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Complement or substitute: Private investment, public expenditure and agricultural productivity in Nigeria

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Abstract

This study examines the complementarity and substitutability effect of private investment and public expenditure on agricultural productivity in Nigeria for the period 1978 to 2018. The study employs the vector error correction modelling (VECM) technique, and the estimate shows that government expenditure on the agricultural sector had the most significant effect on agricultural productivity, followed by commercial bank credit for the agricultural sector. Also, the study found that public expenditure (proxied by government expenditure on the agricultural sector) and private investment (proxied by commercial bank credit for the agricultural sector) are complementary investments in promoting agricultural productivity, while public expenditure on the agricultural sector and foreign direct investment are substitute investments. The study recommends that budgetary allocation to the agricultural sector should be increased, and that commercial banks should be strengthened through the monetary authority by advancing more loans to agricultural businessmen and businesswomen at a reduced lending rate.

Key words: foreign direct investment; commercial bank lending; ACGSF; agricultural productivity; VECM

1. Introduction

The agricultural sector is an indispensable sector, given its potential for, among others, food production, the provision of raw materials for the manufacturing sector, and employment generation. Despite the huge potential of the agricultural sector, it is still beset with challenges, such as a large informal and subsistence sector, a lack of mechanised farming, and the continuous use of crude farm implements and a lack of storage facilities, among others. These challenges are attributable to the lack of finance for the stakeholders in the agribusiness sector, which has undoubtedly constrained the growth of the sector. According to SAHEL (2004), the gap between the supply of and demand for agricultural finance in Nigeria is estimated at a minimum of USD$4 billion per annum. Also, the Food and Agricultural Organization (FAO) estimated that an annual additional $83 billion in private investment funding would be needed to boost agricultural productivity in developing countries' in order to meet the constant and increasing demand for food by 2050 (FAO 2009; Wieck *et al*. 2014).

The recognition of this financial impediment, and the pressing need to resuscitate and stimulate the performance of the agricultural sector, have resulted in the continuous intervention of the government in this sector, including through government budgetary allocation to the sector and the establishment of agricultural programmes. These programmes include the Agricultural Credit Guarantee Scheme Fund (ACGSF), Operation Feed the Nation (OFN), and the Green Revolution Programme (GRP), among others. Such interventions are expected to encourage private investment to boost agricultural productivity. Consequently, a number of studies (Moses *et al*. 2013; Obansa & Maduekwe 2013) have examined the individual effect of the above agricultural investments (that is, government

expenditure on agriculture, the Agricultural Credit Guarantee Scheme Fund (ACGSF), commercial bank credit to agriculture, and foreign direct investment in the agricultural sector) on agricultural performance, but the findings emanating from these studies have been inconclusive.

Besides the above, there have been arguments in the literature (particularly by the classical economists) about the likely crowding-out effect of private investment by government interventions or public expenditure in the real sector of an economy. The classical scholars argue that government intervention results in additional inefficiencies by encouraging rent-seeking by various interest groups. The classicals also stress that government involvement may lead to unhealthy competition with the private sector for resources and investment opportunities (Bhagwati 1982; Udoh 2011). In contrast, Keynesians emphasise that government intervention complements or crowds in private investments by providing the facilities needed to enhance production. While acknowledging that agricultural finance involves both private and public investment, the issue of whether government expenditure complements or acts as substitutes for (that is, crowds out) private investment in relation to agricultural sector performance has not been examined in the literature by previous indigenous studies (Yusuff *et al*. 2015; Ogbanga 2018; Ogboru *et al*. 2018). The issue of the complementary or substitute influence of investment on macroeconomic variables has been researched extensively regarding issues relating to capital inflows (foreign direct investment (FDI), foreign aid and remittances) and economic growth (see Carro & Larrú 2010; Mallaye & Yogo 2011; Janský 2012), while there also are studies on the issue of the effect of domestic and foreign investment on economic growth (see Hermes & Lensink 2003; Choong & Lim 2009; Saibu *et al*. 2011). These studies have shown that certain investment options are complementary in promoting growth, while some are substitute investment, which when combined could retard growth. Within the scope of the agricultural sector, there is limited information (see Tewodaj *et al*. 2012; Wieck *et al*. 2014) on the complementary or substitutability effect of public and private investment on agricultural productivity in Nigeria. Consequently, the research questions listed below were raised for investigation:

a. What has been the impact of both private investment and public investment on agricultural productivity?
b. Are these investments complements or substitutes in influencing agricultural productivity in Nigeria?

Examining the above issues is imperative given the importance of the agricultural sector for the Nigerian economy, as evidenced in the various international and domestic developmental programmes such as the United Nations Millennium Development Goals (MDGs), the Sustenance Development Goals (SDGs), the seven-point agenda of the administration of President Jonathan between 2011 and 2015, and the recent Anchors' borrowers programmes of the current administration. Thus, resuscitating the agricultural sector, making it a veritable sector given its abundant potential for economic development, and reducing the perennial unemployment problem have been the core of the policy agenda of past and current political administrations. Furthermore, capital inflow into the agricultural sector is regarded as effective (FAO 2009; Wieck *et al*. 2014), therefore the outcome of this study will show at a glance the relative contribution and effectiveness of both private and public investment in agricultural productivity in Nigeria and proffer appropriate policy options for policymakers and stakeholders in the agricultural sector.

This study is divided into five sections. Section 1 contains the introduction and section 2 discusses the review of previous literature, while section 3 covers the research methods. Section 4 discusses the data analysis and the empirical results, while section 5 covers the conclusion and policy recommendations.

2. Literature review

In the empirical literature on the effects of private investment and public expenditure on agricultural productivity, Fowowe (2020) examined the relationship between financial inclusion and agricultural productivity in Nigeria. The study utilised the Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA). The findings of the study revealed that financial inclusion contributed significantly to enhancing agricultural productivity in Nigeria. Zuberu *et al*. (2019) explored the relationship between agricultural financing and agricultural productivity in Nigeria for the period 2000 to 2015. The findings of the study reveal that agricultural financing significantly enhanced the technological advancement of mechanised farming and agricultural productivity in the country. The study suggests the need for the government to support financial institutions and agricultural intervention agencies to increase credit to agriculture stakeholders in order to boost agricultural productivity.

Uremadu *et al*. (2019) examined the effect of government expenditure and bank credit on agricultural productivity in Nigeria. The study utilised the ordinary least squares estimation technique, and the results show that government expenditure contributed negatively to reducing agricultural output, while bank credit significantly enhanced this in Nigeria. The study suggests the need to intensify the allocation of government expenditure to the agricultural sector. More so, the study suggests the need for banks to continue to grant credit and advances to the agricultural stakeholders in order to enhance agricultural productivity.

Ademola (2019) explored the effect of agricultural financing on economic growth in Nigeria. The study utilised the ordinary least squares (OLS) technique and the results of the study show that agricultural output had a negative and insignificant effect on economic growth, while commercial bank credit for the agricultural sector contributed positively to economic growth in Nigeria. The study suggested the need to maintain credible macroeconomic policies that can enhance agricultural productivity in the country. Ogboru *et al*. (2018) examined the link between government expenditure on agriculture and unemployment reduction in Nigeria for the period 1999 to 2015. The study observed an insignificant relationship between government expenditure on agriculture and the unemployment rate in Nigeria. Gong (2018) examined the relationship between public expenditure, trade and agricultural productivity in China for period 2004 to 2015. The study employed a semi-parametric production function and the findings of the study show that public expenditure and exports effectively improve agricultural productivity, while imports have no significant effect.

Ogbanga (2018) examined the link between agricultural development and employment generation in Nigeria. Employing an error-correction modelling technique, the study observed that agricultural development significantly contributed to the reduction of unemployment in Nigeria. Ferroni and Zhou (2017) observed that the private sector played important roles in India's agricultural transformation, boosting productivity and creating jobs and value in supply chains. Yusuff *et al*. (2015) examined the relationship between foreign direct investment and agricultural sector performance over the period 1977 to 2010. Employing the vector correction modelling technique, the study observed that FDI had an significant affect on agricultural sector performance. Wieck *et al*. (2014) analysed the relationship between agri-investments and food security development in 70 selected vulnerable countries. The study covered the period 2000 to 2011 and employed the panel least-squares technique. The study observed the relevance of both public and private investment (domestic and foreign) in promoting agricultural productivity, and that good governance supports food security. Specifically, the study finds that government expenditure on agriculture complements official development assistance (ODA) to agriculture, while government expenditure on agriculture crowds out net FDI inflow to agriculture.

Obansa and Maduekwe (2013) examined the link between agricultural financing and economic growth in Nigeria. The study employed both the ordinary least squares and the Granger causality techniques. The results of the tests reported a bi-directional causality between agricultural financing and economic growth. Moses *et al*. (2013) examined the effect of foreign direct investment on the performance of the agricultural sector over the period 1970 to 2010. The results of their study show that foreign direct investment had a insignificant influence on the performance of the agricultural sector. The study recommends the need to implement policies that will attract more foreign direct investment into the sector. Tewodaj *et al*. (2012) reviewed the literature on public investment in agriculture. The study observed that public investment had significant importance in agricultural research and development, irrigation, and agricultural production growth. More so, the study observed that public investment in agriculture increased private investment, but could also result in crowding out the private investment through macroeconomic effects. Adetiloye (2012) assessed the performance of the Agricultural Credit Guarantee Scheme Fund (ACGSF) in relation to food security in Nigeria over the period 1978 to 2006. The results of the study show that credit for the agricultural sector had a significant effect on agricultural output in Nigeria. However, the agricultural sector has not been growing relative to the economy. The study further observed that there is food insecurity in Nigeria, resulting in rising imports of food. The study therefore recommended the need for enlightenment campaigns to bring the youth into agriculture, and the need for professional management of the ACGSF.

Udoh (2011) analysed the effect of public expenditure and private investment on agricultural output growth in Nigeria for the period 1970 to 2008. The study employed the autoregressive distributed lag (ARDL) estimation technique and the results show that public expenditure significantly promoted agricultural output growth, while foreign investment had an insignificant influence on agricultural output. Ijaiya and Ijaiya (2004) observed that government expenditure on agriculture had a positive and significant effect on agricultural productivity in Nigeria.

The literature reviewed above shows that evidence of the effect of public spending on and private investment in agricultural productivity remains inconclusive, while none of the indigenous studies examined the issue of the complementarity or substitutability of these investments in relation to agricultural productivity.

3. Research methods

3.1 Theoretical framework/model specification

This study employed the standard neoclassical Solow's growth model as its theoretical framework, in which output "*Y*" is a function of technology "*A*" (production efficiency), labour "*L*" and capital "*K*". The model is specified as:

$$Y_t = f(A_t K_t^{\alpha} L_t^{1-\alpha}), \quad (1)$$

where A is assumed to be greater than zero and α is a constant, with $0 < \alpha < 1$. The neoclassical production function can be written in intensive form as:

$$y_t = A_t k_t^{\alpha} \quad (2)$$

Capital (k) in a broad sense can be decomposed into human capital $\left(k_H^{\beta}\right)$and physical capital $\left(k_P^{\psi}\right)$, as in Lucas (1988).

Thus,

$$k_t = \left(k_H^{\beta}, k_P^{\psi}\right) \tag{3}$$

Incorporating equation (3) into equation (2), we have:

$$y_t = A_t k_H^{\beta} k_P^{\psi} \tag{4}$$

Following studies by Burnside and Dollar (2000) and Catrinescu *et al*. (2009), physical capital is divided into public and private capital. In this study, and in line with the Food and Agricultural Organization's (FAO 2012) categories of agricultural investment, public domestic agricultural capital is composed of government budgetary expenditure on the agricultural sector (*GXPAG*) and the Agricultural Credit Guarantee Scheme Fund (*ACGSF*). These are public finances directed to the development of the agricultural sector. Private agricultural capital is composed of commercial bank credit for the agricultural sector (*CBCAG*) and foreign direct investment (*FDIAG*) in the agricultural sector. These are private-sector investments directed to the development of the agricultural sector. Thus, physical capital $\left(k_P^{\psi}\right)$ is a function of both private investment and public expenditure on agriculture, that is:

$$k_F^{\psi} = \left(GXPAG_t^{\phi}, ACGSF_t^{\theta}, CBCAG_t^{\varphi}, FDIAG_t^{\tau}\right), \tag{5}$$

where ϕ, θ, φ and τ are the capital shares of government spending on the agricultural sector, the agricultural credit guaranteed scheme fund, commercial bank credit for the agricultural sector and foreign direct investment in the agricultural sector, respectively. Substituting equation (5) into equation (4) gives:

$$y_t = A_t k_{t,H}^{\beta} GXPAG_t^{\phi} ACGSF_t^{\theta} CBCAG_t^{\varphi} FDIAG_t^{\tau} \tag{6}$$

The estimating form of equation (6) is:

$$y_t = A_t + \beta k_t + \phi GXPAG_t + \theta ACGSF_t + \varphi CBCAG_t + \tau FDIAG_t + \varepsilon_t \tag{7}$$

Equation (7) can be re-written as:

$$y_t = \delta_0 + \delta_1 LAB_t + \delta_2 GXPAG_t + \delta_3 ACGSF_t + \delta_4 CBCAG_t + \delta_5 FDIAG_t + \varepsilon_t \tag{8}$$

A_t, β, ϕ, θ, φ, τ and k_H in equation (7) are represented by δ_0, δ_1, δ_2, δ_3, δ_4, δ_5 and *LAB* (labour force) in equation (8). This study introduces rainfall (RAIN) and oil price (OIL) into the model, given the importance of rainfall to agricultural productivity and oil price in the transformation of the Nigerian economy from agriculture to an oil-dependent economy. Thus, equation (8) becomes:

$$y_t = \delta_0 + \delta_1 LAB_t + \delta_2 GXPAG_t + \delta_3 ACGSF_t + \delta_4 CBCAG_t + \delta_5 FDIAG_t + \delta_6 RAIN_t + \delta_2 OIL_t + \varepsilon_t \tag{9}$$

Agricultural productivity (y_t) is measured by the output of the agricultural sector, labour force (LAB) is measured by the total labour force, government expenditure on agriculture (GXPAG) is measured by yearly government budgetary expenditure on the agricultural sector, the agricultural credit guarantee scheme fund (ACGSF) is measured by the yearly allocation to the ACGSF by the government, commercial bank credit to the agriculture (CBCAG) is measured by the volume of commercial bank credit advanced to the agricultural sector, and FDIAG is measured by the foreign

direct investment directed to the agricultural sector. RAIN is measured as the average annual rainfall across the states in Nigeria, while OIL is measured by the international Bonny Light crude oil price.

3.2 Sources of data

Data on agriculture productivity, government expenditure on the agricultural sector, the agricultural credit guarantee scheme fund, commercial bank credit for the agricultural sector, foreign direct investment in the agriculture, annual rainfall and oil price were sourced from the various volumes of the Central Bank of Nigeria (CBN) Statistical Bulletin, while data on the labour force was sourced from World Development Indicator (WDI).

3.3 Methods of data analysis

The preliminary tests conducted included descriptive statistics – mean, standard deviation, skewness, kurtosis and the Jarque-Bera statistics. This was followed by the stationarity test and the co-integration estimate. The results of the stationarity and co-integration estimates informed the use of the vector error-correction modelling (VECM) method.

4. Data analysis

4.1 Appraisal of the agricultural sector in Nigeria

The performance of the agricultural sector in Nigeria has metamorphosed from high to low significance due to the dominance of the oil sector. Prior to the discovery of oil, the agricultural sector contributed about 63.5% to real gross domestic product, but this declined steadily to about 23.5% in 1977 after the discovery of oil. More so, the non-oil sector (led by the agricultural subsector) contributed about 100% to the total federally collected revenue in 1960, but this declined to about 24.4% in 1977, while the oil sector contributed about 75.6% in the same year. The decline in performance of the agricultural sector was accompanied by consequences of food insecurity, loss of agricultural employment opportunities, and a decline in industrial performance due to an inadequate supply of basic agricultural materials, among others. The essential need to address the fallout from the collapse of the agricultural sector necessitated different policy measures introduced by the different political administrations since the mid-1970s. These programmes include Operation Feed the Nation (OFN), introduced in 1976, the River Basin Rural Development Authorities, from 1976, the Agricultural Credit Guarantee Scheme Fund, introduced in 1978, the Green Revolution Programme, from 1980, and various World Bank Agricultural Development projects in different regions of Nigeria in the period from 1974 to 1982, such as projects at Funtua (1974), Gombe (1974), Lafia (1977) and Oyo North (1982), among others.

In addition, the agricultural sector has witnessed recent policies, such as the commercial bank credit scheme in 2009, the agricultural transformation agenda (ATA) in 2011, the anchors' borrowers programme in 2015 and the establishment of the agricultural promotion policy, also known as the Green Alternative, in 2016. In spite of the above policy initiatives, the contribution of the agricultural sector to real gross domestic product is still largely unimpressive, as the sector contributed only about 25.1% to real GDP in 2018, while the oil sector still dominated.

4.2 Descriptive statistics

The descriptive statistics of the variables of the study are presented in Table 1. The mean values of agriculture productivity (AGOT), labour force (LAB), government expenditure on the agricultural sector (GEPAG), the agricultural credit guarantee scheme fund (ACGSF), commercial bank credit to the agricultural sector (CBCAG), foreign direct investment to the agricultural sector (FDIAG),

rainfall (RAIN) and oil price (OIL) are all shown in the table. The skewness statistic shows that, with the exception of the rain variable, which was negatively skewed, the remaining variables (agriculture productivity, labour force, government expenditure on agriculture, agricultural credit guarantee scheme fund, commercial bank credit to the agricultural sector, foreign direct investment in the agricultural sector and oil price) were positively skewed. The kurtosis statistics show that commercial bank credit for the agricultural sector (CBCAG) were leptokurtic, suggesting that the distribution was peaked relative to normal distribution, while the remaining variables were platykurtic, suggesting that their distributions were flat relative to normal distribution. However, the distribution of rainfall (RAIN) and oil price (OIL) were mesokurtic, suggesting that the variables had normal distribution. Finally, the Jarque-Bera statistic rejected the null hypothesis of normal distribution for government expenditure on the agricultural sector (GXPAG), commercial bank credit for the agricultural sector (CBCAG), foreign direct investment in the agricultural sector (FDIAG) and oil price (OIL), while it accepted the null hypothesis of normal distribution for the remaining variables at the 5% level of significance.

Table 1: Descriptive statistics

	AGOT (₦'B)	LAB (B' People)	GXPAG (₦'B)	ACGSF (₦'B)	CBCAG (₦'B)	FDIAG (₦'B)	RAIN (mm)	OIL ($pb)
Mean	7034	37722098	50314	2.84	209184	340563	54795	39.36
Skewness	0.746	0.501	0.899	1.059	3.015	0.989	-0.727	1.094
Kurtosis	2.034	2.042	2.325	2.516	10.529	2.452	2.981	2.965
Jarque-Bera	5.266	3.202	6.143	7.866	155.084	7.026	3.521	7.975
Probability	0.072	0.202	0.046	0.020	0.000	0.030	0.172	0.019
Observations	40	40	40	40	40	40	40	40

Source: Author's computation, 2021

Note: **₦'B** indicates value in ₦ billion, **B' People** indicates value in millions of people (labour force), and **$pb** indicates value in dollars per barrel

4.3 Unit root and co-integration estimates

The study commenced its regression estimate by conducting the unit root test using the Phillips-Perron test, and the results are presented in Table 2. Conducting the stationarity test is important, because non-stationary series produce spurious and incorrect estimates, which might result in a high coefficient of determination and high values of t-ratios. Thus, the unit root test helps in the appropriate estimation of the variables or time series (Asteriou & Hall 2007). The unit root test shows that all the variables were integrated of order one, indicating that the variables are I(1) variables.

Table 2: Unit root test

Phillips-Perron (ADF) test			
Variables	**Level**	**After differencing**	**Status**
LAGOT	0.3737	-6.0642*	I(1)
LLAB	1.1757	-5.4672*	I(1)
LGXPAG	-1.4211	-10.3045*	I(1)
LACGSF	-1.1635	-6.2852*	I(1)
LCBCAG	-0.1803	-6.8875*	I(1)
LFDIAG	-1.7042	-8.7588*	I(1)
LRAIN	-1.9785	-12.5746*	I(1)
LOIL	-1.8776	-8.4659*	I(1)

Source: Author's computation, 2021

Note: * denotes 1% critical values

Following on the unit root test, the Johansen co-integration test examined the existence of co-integration among the variables. This is necessary to show if the variables have any long relationships among each other. Hence, from the co-integration estimate in Table 3, it was observed that the null hypothesis of no co-integration for none, or at most one and at most two, of the variables were rejected

by the trace and maxi-eigen tests because the statistics values were greater than the critical values, while the null hypothesis of no co-integration for at most three was not rejected by both tests. This indicates the existence of co-integration among the variables in equation (9). Thus, the trace and maxi-eigen statistics asserted the existence of a long-run relationship among the variables, indicating that the variables are capable of influencing each other in the long run.

Table 3: Co-integration estimate

Trace test			**Maximum value test**		
Hypothesised no. of CE(s)	Statistics	0.05 critical values	Hypothesised no. of CE(s)	Statistics	0.05 critical values
None*	265.69	159.53	None*	81.87	52.36
At most 1*	183.81	125.62	At most 1*	79.41	46.23
At most 2*	104.41	95.75	At most 2*	44.59	40.08
At most 3	59.82	69.82	At most 3	31.99	33.88

Source: Author's computation, 2021
Note: CE(s) denotes co-integration equations

4.4 Regression estimates

Following the results of the co-integration among the variables in equation (9), and the finding that the variables are integrated at order one, this study proceeded to estimate the relationship between agriculture investment (that is, public and private investment) and agriculture productivity in Nigeria using the vector error-correction modelling (VECM) technique. The VECM has the advantage of providing both the short-run and long-run relationship among the variables. Also, the VECM provides the speed of adjustment in the correction of any disequilibrium from the short-run to long-run equilibrium. Another important merit of the VECM is the ease with which it can fit into the general-to-specific approach to econometric modelling, which is in fact a search for the most parsimonious VECM model that best fits the given set of time series (Asteriou & Hall 2007).

The VECM long-run regression estimate presented in Table 4 showed that labour force (LLAB(-1)), agricultural credit guarantee scheme fund (LACGSF(-1)) and foreign direct investment (LFDIAG(-1)) had negative and significant effects on agriculture productivity in Nigeria. The result on the relationship between foreign direct investment and agriculture productivity is in contrast to that obtained by Yusuff *et al*. (2015), while the results for the agricultural credit guarantee scheme fund (LACGSF(-1)) and agriculture productivity are also in contrast with Adetiloye's (2012) findings. The negative influence of labour force on agricultural sector performance is in contrast with the a priori expectation. A plausible explanation may be the unattractive nature of the sector, which is located in the rural areas, and that young people are also avoiding agricultural activities for white collar city jobs. Thus, as the country's population increases, the less will be the population of youths and adults participating in productive agricultural activities. A plausible reason for the negative relationship between foreign direct investment and agricultural sector performance is that the former retards the output growth of the host economy by taking advantage of market imperfections through the repatriation of investment proceeds to the investors' country rather than re-investment in the host economy (Eden 2009).

In addition, the VECM estimate shows that government expenditure on the agricultural sector (LGXPAG(-1)), commercial bank credit for the agricultural sector (LCBCAG(-1)), annual rainfall (RAIN(-1)) and oil price (OIL) had positive and significant effects on agricultural productivity in Nigeria. This result is in line with the a priori expectation and in support of the findings of Ijaiya and Ijaiya (2004).

4.5 Discussion of results with respect to the study's objectives

With respect to objective one, which was to examine the effect of private investment and public expenditure on agricultural productivity, the results show that public expenditure (measured by government expenditure on the agricultural sector) and private investment (measured by commercial bank credit for the agricultural sector) had a positive and significant effect on agricultural productivity. In terms of the relative importance of these investment options, the study notes that government expenditure on the agricultural sector (LGXPAG(-1)) had the greatest effect on agricultural productivity, followed by commercial bank credit for the agricultural sector (LCBCAG(-1)). A unit increase in commercial bank credit to the agricultural sector is expected to promote agricultural productivity by 0.09 units, while a unit increase in government expenditure on the agricultural sector is expected to enhance agricultural productivity by 0.14 units. However, the VECM estimate shows that public expenditure (measured by the agricultural credit guarantee scheme fund (LACGSF(-1)) and private investment (measured by foreign direct investment (LFDIAG(-1)) negatively affected the productivity of the agricultural sector. This results shows that the agricultural credit guaranteed scheme fund and foreign direct investment have not enhanced the performance of the agricultural sector.

With respect to objective two, which was to examine the complementarity and substitutability effect of private investment and public expenditure on agricultural productivity, the results reveal that both government expenditure and commercial bank credit had the same signs and their coefficients were statistically significant. This implies that these investments are complementary in promoting the performance of the agricultural sector. However, government expenditure on the agricultural sector and foreign direct investment had alternate signs with statistically significant coefficients, indicating that these investments are substitutes in promoting the performance of the agricultural sector, which is in contrast with the findings of Wieck *et al*. (2014). Similarly, the agricultural credit guaranteed scheme fund (LACGSF(-1)) and commercial bank credit for the agricultural sector (LCBCAG(-1)) had alternate signs with statistically significant coefficients. This indicates that these investments are substitutes in promoting the agricultural sector. Furthermore, the agricultural credit guaranteed scheme fund (LACGSF(-1)) and foreign direct investment (LFDIAG(-1) had similar signs with significant coefficients, indicating that these investments were complementary in retarding the performance of the agricultural sector. Finally, the error-correction term (ECM) was insignificant but had the expected negative sign. The insignificance of the ECM term indicates no feedback movement from the short-run disequilibrium to the long-run equilibrium.

Table 4: VECM regression estimate

INDEPENDENT VARIABLES	Coefficients	Standard error	t-Stats
LLAB(-1)	-3.3881	0.0642	-52.7558*
LGXPAG(-1)	0.1354	0.0053	25.4757*
LACGSF(-1)	-0.0627	0.0056	-11.2617*
LCBCAG(-1)	0.0941	0.0068	13.8362*
LFDIAG(-1)	-0.1040	0.0055	-18.9353*
LRAIN(-1)	1.7866	0.0648	27.5577*
LOIL	-0.0951	0.0110	-8.6220*
ECM(-1)	-0.1049	0.0849	-1.3422

Source: Author's computation, 2020
Note: * denotes the 1% level of significance

The robustness of the VECM regression estimate is shown by the serial correlation LM test, which confirmed the absence of serial correlation in the residuals of the VECM estimate. This is because the probability values of the LM-statistics at various lags were insignificant, suggesting that the residuals were conditionally normally distributed and the estimate can be used for policy inferences.

Table 5: VEC residual serial correlation LM test

Lags	LM statistics	Probability
1	59.727	0.1274
2	37.741	0.8789
3	57.678	0.1851

Source: Author's computation, 2020

5. Conclusion and policy recommendations

This study examined the complementarity and substitutability effect of investment in agriculture on agricultural productivity in Nigeria for the period 1978 to 2018. The study employed the vector error-correction modelling (VECM) technique. The results of the VECM estimate show that public expenditure (proxied by government expenditure on the agricultural sector (AGEXP)) significantly promoted agricultural productivity, while public (government) expenditure (proxied by the agricultural credit guarantee scheme fund (ACGSF)) had a negative and significant influence on agricultural productivity. The results also show that private investment (proxied by commercial bank credit to the agricultural sector (CBCAG)) had a positive and significant effect on agricultural productivity, while private investment (proxied by foreign direct investment (FDIAG)) had a negative effect on agricultural productivity. In terms of relative importance of the investment options, the study notes that government expenditure on the agricultural sector had the greatest effect on agricultural productivity in Nigeria.

With respect to the complementarity and substitutability effect of private investment and public expenditure on agricultural productivity, the study observed that public expenditure (proxied by government expenditure on the agricultural sector) and private investment (proxied by commercial bank credit for the agriculture sector) are complementary investments in promoting the growth of the agricultural sector, while public expenditure (proxied by government expenditure on the agricultural sector) and private investment (proxied by foreign direct investment) are substitute investments in promoting the agricultural sector. Similarly, the study also notes that the agricultural credit guarantee scheme fund (LACGSF(-1)) and private investment (proxied by commercial bank credit for the agriculture sector (LCBCAG(-1)) are substitute investments, while the agricultural credit guarantee scheme fund (LACGSF(-1)) and foreign direct investment (LFDIAG(-1)) are complementary investments, but they hinder agricultural productivity.

Based on the above, the study recommends that there is a need for judicious management of the agricultural credit guarantee scheme fund (ACGSF) in relation to core agricultural stakeholders in order to increase its effect on the agricultural sector. More so, there is the need to redirect the flow of foreign direct investment from the rent-seeking oil sector to the agricultural sectors. This will increase the volume of investment in agriculture, which in turn will enhance agricultural productivity. Furthermore, there is a need for government to increase the budgetary allocation to the agricultural sector and to strengthen commercial banks through the monetary authority in advancing more loans at a reduced lending rate for agricultural business stakeholders.

References

Ademola AE, 2019. Impact of agricultural financing on Nigeria economy. Asian Journal of Agricultural Extension, Economics & Sociology 31(2): 1–13.

Adetiloye KA, 2012. Agricultural financing in Nigeria: An assessment of the agricultural credit guarantee scheme fund (ACGSF) for food security in Nigeria (1978–2006). Journal of Economics 3(1): 41–50.

Asteriou D & Hall SG, 2007. Applied econometrics. A modern approach using E-Views and Microfit. Revised edition. New York, NY: Palgrave Macmillan.

Bhagwati JN, 1982. Directly unproductive profit-seeking DUP activities. Journal of Political Economy 90(5): 988–1002.

Burnside C & Dollar D, 2000. Aid, policies, and growth. American Economic Review 90(4): 847–68.

Carro M & Larrú J, 2010. Flowing together or flowing apart: An analysis of the relation between FDI and ODA flows to Argentina and Brazil. MPRA Paper No. 25064, University Library of Munich, Germany.

Catrinescu N, Leon-Ledesma M, Piracha M & Quillin B, 2009. Remittances, institutions and economic growth. World Development 37(1): 81–92.

Choong C & Lim K, 2009. FDI, financial development and economic growth: The case of Malaysia. Macroeconomic and Finance in Economic 2(1): 13–30.

Eden L, 2009. Letter from the editor-in-chief: FDI spillovers and linkages. Journal of International Business Studies 40(7): 1065–9.

FAO, 2009. How to feed the world in 2050. Rome: FAO. Available at http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf (Accessed 17 February 2020).

FAO, 2012. The state of food and agriculture. Investing in agriculture for a better future. Rome: FAO.

Ferroni M & Zhou Y, 2017. The private sector and India's agricultural transformation. Global Journal of Emerging Market Economies 9(1): 1–10.

Fowowe B, 2020. The effects of financial inclusion on agricultural productivity in Nigeria. Journal of Economics and Development 22(1): 61–79.

Gong B, 2018. The impact of public expenditure and international trade on agricultural productivity in China. Journal of Emerging Markets Finance and Trade 54(15): 3438–53.

Hermes N & Lensink R, 2003. Foreign direct investment, financial development and economic growth. Journal of Developmental Studies 40(1): 142–63.

Ijaiya MA & Ijaiya GT, 2004. The impact of agriculture finance on agricultural output in Nigeria. In Jugale VB (ed.), Poverty, globalisation and human development. New Delhi, India: Serials Publications.

Janský P, 2012. Aid and foreign direct investment: Substitutes, complements or neither? International Journal of Trade and Global Markets 5(2): 119–32.

Lucas R, 1988. On the mechanics of economic development. Journal of Monetary Economics 22: 3–42.

Mallaye D & Yogo T, 2011. Remittances, foreign direct investment and aid in fragile states: Are they complements or substitutes? Available at SSRN: http://ssrn.com/abstract=1795253

Moses JD, Okpachu S & Ojonugwa U, 2013. Foreign direct investment and performance of agricultural sector in Nigeria (1970-2010). Journal of Resourcefulness and Distinction 6(1): 1–12.

Obansa SAJ & Maduekwe IM, 2013. Agriculture financing and economic growth in Nigeria. European Scientific Journal 9(1): 168–204.

Ogbanga A, 2018. Agricultural development and employment generation in Nigeria. International Journal of Advanced Studies in Ecology, Development and Sustainability (IJASEDS) 5(1). Available at http://www.internationalpolicybrief.org/images/2018/JULY/IJASEDS/ARTICLE1.pdf (Accessed 21 February 2020).

Ogboru I, Abdulmalik FA & Park IO, 2018. Government expenditure on agriculture and its impact on unemployment reduction in Nigeria: 1999-2015. International Journal of Economics, Commerce and Management VI(3): 1–25.

Saibu MO, Nwosa PI & Agbeluyi MA, 2011. Foreign direct investment, financial development and economics growth in Nigeria. Journal of Emerging Trends in Economics and Management Science (JETEMS) 2(2): 146–54.

SAHEL, 2004. Financing the agricultural sector. Available at https://sahelconsult.com/wp-content/uploads/2019/05/Sahel-Newsletter-Volume-5.pdf (Accessed 15 February 2020).

Tewodaj M, Bingxin Y, Shenggen F & Linden B, 2012. The impact of public investment in and for agriculture: Synthesis of the existing evidence. ESA Working Paper No. 07, Agricultural

Development Economics Division, Food and Agricultural Organization of the United Nations, Rome, Italy.

Udoh E, 2011. An examination of public expenditure, private investment and agricultural sector growth in Nigeria: Bounds testing approach. International Journal of Business and Social Sciences 2(13): 285–92.

Uremadu SO, Ehimare AO & Okhuebor AI, 2019. A review of impact of government expenditure and bank credit on agricultural productivity of Nigeria. Annals of Social Sciences & Management Studies 3(4): 103–12.

Wieck C, Rudloff B & Heucher A, 2014. Agri-investment and public spending in selected vulnerable countries – Will they contribute to reduce food insecurity? Agricultural and Resources Economics Discussion Paper No. 1, Institute of Food and Resources Economics, University of Bonn, Bonn, Germany.

Yusuff MA, Afolayan OT & Adamu AM, 2015. Analysis of foreign direct investment on agricultural sector and its contribution to GDP in Nigeria. Journal of Emerging Trends in Economics and Management Sciences (JETEMS) 6(2): 94–100.

Zuberu E, Ari MA & Iliya B, 2019. Effect of agriculture financing on agriculture productivity in Nigeria. International Journal for Innovative Research in Multidisciplinary Field 5(7): 104–15.