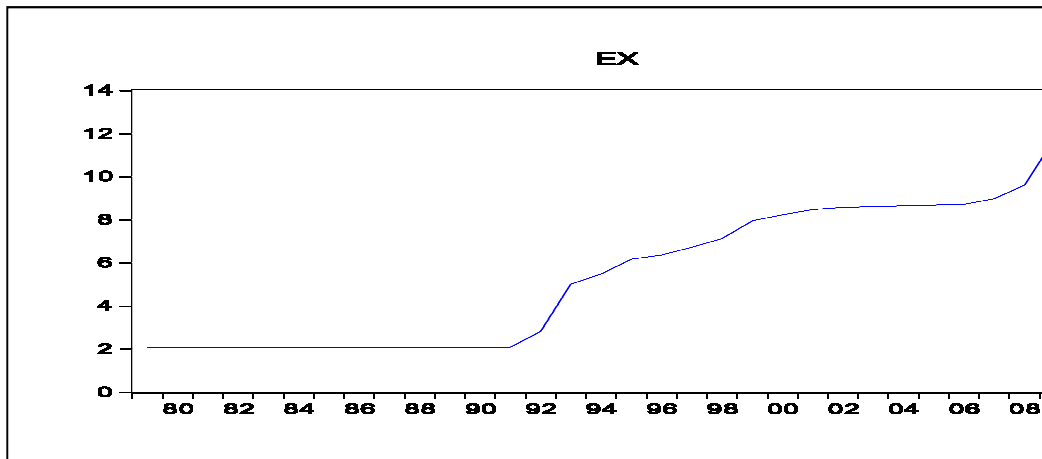


Table 4

Lag Order Selection Criteria

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	91.8198	-	-	-	68.8207	7.05856	7.16037	7.39161
0	-88.0048	7.63	1	0.006	56.5975	6.85748	6.97385	7.23811
2	-85.0294	5.9507	1	0.015	49.5078	6.71639	6.84729	7.14459
3	-79.4641	11.131*	1	0.001	36.0658*	6.39029*	6.53575*	6.86608*
4	-79.4489	.03035	1	0.862	39.1498	6.46064	6.62064	6.984

*** indicates lag length selection with each information criteria

Table 5

Johnson Tests Results for Co Integration

Hypothesized No. of CE(s)	<i>p</i> arms	LL	Maximum Eigenvalue	Trace Statistic	5% critical value
0***	56	-1033.581	1	218.1889	124.24
At most 1**	69	-997.96147	0.90695	146.9496	94.15
At most 2*	80	-971.71295	0.82621	94.4526	68.52
At most 3	89	-947.99974	0.79421	47.0262	47.21
At most 4	96	-933.12306	0.62908	17.2728	29.68
At most 5	101	-925.78324	0.38696	2.5932	15.41

***, **, * denotes rejection of the hypothesis at 5% significance level.

Trace statistic or lowest likelihood Ratio test indicates 3 co-integrating equation(s) at 5% significance level

