MACROECONOMIC DETERMINANTS OF ECONOMIC GROWTH IN ETHIOPIA

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Abstract: *In this paper we examined the macroeconomic determinants of economic growth in Ethiopia. We used annual tome series data ranging from 1980-2014. We used the Johansen multivariate analysis and the vector error correction model. We have found out that, social welfare expenditure has positive and significant impact on the economic growth of Ethiopia while gross domestic capital formation has negative significant impact on the economic growth of the country. The other findings, though not significant, are also reflections of what the Ethiopian economy looks like. The country is agrarian (agricultural development has positive impact), there is no return from mining & energy (as we have negative impact), too much dependent population and those with no jobs (population has negative impact). As a recommendation we suggest that government should do more privatization (as most of the investments currently are government affiliated and this might have resulted in the negative impact), create more conducive investment climate, more infrastructure development, keep up on developing and mechanizing agriculture, more population control and more jobs.*

Keywords: *Economic growth, macroeconomic determinants, VECM, Ethiopia, investment*

I. INTRODUCTION

Ethiopia is an agrarian economy which is still struggling with the problem of poverty. According to (The World Bank, 2016), greater than 80 percent of the total population lives in rural areas out of which more than 30 percent is poor. According to other UN sources, despite the stagnation in agricultural productivity, there are some success stories in Least Developed Countries. In Ethiopia, for instance, there was a tripling of cereal production between 2000 and 2014 resulting in a decline in poverty from 55.3 percent to 33.5 percent. (UN-OHRLLS, 2016). These are indications that poverty is very high in Ethiopia. The paradox of this is that the country is endowed with abundant natural resources which create favorable condition for rapid economic growth. According to (Godswill, Dawit, & Dejene,

2007) Ethiopia has an estimated 55 million ha of arable land out of which only 40% is cultivated. The country also is endowed with eight major river basins which can irrigate about 3.5 million ha of land. However, only 5% of this potentially irrigable land is irrigated. The estimate ranges between 150,000 and 160,000 ha. Thus, we can say that the country has not made use of the existing resources, let alone improving it with new technologies, so as to come out of the chronic poverty.

The United Nations Development Program in 2013 ranked the Human Development Index of the country as 173rd out of 187 countries. According to the World Economic Forum 2013-14 Global Competitiveness Report Ethiopia is ranked 127th out of 148 countries (Wikipedia, 2016).

According to (John W. & Paul, 2010), if a country could maintain a growth rate in agricultural GDP of six percent, it could provide enough employment growth to contribute to the rapid economic transformation of the economy and rapid decline in poverty. But, according to (World Bank, 2016) out of the overall average yearly growth rate of 10.9 percent between 2004 to 2014, agriculture grew by only 3.6 percent while service grew by 5.4 percent and industry grew by 1.7 percent.

The country is following an economic growth and development strategy known as ADLI (agricultural development led industrialization) (Government of Ethiopia, 2016). This strategy is supported by an economic reform program developed in cooperation with the World Bank and the International Monetary Fund (IMF) and on a series of structural adjustment programs since 1992. The long term objective of this strategy was achieving industrialization through the development of the agricultural sector. (Government of Ethiopia, 2016). But, this long term objective has not been achieved even after a quarter of a century after its inception.

Thus, this paper tries to address the macroeconomic determinants of economic growth of Ethiopia.

II. OBJECTIVE

The objective of this paper is to analyze the macroeconomic determinants of the Ethiopian economy. This will be an input for the policy makers and others concerned towards the povert problem of the country.

III. METHODOLOGY

The study of this paper is based on secondary data which are believed to help in achieving the objective of this paper. For this purpose, we collected secondary data from the Central Statistical agency (CSA), National Bank of Ethiopia (NBE), Ministry of Finance and Economic Development (MoFED), Ministry of Agriculture (MoA), Ministry of Education (MoE), World Bank data on the internet, International Monetary Fund (IMF) data on the internet, etc are most of the sources that we relied on for the analysis. The paper is model analysis based on time series annual data ranging from 1980 up to 2014. Specifically the VECM, the vector error correction model is used. The regressions and the various tests were conducted by using the STATA 13.

3.1 Specification of the Model

The paper applied the log-linear transformation of the neo-classical production function in order to establish a long run equilibrium relationship between the real gross domestic product **(RGDP)** of the country and some combinations of macroeconomic variables based on theoretical relevance and availability of data. The relationship was analyzed using Johansen co-integration technique and VECM model. The macroeconomic explanatory variables used include log of budget deficit **(BD)** used as a proxy measure for the fiscal discipline; log of export **(EX)** used as a proxy measure for openness; log of population **(POP)** used as a proxy measure for labor force; log of gross domestic capital formation **(GDCF)** used as a proxy measure for physical capital; log of government expenditure on agriculture **(GA)** used as a proxy measure for agricultural development; log of government expenditure on mining and energy **(GME)** used as a proxy measure for industrialization in the country; and log of government expenditure on social welfare **(GSW)** used as a proxy measure for the trickle- down effect of economic growth in the country.

The functional relationship between RGDP and the other macroeconomic variables, in this study, can be specified as follows:

$$\ln RGDP_t = \beta_0 + \beta_1 \ln GDCF_t + \beta_2 \ln GA_t + \beta_3 \ln POP_t + \beta_4 \ln EX_t + \beta_5 \ln GME_t + \beta_6 \ln GSW_t + \beta_7 \ln BD_t + \varepsilon_t \quad \ldots\ldots \quad \ldots\ldots \quad \ldots\ldots \quad \ldots\ldots (1)$$

Where:

β_0 = the constant or intercept term; t = time; ε_t = the stochastic error term

The βs are coefficients to be estimated. The expected signs for β_1, β_2, β_3, β_4, β_5, and β_6 are positive while that of β_7 is negative.

3.2 Stationarity

According to (Gujarati, 2004), we should worry whether time series is stationary or not because of the following basic reasons; first, autocorrelation sometimes happens if the underlying time series is non-stationary; second, most empirical studies on time series data assume the underlying time series to be stationary and third, if we regress one time series variable on another, we often get a very high R^2 (0.9 or above) even if there is no meaningful relationship between the variables. This kind of relationship is known as nonsense or spurious relationship which arises because of non-stationarity of the underlying time series data. Besides, the validity of our forecasting, that we mostly relies time series analysis for, in turn relies on stationarity of the underlying time series data. Moreover, we may be interested to test for causality by using Granger and Sims tests and these tests assume the underlying time series to be stationary.

3.3 Tests for stationarity

The Unit Root test is a test of stationarity that has become widely popular over the past several years (Gujarati, 2004, p. 837). Suppose we have the following relationship;

$Y_t = \rho Y_{t-1} + u_t$ ……………………………………………………………………………………(2)

where ρ is between -1 and 1; and μ_t is a white noise error term.

If the value of ρ is equal to 1, then this is a unit root case and the equation becomes a random walk model without drift which is a nonstationary stochastic process. Then, in order to check whether ρ is equal to 1 or not we regress Y_t on its one period lagged value of Y_{t-1}. If ρ is statically equal to 1, then Y_t is nonstationary. We perform the following to see whether there is unit root or not in the above relationship;

$Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} + \mu_t$…………… …. ………………………………………………(3)

$\Delta Y_t = (\rho - 1) Y_{t-1} + \mu_t$ which can also be rewritten as

$\Delta Y_t = \delta Y_{t-1} + \mu_t$…… ………………………………………. (4)

Where δ = $(\rho - 1)$ and Δ, as usual, is the first difference operator. We, practically, estimate equation (4) and test the null hypothesis of δ = 0. If δ = 0, then ρ = 1, that we have a unit root which indicates that we have time series data which is nonstationary.

In equation (4) if we make $\delta = 0$, then it will become

$$\Delta Y_t = (Y_t - Y_{t-1}) = \mu_t \quad \text{(5)}$$

And we know that u_t is a white noise error term which is stationary. This implies that the first difference of a random walk time series is stationary.

Turning to the estimation of equation (4) we simply take the first differences of Y_t and regress them on Y_{t-1} and see if the estimated slope coefficient, i.e δ, is zero or not. If it is zero, then we conclude that Y_t nonstationary. But if it is negative, then Y_t is stationary.

The question, however, is what test to use to find out whether the estimated coefficient of Y_{t-1} is zero or not. We cannot use the student's t-test because under the null hypothesis of $\delta = 0$ (i.e., $\rho = 1$), the t value of the estimated coefficient of Y_{t-1} does not follow the t distribution even in large samples.

3.3.1 Dicky Fuller (DF) test

According to (Gujarati, 2004), what we call Dicky Fuller (DF) is what in the literature known as the tau (τ) statistic or test. It is called Dickey-Fuller in order to honor its discoverers. The process of Dicky Fuller (DF) test has several decisions to proceed. One is, we have to know the nature of the underlying random walk process that we are dealing with. A random walk process may have drift or no drift; or it may have both deterministic and stochastic trends. To allow for these differences, the DF test is estimated in three different forms or under three different null hypotheses.

One is, random walk: $\Delta Y_t = \delta Y_{t-1} + u_t$ .... (6)

Second is, random walk with drift: $\Delta Y_t = \beta_1 + \delta Y_{t-1} + u_t$ ....(7)

Third is, random walk with drift around a stochastic trend: $\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + u_t$............ .... (8)

The null of each of the above cases is that $\delta = 0$ or there is a unit root which implies the time series is nonstationary. Rejecting the null implies that Y_t is stationary time series with zero mean in case of (6); with a nonzero mean $[= -\beta_1/(\delta)]$ in case of (7); and that Y_t is stationary around a deterministic trend in case of (8) (Gujarati, 2004, p. 837).

3.3.2 The Augmented Dicky Fuller (ADF) test

The difference between the Dicky Fuller (DF) and Augmented Dicky Fuller (ADF) tests of stationarity lies over the nature of the error term. If the error term is uncorrelated, then we can use Dicky Fuller (DF) test; but if it is correlated, then we have to use Augmented Dicky

Fuller (ADF) test. In the case of ADF test we add the lagged values of the dependent variable, which in other words means we combine the above three equations (6), (7) and (8) in one to get the following equation:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha \Delta Y_{t-i} + \varepsilon_i \quad (9)$$

Where ε_i is a pure white noise error term and where $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$; $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc. The number of lagged difference terms is often determined empirically, the idea being to include enough lagged terms so as to make the error term in equation (9) serially uncorrelated. In ADF we still test whether δ=0 and the ADF test follows the same asymptotic distribution as the DF statistic, so that same critical values can be used. (Gujarati, 2004).

3.3.3 The Philips Perron (PP) test

Another unit root test is the Phillips Perron (PP) test which makes use of the nonparametric statistical methods to address the problem of serial correlation in the error terms with adding the lagged difference terms. This is because of the fact that the asymptotic distribution of the PP test is the same as the ADF test statistic (Gujarati, 2004, p. 841).

We may use the following two regression equations to undertake the PP test (Sreelata & Anup, 2014);

$$\Delta Y_t = \beta_1 + \theta Y_{t-1} + \mu_t \quad (10)$$

$$\Delta Y_t = \beta_1 + \beta_2 t + \theta Y_{t-1} + u_t \quad (11)$$

3.3.4 KPSS Test

This test of stationarity is a little bit different from the previous three as it gives a straight forward test of the null hypothesis of trend stationarity against the alternative of a unit root. The previous three tests differ in such a way that each of them has the null hypothesis of a unit root against the alternative of stationary process (RTMath, 2013). KPSS decomposes the equation into three components; time trend, random walk and a stationary residual.

$$Y_t = \beta_t + (r_t + \alpha) + e_t \quad (12)$$

Where

- $r_t = r_{t-1} + u_t$ is a random walk where the initial value $r_0 = \alpha$ serves as an intercept
- t is the time index

- u_t are independent identically distributed (0, σ^2_μ).

The null and the alternative hypothesis are formulated as follows;

H_0 = Y_t trend or level stationary or σ^2_μ =0

H_1= Y_t is a unit root process

We will test the variables of equation (2) for stationarity. We start with Augmented Dickey Fuller test.

3.4 Unit root and Stationarity tests Results :- DF – GLS, Phillips Perron Unit Root Tests and KPSS Stationarity test

The following Tables (Table 1- Table 6) give us the unit root test results of the variables of the above different tests. Table 1 & Table 2 are for the Dickey-Fuller Generalized Least Squares (DF GLS) at level and first difference respectively; Table 3 and Table 4 are for the Phillips Perron (PP) Unit root test of the variables at level and first difference respectively; and Table 5 and Table 6 are for the KPSS stationarity test of the variables at level and first difference respectively. We made use of STATA 13 software for the DF GLS test and PP while we used the gretl software for the KPSS test. The options of no trend; and intercept and trend were used for this analysis.

From the tests given in the tables below we can conclude that all the variables are not stationary at level except lnGSW. Using the DF-GLS test at first difference, however, (Table 2); lnRGDP, lnEX, lnGA, lnPOP, lnGDCF, lnGME and lnBD become stationary at first difference. Whereas, when we use the PP test for unit root at first difference (Table 4) we find out that lnRGDP, lnEX, lnGA, lnPOP, lnGDCF, lnGME and lnBD become stationary at first difference. On the other hand using the third stationarity test at first difference (Table 6), we found out that lnRGDP, lnGA and lnPOP are first difference stationary variables.

Table 1: DF-GLS Unit root test at level

VARIABLE	**Option**	**LEVEL**			
		T- Statistic	Critical Value		
			1%	**5%**	**10%**
lnRGDP	No Tre	-0.447[6]	-2.644	-2.236	-1.907
	Int & Tre	-1.700[6]	-3.770	-2.882	-2.552
lnEX	No Tre	0.468	-2.644	-2.455	-2.135
	Int & Tre	-1.401[0]	-3.770	-3.386	-3.049
lnGA	No Tre	1.823	-2.644	-2.455	-2.135

	Int & Tre	-1.044[0]	-3.770	-3.386	-3.049
lnPOP	No Tre	-0.019[4]	-2.644	-2.300	-2.983
	Int & Tre	-2.327[7]	-3.770	-2.812	-2.468
lnGDCF	No Tre	0.079[7]	-2.644	-2.237	-1.895
	Int & Tre	-0.725[4]	-3.770	-3.081	-2.759
lnGME	No Tre	-0.007[5]	-2.644	-2.259	-1.939
	Int & Tre	-2.181	-3.770	-3.386	-3.049
lnBD	No Tre	1.589	-2.644	-2.455	-2.135
	Int & Tre	-2.648	-3.770	-3.386	-3.049
lnGSW	No Tre	-1.733	-2.644	-2.455	-2.135
	Int & Tre	-3.099	-3.770	-3.386	-3.049*

***, ** and * means the null is rejected at 1%, 5% and 10% respectively

No Tre= no trend; Int & Tre = intercept and trend; [] = lag length

Source: Computed using STATA 13

Table 2: DF-GLS Unit root test at 1st Difference

Variable	**Options**	**1ST DIFFERENCE**			
		T- Statistic	Critical Value		
			1%	**5%**	**10%**
lnRGDP	No Tre	-1.056[2]	-2.646	-2.416	-2.095
	Int & Tre	-5.059[1]	-3.770	-3.400**	-3.058
lnEX	No Tre	-2.680	-2.646	-2.469**	-2.145
	Int & Tre	-3.121[5]	-3.770	-2.971**	-2.643
lnGA	No Tre	-2.042[2]	-2.646	-2.416	-2.095
	Int & Tre	-6.290[1]	-3.770	-3.400**	-3.058
lnPOP	No Tre	-4.563[4]	-2.646	-2.395**	-1.993
	Int & Tre	-4.140[9]	-3.770	-2.811**	-2.388
lnGDCF	No Tre	-3.920[3]	-2.646	-2.359**	-2.040
	Int & Tre	-4.456[3]	-3.770	-3.400**	-3.058
lnGME	No Tre	-2.847	-2.646	-2.469**	-2.145
	Int & Tre	-3.209[0]	-3.770	-3.400	-3.058*
lnBD	No Tre	-4.770	-2.646	-2.649**	-2.145
	Int & Tre	-3.466[6]	-3.770	-3.400**	-3.058
lnGSW	No Tre	-4.723	-2.646	-2.649**	-2.145
	Int & Tre	-5.251[1]	-3.770	-3.400**	-3.058

***, **, * reject the null at 1%, 5% and 10% respectively.

No Tre= no trend; Int & Tre = intercept and trend; [] = lag length

Source: Computed using STATA 13

Table 3: Philips Perron Unit Root Test at Level

VARIABLE	Option	LEVEL			
		T- Statistic	Critical Value		
			1%	**5%**	**10%**
lnRGDP	No inter	4.631[3]	-2.646	-1.950**	-1.604
	Inter& Tre	-0.130[3]	-4.297	-3.564	-3.218
lnEX	No inter	1.847	-2.646	-1.950	-1.604*
	Inter & Tre	-1.884[3]	-4.297	-3.567	-3.218
lnGA	No inter	3.126	-2.646	-1.950**	-1.604
	Inter & Tre	-1.870[3]	-4.297	-3.564	-3.218
lnPOP	No inter	18.076	-2.646	-1.950**	-1.604
	Inter & Tre	0.664[3]	-4.297	-3.564	-3.218
lnGDCF	No inter	-2.085[3]	-2.646	-1.950**	-1.604
	Inter & Tre	-1.788[3]	-4.297	-3.564	-3.218
lnGME	No inter	0.622	-2.646	-1.950	-1.604
	Inter & Tre	-3.302[3]	-4.297	-3.564	-3.218*
lnBD	No inter	3.713	-2.646	-1.950**	-1.604
	Inter & Tre	0.062[3]	-3.689	-2.975	-2.619
lnGSW	No inter	0.200	-2.646	-1.950**	-1.604
	Inter & Tre	-1.755[3]	-3.689	-2.975	-2.619

***, **, * reject the null at 1%, 5% and 10% respectively.

Source: Computed using STATA 13

Table 4: Philips Perron Unit Root Test at First Difference

VARIABLE	Option	1^{ST} DIFFERENCE			
		T- Statistic	Critical Value		
			1%	**5%**	**10%**
lnRGDP	No inter	-2.488	-2.647	-1.950**	-1.603
	Inter& Tre	-6.091[3]	-4.306	-3.568**	-3.221
lnEX	No inter	-4.499	-2.647	-1.950**	-1.603
	Inter & Tre	-5.290[3]	-4.306	-3.568**	-3.221
lnGA	No inter	-6.780	-2.647	-1.950**	-1.603
	Inter & Tre	-8.513[3]	-4.306	-3.568**	-3.221
lnPOP	No inter	-0.169	-2.647	-1.950	-1.603
	Inter & Tre	-3.760[3]	-4.306	-3.568**	-3.221
lnGDCF	No inter	-6.478	-2.647	-1.950**	-1.603
	Inter & Tre	-8.168[3]	-4.306	-3.568**	-3.221
lnGME	No inter	-7.431	-2.647	-1.950**	-1.603
	Inter & Tre	-7.433[3]	-4.306	-3.568**	-3.221
lnBD	No inter	-6.344	-2.647	-1.950**	-1.603
	Inter & Tre	-8.412[3]	-4.306	-3.568**	-3.221
lnGSW	No inter	-7.463	-2.647	-1.950**	-1.603
	Inter & Tre	-7.776[3]	-4.306	-3.568**	-3.221

***, **, * reject the null at 1%, 5% and 10% respectively.

Source: Computed using STATA 13

Table 5: KPSS Unit Root Test at level

VARIABLE	Options	LEVEL			
		T- Statistic	Critical Value		
			10%	5%	1%
lnRGDP	No Tre	0.915358	0.353	0.462	0.716
	Tre	0.247506	0.122	0.149	0.211
lnEX	No Tre	0.880992	0.353	0.462	0.716
	Tre	0.180076	0.122	0.149	0.211***
lnGA	No Tre	0.893865	0.353	0.462	0.716
	Tre	0.215678	0.122	0.149	0.211
lnPOP	No Tre	0.977615	0.353	0.462	0.716
	Tre	0.237913	0.122	0.149	0.211
lnGDCF	No Tre	0.904515	0.353	0.462	0.716
	Tre	0.206501	0.122	0.149	0.211***
lnGME	No Tre	0.522435	0.353	0.462	0.716
	Tre	0.0799997	0.122	0.149**	0.211
lnBD	No Tre	0.971526	0.353	0.462	0.716
	Tre	0.161994	0.122	0.149	0.211***
lnGSW	No Tre	0.748107	0.353	0.462	0.716
	Tre	0.0732273	0.122	0.149**	0.211

*, **, *** are 10%, 5% and 1% critical levels of significance

No Tre= No trend; Tre = trend

Source: Computed using gretl

Table 6: KPSS Unit Root Test at 1st Difference

VARIABLE	Options	1ST DIFFERENCE			
		T- Statistic	Critical Value		
			10%	5%	1%
lnRGDP	No Tre	0.755266	0.353	0.462	0.715
	Tre	0.0675914	0.122	0.149**	0.210
lnEX	No Tre	0.276811	0.353	0.462	0.715
	Tre	0.0508633	0.122	0.149	0.210
lnGA	No Tre	0.202499	0.353	0.462	0.715
	Tre	0.0930297	0.122	0.149**	0.210

lnPOP	No Tre	0.545261	0.353	0.462**	0.715
	Tre	0.17339	0.122	0.149**	0.210
lnGDCF	No Tre	0.282566	0.353	0.462	0.715
	Tre	0.0486164	0.122	0.149	0.210
lnGME	No Tre	0.10246	0.353	0.462	0.715
	Tre	0.0820775	0.122	0.149	0.210
lnBD	No Tre	0.0917106	0.353	0.462	0.715
	Tre	0.0579873	0.122	0.149	0.210
lnGSW	No Tre	0.183664	0.353	0.462	0.715
	Tre	0.070319	0.122	0.149	0.210

*, **, *** are 10%, 5% and 1% critical levels of significance

No Tre= No trend; Tre = trend

Source: Computed using gretl

Thus, comparing the three tests and taking the comparison we come to the conclusion that the variables of the study, vis-à-vis, lnRGDP, lnEX, lnGA, lnPOP, lnGDCF, lnGME and lnBD are stationary at first difference and hence we can conclude that the variables of the study are integrated of order one, I (1).

Based on the above conclusion, we will be using the Johansen multivariate co-integration analysis in this study. In the types of cases like ours, we can use the multivariate co-integration analysis based on the conclusion that most of the variables are of the same order, i.e., I(1). (Wang, 2016) Therefore, in the following we will proceed with the Johansen multivariate Co-integration analysis.

3.5 Lag Length Selection

The next step in the Johansen Multivariate Co- integration analysis is to determine the optimum lag length for the co-integration test. The STATA 13 output for this test is presented in Table 7 below. From the table, lag length of one (1) is selected taking into account the small sample size (Liew, 2004) of the study besides the confirmation by the selection criteria like Final Prediction Error(FPE), Hannan Quinn Information criteria(HQIC) and Schwarz Byesian Information Criterion(SBIC) . in small sample sizes of less than 60, FPE is one of the best information criteria for lag selection.

Table 7: Optimum Lag length

```
. varsoc lnRGDP lnGDCF lnEX lnPOP lnGA lnGME lnBD lnGSW, maxlag(2)

   Selection-order criteria
   Sample:  1982 - 2014                         Number of obs      =        33
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-56.2673				6.8e-09	3.89499	4.01706	4.25778
1	212.618	537.77	64	0.000	3.1e-14*	-8.52231	-7.4237*	-5.2572*
2	277.587	129.94*	64	0.000	6.2e-14	-8.58102*	-6.50587	-2.41359

```
   Endogenous:  lnRGDP lnGDCF lnEX lnPOP lnGA lnGME lnBD lnGSW
    Exogenous:  _cons
```

Source: STATA 13 output

NB. * indicate the selection of respective lag length by the respective criteria

3.6 The Johansen Co-integration Test and Vector Error Correction Model

We used the Johansen Multivariate Co-integration Methodology which resulted in the Vector Error Correction Model (VECM) (Sreelata & Anup, 2014) so as to establish the long run and short run relationship between RGDP and its macroeconomic determinants in Ethiopia.

The specification of the VECM of order k is given in the following equation:

$$\Delta Z_t = \delta + \sum_{n=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \Pi Z_{t-k} + \psi X_t + u_t \quad \ldots\ldots (13)$$

With $\Gamma_i \equiv -(A_{i+1} + \ldots + A_k), i = 1,2,\ldots,(k-1)$ and $\Pi \equiv -(I - A_i - \ldots - A_k)$

Where;

- Z_t is a (n X 1) vector of jointly determined non-stationary $I(1)$ endogenous variables such that $\Delta Z_t = Z_t - Z_{t-1}$. Again, $\Gamma_i \Delta Z_{t-i}$ is the vector autoregressive VAR component in first difference,
- ΠZ_{t-k} implies error correction components.
- X_t is a (q X 1) vector of stationary $I(0)$ exogenous variables.
- δ is a (n X 1) vector of parameters(intercepts).

- μ_t is the (n X 1) vector of independently normally distributed error term.
- ψ is an (n X q) matrix of parameters.
- Γ_i is an (n X n) matrix of short-term adjustment coefficient among variables with k-1 number of lags.
- Π is an (n X n) long-run impact matrix of error correction mechanism.

The rank of Π i.e., R(Π) provides the basis for determining the existence of co-integration or long-run relationship among variables. The rank may take one of the three alternatives;

- ✓ If $R(\Pi) = 0,$ then the variables are not co-integrated;
- ✓ If $0 < R(\Pi) < n,$ then the variables are co-integrated and there is a long run relationship between the variables; and
- ✓ If $R(\Pi) = n,$ then the variables are stationary and the model is equivalent to a VAR model in levels.

ΠZ_{t-k} term gives us information about the long-run relationship among the variables in Z_t , the Π matrix can be decomposed into the product of two matrices α and β such that Π = αβ where α =an(n X r) matrix which represents the speed of adjustment coefficient of the error-correction mechanism and β =an(n X r) matrix of co-integrating vector represents up to r co-integrating relationship in the multivariate model which represent the long-run steady solutions.

In addition, Johansen as cited in (Sreelata & Anup, 2014) suggested two test statistics, namely the trace test statistic (λ trace) and the maximum eigen value test statistic (λ max). The trace statistic tests the null hypothesis that the number of distinct co-integrating vector is less than or equal to q against the general unrestricted alternatives of q = r. The test is calculated as follows;

$$\lambda trace(r) = -T \sum_{i=r+1}^{n} \ln(1-\lambda_t) \text{ .... (14)}$$

Where: T = the number of usable observations, λ_t's are the estimated eigen value from the matrix.

The second statistical test is the maximum eigen value test (λ max) and it tests the null hypothesis that there is r co-integrating vectors against the alternative r + 1 co-integrating vectors. It is calculated according to the following formula;

$$\lambda \max(r, r+1) = -T \ln(1-\lambda_{r+1}) \text{ ....(15)}$$

In the following table, Table 8, reports of the Johansen multivariate co-integration maximum likelihood tests are given. According to the results, the existence of 1 (one) long run co-integration equation is approved by both the trace and eigen value test statistics at 5% level of significance. Therefore, we can say that there exists one stable long-run relationship between real GDP and its macroeconomic determinants of the Ethiopian economy in this study.

Table 8: Johansen's Number of Co-integrations

```
. vecrank lnRGDP lnGDCF lnPOP lnGA lnGME lnEX lnBD lnGSW, trend(constant) lags
> (1) max

                         Johansen tests for cointegration
>
Trend: constant                                         Number of obs =      3
> 4
Sample:  1981 - 2014                                             Lags =
> 1
```

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	8	113.71384	.	202.1216	156.00
1	23	157.27039	0.92286	115.0085*	124.24
2	36	171.5378	0.56797	86.4737	94.15
3	47	184.31485	0.52838	60.9196	68.52
4	56	195.7887	0.49081	37.9719	47.21
5	63	204.40598	0.39764	20.7374	29.68
6	68	210.6598	0.30779	8.2297	15.41
7	71	213.70858	0.16418	2.1322	3.76
8	72	214.77466	0.06078		

maximum rank	parms	LL	eigenvalue	max statistic	5% critical value
0	8	113.71384	.	87.1131	51.42
1	23	157.27039	0.92286	28.5348	45.28
2	36	171.5378	0.56797	25.5541	39.37
3	47	184.31485	0.52838	22.9477	33.46
4	56	195.7887	0.49081	17.2346	27.07
5	63	204.40598	0.39764	12.5076	20.97
6	68	210.6598	0.30779	6.0976	14.07
7	71	213.70858	0.16418	2.1322	3.76
8	72	214.77466	0.06078		

Source: STATA output
NB.: * indicates selection of the corresponding number of co-integration equations

IV. THE LONG RUN CO-INTEGRATION EQUATION AND THE SHORT RUN ERROR CORRECTION MODEL OF THE STUDY

The long run normalized equation:

Based on the confirmation that we obtained from the above tests, we directly jumped to regressing the vector error correction model to find the long run relationship as well as the short run error correction equation of the study. Accordingly, we have the following discussions based on the results. The long run normalized co-integration equation of our model is given below:

$$\ln RGDP = -7.017 - \underset{(0.003)}{0.823\ln GDCF} - \underset{(0.271)}{0.172\ln EX} - \underset{(0.074)}{0.835\ln POP} + \underset{(0.189)}{0.142\ln GA} - \underset{(0.965)}{0.003\ln GME} - \underset{(0.145)}{0.240\ln BD} + \underset{(0.001)}{0.169\ln GSW} \quad .....(16)$$

In equation (16), our dependent variable (lnRGDP) is given as a function of the independent variables (lnGDCF, lnEX, lnPOP, lnGA, lnGME, lnBD, and lnGSW). This is the long run relationship between the dependent variable and the explanatory variables of our model. The estimated coefficients are given with their respective probability (p-) values given in parenthesis under each coefficient at a 5% level of significance. Accordingly, the estimated coefficients of lnGA and lnGSW have positive signs as expected. The estimated coefficient of lnBD has also negative sign as expected. The implication is that government expenditures on agricultural sector and social welfare have positive impacts on the real gross domestic product (RGDP) of the country. This is another indication of the argument that the country is still agrarian and this sector contributes positively to the real gross domestic product of the country. The estimated coefficient of social welfare is statistically significant. An increase in the budget deficit (BD) of the country has an impact of reducing the real gross domestic product of the country as expected even though not statistically significant.

Contrary to our expectation, the estimated coefficient of lnGDCF has negative and statistically significant impact on the real GDP of the country. That means an increase in the Gross domestic capital formation of the country has been negatively affecting the real gross domestic product of the country. The gross domestic capital formation is the gross investment in the country. The negative and significant impact of this variable on the real gross domestic product of the country is only possible in two cases, either when the investment is only used for maintenances and depreciation costs in which case there is no new capital added to the economy; or, when the investment budget is used for the government enterprises which are not productive enough to come up with net gains in capital formation. Added to this is the mismanagement and inefficiency of the government budget and administration.

Likewise, the estimated coefficients of lnEX, lnPOP and lnGME are negative contrary to our expectation. That means, there is a negative impact running from these variables to the real gross domestic product though not statistically significant.

The short run error correction model:

The following table (Table 9) shows the short run coefficients of the independent variables and also the dependent variable at lag one. It also shows the short-run speed of adjustment coefficient, ECT(-1), for the real GDP. The short-run adjustment coefficient indicates the built-in adjustment mechanism so that the real GDP may deviate from its long run equilibrium in the short-run but it will adjust towards the equilibrium level in the long-run. As shown in the table, the estimated coefficient of ECT(-1) is negative in sign and statistically significant. This is confirmation for us that there is long-run equilibrium or co-integration between the real GDP and its macroeconomic dependent variables of the study.

Table 9: Error Correction (ECM) estimation for real GDP

```
. vec lnRGDP lnGDCF lnEX lnPOP lnGA lnGME lnBD lnGSW, trend(constant)

Vector error-correction model

Sample:  1982 - 2014                         No. of obs      =        33
                                             AIC             = -7.515859
Log likelihood =  211.0117                   HQIC            = -6.188372
Det(Sigma_ml)  =  3.86e-16                   SBIC            =  -3.57052
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_lnRGDP						
_ce1 L1.	-.0735789	.0354244	-2.08	0.038	-.1430096	-.0041483
lnRGDP LD.	-.1282261	.2573042	-0.50	0.618	-.6325331	.3760808
lnGDCF LD.	.0054942	.0795712	0.07	0.945	-.1504624	.1614508
lnEX LD.	-.0001054	.0410448	-0.00	0.998	-.0805517	.0803409

lnPOP						
LD.	.0994774	4.505278	0.02	0.982	-8.730705	8.92966
lnGA						
LD.	.042978	.0339173	1.27	0.205	-.0234986	.1094546
lnGME						
LD.	.0201908	.015913	1.27	0.205	-.0109981	.0513798
lnBD						
LD.	-.0025768	.0449349	-0.06	0.954	-.0906476	.0854939
lnGSW						
LD.	-.012322	.0102518	-1.20	0.229	-.0324151	.0077711
_cons	.3020844	.1063393	2.84	0.005	.0936632	.5105057

Source: STATA out Put

The short-run dynamic relationship can also be summarized by the following ECM equation:

$$D\_\ln RGDP = \underset{(0.005)}{0.302} - \underset{(0.618)}{0.128 \ln RGDP(-1)} + \underset{(0.945)}{0.005 \ln GDCF(-1)} - \underset{(0.998)}{0.0001 \ln EX(-1)}$$
$$+ \underset{(0.982)}{0.099 \ln POP(-1)} + \underset{(0.205)}{0.043 \ln GA(-1)} + \underset{(0.205)}{0.020 \ln GME(-1)} - \underset{(0.954)}{0.003 \ln BD(-1)} - \underset{(0.229)}{0.012 \ln GSW(-1)}$$
$$- \underset{(0.038)}{0.074 ECT(-1)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (17)$$

Where, D_= change in or difference in; the figures in parenthesis under each coefficient is the p-value, the (-1) next to each variable stands for lagged one of the variables and ECT is the error correction term.

As indicated in equation 17 above, the estimated coefficient of the error correction term (0.074) is the magnitude by which the short run disequilibrium adjusts towards the long run equilibrium annually. Accordingly, 7.4 % of the short run deviation from the long run equilibrium will be adjusted annually.

The gross domestic capital formation, population size, government expenditure on agriculture and government expenditure on mining & energy have positive signs as expected. That means, a change in these variables will have positive impact on the real GDP of Ethiopian economy in the short run. The budget deficit also has expected negative sign. But the impact is not statistically significant at 5% level of significance. Contrary to our expectation, the Export variable and the variable of Government expenditure on social welfare have negative impacts on the real GDP of the Ethiopian economy in the short run. That means, a change in these variables will negatively affect the real GDP of the country. But again these impacts are not statistically significant at 5% level.

V. SHORT RUN CAUSALITY

As part of the VECM, we should also check whether there is short run causality running from the lagged value of the independent variables to the dependent variable. The result is presented in the Table 10 below. The null hypothesis of 'no causality' fails to be rejected for each of the variable. None of the independent variables in the model statistically significantly affect the dependent variable in the short run.

Table 10: Short run causality test

```
. test ([D_lnRGDP]: LD.lnRGDP LD.lnGDCF LD.lnEX LD.lnPOP LD.lnGA LD.lnGME LD.l
> nBD LD.lnGSW)

 ( 1)  [D_lnRGDP]LD.lnRGDP = 0
 ( 2)  [D_lnRGDP]LD.lnGDCF = 0
 ( 3)  [D_lnRGDP]LD.lnEX = 0
 ( 4)  [D_lnRGDP]LD.lnPOP = 0
 ( 5)  [D_lnRGDP]LD.lnGA = 0
 ( 6)  [D_lnRGDP]LD.lnGME = 0
 ( 7)  [D_lnRGDP]LD.lnBD = 0
 ( 8)  [D_lnRGDP]LD.lnGSW = 0

           chi2(  8) =    5.41
         Prob > chi2 =    0.7131
```

VI. POST ESTIMATION DIAGNOSTIC TESTS

In order to accept the VEC model results, we should check for the statistical accuracy of the VECM residuals. As per the diagnostic test results given in the following two tables (Table 11 and Table 12), the residuals from our VECM model are not serially correlated (Table 11). The Jarque Bera(JB) test for the residual multivariate normality also proves that the residual are multivariate normal (Table 12).

Table: 11 Diagnostic test for residual autocorrelation

```
. veclmar, mlag(1)

 Lagrange-multiplier test
```

lag	chi2	df	Prob > chi2
1	62.8782	64	0.51623

```
 H0: no autocorrelation at lag order
```

Source: STATA out Put

Table: 12 Diagnostic test for Residual Normal Distribution

```
. vecnorm, jbera

 Jarque-Bera test
```

Equation	chi2	df	Prob > chi2
D_lnRGDP	1.411	2	0.49382
D_lnGDCF	0.546	2	0.76101
D_lnEX	1.042	2	0.59396
D_lnPOP	0.833	2	0.65919
D_lnGA	0.051	2	0.97479
D_lnGME	0.922	2	0.63073
D_lnBD	0.903	2	0.63657
D_lnGSW	4.358	2	0.11318
ALL	10.067	16	0.86313

Source: STATA out put

In general, based on the two post estimation tests (Residual autocorrelation and Residual normality) the specified model is well fitted and we can accept the results of the model. The residual autocorrelation test checks whether the residual is serially correlated or not. The result for this test is given in table 11 above. The null hypothesis is 'no autocorrelation at lag order'. As indicated by the p-value we fail to reject the null which means the residuals are free from serial correlation. Table 12 on the other hand provides the residual test for normality. The null in this case is 'residual is multivariate normally distributed'. As indicated, we fail to reject the null which implies that the model fulfills residual multivariate normality (Hossain, 2016).

VII. CONCLUSION

The paper is conducted on the macroeconomic determinants of the Ethiopian economic growth. By using a vector error correction model on the annual time series data ranging between 1980-2014, we have to the conclusion that the gross domestic capital formation, population size, government expenditure on agriculture and government expenditure on mining & energy have positive signs as expected. These variables will have positive impact on the real GDP of Ethiopian economy in the short run. The budget deficit also has expected negative sign. Contrary to our expectation, the Export variable and the variable of Government expenditure on social welfare have negative impacts on the real GDP of the Ethiopian economy in the short run. That means, a change in these variables will negatively affect the real GDP of the country. Unfortunately, none of the above impacts are statistically significant at 5% level of significance. That is to say, statistically all the variables considered in the model does not affect the real gross domestic gross domestic product of Ethiopia. This is also confirmed by the short run causality test that we conducted. According to this test also, there is no short run causality running from the independent variables to the dependent variable.

As per the long run normalized relationship, we have come to the conclusion that government expenditure on social welfare affects the real gross domestic product in a positive and statistically significant way. More social welfare expenditure better economic growth. This may be related with receivers being able to educate and feed their children.

Contrary to our expectation, gross domestic capital formation affects the real GDP of the country negatively. This is an indication that return on investments in the country are not positive. We believe that this is because of too much government owned enterprises. Most of the investment in Ethiopia is government owned. Therefore, this is just wastage of the scarce resource as more funds on this area of investment is resulting in negative outcome on the real GDP of the country. The negative return on investment may also imply the poor quality infrastructure and a backward and traditional means of production and consumption. Government expenditure on agriculture has a positive impact, budget deficit has negative expected impact; exports, population and mining & energy expenditure have negative but statistically insignificant impacts.

VIII. POLICY SUGGESTIONS

This study has indicated that gross domestic capital formation (gross investment) has negative impact on the economic growth of the country. This is contrary to the literatures and might happen because of the peculiar characteristics of the country. The country is characterized by more government enterprises, poor infrastructure, low savings, backward means of production, those investors who plan to invest and take land and other facilities but never start their investment etc. Thus, we recommend that the government reduce its share of the economy and privatize more; the government should make the investment environment more conducive to investors including infrastructures, institutions, technological progress, etc; the government should monitor those investors who are not starting production within reasonable time period.

The study also indicated that government spending on social welfare has positive and significant impact. This is the nature of poor countries where people rely heavily on these transfers from governments. The Ethiopian government should continue with its social welfare expenditures as this has positive and significant impact on the economic growth of the country.

The government should develop the agricultural sector more, have more bargaining power in the international as well as regional trades, should control its population growth, should continue its search for minerals and energy as the return from these takes long period of time.

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