Determinants of Inflation in Ethiopia: A Time-Series Analysis

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Abstract

The objective of this study was to examine the major determinants of inflation in Ethiopia using data for the period from 1975 to 2014. The study employed the ordinary least square method to test for the existence of a short-run and long-run relationship between inflation and its determinant variables. The co-integrating regression considers only the long-run property of the model, and does not deal with the short-run dynamics explicitly. For this, the error correction from the long run determinants of inflation is then used as a dynamic model to estimate the short run determinants of inflation. The exceptional empirical result of this study is that the GDP is significantly and positively affect inflation rate both in the short and long-run. The explanatory variables accounted for 98 percent of the variation of inflation during the study period. This study suggests that broad money supply is to be controlled and gross national saving is to be encouraged to reduce inflation in the country.

1. Background of the study

Inflation is a sustained rise in general price level of goods and services. The definition of inflation concern neither increase in price of particular commodity nor for particular period of time. For an inflation to be happened, the rise in the general price of goods and services should be sustained. Inflation takes a crucial role in the healthy functioning of a countries economic performance. It is commonly recognized that an unpredictable fluctuation in the rate of inflation is considered a major indicator of the instability of economic activity of a country (Mishkin, 2009).

There are different hypothesis as to the cause of inflation. According to the structuralist, inflation is attributed to the structure of the developing countries economy. According to monetarist, the expansion of money supply beyond the growth of real output is cause of inflation. Inflation may also result from either increase in aggregate demand or a decrease in aggregate supply, these two sources effect price level of an economy. An inflation resulting from increase in aggregate demand is called demand-pull inflation. Demand-pull inflation arises due to many factors like money supply, government expenditures, exports or gross domestic product, etc. Cost-push inflation defined as an increase in general price level resulting from increase in cost of production. The main sources of cost-push inflation may be decrease in aggregate supply that may be due to cost of production, increasing wages, higher imports, rising taxes, budget deficit or fiscal deficit (Robert, 1982).

Price stability is one of the major goals of monetary policy and the key indicators of macroeconomic stability. Sustainable increase in general level of price may affect economic conditions negatively. Economic growth of a country depends on the level of investment resulting from the domestic saving and foreign saving of the economy. The level of investment, in turn, depends on macroeconomic stability and investors' expectation about the economy. Even though countries have desire to achieve sustainable economic growth, its means of financing may have series impact to macroeconomic stability. To achieve fast economic growth governments may exposed to budget deficits. Financing a persistent deficit by money creation will lead to a sustained inflation (Kibrom, 2008).

During the Derg regime, inflation has been low in Ethiopia for the reason that the price was controlled by the government and the government itself was providing goods at fixed price to the public. Further, the lower and fixed exchange rate has also contributed to the lower inflation rate. Similarly, inflation rate has been low in the earlier years of the present government (Sisay, 2008). However, in recent years inflation has been high in Ethiopia. Inflation rate in Ethiopia averaged 18.69 percent from 2006 until 2015, reaching an all-time high of 64.20 percent in July of 2008 and a record low of -4.10 percent in September of 2009 (www.trading economics.com).

Though Ethiopia has experienced a low inflation, recently, double digit inflation has become worrisome for policy makers as well as the society. Emirta (2013) has studied the optimal level of inflation in Ethiopia around which inflation affect economic growth optimally. The study has applied threshold approach. By doing so on the data from 1971-2010 inflation level of about 8%-10% is optimal for Ethiopia. Any inflation level, greater or less than the estimated threshold level, may not allow long-term and sustainable economic growth.

Since the level of income in Ethiopia is very low but expenditure on consumption items such as food is very high, inflationary experience results in a low level of welfare. Thus, it is essential that the government intervene to control the price trend in the country. However, such intervention requires appropriate policies devised from careful observation of the forces behind the price fluctuations. Therefore, studying the possibility of controlling inflation and its dynamics is one of the themes to be addressed in Ethiopia.

2. Objectives of the study

The main purpose of this paper is to examine both demand and supply side determinants of inflation in Ethiopia. Specifically, this study aims at estimating the direction and magnitudes of relationship between inflation and broad money supply, gross domestic product, credit facility, exports of goods and services, imports of goods and services, and gross national saving.

3. Review of Related Literature

Many researchers have undertaken a variety of researches regarding the determinants of inflation. Nevertheless, they did not agree as to the specific variables that causes inflation in the country. This implies that the issue of inflation requires an intensive study with sound methodology so that it may be easy to control and predict it.

Laryea and Sumaila (2001) examined the major determinants of inflation both in the long -run and short-run in Tanzania using OLS method, ADF test for unit root and error correction model for the time series data from 1992 to 1998 on quarterly basis. The result shows that in the short run, output and monetary factors are the main determinants of inflation. However, in the long run, the parallel exchange rate also plays a key role, in addition to output and money.

Ratnasiri (2006) attempted to examine the determinants of inflation for Sri Lanka over the period 1980 upto 2005 using VAR based co-integration approach. The findings indicate money supply growth and the increases in rice price are the most important determinants of inflation in Sri Lanka in the short run and long run. The effect of GDP growth and exchange rate depreciation on inflation has been found to be negligible and statistically not significant. The short-run effect of money growth, rice price and exchange rate effect on inflation is statistically significant. However GDP growth is not significant in short run too. It is obvious that the supply side effect on inflation in Sri Lanka is reflected through rice prices.

Mosayed and Mohammad (2009) examined the determinants of inflation in Iran for the data from 1971 to 2006. The study adopted Autoregressive and distributed lag model (ARDL) and concluded that money supply, exchange rate, gross domestic product, change in domestic prices and foreign prices, a variable that capture the effect of Iran or Iraq war are the major determinants of inflation in Iran and all are positively contributing to the domestic prices in Iran.

Olatunji et al. (2010) have examined the recent factors which are affecting inflation in Nigeria. Time series data has been selected for this particular study. The study reveals that the previous year total imports, previous year consumer price index for food, previous year government expenditure, and previous year exchange rate have negative influence on inflation rate. On the other side, previous year exports, previous year agricultural output, previous year interest rate and crude oil exports have negative impact on the rate of inflation in Nigeria.

Khathlan (2011) examined the determinants of inflation in Saudi Arabia for the period 1980 to 2009, both in the long run as well as in the short run, using cointegration method developed by Pesaran et al. (2001). The result shows that inflation in world economy, depreciation of domestic currency and supply bottlenecks are the major factors influencing inflation in the long run. In the short run, money supply and supply bottlenecks have been found to be the major factors influencing inflation in the country.

Shahadudheen (2012) analyzed the major determinants of inflation in India extracting 54 time series quarterly observations. The study employed Johansen Juselius co-integration methodology to test for the existence of a long run relationship between the variables. The error correction from the long run determinants of inflation is used as a dynamic model to estimate the short run determinants of inflation. The study concluded that the GDP and broad money have a positive effect on the inflation in long run. On the other hand, interest rate and exchange rate has a negative effect.

Ahmed (2007) examined the determinants of inflation in Ethiopia and concludes "structural changes" such as increasing bargaining power of farmers and monetary expansion are the main reasons of inflation in Ethiopia. He argues that monetary expansion is largely dictated by credit expansion in both the public and private sector. Credit expansion is explained on the public side, by decline in foreign finance flow, including a reduction foreign aid. At the same time, he points out private sector credit expands substantially, which is supported by negative real interest rate and increased investment demand.

Durevall et al. (2010), using monthly data from 2000-2009, model inflation in Ethiopia by including error correction mechanisms for food and non-food prices. In contrast to other studies on inflation, they specify separate long-run relationships for the monetary, domestic food, and external food and non-food sectors, though they ignore long-run effects of energy prices. Their findings are that the external sector largely determines inflation in the long run. Specifically, domestic food prices adjust to changes in world food prices, measured in local currency (EBT), and non-food prices adjust to changes in world producer prices. Domestic food supply shocks also have a strong effect on inflation but it is a short-run effect. The evolution of money supply does not affect food prices directly, though money supply growth significantly affects non-food price inflation in the short run. Hence, in the long run, money supply seems to be adjusting passively to demand.

4. Research Methodology

As the primary focus of this paper is to analyze the sources of inflation, the econometric model is specified to facilitate the test of hypothesis that whether explanatory variables cause inflation. Following Kazi and Munshi (2012), this study considers some important supply-side and demand-side factors for building the model as:

$$CPI = \alpha + \beta_1 lnM2 + \beta_2 lnGDP + \beta_3 lnCR + \beta_4 lnEXP + \beta_5 lnIMP + \beta_6 lnGNS + u_i$$

Where

> *ln = the natural logarithm*
> *CPI = Consumer Price Index*
> *M2 = Broad money supply*
> *GDP = Gross Domestic Product*
> *CR = Credit Facility*
> *EXP = Exports of Goods and Services*
> *IMP = Imports of Goods and Services*
> *GNS = Gross National Saving*
> *Ui = Error term*

In this study consumer price index (CPI) is used to study the rate of inflation in Ethiopia. Based on theoretical and empirical grounds the model is specified as following. The study employed secondary data obtained from various sources. The annual data of CPI, credit facility, money supply, and gross national saving were taken from National Bank of Ethiopia (NBE). Annual data on GDP, exports and imports were obtained from Ministry of Finance and Economic Cooperation (MoFEC) and Ethiopian Economic Association (EEA).

5. Results and Discussion

Unit Root Test Stationary Test

Since this study employs a time series data, it is mandatory to test stationary of data. A unit root test is conducted employing Augmented Dickey Fuller (ADF) test to prove whether the variables in the model are stationary or not. The calculated values are compared with the critical values at determined level of significance. If the calculated value is greater than any of the critical values, then we reject the null hypothesis, which actually means the variables are stationary. Otherwise, we do not reject the null hypothesis meaning that there is a nit root implying the variable is non-stationary.

From table 4.3, it can be observed that all variables are not stationary at level. However, they all become stationary after differencing once implying that they are integrated of order one I(1). The results are depicted below.

Table 4.3: Stationary test

Variables	t-statistic at I(0)	t-statistic at I(1)	Critical value at 1%	P-value at I(1)
lnCPI	0.975	-3.665	-3.662	0.0048
lnM2	4.133	-3.260	-3.662	0.0168
lnGDP	4.468	-3.412	-2.964 at 5%	0.0106
lnCR	1.027	-4.911	-3.662	0.0000
lnEXP	-0.484	-9.053	-3.662	0.0000
LnIMP	1.512	-5.251	-3.662	0.0000
lnGNS	1.135	-6.977	-3.662	0.0000

Co-integration Test

As has been made clear above, a regression based on unit roots has meaning if the variables are co-integrated, i.e. have long run relationship. According to time series econometrics, if the residuals from a regression of unit roots are stationary then the variables are said to be co integrated. This is because even if the variables are individually non stationary their linear combination is stationary which is depicted by the stationarity of the residuals. It is now clear that if the residuals from the regression of model 1 are stationary, i.e. the variables are co integrated; the results from the model will show the long run relationship among the variables. In order to check for the existence of long run relationship, co integration, in the model a unit root test on the residuals from the regression has been conducted using Augmented Engle-Granger (AEG) test. The result from the test gives an AEG test statistic of -2.859. The AEG 10 percent critical value is -2.613. Since the computed t is greater than the critical value in absolute terms, the residuals from the regression of CPI on the other variables are I (0); that is they are stationary. Thus, regression of equation 1 shows the long run relationship among the variables.

Table 4.4: Augmented Engle-Granger (AEG) test for co-integration

Variable	Test Statistic	P-value
Residual	-2.859	0.0503
Critical Value	At 1% = -3.655 At 5% = -2.961 At 10%= -2.613	

The Long-run Model

Table 4.5: Long-run results

Dependent variable: Inflation measured by CPI				
Method: Least Squares				
Sample: 1975 to 2014				
Variables	Coefficient	Standard error	t-statistic	P> /t/
C	-2.908099	0.4733919	-6.14	0.000
lnM2	0.5444128	0.0971187	5.61	0.000
LnGDP	0.580078	0.1276046	4.55	0.000
LnCR	-0.0165779	0.0672756	-0.25	0.807
LnEXP	-0.0287585	0.0467631	-0.61	0.543
LnIMP	-0.2602726	0.0969322	-2.69	0.011
LnGNS	-0.1724358	0.0859013	-2.01	0.053
R-Squared	0.9821			
Adjusted R^2	0.9788			
F(4, 35)	301.66			
D-W statistic(5,40)	1.504815			
Hetroscedasticity	Chi2= 0.08(0.7768)			

Source: own computation using stata software

Estimation of the long-run inflation model in the Ethiopian economy gives us the following result.

$$lnCPI = -2.91 + 0.54\ lnM2 + 0.59\ lnGDP - 0.02\ lnCR - 0.03\ lnEXP - 0.26\ lnIMP - 0.17\ lnGNS$$

From the above results, it can be shown that 98.21 % of the variation in consumer price index is explained by the independent variables. Simply the model explains 98.21% of the variation in the dependent variable, i.e. CPI. The f-test shows that all the independent variables jointly explain the dependent variable remarkably. Thus, over-all significance of the model is good. The Durbin -Watson value of 1.5048 which is approximately 2 shows the absence of auto correlation in the model. Generally, the R^2, the adjusted R^2, the F value and the Durbin-Watson value shows that the model is strong. The value of the constant term, -2.91, which is also significant shows that CPI will have a value of -2.91 units if all the explanatory variables included in the model are zero.

Quantity theorists state that inflation is always and everywhere a monetary phenomenon. An increase in broad money supply by one percent ceteris paribus will increase CPI by 0.54 percent on average in the long-run. As it is shown from the estimation result broad money supply is a significant factor affecting inflation. The result is according to macroeconomic phenomenon of classical economists given in quantity theory of money as increase in money supply leads to higher price levels. Due to higher money supply, more funds will be available to invest in the economy, investment will be take place, more employment will be generated, aggregate demand will increase, and finally there will be increase in consumer price index. It affects price level through demand side. However, the monetarist proposition of one to one relationship between inflation and money supply do not work in Ethiopia.

In contrast to the theoretical expectation, GDP is found to be directly related with the CPI. GDP is inducing consumer price index implying that consumer price index will increase by 0.59 percent due to 1 percent increase in gross domestic product on the average in the long run. This positive relationship between GDP and inflation may be due to the economic situation in the country. That is, to support the economy to grow fast enough; the national bank of Ethiopia lowers interest rates to make borrowing more attractive. The logic behind this is that it will encourage spending, which will lead to a rise in GDP. The drawback of this move is that it will also prompt inflation.

Both the credit facility and exports of goods and services were found to have an insignificant impact on inflation in Ethiopia. The insignificance of the credit facility in determining inflation in the country is due to the fact that in Ethiopia the credit market is too small to affect the economy though it is seen in the data trends credit facility was constantly increasing.

An import of goods and services was found to have a significant impact on inflation in Ethiopia. A rise by 1% of the imports, holding other variables constant, results in a 0.26% decrease in consumer price index and this relationship is found to be significant. This is due to the growing economy which demands more importable items that will reduce domestic demand pull inflation. Therefore, a rise in import spending, ceteris paribus,

reduces consumer spending on domestic goods and so reduces domestic inflationary pressure.

The gross national saving has been found to have significant and negative influence on CPI. That is, an increase in the gross national saving by 1 %, ceteris paribus, results in a 0.17% reduction in the consumer price index. An increase in the level of gross national saving in general and personal saving in particular will lead to a corresponding decrease in the total disposable or spendable income of consumers. The assumption is that when consumers do not have as much money to spend after the calculation of their net pay, they will make a downward reversal in their spending and consumption habits, reducing the aggregate demand in the economy, and also bringing down the level of inflation.

The short-run Error correction model (ECM)

Although there is a long-term equilibrium relationship between dependent and independent variables i.e. (co-integration), in the short-run there may be disequilibrium. The error correction model is employed to correct for disequilibrium and determine the short-run relationship between variables. The analysis of short run dynamics is often done by first eliminating trends in variables usually by differencing. The ECM model incorporates the equilibrating error (ECM t-1) to capture the adjustment towards the long-run equilibrium and specified as follows:

$$DCPIt = \alpha + \beta 1 DlnM2t + \beta 2 DlnGDPt + \beta 3 DlnCRt + \beta 4 DlnEXPt + \beta 5 DlnIMPt + \beta 6 DlnGNSt + \beta 7 ECMt - 1 + Ut$$

Where, D= Difference

Table 4.6: Short run model

Dependent variable: Inflation measured by CPI				
Variables	Coefficient	Standard error	t-statistic	P> /t/
ECM	**-.**2556782	**.**1105005	-2.31	0.027
DlnM2	**.**5910263	**.**2191722	2.70	0.011
DlnGDP	**.**4598226	**.**1548345	2.97	0.006
DlnCR	**-.**0273169	**.**0499754	-0.55	0.589
DlnEXP	**-.**012102	**.**0182568	-0.66	0.512
DlnIMP	**-.**0862445	**.**0818749	-1.05	0.300
DlnGNS	**-.**0858332	**.**0430259	-1.99	0.055
C	**-.**0201206	**.**0253307	-0.79	0.433
R-squared	0.6333			
Adj R-squared	0.5505			
F(5, 33)	7.65 (0.0000)			

Own computation using stata software

D= Difference

Based on the above table, R^2 and adjusted R^2 for the short-run model are 63% and 55% respectively showing that 63% and after adjustment 55% of the variation in CPI is explained by the variation in the explanatory variables in the short-run. Further, the result of the short-run model revealed that broad money supply, gross domestic product and gross national saving are significant variables in explaining the variation of inflation in the short-run whereas credit facility, export and import are insignificant variables.

The lagged ECM coefficient indicates that 26 percent of the disequilibrium in CPI in one period is corrected in the next period. In other words, it indicates the speed of adjustment of about 26 percent from the actual price level in the short-run to the long-run equilibrium level. Moreover, it shows 26 percent of the discrepancy between the actual and the long-run or equilibrium value of CPI is corrected each year or it takes more than three years to adjust the disequilibrium of CPI.

6. Conclusion and Recommendations

In Ethiopia, in the face of series macroeconomic problems, which includes continuously rising money supply, huge debt servicing, persistence current account and budget deficits, and currency devaluation, inflationary process is high. Recently, though a continuous growth in GDP has been recording, the inflation trend does not decline as expected but it shows a fluctuation. Given this macroeconomic environment, analysing factors that determines inflationary process is important.

This study examined the effects of some factors on inflation in Ethiopia by means of co-integration and error correction methods using yearly data for a period of 40 years. The results of the analysis reveal that in the long run broad money supply and gross domestic product are contributed in raising consumer price index while consumer price index is bound to decrease due to higher imports and gross national saving. Credit facility and exports are found to be insignificant. In the short run, the coefficient of error correction term is -2.26 suggesting 26 percent annual adjustment towards long run equilibrium. Broad money supply (M2) has more positive effect on inflation than GDP and GNS in the short-run. The broad money supply coefficient is 0.60, implying a one

percent increase in broad money supply trigger 0.60% increase in inflation. On the other hand the GDP coefficient is 0.46 and the GNS coefficient is –0.90, implying a one percent increase in broad money supply trigger 0.46% increase and 0.90% decrease in inflation respectively. The credit facility, exports and imports are found to be insignificant in the short-run in explaining inflation in the country. On the basis of the findings of the study, it can be concluding that inflation in Ethiopia is determined by demand side factors as well as supply side factors but gross domestic product and money supply are critical.

Based on the findings of the study, the following measures may help in reducing inflation in Ethiopia.

- A tightening of monetary policy is necessary for a reduction of the inflation rate. Since it would be difficult to realize sufficient reduction of inflation only by monetary policy, without impacting on economic growth, a reduction of inflation inertia through removal of structural factors is needed. To enhance the central bank's credibility and transparency of monetary policy, it is important to reduce excess money supply.

- Since the gross national saving plays a critical role in reducing inflation especially in the short-run, the government has to take various measures to increase the public saving while encouraging business firms and households to rise the private saving. This action helps not only to lessen the rate of inflation but also to provide potential investors with adequate investible funds.

- The government will have to pursue a monetary and fiscal policy which matches with the actual scenario of real sectors and monetary sectors. It is strongly experienced that further study should be carried out using different sets of variables and appropriate mathematical models to detect the inflation determinants in Ethiopia.

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