

## Interaction of Ethiopian and World Inflation: A Time Series Analysis; VECM Approach

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### Abstract

The research had tried to identify co-integration of the domestic inflation of Ethiopia with the world level. Given this, the study considered effect of world oil price increment on Ethiopian inflation by considering time series data from 1981-2012 sourced World Bank. Vector Error Correction Model was employed to model long run co-integration of variables and to identify the significant independent variables as well as speed of adjustment of the long run equilibrium. Different tests that are pre-conditions for this model were done by having respective methods. Based on the result obtained in the long run co-integration model world oil price, household level and government expenditure of the country, world level inflation and money supply growth of the country affect the domestic inflation positively as well as significantly. Given this, world oil price and government expenditure of the country affects the domestic inflation positively and in a significant level even in the short run. Speed of adjust of deviation from the equilibrium trend is not as such fast enough. Domestic inflation of Ethiopia is very responsive to each shock in the world level inflation and world oil price as depicted by the impulse response graphs.

**Keywords:** Inflation; Co-integration; Ethiopia

### Abbreviations

AIC: Ackakie Information Criterion

CPI: Consumer Price Index

CSA: Central Statistics Agency

EDRI: Ethiopian Development Research Institute

FAO: Food and Agricultural Organization

GDP: Gross Domestic Product

HQIC: Hannan-Quinn and Information Criterion

IMF: International Monetary Fund

LR: Likelihood Ratio

NBE: National Bank of Ethiopia

SBIC: Schwarz Bayesian Information Criterion

VECM: Vector Error Correction Model

WB: World Bank

WDI: World Development Indicator

### Introduction

#### Background

As the world's economies become more interconnected, a thorough understanding of how foreign policies affect domestic activity becomes crucial. Whether and how macroeconomic policy actions can be transmitted across countries and the extent to which flexible exchange rate may insulate an economy from foreign repercussion are important issues for today's monetary policymakers [1]. In a context of high and more volatile prices, understanding to what extent and speed price changes on international markets are transmitted to consumers is a key variable in assessing vulnerability of society from foreign price shocks.

International food price inflation could transfer directly to domestic food prices through purchase of imported goods from wholesalers

on international output markets and indirectly, through purchase of imported agricultural inputs from producers on international markets. Transport and transaction costs incurred in import market are often cited as one of the main sources of non-linearity in the price transmission process. A wide range of policy intervention affects degree of correlation between international market prices and domestic consumers' ones [2].

Arguments continued as to what are the reasons behind the recent global food price hike. Generally, several factors such as increase in aggregate demand, shortage of supply, environmental calamities, population increase, diversion of agricultural products usage for non-food purpose, rapid economic growth (mainly in emerging economies), an alarming increase of oil price, etc are claimed for the skyrocketing prices. However, FAO's report in 2008 rejects the claim that emerging economies have been a reason for the food price explosion, since domestic production in countries like China and India has been growing correspondingly during the same period. Rather, the use of agricultural products for purposes other than food such as feedstock and bio-fuel production has been the most important factor behind the rise of global inflation.

Since the last two decades, as part of the global and national initiatives, the government of Ethiopia together with its development partners has been pushing towards economic development with aim of achieving a broad based and sustained economic growth. Lack of clarity as to what exactly causes such a spike in price is still a challenge to reinforce sound policies in the course of taking corrective actions

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[3]. Hence, a further study to identify the real causes of food inflation is still essential [4].

In Ethiopia, inflation was not a concern until 2002/03 [5], but afterwards began to increase at an alarming rate. For instance, the annual average food inflation rate between July 2011 and June 2012 was 36.9% and in October 2012 compared to October 2011 was 30.4% [6]. Several factors have been claimed for the soaring food inflation of Ethiopia. As reported by the Ethiopian CSA [7] the cause of food inflation during the period from June 2007 to June 2008 was export of food items. Monetary developments are seminal factors for high food inflation in Ethiopia [8]. Increase in aggregate demand is the preceding reason for food inflation due to high demand for food [9]. On the other hand, internal and external factors such as international commodity price increase, enticing economic performance, increase in money supply and injection of cash into the rural economy, behavioural changes in farmers, and local purchase increment by institutions and agricultural cooperatives are accountable for the recent inflation [10]. Alarming increase in demand, poor harvest, higher fertilizer, transportation costs; and world oil price hiking are also mentioned as major causes for food price inflation [11]. However, there is no agreement between academicians, researchers and the government on the real factors responsible to the hiking price of food items in the nation [4]. To continue the envisaged economic growth, searching for the real causes of inflation is a first step one has to do in order to propose an outright solution to the problem.

### Statement of the problem

Inflation is erosion in the purchasing power of money, a loss of real value in the internal medium of exchange and unit of account in the economy [12]. High and increasing food prices pose a significant policy challenge particularly in developing countries where the share of food in household income is relatively high [13]. Inflation is one of the multifaceted challenges that the Ghanaian economy have been encountering for a very long time in spite of the numerous economic policies that have been formulated to neutralize its existence. It is indeed imperative to research for effective and efficient measures to curb inflation in order to sustain development and increase economic growth [14].

The concern with inflation emanates not only from the need to maintain overall macroeconomic stability, but also from the fact that inflation hits the poor particularly those who do not possess effective inflation hedges. Inflation injects noise into the price system, makes long-term financial planning of the country more complex phenomenon. Rapid price rise now-a-days is at the top agendum of the international community. People developing countries particularly are highly exposed to food insecurity as they are financially incapable to afford basic food crops. High inflation has been the most adverse economic shock that has continued to adversely affect Ethiopian economy where significant proportion of households had to adjust their consumption in response [15].

Successive inflation would automatically increase living cost of households in poor countries in which the society has not buffered stock. Because of higher food inflation, households have to make reductions in some areas of their consumption leading to malnutrition. High inflation erodes benefits of growth and leaves the poor worse off [16]. It hurts the poor more, since more than half of the budget of low wage earners goes toward consumption. It redistributes income from fixed income groups to the owners of assets and businessmen and increases the gap between rich and poor [17]. Relative strength of the

impact of this macroeconomic problem also crucially depends on the share of imports in domestic demand, which is positively correlated to price transmission [2]. Though there are plenty of researches done in connection with inflation in both national and international level but they did not address co-integration of domestic inflation with the world and regional levels. They also do not address the issue of integration between the world and local markets. Based on these circumstance this study had tried to examine whether the domestic inflation has co-integration with the world level inflation or not. Specifically it had tried to assess trend of Ethiopian inflation, examine co-integration of domestic inflation with the world inflation and world oil price, and identify macroeconomic factors that aggravate domestic inflation.

## Methodology

### Type and method of data collection

The research used secondary series data, which were compiled from CSA, NBE, IMF and world development indicator (WDI) of World Bank. It covered time interval of 1981-2012. The interval covers more than 30 years, which is enough to apply times series analysis both in the long and short run methodologies. Different scholars used time series data that were smaller than what this research considered. Time interval from 1990-2009 was considered to assess macroeconomic determinants of inflation in Ghana [14]. In the same logic [18] in 2011 used time series data runs from 2000-2011, which is very short period to say time series analysis and to apply the period based error correction model. Some of the variables may not be stationary at zero level of differencing or they may not be zero order integration. Then differencing of each value would be the solution in order to fulfill precondition of stationary. After differencing the non-stationary variables the research finally had left with 30 years data.

### Method of data analysis

Based on the view of monetary economists inflation is caused by monetary factors, real factors and anticipated prices. Taking into account those factors the general model could be specified as equation (1):

$$I = F(MtYtEtPte) \quad (1)$$

Where, I = Inflation measured as the average growth in consumer price index (CPI).

M = Money supply which is defined as the sum of currency outside deposit money, banks and demand deposits plus quasi-money.

E = Exchange rate, defined as annual average of official exchange rates based on monthly averages (local currency units to the US dollars).

Y = Growth in GDP.

P<sup>e</sup> = Price expectations computed from CPI.

t = Time period denoting the t<sup>th</sup> year.

Thus, the specific long-run equation for estimation would be equation (2):

$$I_t = a_0 + a_1M_t + a_2Y_t + a_3E_t + a_4P_t^e + \mu_t \quad (2)$$

Where 'a<sub>0</sub>' and 'μ<sub>t</sub>' in the model are constant and error or stochastic disturbance term respectively. The error term addresses influence of other factors on inflation that have not been mentioned in the model. After incorporating independent variables that affect domestic inflation of the country the equation will be transformed to equation (3):

$$DI_t = \beta_0 + \beta_1 M2_t + \beta_2 GovEXP_t + \beta_3 EXR_t + \beta_4 HHcon_t + \beta_5 GDP_t + \beta_6 WOP_t + \beta_7 WI_t + \beta_8 RI_t + \varepsilon_t \quad (3)$$

Where: DI = Domestic inflation.

M2= Broad money supply.

GovEXP= Government expenditure.

EXR = Exchange rate.

HHcon =Household consumption expenditure.

GDP = Gross Domestic Product.

WOP = World oil price at the international market.

WI = World inflation.

RI = Regional import.

For regressing the above equation Vector error correction model (VECM) was employed, which is a model appropriate to identify both short and long run determinants of inflation. At the same time the model could also help the research to analyze speed of adjustment of each deviation from the long run equilibrium. Co-integration relations among price indices were identified by applying Johansen's co-integration tests, while potential causal relations were examined by employing Granger's causality tests. Application of VECM could allow examining existence of short term adjustments and long-term dynamics. Unit root test was done for all the variables to identify non stationary at level and stationary at first difference.

### Definitions of variables

**GDP:** Difference in log of GDP per capita income would be incorporated in the regression to capture the economic conditions of the country in terms of business cycle and hence to capture the income-driven increase in demand for food.

**Government expenditure:** Increment in government expenditure may result into dumping of huge money in the economy, which in turn leads to demand pull inflation due to increment in purchasing power of the society.

**Household consumption:** Since it is source of demand pull inflation within the domestic economy this variable will be considered as an independent variable and it is expected that there will be significant and positive co-integration with both food and non-food inflation of the country.

**Import from different regions in the world:** Merchandise items imported from main trade share of the country would be considered. This is to assess interaction of the inflation in those regions with the domestic one. Greater dependence and interaction with regions imports would result into higher food price inflation rates in the domestic economy.

**Exchange rate:** Since it is one of the bridge or transfer of foreign inflation and the domestic one the research will consider exchange rates (local currency per US\$) of the country as one explanatory variable. Depreciation of local currency against the US\$ will result in higher domestic prices of imported food products in local currency, this variable is expected to have a positive sign in affecting the domestic inflation.

**World level inflation:** Global price inflation based on FAO's food price index would be considered as a regressor expecting that there will be significant interaction with the domestic inflation level.

**Sub-Saharan African inflation:** Inflation index of this region will be considered as one independent variable to observe its interaction with the domestic inflation.

**Domestic money supply:** It is one source of inflation as to the view of many scholars; especially demand pull inflation is directly sourced from it.

**World oil price:** Since Ethiopia is dependent on foreign markets for its oil consumption global oil price inflation may highly affect domestic inflation as well as the whole economy. This is to account the derived influence of global oil prices on individual countries' food prices.

## Result and Discussion

### Inflation trend of Ethiopia

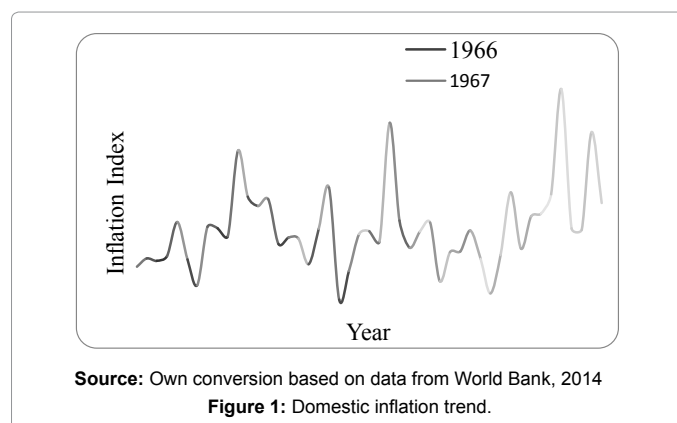
Overall inflation of the country showed greater oscillation in different fiscal years. Though there is no clear identification of the respective determinants of this circumstance, but it may be pulled and pushed by different factors and result into having different level at each respective times (Figure 1).

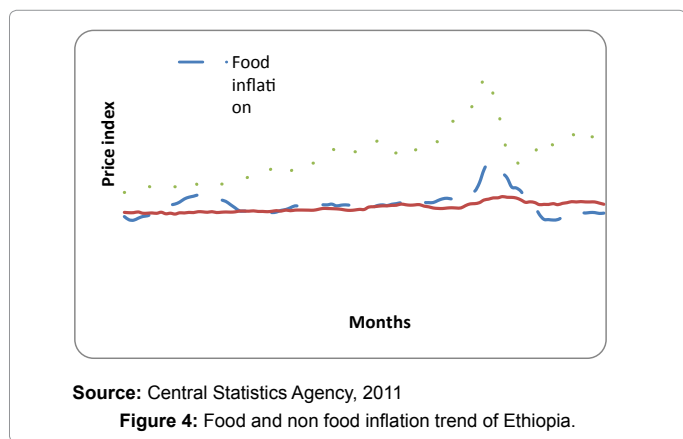
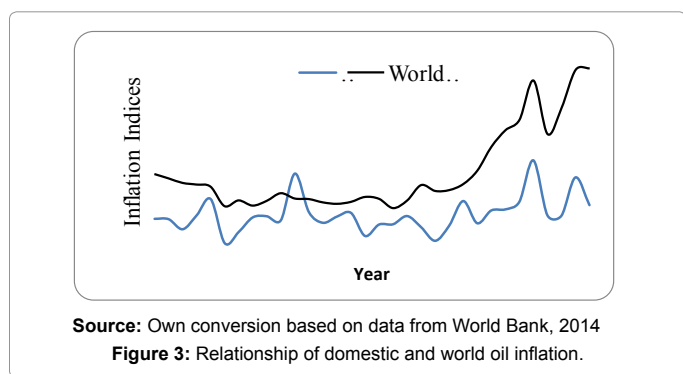
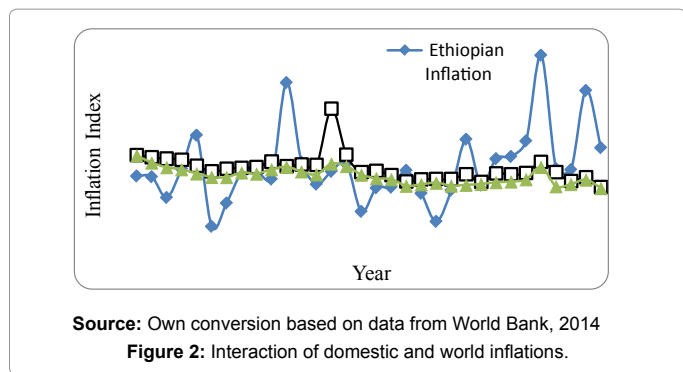
Based on the above graph there is no a clear trend in inflation movement of the country. In some years it was galloping type (in 1976, 1991 and 2008) and sometimes there were great deflation (1973, 1987 and 2002). The extreme galloping inflation of 2008 may had connection with the world economic crises of the time.

The figure below showed that there was similar trend in world and the regional inflation level of Sub Sahara African. Although Ethiopian food price index showed similarly increasing trend as to world price index in most of the times, meanwhile Ethiopian price index has been consistently higher than world level. This suggests existence of significant local causes behind the food price surge of Ethiopia (Figure 2).

Even though, when the world oil price dropped below US\$70 per barrel between September 2006 and June 2007, Ethiopian food price index was still rising [19], but one can perceive that world oil price seems to play a major role in food price hike of Ethiopia. Based on the above graph there is clear cut relationship between inflation in SSA and the world economy. Based on the similarity exhibited above inflation of SSA may have greater co-integration with world level throughout the times considered (Figure 3).

Domestic inflation of Ethiopia had similar movement with that of world oil price, in which the co-movement of the two showed greater similarity starting from 1992 onwards. After 1985 the world oil price revealed trend like movement of successive increasing and radical type





of increment after 2003. On behalf of this year the two indices show similar movement in their ups and downs indicating co-integration between them. The highest level domestic inflations and world oil price hike happened in the same fiscal year of 2008. This co-integration was also observed before 1970s.

### Food and non-food inflation of Ethiopia

In most of the times food inflation is higher as compared to the non-food one in the country. Given this, the larger share in overall inflation of the country is sourced from the food inflation as it was observed in 2002 and 2008 when there was drastic inflation. Monthly inflation of non-food items of the country was not as such oscillatory as compared to the food inflation (Figure 4).

### Inflation transmission

Domestic monetary policy influences real activity of the country through an inflation-tax channel. These real effects are transmitted to

foreign nations via fluctuations in real exchange rate. Under a flexible nominal exchange rate, inflation is a beggar-thy-neighbor policy. Under a flexible nominal exchange rate each country suffers a welfare loss when one inflates [1].

Transport costs associated with shipment of imported commodities within the country's borders have to be distinguished from those incurred to ship commodities, domestically produced or not, to domestic consumption hubs. Exchange rate fluctuations can absorb or amplify price changes on international markets, as the national currency appreciates or depreciates vis-à-vis the currency in which commodities are traded [20]. A wide range of policy interventions affect the degree of correlation between international market prices and domestic consumers' prices. Most important determinants of non-food inflation are inflation expectation, real money growth and interest rate, in order of their importance. Monetary growth leads increment in demand and, for a given supply of non-food items, leads to rise in non-food price [5].

### Analysis results

Different researcher who had forward their findings argued that real income, interest rate, inflation expectations, exchange rate, international prices, administered prices, wages and food supply are the core short run determinants of inflation in Ethiopia. Growth in real income, interest rate and wages would fuel the demand and lead to rising prices for a given level of output while food supply growth serves to cool down the price pressures. The exogenous international prices and administered prices are also found to be significant [5]. Though there was identification of the determinants of domestic inflation by different scholars but they did not show interaction of world inflation and fuel price with that of domestic inflation. Here in this research there was consideration of regional prices and import values to observe whether they have integration with the domestic inflation or not? Thus, to have this co-integration this study considered the long and short run co-integration of the domestic inflation and other macro economic variables.

**Stationary test/Unit root test:** Augmented Dickey-Fuller (ADF) test was applied to have unit root test for each variable having a unit-root null versus a stationary alternative hypothesis. The test result is presented below (Table 1) for all of the variables except for dummy variables. Non-stationary variables at their level were differenced to make them stationary and the null hypothesis of unit root was rejected at conventional level of significance. Based on the result, money supply growth of the country, domestic and world level inflation were  $I(0)$  at 5% and 10% level of significance, while all other variables used in the model are integrated of order one ( $I(1)$ ), in which domestic household

No.	Variable name	P-value at level	P-value 1st difference	Integration order
1	Domestic inflation	0.0134	0.0000	$I(0)$
2	SSA inflation	0.1019	0.0000	$I(1)$
3	World inflation	0.0574	0.0000	$I(0)$
4	World oil Inflation	0.9806	0.0000	$I(1)$
5	Government expenditure	0.7901	0.0032	$I(1)$
6	Household Consumption	1.0000	0.0119	$I(1)$
7	Import N&E Africa	1.0000	0.0452	$I(1)$
8	Import S Asia	0.9805	0.0000	$I(1)$
9	Imports East Asia Pacific	0.9991	0.0052	$I(1)$
10	Money SS growth	0.0574	0.0000	$I(0)$

Source: Own calculation from World Bank data, 2014

Table 1: Unit root test of variables.

consumption and import from North and East African nations are stationary at 5% level of significance.

The test result suggests that the variable of interest, domestic inflation exhibit a non-stochastic trend or stationary drift even at its first order of integration, though it is not perfectly stationary (Table 1).

Thus, co-integration analysis attempts to explain the long-run trend developments by identifying long-run determinants, or I(1) explanatory variables, which share a common trend, i.e., co-integrate, with domestic inflation.

Having this test of unit root the long run co-integration equations only consist of variables which are I(1). Given this, imperfection in having unit root at I(0) for some of the variables including the dependent one, domestic inflation, long run co-integration conserved them at I(1). Variables appear to be stationary at I(0) so that (transitory) changes in these variables are likely to have only a short-run impact on the explained variable. Thus, these variables should only be introduced in the short run equation of the domestic food price inflation. Differences in the long-run level of such variables should be reflected in the constant terms of the co-integrating equations, representing level rather than trend implications. Construction of the parsimonious vector error correction model specified in equation (4) is based on this argument.

**Lag length determination:** Since the dependent variable is time series type, the previous year observation of either the dependent or independent variable may be considered as an explanatory. Previous year value of the dependent variable may be also taken into account as an independent variable. This process could force the research to determine the lag length that will be considered in the operation. To determine this one can use one of the well known methods of determining the lag length. Likelihood Ratio, Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC) and Schwarz Bayesian Information Criterion (SBIC) were used to determine the appropriate lag length that would be incorporated in the regression (Table 2). One could make some subjective judgment if necessary in determining the lag length when the three results pointed different level [21]. In this research four of the information criterion indicated the same level of lag length. Based on information gained from those tests (LR, AIC, HQIC and SBIC) the research fixes lag length three as optimum level. Therefore, the research considered three to be the optimum lag lengths as this value is indicated by majority of the criteria (Table 2).

**Johansson test of co-integration:** The implication behind this series of tests is that if each time series variable is non-stationary, linear combinations of such them are stationary and might exist. In that case, multiple times series are co-integrated and share some common stochastic trends. One can interpret presence of co-integration to imply that long run movements in these multiple time series are related to each other. Indeed, if there is a long-run relationship between two or more non-stationary variables then the general concept of co-

Lag	LR	FPE	AIC	HQIC	SBIC
0	--	7.8e+99	255.55	255.679	255.982
1	143.57	2.e+100	256.233	257.517	260.552
2	1324.8	6.6e+82*	213.168	215.608	221.374
3	<b>14632*</b>	--	<b>-323.42*</b>	<b>-319.952*</b>	<b>-311.757*</b>

\*indicates the optimal lag

Source: Own test result from World Bank data, 2014

Table 2: Test result for lag length determination.

Maximum rank	Eigen value	Trace statistic	5% critical value
0	---	393.3482	192.89
1	0.99477	241.0070	156.00
2	0.96716	141.9397	124.24
3	0.88333	<b>79.6370*</b>	<b>94.15</b>
4	0.72320	42.3877	68.52
5	0.49133	22.7848	47.21
6	0.35117	10.2399	29.68

\*Indicates the rank of the co-integrating matrix

Source: Own regression result, 2014

Table 3: Johansson co-integration test result.

integration is that deviations from this long run path are stationary. If this is the case, variables in question are said to be co-integrated of a certain order level. A time series can however, only be co-integrated if it is integrated of the same order [22]. Any co-integration series has an error correlation presentation suggesting that co-integration is a necessary condition for an error correction model (ECM) to hold [23]. Indeed, such models incorporate both economic theory relating to the long run relationship between variables and short run disequilibrium behaviors [24].

This test tried to show co-integration of the dependent variable and independent ones. It is way of asserting existence of co-movement in the two variables. Existence of correlation between the two variables should be tested by running this test. Here the research performed this test to assert existence of long run co-integration between the dependent and independent variables. This implies that here the research is trying to see long run first order of integration. Result of the Johansen co-integration test depicted in Table 3 shows that there are three co-integrating equations (Table 3).

This analysis is the pre-condition and base of having both the long and short run inter relationship of the dependent and independent variables.

**Long run co-integration analysis:** Macroeconomic theory is mainly based on long-run equilibrium relations and economic theory rarely tells us everything about short-run dynamics after having frequent long time analysis. If variables are non-stationary but co-integrated, it is possible that the parameters of long-run relations are estimated consistently without considering short-run dynamics. In order to estimate long-run equilibrium relations consistently, there may not be need of complete and fully specified model [25].

Based on the pre-estimation diagnostic tests variables are co-integrated among themselves. If a set of variables are co-integrated, then there exists a valid error-correction representation of the data [22,26]. This parsimonious VECM is specified in equation1 from which the long run and short run determinants of domestic inflation would be estimated. Given that the co-integrating matrix is of rank three for each case, potentially co-integrating equation of the model for this study period was estimated and the following result was obtained (Table 4).

In the long run model result presented above, almost all of the variables are statistically significant in affecting the dependent variable, domestic inflation. Thus, it can be argued that those variables are long run determinants of the domestic inflation of Ethiopia. The two international variables (world inflation and world oil price) that are related to inflation are significant and having the expected sign of interaction with the dependent variable. World inflation has elastic type of co-integration with domestic inflation level. Price hike at international market would push the domestic price up since it makes

No	Variables	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
1	DWorldinf	1.818815	0.0001487	-1.2e+04	0.000	-1.819106 -1.818524
2	DSSAif	-0.580797	0.0000521	1.1e+04	0.000	.5806947 .5808991
3	Dgovexpend	2.43e-10	3.48e-14	-6983.07	0.000	-2.43e-10 -2.43e-10
4	Dhhconsum	1.28e-10	1.66e-14	-7707.03	0.000	-1.28e-10 -1.28e-10
5	Dimports NAfr.	-1.80e-08	4.44e-13	4.1e+04	0.000	1.80e-08 1.80e-08
6	Dimports Asia	-4.52e-09	3.64e-13	1.2e+04	0.000	4.52e-09 4.52e-09
7	Dimports EAsia	-2.42e-10	1.72e-13	1404.95	0.000	2.42e-10 2.42e-10
8	Dmonessgro	-0.000076	0.000031	2.48	0.013	0.0000158 0.000136
9	DWorldoilpri	0.87432	0.000042	-2.1e+04	0.000	-0.874401 -0.874236
10	Cons.	-0.283778				

Source: Own regression result, 2014

Table 4: Long run co-integration VEC model result.

No	Variables	Coef.	Robust Std. Err.	Z	P> z	[95% Conf. Interval]
1	DimportsNAfr.	-7.25e-09	2.29e-09	-3.16	0.005	-1.20e-08 -2.47e-09
2	DimportsNAfr_1	-1.07e-08	3.53e-09	-3.02	0.006	-1.80e-08 -3.33e-09
3	Moneessgrowth	0.773779	0.339144	2.28	0.033	0.068491 1.479066
4	Dgovexpend_1	1.29e-09	6.27e-10	2.06	0.052	-1.44e-11 2.59e-09
5	Dhhconsum	-3.94e-10	1.21e-10	-3.25	0.004	-6.46e-10 -1.42e-10
6	DimportSAsia_1	3.90e-09	1.90e-09	2.05	0.053	-4.85e-11 7.84e-09
7	DWorldoilpri	0.9106081	0.1642894	5.54	0.000	0.5689495 1.252267
8	CEM_1	-0.3359227	0.125253	-2.68	0.014	-0.596401 -0.075445
9	Cons.	-8.825261	4.67713	-1.89	0.073	-18.55188 0.901364

Source: Model result based on the data from World Bank data, 2014

Table 5: Parsimonious VEC model (Dependent variable of Differenced domestic inflation).

imported items more expensive. Impact of an increase in oil prices on general price level can be expected to be positively correlated with the fuel intensity of an economy [27]. Two of them affect domestic inflation positively and one can say that there is transmission of international inflation to the domestic one. Based on this finding, it may be possible to conclude that domestic inflation of open economy may be imported type, having *citrus paribus* condition in the domestic economy.

Based on Table 4 the two main sources of demand (government and household consumption expenditure) in the domestic economy have had significant effect in the long run inflation variation of the country. Expansion of the two expenditures would automatically result into huge increment in domestic inflation. Accordingly, national income and exchange rate affect domestic food price dynamics both in the short run and long run. Most of the coefficients have appeared with their expected signs.

Given these, inflation of SSA region showed negative long run co-integration with the domestic inflation, this may be because of market diversion or searching alternatives by Ethiopian economy when there is price increment in the neighbor countries. Since import increment of a nation has both value and volume effects, increment in import may has ambiguous effect on the domestic inflation. This circumstance happened on this result where increment in import of the country from the three main trade partner regions result in reduction of domestic inflation.

**The short run equation:** The presence of a long run co-integrating relationship implies that there exists a parsimonious error-correction model that describes the short-run dynamics consistently with the long-run relationship [24]. Given evidence about long-run equilibrium relationship between integrated variables, the short-run dynamics is captured by lags of the differenced variables and an equilibrium correcting term. As a result, the remaining part of the model specified

in equation (4) was fit and the short run coefficients and speed of adjustment to the long-run equilibrium have been estimated and the parsimonious vector error correction model have been reported in Table 5 along with their significance level. ECM is the time series residuals from the co-integrating vector coefficient of the long run analysis. Equation of this model incorporates a corrective mechanism by which previous disequilibrium in relationship between level of the dependent variable and one or more determinants are permitted to affect current change.

The short run equation can then be reduced to a parsimonious equation after elimination of insignificant terms and imposition of constraints that holds a reasonable approximation [4]. This econometric analysis tries to show short run interaction of variables and it is direct extension of the long run result after considering significant variables and their coefficients only. Speed of adjustment in the deviation from the equilibrium was formulated based on the long run regression result. Change in one or more of the independent variables would result into short run deviation from long run trend of the domestic inflation. Thus, the equation would be formulated in the following form:

$$CEM = D \text{ dominfla} + 1.818815 * D \text{ World inf} - 0.5807969 * DSSAif + 2.43e^{-10} * Dgovexpe + 1.28e^{-10} * Dhhcon - 1.80e^{-08} * Dimports Midl ENAfrica - 4.52e^{-09} * DimportSAsia - 2.42e^{-10} * DI mE Asia Paci - 0.000076 * D moss grow + 0.8743185 * D Worldoilpri - 0.2837779. \quad (4)$$

Short run significant impact of world oil price increment may be expressing the country's pure dependency on imported crude oil and gas as source of energy. The world oil price shock directly affects the domestic food price through its impact on transportation costs and high cost of production. This is particularly true in an area where most of domestically produced food items are obtained from other surplus producing distant areas within the country [13].

The model result presented below showed that all of the variables considered in the regression affect the dependent variable significantly but in different directions. Some of the variables like, world oil price, government expenditure, money growth rate and imports from south Asia affect the dependent variable positively and significantly. From those variables the first two affect the dependent variable in both the long and short run operation in significant and positive direction (Table 5).

Successive increment of government expenditure has long run effect which means previous year increment of the expenditure would have positive effect on domestic inflation of the country. Due to huge dependency on imported items effect of world oil price on domestic inflation is very fast and one can say that short run inflation of Ethiopia can be imported type.

Impact of household consumption expenditure showed reversed effect on the short run domestic inflation as compared to its long run effect. Consistently negative impact on domestic inflation is happening from import increment of North African countries. Both the short and long run effect of import increment of the country from different regions is consistent in affecting domestic inflation.

Given all the above, speed of adjustment of the deviation/disequilibrium that results from change in one of the independent variables in the short run from the long run trend is not as such fast that is 33.6% per year, which means no full adjustment within one year.

**Measuring impulse response of the domestic inflation:** Several econometric techniques have been employed to assess how world prices changes are transmitted to domestic prices. Earlier studies of price transmission relied on simple correlation coefficient: a high correlation value was interpreted as a sign of strong integration between markets [28]. As it is well known, the approaches based on correlation coefficients suffer from several shortcomings. Apply a regression technique could be better for modeling transmission of world agricultural commodity prices [29]. However, this was also criticized by later studies because the relationship between domestic and world prices was analyzed in a static framework. It is suggested that inclusion of some dynamics is necessary since price adjustments usually do not completely instantaneous but take time. Error correction models proposed to take price dynamics into account [30,31]. A vector error correction model is also postulated to better capture the dynamics among prices.

Given those model employed before, this study tried to assess response of domestic inflation for single time shock in the world inflation and world oil price. Based on impulse response result shock in the two variables has similar effect on domestic inflation, which means their impact lasts longer period of time while disturbing domestic inflation of the country. The domestic inflation is too responsive for shocks resulted in world inflation than world oil price.

The x-axis gives time horizon or duration of the shock whilst the y-axis gives direction and intensity of impulse or percentage variation in the dependent variable, domestic inflation, away from its base line level. The response lasts longer period after it showed drastic variation in the short period. It has an upward moving trend in the long period of time (Figure 5).

Impulse response of the domestic inflation to the world oil price shock exhibits a rising trend initially though it is not as such huge like that of world inflation (Figure 6).

Moreover, the shocks of world oil price have initially negative effect

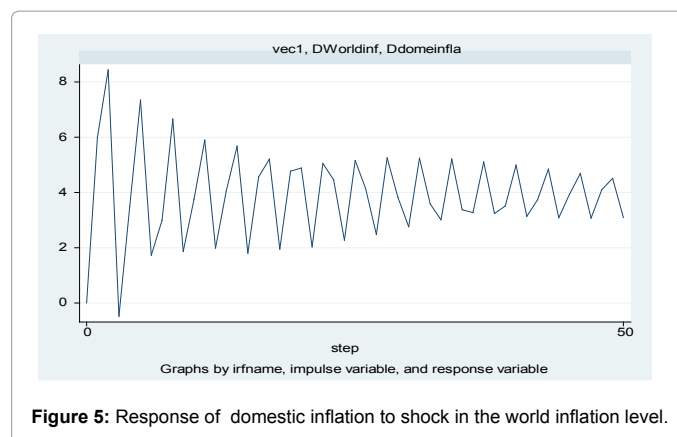


Figure 5: Response of domestic inflation to shock in the world inflation level.

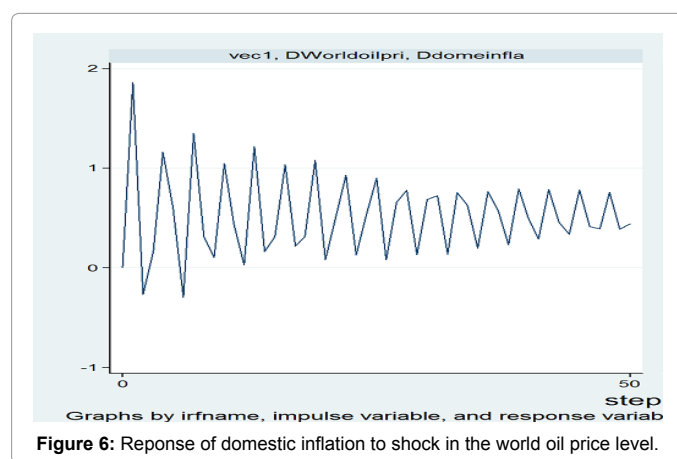


Figure 6: Response of domestic inflation to shock in the world oil price level.

on domestic inflation and then its effect becomes small with the going of time.

## Conclusions and Recommendations

This work examined main determinants of domestic inflation of Ethiopia from both domestic and world level factors. In doing so there was examination of trend in domestic inflation with the going of time having separate assessment of the inflation source (food, non-food and energy). Inflation sourced from energy took the right hand share in affecting overall inflation of the country throughout the fiscal years considered in the research. Since Ethiopia is purely dependent on imported oil as source of energy inflation from it would have direct link with imported type of inflation. As compared to the sub-Saharan Africa and world level inflation the domestic inflation in Ethiopia was higher and more volatile in most of the sample years.

Increment in economic integration is often essentially mean an increase in price transmission among countries, or as an increase in the ease with which market forces establish uniformity of price movements in different countries for any particular good. In order to test whether Ethiopian inflation has co-integration with world level inflation and world oil price the study employed descriptive and mathematical analysis. The graphical description showed that domestic inflation has consistent co-movement with world oil price level, which is a rough indicator of interaction. Since imported oil is one crucial input in the domestic production process each change in its price would result into cost push type of inflation in both food and non-food items. This

circumstance may result in having a cause and effect type of interaction between oil price and domestic inflation. The two inflations show upward movement in recent times though they exhibit a bit reduction after 2012. Thus, this circumstance may lead to a conclusion that Ethiopian inflation may have interaction with the world oil price.

Both short and long run analysis showed that government expenditure of the country has positive and significant effect on domestic inflation since it has money injection effect on the economy. Each successive increment in government expenditure would have both production and inflationary effect on the domestic economy, which needs due concern to curve down the latter effect. Thus, there should be giving attention about the negative consequence of each economic policy before implementing policies like government expenditure and money supply increment within the country.

World price increment has both short and long run significant effect on domestic inflation. Having this, the country is highly dependent on imported manufactured items indicating that each and every increment in the world price of those items especially oil would result into huge crisis. Ethiopia purely dependent on imported oil in which imported inflation would have both social as well as economic impact unless there should be shifting from this source of energy. An important role in the process of inter-nationalization of economic relations is played by the world market. It may be viewed from many different angles, on the one hand, world market is used by individual countries as a device to mitigate their internal problems, and on the other, it can be a "transmission belt" for unfavorable economic circumstances happening on at world scale. This is also true of inflation, which affects all the countries in the contemporary world. Given this, world level inflation has positive long run effect on the domestic inflation of Ethiopia, which implies that there should be having due attention by policy makers to take into account in their policy analysis if there is price movement in the world market. Currently Ethiopia is importing huge amount of merchandise from different direction of the world, which would directly aggravate the domestic inflation in the short run. This circumstance is shown in the previous two regression results, in which the short run model result showed that imports of manufactured products from South East Asian countries has positive effect but long run effect of them is in the reverse direction. Based on regression result of the long run model all type of imports has negative effect on the domestic inflation of the country. Due to substitution effect in the commodities imported from African countries that has similar products for their export to Ethiopia, the inflation in those countries has negative short run effect on domestic inflation of the country. In contrast to this, imports from south East Asian countries like China has positive and significant effect on the domestic inflation, since the products imported from them are more of manufactured type and they are intermediate inputs for further production and investment of the country. This condition would result into cost push inflation within the domestic economic system of the country. Based on short run regression result speed of adjustment of each deviation in equilibrium from the long run trend line is not as such fast enough that is 33.6% in one year and it will completely converge to its long-run equilibrium in around three years. If there is unexpected shock in the economic system that result a change in the equilibrium trend of the inflation, then the system is not active enough to come down to its long run equilibrium within a year. Besides to numerical value of the error correction term, which is lower than 100%, one can see the impulse response of domestic inflation level to changes in the oil price shock in which the vibration continuous for longer periods though there is successive reduction in each bounce. Exchange rate fluctuations

can absorb or amplify price changes on international markets, as the national currency appreciates or depreciates vis-à-vis the currency in which commodities are traded. This indicates that exchange rate type within a country could be one actor in the transfer of inflation among countries. Under a fixed nominal exchange rate, each country suffers a welfare loss when there is inflation in the other. Since exchange rate in Ethiopia is managed floating type that is not fully flexible as to the market condition, it could not insulate the economy from foreign disturbances. Thus, there should be taking additional policy measures to insulate economic problems like inflation that could easily transfer from one country to the other.

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