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Impact of Interest Rate on Agricultural Productivity in Nigeria; Analysis of Policy Implication (Subsidy Removal 2012-2022)

[1]Dorcas N. Munaji, [*1]Samson G. Simon and [1]AbdulAziz Shehu

[1]*Department of Economics, Baze University, Abuja, Nigeria*

[*]*Corresponding Author E-mail: dorcaskaruri@gmail.com*

Abstract

The study examined the impact of interest rate on agricultural productivity in Nigeria. The aim was to ascertain whether interest rate impacts agricultural productivity as measured by AGDP and how government policies/ intervention schemes such as subsidy removal in 2012, 2016, and 2020 impacted the sector's productivity. Quarterly time series data were used which covered a span of 11 years (2012-2022) i.e. 44 quarters. The independent variables analyzed include interest rate, guaranteed loans from ACGSF, exchange rate, and deposit money bank loans to the agricultural sector. Agricultural GDP stood as the dependent variable. The econometric models used in the research included ADF unit root tests, Auto Regressive Distributive Lag model (ARDL) and Granger Causality model. The result of the short and long-term coefficient and ECM indicated Interest rate had an insignificant negative impact on agricultural productivity while, LACGSF, and DMB loans exhibited a positive impact on agriculture. Results of the Granger causality test revealed no causality between AGDP and INT. The recommendation, therefore, is that the government and monetary authorities should stabilize the business environment in Nigeria as policy implications such as subsidy removal greatly impact these macroeconomic variables which in turn impact the real sector. Also, ease of access to credit opportunities for farmers especially those in the rural areas, and ensuring that government-introduced agricultural schemes and programs such as the ACGSF get to the targeted population is highly recommended.

Keywords: Interest Rate, Agricultural productivity, Agricultural Credit Guarantee Scheme

Introduction

Monetary policy instruments are used by the central bank to achieve the desired results of the government. For instance, interest rate controls the direction of credit which in turn influences the level of economic activities to achieve desired investment in an economy (Chigbu & Okonkwo, 2014). A major tool of the CBN is interest rate and governments can channel the expected level of desired change in particular sectors within their economy through policies of the CBN. These help to gear resources in favor of their goals and objectives. Interest rate is a crucial macroeconomic indicator in any monetary framework as it affects the direction of investment in an economy. It also determines the return on investment. Investors will therefore be compelled to move their investments from low-interest-rate yielding areas to higher interest-rate-prone areas as it provides the desired incentive, (Dixon, 2022). The central bank adjusts the rate of interest to maintain a healthy level of rising prices in the economy and steer investments in the needed direction. Interest rate makes borrowing funds expensive and can be tied to the presence of inflationary pressures in the economy. The inflation rate in the economy and transfer of monetary impulses to the real sectors of the economy are important topics in macroeconomics (Ademola, Alalade, Ogbebor & Olalekan, 2023). Interest rate as a monetary policy instrument is crucial in terms of its role in enlisting financial resources to support growth in the agricultural sector. An increase in the rate of interest could hinder farmers from accessing credit, thus reducing potential output (Abubakar & Muhammad, 2023). Change in interest rate directly affects profitability of agricultural production by influencing borrowing, consumption, and investment, since agricultural production is capital-intensive. Interest rates impact agriculture by affecting economic activity, such as output and employment, exchange rates, and international trade. The advancement of agriculture and value-addition activities in the downstream agro-processing sub-sector offers a potential platform for effective wealth generation and sustainable poverty eradication.

The agricultural sector has however been in almost a steady decline in the estimates of Nigeria's production from the early 1960s to the late 1980s. (Etale, Suwari, & Adaka, 2021). Abubakar and Muhammed (2023) stated that during 1960-1970, the sector contributed 55.8% of GDP but between 1971 and 1980, this dropped to 28.4%. The average value for agricultural output in Nigeria during 1981-1990, 1991- 2000, 2001-2010, and 2011-2020 was 18.2%, 24.42%, 27.39% and 21.46% respectively (World Bank, 2020). Toward the end of the 20th century, Nigeria became dependent on oil revenue, impacting food production and security

(Okafor, 2022). (Abayomi, Adam & Alumbugu, 2015) emphasized that increasing agricultural production is essential for achieving industrialization. To enhance agricultural productivity in Nigeria, the government adopted various agricultural funding schemes and monetary policy strategies so as to bring about growth and increased development in the economy (Bayo, 2005). Government initiatives, like the Agricultural Credit Guarantee Scheme fund (ACGSF) aimed to enhance the level of bank credit to the agricultural sector by providing guarantees concerning loans granted by lending banks; the Good Luck Ebele administration set up the Agricultural Transformation Agenda (ATA) to develop value chains in the agricultural sector through the growth enhancement scheme (GES) and staple crop processing zones (SCPZ) (Ogah, Solomon & Edet, 2022). Under the Muhammadu Buhari administration, the Anchor Borrowers Program (ABP) was launched and with this, average rice and maize production increased. The sectoral contribution also showed an average growth of 27.5 percent under the Obasanjo administration, 25.6 percent under the Yar'Adua administration, and 21.75 percent under the Jonathan administration then 24.4 percent under the Buhari regime (Zhizhi, 2018). Abu, 2012, revealed that total bank lending expanded from about 2 percent in 2011 to 5 percent in 2013; lending to seed companies and agro-input dealers also expanded from $100 million in 2012 to $500 million in 2014. (Itodo,2016) in his analysis shared that by 2015, Nigeria became a net exporter of rice, which was a shift from decades of rice importation that cost the country an average of ₦1 billion daily.

Literature Review and Theoretical framework

Conceptual Review

Interest Rate

Interest rates are very important to finance and economics. It is the cost of borrowing or the amount of profit gained after investment. Types include nominal, real, fixed and variable interest rates. At the heart of monetary policy is interest rate, not just passive as a reflector on money supply but as one of the main policy tools of the central bank. It is influenced by policies, inflation, economic conditions, and the supply/demand for loans. It is usually expressed as a percentage and represents the compensation that a lender receives for providing funds to a borrower or the earnings an investor receives on an investment. In developing nations, high rates of interest have been essential to many stabilization programs during periods of high inflation since the 1980s (Asgharpur, Kohnehshari & Karami, 2007). In defining the rate of interest, a distinction between interest rates in terms of money (e.g., silver) and in terms

of goods (e.g., wheat) is important. A nominal rate is the rate of interest on a financial instrument or loan, without accounting for the effects of inflation. It is the actual interest rate charged or earned on an investment or loan before taking cognizance of changes in purchasing power as a result of high inflation. Real interest rate takes into account the effects of inflation. The real interest rate adjusts the nominal interest rate for changes in purchasing power, providing a more accurate measure of the real cost of borrowing or return on investment. (Amaefula 2016).

At the core of interest rate policy in Nigeria is the moderation of inflation, promoting financial savings and investment, encouraging a reduction in the balance of payments pressure, achieving exchange rate stability, and enhancing macroeconomic stability in the financial sector (Kenton, 2023). Interest rate management in Nigeria has historically involved two main approaches: direct and indirect. Directly, the approach would be to administratively adjusting lending and saving rates, while the indirect, is when market forces can be relied upon. Both approaches aim to stimulate economic growth in their ways. The CBN is mandated and has authority to interfere with activities of the money market to maintain orderly interest rate development**. (**Ajayi, Oladipo, Ajayi, & Nwanj, 2017)

Exchange Rate

Exchange rate can be defined as the value of one currency expressed in terms of another. It is the rate at which one can exchange a currency for another. The fluctuations in exchange rate can be attributed to various factors such as economic indicators, political stability, and market demand. These rates are very key in determining the ease of international trade and finance, influencing the cost of imported goods, exports, and overall economic conditions. The effect of rising prices on an economy is that it weakens purchasing power, making things very expensive and cost of living high for occupants of a particular location. This turns investors away from doing business. When the inverse happens, a high inflow of money into a country is expected, and the currency becomes more valuable as its buying power increases due to increased transactions. This strengthens the exchange rate. Higher interest rates attract foreign investment, increasing the demand for a country's currency. It is a fine balance and so is the resulting impact on a country's exchange rate. (Potters & Rubin, 2023)

Agricultural Productivity

Agriculture is the science, art, or practice of cultivating the soil, producing crops, and raising livestock. It involves the preparation and marketing of the resulting products (Webster Dictionary, 2021). Agricultural productivity has to do with the efficient use of resources like land, labor, water, and capital to produce crops and livestock. It is measured by yield, output per unit of labor, and total factor productivity (TFP). TFP assesses overall efficiency in agricultural production. The total industry contribution (AGDP) in value terms (Naira) is used as a proxy to measure agricultural productivity in this study. The impact of agriculture is felt on all sectors in the economy, especially the industrial sector, as it is capable of generating broad-based sustained growth necessary for development. Agriculture provides food for local consumption and for the excess to be exported to other countries. As a result of this, the country gains foreign exchange and increased national income in the long run (CBN, 2021). Contributions of the sector also include; the generation of employment, provision of raw materials for industrial processing, provision of markets for primary inputs and consumer products. Skills developed within the sector can be transferred during labor migration (Ekine & Nwaokedibe, 2018)

Agricultural Gross Domestic Product (AGDP)

AGDP measures total output produced within the sector over a specific period. The measurement usually covers the duration of a year, quarter or month. It is the market value of all goods and services produced by the factors of production (such as land, capital, and labor) within an economy. Insight into the overall economic health of an economy can be better understood through monitoring agricultural productivity as a component of GDP. As the importance of agriculture in driving economic growth, and the potential opportunities within the agricultural sector cannot be overemphasized. Policymakers therefore closely monitor agricultural productivity to inform investment decisions and strategies for rural development. A majority of Nigeria's population depends on agriculture (More than 70 percent) as its contribution to GDP constitutes roughly 25 percent and 60 percent of non-oil exports (World Bank, 2023). A major way out of poverty and the achievement of long-term growth economically, especially in developing nations can be through agricultural productivity (Ezihe, Agbugba, & Idang, 2017). The sector contributes a significant part of the nation's GDP. It contributed almost 30% of the total GDP between July and September 2021 (Sasu, 2022).

Deposit Money Bank Loans to the Agricultural Sector

Loans given by deposit money banks to farmers and stakeholders within the agricultural sector are channels of investment designed specifically to provide funding to individuals, businesses, cooperatives, and organizations engaged in agricultural activities. The loans support different aspects of agricultural operations, including agribusiness, livestock farming, crop production, and rural development initiatives, to mention but a few. Loans are offered by various financial institutions, including commercial banks, credit unions, agricultural lenders, and government-sponsored agencies to the agricultural sector. The specification of terms, conditions, and eligibility requirements for these loans depends on the lender, the loan type, and specific needs. (Salisu & Alamu, 2023). Deposit money bank loans are key in expansion of the agricultural sector, particularly in developing economies. By addressing current challenges and seizing emerging opportunities, these financial instruments can drive sustainable growth, enhance food provision, and improve livelihoods of million farmers worldwide.

Agricultural Credit Guarantee Scheme Fund (ACGSF)

The ACGSF was set up by the Nigerian government to guarantee credit facilities extended by banks to farmers and agribusinesses. The primary aim of the scheme is provision of security for loans granted by banks to farmers, thereby reducing risk for lenders and encouraging them to offer more. This helps farmer's access necessary funds for different agricultural activities such as purchasing inputs, and machinery, or expanding their operations. The scheme (ACGS) was established by decree No. 20 in the year 1977. It became operational in 1978 and is funded by the federal government and central bank (at a 60% to 40% ratio). Under the scheme the share capital is N50 billion (fifty billion naira) and is under the management of the Agricultural Credit Guarantee Scheme Fund Board. The Central Bank of Nigeria is the managing agent for the administration of the scheme. It allows farmers to borrow from lending banks including community banks at market-determined rates (CBN, 2022). Banks eligible under the ACGSF include deposit money banks and microfinance banks.

A good number of countries put in place regulations that require banks to commit portions of their loans to the agricultural sector. Like there is the Indian Priority Sector Lending (PSL) guidelines that offer various provisions to aid farmers, such as loans for solar pumps, biotechnological advancements, and pre and post-harvest activities. Also, government provides interest rate subsidies or guarantees like the ACGSF on agricultural loans to facilitate

borrowing. For instance, Pakistan's Zarai Taraqiati Bank offers subsidized loans for crop production, farm mechanization, and other agricultural activities. The World Bank has been instrumental in funding agricultural projects, emphasizing the importance of developing sustainable food systems to address poverty and food insecurity.

Theoretical Framework

Keynesian Reformulated Quantity Theory

The theory established an indirect and non-proportional connection between the quantity of money and prices. To establish this, Keynes brought a transition from a pure monetary theory of prices for output and employment, thereby integrating monetary theory and value theory. He connects these two theories alongside the theory of output and employment through interest rate which plays a critical role. When money supply increases, the rate of interest falls leading to an increased volume of investments and aggregate demand. This trickles down to positively impacting output and employment levels. With this increase comes further increase in the demand for factors of production, and subsequently, bottlenecks will set in raising marginal cost. The resulting effect is price rise (inflationary pressures) hence establishing the connecting link between monetary theory and value theory. His theory emphasizes important policy implications establishing that prices will rise gradually with no danger of inflation when the economy is not fully employed. A price rise is inflationary when the economy reaches full employment. He concludes that the concurrent attainment of full employment and price stability may be inherently irreconcilable (Jhingan, 2008).

Empirical Review

Factors that affect interest rates in terms of credit availability and ease of access to farmers range from economic conditions (recession/depression), monetary policy, creditworthiness of borrowers, loan purpose and type, government programs, etc. Abubakar and Muhammad (2023) wrote on commercial banks financing the agricultural sector in Nigeria. Agricultural financing was defined by commercial bank credit to the sector. Interest rate and inflation were the controlled variables. Using ARDL, they discovered that independent variables had a long-run relationship with the explained variable and that the commercial bank agricultural financing positively impacted agricultural output. There was however a negative and insignificant relationship between interest rates and inflation with agricultural output in the long run. Also, Salisu and Adamu (2023), looked into the impact of bank lending on the output of the agricultural sector in Nigeria from 1981-2021. They used descriptive statistics and

ARDL. The result showed that commercial bank lending positively impacted agriculture and also interest rate on agricultural output in Nigeria.

Ademola, Alalade, Ogbebor, and Aworinde, (2023) analyzed how bank lending influenced the growth of the agricultural sector in Nigeria, utilizing time series data spanning 1990 - 2020. The aim was to ascertain the impact of credit disbursement on agricultural sector development and assess the government funds' contribution to enhancing agricultural productivity. It also examined the correlation between agricultural produce prices and the level of productivity; evaluating the influence of ACGSF on the sector. The study utilized various regression techniques, including ordinary least squares and the error correction model analyzing the relationships based on statistical data. The results showed a negative and significant impact of commercial bank credit to the sector and the agricultural output index. Also, a positive and significant impact of the ACGSF loans and agricultural production output index. There was however a significant negative impact of government's fund allocation on the production index and a significant positive impact of produce prices and the production index.

Mbanaso & Emerole (2021), examined the trend analysis of interest rate and agricultural finance. They used time series annual data spanning 1986 - 2017. Data was subjected to statistical and econometric analysis. Analyzing the trend revealed a steady rise in the rate of interest from 1986- 1998 (i.e. SAP era). It dropped between 2000 and 2006 slightly and resumed an upward movement between 2007 to 2017 indicative of the resulting effect of interest rate volatility to agricultural funding. The results showed that interest rates depicted a negative non-significant trend while the volume of formal agricultural finance had a positive trend from 1986 to 2017 in Nigeria. The recommendation was that the monetary authorities should maintain stability in interest rate policy for adequate formal financing to flow from banks to the agricultural sector.

Muhammed (2023), assessed determinants of output in the agricultural sector in Nigeria from 1981 - 2018. Agricultural growth, agricultural credit, government expenditure on agriculture, and money supply were the variables used in the study. Models used for the study include descriptive statistics, unit root test, granger causality test, Johansen co-integration test, and Ordinary Least square regression. The objective was to assess if these variables impact

agricultural output. Findings revealed credit and expenditure of government on agriculture both had negative effects on output while money supply impacted on output positively.

On the other hand, Oboh, Tule & Ebuh (2019), tried to answer the question whether or not monetary policy matters for agricultural sector performance. Annual time series data was used from 1981 – 2016. Auto-regressive distributed lag (ARDL) approach was used and it established a long-run relationship between some monetary policy variables and value added to agriculture. In the long run, maximum lending rate and the supply of money significantly impacts on value added to agriculture while exchange rate and inflation do not. An expansionary but non-inflationary policy to improve value addition to the agricultural sector of the Nigerian economy is recommended. Iliyasu (2019), carried out his research on the impact of interest rates on agriculture in Nigeria. He tried to establish a link between lending rate of interest and the activity of the agricultural sector using regression analysis for real and nominal values. Result showed a strong significant negative impact of interest rate on agricultural sector activity.

Lawal, Olayanju, Ayeni & Olaniru (2019), reviewed bank credit impact on the productivity of agriculture in Nigeria. The objective was to ascertain the causality among the duo. In the study, agricultural gross domestic product, credit from commercial banks to the agricultural sector, interest rate charges, government spending on agriculture, and agricultural credit guarantee scheme. Sourced data was from CBN statistical bulletin. The Toda and Yamamoto Granger non-causality techniques, unit root test, Johansen Co-integration test, and the Vector Auto regression estimate decomposition test were the tools of analysis used to show the contribution of each independent variable to the forecast of other variables. Results showed no long-term relationship among variables and a unidirectional causality running from ACGSF to AGDP. Ogbuabor & Nwosu (2017) analyzed the impact of loans extended by deposit money banks on productivity of the agricultural sector in Nigeria. Using an ECM and annual time series data covering 1981 to 2014. Research findings showed presence of an equilibrium relationship among variables and that both in the long and short run, deposit money banks credit impacts positively and significantly on agricultural productivity. Climate change variables (such as annual rainfall and average temperature) had a non-significant impact throughout. Policies that will enhance bank credit availability and affordability through interest rates to the agricultural sector were proposed.

Methodology

Research Design

The methodology used for this study is quantitative research. It employs quarterly time series data on interest rate and agricultural productivity given by the aggregate of agricultural contribution to GDP i.e. AGDP, DMB loans to the agricultural sector, ACGSF loans, and exchange rate from 2012-2022. This model design was adopted with modifications on the variables used for the study because it has been used in previous research works such as that of Adekanbi (2019) who researched the impact that interest rate, inflation and exchange rate would have on gross domestic product. Data is from the CBN (statistical bulletin, ACGSF reports, and database), and the NBS.

Model Specification

The adapted model is from the work of Adekanbi (2019). His research work covered interest rate, inflation, exchange rate, and the effect of these variables on GDP in Nigeria, to define the functional form of this research. Adekanbi's study considered GDP as the dependent variable and interest rate, inflation, and rate of exchange as independent variables.

The specification in functional form of the model is as:

GDP = F (Inf. Rate, Ex. Rate and Int. Rate) (1)

The variables to be adopted for this study have been modified to include agricultural productivity measured by total production for the sector (AGDP), and the contribution of government programs to output measured by loans guaranteed by the ACGSF and DMB loans, for period under review. This is due to the level of potential impact from historical contributions that the sector has had to GDP in Nigeria and the urgent need for diversification of the economy.

AP = F (INT, EXG, LAGR and ACGSF) (2)

The model in logarithmic form is represented as follows,

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$LAGDP_t = \beta o + \beta_1 INT_t + \beta_2 LLAGR_t + \beta_3 EXG_t + \beta_4 LACGSF_t + \varepsilon_t$ .....(3)

$\Delta LAGDP_t = \sum_{t-1}^{k} \Delta LAP_{t-1} + \sum_{t-1}^{k} \Delta INT_{t-1+} + \sum_{t-1}^{k} \Delta LLAGR_{t-1} + \sum_{t-1}^{k} \Delta EXG_{t-1} + \sum_{t-1}^{k} \Delta LACGSF_{t-1} + \varepsilon c_{t-1} + \varepsilon t$

Where AGDP: Total Agricultural contribution to GDP (Dependent variable)

INT: Interest Rate

EXG: Exchange Rate

LAGR: DMB Loans to agriculture

Bo: the intercept

B_1, β_2, β_3, and $\beta_4$are coefficients of the independent variable

εt is the error term

Causality among Interest Rate and Agricultural Productivity

Using the pairwise granger causality model, the relationship among interest rate and agricultural productivity is as follows:

1. $INT_t = \alpha o + \sum_{i=1}^{p} a_{iINT_{t-1}} + \sum_{j=1}^{p} w_{jAGDP_{t-j}} + \varepsilon_{1t}$ .....(4)

$AGDP_t = \beta_o + \sum_{i=1}^{p} \beta_{1\ AGDP_{t-1}} + \sum_{j=1}^{p} \phi_{jINT_{t-j}} + \varepsilon_{2t}$ .....(5)

Data Presentation, Analysis and Interpretation

Result of Descriptive Statistics and Trend Analysis

The table presents the results obtained from descriptive statistical analysis of variables used in this research, total agricultural gross domestic production (AGDP), interest rate (INT), loans to agriculture (DMBL), exchange rate (EXG), and loans guaranteed by the agricultural credit guarantee scheme fund (ACGSF).

Table 1: Result of Descriptive Statistical Analysis of variables

	LAGDP	INT	LACGSF	EXG	LDMBL
Mean	8.5566	28.03	14.2735	280.1502	13.2518
Median	8.3377	27.61	14.2573	305.75	13.1675
Maximum	11.8772	31.55	15.0527	432.87	14.3211
Minimum	7.9394	23.21	13.1277	155.7	12.4617
Std. Dev.	0.8933	2.4049	0.5005	93.6521	0.5496
Skewness	3.0203	-0.1283	-0.1925	-0.0595	0.4044
Kurtosis	10.8278	1.9586	2.1941	1.6850	2.2006
Jarque-Bera	167.0147	1.9651	1.3626	2.9785	2.2093
Probability	0	0.3743	0.5060	0.2255	0.3313

Source: Authors computation with E-views 9, (2012-2022)

The results from the table above show exchange rate to have the highest mean value of 280.1502 among the variables. The mean value represents the typical value of a given data set. The lowest mean value is that of total agricultural production with a value of 8.5566. It is worth noting that all the variables have positive median values indicative of an even distribution in the dataset. The standard deviation measures variability of data points around

the mean in a dataset and a higher standard deviation indicates greater variability from the results, with exchange rate being the highest and having the highest variability among the variables while total loan guarantee from the ACGSF has the lowest variability. INT, EXG, and ACGSF are negative in terms of skewness indicative of a long left tail in distribution. GDP and DMBL are positive implying positive skewness with a distribution that has a long right tail. All variables are platykurtic except for AGDP in terms of kurtosis because the values are less than 3 this indicates a distribution with a lower peak. An implication of this is that the data has fewer extreme values and is more dispersed around the mean compared to a normal distribution. So it has less variability. AGDP is leptokurtic. The Jarque Bera test indicates a P-value that is above the significance level of 5%, therefore not enough evidence is seen to reject the null hypothesis. This implies that the data follows a normal distribution.

Trend Analysis of the Variables

From the figure below, loans from deposit money banks (DMBL) indicate a steady upward movement with volatility but an increase over the last ten years. The breaks in the trend lines on the other variables show a high level of volatility given reactions to subsidy removal and movement of inflation and interest rates, also the use of quarterly data. The use of quarterly data gives a microscopic view of the trend movement and captures any disruptions in the flow of economic activities within quarters displaying the movement as seen on the graphs.

Table 2: Results of ADF Unit Root Test

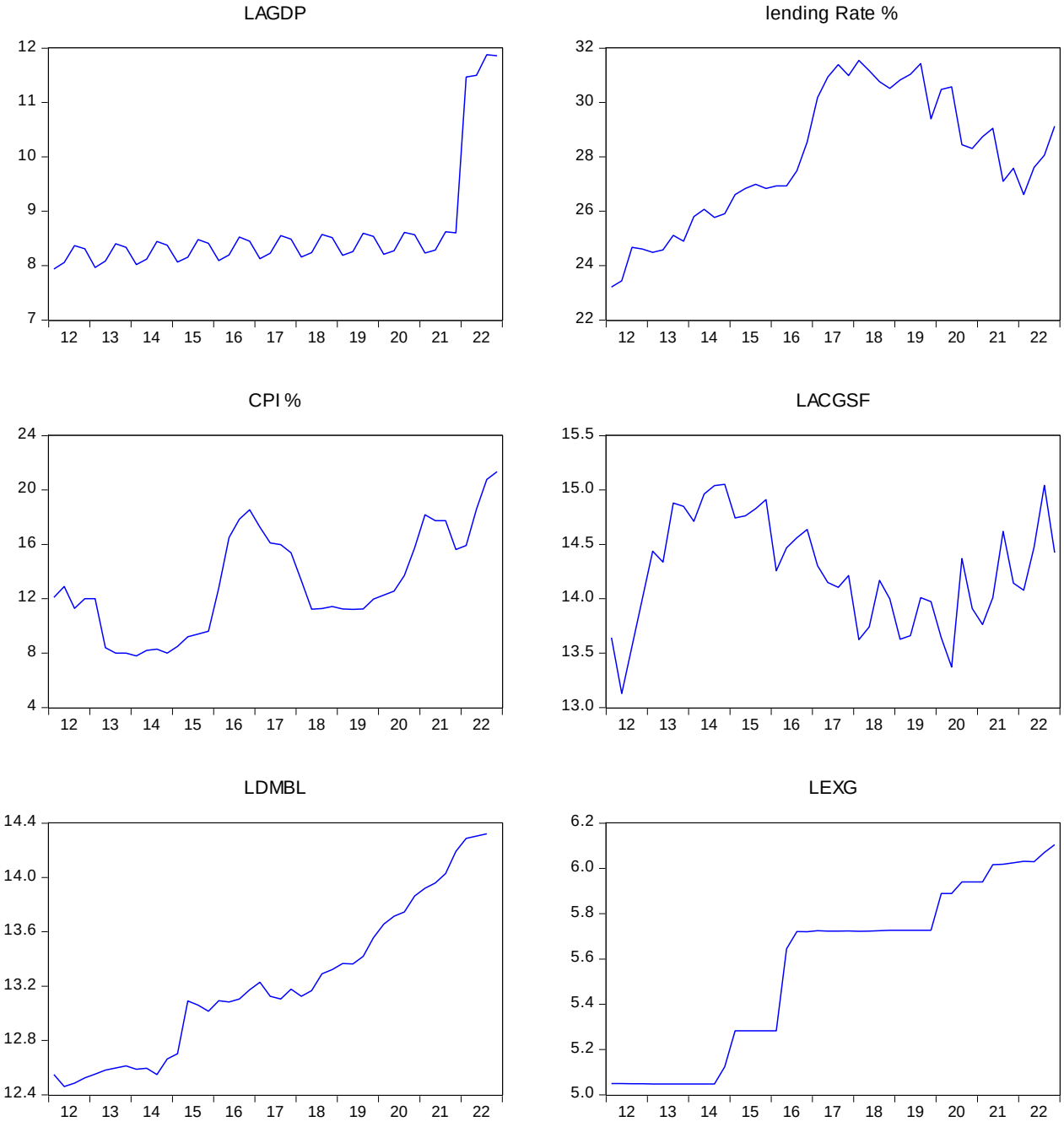
Variable	At Level		At 1st Difference		Order of Stationarity
	T-STAT	PROB	T-STAT	PROB	
LAGDP	0.019808	0.9552	-6.498915	0	I(1)
INT	-1.936538	0.3130	-6.590642	0	I(1)
LDMBL	0.969447	0.9955	-6.544411	0	I(1)
EXG	0.122004	0.9639	-5.990006	0	I(1)
LACGSF	-3.195839	0.0302	-	-	I(0)

Source: Authors computation using Eviews 9 (2012-2022)

The unit root test was carried out to ascertain whether or not the data samples were stationary or non-stationary. Stationarity enables the selection of the appropriate model to be used for forecasting and analysis, to ensure accuracy of result findings. It addresses the issue

of spurious regression; this is where an unrelated time series may exhibit the existence of a relationship due to non-stationarity. The results obtained from the ADF unit root test show stationarity at 1st difference for all variables except LACGSF which is stationary at level. The variables LAGDP, INT, LDMBL, and EXG are not stationary at the level; this implies a high level of volatility in these variables. Variables are of mixed integration order

Graphical presentations of the variables



Source: Author's Computation using Eviews9

Table 3: Result of ARDL test (short run Analysis)

Test Statistic	Value	K
F-statistic	2.037305	4
Critical Value Bounds		
Significance	**I0 Bound**	**I1 Bound**
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Source: Author's computation using Eviews 9. (2012-2022)

ARDL test allows us to determine short-run and long-run relationships among the variables under study. The decision rule for the ARDL bounds test states that if the value of the F statistic is greater than the upper bound I (1) then we reject the null hypothesis of no co-integration between the variables. From the table above, the value of the F statistic is 2.037305 which is less than both the upper and lower bounds at 5% levels of significance. The null hypothesis is therefore rejected, meaning there is no long-run co-integration.

Table 4: Result of the ARDL Short Run Estimates

Cointegrating Form				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(INT)	-0.15955	0.11804	-1.35169	0.1863
D(INT(-1))	0.20729	0.10609	1.95391	0.0598
D(LACGSF)	0.09916	0.29131	0.34040	0.73585
D(EXG)	0.00044	0.00333	0.13155	0.89619
D(LDMBL)	0.58734	0.56287	1.04348	0.30480
CointEq(-1)	-0.19350	0.15249	-1.26896	0.21390
Cointeq = LAGDP - (-0.3940*INT + 0.5125*LACGSF + 0.0023*EXG + 3.0354 *LDMBL -28.2642)				

Source: Author's computation using Eviews 9, (2012-2022)

ARDL coefficient of the ECM result is negative (-0.19350) and insignificant (0.21390). It implies no short-run convergence among the variables, as the precondition for significance is that the ECT must be negative and significant at a 5% LS. This coefficient measures speed of adjustment to long-run position. The results obtained imply no short-run convergence in variables under study. The adjustment coefficient -0.19350 indicates the speed at which shifts from long-run equilibrium are corrected. The negative coefficient suggests that the adjustment is towards the equilibrium level, -0.19350 implies that approximately 19% of the deviation

from the long-run equilibrium is corrected within one period. This means the system tends to return to equilibrium relatively slowly after a shock or disturbance. The coefficient of INT is negative implying an inverse relationship that exists between interest and agricultural GDP as it affects the affordability of credit access. DMBL and EXG have positive coefficients reflective of the level of importance that a good credit system and thriving currency can have on productivity.

Table 5: Results of the Pairwise Granger Causality Test

Null Hypothesis:	F-Statistic	Prob.	Decision
INT does not Granger Cause LAGDP	0.6545	0.5256	Accept
LAGDP does not Granger Cause INT	1.3536	0.2708	Accept
LACGSF does not Granger Cause LAGDP	0.9882	0.3830	Accept
LAGDP does not Granger Cause LACGSF	0.8179	0.4501	Accept
EXG does not Granger Cause LAGDP	1.5182	0.2324	Accept
LAGDP does not Granger Cause EXG	1.1809	0.3183	Accept
LDMBL does not Granger Cause LAGDP	2.4349	0.1019	Accept
LAGDP does not Granger Cause LDMBL	0.2698	0.7651	Accept

Source: Authors computation using E-views 9, (2012-2022)

The result of Granger causality test indicates that the Ho of INT not granger causing LAGDP and LAGDP not granger causing INT cannot be rejected as their probability values exceed the 5 percent level of significance i.e. 0.5256 and 0.2708 respectively. This implies no causal relationship among interest rate and agricultural productivity as measured by AGDP.

Post-Estimation Stability and Diagnostic Test Result

Table 6: Serial Correlation Result

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.510610	Prob. F(4,27)	0.7284
Obs*R-squared	2.742714	Prob. Chi-Square(4)	0.6018

Source: Authors computation using Eviews 12 (2012-2022)

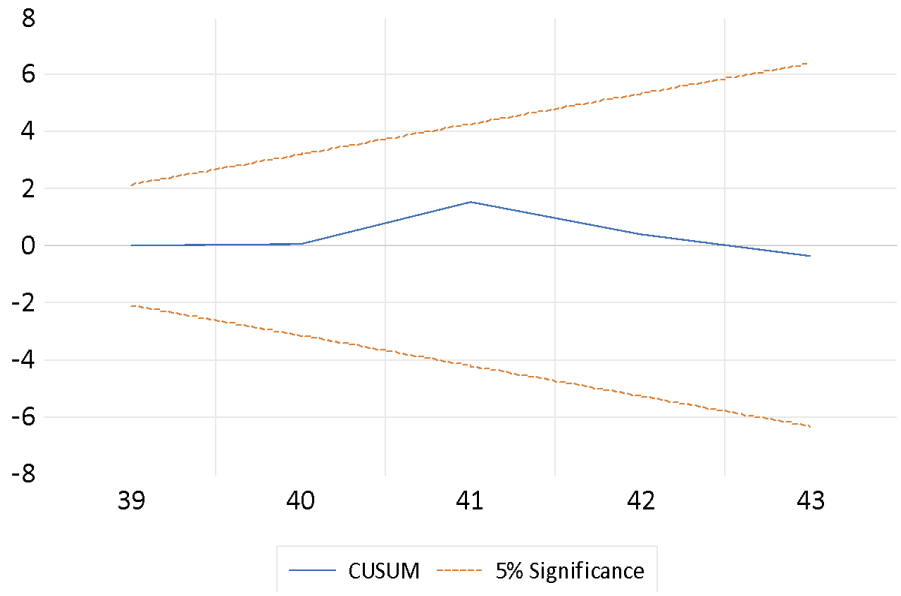
Table 7: Heteroscedasticity Test Result

Heteroscedasticity Test: ARCH			
F-statistic	0.067923	Prob. F(1,36)	0.7959
Obs*R-squared	0.071561	Prob. Chi-Square(1)	0.7891

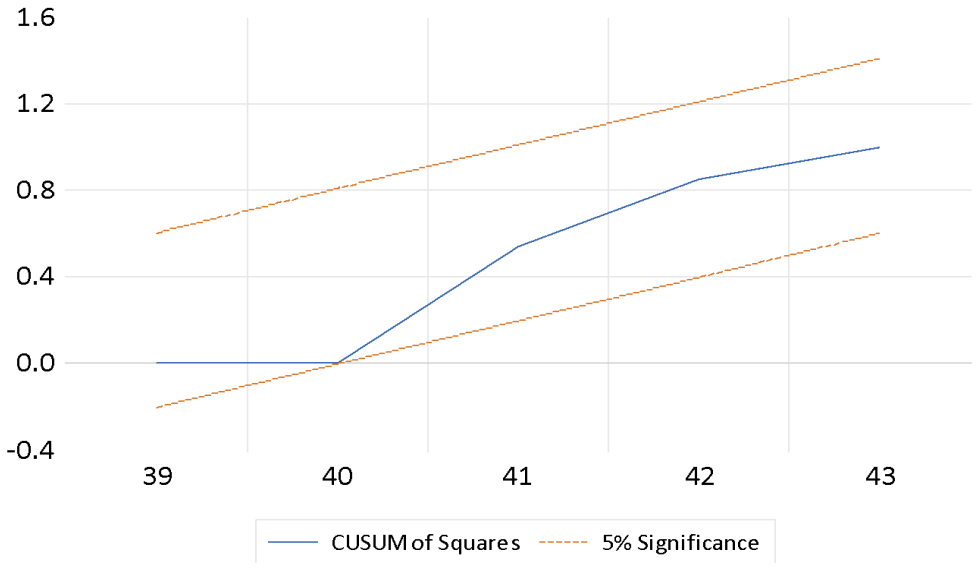
Source: Authors computation using Eviews 12, (2012-2022)

The above post-estimation test was carried out for model one. The normality test, heteroscedasticity, serial correlation test, and stability tests were carried out using the Jarque-Bera, Breusch-Godfrey, ARCH test, and CUSUM tests respectively. Test results imply no serial correlation or heteroscedasticity as the probability values are above 0.05 level of significance. The CUSUM test shows the variables move within the critical bounds, though the results of the Jarque-Bera indicate extremity in the distribution of the variables which could be attributed to the impact of the subsidy removal through the various administrations under review and high volatility of quarterly data.

CUSUM Stability Test Result



CUSUM of Squares Stability Test Result



The stability test findings, illustrated above indicate that the model successfully passed the stability test at the 5% LS. This is evident as the line plotted (representing the recursive errors) remained within the V-mask on the graph. Therefore, the model utilized in the research is deemed stable, ensuring the reliability of the regression results. A model is classified as unstable if the plotted line deviates from the parallels or the V-mask.

Hypothesis Test Result

Hypothesis

H0: interest rate has no impact on agricultural productivity in Nigeria

The condition for short-run convergence in ARDL approach is met only if the coefficient of the ECT is negative and significant; this indicates that variations from long-run equilibrium are being adjusted. From results obtained, the coefficient of the ECT is -0.19350 with a probability of 0.21390. The results imply no short-run co-integration. Interest rate negatively affects agricultural output as high interest rates mean increased cost of borrowing for farmers in the long run. This makes investing unattractive for the sector. Hence the null hypothesis of no impact and cannot be rejected.

Discussion of Findings

In the short run, ARDL revealed no convergence among variables with the rate of interest having a non-significant negative impact on AGDP. This implies that the rate of interest and AGDP are inversely related as they affect the cost of borrowing, reducing the farmer's ability to access credit, expand operations, invest in technology, or improve productivity. This agrees with the findings of Abubakar & Muhammad (2023) whose results showed a significant relationship between agriculture and the rate of interest that was negative, and Mbanaso & Emerole (2021) whose test result showed that the rate of interest exhibited negative but not considerable trend to agricultural GDP. There is however an expectation of slight variation in findings because data used in referenced research works make use of yearly time series data whereas quarterly data is used for this study. If lending rates in the short run for instance are consistently high, there will be a fall in agricultural investments because oftentimes, initial investments require significant upfront costs with uncertain returns, leading to negative interest. However, an optimum lending rate in the long run alongside improved technology, productivity gains, and stable markets tends to generate positive returns, making agriculture an attractive investment. The results further show no causality between interest rate and AGDP or

between AGDP and interest rate Lawal. Olayanju, Ayeni & Olaniru (2019). Overall interest rate negatively impacts AGDP though it is not significant.

Summary of Major Findings

The aim of the research was to ascertain whether or not interest impacts the productivity of agriculture as measured by agricultural GDP in Nigeria and also if there exists a causal relationship among these variables. The result of the ARDL coefficient of the ECT is negative but not significant for interest rate. The implication of the results obtained is that INT impacts negatively in the short run but at lag 1 it shows a positive coefficient of INT impact on agricultural productivity. This agrees with the inverse relationship this study seeks to explain. The coefficient of the rate of interest is negative in the short run and impacts agricultural output negatively. The results on Granger causality implies no causality among the independent variables to the dependent variable. Interest rate does not granger cause agricultural GDP; and AGDP. EXG, DMBL, and ACGSF do not granger cause agricultural GDP either.

Recommendations

From the research findings, interest rate impacts agricultural productivity negatively though not significantly and the fluctuation observed is reactionary. The co-movement shows an interconnectivity of the real sector to the oil and gas sector, as subsidy removals trigger the spiral movement in price levels due to adjoining costs. This shows how government policies impact the macroeconomic environment triggering a reaction from the monetary authorities to maintain stability. The monetary authorities, therefore, have a responsibility for domestic policy alignment to ensure that monetary policies are aligned with the government's fiscal policies and economic targets (inflation and unemployment for instance), lessen the disadvantages of the agricultural sector and real sector at large. The results of the research depict a negative impact of interest rates on agriculture in the short run, this allows for adjustments to be made in the most prudent rate to bring about positive results in terms of ROI and increased investment in the sector. DMBL and LACGSF positively impact agricultural productivity, hence the government alongside monetary authorities should enable easy access to financing options especially for rural farmers. Implementing policies that promote financial inclusion and reduce the cost of borrowing this may involve setting up special loan programs or providing subsidies for loans. like the ACGSF and educate these farmers on how to access these loan provisions and the implications thereon. Also, provide training and extension

services to farmers on new agricultural techniques and policies of the government that are beneficial to them.

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