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EFFECTS OF SOME MACROECONOMIC VARIABLES ON AGRICULTURAL OUTPUT: IMPLICATION FOR FOOD SECURITY IN NIGERIA (1981-2020)

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Abstract
The study explored the effects of some macroeconomic variables on agricultural sub-sector output: implication for food security in Nigeria (1981-2020). The study specifically looked at the effects of money supply, interest rate, inflation rate, exchange rate and government recurrent expenditure on agricultural output in Nigeria. Central Bank of Nigeria (CBN) Statistical Bulletin, index mundi and journals were used as sources for the annual time series data on the research variables for the period 1981–2019. The Autoregressive Distributed Lagged Model was used in the study. The unit root test revealed in the pre-diagnostic tests that the variables were stationary at 1(0) and 1(1). The ARDL Bound test for co-integration revealed that the variables had long-run co-integrating relationship. Additionally, empirical findings indicated that, in the short run, exchange rate, government recurrent expenditure and money supply as macroeconomic variables affected agricultural output The study recommends that since the research showed that money supply had positive effect on agricultural output, government should inprove on money supply so as to enable farmers meet up their required purchases.
Keywords: Agricultural output, Money supply, Exchange rate, Inflation rate, Government recurrent expenditure

Introduction

A major goal of macroeconomic variables is to achieve sustainable economic growth and development. The performance of the national economy is influenced by the government of Nigeria through fiscal and monetary policies. For instance, altering the level of taxation, government spending, or the supply of money or credit to the economy. By adjusting these variabless, the national income, prices, interest rates and exchange rates are affected thereby influencing economic development (Aroriode and Ogunbadejo, 2014). 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. Researchers and economists believes that change in macroeconomic variables often have substantial impacts on agricultural economy worldwide. 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 in paripassu with the other sectors. The macroeconomic factors drive the development of sustainable agriculture. The management of these factors creates an atmosphere that allows agriculture to develop in line with other sectors. These factors must be in harmony and mutually reinforcing with agricultural policies because they have a significant impact on the profitability of the agricultural sector and the welfare of farmers because they influence the flow of funds to the sector when it comes to subsidies, credit, budgetary allocation, and taxes.

According to Okidim, Obe-Nwaka, Okuduwor and Tuaneh (2023), Nigerian governments have repeatedly ignored the need to develop appropriate macroeconomic policies that will reduce the impact of both internal and external macroeconomic shocks on farmers' incentives to produce, which has prevented the agricultural sector from performing to its desired level in recent years.

Although numerous policies have been implemented to address Nigeria's agricultural issues, many of these efforts have not adequately attended to agricultural problems, and recent studies on the topic—including those by Chris and Mbat (2016) and Chandio, Jiang, Rehma, and Jingdong (2016)—have yielded conflicting findings. The study of Chandio, Jiang, Rehma, and Jingdong (2016) revealed that agricultural output, government expenditure have significant influence on economic growth of Pakistan whereas the study of Chris and Mbat (2016) found that credit had an inverse relationship with agricultural output in Nigeria. The problem may be emanating from the fact that policies used were not holistic and far reaching enough. In order to fill the existing gap, the present study incorporated a broad spectrum of macroeconomic variables (inflation, interest rate, exchange rate, money supply and government recurrent expenditure) in its model to critically examine macroeconomic variables that might be significant in proffering practicable solution to agricultural production in Nigeria. Using regression analysis, Abubakar (2019) evaluated the relationship between lending interest rates and agriculture sector activity in Nigeria from 1999 to 2016. Result showed that interest rate exhibited a strong and significant negative link with agriculture sector activity. Yaqub (2019) examined the Exchange rate changes and output performance in Nigeria: a sectoral analysis using seemingly unrelated regression estimation technique and found that exchange rate had a significant contractionary effect on agricultural output hence existing structures do not support an expansionary depreciation argument. In the same vein, Uremadu *et al.* (2018) used time series data from 1981 to 2014 to investigate the impact of government agriculture expenditure on agricultural output. Agricultural output adjusted quickly to changes in total government agricultural expenditure, real exchange rate, banking system loans to agriculture, average annual rainfall, and population growth rate, according to the results of the vector error correction model. In line with these mentioned facts, the study sought to achieve the following specific objectives:

i. evaluate the effect of money supply on agricultural output?
ii. assess the effect of interest rate on agricultural output?
iii. determine the effect of inflation rate on agricultural output?
iv. examine the effect of exchange rate on agricultural output?
v. determine the effect of government recurrent expenditure on agricultural output?

Methodology

Study Area

Nigeria is one of the most populous nations in sub-Saharan Africa countries situated on the Gulf of Guinea in the Western African region between the latitudes of $3^{0}10'$ and $14^{0}45'$ North and between longitudes $3^{0}42'$ East. It is bounded in the North by the Niger Republic and Chad, in the West by Benin republic, in the East by Cameroon Republic and the South the Atlantic Ocean. Nigeria is divided into six geo-political zones; North-East, North-West, North-Central, South-East, South-West, and South-South. These six geopolitical zones contribute in agricultural production through the production of various food crops as well as livestock that are adaptable to their regions thereby providing food for the teaming population. Nigeria has thirty-six (36) States and a Federal Capital Territory (Abuja), and consists of 774 Local Government Areas. Nigeria is an agricultural nation, hence agriculture employs a significant amount of its workforce, with employment rates averaging 44.18 percent between 1991 and 2019 (O'Neill, 2021).

Sources of Data/Method of Data Collection

This paper relied on past quantitative data that are accessible in secondary form. The research was based on annual statistical information from 1981 to 2020. The data used were sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin, index mundi and journals.

Analytical Techniques

Relevant statistical and economic techniques, including the ARDL model, mean, standard deviation, skewness, kurtosis, and trend analysis, were employed to examine the data. The Augmented-Dickey Fuller test and the ARDL Bound cointegration test were both used to ascertain whether there is a long-term relationship between dependent and independent variables. The data were analyzed using E-view software.

The model's specification was as follows:

AO = f (MS, INFR, INTR, EXR, GREXP) ……………………………………..................(1)

Where:

AO = Agricultural output
MS = Money Supply
INTR = Interest Rate
INFR = Inflation Rate

EXR = Exchange Rate
GREXP = Government Recurrent Expenditure

To test for cointegration between the variables under consideration, the aforementioned equations were written as an unconstrained error correction model (UECM):

Unrestricted Error Correction Model (UECM)

$\Delta AO_t=\alpha_0+\sum\alpha_1\Delta AO_{t-i}+\sum\alpha_2\Delta INFR_{t-i}+\sum\alpha_3\Delta INTR_{t-i}+\sum\alpha_4\Delta EXR_{t-i}+\sum\alpha_5\Delta EXR_{t-i}+\sum\alpha_6\Delta GREXP_{t-i}+\beta_1 AO_{t-1}+\beta_2 INFR_{t-1}+\beta_3 INTR_{t-1}+\beta_4 EXR_{t-1}+\beta_5 MS_{t-1}+\beta_6 GREXP_{t-1}+U_t$. ....(2)

Where:
Δ = first difference operator
βs = vector long run multipliers
αs = vector of short term coefficients
U_t = error term

Once cointegration has been demonstrated, the conditional ARDL model with the following specifications is used to estimate the long-run relationship:

$AO_t=\beta_0+\beta_1 CO_t+\beta_2 INFR_t+\beta_3 INTR_t+\beta_4 EXR_t+\beta_5 MS_t+\beta_6 GREXP_t+U_t$ ....(3)

Using an error correction model with the following specifications, the short run dynamic relationship is estimated:

$\Delta AO_t=\alpha_0+\sum\alpha_1\Delta CO_{t-i}+\sum\alpha_2\Delta INFR_{t-i}+\sum\alpha_3\Delta INTR_{t-i}+\sum\alpha_4\Delta EXR_{t-i}+\sum\alpha_5\Delta MS_{t-i}+\sum\alpha_6\Delta GREXP_{t-i}+\delta ECT_{t-1}+U_t$......................................(4)

Where:
Δ = first difference operator
βs = vector long run multipliers
αs = vector of short term coefficients
U_t = error term
ECT = component of the error correction
δ = Component of error correction, it shows the speed of adjustment from short-term to long term.

Results and Discussion

Table 1 displays the descriptive statistics of the variables used in the study, paying particular attention to each variable's mean, median, maximum, minimum, standard deviation, skewness, kurtosis, and likelihood. The average figure for agricultural output was found to be about ₦8216.517, 17.61500%, 19.71550%, and 19.21150% for interest rate, inflation, and government recurrent expenditure. The variables' standard deviation served as a barometer for the dispersion of the series. The standard deviation for agricultural output was ₦5530.399, while the standard deviation for money supply was 5.867642%. The distributions of the other variables (agricultural output, money supply, and government recurrent expenditure) were flat in comparison to the normal distribution because their values were less than three, whereas the inflation rate and interest rate had the highest kurtosis, at 4.796853 and 3.344721, respectively, indicating that these distributions were peaked. The positive skewness of the variables chosen indicates that the distributions have a lengthy right tail. All of the variables' standard deviations were smaller than their averages, which suggests that they grew slowly throughout the time period under study.

Table 1: Descriptive Statistics, using the observation 1981 – 2020

	AO (₦Billion)	EXR (%)	GREXP (%)	INFR (%)	INTR (%)	MS (%)
Mean	8216.517	100.8727	19.21150	19.71550	17.61500	16.37632
Median	4932.755	107.0250	7.300000	13.02000	17.22000	13.46344
Maximum	18348.18	358.8100	70.27000	76.76000	29.80000	27.37879
Minimum	2303.510	0.610000	0.010000	3.230000	7.750000	9.063329
Std. Dev.	5530.399	100.7593	22.78956	18.04378	4.700613	5.867642
Skewness	0.533492	0.885311	0.913162	1.661423	0.198060	0.564520
Kurtosis	1.733249	2.987528	2.500593	4.796853	3.344721	1.674693
Jarque-Bera	4.571858	5.225433	5.974784	23.78331	0.459573	5.051950
Probability	0.101680	0.073335	0.050419	0.000007	0.794703	0.079980
Sum	328660.7	4034.910	768.4600	788.6200	704.6000	655.0528
Sum Sq. Dev.	1.19E+09	395945.2	20255.19	12697.54	861.7348	1342.740

Source: Author's Computation from Eviews 10

Unit Root Test

In contrast to agricultural output, interest rates, money supply, exchange rates, and government recurrent expenditures, which were all stationary at first difference, the table shows that only inflation rate was stationary at level. The variables utilized in the study were a good instrument for examining the error correction process since they were stationary at level and first difference, which has consequences for these empirical conclusions.

Table 2: Results of Augmented Dickey Fuller Test at Level and First Difference

Variables	Levels	Critical Values 5%	Critical Values 10%	1st Difference	Critical Values 5%	Critical Values 10%	Remark
AO	2.072854 (0.9998)	-2.938987	-2.607932	-4.897050 (0.0003)	-2.941145	-2.609066	1(1)
EXR	2.161732 (0.9999)	-2.938987	-2.607932	-4.125913 (0.0026)	-2.941145	-2.609066	1(1)
GREXP	-0.670352 (0.8422)	-2.941145	-2.609066	-6.982423 (0.0000)	-2.943427	-2.610263	1(1)
INFR	-3.624010 (0.0098)	-2.941145	-2.609066				1(0)
INTR	-2.373653 (0.1557)	-2.941145	-2.609066	-9.423074 (0.0000)	-2.941145	-2.609066	1(1)
MS	-0.952598 (0.7604)	-2.938987	-2.607932	-5.142867 (0.0001)	-2.941145	-2.609066	1(1)

Source: Author's Computation from Eviews 10, Values on bracket are probability values

ARDL Bounds Test for Cointegration

The results of the calculated F-statistics and values for both the upper and lower bound were shown in Table 3, where the calculated F-statistics was higher than the upper critical bound for 5% and 10% critical values. The study therefore concludes from the ARDL bounds test that the coefficients of the lagged variables in the level form are zero (no co-integration between the variables).

Table 3: ARDL Bounds Test for Cointegration

(Dependent variable: AO)		F-Statistics
F(INFR, INTR, EXR, MS, GREXP)		5.254916
Critical Values	**Lower Bound 1(0)**	**Upper Bound 1(1)**
K=5; n=40		
10%	2.26	3.35
5%	2.62	3.79

Source: Author's Computation from Eviews 10

ARDL Result

The outcomes for both the long-run and short-run scenarios are shown in Table 4. A 1% increase in the exchange rate would enhance agricultural output by 91.49 percent, according to the long-run statistics, which showed that the exchange rate had a positive (91.49343) substantial influence on agricultural productivity. The link between exchange rates and agricultural production is positive because, in the case of flexible exchange rates, fiscal expansion increases output. This might, however, be linked to the revenue from agricultural exports, which reduce imports, improve the prices of local agricultural products, and eventually boost the income of the agricultural sector. This study support the findings of Okidim *et al.* (2023), who discovered that over time, exchange rates increase agricultural production by 31%. The exchange rate, however, had a negative (-11.81031) and considerable impact on agricultural output in the near term following the second gap. This suggests that if the value of the naira declines versus the dollar, prices will increase and have an impact on output levels. This result is in line with a research by Osuagwu (2020), who discovered that the exchange rate had a negative influence on Nigeria's agricultural output in the short-run.

Table 4: Error Correction Model result of the macroeconomic variables and agricultural output

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long-Run Result				
EXR	91.49343	39.31252	2.327336	0.0295**
GREXP	-29.07730	151.6924	-0.191686	0.8497
INFR	-75.92118	53.09571	-1.429893	0.1668
INTR	209.2200	194.7123	1.074508	0.2942
MS	109.3848	442.4024	0.247252	0.8070
Short-Run Result				
C	206.5479	67.16716	3.075133	0.0055
D(EXR)	0.852916	2.738083	0.311501	0.7584
D(EXR(-1))	-5.732473	3.308117	-1.732851	0.0971
D(EXR(-2))	-11.81031	3.790499	-3.115765	0.0050***
D(GREXP)	-9.782695	3.812301	-2.566087	0.0176**
D(GREXP(-1))	-17.25641	4.325104	-3.989825	0.0006***
D(GREXP(-2))	-22.55742	3.768119	-5.986388	0.0000***
D(MS)	11.19678	21.64223	0.517358	0.6101
D(MS(-1))	75.05533	21.30943	3.522165	0.0019**
CointEq(-1)*	-0.094695	0.015223	-6.220554	0.0000
C	206.5479	67.16716	3.075133	0.0055

R-squared	0.742445	Mean dependent var	430.7865
Adjusted R-squared	0.656594	S.D. dependent var	474.3750
S.E. of regression	277.9879	Akaike info criterion	14.31849
Sum squared resid	2086486.	Schwarz criterion	14.75387
Log likelihood	-254.8921	Hannan-Quinn criter.	14.47198
F-statistic	8.648013	Durbin-Watson stat	2.028925
Prob(F-statistic)	0.000006		

Source: Author’s Computation from Eviews 10
*** - Significant at 1%, ** - Significant at 5%

Government recurrent spending in the present (-9.782695), first (-17.25641), and second (-22.55742) lags had a negative and substantial influence on agricultural output in the short term, respectively. This suggests that a decline in government recurrent expenses result in decrease in agricultural output. This was not anticipated because higher recurring government spending was thought to boost agricultural output. Higher recurrent expenditure by government means less available resources on investment spending capital projects, depriving farmers of the credit that could have been utilized to boost output. This finding is similar to the findings of Ademola (2019), who reported that agricultural funding does not boost the Nigerian economy.

The effect of the money supply on agricultural production was positive (75.05533), indicating that for every unit rise in the money supply, there would be a corresponding gain in agricultural output of 75.05 units. This result agrees with that of Ahmad *et al.* (2021), who reported that the availability of money had a favorable impact on rice production in Nigeria.

From Table 1, the R^2 was 0.742 implying that the macroeconomicvariables included in the model accounted for 74.2 percent of the variation in agricultural production, with other variables other than those in the model accounting for the remaining 25.8 percent. The error correction term (ECT), which had a coefficient of -0.094695 and was statistically significant (P = 0.0000 0.05), predicted a short-run rate of adjustment of 9% and suggested a slow rate of adjustment of monetary policy instruments towards equilibrium. The greater than 2.0 Durbin-Watson value indicates that there is no autocorrelation.

Conclusion and Recommendations

Based on the results and findings of this study, it can be concluded that macroeconomic variables were significant in driving agricultural growth in Nigeria. The selected macroeconomic variables; exchange rate, government recurrent expenditure and money supply affected agricultural output in the short-run while only exchange rate affected agricultural output in the long-run.

On the basis of the findings, the following suggestions were made:

i. Exchange rate management should be cautious and that should be taken to lessen the negative effects of exchange rate depreciation on agricultural outputG
ii. Government should put in measures to track funds released for agricultural puposes in order to ensure proper disbursement and utilization
iii. Government should inprove in the release of the supply of money so as to enable farmers meet up their required purchases.

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