Research in: Agricultural & Veterinary Sciences
Vol.3, No.3, 2019, pp.152-167

ANALYSIS OF FACTORS AFFECTING AGRICULTURAL OUTPUT GROWTH IN ETHIOPIA: MACRO-ECONOMIC PERSPECTIVE

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Abstract. Agriculture sector plays a decisive role in economic growth and development, especially for developing countries. Many scholars believed that macroeconomic policy changes have substantial effects on agricultural economy and *analyzing this effect is valuable for designing suitable agricultural policies*. This study examined the effect of some macroeconomic variables on agricultural sector output of Ethiopia from the year 1991 to 2017. The study employed Autoregressive Distributed Lag (ARDL) bounds test approach and error correction model (ECM). Accordingly the study found a long-run relationship between agricultural sector output and macroeconomic variables such as; inflation rate, lending rate, trade balance, foreign direct investment, exchange rate and external debt stock. Trade balance which is negative throughout the study year and, external debt stock have a negative effect on agricultural sector output; both in the long-run and in the short-run. The official exchange rate and lending rate have a positive and significant effect. However, inflation rate and foreign direct investment have insignificance effect on agricultural output. Thus the concerned body needs to improve the nation's trade balance by applying a policy that enlarges export. Finally, the government has to limit its external debt, and mobilize and use domestic productive capital more efficiently.

Keywords: *Agricultural output, ARDL Bound Test, Macroeconomic Variable, Ethiopia***.**

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Received: *28 October 2019;* ***Accepted:*** *29 November 2019;* ***Published:*** *30 December 2019.*

1. Introduction

Back ground of the study

The agricultural sector for every country is the basic catalyst and accelerator of growth (Patrick, 2013). Agriculture sector plays a decisive role in economic growth and development, especially for developing countries (Sharif & Noor, 2015). The sector has a potential inreducing poverty and creating employment for a large number of people in developing countries (Ukpe *et al.*, 2018).

Agriculture has been the main the contributor to gross domestic product in developing countries including Ethiopia. This particular sector determines the growth of all the other sectors and, consequently, the whole national economy (Atsbaha & Tessema, 2010). The sector comprises 35.8 percent of gross Domestic Product(Adisu, 2018) and, more than 70% of Ethiopia's population is employed in the agricultural related activities (trading economics, 2017). The sector is also a major contributor to export earnings, with over 80 percent of goods exports (Ahmed, 2018). Hence, the country's aspiration for achieving overall economic growth largely depends on the performance of the agriculture sector (UNDP, 2016). In spite of huge agricultural potential, the growth in agricultural production has not been able to keep pace with that

of the demand (CSA, 2017) which has compelled the country to depend on foreign food.

Moreover the current Ethiopian development policy stresses on development push from agriculture to industry based on use of all means's of increasing productivity and production of the sector (Dagninet & Wolelaw, 2016). Due to such importance of agricultural sector, the Ethiopian government gives high priority to the sector by planning and implementing different strategies (MoA, 2015). Agricultural Development Led Industrialization (ADLI) is the central pillar of the economic strategy of the country (Mohammed, 2018) whose prime objective is to strengthen the linkage between agricultural and industrial sectors (Fantu, 2016). The government also has been implementing the Agricultural Growth Program I and II (AGP-I and II) to increase agricultural productivity and commercialization via addressing some of the key constraints to agricultural growth (MoA, 2015). The agricultural sector growth can be constrained by several factors.

Many researchers and economists believed that macroeconomic policy changes have substantial impacts on agricultural economy (Roslina, 2010, Aroriode *et al*., 2014). The policies that governments use are of particular importance in influencing the economy as a whole (Ernest, 2014). For instance devaluation of domestic currency makes domestic goods cheaper compared to imported goods, thus resulting to an increase in net exports leading to an increase in output (Mishkin, 1955). Similarly lower lending rate leads domestic firms to borrow and invest on agricultural sector. Hence, macroeconomic policy changes often dramatically impact the agricultural economy.

The Ethiopian economy has been experienced high growth rate compelled with tremendous macroeconomic fluctuations. For instance, double digit inflation (13.6 percent in November, 2017 (IMF, 2018) and 13.7 percent in April 2018 (UNDP, 2018)), flagging export to GDP ratio (Since 2010/11, it has been on a declining path (WB, 2018)), weak trade balance, excessive stock of public external debt ($24.2 billion in 2017 (UNDP, 2018), unpredictable foreign direct investment flows and devaluation of domestic currency. According to WB (2018) the value exports of goods and services do not exceed 10 percent of GDP of Ethiopia. Although there is an improvement in the trade balance in 2017 it was bound by a slowdown in imports rather than an increasing in exports (WB, 2018; IMF, 2018). The weak performance of Ethiopian export is often attributed to a low income elasticity for the type of commodities that Ethiopia exports, declining prices for its exports, and limited destinations for Ethiopian exports (Negussie & Ashebir, 2016). The country also suffers from accumulation of external debt. The deterioration in debt indicators was mainly due to poor export performance, but there was a significant improvement in debt policy over the year WB (2018). The external debt and debt service burden pose the main identifiable risk to macroeconomic stability (IMF 2018).

The Current debt service of Ethiopia is becoming significant. According to IMF (2018) Ethiopia faces about US$1.5 billion in external public debt service payments coming due during 2017/18 and significant obligations over the medium term. Since the debt service is payable from export of goods and services, eventually it would have a substantial effect on the production of exportable commodities. However, the export structure is highly concentrated to a few agricultural commodities, such as coffee, hides, skins, oilseeds, and pulses (Ahmed *et al.*, 2018).

With the context of reoccurring unstable macroeconomic performance of Ethiopia, it is worthwhile to understand how these macroeconomic variables affect the

agricultural sector output. However there is a limited study has conducted in the area. This work aimed to assess the macroeconomic factors affecting agricultural output growth. Specifically this study identifies the major macro-economic variables that affect agricultural output in Ethiopia, and examine the extent to which the agricultural sector is affected by these variables. The outcome of this study could bring better understanding about the effect macroeconomic factors agricultural output and provide useful information for more beneficial and appropriate public policies.

Review of literature

Macroeconomics which refers to the study of a nation's overall economic performance, through its policy radically affects the agricultural sector. Policies concerning to macro-economy are intended to improve the national economy as a whole. However, according to (Aroriode *et al.*, 2014) these policies often have unintended and harmful effects on the agricultural economy, hence, and policymakers must understand the policy process and the impact that changing macroeconomic policies can have on agriculture. According to Ernest (2014), macro-economic policies affect agriculture can be categorized in to three: monetary and fiscal policies, foreign exchange rate policies, and factor price, natural resource, and land use policies.

The agricultural sector is very sensitive to changes in interest rates and inflation and thus monetary policy changes. The change in the foreign exchange rate has a direct effect on agricultural product prices and input costs. Since most agricultural commodities are traded globally, the exchange rate thus directly influences the price of an agricultural commodity (Pearson, 2002). The general price level can also causes instability in agricultural product prices (Fischer, 1981; Ernest, 2014). However, the changes of macroeconomic indicator directly come from implementation of monetary and fiscal policies that affect agricultural productivity through their influence on the exchange rate, inflation rate, export, interest rate, government expenditure, and money supply (Sharif, 2015). Therefore the change in macroeconomic variable (intentionally through policy change or unintentionally by other exogenous factors) affects national income and hence the agricultural economy.

There are large numbers of empirical studies, which have recorded the relationships of macroeconomic variables and agricultural sector. Shakira (2018) assessed the determinants of agricultural productivity in Malawi. Using a time series data from 1980 to 2015 and ARDL, the study found in the long run, an increase in agricultural expenditure increases agricultural productivity. In the short run, an increase in inflation will increase agricultural productivity; however there is no significant relationship in the long run. A study by George and Beth (2017) in Kenya, by employing OLS estimation technique as the method of analysis and using secondary data from the period 1980 - 2013; found that increase of one percent in labour force caused an increase in agricultural productivity by 0.198%.

Shakeeb *et al.* (2016) investigated the determinants of agricultural output in Syria, 1980-2010. Using Johansen co-integration test they found that agricultural outputs are positively related to the capital, food exports, expenditure and arable land, and negatively related to the oil price. Cristea *et al.* (2015) analyzed relationship between agriculture in GDP and the main macroeconomic variables, in Romania. Using a time series data ranging from 1995-2014 the study they found that exchange rate, the interest rate for credits and the interest rate for deposits affects agricultural GDP.

Shariff and Noor (2014) investigated the impact of macroeconomic variables on agricultural productivity in Malaysia. Using time series data covering from 1980 to 2014 and Autoregressive-Distributed Lag approach, their study confirmed a long- run-relationship between agricultural productivity and; nominal exchange rate, net export, inflation rate, interest rate, government expenditure and money supply. However, only nominal exchange rate shows significant impact on agricultural productivity in the long run.

Patrick and Prudence (2013) identified the macroeconomic factors which influence agricultural production in Ghana. By applying the OLS estimation technique their study identified; labour force, inflation, real exchange rate and real GDP per capita are the key macro-economic factors that influence agricultural productions in Ghana. The study further showed inflation and real exchange rate have a positive significant effect agricultural production. Khalil (2012) by using annual data covering form 1965 – 2009 and employing autoregressive distributive lag model studied the determinants of agricultural productivity growth in Pakistan. His result indicated that fertilizer and human capital are the most important determinant of long run and short run agricultural productivity growth. While, agricultural credit has relatively lower short run and long run impact on the growth of productivity. However, for the case of Ethiopia there is insufficientresearches have conducted on the similar issue.

2. Material and methods

Data type, sources and collection techniques

The study used a secondary time series data ranging from 1991 up to 2018. The data are obtained from Ministry of Finance and Economic Cooperation (MoFEC) of Ethiopia and the World Bank. The rationale for using data started from 1991is due to the secession of Eritrea from Ethiopia. And most macroeconomic time series data before 1991 of Ethiopia are found amalgamated with Eritrea's. This study used both empirical and descriptive type of research in order to assess the effect of macro-economic variables on agricultural output of Ethiopia.

Model Specification and Estimation procedure

In macroeconomics aggregate production functions are estimated to create a framework in which to distinguish how much economic growth to attribute to change in the factor allocation and advancing technology. From the literature, the Cobb- Douglas production function through the application of Auto Regressive Distributed Lag (ARDL) model is adopted to examine the effects of macroeconomic variables on agricultural outputs of Ethiopia. A production function describes the technical relationship that transforms inputs (resources) into outputs (commodities) resources into outputs (commodities). A general way of writing a production function is;

$$Y = f(L, K, A) \quad (1)$$

where Y is an output and L and K are the collection labour and capital inputs, respectively. And 'A' captures the productivity factor (which is a technology or any other factor which affect long run growth in addition to Labor and Capital) is augmented in the production function. The general neoclassical production function is given as;

$$Y = AK^{\alpha}L^{\beta} \quad (2)$$

where Y is the output level; A, α & β are positive constants indicating the total factor productivity (TFP), capital and labour elasticities, respectively. K & L are capital and labour input respectively. The factors are constant and determined by the available technology (Koutsoyiannis, 2006). The Cobb-Douglas production function is of degree one if $\alpha + \beta = 1$. A production functions of degree one has constant returns to scale. If $\alpha + \beta > 1$ and if $\alpha + \beta < 1$ then the production function is said to be exhibiting an increasing and a decreasing returns to scale, respectively. Since the values of α and β are not limited, Cobb-Douglas production function can exhibit any degree of returns to scale (Koutsoyiannis, 2006). To eliminate the bias in Cobb-Douglas production function, the equation can be transformed by taking the logarithms of both sides. This transformed function can be estimated through ordinary least square technique. Thus the Cobb-Douglas production function can be written as;

$$ln\,Y = lnA + \alpha\, lnK + \beta\, lnL \quad (3)$$

Ordinary least square can be used to estimate the log-linear model as it is now linear in parameters. The logical basis for choosing Cobb-Douglas production function is based on the fact that it is relatively simple and convenient to specify and interpret (Shakira, 2018).

Estimation procedure

In analyzing the effect of macroeconomic variables on agricultural output, Auto Regressive Distributed Lag (ARDL) model with a bound test for co-integration approach which is developed by Pesaran *et al.* (2001) is applied for this study because of its numerous advantages. First, unlike the Johansen co-integration test, the ARDL does not need that all the variables under study to be integrated of the same order and it can be applied when the under-lying variables are integrated of order one, order zero or mixed. Second, ARDL test is relatively more efficient in the case of small and finite sample data sizes. Finally, by applying the ARDL technique obtained results will be unbiased estimates of the long-run model (Kumneger, 2018). Moreover, the ARDL approach also serial correlations and endogeneity problems and provides unbiased estimates of the long run and short run model and valid t-statistics (Harris, 2003; Kumneger, 2018)

However before going through it we need to check the stationary of variables. In doing so the study relied on the augmented version of the Dickey–Fuller (ADF) and The Phillips-Perron (PP) tests. In this study, an econometric model for agricultural output is established as follows:

$$AGDP = f\,[lagged\,INF, LR, TB, FDI, ER, DBT] \quad (4)$$

where AGDP, INF, LR, TB, FDI, ER and DBT stands for agricultural output, inflation rate, lending rate, trade balance, foreign direct investment, official exchange rate and external debt stock, respectively. The multiple regression equation models to explore the macroeconomic factors that influence agricultural output in Ethiopia is stated as:

$$lnAGDP_t = \beta_0 + \beta_1(INF)_t + \beta_2(LR)_t + \beta_3(TB)_t + \beta_4(lnFDI)_t + \beta_5(lnER)_t + \beta_6(lnDBT)_t\varepsilon_i \quad (5)$$

where $lnAGDP_t$ is the natural log of agricultural output, INF_t is inflation rate, LR_t is lendingrate, TB_t is trade balance $lnFDI_t$ is the natural log offoreign direct investment, $lnER_t$ is the natural log of official exchange rate, $ln\text{DBT}_t$ is external debt service, and ε_i is the stochastic error term.

ARDL Bounds test for co-integration

The above equation (5) is re arranged into ARDL form to estimate both short-run and long- run relations and error correction term(ECT), is derived from long run relation. The resulting new equations (6) became as follows.

$$D\big(ln(AGDP)\big) = \beta_0 + \beta_1 ln(AGDPt-i) + \beta_2(INFt-i) + \beta_3(LRt-i) + \beta_4(TBt-i) + \beta_5 ln(FDIt-i) + \beta_6 ln(ERti) + \beta_7(DBTti) + \sum_{i=1}^{p} \alpha_1 D\big(ln(AGDPt-i)\big) + \sum_{i=1}^{p} \alpha_2 D\big((INFt-i)\big) + \sum_{i=1}^{p} \alpha_3 D(IRt-i) + \sum_{i=1}^{p} \alpha_4 D(TBt-i)) + \sum_{i=1}^{p} \alpha_5 D(ln(FDIt-i)) + \sum_{i=1}^{p} \alpha_6 D(\ln(ERt-i)) + \sum_{i=1}^{p} \alpha_7 D(DBTt-i) + \varepsilon t \quad (6)$$

In the equations above (6), all the variables are previously defined, ***ln*** denotes logarithmic operator, ***D*** is difference of a variable and ε_t are error terms. ***i*** is the maximum lag number, β_1-β_7 represent long-run coefficients of explanatory variables and α_1– α_7 represent short-run coefficients of explanatory variables. The F-statistic is carried out on the joint null hypothesis that the coefficients of the lagged variables is equal to zero ($\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$) and alternative hypothesis $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq 0$, to test long-run relationship of the model. Then the ARDL technique provides a unified framework for testing and estimating of co-integration relations in the context of a single equation. However since the ARDL procedure is sensitive for a given lag length, the number of appropriate lags in the dependent variable will be chosen by the Akaike Information Criteria (AIC) and SIC (Schwartz Information Criterion) to ensure that the errors are white noise (Katircioglu, 2019).

The ARDL bound test has three possible decision rules. If the F-statistics lied above the upper bound of the critical value for a given significance level, the study will fail to accept the null hypotheses of no co-integration. If the F-statistics lied below the lower bound of the critical value for a given significance level, the study will fail to reject the null hypotheses of no integration. However if the F-statistics lied in between the lower and the upper bound of the critical value for a given significance level, conclusive inference can be made. Once the existence of co-integration is confirmed, a dynamic error correction model can be derived from ARDL through a simple linear transformation. If error correction term (ECT) is negative and significant it will signify the long run causality Granger (1988).

$$D\big(ln(AGDP)\big)t = \beta_0 + \sum_{i=1}^{p} \beta_1 D\big(ln(AGDPt-i)\big) + \sum_{i=1}^{p} \beta_2 D(Xt-i) + \Upsilon ECTt-1 + \mu t \quad (7)$$

where β's are the coefficients associated with short-run dynamics of the model coverage to equilibrium, X represents independent macroeconomic variables, ECT−1 is the error correction term and μt is stochastic error term. Once the error correction model is

estimated, the cumulative sum of recursive residuals (CUSUM) and the CUSUM of square (CUSUMSQ) tests are used to assess the parameter stability.

Definition and Expected signs of variable

Agricultural output is included to capture the performance of the agricultural sector. It is measured as a natural log of Agricultural output (*ln*AGDP). Agriculture includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. The study expects that the inflation rate, lending rate, foreign debt stock and trade balance would have a compressing effect on agricultural sector output while foreign direct investment and official exchange rate will have a positive effect on the sector.

Table 1. Summary of variable and their expected sign

Variables	Notation	Definition	Expected signs
Inflation rate	INFt	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods	-
Lending rate	LRt	It is the rate at which banks charge borrowers for their loan	-
Trade balance	lnTBt	Net trade in goods is the difference between exports and imports of goods.Data are in current U.S. dollars.	-
Foreign direct investment	lnFDIt	Foreign direct investment refers to direct investment equity flows in the reporting economy. It is the sum of equity capital, reinvestment of earnings, and other capital.	+
Official exchange rate	lnERt	The exchange rate determined by national authorities. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar).	+
External debt stocks	lnDBRt	It is debt that has an original or extended maturity of more than one year. It has three components: public, publicly guaranteed, and private nonguaranteed debt.	-

3. Results and discussion

An overview of Ethiopian agricultural sector

The economy of most developing nations including Ethiopia is characterized by the predominance of agriculture sector. The sector is the major source for employment generation, foreign exchange earnings and raw material for manufacturing sectors. The share of agriculture sector to the national product is on the declining track. 'Figure1' shows the share agricultural sector output in national GDP. In earlier times agriculture covers more than 50 percent of national GDP. For instance in 1992 it takes up to 60 percent of the GDP; since then the sector has been declining until it covered 40 percent in 2003. In 2012 the sector contributes about 40 percent and in 2017 it covers less than 35 percent of the total output of the nation; which is the lowest one in the history. However, since much of the employment and foreign exchange earnings are come from the sector, the declining share of the sector to GDP does notmean the role of the sector is diminishing.

In 'Figure 1' the vertical axis represents the value of agricultural production in Billion USD. As it is portrayed in the above figure the agricultural GDP has been increasing over the study years. However in 1985 it was declined to 3.7 billion USD.

This is due to the incidence of drought and the resulting famine that put the nation at higher risk. Starting from 2003 the sector is increasing without significant fluctuation.

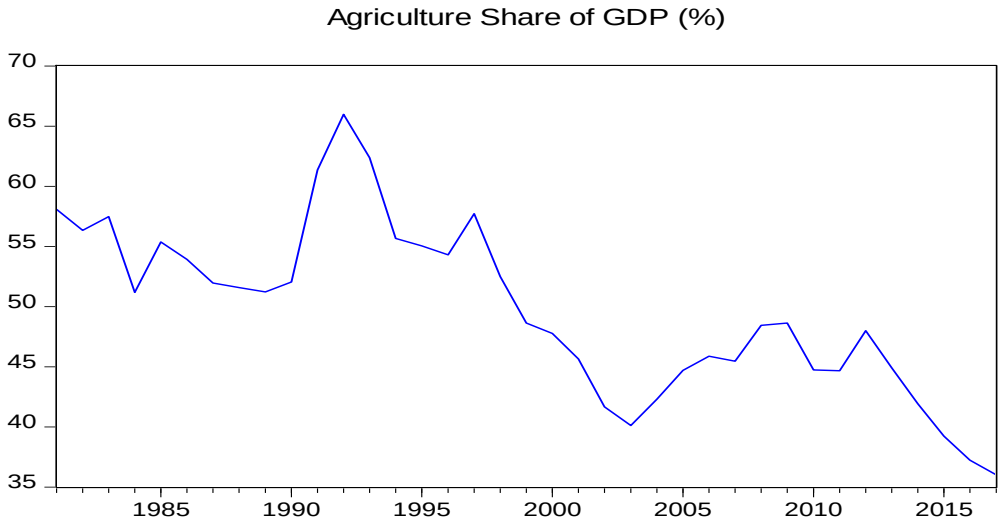

Figure 1. The percentage share of agricultural sector to GDP
Source: author's computation

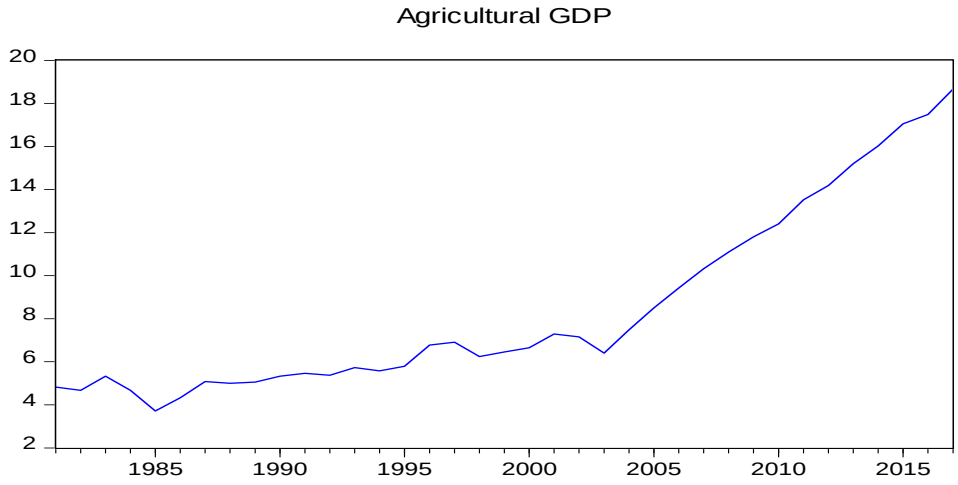

Figure 2. The value added of the agricultural sector
Source: Author's computation

The growth rate of GDP is contributed by the three (agricultural industrial and service) sectors. As 'figure 3' shows Starting from 1999 service sector has provided most growth rate of GDP. This is due to the fact that role sectors to GDP has shifted from agriculture sector to service sector, however according to (Adisu, 2018) whether this is due to structural transformation of the economy or not is doubtful. The growth rate of the agriculture as portrayed by 'figure 3' sector is fluctuating across the study years; this is because of the sector is backward and rain dependent that leads to frequent drought and famine.

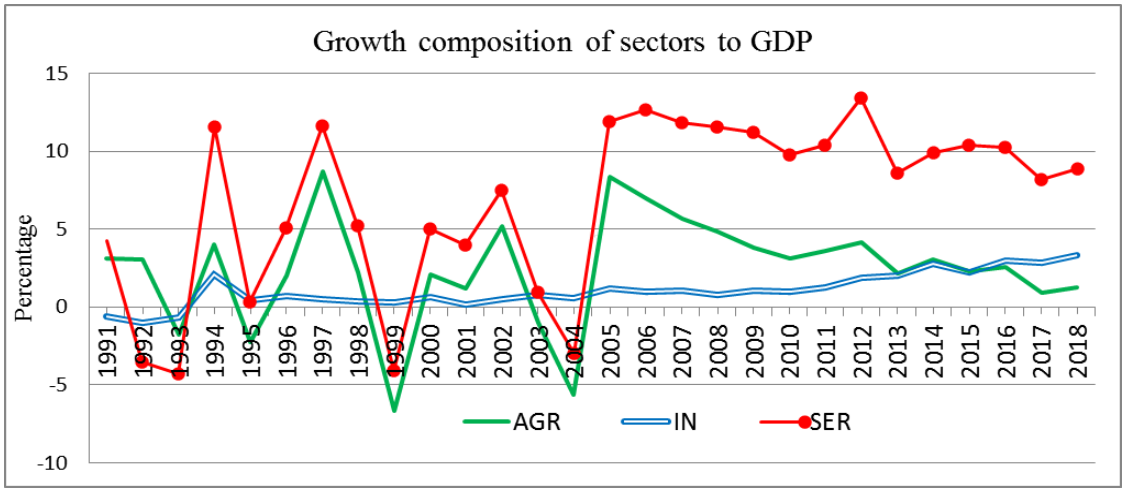

Figure 3. Growth composition of sectors to GDP
Source: Author's computation

In 1995 the growth rate of GDP contributed by agriculture sector was high (although it is negative). From 1991 to 1993 the growth rate of GDP contributed by industry and service sector were negative this is because of the civil war had reached in its pick and Eritrea was departed from Ethiopia; which stunted the economy, especially the industrial and the service sectors. The growth rate of GDP has been significantly affected by the growth of agriculture sector until 1997. After this year the role of the other two sectors namely the industry and service sector started increasing and the growth rate contribution by agriculture sector begun diminishing.

Regression analysis

Unit root test (stationary test) analysis

The first step to analyze time series data is to look at the stationary of the variables (Sharif, 2015). The justification behind the unit root test is to take a care on the order of integration not above I (1) in which we cannot apply ARDL bounds test to co-integration (Tekilu *et al.*, 2018). The result of ADF tests indicates that official exchange rate and inflation rate are integrated of order zero I(0) Whereas the remaining variables are found integrated order of one I(1).

Table 2. Augmented dickey fuller stationary test result

Augmented dickey fuller								
	Level I(0)				Differenced I(1)			
Variables	Statistics test	Critical values		P-value	Statistics test	Critical values		P-value
		1%	5%			1%	5%	
lnAGR	-2.102105	-4.339330	-3.587527	0.5216	-4.596156	-4.356068	-3.595026	0.0058*
INF	-4.583100	-4.339330	-3.587527	0.0058*	-6.928713	-4.374307	-3.603202	0.0000*
LR	-1.686229	-4.394309	-3.612199	0.7259	-3.510832	-4.416345	-3.622033	0.0618***
TB	-3.129986	-4.356068	-3.595026	0.1205	-8.407591	-4.374307	-3.603202	0.0000*
lnFDTt	-2.935985	-4.339330	-3.587527	0.1677	-5.266333	-4.374307	-3.603202	0.0014*
lnER	-4.036406	-4.374307	-3.603202	0.0206**	-2.612768	-2.656915	-1.954414	0.0111**
lnDBTt	-0.598656	-4.356068	-3.595026	0.9705	-4.217169	-4.374307	-3.603202	0.0140* *
Phillips-Perron (PP)								
	Level I(0)				Differenced I(1)			
lnAGR	0.578082	-3.699871	-2.976263	0.9863	-4.650969	-3.711457	-2.981038	0.0010*
INF	-4.199170	-3.699871	-2.976263	0.0030**	-9.968056	-3.711457	-2.981038	0.0000*
LR	-3.460233	-4.339330	-3.587527	0.0644***	-5.596944	-4.356068	-3.595026	0.0006*

TB	-3.129986	-4.356068	-3.595026	0.1205	-8.613541	-4.374307	-3.603202	0.0000*
lnFDI	-4.840247	-4.339330	-3.587527	0.0032*	-5.472380	-4.356068	-3.595026	0.0008*
lnER	-3.582268	-4.339330	3.587527	0.0505***	-2.612768	-2.656915	-1.954414	0.0111**
lnDBTt	-0.844973	-4.356068	-3.595026	0.9477	-4.209414	-4.374307	-3.603202	0.0143*

Source: Author's calculation from E view 10 results, 2019

For PP tests report also shows that inflation rate, lending rate, foreign direct investment and official exchange rate are stationary in their levels at 5% significance level. Other variables become stationary after taking the first difference. Overall, the orders of integration for all series are integrated of order zero and integrated of order one-which is viable to precede the bound test of co-integration analysis.

Long run ARDL bounds tests for co-integration

Once the series are tested for stationary, the next step is testing for the existence of long run relationship. Because a procedure of ARDL is sensitive to the lag length (Sharif & Noor, 2015) we need to select the appropriate lag length. As result two lag lengths is selected based on AIC, SCZ and HQ methods and the selected model becomes ARDL (2, 2, 2, 1, 2, 2, 2). We employed ARDL model through bounds test to identify the presence of the long run relationship among all the series. If the F-statistics lied above the upper bound of the critical value for a given significance level, the study will fail to accept the null hypotheses of no co-integration. The result of the bounds tests is reported in table 3.

Table 3. Long run ARDL bounds tests

Model	F-Statistics	Significance level	Lower bound	Upper bound	Decision
Agriculture	7.774333* (k=6)	10%	2.12	3.23	Co-integration
		5%	2.45	3.61	
		1%	3.15	4.43	

Source: Author's calculation from E view 10 results, 2019

Notes: ARDL Models selected on Akaike info criterion (AIC) automatically, intercept and no trend for *k*-6; the sign of * indicate the level of significance at 1% to reject the null hypothesis of No long-run relationships exist respectively

The value of F-Statistics (7.774333) is much greater than the upper bound value of 1%, 5% and 10% significance level. Therefore we can conclude that; Agricultural output, inflation rate, lending rate, trade balance, foreign direct investment, official exchange rate, and External debt stocks, have long-run relationship when agricultural output is modeled as dependent variable.

Long-run equation

Since we have specified the growth model in a log-log form except for inflation and lending rate because these are expressed in growth rate form, the coefficients can be interpreted as elasticity with respect to agricultural output. But interest rate and inflation rates are already given as percentage. The long-run coefficients of the ARDL model are reported in Table 4 below.

Table 4. Long-run coefficients

Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF	-0.002022	0.002275	-0.888486	0.3974
LR	0.096817	0.024257	3.991338	0.0032*
lnTB	-0.196928	0.050591	-3.892585	0.0037*
lnFDI	0.014990	0.017376	0.862695	0.4107
lnER	0.566936	0.145824	3.887805	0.0037*
lnDEBT	-0.128138	0.053878	-2.378302	0.0413**
C	18.816189	1.302361	14.447748	0.0000*

Source: Author's calculation from E view 10 results, 2019

Note**:** The sign * and *** indicate that the variables are significant at the level of 1% and 10% respectively.

From the long-run coefficients except the inflation rate and foreign direct investment, all other independent variables affect the agriculture output significantly. Inflation rate is found to be having a negative but insignificance effect on agricultural output. The result is inconsistence with our prior expectation. The possible explanation for this insignificant effect could be the weak response of agricultural sector for price change.

However the effect of lending rate on agricultural sector output is unexpectedly positive at one percent significant level. When banks' lending rate increases by one percent, agricultural GDP increases by about 0.09 percent approximately. The regression output also shows that in the long-run the flow of the foreign direct investment has no significant effect on agricultural output. Trade balance (export value less import value) is found to be negative with 1 percent significance level-this result is parallel with our priori expectation. A one percent increase in the trade balance leads the agricultural output to decrease by about 0.197 percent. The official exchange rate which is defined as the number of domestic currency per unit of USD is found to be affecting the agricultural sector positively and significantly. This implies that in the long run devaluation of domestic currency with respect foreign currency encourages production of agricultural commodities. Since most of exportable products in Ethiopia are agricultural commodities (such as such as coffee, hides, skins, oilseeds, and pulses) devaluation these make them cheaper compare with imported products. This raises the demand for agricultural products in international market and the agricultural production could boost. Therefore, when the official exchange rate increases by one percent the agricultural output increases by about 0.567percent, approximately. The external debt stock also found to be negative with at five percent significance level. Accordingly in the long run a one percent increase in external debt accumulation leads to 0.128 percent decline in the agricultural output. Theoretically debt stock (capital accumulation) would have a positive role to play for the overall economic growth; however it might have also a depressing effect on agricultural sector. The accumulation of external debt stock unswervingly increases the debt service of the nation; which is payable from the amount export of goods and services. Therefore, it discourages export of products (mostly agricultural) and eventually reduces the productive capacity of the country.

Short run coefficients

The short run models also confirmed that trade balance has a negative and significant effect on agricultural output growth in short run. The external debt stock also found to have a negative and significant effect on agricultural output growth in the short run-This result is parallel with the long-run one. The coefficient of the error correction (ECT_{-1}) term which measures the speed of adjustment back to equilibrium whenever the system is disturbed indicates that adjustment is relatively fast. As table shows the coefficient of error correction term is -0.70 with expected sign and is statistically significant at the 1 percent level, suggesting that about 70 % of the disequilibria from previous year shock converge back to the long run equilibrium each period. Moreover, the significance value of the lagged error correction term confirms the existence of bound test for co-integration.

Table 5. Short-run coefficients for agricultural output growth

Co-integrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNAGR(-1))	0.238766	0.164409	1.452268	0.1804
D(INF)	-0.000229	0.000974	-0.234562	0.8198
D(NOMINAL_LR)	0.061386	0.012148	5.053297	0.0007*
D(NOMINAL_LR(-1))	0.011846	0.006581	1.800018	0.1054
D(TB)	-0.200354	0.046213	-4.335488	0.0019*
D(TB(-1))	-0.149339	0.054064	-2.762250	0.0220**
D(LNFDI)	0.010541	0.012239	0.861221	0.4115
D(LNER)	0.398661	0.105913	3.764028	0.0045*
D(LNDEBT)	-0.092875	0.036892	-2.517472	0.0329**
D(LNDEBT(-1))	-0.071398	0.030694	-2.326103	0.0450**
ECT(-1)	-0.703185	0.143411	-4.903270	0.0008*
Cointeq = LNAGR - (-0.0020*INF + 0.0968*NOMINAL_LR -0.1969*TB +				
0.0150*LNFDI + 0.5669*LNER -0.1281*LNDEBT + 18.8162)				

Source: Author's calculation from **E-view 10** results, 2019
Note: The sign * and ** indicate that the variables are significant at the level of 1% and 5% respectively.

Model diagnostic test

In order to analyze validity of the short-run and long-run estimation in the ARDL model, the diagnostic tests are the mandatory. Different diagnostic test such as Serial correlation test (Brush &Godfray LM test), Heteroscedasticity test (Brush and Godfray LM test), Normality (Jaque-Bera test) and Functional form (Ramseys RESET) test were performed. The tests and their respective statistics are summarized by table 6 below.

Table 6. Long run ARDL (2, 2, 2, 1, 2, 2, 2) Diagnostic Tests for agricultural output growth

Tests	LM-version		F-version	
	Statistic	P-value	Statistics	P-value
Normality: Jarque-Bera test	X^2 (2)=0.324006	0.850439	Not applicable	
Serial Correlation: Breusch-Godfrey serial correlation LM test	(2)=5.601796	0.0608	F(2,4)= 1.010727	0.4115
Heteroskedasticity:Breusch-Godfrey test	(19)=15.52578	0.4142	F(15,9)=0.983245	0.5311
Ramsey RESET test	X^2(8)= 2.023483	0.07760	F(1,8)=4.094483	0.0776

Source: Author's calculation from E view 10 results, 2019

Accordingly error terms of the specified model are normally distributed, the residuals of the equation has no problem of heteroscedasticity and there is no serial correlation between residuals under this study.

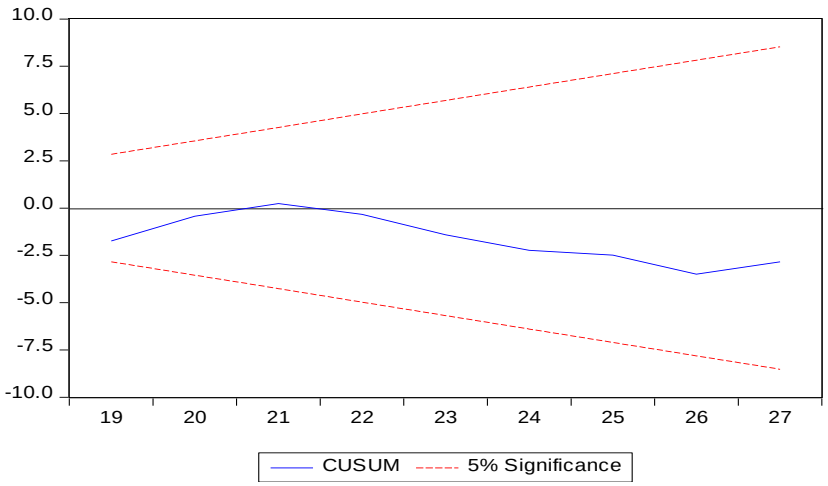

Figure 4. Cumulative sum test result
Source: Author's calculation from E view 10 results, 2019

The figure '4' and '5' depict the plot of CUSUM and CUSUMSQ test respectively and it shows no evidence of instability of the error correction model. In other words, the error correction model can be said to be stable. As it can be seen from the figures, the plots of CUSUM and CUSUM square stays within the critical 5% boundaries-implying there is no instability problem and regression equation is correctly specified.

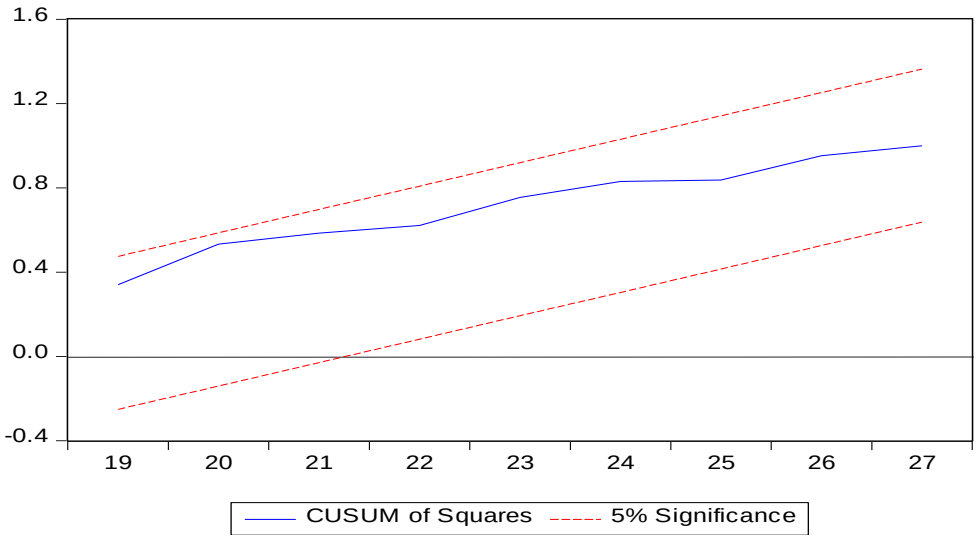

Figure 5. Cumulative sum square test result
Source: Author's calculation from E view 10 results, 2019

4. Conclusion

This study examined the impact of some macroeconomics variables on agricultural sector output of Ethiopia. The study employed autoregressive distributed lag (ARDL) bounds test approach and error correction model (ECM) to identify the presence of a long run and the short run association between selected macroeconomic variables and agricultural production growth from 1991 to 2017. The results of bounds test showed the existence of a long-run association ship between agricultural output, inflation rate, lending rate, trade balance, foreign direct investment, exchange rate and external debt stock.

The long-run ARDL result depicts that; lending rate, trade balance, exchange rate and external debt stock affect the agriculture output significantly. However, inflation rate and foreign direct investments are found to be having an insignificance effect on agricultural output. However the effect of lending rate is unexpectedly found to be positively and significantly affecting the agricultural output. Trade balance which is negative throughout the study year is found to be affecting the agricultural sector output negatively with a one percent significance level; both in the long-run and in the short-run. The official exchange rate also has a positive and significant effect on the agricultural sector output. Since most of exportable commodities of Ethiopia are agricultural, devaluation would make them competitive in the international market. This wills possibility raises the demand for it in, and the agricultural production could boost. The external debt stock has also a negative and significant effect on agricultural sector output both in the long-run and in the short run. Although external debt stock would have a positive role to play for the overall economic growth, it might have also a depressing effect on agricultural sector. The accumulation of external debt stock increases the debt service of the country; which is payable from the amount export of goods and services. Hence, it discourages export of products (mostly agricultural) and ultimately reduces the productive capacity of the country. The coefficient of the error correction term which measures the speed of coefficient of error correction term (ECT-1) is -0.70 with expected sign and is statistically significant at the one percent level, suggesting that about 70 % of the disequilibria from previous year shock converge back to the long run equilibrium each period. Based on the above finding, the study recommended that the policy makers should improve the nation's trade balance by applying a policy that might be reduce import and enlarges export. Since most agricultural commodities are price and income inelastic and, its price is determined by global market, the government should focus to export diversification through a broad base of production technologies. Therefore this probably increases the country's exports-to-GDP ratio. The official exchange rate should also be set at a level that would encourage agricultural product export. In addition to this the government should focus to limit its external debt stock by mobilizing and using domestic productive capital more efficiently.

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