



Effect of Macroeconomic Variables on the Output of Agricultural Sector in Nigeria

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Abstract

Agricultural sector plays a decisive role in economic growth and development of a country. This sector still significantly becomes the main engine or a contributor to gross domestic product (GDP). In order to achieve a desired social and economic growth in Nigeria through agriculture, the performance of agricultural sector to a very large extent depends on its macroeconomic variables. The specific aims of this study are to analyse the effect of exchange rates (EXCR) on agricultural output, examine the effects of interest rates (INTR) on agricultural output, evaluate the effect of inflation rates (INFR) and its consequences on agricultural output in Nigeria and to investigate the long run relationship between macroeconomic variables and agricultural sector output in Nigeria using annual time series data spanning from 1981 to 2020. The data were analysed using the Autoregressive Distributed Lag (ARDL) Model... Findings revealed that exchange rate and commercial bank credit to agriculture has positive effects on agricultural output (AGDP) while interest rate and inflation rate have negative effects on agricultural output (AGDP) in the long-run. In addition, the short- run results revealed that exchange rate in the third period lag, commercial bank credit to agriculture (CBCA) in the current year, interest rate (INTR) in the first period lag, inflation rate (INFR) in the current year, first and second period lags have positive relationship with agricultural output (AGDP) while exchange rate (EXCR) current year, first and second period lags, commercial bank credit to agriculture's (CBCA) first and second period lags, interest rate (INTR) current year all have negative significant relationship with agricultural output (AGDP) in the short- run. Therefore, based on this result the study recommend that Government should ensure adequate and effective implementation of macroeconomic policies that would enhance stable exchange rates, as effective and prudent management of exchange rate policies will significantly ensure stability of country's exchange rate (naira). Furthermore, access to commercial bank credit at low interest rate should be made easier as this will encourage more investors into the sector. With adequate financing which is easily accessible, purchase and maintenance of farm equipment used for production will be made much easier and thereby hasten the production process.

Keywords: Agriculture, Agricultural output, Macroeconomic Variable

JEL Classification: Q17, Q18, Q28.

Contribution to/Originality Knowledge

In addition to adding value to the body of knowledge, this study provides an indebt knowledge on how macroeconomic variables such as exchange rate, commercial bank credit, interest rate and inflation rate influence the performance of agricultural sector and the policy measures and programme aimed at improving the sector output within the period of study.

1.0 Introduction

Agriculture constitutes one of the most important sectors of the Nigerian economy. It is also a veritable tool in combating poverty in the third world countries and achieving long term economic development. Although Nigeria depends heavily on the oil industry for its



budgetary revenues, the country is predominantly still an agricultural society with approximately 70% of the population engaging in agricultural production at subsistence level (FAO, 2020), hence the role of agriculture in human development cannot be overemphasized. Because of its vast and rich soil, the country produces varieties of crops while a significant portion of the agricultural sector in Nigeria involves in livestock production, fishing, poultry, and lumbering. The sector is made up of four sub-sectors: Crop Production, Livestock, Forestry and Fishing.

The agricultural sector is seen as one of the major sectors in the economy, contributing to its development through production of goods, foreign exchange and exports. Agriculture is necessary for the sustenance of life and it is the bedrock of a country's economic development, especially in the supply of adequate and nutritious food so vital for the development of humans and industrial raw materials (Okumadewa, 1997). Macroeconomic variables are the strategies used by government to regularize investment in the national economy through the checking of macroeconomic factors such as national income, gross domestic products, inflation, economic growth rate, price level, interest rate, government spending, exchange rate, tax and money supply (Rahman, 2004). The macroeconomic tools that governments use are of particular importance in influencing the economy. Macroeconomic tools consist of fiscal, monetary and other tools that govern macro-prices. Fiscal tools deal with the level of government spending and the balance between taxation and spending. Monetary tools control the availability of money and access to credit.

Fan et al., (2008) argued that change in macroeconomic variables often have substantial impacts on agricultural output globally. Sustainable agricultural development is propelled by the macroeconomic variables available in the country. The implementation of these variables provides enabling environment for agriculture to grow *pari passu* with the other sectors. These variables have great impact on the lucrateness of the agricultural system and the welfare of farmers as they affect the flow of funds to the agricultural sector when it comes to subsidies, credit, budgetary allocation, taxes and therefore must be in concordance and mutually reinforcing with the agricultural policies.

Available statistics from World Bank Development Indices shows that agriculture is the most important Nigerian economic sector and remain the largest sector that contributes an average of 24% to the nation's GDP and providing employment for about 35% of the population including about 80% of the rural population as of 2020 (World Bank, 2020). A feat which ranks the sector as the largest employer of labour in the country (Food and Agriculture Organization [FAO], 2020). Agriculture remains the foundation of the Nigerian economy, despite the presence of oil in the country. It is the main source of livelihood for most Nigerians.

However, with oil discovery and the oil boom of the 1970s, the sector suffered neglect with the sector's contribution to GDP declining to around 24% in 2020 from 65.7% in 1957 leading to food insecurity and increased level of poverty in the country. As of 2019, the population growth rate is higher than the economic growth rate, leading to a slow rise in poverty. According to report by the World Bank, almost half the population is living below

the international poverty line (\$2 per day), and unemployment peaked at 33.30% in the fourth quarter of 2020 (World Bank, 2020). Despite the contribution to the economy, Nigeria's agricultural sector faces many challenges which impact on its productivity. These include; organizational and weak policy, poor land tenure system, low level of irrigation farming, climate change and land degradation, there are infrastructural inadequacies as the sector suffers from poor road network. Others are low technology, high production cost, poor distribution of inputs, limited financing leading to the problem of high food importation, high post-harvest losses and poor access to markets.

These challenges have stifled agricultural productivity affecting the sector's contribution to the country's GDP as well as increased food imports due to population rise hence declining levels of food sufficiency. For instance, between 2016 and 2019, Nigeria's cumulative agricultural imports stood at N3.35 trillion, four times higher than the agricultural export of N803 billion within the same period (Oyaniran, 2020). Besides the challenges of inadequate attention from government, the sector performance is being affected by the macroeconomic environment. such as high interest rate been charged on loans and credit to agricultural by banks, unstable exchange rate which significantly affects importation of farm machineries and agro inputs as well as high inflation rates which has affected prices of related goods and services in the sector (Soludo,2006). However, most Agricbusiness operators and farmers are less familiar with one of the major risk variables that can significantly affect the profitability of their business operations, this is government policy. Although policymakers try to make policies that would make the national economy improve, these policies however often have harmful effects on the agricultural economy, hence, policy makers, farmers and agricbusiness operators must understand the policy process and the impact that changing macroeconomic variables can have on agriculture.

Most problems associated with agricultural produce such as lack of modern tools and equipment, poor storage facilities, difficulties in accessing bank credits by a large segment of rural farmers, poor pricing, unavailability of advance seedlings, and so on are associated with macroeconomic variables. Macroeconomic variables imply strategic policies behind nation's overall economic performance such include polices on exchange rate, interest rate, bank credit and inflation rate, etc. which have serious economic implications on the sustenance of agricultural production and stimulation of export as agricultural producers and consumers are heavily influenced by these variables. Changes in any of the above-mentioned variables affects the performance of the agricultural economy through their respective influence on input and other factors. Take for instance, fluctuation in exchange rate become challenging for access to foreign currency which the farmers depend on for their importation of farm machinery and inputs. Furthermore, foreign exchange outflow on export have not only depreciated the value of Nigeria's currency but have also eroded the competitiveness of domestic produced agricultural goods in comparison with low-priced imported goods, leading to a reduction in agricultural activities in the country (Fan et al., 2008).

The exchange rate regime adopted during the Structural Adjustment Programme (SAP) has never resulted in any meaningful export of agricultural produce over time. In the same vein,



the persistent rise in general price level does not only affect the value of naira but also make demand and supply of Nigerian agricultural produce unpredictable both within and outside of the country. Supported by unbearable returns on capital for farm investment by farmers which is considered as high interest rate at the face of insecurity on farm settlement in Nigeria stand as an obstacle to investment in agricultural production. Even when these is available at such high interest rate, only few percentage of the rural farmers can access it. This is why bank credit to agriculture has not fully achieved its aims in Nigeria. Agriculture supposed to be a means to curb major problem in Nigeria such as unemployment, poverty, food insecurity and lot more. This is why macroeconomic variables are essential to the success of agricultural production in Nigeria. Literature has also reported that despite Nigeria's rich agricultural resource endowment, there has been a downturn in agriculture's contributions to the nation's economy. The agricultural sector had not performed to its desired level because of several decades of neglect from successive Nigerian government in creating appropriate macroeconomic policies (i.e. monetary, fiscal and exchange rate) that will cushion the effects of internal and external macroeconomic shocks on farmers' incentives to produce (Manyong et al., 2005). Against this backdrop, the paper is set out to examine the effect of macroeconomic variables on the output of agricultural sector in Nigeria from 1981 to 2020 using Autoregressive Distributed Lag (ARDL) model. The rest of the paper is divided into the following sections; section two discussed literature review, section three is the methodology; section four unveil data analysis and results interpretation and lastly, section five conversed the conclusion and policy recommendations.

2.0 Literature Review

Considerable number of studies have explored the relationship between macroeconomic variables and agricultural sector output in both developed and developing countries, Nigeria inclusive. Some of which established positive and negative relationship between macroeconomic variables and agricultural sector output in those countries of studies.

Agbonkhese and Ughulu (2020) determined the impact of macroeconomic policy variables on agricultural sector output growth in Nigeria from 1986 to 2018. The study adopted a vector autoregressive (VAR) model, this is to avoid the endogeneity problems by treating all variables to be endogenous, and it is a dynamic system of equations in which the current level of each variable in the system depends on past movements in that variable and all other variables in the system. The VAR result revealed that agricultural sector output was responsive to changes in macroeconomic policy variables which in turn have affected agricultural output growth in Nigeria. The variance decomposition result showed that variation in agricultural sector output was precipitated by changes in macroeconomic policy variables with the highest contribution from credit to the agricultural sector.

In the same vein, (Chukwuemeka & Ibekwe, 2020) examined the effects of Exchange Rate on Agricultural Sector Output in Nigeria from 1987 to 2019. The study adopted the use of Ordinary Least Square (OLS). The result of regression indicate that nominal exchange rate and money supply have positive and significant effect on agricultural sector output while

interest rate and inflation rate have negative and insignificant effect on agricultural sector output.

Adisu (2019) examined the effect of some macroeconomic variables on agricultural sector output in 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 has 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.

Aduralere (2019) investigated the impact of commercial bank credits on agricultural output in Nigeria over the period 1980 to 2015. Data were sourced from CBN and NBS respectively. The study employed Fully Modified Ordinary Least Squares (FMOLS) approach to analyse the data. Findings shows that interest rate on commercial banks' credit to agriculture and deposit money bank's assets are statistically significant in determine agricultural output in Nigeria within the period considered. Also, commercial bank loan on agriculture and deposit money bank's assets determine the output of crop production in Nigeria; commercial bank loan on agriculture and interest rate on commercial banks' credit to agriculture determine the output of livestock production in Nigeria and commercial bank loan on agriculture and interest rate on commercial banks' credit to agriculture determine the output of forestry in Nigeria while commercial bank loan on agriculture and interest rate on commercial banks' credit to agriculture determine the output of fishing in Nigeria.

Shariff and Noor (2015) investigated the impact of macroeconomic variables toward agricultural productivity in Malaysia using annual data spanning the period 1980 to 2014. The study aimed at examining the short run and long run links between agricultural productivity and some key macroeconomic fundamentals in Malaysia. Autoregressive-Distributed Lag (ARDL) approach was adopted, the result shows that there is a long-run relationship between agricultural productivity and macroeconomic variables, namely net export, inflation rate, interest rate, nominal exchange rate, government expenditure and money supply. The notable result is only nominal exchange rates which shows significant impact on agricultural productivity in the long run while the other variables do not have a significant impact upon agricultural productivity in the long run. In addition, net export, government expenditure, and inflation rate seem to influence agricultural productivity in the short run.

Medugu et al., (2019) empirically examined the impact of Commercial Banks' credit on Agricultural output in Nigeria using annual time series data covering a period between 1980 to 2018. Ordinary least square (OLS) Method was employed to estimate the relationships among the variables. Stationary test was also conducted on variables to ascertain whether they have unit roots. The result shows that they were all stationary at first difference. Co-



integration test however, revealed that long run relationship exists among the variables, also ECM model result showed that the model returns to short run equilibrium after an exogenous shock, with speed of adjustment of negative one (-1), this implies that 100% of all the deviations in the past will adjust to equilibrium. Furthermore, result of the OLS indicated that positive and significant relationship exists between commercial banks' credit and Agricultural output in Nigeria, the same relationship also exists between Expenditure made on Agriculture by Government and Agricultural output in Nigeria.

Odior (2014) examines the consequences of macroeconomic policy indicators on agricultural performance in Nigeria. The data set for this study consists of annual time series from 1970 to 2012. The study employed a One-Step Dynamic Forecast Model to analysis the nature of this impact. by assessing the short run dynamic impact between some macroeconomic indicators and agricultural performance. The variables under his study include: agricultural gross domestic product, (dependent variable) used as proxy for agricultural performance. Real money aggregate, exchange rate, nominal interest rate, inflation rate, credit to agricultural sector and government expenditure. Findings reveal that technological change introduced overtime play a crucial role (positive) in affecting the farm income in Nigeria.

Obiajulu et al., (2018) examined the effects of interest rate deregulation on agricultural financing in Nigeria from 1970 to 2014. The study specifically examined the trend in the rate of interest, volume of credit to agricultural sector and agricultural GDP contribution under the period. The study employed descriptive/trend statistics, ordinary least square (OLS) regression and correlation analysis to achieve its results. The results show that interest rate has a strong influence in the volume of credit to the agricultural sector and it also has weak influence on the agricultural GDP contribution. It was also observed that interest rate has been fluctuating under the period (1970-2014) that have resulted to low productivity and unemployment in agricultural sector but makes the financial institutions to be willing to disburse credit to the public. The agricultural GDP contribution has a downward and upward trend during the period which is as a result of the neglect of the government based on the discovery of oil and lastly there was an upward trend in the volume of credit to the agricultural sector, which means funds were sent to the sector by government but because of bureaucratic processes most farmers are unable to access it.

Aroriode and Ogunbadejo (2014) estimated the impact of macroeconomic policy on agricultural growth in Nigeria, using time series data from 1970 to 2010. The study adopted Ordinary Least Square (OLS) multiple regression method for its analyses. Findings showed that gross domestic product (GDP), credit loan to agriculture (CLA) and exchange rates are significant with positive influences. Income elasticity of agricultural growth was low at 0.939 percent indicating income inelastic nature of agricultural commodities. There is a positive relationship between the dependent variable (agricultural output) and the independent variable (GDP). On the other hand, money supply has an inverse relationship (negative influence) on agricultural production which is contrary to expectations.

Obasaju and Baiyegunhi (2019) assessed the short-run and long-run linkages of macroeconomic policies with real agricultural output in Nigeria (1980: Q1 – 2014: Q4) by a

vector error correction model (VECM) and Variance Decomposition techniques. Their study showed that in the long run, inflation and money supply are the two macroeconomic variables that are statistically significant in explaining variation in real agricultural output, with inflation having greater impact on real agricultural output. Also among his findings are that inflation rate Granger-causes real agricultural output in Nigeria.

Shakira (2018) assessed the determinants of agricultural productivity in Malawi. Using a time series data sourced from Food and Agricultural Organization, World Bank and locally from National statistics office between 1980 and 2013. Also, Autoregressive Distributed Lag (ARDL) Model was applied to analyse the data, 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.

Onakoya et al., (2018) took a critical long run and short run analysis of value addition in agriculture was the main objective, covering a period between 1970 and 2016 and using Vector Error Correction Model (VECM) to analyse their data. Findings showed that in the long run, inflation rate, exchange rate and agricultural employment rate were positively related and significant in forecasting the value added in agricultural output.

It was however discovered that none of these studies has been able to capture the effect of each of these macroeconomic variables on agricultural sector output in the short and long run using Nigeria as their case study. Aroriode and Ogunbadejo (2014) study was only on the impact of macroeconomic policy on Agricultural growth in Nigeria with their focus on money supply and commercial loan to Agriculture but he did not study the effect of these macroeconomic variables on Nigeria's Agricultural Sector Output in the long run and short run. Shariff and Noor (2015) study was on the short and long run impact of macroeconomic variables on Agricultural sector in Malaysia using net export, inflation rate, interest rate, nominal exchange rate, government expenditure and money supply but Nigeria was not use as their case study. While Odior (2014) researched on the short run impact of some macroeconomic indicators which are: real money aggregate, exchange rate, nominal interest rate, inflation rate, agricultural sector credit and government expenditure on Agricultural performance in Nigeria but his study was not on the long run impact of these macroeconomic variables on Agricultural performance in Nigeria.

In testing for the impact of the macroeconomic variables on agricultural sector, most studies focused mainly on Johansen Cointegration Test, which is only suitable when (i) all the variables are integrated of order one, that is, $I(1)$ and (ii) when a system of equations is involved. To fill this gap, the present study employed the Autoregressive Distributed Lag (ARDL) Bounds Test as it has an advantage over other techniques including the Johansen Test in terms of dealing with pure $I(1)$ variables and a combination of $I(1)$ and $I(0)$ variables., corroborating Adisu (2019), Shakira (2018), Shariff and Noor (2015). This study is hereby meant to minimize the gaps and contribute to the literature by studying the effect of each of these macroeconomic factors (Interest rate, Exchange rate, Inflation rate, Commercial bank credit to Agricultural sector) in the long and short run on the output of agricultural



sector in Nigeria. Therefore, the study examined effect of macroeconomic variables on the output of agricultural sector in Nigeria from 1981 to 2020.

3.0 Methodology

3.1 Data and Source

The study used secondary annual time series data. The data for all the variables were obtained from the statistical bulletin of the Central Bank of Nigeria (CBN, 2020). The variables on which the data was collected are Agricultural Gross Domestic Product (AGDP), Exchange Rate (EXCR), Commercial Bank Credit to Agriculture (CBCA) as a control variable, Interest Rate (INTR) and Inflation Rate (INFR). Where AGDP is the dependent variable on whose other variables are explained.

3.2 Model Specification

The study uses the Autoregressive Distributed Lag Model to analyse the effect of macroeconomic variables on agricultural sector output in Nigeria from 1981 to 2020. The model was adapted from the work of Adisu (2019) who established the effect of some macroeconomic variables on agricultural sector output in Ethiopia from 1991 to 2017 by replacing some variables such as LR, TB, FDI and DBT and replacing them with interest rate (INTR) and commercial bank credit to agriculture (CBCA). Note that CBCA was incorporated in the model as a control variable due to the role it plays at macro level in aiding agricultural productivity in Nigeria. Another reason for including CBCA is that, through moral suasion, the monetary authority (CBN) directs commercial banks to channel certain share of their credits to agriculture in order to improve its productivity.

3.3 Functional Model

$$AGDP = f(EXR, INTR, INFR, CBCA) \quad (1)$$

Where:

AGDP is the agricultural GDP as a ratio of total GDP (Used as a proxy for agricultural sector output). EXCR is nominal exchange rate in naira per US dollar (₦/\$), INTR is interest rate (lending rate) in percent (%), INFR is annual rate of inflation in percent (%) and CBCA is the total credit accessed by farmers from commercial banks in billions of Naira.

This is expressed in an explicit econometric equation as:

$$AGDP_t = \lambda_0 + \lambda_1 EXCR_t + \lambda_2 INTR_t + \lambda_3 INFR_t + \lambda_4 CBCA_t + \mu_t \quad (2)$$

For estimation purpose, equation (2) is re-specified in a log – linear functional form in order to linearize non-linear variables and also to minimize spurious results, the study therefore, converted the equation into their natural log form. Hence, the new equation is of the form:

$$\ln AGDP_t = \lambda_0 + \lambda_1 \ln EXCR_t + \lambda_2 \ln INTR_t + \lambda_3 \ln INFR_t + \lambda_4 \ln CBCA_t + \mu_t \quad (3)$$

Where:

$\ln AGDP_t$ is the natural log of agricultural GDP as a ratio of total GDP (Used as a proxy for agricultural sector output), $\ln EXCR_t$ is the natural log of nominal exchange rate in naira per US dollar (₦/\$), $INTR_t$ is the interest rate (lending rate) in percent (%), $INFR_t$ is the annual rate of inflation in percent (%), $\ln CBCA_t$ is the natural log of total credit accessed by farmers from commercial banks in Nigeria, v_t is error terms, $\ln$ is natural log transformation and $\lambda_0 - \lambda_4$ is parameters to be estimated.

The above equation (3) is re arranged into ARDL form adapted from the work of Adisu (2019) to estimate both short-run and long- run relations and error correction term (ECT). The resulting new equations (4) is as follows;

$$\begin{aligned} \Delta(\ln(AGDP_t)) = & \beta_0 + \beta_1 \ln(AGDP_{t-1}) + \beta_2 \ln(EXCR_{t-1}) + \beta_3 (INTR_{t-1}) + \beta_4 (INFR_{t-1}) \\ & + \beta_5 \ln(CBCA_{t-1}) + \sum_{i=1}^m \lambda_1 \Delta(\ln(AGDP_{t-i})) + \sum_{i=0}^n \lambda_2 \Delta(\ln(EXCR_{t-i})) + \sum_{i=0}^o \lambda_3 \Delta(INTR_{t-i}) \quad (4) \\ & + \sum_{i=0}^p \lambda_4 \Delta(INFR_{t-i}) + \sum_{i=0}^q \lambda_5 \Delta(\ln(CBCA_{t-i})) + \phi ECT_{t-1} + \mu_t \end{aligned}$$

Where,

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ represent long-run coefficients of explanatory variables, $\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5$ represent short-run coefficients of explanatory variables, ϕ represent the coefficients of the error correction term, p is the lag of dependent variable, q is the lag of independent variables, $\sum$ is summation sign, Δ is difference operator, $\ln$ is the natural log transformation and v_t is error term

The F-statistic is carried out on the joint null hypothesis that the coefficients of the lagged variables is equal to zero ($\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$) and alternative hypothesis $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$, 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). This is to ensure that the errors are white noise.

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, then it is said to be inconclusive.

4.0 Result and Discussion

Augmented Dickey- Fuller (ADF) Unit Root Test



Table 1: Results of the Unit Root Test

VARIABLES	Levels		First Difference		Remark
	ADF	5% Critical value	ADF	5% Critical value	
LAGDP	-1.923798	-3.529758	-5.872816	-3.533083	I(1)
LEXCR	-1.345659	-3.529758	-5.685883	-3.533083	I(1)
LCBCA	-2.553223	-3.529758	-7.093479	-3.533083	I(1)
INTR	-3.276273	-3.529758	-6.883530	-3.536601	I(1)
INFR	-4.084917	-3.568379	-2.914312	-3.552973	I(0)

Source: Authors' computation using E-views 10

The unit root test of stationarity was carried out using Augmented Dickey Fuller (ADF) unit root test. The result of the ADF tests shown in table 1 showed that LAGDP, EXCR, LCBCA and INTR were stationary at first difference I (1) while INFR was stationary at level I (0). The mix order of integration satisfied the condition for the choice of ARDL model

4.1 Lag Length for F- Bound Cointegration Test

Table 2: presents the lag length criteria for F-Bound Test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-348.2008	NA	228.8236	19.62227	19.84220	19.69903
1	-187.5124	267.8140	0.123728	12.08402	13.40362	12.54460
2	-158.7894	39.89300	0.109548	11.87719	14.29646	12.72158
3	-139.6425	21.27436	0.191300	12.20236	15.72129	13.43056
4	-52.02935	73.01096*	0.009815*	8.723853*	13.34245*	10.33587*

Source: Author's computation using E-views 10

* indicates lag order selected by the criterion

It is necessary to determine the optimal lag length before conducting the ARDL cointegration test. Table 2 above presents the lag order selection by five different criteria. All the lag selection criteria suggest that a lag length of four (4) is optimal for the F-bound cointegration test. Therefore, this study used a lag length of four for the cointegration test.

Table 3: ARDL Bound Testing for Cointegration Analysis

H₀: No cointegration

Test Statistic	Value	Significance.	I(0)	I(1)
F-statistic	11.77299	10%	2.45	3.52
K	4	5%	2.86	4.01
		2.5%	3.25	4.49
		1%	3.74	5.06

Source: Authors' computation using E-views 10

The result of the ARDL Bound Test for Cointegration shows that the F-statistics value 11.77299 is greater than both the upper boundary at 10%, 5%, 2.5% and 1% level of significance, implying that the response variables have a long run relationship with the

dependent variable. Therefore, the null hypothesis of no cointegration between the variables is rejected and the alternative hypothesis is accepted. Hence, the variables have long run equilibrium relationship with one another.

Table 4: Estimated Long-Run Coefficient using the ARDL Approach

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LEXCR	0.010682	0.059481	0.179591	0.8595
LCBCA	0.279103	0.053684	5.198954	0.0001
INTR	-0.026209	0.013332	-1.965922	0.0649
INFR	-0.015048	0.004087	-3.682163	0.0017

Source: Authors' computation using E-views 10

The relationship among the variables are shown in table 4, where the coefficient of exchange rate (EXCR) in the long run has a positive insignificant relationship with agricultural sector output (AGDP). This implies that, a per cent increase in exchange rate will increase agricultural sector output by 0.011 per cent. This is consistent with apriori expectation and also conformed with the findings of Chukwuemeka and Ibekwe (2020), Adisu (2019), Aroriode and Ogunbadejo (2014), Onakoya et al (2018). The positive relationship between exchange rate (EXCR) and agricultural sector output due to the increase in exchange rates tend to stimulate exports and decreases imports, thus increasing the prices of domestic agricultural production and boosting the income of the agricultural sector in the long run.

Furthermore, commercial bank credit to agriculture (CBCA) was also found to be positively related to agricultural sector output (AGDP) in the long run. This is also consistent with apriori expectation. This conformed to the findings of Agbonkhese and Ughulu (2020), Medugu et al., (2019), Aroriode and Ogunbadejo (2014). The positive coefficient of commercial bank credit to agricultural sector shows that one per cent increase in the commercial bank credit to the sector results to a rise in agricultural sector output (AGDP) by 0.28 per cent. However, there exist an insignificant negative relationship between interest rate (INTR) and agricultural sector output (AGDP) in the long run. The sign is consistent with economic theories and conformed with the findings of Chukwuemeka and Ibekwe (2020), Obiajulu et al., (2018). This implies that a per cent increase in interest rate (INTR) will reduce agricultural sector output (AGDP) by 0.03 per cent in the long run. This is because interest rate (INTR) has impact on decisions of investment in this sector and by this leads to changes in agricultural costs. Rising the interest rate increase the cost of borrowing money to farmers, the costs of operating expenses and capital expenditures for long-term investment, and reduces the farmers' income.

In the same vein, result from the table also showed that inflation rate (INFR) has negative significant relationship with agricultural sector output (AGDP) in the long run. The result is however consistent with apriori expectation because increase in inflation will raise the price of agricultural commodities which could result in reduction in agricultural commodity demand and supply in the long run period. This also conformed with the findings of Chukwuemeka and Ibekwe (2020). It implies that agricultural sector output (AGDP) has a



negative relationship with the rate of inflation in the country. Therefore, increasing inflation rate (INFR) by one per cent will result to reduction in agricultural sector output (AGDP) by 0.02 per cent and vice versa.

Table 5: Results of ARDL Short-run and Error Correction Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
<i>C</i>	2.142462	0.246103	8.705565	0.0000
<i>D(L EXCR)</i>	-0.059322	0.022019	-2.694137	0.0148
<i>D(LEXCR(-1))</i>	-0.119763	0.023343	-5.130455	0.0001
<i>D(LEXCR(-2))</i>	-0.078222	0.021522	-3.634540	0.0019
<i>D(LEXCR(-3))</i>	0.178279	0.022052	8.084392	0.0000
<i>D(LCBCA)</i>	0.016083	0.022296	0.721347	0.4800
<i>D(LCBCA(-1))</i>	-0.046590	0.022642	-2.057660	0.0544
<i>D(LCBCA(-2))</i>	-0.028981	0.021510	-1.347312	0.1946
<i>D(INTR)</i>	-0.002959	0.001637	-1.807878	0.0874
<i>D(INTR(-1))</i>	0.004748	0.001439	3.299076	0.0040
<i>D(INFR)</i>	0.000976	0.000471	2.071716	0.0529
<i>D(INFR(-1))</i>	0.002380	0.000510	4.666925	0.0002
<i>D(INFR(-2))</i>	0.001989	0.000557	3.573376	0.0022
<i>ECT(-1)*</i>	-0.238593	0.028129	-8.482100	0.0000
R-squared	0.884099	Mean dependent var		0.057642
Adjusted R-squared	0.815612	S.D. dependent var		0.072886
S.E. of regression	0.031298	Akaike info criterion		3.805241
F-statistic	12.90904	Durbin-Watson stat		2.562005
Prob(F-statistic)	0.000000			

Source: Authors' computation using E-views 10

Table 4 shows the results of the short-run relationship between agricultural sector output (AGDP) and the explanatory variables (EXCR, CBCA, INTR and INFR). The result revealed that exchange rate (EXCR) current year and its first and second period lags are negative and significant. This mean that, a per cent increases in these exchange rates will lead to a reduction in agricultural sector output (AGDP) by 0.06, 0.12 and 0.08 per cents respectively. The negative sign of the exchange rates indicates that a rise in the price of foreign currency diminishes agricultural sector output by way of a rise in the domestic prices of imported inputs. This implies that, exchange rates were not favourable in this years, thereby making less agricultural output to be produced within the period.

However, the estimated coefficient of the third period lag of exchange rate (EXCR) was positive and statistically significant. Invariably, the result indicates 0.18 per cent increases in agricultural output as exchange rate increase by one percent in that year. The positive relationship between the third period lag of exchange rate and agricultural sector output was probably as a result of favourable exchange rate within that period which stimulated exports and decreases imports, thus increasing the prices of domestic agricultural production and boosting the income of the sector.

Also, the commercial bank credit to agriculture (CBCA) in the current year has a positive insignificant relationship with AGDP which mean that a per cent increase in commercial bank credit to agriculture sector increases AGDP by 0.02 per cent. But its first and second lag periods revealed negatives significant relationship with agricultural output (AGDP). This means a unit increase in credit to the sector will lead to a decrease in agricultural sector output by 0.05 and 0.03 units respectively. This result could be attributed to several factors peculiar to the Nigeria's economy. Some of these factors includes: increase corruption among government officials, poor policy implementation, weak institutional framework and increase poverty among farmers. These factors affect credit flow in several ways such as; prevention of real farmers from accessing credit from government credit institutions and diversion of credits among others.

The interest rate (INTR) in the current year has a negative insignificant relationship with AGDP in the short run with estimation coefficient of -0.002959. The sign is consistent with economic theories as explained earlier. It means a per cent increase in interest rate reduces agricultural sector output (AGDP) by 0.003% in the short run. We can say that it's because the interest rate (INTR) in the current year have effect on decisions of investment in the sector and by this leads to changes in agricultural costs. Meanwhile interest rate (INTR) in the first period lag has a positive significant relationship with agricultural sector output (AGDP) with a coefficient of 0.004748. this signify 0.005% rise in agricultural sector output (AGDP) as the first period lag of interest rate increases by one percent.

Similarly, inflation rate (INFR) in the current year coupled with the first and second period lags are found to have positive relationship with agricultural sector output (AGDP) in the short run with coefficients of 0.000976, 0.002380 and 0.001989 respectively. This conformed with the findings Obasaju and Baiyegunhi (2019), Onakoya et al., (2018), Shakira (2018). This implied that a per cent increase in inflation rate (INFR) in those periods had increased agricultural sector output (AGDP) by 0.001, 0.002 and 0.002 per cents respectively. The result is inconsistent with the apriori expectation because increase in inflation rate at any point will raise the price of agricultural commodities which could result in reduction in agricultural commodity demand and supply in the short run period.

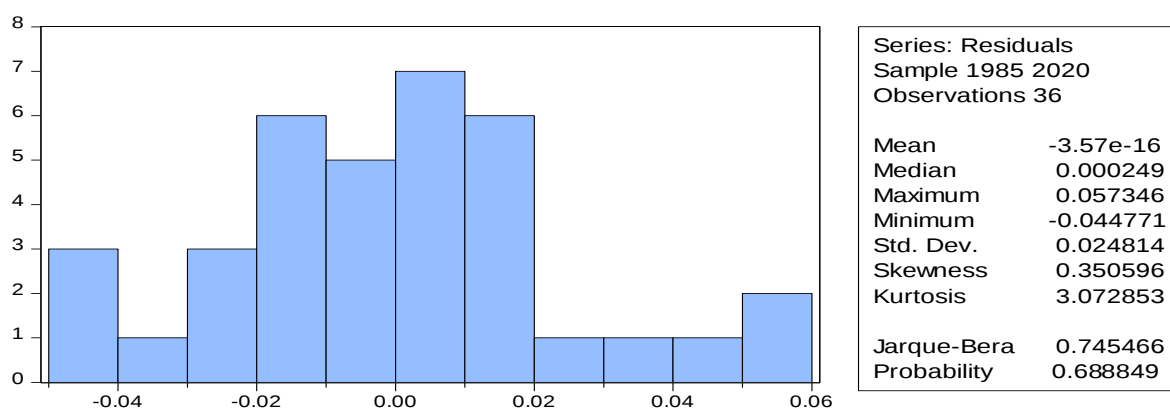
The coefficient of the error correction term (ECT (-1)) which captures the speed of adjustment towards the long run equilibrium indicates that about 24 per cent of the deviation is corrected within one year. The coefficient is properly signed and significant.

Table 6: Results of the Diagnostic Test

Test	F-statistics	Obs* R-squared	Probability
Serial Correlation	1.272698	4.941078	0.3070
Heteroscedasticity	0.764473	15.09410	0.7080
Ramsey Reset	0.302296		0.5896
Jaque Bera	0.745466		0.688849

Source: Authors' computation using E-views 10

Table 6 reveals the post estimation statistics in order to check whether the coefficients of the model have the potential for generating inference or not. This is done after estimating the ARDL regression by employing the “Breusch –Godfrey Serial Correlation LM Test” to test for serial correlation, the “Breusch - Pagan–Godfrey Test” to test for heteroscedasticity problem, the “Ramsey Reset Test” to test for mis-specification and the “Jargue –Bera Test” to test for normal distribution. Evidence from table 5 shows that the residuals in ARDL model have no heteroscedasticity problems, exhibits no serial correlation, no functional misspecification and are normally distributed. These test results are shown in table 6 and figure 1



Source: Authors' computation using E-views 10

Figure 1: Normality Test

4.2 Stability Test

In order to check the stability of ARDL model, the study examines the “constancy of the cointegration space” using CUSUM and CUSUM sum of squared tests. Evidence from figure 2 and figure 3 shows that, both CUSUM and CUSUM sum of squares are within the 5% significance level; thus, the ARDL model is robust and stable in its form.

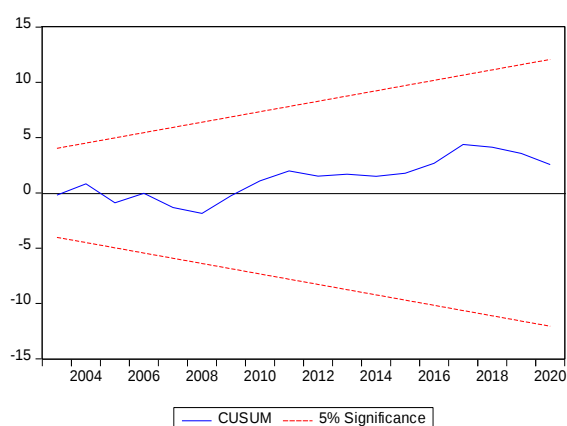


Figure 2. Showing Cusum Test
Source: E-views 10

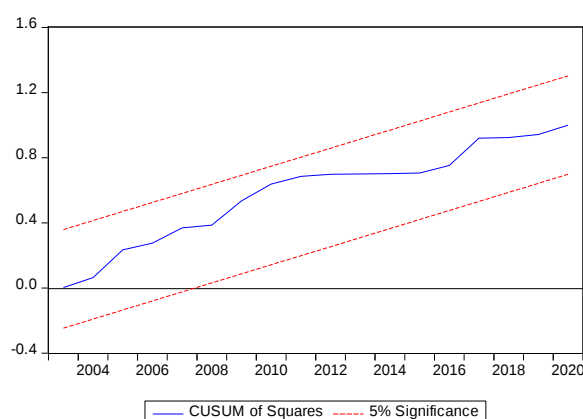


Figure 3. Showing Cusum Sum of Squared
Source: E-views 10

5.0 Conclusion

The study examines the effect of macroeconomic variables on output of agricultural sector in Nigeria over the period of 1981 to 2020. Findings shows that exchange rate (EXCR) have positive effects on agricultural sector output (AGDP). The positive relationship between exchange rate and agricultural sector output is due to the increase in exchange rates tend to stimulate exports and decreases imports, thus increasing the prices of domestic agricultural production and boosting the income of the agricultural sector in the long run. Though, this is not the same with the current year up to the second lag period of exchange rate that shows negative relationship in the shortrun.

In the same vein, a rise in commercial bank credit to agriculture with uninterrupted access by the agricultural sector is a clear evidence of agricultural output increases in the long run. Although this is not the same with the first and second lag period in the short run as inaccessibility of famers to the credit of commercial bank is enough to be responsible for this. The inverse relationship of interest rate and inflation rate on agricultural sector output is due to the fact that interest rate impact on decisions of investment in this sector and by this leads to changes in agricultural costs. Rising the interest rate increase the cost of borrowing money to farmers, the costs of operating expenses and capital expenditures for long-term investment, and reduces the farmers' income. This is different from their case in the shortrun as interest rate in the previous year was positive. This is an indication that at short run, effect on the agricultural output is visible positively. But can't be sustained on the long run. Similarly, rise in inflation rate is a signal to increase in the price of agricultural commodities which could result in reduction in agricultural commodity demand and supply in the long run period. However, the situation in the short run differs in that from the current year to the last second lags period revealed that agricultural sector output response positively to a rise in inflation rate. Theoretically, existing investment gain initial inflation rate which does not last for long.

Based on the findings of this paper, the following recommendations have been advanced:

- i. Government should ensure adequate and effective implementation of macroeconomic policies that would enhance stable exchange rates, as effective and prudent management of exchange rate policies will significantly ensure stability of country's exchange rate (naira) since exchange rate depreciation affects agricultural output negatively, maintenance of favourable exchange rate policy will help the farmers to import the needed technology to improve efficiency in the sector and operates in large scale.
- ii. The study also recommends providing easier access to commercial bank credit at low interest rate as this will encourage more investors into the sector. With adequate financing and easy access, purchases and maintenance of farm equipment's will be made much easier which will hasten the production process.



- iii. Low interest rate should be considered for farmers and investors as this will encourage rural farmers to borrow to invest in large scale agriculture. Thereby impacting significantly on the output levels of the sector.
- iv. Furthermore, Nigerian government should put in place policy that will help curb inflation. Policy such as selective credit control can be introduced by the central bank of Nigeria with full implementation. As this will help increase production forcing the price of agricultural goods and services to reduce.

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