Analysis of economic growth indicators in Ethiopia using vector autoregressive models

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ABSTRACT

The objective of this study was to carry out an Analysis of Economic Growth indicators in Ethiopia using Vector Autoregressive models. Yearly data set on the variables for the period of 1988 to 2018 was obtained from the National Bank of Ethiopia (NBE) and CSA. Vector Autoregressive (VAR) Models, Testing Stationary: Unit root test, Estimating the Order of the VAR, Cointegration Analysis (testing of cointegration), and Vector Error Correction (VEC) Models were used in this study for data analysis. Unit root test reveals that all the series are nonstationary at level and stationary at first difference. The result of Johansen test indicates the existence of one cointegration relation between the variables: LRGDP, Lexport, Limport, inflation and Exchange rate are co-integrated, which implies that the variables have long run equilibrium relationship. The Result of Vector Error Correction Model (VECM) from term in LRGDP equation is weakly significant at 5% level and has a negative value, implying that there exists a long run relationship running from inflation, Lexport, Limport and Exchange rate to Real GDP. The final result shows that a Vector Error Correction (VEC) model of lag two with one cointegration equation best fits the data.

Key words: Vector autoregressive, Ethiopia, vector error correction and economic growth.

INTRODUCTION

Background of the study

Economic growth refers to an increase in aggregate production in an economy. That leads to an increase in incomes, moving consumers to open up their wallets and buy more, which means a higher material quality of life or standard of living. It is one of the most powerful instruments for reducing poverty and improving the quality of life in developing countries. Whenever a country overall output increases, the country’s Real GDP increases and we call it economic growth. Economic growth of any country reflects its capacity to increase production of goods and services. Moreover, economic growth can be stated as the increase in the Gross Domestic Product (GDP) of the country. Economic growth is one of the indicators for an economic progress. It can be measured as the percentage change in Gross Domestic Product (GDP), specifically the percentage change of the Real GDP where increments are adjusted for the effects of inflation (https://www.investopedia.com/terms/e/economicgrowth.asp).

Ethiopia is one of the developing countries in the world; its economy remains heavily dependent on agriculture, which accounts for 43% of the GDP. Accordingly, 83% of the population gains its livelihood directly or indirectly from agricultural production. Despite the fact that the history of growth performance was poor in the past decades, the country has experienced strong economic growth in the current time. Real GDP growth averaged 11.2% per annual during 2008/09 and 2010/11 period, placing Ethiopia among the top performing economies in African sub-Sahara country (NBE, 2013/14).

The Ethiopian economy has experienced very large growth performance over the last decade with average GDP
growth rate of 11%, which is about double of the average growth for Sub Saharan Africa 2012/13 was evidently successful in terms of maintaining macroeconomic stability. The medium-term outlook shows that the growth would continue although at a slow pace than the previous years. To attain the national vision of achieving the MDGs by 2015 and becoming a middle-income country by 2025, the country faces some challenges that could delay on the growth and transformation agendas (Abdi et al., 2013).

The economic prospects for 2019 and the medium term should remain stable, although less spectacular than in 2017. Annual GDP growth was projected around 9.1 in 2019 and 9 percent in the medium term. The reform agenda proposed by the new Ethiopian Prime Minister in 2018 was expected to address macroeconomic imbalances such as foreign exchange shortages. Moderate fiscal shortages and sensible monetary policy are expected to reduce the rate of inflation and keep it in the single digit. Merchandise exports could recover in the medium term, as large investment projects, such as the railway to the Port of Djibouti, large power dams with potential for electricity exports and industrial parks become fully operational (World Bank, 2018).

A number of parameters are employed to measure the economic development of nations and evaluate the improvements in the living standards of citizens. One of such measurement is real gross domestic product (GDP). Although there are difficulties in using real GDP as a measure of the quality of life, it is reasonably correlated with other measures of well-being such as health and literacy. Economic growth improves living standards through many channels. It creates more jobs, accelerates investment, boosts business confidence, and increases the revenue to the state in the form of taxes. Environmental benefits are also to be maximized as cleaner technologies are likely to be installed (Riley, 2012). With growth, families are better able to purchase more goods and services. It also has positive impacts on physical health and political freedom. As a result, living standards in both poor and rich countries can be improved. It can be said that growth is a moral imperative for achieving lasting human fruitfulness (Noell et al., 2013; CSA, 2005).

Again, the recent double-digit achievement in economic growth, though significant, seems to disconnect theoretically with some key macroeconomic variables (Noell et al., 2013). Different studies have discussed the economic growth of the country. The existence of the long run relationship between imports and economic growth given exports stationary and both exports and imports are considered main determinants of economic growth in Palestine (Agalega et al., 2013; Abugamea 2010). Cointegration analysis, VAR and Granger causality tests were employed in the empirical analysis and the results showed that there is a causal relationship from exports to economic growth and from exports to imports (Siles, 2011; Obsi et al., 2015; Shahzad et al., 2013). The study by Neda (2010) was the multivariate time series analysis of inflation in the case of Ethiopia based on price index, the result indicates that, the long run coefficients of consumer price index has a positive long run relationship with food price index and non-food price as expected in the theory.

Yet there is no all-inclusive empirical study which determines indicator of Ethiopian economic growth that includes export, import, exchange rate and inflation together. This study would examine the decomposed combined dynamic relationship among selected macroeconomic variables: Exports (EXP), Imports (IMP), Inflation, Exchange rate (EXR) and Real GDP using data from 1988-2018 in Ethiopia.

Objectives of the study

The main objective of this study is the Analysis of Economic Growth indicators in Ethiopia using Vector Autoregressive models. Specifically, the following are aims of this research:

- To analyze the Economic Growth indicators variables using Vector Autoregressive models in Ethiopia.
- To study the relationship between real economic growth which is measured by Real GDP and economic growth indicator variables.
- To examine the response of real economic growth as measured rate of Real GDP to the impulses of other indicator variables.

MATERIALS AND METHODS

Methods of data collection

This study was conducted in Ethiopia. it applied the secondary data type collected from different organizations and institutions (CSA, Ministry of Finance and Economic Development (MOFED), and National Bank of Ethiopia). Annual data on inflation, exchange rate, export, import and Real GDP for the period of 1988 to 2018 was obtained from
the stated organizations and institutions.

Methods of data analysis

Vector Autoregressive (VAR) Models

The VAR model is one of the most popular systems of regression models, successful, flexible, and easy to use models for the analysis. The VAR model has proven to be especially useful for describing the dynamic behavior of economic and financial time series and for forecasting.

Stationary Vector Autoregression Model

Let $Y_t = (y_{1t}, y_{2t}, ..., y_{nt})^T$ denote ($n \times 1$) random vector of time series variables. The basic $p$-lag vector autoregressive (VAR($p$)) model has the form (Hamilton, 1994).

$$Y_t = C + \pi_1 Y_{t-1} + ... + \pi_p Y_{t-p} + \epsilon_t, \quad t = 1, 2, ..., T$$

(1)

Where $\pi$ is a fixed coefficient matrix, $C = (c_1, c_2, ..., c_n)^T$ is a fixed $n \times n$ vector of intercept terms allowing for the possibility of a non-zero mean $E(Y_t)$.

Stationary Processes: A stochastic process $Y_t$ is weakly stationary if its first and second moments are time invariant. In other words, a stochastic process is stationary if:

(i) $E(Y_t) = \mu$, constant for all value of $t$ and

(ii) $\text{Cov}(Y_t, Y_{t-j}) = \gamma_j$, for all $t, j = 0, 1, 2, ..., T$  

(3)

(4)

Condition (3) means that all $Y_t$ have the same finite mean vector $\mu$ and (4) requires that the autocovariances of the process do not depend on $t$ but just on the period $j$ the two vectors $Y_t$ and $Y_{t-j}$ are apart. Therefore, a process is stationary if its first and second moments are time invariant.

The stationarity of the series is tested by using statistical tests such as Augmented Dickey-Fuller (ADF) test due to Dickey and Fuller (1979, 1981) and the Phillip-Perron (PP) due to Phillips (1987). In this study, Augmented Dickey-Fuller (ADF) test was used for test of stationarity.

Consider a simple AR (1) process:

$$Y_t = \theta Y_{t-1} + X_t' \delta + \epsilon_t$$

(5)

$X_t$ are optional exogenous regressors which may consist of constant or a constant and trend, $\theta$ and $\delta$ are parameters to be estimated, and $\epsilon_t$ is assumed to be white noise. If $|\theta| \geq 1$, $Y_t$ is a non-stationary series and the variance of $Y_t$ increases with time. If $|\theta| < 1$, $Y_t$ is a stationary series.

Thus, the hypothesis of stationarity can be evaluated by testing whether $\theta$ is strictly less than one that is, $H_0: \theta = 1$ (unit root in $\theta \neq 0$) $\Rightarrow Y_t \sim I(1)$ $H_1: |\theta| < 1 \Rightarrow Y_t \sim I(0)$

The standard Dickey-Fuller test is conducted by estimating equation (5) after subtracting $Y_{t-1}$ from both side of the equation and obtain the following equation.

$$\Delta Y_t = \alpha Y_{t-1} + \epsilon_t$$

(6)

$$\epsilon_t \sim N[0, \sigma^2], \text{and} \text{Cov}[\epsilon_t, \epsilon_s] = 0 \forall t \neq s.$$  

Where $\alpha = \theta - 1$ and $\Delta Y_t = Y_t - Y_{t-1}$. The null and alternative hypotheses may be re-expressed as $H_0: \alpha = 0$ versus $H_1: \alpha < 0$ and evaluated using the conventional $t$-ratio:

$$t_\alpha = \frac{\hat{\alpha}}{s.e(\hat{\alpha})}$$

(7)

Where $\hat{\alpha}$ is the estimate of $\alpha$, and $s.e(\hat{\alpha})$ is the standard error of $\hat{\alpha}$.

Dickey and Fuller (1979) showed that under the null
hypothesis of a unit root, this statistic does not follow the conventional Student’s t-distribution, and they derive asymptotic results and simulate critical values for various test and sample sizes.

Estimating the order of the VAR

The lag length for the VAR model may be determined using model selection criteria. The general approach is to fit VAR models with orders \( m = 0, \ldots, p_{\text{max}} \) and choose the value of \( m \) which minimizes some model selection criteria (Lutkepohl, 2005). The general form model selection criteria have the form:

\[
C(m) = \sum_m + C_{\text{T}} \phi(m, K)
\]

(8)

Where \( \sum_m \) is the residual covariance matrix estimator for a model of order \( m \), \( \phi(m,k) \) is a function of order \( m \) which penalizes large VAR orders and \( C_{\text{T}} \) is a sequence which may depend on the sample size and identifies the specific criterion. The term \( \log|\sum_m| \) is a nonincreasing function of order \( m \).

The three most commonly used information criteria for selecting the lag order are the Akaike information criterion (AIC), Schwarz-Bayesian information criterion (SBIC), Hannan-Quin (HQ) information criteria:

\[
\text{AIC}(m) = \ln|\sum_m| + \frac{2}{T} mn^2
\]

(9)

\[
\text{SBIC}(m) = \ln|\sum_m| + \frac{1}{T} mn^2
\]

(10)

\[
\text{HQ}(m) = \ln|\sum_m| + \frac{2}{T} mn^2
\]

(11)

In each case \( \phi(m,n) = mn^2 \) is the number of VAR parameters in a model with order \( m \) and \( n \) is number of variables. The AIC criterion asymptotically overestimates the order. On the other hand, the HQ and SBIC criteria are both consistent, that is, the order estimated with these criteria converges to the true VAR order \( p \) under quite general conditions if the true order (\( p \)) is less than or equal to \( p_{\text{max}} \).

Cointegration Analysis: using Johansen's methodology

The starting point in Johansen’s procedure (1988), in determining the number of cointegrating vectors, is the VAR representation of \( Y_t \). It is assumed a vector autoregressive model of order \( p \) and is expressed as follows:

\[
y_t = A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_p y_{t-p} + B X_t
\]

(12)

where \( y_t \) is a k-vector of nonstationary I(1) variables (If a nonstationary series \( y_t \) must be differenced \( d \) times before it becomes stationary, then it is said to be integrated of order \( d \). This would be written \( y_t \sim \text{I}(d) \)). \( X_t \) is a d-vector of deterministic variables, and \( \epsilon_t \) is a vector of innovations.

We may rewrite this VAR as:

\[
\Delta y_t = \pi y_{t-1} + \sum_{i=1}^{p-1} r_i \Delta y_{t-i} + B X_t + \epsilon_t
\]

(13)

Granger’s representation theorem asserts that if the coefficient matrix \( \pi \) has reduced rank \( r<k \), then there exist \( k \times r \) matrices \( \alpha \) and \( \beta \) each with rank \( r \) such that \( \pi=\alpha \beta' \) and \( \beta' y_t \) is I(0). Where \( r \) is the number of cointegrating relations (the cointegrating rank) and each column of it is the cointegrating vector. Johansen (1988) proposed two tests for estimating the number of cointegrating vectors: the Trace statistics and Maximum Eigenvalue. Trace statistics investigate the null hypothesis of \( r \)-cointegrating relations against the alternative of \( n \) cointegrating relations, where \( n \) is the number of variables in the system for \( r = 0, 1, 2...n-1 \). Define \( \lambda_i, i=1,2,...,k \) to be a complex modulus of eigenvalues of \( \pi \) and let them be ordered such that \( \lambda_1 > \lambda_2 > \ldots \ldots > \lambda_p \). The statistic computed as:

\[
\lambda_{\text{trace}}(r) = -T \sum_{i=r+1}^{n} \log(1 - \lambda_i)
\]

(14)

The Maximum Eigenvalue statistic tests the null hypothesis of \( r \) cointegrating relations against the alternative of \( r+1 \) cointegrating relations for \( r = 0, 1, 2...n-1 \). This test statistic is computed as:

\[
\lambda_{\text{max}}(r, r+1) = -T \log(1 - \lambda_{r+1})
\]

(15)

where \( \lambda_{r+1} \) is the \((r+1)\)th ordered eigenvalue of \( \pi \), and \( T \) is the sample size. The critical values tabulated by Johansen and Juselius (1990) will be used for these tests.

Vector Error Correction (VEC) Models

A vector error correction (VEC) model is a restricted VAR designed for use with nonstationary series that are known to be cointegrated. The VEC has cointegration
**RESULTS AND DISCUSSIONS**

**Descriptive analysis**

The aim of this study was to assess the impact of main macro-economic variables on Real economic growth measured as Real GDP in Ethiopia and the relationship between macroeconomic indicator variables, namely: Economic growth measured as the rate of Real GDP, exports, import, inflation and exchange rate. The descriptive statistics shows the LRGDP has a slighter standard deviation among all the variables. That means there is small variation in LRGDP from one year to the other year in the given period of time. Similarly, inflation has high standard deviation, this implies inflation has highly fluctuate from year to year. The standard deviation shows that the spread of inflation from its mean is higher than the spread of LRGDP, that is, 10.5 is greater than 0.78. Over the period of the study, LRGDP averaged 2.54 from 1988 to 2018 in Ethiopia as shown in Table 1. The Exchange rate (currency in US$) was on average 10.12. On the other hand, inflation, averaged 10.57 over the study period. Generally, the standard deviation shows that the spread of LRGDP from its mean is smaller than the spread of other indicator of economic growth.

**VAR model analysis: Unit root test results**

The estimation begins with the testing of variables for unit roots to determine whether they can be considered as a stationary or nonstationary process. Table 2 presents the Augmented Dick-ey Fuller (ADF) and PP tests of series. The tests showed that all the variables were non-stationary at level and stationary at first difference.

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### Table 1: Descriptive statistics of series:1988 to 2018.

<table>
<thead>
<tr>
<th>Value</th>
<th>LRGDP</th>
<th>INF</th>
<th>LEXPO</th>
<th>LIMP</th>
<th>EXCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>12.54</td>
<td>10.57</td>
<td>15.68</td>
<td>17.02</td>
<td>10.12</td>
</tr>
<tr>
<td>Median</td>
<td>12.22</td>
<td>7.51</td>
<td>15.24</td>
<td>16.59</td>
<td>8.58</td>
</tr>
<tr>
<td>Maximum</td>
<td>14.36</td>
<td>44.9</td>
<td>18.10</td>
<td>19.79</td>
<td>26.11</td>
</tr>
<tr>
<td>Minimum</td>
<td>11.74</td>
<td>-9.14</td>
<td>12.61</td>
<td>14.41</td>
<td>2.070</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.78</td>
<td>10.75</td>
<td>1.66</td>
<td>1.77</td>
<td>6.69</td>
</tr>
<tr>
<td>Observations</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

Source: Author computation by eviews9,2019.

### Table 2: Results of ADF and PP Unit Root Tests at level (with Trend) and at First Difference (without Trend).

<table>
<thead>
<tr>
<th>Series</th>
<th>Level with Intercept and Trend</th>
<th>First difference with Intercept and Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test Statistic</td>
<td>Prob.*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LRGDP</td>
<td>ADF 1.324</td>
<td>0.999</td>
</tr>
<tr>
<td></td>
<td>PP 0.242</td>
<td>0.101</td>
</tr>
<tr>
<td>INF</td>
<td>ADF -3.136</td>
<td>0.040</td>
</tr>
<tr>
<td>LEXPORT</td>
<td>PP -2.658</td>
<td>0.040</td>
</tr>
<tr>
<td>LIMPORT</td>
<td>ADF -2.547</td>
<td>0.305</td>
</tr>
<tr>
<td>EXCH</td>
<td>PP -2.464</td>
<td>0.263</td>
</tr>
</tbody>
</table>

Source: Author computation by eviews9,2019.
Since all the series are non-stationary at level, the next step is to go for differencing so as to make the data stationary. It is also at this instance, the orders of integration for the four non-stationary series of this study were determined. Then the order of integration of a series is given by the number of time series was differenced in order to make a stationary series. The output shows that the rejection of the Null hypothesis for the first differenced series with intercept and trend at 5% level of significance for all indicator of economic growth. The unit root test confirms that each time series was stationary at first difference chosen level of significance at 5%, that is, each time series was integrated of order one. Thus, for the result of other next tests, all the considered macroeconomic indicator variables are regarded to be stationary at first difference integrated of order one that is, I (1).

Determining lag order

The optimal lag-length of the lagged differences of the tested variable was determined by minimizing the Akaike Information Criteria (AIC), Hannan-Quinn information criterion (HQIC) and Schwarz Information Criteria (SIC). For determining the appropriate lag length for the VAR model, the Akaike information criterion (AIC), Schwarz information criterion (SIC) and Hannan-Quinn information criterion (HQIC) were used. The lag length selection criteria are given in Table 3 below. Assuming that the data series of the five indicator variables follow a restricted VAR model, we applied the information criteria to specify the order. The all criteria select a restricted VAR (1) model as shown in Table 3 and thus the joint optimum lag length of order one was considered in the study.

Co-integration test

After checking the stationarity of the variables: LRGDP, Inflation, LEXP, LIMP and Exchange rate in Table 4 co-integration test was computed. The two common tests for co-integration is Johansen (1994) maximum likelihood procedure. The Determination of the number of co-integrating vectors is usually based on the method of two likelihood ratio (LR) test statistic; the Trace test and the Maximum eigenvalue test.

The values of the test statistic and critical values (at 5% level significance) are listed in Table 4 corresponding to the Eigenvalues. The null hypothesis is rejected when the test statistic is greater than the critical level. Accordingly, the co-integration tests of findings indicated that both trace test and maximum Eigenvalue statistic are significant at 5% level. Thus, the Johansen co-integration test suggests that there was long run relationship between inflation, Lexport, Limport, Exchange rate and economic growth as measure of Real GDP in Ethiopia.

Based on the results of Johansen co-integration test which was presented in Table 4, The trace test tells the existence of one co-integrating equation at 5% level of significance and the maximum eigenvalue test also

<table>
<thead>
<tr>
<th>Lag</th>
<th>AIC</th>
<th>SIC</th>
<th>HQIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>14.65196</td>
<td>14.88985</td>
<td>14.72468</td>
</tr>
<tr>
<td>1</td>
<td>8.427861*</td>
<td>9.855223*</td>
<td>8.864220*</td>
</tr>
<tr>
<td>2</td>
<td>8.490638</td>
<td>11.10747</td>
<td>9.290630</td>
</tr>
</tbody>
</table>

Table 4: Results of Johansen co-integration trace test.

<table>
<thead>
<tr>
<th>Hypothesized No.ofCE(s)</th>
<th>Eigen value</th>
<th>Trace Test Statistic</th>
<th>5% critical value</th>
<th>Prob.**</th>
<th>Maximum Eigen value test Statistic</th>
<th>5% critical value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>r = 0</td>
<td>0.762</td>
<td>86.131</td>
<td>69.819</td>
<td>0.002</td>
<td>40.135</td>
<td>33.877</td>
<td>0.008*</td>
</tr>
<tr>
<td>r ≤ 1</td>
<td>0.522</td>
<td>45.996</td>
<td>47.856</td>
<td>0.074</td>
<td>20.659</td>
<td>27.584</td>
<td>0.297</td>
</tr>
<tr>
<td>r ≤ 2</td>
<td>0.435</td>
<td>25.337</td>
<td>29.797</td>
<td>0.149</td>
<td>15.978</td>
<td>21.132</td>
<td>0.226</td>
</tr>
<tr>
<td>r ≤ 3</td>
<td>0.216</td>
<td>9.359</td>
<td>15.495</td>
<td>0.333</td>
<td>6.799</td>
<td>14.463</td>
<td>0.513</td>
</tr>
<tr>
<td>r ≤ 4</td>
<td>0.087</td>
<td>2.559</td>
<td>3.842</td>
<td>0.109</td>
<td>2.559</td>
<td>3.841</td>
<td>0.108</td>
</tr>
</tbody>
</table>

**MacKinnon (1996) one-sided p-values
*denotes rejection of the hypothesis at the 0.05 level


Table 3: VAR Lag order selection by different selection criteria.

<table>
<thead>
<tr>
<th>Lag</th>
<th>AIC</th>
<th>SIC</th>
<th>HQIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>14.65196</td>
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</tr>
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<tr>
<td>2</td>
<td>8.490638</td>
<td>11.10747</td>
<td>9.290630</td>
</tr>
</tbody>
</table>
This implies that the null hypothesis of no cointegration relations is rejected at the 5% significance level in favor of the alternative one which states that there exists one cointegration relation. Therefore, the rank of cointegration matrix was equal to one, meaning, there was only one cointegrating equation in the system. Therefore, Johansen co-integration test shows that LRGDP, Lexport, Limport, inflation and Exchange rate are co-integrated. This infers that all indicator variables have long run equilibrium relationship.

**Vector error correction model (VECM) estimation**

Having the variables in the VAR model appear to be co-integrated, we continued to estimate the short run behavior and adjustment to the long run equilibrium, which was represented by vector error correction model (VECM). Coefficient estimates of the VEC model were presented in Table A1 (appendix). The result indicates that, the long run coefficient of LRGDP has a positive long run relationship with Lexport, and Limport. In opposite direction, it has negative long run relationship with inflation and Exchange rate. Therefore, export and import have positive impact on Real GDP in the long run. In opposite inflation and exchange rate (currency Us$) have negative impact on Real GDP in the long run. The long run equation is given as follows:

$$LRGDP_t = 7.65 - 0.006INF_{t-1} + 0.140LEXPORT_{t-1} + 0.403LIMPORT_{t-1} - 0.162EXCH_{t-1}$$ (16)

The value 0.140 indicate that, a one percent change in Lexport leads to about 14.0% increase in current Real GDP (LRGDP). Similarly, the value 0.403 indicate that, a one percent change in Limport leads about 40.3% increase in current Real GDP (LRGDP). This may be due to the fact that Ethiopia imports very imperative economic stimulator such as fuel, machinery, vehicles, iron and steel which is the basic economic initiators. In the reverse, one percent change in exchange rate results about 16.2% decrease in current Real GDP (LRGDP). Furthermore, the values 0.006 indicate that a one percent change in inflation induces, about 0.6% decrease in current Real GDP (LRGDP). Therefore, export and import, have positive impact on economic growth measured as Real GDP. On the other hand, Inflation and exchange rate (currency Us$) has negative impact on current Real GDP.

In similar case, in the short run, the coefficient of error correction term of Exchange rate and inflation was observed to be statistically significant at 5 percent level, by considering LEXPORT as Dependent variable indicating that the percentage change in Exchange rate associated with 13.9% increase in LEXPORT in a short run. And again, the percentage change in inflation exhibits decrement of about 0.91% on LEXPORT in the short run.

Furthermore, in the short run, the coefficient of error correction term of inflation and LRGDP was observed to be statistically significant at 5 percent level, by considering LIMPORT as dependent variable, indicating that, the percentage change in inflation exhibits the increment about 0.31% on LIMPORT in the short run. Again, in a short run the LRGDP displays the decrement about 29.3% on LIMPORT. Finally, in the short run, the coefficient of error correction term of LRGDP, inflation, and Exchange rate itself are observed to be statistically significant at 5 percent level, by considering Exchange rate as dependent variable, indicating that, the percentage change in inflation is associated with 2.67% displays the decrement on Exchange rate in a short run. By applying the error correction term, we can estimate the following Vector Error Correction Model.

**Model of Real GDP:**

$$
\Delta LRGDP_t = -0.231(LRGDP_{t-1} + 0.006*INF_{t-1} - 0.140*LEXPORT_{t-1} - 0.403*LIMPORT_{t-1} + 0.162*EXCH_{t-1} + 7.65) - 0.370*\Delta LRGDP_{t-1} - 0.027*\Delta INF_{t-1} - 0.126*\Delta LEXPORT_{t-1} + 0.239*\Delta LIMPORT_{t-1} + 0.002*\Delta EXCH_{t-1} + 0.056
$$

(i)

**Model of Inflation:**

\[\Delta INF_t = 3.66(LRGDP_{t-1} + 0.006*INF_{t-1} - 0.140*LEXPORT_{t-1} - 0.403*LIMPORT_{t-1} + 0.162*EXCH_{t-1} + 7.65) - 0.632*\Delta LRGDP_{t-1} - 0.003*\Delta INF_{t-1} + 0.315*\Delta LEXPORT_{t-1} - 12.201*\Delta LIMPORT_{t-1} + 0.059*\Delta EXCH_{t-1} + 5.599
\]

(ii)

**Model of Export:**

\[\Delta LEXPORT_t = -0.117(LRGDP_{t-1} + 0.006*INF_{t-1} - 0.140*LEXPORT_{t-1} - 0.403*LIMPORT_{t-1} + 0.162*EXCH_{t-1} + 7.65) - 0.021*\Delta LRGDP_{t-1} - 0.009*\Delta INF_{t-1} + 0.128*\Delta LEXPORT_{t-1} - 0.069*\Delta LIMPORT_{t-1} + 0.139*\Delta EXCH_{t-1} + 0.128
\]

(iii)

**Model of Import:**

\[\Delta LIMPORT_t = 0.013(LRGDP_{t-1} + 0.006*INF_{t-1} - 0.140*LEXPORT_{t-1} - 0.403*LIMPORT_{t-1} + 0.162*EXCH_{t-1} + 7.65) - 0.293*\Delta LRGDP_{t-1} - 0.003*\Delta INF_{t-1} + 0.218*\Delta LEXPORT_{t-1} - 0.045*\Delta EXCH_{t-1} + 0.239
\]

(iv)

**Model of Exchange Rate:**

\[\Delta EXCH_t = 2.995(LRGDP_{t-1} + 0.006*INF_{t-1} - 0.140*LEXPORT_{t-1} - 0.403*LIMPORT_{t-1} + 0.162*EXCH_{t-1} + 7.65) - 0.032*\Delta LRGDP_{t-1} - 0.026*\Delta INF_{t-1} + 0.034*\Delta LEXPORT_{t-1} - 1.319*\Delta LIMPORT_{t-1} + 0.479*\Delta EXCH_{t-1} + 0.056
\]
EXCHt-1-0.074 

(v)

Where: 'D' represent for first difference(D), the value in the bracket is the error correction term and the coefficients of error correction term are called adjustment coefficient.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

A stationarity test was carried out using the Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) tests. The null hypothesis of a series has unit root (non-stationary) was failed to reject for all series under consideration, that means the series were non-stationary at level. Therefore, the first differenced series were considered for further analysis as the corresponding unit root tests indicated the absence of unit roots. Using annual data set on Real GDP, inflation, Export, Import, and Exchange rate (US$) for the period of 1988 to 2018, an empirical analysis has been made through the vector error correction model. For the period spanning from 1988 to 2018, there was one co-integrating relationship between inflation, export, import, exchange rate and economic growth measured as rate of Real GDP. In order to assess whether inflation, exports, imports, Exchange rate and Real GDP growth are co-integrated using Johansen approach, and the test suggests that there was long run relationship between inflation, exports, imports, Exchange rate and economic growth in Ethiopia.

The VEC model tell us the current real economic growth of Ethiopia measured as rate of Real GDP is significantly affected by past one lagged value of its own, inflation, exports, imports, and exchange rate. The result indicates that; the long run coefficient of Real GDP has a positive long run relationship with export and Import. But it has negative long run relationship with, inflation and Exchange rate.

In Similar case, exchange rate exhibiting the strong endogenous influence, in predicting export in the short run and has weak influence in the long run. Real GDP, import and inflation are exhibiting the weak endogenous influence, in predicting export either in the short run or in the long run. In the first period 45.23% of forecast error variance in import was explained by import itself in the short run. Moreover, inflation exhibiting the weak influence, in predicting import in the short run and strong influence in the long run. Real GDP, Export and Exchange rate are exhibiting weak endogenous influence, in predicting import in the short run and in the long run.

Recommendation

Based on the findings, the following possible recommendations were made:

(1) The findings show that export has long-run positive impact on economic growth measured as Real GDP but it was a small amount in percent (14.03%). Since Ethiopia has high speed to change the economy through agricultural development guided by industrialization policy; government should highly invest in local industries to increase domestic tradable production of which would maintain higher export to reduce impact of inflation, in that way Real GDP growth rate will increase.

(2) Inflation has negative impact on economic growth in Ethiopia, so focus should be given to decrease it. In Ethiopia, there is fast economic growth as well as high level of inflation at the same time. If the sources of growth are dominated by inflationary different public investments, it creates the problems of high inflation existing in the country's economy.

REFERENCES


**Table A1: Estimated coefficients of Vector Error Correction Model.**

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<td>LRGDP(-1)</td>
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<tr>
<td>INF(-1)</td>
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<tr>
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</tr>
<tr>
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<td>[  1.69800]</td>
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<td>LEXPO(-1)</td>
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<table>
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<th>Error Correction:</th>
<th>D(LRGDP)</th>
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<th>D(LEXPO)</th>
<th>D(LIMP)</th>
<th>D(EXCH)</th>
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