EXPLORING THE IMPACT OF FINANCIAL DEVELOPMENT ON AGRICULTURAL OUTPUT IN NIGERIA: THE MODERATING ROLE OF INSTITUTIONAL QUALITY

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ABSTRACT.
This study investigates the nexus between financial development, agricultural output, and institutional quality in Nigeria using annual time series data from 1990 to 2022. The Autoregressive Distributed Lag (ARDL) model and Toda-Yamamoto's (1995) non-causality approach are employed to assess the moderating influence of institutional quality on the relationship between financial development and agricultural output. The long-run findings reveal that financial development, institutional quality, and lending interest rates exert a positive and significant impact on agricultural output, while human development has a negative and significant impact. Conversely, the short-run results indicate that financial development and human development positively and significantly influence agricultural output, whereas lending interest rates negatively and significantly impact agricultural output. Based on these findings, the study recommends that policymakers enact measures to promote financial development, enhance institutional quality, and reduce interest rates to stimulate agricultural growth. Additionally, strengthening institutional quality is crucial to ensure that the benefits of financial development reach smallholder farmers, who play a pivotal role in Nigeria's agricultural sector. This study contributes to the literature by examining the moderating role of institutional quality in the relationship between financial development and agricultural output in Nigeria.
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1. INTRODUCTION

In recent years, there has been a significant focus on the relationship between financial development and agricultural output, especially in developing countries like Nigeria. Agriculture is a crucial part of the Nigerian economy, accounting for about 22% of GDP and employing over 70% of the population (World Bank, 2019). Financial development, which includes access to credit, insurance, and other financial services, has been acknowledged for its significant impact on agricultural productivity and output. Access to credit allows farmers to invest in modern technologies, obtain high-quality inputs, and expand their operations, ultimately leading to increased agricultural output. Furthermore, access to insurance helps to mitigate risks related to weather, pests, and market fluctuations, giving farmers the confidence to invest in their farms and increase productivity (Adjognon et al., 2017; Awoke, Awoke, &Obaji, 2019; Raifu, & Aminu, 2020; Nadabo, & Salisu, 2021; Obi-Egbedi, &Owosho, 2023).

In Nigeria, the connection between financial development and agricultural output is especially important because of the large number of smallholder farmers who do not have access to formal financial services. By improving access to credit and insurance for these farmers, there is great potential to significantly increase agricultural productivity and contribute to overall economic growth (Bjornlund et al. 2020; Gyong, et al. 2022; Parlasca, Johnen, & Qaim, 2022; Tang, & Sun, 2022; Chandio et. al. 2022; Xu, & Wang, 2023). Additionally, financial development helps smallholder farmers become part of value chains, allowing them to access markets and receive fair prices for their products. This, in turn, encourages farmers to improve their productivity and contribute to the overall growth of the agricultural sector (FAO, 2002; Adeleye et al. 2020; Chandio et al., 2020; Abdul, et al.2022; Zhang, et al. 2023).

Nigeria's contribution to GDP from agriculture has varied significantly from 1980 to 2022, but overall, it has decreased. In 1980, agriculture made up 32.4% of GDP, but by 2022, it had dropped to 25.5%. This decline can be attributed to several factors, including the expansion of the oil industry, which has become the dominant sector of the Nigerian economy. Additionally, the agricultural sector has faced challenges such as inadequate infrastructure, limited access to credit, and low productivity (FAO, 2023; ADB, 2023).

The agricultural output is the total value of the economy's crop production, livestock, forestry, and fishery. According to the Food and Agriculture Organization of the United Nations (FAO), as cited in Raheem et al. (2014), Nigeria's low fertilizer and improved seed utilization, access to financial services as well as inadequate government expenditure, are largely responsible for low productivity and the inability to compete with others. Often, farmers rely on less efficient traditional tools, resulting in lower output compared to the use of tractors and harvesters. Agriculture in Nigeria comprises four main sub-sectors: crops, livestock, forestry, and fishing. Crops represent the largest sub-sector, accounting for over 73% of total output. Major crops include maize, cassava, sorghum, yam, millet, and rice, cultivated for both domestic consumption and export. Livestock contributes around 16% to Nigeria's agricultural output, encompassing cattle, sheep, goats, poultry, and other animals for meat, milk, and egg production. Nigeria is a major producer of livestock products for both local and international markets. Forestry accounts for about 3% of Nigeria's agricultural output and plays a crucial role in environmental conservation and livelihood support. The country's rich forest cover provides resources for timber, fuelwood, and non-timber forest products. Fishing contributes approximately 7% of Nigeria's agricultural output. Nigeria's vast coastline and inland waterways provide abundant resources for fishing activities, making it a major producer of fish for both domestic consumption and export.

The Nigerian government has implemented several policies to support financial development in agriculture. One notable initiative is the Agricultural Credit Guarantee Scheme Fund (ACGSF), which was established in 1977. In 2011, the CBN launched the National Financial Inclusion Strategy (NFIS) to promote financial access and inclusion for all Nigerians, including farmers. The CBN also introduced the Micro, Small, and Medium Enterprises Development Fund (MSMEDF) in 2013, offering low-interest loans to small and medium-sized enterprises, including agribusinesses. In 2015, the Central Bank of Nigeria (CBN) launched the Anchor Borrowers' Programme (ABP) to provide credit to smallholder farmers and boost agricultural productivity. Another government initiative is the Growth Enhancement Support (GES) scheme, which was introduced in 2012. Additionally, the Nigerian Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL) has partnered with various financial institutions to provide credit and insurance products tailored to the needs of smallholder farmers. Despite the government's efforts, the impact of financial development on agricultural

output in Nigeria has been unsatisfactory, partly due to the lack or absence of institutional quality.

By and large, financial development alone may not lead to the desired agricultural output. However, incorporating institutional quality can significantly enhance the impact of financial development on agricultural output. The role of institutions in promoting financial development and agricultural output has been acknowledged in the literature (North, 1990; Hessels et al., 2011; Iman, 2017; Ovidiu, 2020; Ogbaro, 2019; Zergawu et al., 2020; Saha&Sen 2020; Andohol, Doki, &Ojiya, 2020; Sahni, Nsiah &Fayissa, 2021).

Improving institutional systems within countries can help reduce the negative impact of climate variability and ease the financial burden on farmers. Several studies have found that a certain level of institutional quality is necessary. Francis and Youngberg (1990) emphasized the need for a strong formal and informal institutional framework to enhance agricultural productivity and sustainability. They argued that agricultural systems should maintain productivity, promote economic viability, reduce environmental degradation, sustain rural communities, and enhance quality of life. Ikerd (1990) also believes that for sustainable agriculture, farming systems should be commercially competitive, resource-conserving, environmentally sound, and socially supportive. Achieving these goals requires the formulation and implementation of policies that take these factors into account and establish more inclusive institutions in developing countries to ensure that the benefits of productive processes improve the livelihoods of farmers who rely heavily on agriculture.

Improvement in the institutional quality in Nigeria could be a possible remedy for low agricultural output. Therefore, the study hypothesizes that improved agricultural output will enhance productivity, whereas productivity improvement will improve financial development and, by extension, business continuity, poverty reduction, and employment creation.To the best of our knowledge, no known study investigates the moderating role of institutional quality on financial development and agricultural output nexus in Nigeria, hence the motivation for this study. The main objective of the research is to examine the relationship between financial development and agricultural output in Nigeria: the moderating role of institutional quality the specific objectives are as follows:

i. To explore the impact of financial development on agricultural output in Nigeria.
ii. To examine the causal relationship between financial development, institutional quality, and agricultural output in Nigeria.

Following this introductory section, the rest of the study is structured as follows. Section 2briefly reviews the extant literature. Section 3 focuses on the theoretical framework,methodological approach, model specification as well as data sources and description. Section4 presents thefindings while Section 5 concludes with policy recommendations.

2. LITERATURE REVIEW

Conceptual Issues

Concept of Agricultural Output

Agricultural output is the total quantity of goods produced by the agricultural sector, including crops, livestock, and forestry products. It is a key measure of the performance of the agricultural sector and is closely linked to food security and economic development. The Food and Agriculture Organization of the United Nations (FAO) defines agricultural output as "the total

quantity of agricultural products produced in a given period.The World Bank (2008) defines agricultural output as "the value of all goods and services produced by the agricultural sector."

Concept of Financial Development

Shaw (1973) defined financial development as the expansion and diversification of financial institutions and markets. McKinnon (1973) defined financial development as the process by which financial markets and institutions become more efficient and effective in allocating savings and investment. Levine (1997) defined financial development as the growing stock of financial assets and the increasing role of financial intermediaries in the economy. Svirydzenka (2016) defined financial development as the process of improving the quality and quantity of financial services available to economic agents. These definitions highlight the importance of financial institutions and markets, the allocation of savings and investment, and the efficiency and effectiveness of financial systems. However, they differ in their emphasis. Shaw (1973) and McKinnon (1973) focus on the expansion and diversification of financial institutions and markets, while Levine (1997) and Svirydzenka (2016) emphasize the role of financial intermediaries in allocating savings and investment.

Concept of Institutions

The World Bank's 1989 study on Africa defined governance as the exercise of political power to manage a nation's affairs. In 1992, the World Bank further described governance as "how power is used to manage a country's economic and social resources for development." North (1990) defined institutions as the rules of the game or, more formally, as the humanly devised formal and informal constraints that shape human interactions. He stated that formal institutions are primarily constitutions, statutes, and clear government rules and regulations, codified and imposed by impersonal mechanisms, most importantly, the state with its coercive power and organization. Kaufmann et al. (2010) identified governance measures that capture six dimensions or indices of institutional quality corresponding to each of these measures. They include voice andaccountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, the rule of law, and control of corruption.

Theoretical Review

Endogenous Growth Theory

Endogenous growth theory is a theory of economic growth that emphasizes the role of internal factors in driving economic growth. These factors include investment in human capital, innovation, and knowledge. The theory also recognizes the positive externalities and spillover effects generated by a knowledge-based economy, fostering economic development. Moreover, it underscores the significance of policy measures in influencing long-run growth rates. For instance, government spending on education, infrastructure, and research and development can stimulate innovation and productivity, thereby enhancing economic growth (Romer, 1990; Lucas 1988; Gupta et al., 2005).

Financial liberalization Theory

In the 1970s, developing countries were dealing with financial repression. Shaw (1973) and McKinnon (1973) advocated for financial liberalization to promote economic growth in these countries. They believed that direct government control of financial markets, such as interest rate ceilings, credit controls, and high reserve requirements, was hindering financial development and economic growth.The advent of endogenous growth models in the 1980s and 1990s led to the formalization of models in which financial intermediaries have a positive impact on economic growth (Greenwood & Jovanovic, 1990; Pagano, 1993; King and Levine, 1993a, b;Levine, 1997).

New Institutional Economics

The emergence of the New Institutional Economics (NIE) approach shared common intellectual ground on institutional economics, emphasizing that institutions matter and suggesting that institutions determine the economic performance differentials across countries (North, 1990).

Empirical Literature

Several empirical studies have explored the connection between financial development and agricultural output. Oyinbo et al. (2014) investigated the relationship between exchange rate deregulation and the agricultural share of gross domestic product (GDP) in Nigeria from 1986 to 2011. They discovered a unidirectional causality from exchange rate to agricultural share of real GDP, indicating that changes in exchange rate influence the agricultural sector's contribution to overall GDP. Additionally, they found that exchange rate deregulation negatively impacts the agricultural share of real GDP, suggesting that fluctuations in exchange rates can hinder the growth of the agricultural sector.

In another study, Udoka et al. (2016) examined the impact of commercial bank lending on agricultural output in Nigeria from 1970 to 2014. They found a positive and statistically significant relationship between commercial bank credit allocated to the agricultural sector and agricultural production in Nigeria. This suggests that increased access to financing through commercial banks can promote agricultural growth. Oluwatoyose et al. (2016) analyzed the macroeconomic factors influencing Nigeria's agricultural sector between 1981 and 2013. They identified commercial bank loans to agriculture, interest rates, and food imports as significant factors affecting agricultural output. In contrast, they found that exchange rates, inflation rates, and unemployment rates did not have a significant impact on agricultural output.

Nkoro and Uko (2016) employed the Autoregressive Distributed Lag (ARDL) model to examine the relationship between agricultural output and financial development in Nigeria from 1990 to 2015. Their findings indicate that financial development has a positive and statistically significant impact on agricultural output in the long run. This implies that enhancing financial development can contribute to sustainable agricultural growth. Onakoya et al. (2018) analyzed the long-run and short-run value addition in agriculture between 1970 and 2016 using the Vector Error Correction Model (VECM) technique. They found that inflation rate, exchange rate, and agricultural employment rate were positively and significantly related to forecasting the value added in agricultural output.

Ouedraogo and Sanou (2018) analyzed the relationship between agricultural output and financial development in Burkina Faso using the Autoregressive Distributed Lag (ARDL) model from 2000 to 2017. The results suggest that financial development positively and significantly impacts agricultural output in the long run. Policymakers should focus on improving financial development to enhance agricultural output.Adisu (2019) conducted a study on the impact of macroeconomic variables on agricultural sector output in Ethiopia from 1991 to 2017. The study utilized the Autoregressive Distributed Lag (ARDL) bounds test approach and error correction model (ECM) and 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 and external debt stock had a negative effect on agricultural sector output, while the official exchange rate and lending rate had a positive and significant effect. The inflation rate and foreign direct investment had insignificant effects.

Another study by Raifu and Aminu (2019) found that financial development, measured by private credit to agriculture, has a significant positive effect on agricultural output growth in Nigeria. Similarly, Tadesse, and Tadesse, (2019) investigated the impact of financial development on agricultural output in Ethiopia using the Vector Error Correction Model (VECM) from 2000-2018. The results indicate financial development has a positive and significant impact on agricultural output in the long run. Policymakers should focus on improving financial development to enhance agricultural output.

Rahman and Khan (2020) investigated the impact of financial development on agricultural output in Bangladesh using the Vector Error Correction Model (VECM) from 1990 to 2018. Their findings reveal that financial development positively and significantly impacts agricultural output in the long run. Chandio et al. (2020) examined the relationship between financial development and agricultural production in China using country-level time-series data from 1989 to 2016. Their study employed the autoregressive distributed lag (ARDL) approach to analyze the long-term cointegration relationship between the variables and the fully modified ordinary least squares (FMOLS) for a robustness check. The results indicated a significantly positive impact of financial development on agricultural production in both the long-run and short-run.

Xu and Wang (2023) examined the impact of digital inclusive finance on the level of agricultural output in China. Using panel data from Beijing University's Digital Inclusive Finance Index and 31 provinces and cities in China from 2011 to 2020, the authors employed a double-fixed-effect and panel threshold model to study the relationship between digital inclusive finance and agricultural output. The study found that digital inclusive finance significantly improves the level of agricultural output, with a double threshold effect. Heterogeneity analysis revealed that the coverage and depth of digital inclusive finance play a significant role in improving agricultural output, with depth of use having a greater impact. The impact of digital inclusive finance was found to be significant in the Midwest regions and major agricultural provinces, but not in the eastern regions and non-agricultural provinces.

Ngong, et al. (2023) investigated the impact of bank credit on agricultural productivity in the Central African Economic and Monetary Community (CEMAC) from 1990 to 2019. Using the autoregressive distributed lag technique, the study found that domestic credit to the private sector by banks, land, and physical capital have a positive impact on agricultural productivity, while broad money supply, inflation, and labor have a negative impact.

Farooq et al. (2023) investigated the long-run relationship between financial inclusion and agricultural growth in Pakistan for the period of 1960–2018. Their study utilized the autoregressive distributed lag (ARDL) approach, the Johansen co-integration test, and the dynamic ordinary least squared (DOLS) method for the evaluation. Their findings indicated that domestic credit has a significantly negative impact on agricultural growth in both the short and long run, while broad money and cropped area positively affect agricultural growth in Pakistan.

The gap in the literature is the need for further research on the impact of financial development, including factors such as digital inclusive finance, domestic credit, and broad money supply, on agricultural output in various countries and regions. Additionally, there is a need for more studies that investigate the relationship between macroeconomic variables, climate change, and agricultural productivity, as well as the moderating role of institutional quality, and human capital in this relationship. Furthermore, there is a need for more research on the impact of bank credit and land on agricultural productivity, as well as the long-run relationship between financial inclusion and agricultural growth.

3. METHODOLOGY

3.1 Theoretical Framework

The foundation of this work is based on theendogenous growth model originated by Romer (1990) and Lucas (1988), which is the extension of the neoclassical growth model developed by Ramsey (1928). It will be expanded to incorporate financial development, Institutions, and Agricultural output. The neoclassical model was popularized by Solow (1956). This model assumes technological change as exogenous and returns to scale considered to be constant. The model postulates that capital and labour can be substituted, and their marginal products are assumed to be diminishing. The essential neoclassical production function can be written as:

$Y = f(K, L)$ (1)

Here, Y denotes the output level, K capital formation, and L labor force. Romer (1990) and Lucas (1988). Extended the neoclassical model specified in equation (1) by incorporating human capital, (H) innovation, (I), and knowledge as the determinants of economic growth to formulate the new endogenous growth model as follows:

$Y = f(K, L, H, I,)$ (2)

Equation 2 represents the new endogenous growth model that expresses economic growth as a linear function of human capital, innovation, and knowledge.

3.2 Model Specification

This study adopted the model ofRaifu, & Aminu (2020). The model assumed that agriculture sector performance is determined by a set of financial development variables and thus, agricultural output can be express as follows:

$AVA = f(FDI, INSQ, LIR, HDI)$ (3)

Taking the natural logarithms of AVA, we arrive at the mathematical model of the study as shown in equation 4

$\ln AVA_t = \beta_0 + \beta_1 FDI_t + \beta 2\ INQ_t + \beta 3 LIR_t + \beta 4 HDI_t$ (4)

Where: AVA represents the natural log of agriculture value added (AVA) FDI depicts financial development, INQ is the institutional quality, LIR lending interest rate, and HDI describes human development index.

Furthermore, the model in equation (4) assumes that AVA (lnAVA) is linearly determined by (FDI) financial development index, (INQ) the institutional quality proxy by quality of bureaucracy, (LIR) lending interest rate and (HDI) the human development index. βo is a constantparameter, while β1, β2, β3, and β4, are parameters estimates measuring the effects of explanatory variables on the dependent variable.

Equation 5 is the stochastic model employed to achieve the study's objectives after further transformation.

$LAVA_t = \alpha_0 + \beta_1 FDI_t + \beta 2\ INQ_t + \beta 3 LIR_t + \beta 4 HDI_t + \mu t$ (5)

The ARDL Approach to Cointegration

This study adopts the bounds-testing approach to cointegration based on the Autoregressive Distributed Lag (ARDL) model framework, as proposed by Pesaran, Shin, and Smith (2001).

The uniqueness of the ARDL approach compared to other cointegration approaches is that the ARDL does not impose restrictions on the integration order of the variables, whether they are all I(1). Consequently, the ARDL can be applied regardless of whether the variables are all I(0), I(1), or mutually cointegrated (Pesaran et al., 2001). The ARDL approach involves the estimation of a restricted error correction (EC) version of the ARDL model.

The ARDL model is therefore specified as:

$$\Delta(lnAVA)_t = a_0 + a_1\,(\ln AVA)_{t-1} + a_2\,(\mathrm{FDI})_{t-1} + a_3(\mathrm{INQ})_{t-1} + a_4\,(\mathrm{LIR})_{t-1} + a_5\,(\mathrm{HDI})_{t-1} + \sum_{i=1}^{h} \beta_1\,\Delta(lnAVA)_{t-i} + \sum_{i=0}^{o} \beta_2\,\Delta\ln(FDI)_{t-i} + \sum_{i=0}^{j} \beta_3\,\Delta(LIR)_{t-i} + \sum_{i=1}^{q} \beta_4\,\Delta\ln(HDI)_{t-i} + \mu_t \quad (6)$$

The meaning of variables remains constant, $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ *and* β_6 are short-run parameters estimated, Δ denotes differencing, ln means logarithm, and *h, o, j, q k, l* are the optimal lag length.

To get the short-run coefficients, an error correction model (ECM) is estimated. The ARDL specification of the ECM is represented in Equation (7) below.

$$\Delta(lnAVA = \sum_{i=1}^{h} \beta_1\,\Delta(lnAVA)_{t-i} + \sum_{i=0}^{o} \beta_2\,\Delta\ln(FDI)_{t-i} + \sum_{i=0}^{j} \beta_3\,\Delta(LIR)_{t-i} + \sum_{i=1}^{q} \beta_4\,\Delta\ln(HDI)_{t-i} + ECT_{t-1} + \mu_t \quad (7)$$

The error correction mechanism (ECM) first used by Sargan and later popularized by Engle and Granger (1987) corrects for disequilibrium. An important theorem, known as the Granger representation theorem, states that if two variables *Y* and *X* are cointegrated, then the relationship between the two can be expressed as ECM (Gujarati, 2003).

3.3 Toda Yamamoto Causality

If the series are integrated of the same order, then Engle and Granger (1987), However, since the variables are a combination of I(1) and I(0), the study used Toda Yamamoto's (1995) causality test to examine the impact of financial sector development on agricultural output.

To test for Toda-Yamamoto causality the following bivariate VAR (*k*) model is specified:

$$\Delta lnAVA_t = \omega_X + \sum_{i=1}^{k+m} \in_y \Delta lnAVA_{t-1} + \sum_{i=1}^{k+m} \tau_y\,\Delta lnFDI_{t-1} + \mu_{ty} \quad (8)$$

$$\Delta FDI_t = \omega_y + \sum_{i=1}^{k+m} \in_y \Delta FDI_{t-1} + \sum_{i=1}^{k+m} \tau_y\,\Delta lnAVA_{t-1} + \mu_{ty} \quad (9)$$

$$\Delta INQ_t = \omega_y + \sum_{i=1}^{k+m} \in_y \Delta INQ_{t-1} + \sum_{i=1}^{k+m} \tau_y\,\Delta lnAVA_{t-1} + \mu_{ty} \quad (10)$$

$$\Delta LIR_t = \omega_y + \sum_{i=1}^{k+m} \in_y \Delta LIR_{t-1} + \sum_{i=1}^{k+m} \tau_y\,\Delta lnAVA_{t-1} + \mu_{ty} \quad (11)$$

$$\Delta HDI_t = \omega_y + \sum_{i=1}^{k+m} \in_y \Delta HDI_{t-1} + \sum_{i=1}^{k+m} \tau_y\,\Delta lnAVA_{t-1} + \mu_{ty} \quad (12)$$

In equation and, Δ is the first-deference operator, k is the maximum order of integration, m is the optimal lag length, $\omega_x and \omega_y$ are the intercepts (constants), $\in_x$ and $\in_y$ are the coefficients.

3.4 Data Source and Variables Measurement

The data for the study are annual time series data covering the period 1990-2022 and were sourced from the World Bank (World Development Indicators, 2023), International Monetary Fund (IMF, 2023), International Country Risk Guide (ICRG, 2023), and United Nations Development Program (UNDP, 2023). Agricultural output is measured by agricultural Value added % of GDP (AVA), Financial development proxied by financial development index (FDI), Institutional quality measured by quality of bureaucracy (INQ), Lending interest rate (LIR) and Human development index (HDI).

3.5Estimation Techniques

In order to achieve the study objectives, we utilized a five-step strategy: descriptive statistics, correlation matrix, unit root tests, the bounds test for cointegration and Toda-Yamamoto Causality test. Additionally, we analyzed the long-run and short-run dynamic effects of financial development andinstitutional quality variables on agricultural output.

4. RESULTS AND DISCUSSION OF FINDINGS

4.1 Descriptive Statistics

The study summarized the variables; Agricultural Value Added % of GDP (AVA), Financial development index (FDI) institutional quality measured by quality of bureaucracy (INQ), Lending interest rate(LIR), and Human Development Index (HDI). The detailed interpretation of this table is explained under Table 1 as follows.

Table1 Descriptive statistics.

Variables	Mean	Std. Dev.	Min	Max	Kurtosis	Skewness	J.B	P-Value	Obs.
AVA	6.998	0.790	6.991	0.887	1.463	-0.188	3.234	0.189	32
FDI	21.763	1.008	21.765	22.967	1.946	-0.214	1.665	0.436	32
INQ	24.270	0.637	24..270	25.541	1.786	-0.068	1.925	0.388	32
LIR	17.273	0.254	17.278	17.948	1.838	-0.245	2.095	0.352	32
HDI	4.483	1.098	4.486	5.887	2.245	-0.738	3.555	0.168	32

Source: Authors' analysis (2023)

The Agricultural value added % of GDP (AVA) has a mean value of 6.998 and a standard deviation of 0.790, with a minimum value of 6.991 and a maximum value of 0.887. The kurtosis is 1.463, indicating a platykurtic distribution and the skewness is -0.188, indicating a slight left skew. The J-B test for normality has a p-value of 0.189, suggesting the distribution is not significantly different from a normal distribution. The Financial development index (FDI) has a mean value of 21.763 and a standard deviation of 1.008, with a minimum value of 21.765 and a maximum value of 22.967. The kurtosis is 1.946, indicating a platykurtic distribution and the skewness is -0.214, indicating a slight left skew. The J-B test for normality has a p-value of 0.436, suggesting the distribution is not significantly different from a normal distribution. The Quality of bureaucracy (INQ) has a mean value of 24.270 and a standard deviation of 0.637, with a minimum value of 24.270 and a maximum value of 25.541. The kurtosis is 1.786, indicating a platykurtic distribution and the skewness is -0.068, indicating a very slight left skew. The J-B test for normality has a p-value of 0.388, suggesting the distribution is not significantly different from a normal distribution.

Lending interest rates (LIR) have a mean value of 17.273 and a standard deviation of 0.254, with a minimum value of 17.278 and a maximum value of 17.948. The kurtosis is 1.838, indicating a platykurtic distribution and the skewness is -0.245, indicating a slight left skew. The J-B test for

normality has a p-value of 0.352, suggesting the distribution is not significantly different from a normal distribution.The Human development Index (HDI) has a mean value of 4.483 and a standard deviation of 1.098, with a minimum value of 4.486 and a maximum value of 5.887. The kurtosis is 2.245, indicating a platykurtic distribution and the skewness is -0.738, indicating a moderately left skew. The J-B test for normality has a p-value of 0.168, suggesting the distribution is not significantly different from a normal distribution.

4.2 Correlation Matrix

The correlation matrix is a measure that shows the direction and strength of the relationship among the variables. The positive or negative sign indicates the direction of the relationship before the value of the coefficient. If the coefficient is positive, it means that as one variable increases, the other also increases. On the other hand, if the coefficient is negative, as one variable increases, the other decreases. The value of the coefficient varies from 0.0 to 1.0. The closer is to 1.0, the stronger the relationship among the variables. Table 2 provides the correlation matrix between the variables under study.

Table 2 Correlation Matrixfor the variables used in the study (Obs=32)

Variables	AVA	FDI	INQ	LIR	HDI
AVA	1				
FDI	0.014	1			
INQ	-0.586	0.140	1		
LIR	-0.109	-0.199	0.066	1	
HDI	-0.244	0.287	0.310	-0.121	1

Note: ***, **, and *: Correlation is significant at the 0.01, 0.05, and 0.1 levels respectively.

Source: Authors' analysis

4.3. Testing the Unit Root

Table 3 below reports the test statistic values for Augmented Dicky Fuller, as well as Philips & Peron tests of stationarity. The table reports the test statistic values of both tests at the level and the first difference for five variables; in the present study. The detailed interpretation is given in Table 3 as follows.

Table 3Unit root test (Based on ADF and PP).

Variables	Augmented Dickey Fuller (ADF)			
	Level		First Difference	
	Without trend	With trend	Without trend	With trend
AVA	-0.597	-1.492	-4.218***	-4.135**
FDI	-1.466	-1.992	-2.344	-2.257**
INQ	0.238	-3.452*	-3.987***	-4.026**
LIR	-1.977	-1.811	-3.702***	-4.212**
HDI	-1.872	-2.244	-5.063***	-5.157***

Variables	**Philip Perron (PP)**			
	Level		**First Difference**	
	Without trend	With trend	Without trend	With trend
AVA	-0.645	-1.870	-4.196***	-4.067***
FDI	-1.808	-1.930	-6.709***	-6.709***
INQ	-0.058	-3.102	-3.896***	-3.896**
LIR	-1.899	-1.374	-2.732*	-2.710
HDI	-1.965	-2.268	-5.067***	-5.258***

Source: Authors' analysis (2023)

Note: * significant at 10%, ** significant at 5%, *** significant at 1%.

The Augmented Dickey-Fuller (ADF) and Philip-Perron (PP) unit root tests were used to ensure that none of the variables in the model are integrated of order two. The results in Table 3 show that none of the variables in this study are integrated to an order of two. This indicates that the cointegration relationship between variables can be investigated using the ARDL-bounds testing approach.

4.4. Results of ARDL Bound Tests

Table 4 displays the co-integration testing results for the long-run relationship between the variables under study using the bound testing procedure of the ARDL process. The table includes the test statistic values for F and t, as well as their critical values based on significance levels of 1%, 2.5%, 5%, and 10%. The null hypothesis for this test is that there is no co-integration between the variables being studied. If the test statistic value of F >is greater than the upper bound I(1) values, the null hypothesis is rejected. Similarly, if the t-value of the test statistic is less than the upper bound I(1), the null hypothesis is rejected.

Table 4Bound test for cointegration

F-value = 4.098 T-value = 3.972	**Critical Values Based on F-test**		**Critical Values-Based on T-test**	
K = 4				
Significance Level (%)	**I(0)**	**I(1)**	**I(0)**	**I(1)**
10%	1.90	3.02	-2.57	-3.86
5%	2.62	3.43	-2.86	-4.19
2.5%	2.69	3.90	-3.13	-4.46
1%	3.08	4.44	-3.43	-4.79

Source: Authors' computation (2023)

Table 4 shows that the F-value of the test statistic is 4.098, which exceeds the critical F-test value from the upper bound I(1). Additionally, the t-value from the test statistic is 3.972, which is greater than the t-test critical value. As a result, the null hypothesis is rejected, and it can be inferred that there is a long-run relationship between the variables in the study.

Table 5 Long-run, Short-run Estimation Resultsand Diagnostics Tests (DependentvariableAgricultural Output)

Variables	Coefficient	Std. Error	T-Statistics	P-Value
Panal A: Long-run Estimate				
FDI	0.484	0.132	3.337	0.004***
INQ	-1.078	0.298	-3.598	0.007***
LIR	0.193	0.087	2.304	0.037**
HDI	0.659	0.303	2.146	0.049**
Panel B: Short-run Estimate				
D(FDI)	0.018	0.027	0.662	0.522
D(FDI(-1))	-0.082	0.035	-2.345	0.029**
D(INQ)	-0.778	0.279	-2.558	0.587
D(HDI)	0.785	0.083	9.473	0.000***
D(LIR)	-0.101	0.0349	-2.880	0.006**
CointEq(-1)*	-0349	0.077	-4.945	0.000***
Panel C: Diagnostics Test				
	LM-test	**BGP Test**	**Wald Test**	**CUSSUMS**
	0.022 (0.978)	0.819 (0.558)	18.230 (0.000)	Stable

Source: Authors' compilation (2023)

Note that *, ** and *** donates statistically significant at 10%, 5% and 1% respectively.

The long-run and short-run estimations of the determinants of agricultural output were analyzed in Table 5. The long-run estimate revealed that financial development, institutional quality, lending interest rate, and human development all significantly impact agricultural output. The positive impact of financial development on agricultural output is consistent with previous studies (Agosin& Mayer, 2005;Anumudu, et. al. 2018), while the negative impact of institutional quality on agricultural output is also supported by previous research (Ades & Chua, 1998; Hall & Jones, 1999, Nadabo, 2023). Additionally, the positive impact of LIR on agricultural output is consistent with previous studies (Feder, Just, & Zilberman, 1989; Deaton & Nugent, 2000), and the negative impact of HDI on agricultural output is also supported by previous research (Ravallion&Datt, 2002; Fan, Zhang, & Zhang, 2000).

In the short-run estimate, the lagged effect of FDI and the positive impact of HDI on agricultural output were consistent with previous studies (Ravallion&Datt, 2002; Fan, Zhang, & Zhang, 2000). However, the negative impact of LIR on agricultural output in the short run was also consistent with previous research (Feder, Just, & Zilberman, 1989; Deaton & Nugent, 2000). The cointegration test indicated a long-run relationship between agricultural output and the explanatory variables, and the CUSUMS test showed that the model is stable, indicating reliable results.

Figure 1. CUSUM Test

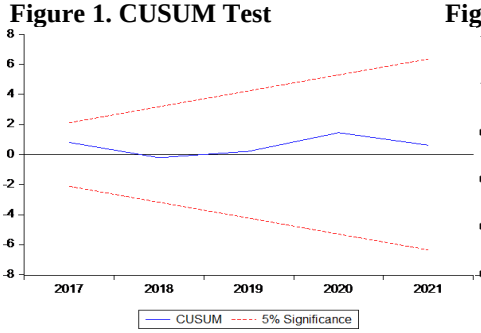
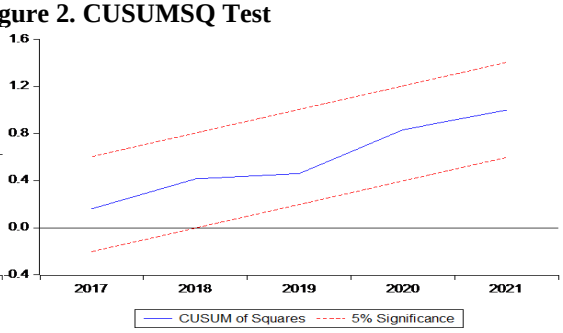


Figure 2. CUSUMSQ Test



4.5 Results of T -Yamamoto (1995) Causality Test

Table 6 shows the directions of causal relationship among the variables using Toda -Yamamoto (1995) approach to causality.

Table6 Results of Toda Yamamoto Causality

Null hypothesis	Df	MWALID	Prob	Decision	Direction of causality
lnAVA→FDI	2	21.826	0.000	Reject	Unidirectional
FDI→ lnAVA	2	8.389	0.015	Reject	Unidirectional
lnAVA →INQ	2	0.006	0.937	Do not reject	No causality
INQ→ lnAVA	2	1.980	0.996	Do not reject	No causality
lnAVA →LIR	2	3.079	0.215	Do not reject	No causality
LIR→ lnAVA	2	0.087	0.768	Do not reject	No causality
lnAVA →HDI	2	0.001	0.991	Do not reject	No causality
HDI→ lnAVA	2	15.184	0.005	Reject	Unidirectional

Notes: → denotes 'does not Granger cause'; Df indicates degree of freedom and MWALD is the modified Wald chi-square of the Toda-Yamamoto (1995) causality test.
Source: Authors' computation (2023)

The summary of the results of the Toda-Yamamoto causality test is presented in Table 6. It reveals a unidirectional causality running from agricultural output (AVA) to financial development (FDI). This result is in line with the studies of Shahbaz and Khan (2023).

5. CONCLUSION AND POLICY RECOMMENDATIONS

In conclusion, this study has found that financial development, institutional quality, and lending interest rates significantly affect agricultural output in Nigeria in the long run, while the Human Development Index (HDI) plays a crucial role in the short run. The study also establishes a unidirectional causality between agricultural output and financial development.

Based on these findings, the following specific and targeted policy recommendations are offered:

1. Policymakers should prioritize measures that promote financial development, enhance institutional quality, and lower interest rates to stimulate agricultural growth.

2. Policies aimed at improving human development should be implemented to positively impact agricultural output in the short term.

3. Efforts should be directed towards strengthening institutional quality to ensure that the benefits of financial development improve the livelihoods of farmers reliant on agriculture. This may involve targeted interventions by specific government bodies responsible for institutional quality and governance.

4. The government should consider implementing policies that encourage investment in agricultural technology and infrastructure, as well as facilitate access to new technologies, markets, and financing to stimulate agricultural growth.

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