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Impact of Foreign Direct Investment on Nigeria's Agricultural Sector (1981 to 2019)

Elaigwu Christopher Ogbanje[1], Abubakar Onoja Salami[2]

[1]Department of Agribusiness, Federal University of Agriculture, Makurdi, PMB 2373, Makurdi, Nigeria.
[2]Department of Agricultural Economics and Extension, Federal University, Lafia, Nasarawa State, Nigeria.
Corresponding Author: ogbanje.christopher@uam.edu.ng

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Abstract— *The need to augment the financial policy interventions of the Central Bank of Nigeria in the agricultural sector is sine qua non. Since agriculture is still the mainstay of Nigeria's economy, its reliance on foreign direct investment (FDI) ought to be ascertained. Consequently, this study investigated the impact of foreign direct investment on Nigeria's agricultural sector. Time series data between 1981 and 2019 were obtained from the databases of the Central Bank and Food and Agriculture Organisation. The Augmented Dickey-Fuller test shows that the variables were I(1). Johansen's co-integration test suggested long-run relationship among the variables. Findings revealed slower acceleration of agricultural productivity (6.28) than FDI (17.99). Also, FDI and exchange rate had statistically significant ($p < 0.05$) and negative impact on the agricultural productivity, while implicit price deflator for the agricultural sector had statistically significant ($p < 0.001$) and positive impact on agricultural productivity in the long-run. The error correction term indicates that the speed of adjustment to the short-run equilibrium was high (79.71%). Hence, reliance on foreign direct investment would have adverse effect on agricultural gross domestic product in the long-run. The Federal Ministry of Agriculture and Rural Development should evolve policies that would guarantee steady inflow of foreign direct investment to agriculture in a manner to reverse the negative impact or explore alternatives. In addition, the Central Bank of Nigeria should adopt a sound monetary policy to attain stability in the exchange rate as well as supply of FOREX to ease purchase of agricultural inputs.*

Keywords*— *agricultural finance, growth rate, foreign direct investment, vector error-correction model.

I. INTRODUCTION

There is no gainsaying that agriculture is the mainstay of Nigeria's economy owing to the preponderance of agricultural activities across the landscape of the country and the contribution of the sector to the overall gross domestic product of the nation. A simple ratio analysis of data from the statistical bulletin of the Central Bank of Nigeria (CBN) shows that, on average, agriculture contributed 23.17% to the overall GDP of Nigeria between 1981 and 2019, rising from only 11.77% in 1981. In Nigeria, because 70% of the population is employed in the agricultural sector, economic growth will be almost impossible to achieve without developing the sector (Odetola and Etumnu, 2013). According to Lawal *et al.* (2018), the role of agriculture in pioneering the growth and development of the nation's economy cannot be overemphasized as it fosters sustainability in economic activities; ensure food security; provide employment to dwellers in rural areas; and reduce poverty; among others. Sekyi *et al.* (2017) added that agriculture continues to be the mainstay of most developing countries in Africa with majority of the people farming at subsistent level with very low incomes. For these reasons, constraints besetting agriculture should be given adequate attention, especially those that relate to financing.

Consequently, various governments have made concerted efforts in the area of agricultural finance to keep the sector afloat. Through the instrumentality of the CBN, series of financial policy interventions have been evolved over time to support the growth of the sector. Some of the interventions include ACGSF (Agricultural Credit Guarantee Scheme Fund); CAADP (Comprehensive African Agriculture Development Program) CRIN (Cocoa Research Institute of Nigeria); EEG (Export Expansion Grant); FSS (farm settlement schemes); NAFPP(National Accelerated Food Production program); OFN (Operation Feed the Nation); RBRDA (River Basin and Rural Development Authorities) (Lawal *et al.*, 2018; Ogbanje *et al.*, 2016).

These efforts were aimed at sustaining increased agricultural productivity. The sector comprises mainly crop, livestock, fishery and forestry production (Abah *et al.*, 2021; Ogbanje *et al.*, 2012). Since the outputs from these subsectors are diverse in nature, several empirical research works (Abah *et al.*, 2021; Ogbanje *et al.*, 2016, 2012) used the gross domestic product (GDP) as a measure of the productivity of the sector. As a matter of fact, the GDP measures the value of production in an economy in a given year. Hence, the agricultural GDP (GDPA) represents the value of production in the entire sector on annual basis. It is noteworthy to state that the GDPA is representative of the GDPs from the subsectors in agriculture.

In addition to home-grown policy support, efforts aimed at capital importation to the sector has enjoyed a boost, the most popular among which is the foreign direct investment (FDI). According to Evans *et al.* (2018), FDI and its probable growth impact especially in developing countries has been a major subject of scrutiny in both the fields of international economics and development. This follows the widespread view that FDI has the potential of positively affecting economic development. According to UNCTAD (1999), FDI is a potent instrument through which economies are integrated at the level of production into the globalizing world economy by bringing a package of assets, including capital, technology, managerial capacities or skills, and access to foreign markets. Awunyo-vitor and Sackey (2018) added that international partnership in form of FDI help countries to be innovative and acquire greater resources to develop, grow and expand their regional economies.

Developing countries lack substantial domestic financial resources to propel the much-needed economic growth. Consequently, FDI is considered a significant source of external funding (Okada and Samreth, 2014). In the quest to lure investors, many governments in Africa have adopted open policies which have made FDI the major and most dependable source of capital inflows in Africa (UNCTAD, 2013). The limelight on developing countries has also been necessitated by its enormous receipt of FDI inflows in recent years. For instance, as global inflows of FDI declined, inflows to developing countries increased. In 2014, inflows to developing countries reached its peak of $681 billion, representing a 2% rise from the previous year (UNCTAD, 2015). Kosova (2010) in UNCTAD (2015) asserted that from the mid-1990s, FDI became the major source of external finance for countries in the developing region, and this accounts for more than twice as large as official development assistance. Lipsey (1999) in UNCTAD (2015) also recounted that FDI has become the most dependable source of foreign investment for developing countries. Data from the Food and Agriculture Organisation (FAO) revealed that Nigeria received the sum of US$100,179.11 million from 1991 to 2019. Awunyo-Vitor and Sackey (2018) added that FDI plays a very significant role in increasing agricultural sector growth by offsetting the investment and technological gaps and facilitating capital formation, owing mainly to limited income and sources of credit.

In spite of the colossal financing of the agricultural sector, there are indications that the sector, as well as the economy itself remains underdeveloped. For instance, Joel (2021) observed that Nigeria's potential for growth and economic stability is yet to be achieved, due to the fact that the economy has witnessed so many shocks and disturbances both internally and externally over the decades. For the agricultural sector, Santangelo (2018) found that FDI in land by developing-country investors negatively influenced food security by decreasing cropland due to domestic institutional pressure to align with national interests and government policy objectives, in addition to negative spillovers.

The foregoing depicts divergent opinions among researchers on the impact of FDI on economic development of critical sectors of developing countries' economies, either in the short-run or long-run. It thus became imperative to contribute to the ongoing debate on the reliance of agricultural sector on international funding. The specific objectives of the study, therefore, were to estimate the growth of FDI and GDPA; determine the long run impact of FDI on Nigeria's agricultural economy; and examine the possibility of short run equilibrium restoration. It was hypothesized that there is no cointegration between FDI and GDPA; and there is no chance of restoration to short run equilibrium. The outcome of the study will be useful in providing policy direction on the foreign agricultural finance beyond the short-run.

II. METHODOLOGY

The study was carried out in Nigeria, the acclaimed most populous country in Africa and among the black nations of the world as well as among the eight most populous countries in the world (Abah *et al.*, 2021). It is Africa's largest economy as a result of the recent rebasing exercise (Ismail and Kabuga, 2016). The country has a total geographical area of 923,768 square kilometers, comprising land area of 910,768 square kilometers and water area of 13,000 square kilometers. With a population growth rate of 2.6%, Nigeria has an estimated population of 206 million in 2020. Nigeria is located between 4°16 and 13°53 north latitude and between 2°40 and 14°41 east longitude (Central Intelligence Agency [CIA] Fact Book, 2009). It also has a highly diversified agro-ecological climatic condition and hence, agriculture constitutes one of the most important sectors of the economy. The climate varies with Equatorial Guinea in South and Tropical in the Centre and North. There are two seasons – the wet season (April-October) and the dry season (November-March). The type of vegetation is grassland savannah in the North and forest in the south. This vegetation has made agriculture the major employer of labour in the country. Agricultural holdings are generally small and scattered, farming is often subsistence and mostly characterised by simple tools and shifting cultivation. Agricultural farming activities are largely in the hands of smallholder farmers (Hamzat *et al.*, 2006; Ismail & Kabuga, 2016).

Macroeconomic time series data were obtained for the study. While data on agricultural sector GDP, foreign direct investment to the agricultural sector and implicit price deflator were obtained from CBN, data on exchange rate were obtained from FAOSTAT. Descriptive statistics such as mean, standard deviation and coefficient of variation were used for preliminary data analysis. The compound growth model as proposed and employed by Oparinde *et al.* (2017) was also used for the study to estimate the growth rate of the variables for the study. The model is as specified in Equation (1):

$$Y = b_0 e^{bt} \quad (1)$$

Linearising,

$$Log\ Y = b_0 + b_{1t}$$

The growth rate, r is given by

$$r = (e^b - 1) \times 100$$

e is Euler's exponential constant, which is equal to 2.7183

The data were also subjected to pre-estimation tests such as Augmented Dickey Fuller (ADF) test for unit roots, Johansen's maximum likelihood test for co-integration and optimal lag selection. The Johansen test for co-integration test permits more than one co-integrating relationship so is more generally applicable than the Engle–Granger test which is based on the Dickey–Fuller (or the augmented) test for unit roots in the residuals from a single (estimated) co-integrating relationship. In addition, the long-run relationship was estimated using Johansen co-integration technique with normalization restriction imposed. Furthermore, post-estimation tests were carried out. These include lagrange-multiplier test for autocorrelation, Jarque-Bera test for normality, and Eigenvalue stability condition's test.

The aim of the ADF test was to ensure that the data were stationary or have no unit roots, and results of subsequent analyses were not spurious and misleading. Differencing was used to determine the order of integration. If a series is stationary without any differencing, it is designated as I(0), or integrated of order 0. On the other hand, a series that has stationarity at first differences is designated I(1), or integrated of order one (1). The formula for unit root test using ADF was specified in Equation (2):

$$\Delta X_t = \alpha_0 + \sigma X_{t-1} + \sum \beta \Delta X_{t-1} + e_t \quad (2)$$

where:

X_t = current values of variables;

X_{t-1} = immediate past values of variables;

Δ = difference operator

α, σ, and β = parameters to be estimated

e = error term

The test statistics of the estimated coefficient of Y is then used to test the null hypothesis that the series is non-stationary (has unit root). If the absolute value of the test statistics is higher than the absolute value of the critical value (which could be at 1, 5, or 10 percent) then the series is said to be stationary, therefore we would reject the null hypothesis, otherwise it has to be differentiated until it becomes stationary. The econometric technique adopted was based on the Johansen maximum likelihood estimation procedure and the vector error correction model (VECM). While the former helps to determine cointegration rank of the model, the later helps to ascertain the possibility of error correction as the model approaches its long run equilibrium path.

The choice of a cointegration technique over the ordinary least square techniques lies on the following: i. most time series data are not stationary, implying that the assumption of a constant mean, a constant variance and a constant auto variance for every successive lag is mostly violated, so the use of the OLS method of estimation could only yield a spurious result. ii. Cointegration approach is a convenient approach for the estimation of long run parameters. iii. The cointegration approach provides a direct test of the economic theory and enables utilization of the estimated long run parameters into the estimation of the short run disequilibrium relationships. iii. The traditional approach is criticized for ignoring the problems caused by the presence of unit roots in the data generating process. However, both unit root and cointegration have important implications for the specification and estimation of dynamic models (Awunyo-vitor and Sackey, 2018; Evans *et al.*, 2018; Ogundipe *et al.*, 2014; Omorogiuwa *et al.*, 2014). The model for long run relationship is as specified in Equation (3):

$$\Delta lngdpa_t = \sigma + \sum_{i=1}^{k-1} \beta_1 \Delta lngdpa_{t-i} + \sum_{m=1}^{k-1} \varphi_m \Delta lnfdia_{t-m} + \sum_{n=1}^{k-1} \emptyset_j \Delta lnexr_{t-n} + \sum_{p=1}^{k-1} \emptyset_j \Delta lngipd_{t-p} + \lambda_1 ECT_{t-1} + \mu_{1t} \quad (3)$$

where:

GDPA = Agricultural sector Gross Domestic Product (₦ billion); FDIA = Foreign Direct Investment to agricultural sector (₦ billion); EXR = Exchange rate of naira to dollars (%); GIPD = Gross Domestic Product implicit price deflator (%).

K – 1 = lag length

β,φ,ϕ, = short-run dynamic coefficients of the model's adjustment to long-run equilibrium

λi = speed of adjustment parameter which comes negative sign to ensure convergence to long-run

ECT_{t-1} = the error correction term which is the lagged value of the residuals obtained from the long-run

U_{it} = stochastic error term called impulses or innovations or shocks

The control variables in the model were exchange rate, implicit price deflator for the agricultural sector. The exchange rate was included as control variable because, according to Ogundipe *et al.* (2014), exchange rate affects the value of FDI inflow into the economy. It is the amount of money contractually promised at a certain specified future dates as a proportion of the principal borrowed. Similarly, the inclusion of the implicit price inflation was based on the belief that it affects the real value of agricultural productivity.

III. RESULTS AND DISCUSSION

The analysis of the descriptive statistics of the variables in the systems equation was presented in Table 1. The result shows that the variable with the highest coefficient of variation within the period under review was FDIA (2.50 %). This implies a large variation, invariably fluctuation, in FDI inflow to the agricultural sector. This could affect planning and projections of agricultural sector output and outcomes. The variable with the least coefficient of variation was GDPA (0.67 %), the target variable in the study. This result implies some level of stability over time. It could also mean slow growth.

Table 1: Descriptive Statistics of Variables

Statistics	Mean	Minimum	Maximum	Standard deviation	Coefficient of variation
GDPA	7,956,731.00	2,303,505.00	18,000,000.00	5,349,728.00	0.67
FDIA	18,800,000,000.00	117,000,000.00	198,000,000,000.00	47,000,000,000.00	2.50
EXR	99.92	0.62	306.92	89.62	0.90
GIPD	54.41	0.71	202.01	59.90	1.10

Source: Computed with data from CBN and FAO databases

Growth rate

The analysis of the growth rate of the variables in the study was presented in Table 2. The result shows that the quadratic time t^2 for LNGDPA, FDIA, EXR and GIPD was positive and statistically significant ($p<0.01$). According to Amos & Ayanda (2004) and Oparinde *et al.* (2017), this result implies significant acceleration. The result further revealed that GDPA had a very slow growth rate (6.28%). This is a confirmation of the declining agricultural productivity which has been variously reported. It is a result of the myriads of the constraints, including government's neglect, affecting the sector, notwithstanding its importance to the economy.

FDIA and EXR exhibited similar acceleration. However, it is noteworthy that the naira gained and sustained its free fall against the dollar during the period under investigation. Akinbode & Ojo (2018) had stated there have been fluctuations in the exchange rate of the ₦aira to other major world currencies especially the US Dollar over time. According to Alori & Kutu (2020), the upsurge was exasperated by the introduction of both dollars pegged systems and managed float of exchange rate policies in the Nigerian economy. Increasing exchange, invariably declining value of the ₦aira has the potential to discourage current and potential investors because it heightened uncertainty over the return on investment. In addition, an accelerating exchange rate makes it difficult for farmers to purchase production inputs like herbicides and fertilizers as well as farm assets like the knapsack sprayer and tractor. Similarly, the costs of various operations increase and reduce the scale of operation, thereby inhibiting productivity.

For GIPD, the result is outrageous. As a measure of inflation, the result is an empirical representation of the galloping food inflation in the economy as food prices are going beyond the reach of an average Nigerian. This result suggests some form of neglect in the management of inflation by appropriate authorities.

Table 2: Growth Rate

Variables	Coefficient (b)	t-value	R^2	Growth rate, r (%)
LNGDPA	0.0609	33.28*	96.77	6.28
LNFDIA	0.1654	10.46*	74.72	17.99
LNEXR	0.1596	13.58*	83.29	17.30
LNGIPD	4.8843	15.36*	86.44	13,120.22

* statistically significant growth

Source: Computed with data from CBN and FAO databases

Stationarity test

The result of the stationarity test was presented in Table 3. At levels and as specified in equation (2), the absolute values of the variables were less than the critical values at 5%. This implies that the variables had unit roots at level [I(0)]. This submission is in line with Awe (2013) and Anwana & Affia (2018). A further proof of the presence of unit roots in the series is that the R^2 (0.9515) was greater than the Durbin-Watson statistic (0.3366) in the spurious regression of the variables in their levels form. Under this scenario, the variables were deemed to be non-stationary.

However, the variables became stationary in their first differences [I(1)]. The basis is that the absolute values were greater than the critical values at 5% level. The decision conforms with Aminu (2020) and Afolabi *et al.* (2021). The models were dictated by the nature of the trend in their line graphs as stipulated by Gujarati (2003). Furthermore, in their first differences, the regression result shows that R^2 (0.0336) was less than the Durbin-Watson statistic (1.9553). These results imply that the variables were stationary in their first differences.

Table 3: Stationarity Test

	At level I(0)		At first difference I(1)	
Variable	**Test statistic (Z(t))**	**5% Critical value**	**Test statistic (Z(t))**	**5% Critical value**
GDPA	-2.003	-3.552	-4.378	-3.556
FDIA	-1.365	-1.691	-7.679	-1.692
EXR	-1.46	-3.552	-3.708	-3.556
GIPD	-1.44	-1.691	-2.683	-1.692

Source: Computed with data from CBN and FAO databases

In addition, the line graphs of the series in their levels form, as shown in Figure 1, show that the variables were largely trending upwards and failed to revolve around zero. Thus, they can be said to have unit roots. But in Figure 2, the line graphs exhibited mean reversion, implying that they became stationary after their first differencing.

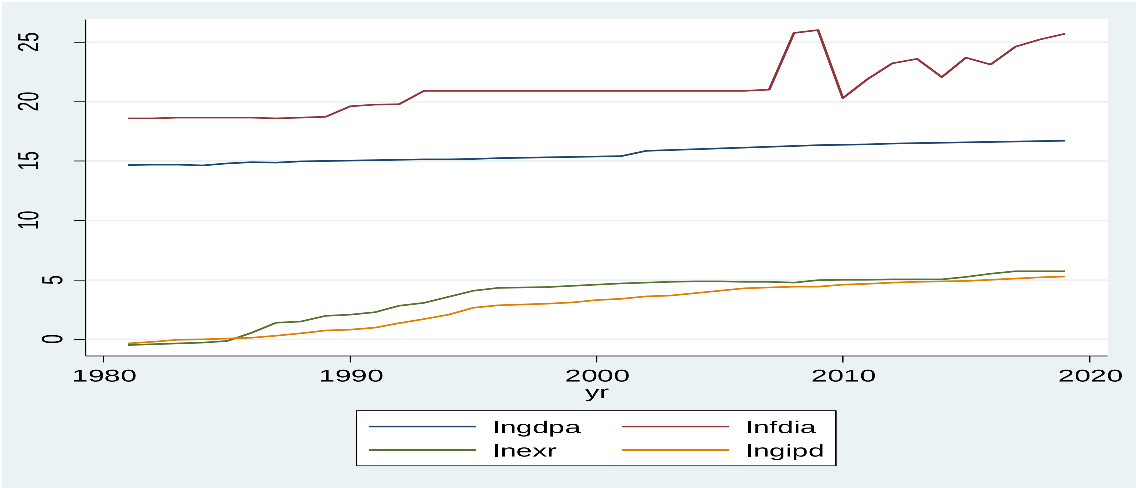

Fig.1: Line graphs for the variables at their levels form

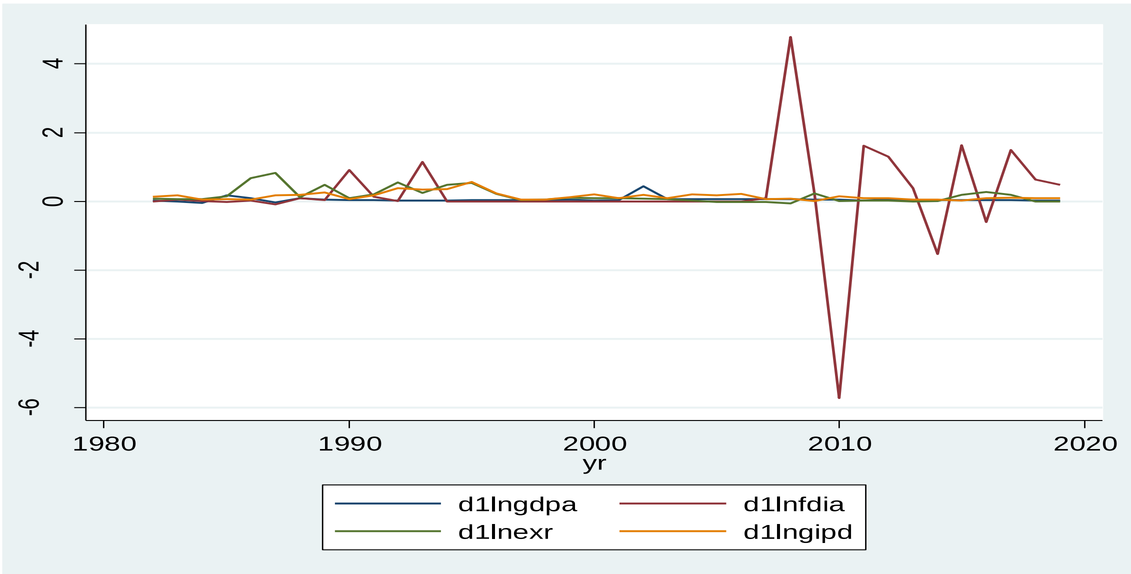

Fig.2: Line graphs for the variables in their first differences

Johansen Maximum Likelihood Test of Co-integration

The result of Johansen's test of co-integration was presented in Table 4. The essence of this test was to confirm the existence or otherwise of long run relationship. The result shows that the first null hypothesis of no co-integration was rejected because, at 5%, the trace statistic (51.0903) was greater than the critical value (47.21). This was in line with Ismaila & Imoughele (2015), Victor (2015), Ismail & Kabuga (2016) and Osabohien *et al.* (2019).

The study, however, failed to reject the second null hypothesis of at least one co-integrating equation because the trace statistic (28.2633*) was less than the critical value (29.68). These results were corroborated by the maximum statistics. The confirmation of co-integration implies that there is a long-run relationship among the variables in the system equation (Andrei & Andrei, 2015; Akinkunmi, 2017). In other words, there is cointegration between FDI and GDPA. The result paves way for the estimation of long-run relationship with vector error-correction model.

Table 4: Johansen Maximum Likelihood Test of Co-integration

Null hypothesis	Trace statistic	5% Critical value	Maximum statistic	5% critical value
0	51.0903	47.21	22.827	27.07
1	28.2633*	29.68	13.6368	20.97
2	14.6265	15.41	9.3072	14.07
3	5.3193	3.76	5.3193	3.76

* Available co-integrating equations

Source: Computed with data from CBN and FAO databases

Optimal Lag Selection

In Table 5, six optimal lag selection criteria were used namely, LL, LR, FPE, AIC, HQIC, and SBIC. The result shows that LR, FPE, AIC, HQIC and SBIC recommended one lag. The bases were the asterisk from the software and the concept of the least the value the better. Hence, the estimation of vector error-correction model will use one lag as suggested and implemented by (Adongo *et al.*, 2020).

Table 5: Optimal lag selection

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-126.021				0.019808	7.42976	7.49112	7.60751
1	49.9946	352.03*	16	0.001	2.1e-06*	-1.71398*	-1.40717*	-0.825206*
2	62.0176	24.046	16	0.089	2.80E-06	-1.48672	-0.93448	0.113064
3	65.9292	7.8231	16	0.954	6.20E-06	-0.79595	0.001735	1.51485
4	73.8225	15.787	16	0.468	0.000012	-0.33271	0.710417	2.6891

* Recommended lag criteria

Source: Computed with data from CBN and FAO databases

Estimation of long-run relationship with Johansen normalization restriction imposed

The result of vector error-correction model was presented in Table 6, with Johansen normalization restriction imposed on the GDPA. The chi-square statistic (131.6573) for the overall co-integrating equations was statistically significant ($p < 0.01$). This marked the final confirmation of the presence of long run relationship in the systems equation. The result also shows that lag one of the natural logarithms of FDIA, EXR and GIPD had asymmetric and statistically significant ($p < 0.01$) impact on agricultural sector GDP in the long-run.

Specifically, lag one of the log of FDIA had negative impact on the agricultural GDP since the z-statistic (3.08) was statistically significant ($p < 0.05$). Hence, a 1% increase in FDIA would reduce agricultural sector GDP by 0.2678 % in the long-run. This result further implies that FDIA and GDPA would move in different directions in the long-run. The injection of foreign capital into the agricultural sector resulted in negative outcome in the sector because of the large coefficient of variation that was observed in this study. Within the context of neoclassical growth models, the reason could be attributed to the possibility of diminishing marginal returns to capital. According to Evans *et al.* (2018), FDI can only have effect on the level of income without affecting long run growth rate. In other words, the probable effect of FDI on growth is limited to the short-run, and the extent of the effect depends on the transitional dynamics to the steady-state growth path. Epaphra and Mwakalasya (2017) also found that there was no significant effect of FDI inflows on agriculture value added-to-GDP ratio in Tanzania despite the fact that FDI inflows in economy was outstanding particularly between 1990 and 2015. However, the finding of this study is at variance with Awunyo-vitor and Sackey (2018) who found a positive and significant relationship between economic growth and foreign direct investment flow to the agricultural sector and volume of trade in Ghana. The difference in the impact of FDIA on agricultural sector across these African countries can be attributed to differences in policies and level of technology available and adoption.

Furthermore, lag one of the log of exchange rate had negative impact on the agricultural sector GDP since the z-statistic (4.59) was statistically significant ($p < 0.001$). Hence, a 1% increase in exchange rate would reduce agricultural sector GDP by 0.7974% in the long-run. This result further implies that exchange rate and agricultural sector GDP would move in different directions in the long run. Increase in exchange rate is synonymous with declining value of the local currency and invariably with the declining growth rate of the economy. In other words, a relatively large volume of the local currency (the naira) would be required to obtain a given volume of dollars, for instance. Hence, the price of imported agricultural inputs would be high. Also, as long as the exchange rate increases, the growth of the agricultural sector economy would decrease. As noted by Ogundipe *et al.* (2014), the conservative monetary management policies put in place for stabilizing the exchange rate of a unit U.S dollar to naira over the years would have been ineffective. Consequently, Zehra *et al.* (2019) stated that the adoption of flexible exchange rate regime among others, have made central banks around the globe to be more concerned about money demand. This was probably intended to ameliorate agricultural financing challenges. To this end, Onyiriuba *et al.* (2020), in a study of government policies in agricultural financing, asserted that the authorities seek to get rid of bottlenecks, ease participation and redress constraints on access to finance in agriculture through policy interventions as a means of sustainable economic growth. The finding of this study is inconsistent with Adeniran *et al.* (2014) who found that exchange rate had positive but insignificant effect on Nigerian economic growth between 1986 and 2013.

Finally, lag one of the log of implicit price deflator for the agricultural sector GDP had positive impact on agricultural GDP in the long-run since the z-statistic (-7.53) was statistically significant ($p < 0.01$). Hence, a 1% increase in GIPD would increase GDPA by 1.5939%. The inverted sign of the variable implies that GIPD and GDPA would move together in the long-run. Normally, inflation increases and pushes the value of commodities beyond the reach of an average income earner. In this case, the valuation of GDPA would be high. This finding is in conformity with Olatunji *et al.* (2012) that there was direct relationship between agricultural output change and inflation rate in Nigeria between 1970 and 2006. Similarly, Oyinbo and Rekwot (2014) found that there was a unidirectional causality from inflationary trend to agricultural productivity.

Table 6: Long-run relationship with Johansen normalization restriction imposed

beta	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
lngdpa	1	.	.	.	.	.
lnfdia	0.267802	0.086934	3.08*	0.002	0.097414	0.43819
lnexr	0.797387	0.173884	4.59*	0.001	0.456581	1.138193
lngipd	-1.59397	0.21163	-7.53*	0.001	-2.00875	-1.17918
_cons	-19.7855	.	.	.	.	.

chi2 = 131.6573; P>chi2 = 0.0000; * Statistical significance at 0.01 level

Source: Computed with data from CBN and FAO databases

The Vector Error Correction Model

The result of the vector correction model (VECM) for the study was presented in Table 7. The ECM coefficient is known as the speed of adjustment factor. It estimates how fast the system can adjust to restore equilibrium. According to Arize (2003), the ECM therefore reflects how the system converges to the long run equilibrium. Rashid & Jehan (2014) used the VECM to estimate the speed at which the variables converge to its long-run equilibrium. According to Gujarati & Porter (2009), the model also captures the reconciliation of the variables over time from the position of disequilibrium to the period of equilibrium as much as possible. The basic criteria for analyzing VECM, according to Ogundipe *et al.* (2014), are (i) that the ECM must lie between 0 and 1; (ii) it must be negative for it to be meaningful. If it's positive there is no error correction and therefore diverges; and (iii) the t-statistic (or z-statistic) must be at least two and significant to confirm the possibility of restoration due some shocks.

Table 7: Vector Error Correction Model

Variables	ECM (-1)	Std. Err.	z	P>|z|	[95% Conf. Interval]	
D_lngdpa	-0.02023	0.020904	-0.97	0.333	-0.0612	0.02074
D_lnfdia	-0.79713	0.37076	-2.15*	0.032	-1.52381	-0.07045
D_lnexr	0.1892	0.052414	3.61	0.001	0.086471	0.291929
D_lngipd	0.111265	0.027279	4.08	0.001	0.057798	0.164731

*** Correctly signed and statistically significant at 0.05 level**

Source: Computed with data from CBN and FAO databases

The speed of adjustment co-efficient for FDIA is -0.79713. The ECM for FDIA was correctly signed and, in terms of magnitude, lies between 0 and 1. Furthermore, the z-statistic was above 2 and statistically significant ($p < 0.05$). Hence, the study rejected the null hypothesis of no possibility of restoration to short run equilibrium. Consequently, the model has the capacity to correct errors generated in the immediate past periods as it approaches its long run equilibrium path. Precisely, the error correction model in this study implies that about 79.71% of errors generated between each period are correlated in subsequent periods while 20.29% are uncorrelated. The speed of adjustment to the short run, in order to restore equilibrium, is as high as 79.71%. Since errors are short lived in our model, it implies that the long run relationship obtained is sustainable and this result is reliable.

Postestimation test

Three postestimation tests namely, autocorrelation, normality and stability conditions were carried out. In Table 8, the lagrange-multiplier test shows that there was no autocorrelation of errors in the systems equation. The result of the Jarque-Bera Test for normality was presented in Table 9. The result shows that the errors were normally distributed for EXR and GIPD but not for GDPA and FDIA. Overall, the errors are not normally distributed. The result of the Eigenvalue stability condition was presented in Table 10. The result shows that the systems equation was stable. In addition, the VECM specification imposed 3-unit moduli.

Table 8: Lagrange-multiplier Test for autocorrelation

lag	chi2	df	Prob > chi2
1	5.4121	16	0.99329
2	8.0692	16	0.94678

H0: no **autocorrelation** at lag order

Table 9: Jarque-Bera Test for normality

Equation	chi2	df	Prob > chi2
D_lngdpa	464.025	2	0.0001
D_lnfdia	29.861	2	0.0001
D_lnexr	1.307	2	0.52032
D_lngipd	2.496	2	0.28709
ALL	497.689	8	0.0001

Table 10: Eigenvalue stability condition

Eigenvalue	Modulus
1	1
1	1
1	1
0. .7398102	0. 73981

IV. CONCLUSION

The study determined the impact of foreign direct investment on Nigeria's agricultural sector, using time series data from 1981 to 2019. From the results of the study, it can be concluded that reliance on foreign direct investment would have adverse effect on agricultural gross domestic product in the long-run. This submission could be due the instability of foreign direct investment inflow within the period. Improper utilization, as is the case with agricultural finance interventions, is also suspect. The impact of foreign direct investment would have been worsened or masked by the outrageous growth in inflation and free fall of the naira as exemplified by a high growth rate. However, available statistical evidence shows that there is a high speed of adjustment to the short run equilibrium.

RECOMMENDATIONS

The Federal Ministry of Agriculture and Rural Development should evolve policy that would attract steady inflow of foreign direct investment to agriculture so that in the long-run the negative impact can be forestalled. It is also imperative to commence the exploration of agricultural financing to FDI. The monetary authority should collaborate in this effort by ensuring that high exchange rate and outrageous inflation do not discourage both current and prospective foreign investors. Apart from the empirical basis, this recommendation arose from the obvious fact that supplementary agricultural financing to augment domestic funding would be necessary in a long time to come.

In addition, Central Bank of Nigeria should adopt a sound monetary policy to attain stability in the exchange rate as well as supply of FOREX as they relate to the agricultural sector. This will ensure that exchange rate movement favours growth in the agricultural sector. Finally, measures to absorb excess agricultural output and cautiously finance the sector should be developed by the Federal Ministry of Agriculture and Rural Development in conjunction with the Central Bank of Nigeria. These measures will ensure stability in food prices and inflation in a manner that will facilitate growth in the value of agricultural productivity in Nigeria.

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