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RESEARCH ARTICLE

Impact of selected macroeconomic variables on economic growth in Ethiopia: A time series analysis

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Abstract

Our study examines the conventional wisdom that causality runs from selected macroeconomic variables to economic growth in Ethiopia. Time series data from 1975 to 2018 were used to determine short and long run relationships among variables. A Johansen's Cointegration test was used to investigate the presence of long run equilibrium relationship between variables while the Vector Error Correction Model and Granger Causality were used to test the short and long run causality direction between variables. The data were derived from the National Bank of Ethiopia (2020) and World Bank report (2020). Findings reveal that domestic savings, capital formation, exchange rate and price inflation have a positive and significant impact on long-run growth, although they have an insignificant impact in the short run. The result of causality generated a bidirectional association running from trade openness and domestic saving to growth. Unidirectional causality is exhibited between the rest of the variables and economic growth. The estimated coefficient of error correction term was found -0.3751, showing that deviations from long run equilibrium are corrected at 37.51% annually and converge towards its long run steady state path. This indicates a signal that long run policy toward inspiring selected macro variables has a significant impact on growth

Keywords: Macroeconomics, Economic growth, Time-series data.

Introduction

Economic development is the major goals of every economy and needs economic growth as its requisites. Growth refers to an increase in total income, taking into account a growing population convoyed by decisive changes in the structure of the economy. Countries can experience growth when there is an upsurge in real gross domestic product (Rafiy *et al.,* 2018). Likewise, growth relies on many factors, which reflects how nations can speed up and realize their growth. Economists theoretically proved that macroeconomic variables such as the expansion of capital, labor, savings and favorable international trade relation can boost economic growth at reasonably lower price inflation (Gofe, 2018). Generally, the economic literature revealed some macroeconomic variables are the key determinant of growth theoretically and empirically. As a result, the dynamic relationship between macroeconomic variables and growth in developing economies continues to receive significant empirical attention in ever-growing literature. Most of reviewed empirical literature produced a mixed view concerning impact of macroeconomic variables on economic growth. Yet, the macroeconomic natures of the countries play a key role in determining economic growth to vary across countries. Theoretically, the conventional wisdom confirms causal relation runs from selected macroeconomic variables to economic growth, but some other empirical findings also indicated that this does not hold true. This means that findings on the nexus between macroeconomic variables and economic growths are still inconclusive.

In Sub Sahara African countries like Ethiopia with abundant resources, inducing labor force participation, capital formation through savings, opening the economy to the external world, and achieving reasonable price inflation and exchange rate are desirable to foster continued growth. It started to record a double-digit growth through its integration into economies of globalization and

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prompting capital formation via savings and investment facilities, improving the labor force on the basis of national economic development targets (MoFED, 2007; 2010). In fact, such economic progress in the recent decade was mainly attributed from transforming an agriculture-based economy to industrial and service-based one. Following these shifts, the GDP share of agriculture, industry and service sector has reached to 33.8, 27 and 39.2%, respectively in 2018 from 75.5, 8.92 and 15.58%, respectively in the year 1975 (NBE, 2020).

Despite considerable, Ethiopia's recent growth performance is challenged by the macroeconomic problem of high inflation, poor savings and investment facility with low capital formation, unemployment, rigidity in external relations, and high level of domestic inflation with an unstable foreign exchange market. For instance, there has not been a synergy between savings to spur desired growth due to low income, policy irregularity, over-reliance on agricultural income, corruption, low labor productivity, scanty savings amenities. These generate low investment, low capital formation, weak technological progress and misery of reasonable economic growth.

Therefore, this study is imperative as it lets the incumbent government understand the impact of macroeconomic variables on economic growth to sustain the growth in the country by isolating the major challenges of growth determinates.

Literature Review

Although studies on the impact of selected macroeconomic variables on economic growth were documented in many literatures, it has remained one of the controversies regarding the direction of causations. For instance, the growth models given by (Harrod, 1939; Domar, 1946; Solow and Swan, 1956; Romer, 1986) validated that higher rate of saving and capital accumulation can trigger economic growth. However empirically a, conflicting views have been observed with regard to savings and growth nexus. Empirical works done by (Sinha and Sinha, 1998; Rodrik, 2000; Jappelli and Pagano, 1994) claimed that growth causes saving to change. Lewis, (1955); Mankiw *et al.,* (1992) and Pickson *et al.,* (2017) confirmed that capital accumulation through savings can be transformed to viable long run growth. Some authors said these variables created a bidirectional causal relationship (Tang and Tan 2014; Kumar, 2017). While as some others discovered no causal link between savings and growth (Mavrotas *et al.,* 2001; Baharumshah *et al.,* 2003).

Besides savings, the impact of labour force participation and capital formation on economic growth also got uprising attention from many researchers and economists in many countries. Studies such as (Shahid, 2014; Meskerem, 2014; Uneze, 2013; Gilbert *et al.,* 2013) confirmed that higher capital formation leads to higher economic growth and increases in growth result in higher capital formation. An active labor force is considered as one of the sources of economic growth in different countries. Findings from studies (Dunya *et al.,* 2018; Gilbert *et al.,* 2013) shows strong positive link between labor force participation and economic growth as economic theory stipulates.

In a traditional point of view, the exchange rate through aggregate demand can enhance the global competitiveness of domestic goods, while in aggregate supply its depreciation increases cost of production and helps redistribution of income in favor of rich. The finding of (Koirala, 2018; Uremadu and Onyele, 2016) confirmed that real exchange rate positively and significantly impacts economic growth. The finding of this study shows that the traditional view holds true for Ethiopia as the channel is growth-enhancing over long run. The theory suggests that openness to international trade has negative and positive impacts on economic growth. Empirically, it has been argued that passive liberalization policy may not necessarily lead to positive economic outcomes, particularly in least-developed economies. However, some studies support that trade openness leads to economic efficiency and market perfection on individual countries (Keho, 2017). Macroeconomic variables such as capital formation, labor force participation, and investment are the main source of growth, according to the findings of (Ferdinand *et al.,* 2017). Bal *et al.,* (2016) and Faridi (2012) examined the impact of capital formation on growth. Their findings revealed that capital formation, trade openness, exchange rate and factor productivity positively affect growth while inflation negatively affects growth.

Fekadu's (2012) empirical study supports the view that long-run growth is adversely affected by inflation at the macroeconomic level in Ethiopia. The negative effect of inflation on output makes it more difficult for economic agents to plan efficiently, reducing the economy's investment level.

It is recognized that previous studies have made a useful contribution to realize the role of selected macroeconomic variables on growth; yet, many studies apply a cross-country regression analysis and this would have heterogeneous results which lacks generalization. This can be explained using a country-specific study as the impact of macroeconomic variables is more dynamic. Further, a time series study on the impact of macroeconomic variables on economic growth has been ignored to some extent in Ethiopia despite it has a policy relevance to identify growth target. Concerning the methodological gap, key limitation of most reviewed literature is omitting basic variables and few studies have addressed specification issues. For instance, Verma (2007) and Budha (2011) specified their growth models by omitting basic growth inputs like labor. Besides, the exclusion of key macroeconomic variables such as openness, price inflations and exchange rate in some studies, Engle-Granger cointegration test has faced several weaknesses.

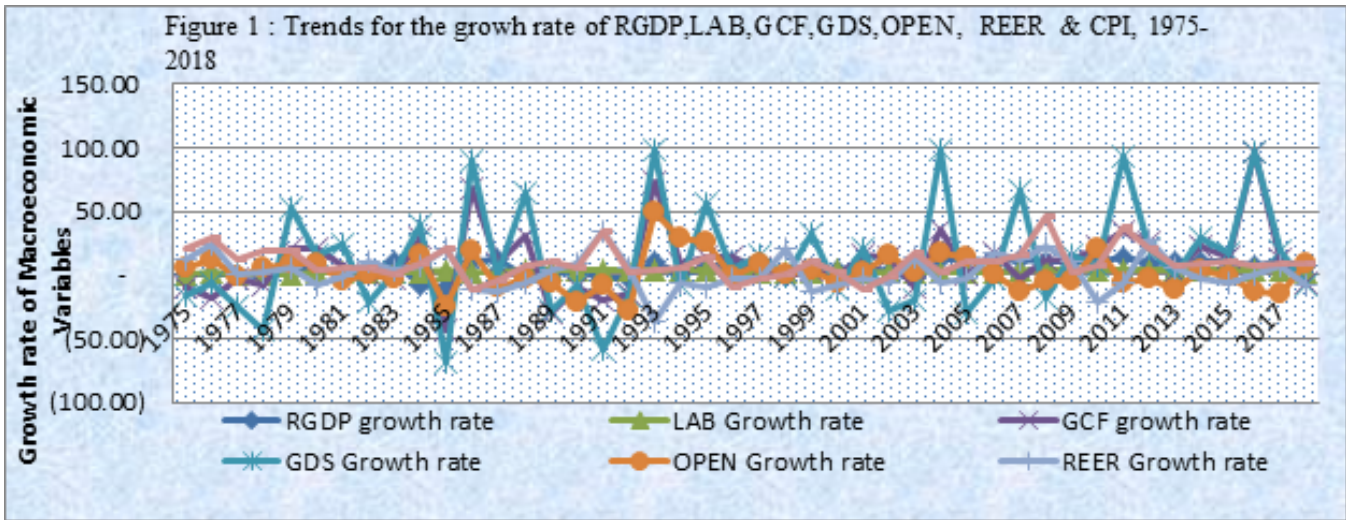

Figure 1 : Trends for the growh rate of RGDP,LAB,GCF,GDS,OPEN, REER & CPI, 1975-2018

Source: Authors sketch based on the data from NBE and WB, 2020

The nobility of the current study is that it allows the researchers to fill the existing misspecification and provide wide-ranging observations about the impact of selected variables on growth in Ethiopia. Our study extends to include large data set of about 44 observations from 1975-2018(inclusive).

*Trends for a growth rate of selected macroeconomic variables in Ethiopia (1975-2018):*A careful watch on trends of selected macroeconomic variables and growth in Ethiopia indicates that the economy has gone through mixed phases over the study periods. Figure_1 presented the trends for growth rate of LAB, GCF, GDS, OPEN, REER, CPI and RGDP over 44 years. Growth of domestic savings has been low with high fluctuation in spite of the recent recovery. On average, growth of domestic saving was 12.73% with the highest 98.65% in 2004 and lowest (68.50)% in 1985. During the same period, average economic growth rate was recorded as 5.34% with the highest 13.46% in 2011 and the lowest (8.79) in 1985 over the study period.

Besides, the trends for growth rate of capital formation were 10.54% on average with the highest 97.26% in 2016 and lowest (42.62%) in 1985. There was a recent improvement in its growth rate in the last decade (2009-2018) as compared to the first three decades (1975-2008) of the study period with an average growth rate of 23.63 and 6.72%, respectively (NBE, 2020). The trend for labor force participation growth rate in Ethiopia was recorded as 2.95% on average with the highest 3.66% in 2011 and the lowest 1.40% in 1975 over the study period (WB, 2020).

Trade openness of Ethiopian economy has been sluggish over the study period and recorded an average of 2.21% over the study period, despite its recent recovery. It has been stifled for most pre-1992 era, the socialist regime is most awful. Over the study period, the maximum (49%) was recorded during 1993, while the minimum (-27.92%) was since 1992. This was mainly due to transitional period insecurity. Over the study period, Ethiopia has gone through paths of price inflation, with the highest 45.24% in 2008 and the lowest (11.82) in 1986. Before 2003, Ethiopia was a country with lower price inflation and relatively lesser growth while latter periods witnessed high price inflation with relatively high and continued economic growth. While

Table 1: Variable Definitions, their Expected sign and Sources of the Data

Variables	Variable type and measurement	Expected sign	Source of Data
Dependents variables			
RGDP	(Log) Real Gross Domestic Product (Economic Growth)		NBE
Explanatory variables			
LAB	(Log) Labor Force Participation (between the age 15-64)	Positive	WB
GCF	(Log) Gross Capital Formation (measured in capital)	Positive	NBE
GDS	(Log) Gross Domestic Savings (measured in gross domestic savings)	Positive	NBE
OPEN	(Log) Trade Openness (measured by export plus import to GDP ratio)	Positive	NBE
REER	(Log) Real Effective Exchange Rate	Positive	NBE
CPI	(Log) Consumer Price Index (used to measure in price inflation)	Negative	NBE

the average exchange rate was 2.33% with the highest at 27.38% and the lowest (36.53%) (NBE, 2020).

Ethiopia is endowed with abundant resources with huge development potential, which is desired to prompt economic growth, yet it is still facing problems to sustain its growth as the country has been generating limited income the allied economic activities. One of the problems emanate from a weak synergy between domestic savings and investment, failure to engage active labor force in productive activities, high level of price inflation, frail external trade relation to spur desired growth. This weak linkage in turn generates misery of reasonable economic growth in the country. Thus, it is imperative to empirically examine impact of those macroeconomic variables on economic growth by taking in to account the recent data.

Data and Methodology

In order to realize the objective of our study, we used annual time-series data from the period 1975 to 2018 which was collected from the baseline data of the National Bank of Ethiopia (NBE, 2020) and World Bank (WB, 2020). The required variables such as real gross domestic product (RGDP), labor force participation (LAB), gross capital formation (GCF), gross domestic savings (GDS), trade openness (OPEN), real effective exchange rate (REER), and consumer price index (CPI) were used for analysis purpose. The sample period consists of 44 observations, and we have used methods such as Johansson's cointegration, VECM and Granger causality to test whether the conventional wisdom that macroeconomic variables cause growth in Ethiopia. In fact the results are sensitive to choice of variables used as proxies in the analysis.

Model Specification

To examine the nexus among selected macroeconomic variables and economic growth in Ethiopia, we used a model based on typical neoclassical growth theories and conventional beliefs (Solow and Swan, 1956; Romer, 1986; Ogoe, 2009; Saltz, 1999) that higher savings, labor, capital and other macroeconomic determinants led growth together. Hence, the typical framework for the neoclassical growth model is arranged in equation (1).

$$\mathrm{GDP}t = \mathrm{f}\,(\beta 0 + \beta 1\ \mathrm{LAB} + \beta 2\ \mathrm{GCF} + \beta 3\ \mathrm{GDS} + \mathrm{U}t) \ldots\ldots (1)$$

Where, GDP (proxy for growth) is real gross domestic product, t represents a time period (in years), LAB is labor force participation, GCF is gross capital formation, GDS is gross domestic savings, β_0 is the level of technology utilized, U is represented as error term. β1, β2 and β3 represents the degree of responsiveness of independent variables to change in growth. The growth model can be further extended to include other macroeconomic variables such as trade openness, real effective exchange, consumer price index as presented in equation(2).

$$\mathrm{RGDP}t = \beta 0 + \beta 1\ \mathrm{LAB} + \beta 2\ \mathrm{GCF} + \beta 3\ \mathrm{GDS} + \beta 4\ \mathrm{OPEN}_t + \beta 5\ \mathrm{REER}_t + \beta 6\ \mathrm{CPI}_t + \mathrm{u}t \quad (2)$$

However to eliminate the heteroskedasticity in the data series in estimation a logarithm form of the above equation is as follow.

$$\mathrm{LRGDPt} = \beta_0 + \beta_1 \mathrm{LLAB}_t + \beta_2 \mathrm{LGCF}_t + \beta_3 \mathrm{LGDS}_t + \beta_4 \mathrm{LOPEN}_t + \beta_5 \mathrm{LREER}_t + \beta_6 \mathrm{LCPI}_t + \mathrm{Ut} \ldots\ldots (3)$$

The variable definitions and expected signs are presented in Table 1.

Methods of Data Analysis

We have analyzed annual time series data (1975-2018) using the econometric software SATA- 14. Several statistical and econometric techniques were used to understand the associations between macroeconomic variables and growth in Ethiopia based on the neoclassical growth model.

Stationarity Test

The researchers employed stationarity tests for two reasons. First, these tests are necessary to ensure that none of the variables is integrated in order higher than 1. Second, variables in the model need to be stationary to avoid spurious regressions and obtain reliable results from Granger causality tests (Granger and Newbold, 1974). There are many tests for observing the existence of unit root problems in the data series. However, we employed both Augmented Dickey-Fuller (Dickey and Fuller, 1979) and Phillips-Perron (Phillips Perron, 1988) tests for estimation of the robustness of results. Accordingly, the following regressions were used.

$$[\text{Without drift and trend}] \Rightarrow \Delta \mathrm{Y}t = \delta \mathrm{Y}_{t-1} + \alpha t \sum_{t=1}^{m} \Delta \mathrm{Y}_{t-1} + \mathrm{Ut} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$[\text{With drift}] \Rightarrow \Delta \mathrm{Y}t = \beta_0 + \delta \mathrm{Y}_{t-1} + \alpha t \textstyle\sum_{t=1}^{m} \Delta \mathrm{Y}_{t-1} + \mathrm{Ut} \ldots\ldots\ldots\ldots\ldots (5)$$

$$[\text{With drift and trend}] \Rightarrow \Delta \mathrm{Y}t = \beta_0 + \beta 1 \mathrm{Y}_t + \delta \mathrm{Y}_{t-1} + \alpha t \textstyle\sum_{t=1}^{m} \Delta \mathrm{Y}_{t-1} + \mathrm{Ut} \ldots\ldots\ldots (6)$$

Cointegration Test

This test is mostly used to examine whether independent variables impact growth and also shows a joint strategic trend in the long run. To cross check the existence of cointegration in the model, we have used two approaches i.e. Engle and Granger approach, which is mainly used for single equation models and Johansen's approach, which is commonly used in multivariate equations on the basis of trace statistic and maximum Eigenvalues tests (Johansen, 1988).

Error Correction Model (ECM)

Engle and Granger (1987) assumes that if two variables are co-integrated in their first difference, their relations can be stated as ECM by taking past volatility as descriptive variables for the vibrant behavior of the current variables. ECM was used for the first time by (Sargan, 1984) and was extended by Engle and Granger to correct for past volatility. ECM permits to observation short-run dynamics in the relations between *Y* and *X* (Wooldridge, 2013). The size of the error correction coefficient (ECT) determines the speed

of adjustment towards long run equilibrium and must have negative value indicating the existence of a short-run relationship among variables. For this particular study, ECM can be estimated as.

$$\Delta LRGDPt = \beta_0 + \beta_1 \Delta LLAB_{t-1} + \beta_2 \Delta LGCF_{t-1} + \beta_3 \Delta LGDS_{t-1} + \beta_4 \Delta LOPEN_{t-1} + \beta_5 \Delta LREER_{t-1} + \beta_6 \Delta LCPI_{t-1} + \alpha ECM(t-1) + Ut \quad (7)$$

Where, Δ represents a first difference of the variable and $_{t-1}$ indicates short -run disequilibrium adjustments of the estimates of long-run equilibrium error and α is the error correction term coefficient (ECT) coefficient.

Granger Causality Test

The causality tests is a tests of forecast capacity in showing the extent to which one series contain information about the other series. This causation can be either unidirectional, bi-directional or independent. The existence of stationarity and cointegration among variables denotes the presence of long run causality among them at least in one direction. Typically, in multivariate analysis, causality test is done to check which variable causes another. This concept relates whether one variable can help to improve forecast of another variable. In order to determine whether causes , to see how much of the current value of could be described by the past values of, and to see if adding lagged values of could improve the expression in better way Granger (1969) causality test is frequently used.

Hence the expressions are given as.

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \cdots + \alpha_k Y_{t-k} + \beta_1 X_{t-1} + \cdots + \beta_1 X_{t-k} + Ut \ldots\ldots (8)$$

$$X_t = \alpha_0 + \alpha_1 X_{t-1} + \cdots + \alpha_k X_{t-k} + \beta_1 Y_{t-1} + \cdots + \beta_1 Y_{t-k} + Ut \ldots\ldots (9)$$

the Wald statistics test for the joint hypothesis for the possible equation becomes:

$$\beta_1 = \beta_2 = \beta_3 \ldots . \beta_k = 0 \ldots\ldots (10)$$

Therefore, the null hypothesis is that does not granger cause in equation_8 and that Y does not granger cause X in equation (9) is an empirical issue and need to be tested.

Results and Discussion

Descriptive Statistical Analysis

Table 2 describes summary statistics and nature of the data series of the macroeconomic variables used for analysis.

The mean value of RGDP over the study period (1975–2018) was reported as 260,747.7 million Birr. While the mean value of LAB (as proxied by population between the ages 15-64) was reported as 32.7 million active people, gross capital formation has the mean value of 102,294.1 million Birr, the mean value of gross domestic savings were found to be 54,895.37 million Birr. Similarly, the mean value of trade OPEN was 24.42, while that of REER was 158.19, and the mean value of CPI was 42.28. It has been observed from the whole study period that RGDP, GCF, GDS and OPEN shown an increment in their values, which is credited to recent policy reforms and liberalization. Since, Skewness is the measure of departure from the regularity of the actual data. The variables RGDP, LAB, GCF, GDS, and CPI built in the analysis are found positively skewed, while LAB, OPEN and REER are found very smaller value and thus, normally distributed. Kurtosis as a measure of departures from normality and its normal distributions is 3. However, the Kurtosis of RGDP, GCF, GDS, REER and CPI were found greater than 3 which show leptokurtic distribution, while LAB and OPEN are less than 3 showing Platykurtic distributions in the present study.

Unit Root Test

Prior to the estimation process, model diagnostic tests were used in time series analysis. We used our study's ADF and PP unit root tests to determine whether the series possess any non-stationary possessions. Accordingly, in our study, the null hypothesis of unit root cannot be rejected even at 10% level of significance for all variables as the critical values for ADF and PP were (-3.628) at 1%, (-2.950) at 5% and (-2.608) at 10% level. It implies that all the variables in the series possess non-stationary (unit root problem). Therefore, at this stage null hypothesis cannot be rejected on the basis ADF and PP test results. However, after applying the first difference, the variables appeared to be stationary I(1). This implies that the conventional ADF and PP test statistic in first difference were found significant even at 1% level of significance. Therefore, it would become a sufficient rationale to reject the null hypothesis and also can be determined that all the variables are integrated of order one I (1). Test results at I (0) and at I (1) were reported in Tables 3 and 4, respectively.

Determination of Optimal Lag Length

If there are several lags in the model then the chances of error estimation is higher, as the presence of too few lags could leave out the relevant information to be measured (Wooldridge, 2013). We have checked optimal lag length of the model based on the suggestion of different information criterion. Accordingly, the study employed optimal lag length of three (3) as most information criterion selected similar lag length and the result is presented in Table 5.

Cointegration Test

The evidences from both tests viz. Engle-Granger two-step and Johansen's cointegration presented in Tables 6 and 7 indicated that there is a stable long-run relationship among variables in the model. In Table 6, the residual of the model does not possess problem of unit root at significance at 1 % level, while as Table 7 reflects rejection of null hypothesis on the basis of max statistic and maximum Eigen value yields 1 cointegration at the 0.05 significance level. Thus, variables such as labor forces participation, capital formation, domestic savings, trade openness, real effective exchange

Table 2: Descriptive statistics

Statistics	*RGDP*	*LAB*	*GCF*	*GDS*	*OPEN*	*REER*	*CPI*
Mean	260747.7	3.27e+07	102294.1	54895.37	24.425	158.1966	42.28023
Max	892927.6	5.87e+07	662837.3	410313.3	40.49	298.4	167.6
Min	97651.09	1.70e+07	14116.01	4397.33	8.5	90.83	4.28
Skew.	1.553777	.5415686	2.598429	2.788852	.2471965	.7914631	1.545193
Kurt.	4.281603	2.0857	8.879722	9.797073	2.043322	3.558814	3.98391
SD.	217007.9	1.29e+07	157700.5	95453.65	8.382161	49.1535	47.446
Observ.	44	44	44	44	44	44	44

Source: Authors Estimation based on the data from NBE and WB, 2020

Table 3: Unit root test at I (0) showing non-stationarity of variables

Variables	Augmented Dickey-Fuller (ADF)		Phillips- Peron (PP)	
	P-value	Test- statistic	P-value	Test- statistic
LRGDP	1.0000	4.052	1.0000	4.580
LLAB	0.9936	0.941	0.9952	1.093
LGCF	0.9960	1.196	0.9987	2.003
LGDS	1.0000	-0.125	0.9853	0.514
LOPEN	0.4639	-1.637	0.4300	-1.702
LREER	0.3343	-1.895	0.3092	-1.949
LCPI	0.9411	-0.178	0.9331	-0.244

MacKinnon critical test used by ADF and PP: at 1% = -3.628, 5% = -2.950 and 10% = -2.608

Source: Authors Estimation based on the data from NBE and WB, 2020

Table 4: Unit root test at I(1) (showing stationarity of variables)

Variables	Augmented Dickey-Fuller (ADF)		Phillips- Peron (PP)	
	P-value	Test- statistic	*P-value*	Test- statistic
LRGDP	0.0003	-4.442***	0.0003	-4.416***
LLAB	0.0000	-7.228***	0.0000	-7.336***
LGCF	0.0000	-7.456***	0.0000	-7.481***
LGDS	0.0000	-8.641***	0.0000	-8.787***
LOPEN	0.0000	-6.362***	0.0000	-6.363***
LREER	0.0000	-5.903***	0.0000	-5.895***
LCPI	0.0000	-5.781***	0.0000	-5.777***

MacKinnon critical test used by ADF and PP: at 1% = -3.628, 5% = -2.950 and 10% = -2.608 (***)Significant at 1% level

Source: Authors Estimation based on the data from NBE and WB, 2020

Table 5: Lag length selections criterion

Lags	LogL	LR	FPE	AIC	HQIC	SBIC
0	288.497	NA	1.8e-15	-14.0748	-13.968	-13.7793
1	571.483	565.97	1.6e-20	-25.7741	-24.9192	-23.4097
2	636.888	130.81	8.7e-21	-26.5944	-24.9914	-22.1611
3	857.635	252.15**	2.1e-22**	32.7317* *	-29.6327* *	-24.1607**
4	NA	NA	2.08e-53	NA	NA	NA

FPE_ Final prediction error

SBIC_Schwarz's Bayesian information criterion.

AIC _Akaike's information criterion

HQIC _Hannan Quinn information criterion.

(**) Indicates that lag order selected by the criterion at 5% level of significance

Source: Authors Estimation based on the data from NBE and WB, 2020

rate, consumer price index are long run determinants of growth in Ethiopia.

Long-run Model Estimation (1975-2018)

Table 8 presentedlong-runn relationship between macroeconomic variables in the model and economic growth for 1975 to 2018, estimated using equation 3. The results displayed that the coefficient of LGDS, LOPEN, and LREER are found positive and statistically significant at 1% level, while as the coefficient of LLAB and LCPI are statistically significant at 5% and LGCF is positively significant at 10% level and variables are long run determinate of growth in Ethiopia. The overall estimated adjusted R^2_of the model was found 0.8055 implied that, 80.56% of variation in RGDP is described by variation of significant macroeconomic variables in the model.

$$LRGDPt = -5.754 + 0.614 * LLABt + 0.148 * LGCFt + 0.247 * LGDSt + 0.265 * LOPENt + 0.188 * LREERt - 0.360 * LCPI \ldots \ldots (11)$$

(0.1363) (0.1081) (0.0568) (0.0423) (0.0520) (0.0364)

Model results show that labor force (LAB) has a positive and statistically significant impact on economic growth

Table 6: Engle granger cointegration test (unit root residuals test)

	Test-statistic	*p-value*	*Conclusion*
ADF test for			
unit root	-3.953***	0.0017	H_0 is rejected
PP test for unit root	-3.863***	0.0023	H_0 is rejected

MacKinnon critical test: at 1% = -3.628, at 5% = -2.950, and at 10% = -2.608

H0: The residual has a unit root, (***) significant at 1% level of significance

Source: Authors Estimation based on the data from NBE and WB, 2020

Table 7: Johansen's Max test (Rank Test)

No .of CE(s)	*LL*	*Eigen value*	*Max Statistic*	*Critical value at 5%*
None	546.88046	-	140.7104	124.24
1	568.73583	0.63815	96.9997 **	97.15
2	583.55709	0.49810	67.3571	69.52
3	595.38588	0.42315	43.6996	47.21
4	606.42095	0.40146	21.6294	29.68
5	612.52423	0.24714	9.4229	15.41
6	616.50611	0.16907	1.4591	3.76
7	617.23566	0.03336	1.321	2.35
8	619.22407	0.01350	-	-

(**) rejection of H0: at 5% , Max test shows 1 co-integrating eqn(s) at 5 % , & Ho: There is no co-integration

Source: Authors Estimation based on the data from NBE and WB, 2020

in Ethiopia. The coefficient of LAB 0.6143 inferred that an increase in labor force by 1% results 61 % increase in economic growth ceteris paribus. This empirical finding is in line with studies such as (Ferdinand *et al.,* 2017; Shimelis, 2014).

Gross capital formation (GCF) is considered as vital factor for rapid growth. In the present study, coefficient of capital formation were found 0.1481 which reflects real GDP growth in Ethiopia increases by 14 % as there is 10% increment in gross capital formation. This finding is in line with studies such as (Faridi, 2012; Gilbert *et al.,* 2013) had also confirmed that capital formation generated a positively significant impact on long run growth of countries. The coefficient of domestic savings (GDS) was found positive sign and is different from zero. Its coefficient was found 0.2479, meaning that a 1% level increase in gross domestic savings would increase real GDP growth by 24%. This finding coincides with studies of (Abu, 2010; Adeleke, 2014; Aghion *et al.,* 2005).

The coefficient of trade openness (OPEN) revealed significant impact of macro policy settings to growth, as it is found with coefficient of 0.2654, statistically significant at 1% and different from zero with expected sign. Openness seems to exert comparable impact on long run growth with domestic savings. Its estimation indicated that 1% increment

Table 8: Estimation of long run relationship

Dependent(LRGDP)	*Coefficient*	*Std. Err.*	*Z*	*P*
LLAB	0.6143	0.1363	4.51	0.022**
LGCF	0.1481	0.1081	0.17	0.071*
LGDS	0.2479	0.0568	4.36	0.000***
LOPEN	0.2654	0.0423	6.27	0.000 ***
LREER	0.1885	0.0520	3.62	0.001***
LCPI	-0.3601	0.0364	9.89	0.036**
Constant	- 5.7540	-	-	-

(***) ,(**) , and (*) shows significant at 1%, 5% and at 10% level respectively

DW statistics = 2.03 and Adj. R squared= 0.8055 =>80.56%

Source: Authors Estimation based on the data from NBE and WB, 2020

in degree of openness would results in 26% increases in long run growth in Ethiopia. Studies for example (Muhammad *et al.,* 2015; Mireku *et al.,* 2017; Naveed *et al.,* 2006) found same results for trade openness.

Similarly, long run growth increases by 18% due to 1% increase in real effective exchange rate (REER) keeping the other factors constant. It is statistically significant at 1%. This suggested a need to shift production and tradable goods structures towards demand elastic and value added exportable commodities. This finding is in line with (Uremadu and Onyele, 2016; Koirala, 2018) that upholding exchange rate will stimulate long run growth.

Consumer price index (CPI), used as a proxy for inflation in this study, reflected changes in costs to average consumer of acquiring basket of goods and services. From the result in table for CPI was negative and statistically significant at 5% in explaining long run economic growth. The result shows an inverse relationship between growth and inflation, i.e. an inflation increase by 5% would decrease growth by 36%. Therefore, growth can be facilitated even by lowering moderate inflation. This result is supported by the findings of (Idris and Bakar, 2017; Erbarykal and Okuyan, 2008; Kasidi and Mwakanemela, 2013).

Estimation of Short run ECM (1975-2018)

A predicted short run relationship among variables in the series has been calculated by employing a conventional technique i.e. Vector Error Correction Model (VECM). The error correction coefficient has information about the speed of adjustment moving toward its stable long-run equilibrium trend after an exogenous shock to the system. Table 9 presents short run dynamic link and set of generated short run coefficients in VECM.

From the short run model, it can be observed that error correction term (ECT) is negative, and less than one, (0.3751). It is statistically significant at 5% level of significance and consistent with economic theory. The results revealed that any deviation from long-run equilibrium is adjusted at

Table 9: Vector Error Correction Model (VECM) Estimation

LRGDP	*Coef.*	*Std. Err.*	*Z*	*P-value*
Constant	-0.308	0.0179	-1.72	0.086**
LRGDP(-1)	0.8446	0.2370	1.03	0.030**
LLAB(-1)	-0.9223	0.8608	2.23	0.026**
LGCF(-1)	-0.1218	0.0880	1.38	0.166
LGDS(-1)	-0.498	0.0533	-0.93	0.350
OPEN(-1)	0.1336	0.0797	1.68	0.094*
LREER(-1)	0.1076	0.0938	1.45	0.251
LCPI (-1)	0.1303	0.0899	0.52	0.147
ECM (t-1)	- 0.3751	0.12708	0.30	0.016**

(**) , and (*) are significant at 5% and 10% level respectively

DW statistics = 2.03 , and Adj. R^2 = 0.8056

Source: Authors Estimation based on the data from NBE and WB, 2020

37.51% yearly in the short run. By the same token, RGDP is estimated an average of almost two years and six months to return to its long run equilibrium following any shocks to the system. The significant coefficient of one year lagged value of indicated that the system corrects the prior disequilibrium at the speed of 84 % between economic growth and lagged one year growth (LRGDP (-1)).

The coefficient of one year lagged value of LLAB (-1) generated statistically significant negative value in short run. Ethiopia, a highly populated country, has a greater labor force resulting from a much younger population. However, labor forces were not fully utilized for production purposes in short run to spur the desired growth. This is justifiable in most developing countries in general and Ethiopia in particular as there is prevalent and higher unemployment though there is a much labor force supply. ΔLLAB (-1) coefficient is -0.9223, which is statistically significant at 5% in explaining short-run growth. This implied that a percentage increase in the labor force in its one year lagged period wored ucen of growth by 92% the in short run. In contrast long run estimation of LLAB possesses positive and statistically significant result.

Unlike long run, the coefficient of one year lagged value of domestic savings LGDS (-1) as proxied by gross domestic savings was found statistically insignificant with a negative value in short run. This indicated that in the short run, domestic saving has not been able to spur Ethiopia's desired economic growth. This is because poor financial infrastructures weak culture of savings; however, this would eventually be improved through learning by doing and become a continuous source of financing long term economic growth. Hence, it can become a positively significant factor in the long run. As households and firms build their saving-investment capacity, its return will steadily exceed its cost and support economic growth in the long run. Unlike the case of long run, the coefficient of one year lagged value of real effective exchange rate LREER(-1) and Gross capital formation were also found to be statistically insignificant value in short-run.

The coefficients of one year lagged values ofOPEN (-1) generated a statistically significant value at 10% level of significance, indicating that 1% increment in trade openness would result in a 13 % increment in RGDP in the short run. While LCPI (-1) is statistically insignificant, its positive value explains short-run economic growth in Ethiopia. Finally, the constant term in the short run model was -0.308 implying that growth will lower by 30% on average in the short-run under the assumption of ceteris paribus at 10% significance level.

Granger Causality Test

Granger causality tests were employed to establish the direction of causations among explanatory variables in the model and economic growth using equation 8 and 9. Consequently, Table 10 presented the long run Granger causality test. It is observed from the results that null

Table 10: Granger Causality Tests (period-1975 – 2018)

[H_0] Null hypothesis	*Observation*	*chi² (χ2)*	*Probability*	*Conclusion*
LGDS does not granger cause LRGDP		9.8991	0.002***	Null hypothesis is rejected
LRGDP does not granger cause LGDS	44	5.2264	0.022**	Null hypothesis is rejected
LGCF does not granger cause LRGDP		26.596	0.000***	Null hypothesis is accepted
LRGDP does not granger cause LGCF	44	.24237	0.622	Null hypothesis is rejected
LLAB does not granger cause LRGDP		18.971	0.000***	Null hypothesis is accepted
LRGDP does not granger cause LLAB	44	4.9458	0.1115	Null hypothesis is rejected
LOPEN does not granger cause LRGDP		13.937	0.000***	Null hypothesis is rejected
LRGDP does not granger cause LOPEN	44	3.2144	0.073*	Null hypothesis is rejected
LREER does not granger cause LRGDP		3.41057	0.052 *	Null hypothesis is accepted
LRGDP does not granger cause LREER	44	1.4614	0.227	Null hypothesis is rejected
LCPI does not granger cause LRGDP		15.843	0.000***	Null hypothesis is accepted
LRGDP does not granger cause LCPI	44	1.3684	0.242	Null hypothesis is rejected

(*), (**), and (* **) shows significant at 10%, 5 % and 1% significant level respectively.

Source: Authors Estimation based on the data from NBE and WB, 2020

hypothesis of granger causes between gross domestic saving and trade openness with economic growth were rejected at 1 , 10 and 5% level of significance, respectively. This information indicated that there exists a bidirectional causality running from growth to domestic saving, open trade and vice versa. However, the causality running from LGCF to LRGDP, the null hypothesis is rejected, showing that capital formation Granger causes LRGDP. Similarly, the null hypotheses that state LLAB, LCPI and LREER don't granger causes economic growth (LRGDP) were also rejected. This depicted that there is a unidirectional causality running growth to LGCF, LLAB, LCPI and LREER and vice versa.

Conclusion

The researchers used a base of conventional neoclassical growth models to check whether Ethiopia's selected macroeconomic variables lead growth. They analyzed annual time series data for such variables for the period of 1975 to 2018 extracted from NBE and WB. Both Engle-Granger and Johansen cointegration test results revealed a long-run relationship among variables. From findings, the long run estimated model of the study shows that about 80% variation of real GDP is due to variation of selected macroeconomic variables. We found the long run coefficients of LGDS, LOPEN, and LREER are positive and statistically significant at 1% level, the coefficients of LLAB and LCPI are significant at 5% level and LGCF is positively significant at 10% level. This signals a strong and stable long-run relationship exists between domestic saving, labor force, domestic capital formation, trade openness, exchange rate, inflation and economic growth in Ethiopia. Similarly the significant negative sign in error correction term (ECT-1) of -0.3751 indicated that equilibrium is adjusted at 37.51% yearly. In the short run estimated model, the coefficient of one year lagged values of ΔLRGDP, ΔLLAB and ΔOPEN were found significant at 5 and 10% level and indicates a strong impact on economic growth in Ethiopia. Granger causes a bidirectional causality from growth to domestic saving, open trade and vice versa. However, LLAB, LGCF, LCPI and LREER granger causes economic growth (LRGDP) reflects that there is unidirectional causality running growth and vice versa.

Based on the findings, we recommend that the incumbent government encourage saving in home economy and channel it to investors to spur investment activities and economic growth. There is need to build training centers to provide trained and productive labour force. Similarly, opening the economy to the rest of the world ensures relatively lower price inflation in the domestic economy, as well as investors' confidence.

Conflict of Interests and Funding agency

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