INTERROGATING THE ASYMMETRIC IMPACT OF EXCHANGE RATE ON AGRICULTURAL OUTPUT IN NIGERIA

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Abstract

The agricultural sector is vital to the Nigerian economy. It serves several functions including food supply for the populace, a source of income for a sizable section of the domestic labour force, a supplier of raw materials for industrial production, and provision of foreign exchange revenues to the economy. However, due to the country's abundance of natural resources like crude oil, the agriculture sector is vulnerable to the fluctuations in the exchange rate caused by international financial markets. This analysis looked at how changes in the value of the naira relative to dollar affects agricultural production. In order to contribute to the current body of literature for the time period between 1981 and 2021, this study employed the Dutch Disease Syndrome theoretical framework through the use of the non-linear autoregressive distributed lag (NARDL) method for Nigeria. This research shows that while the long-term effect of the exchange rate on agricultural output in Nigeria is symmetrical, the short-term effect is asymmetrical. Consequently, since exchange rate exerted positive impact on agricultural production in the long run, it is suggested that the Nigerian government explores the increased competitiveness of the sector in its economic diversification efforts. In other words, the agricultural sector could provide an avenue to expand the revenue base of the government.

Keywords: *Exchange Rate, Asymmetric Impact, Agricultural Output, Dutch Disease Syndrome, Non-linear Autoregressive Distributed Lag.*

1. Introduction

Agriculture encompasses not only the raising of livestock and aquatic organisms for human consumption and industrial production, but also the exploration and use of forests for these same ends. Since agriculture accounts for a significant portion of Nigeria's GDP and provides millions of people with jobs, it is vital to the country's economy. To be more specific, agriculture helps the industrial sector by providing surplus labour, food for domestic consumption, a market for industrial output, domestic savings for industrial investment, and foreign exchange earnings from agricultural exports. Based on the latter argument, it's reasonable to assume that changes in the value of the naira can have effect on the profitability and competitiveness of agricultural output in Nigeria.

Conversely, the appreciation or depreciation of one nation's currency relative to the economies of other countries has an effect on the agricultural production and balance of payment of the country providing the data. Economic

factors and sectors including export profits, the cost of imported inputs, food price inflation, investment and production choices, and government policies are all susceptible to the effects of swings in exchange rates. Nigeria's agricultural exports may become less competitive as a result of fluctuations in the exchange rate. When the naira weakens against major international currencies like the US dollar, Nigerian agricultural exports become more competitive on worldwide markets (Akinbode & Ojo, 2018). Export earnings for Nigeria's farmers may improve if foreign buyers can get more of the country's food for the same amount of money in their currency.

Because of its reliance on foreign inputs like herbicides, equipment, and fertilisers, Nigeria's agricultural business can also be hit by fluctuations in the price of these items. Input prices may be affected by a depreciation of the local currency due to the higher price of imported goods (Onyeagocha, Chukwu, & Nweke, 2021). Farmers' profitability and competitiveness may suffer as a result of higher production costs. Changes in the value of the naira might potentially have an effect on the cost of food in Nigeria. When the local currency gains, the cost of imported goods rises (Onwuka & Oyewumi, 2019). Consumers may be harmed, especially those with lower means who may have a harder time locating reasonably priced food that is also healthy. The uncertainty caused by changes in the value of a currency might affect agricultural output and investment decisions. It's possible that farmers and agribusinesses won't invest in long-term projects or boost output if the currency rate remains volatile (Onyeagocha,et al, 2021). Reduced agricultural production and slow sector growth are possible outcomes. Currency fluctuations may have a significant impact on the agriculture industry, thus governments sometimes step in to stabilise the market or mitigate the fallout. The Central Bank of Nigeria, for instance, may employ capital controls or currency interventions to dampen fluctuations in the value of the naira (Onwuka & Oyewumi, 2019). These bills are an attempt to guarantee the agriculture sector's continued success and expansion over the long term by providing stability and aiding it.

Stylized Facts about Nigeria's Agricultural Sector

The government has used both monetary and fiscal measures to help agriculture regain its former glory and prevent its role in the economy from shrinking further. The Nigerian Agricultural Bank (NAB) was founded in 1972 as a direct result of government policies and projects. Before becoming the Bank of Agriculture (BOA) in 2000, it was known as the Nigerian Agricultural and Cooperative Bank (NACB) from 1978 to 1978. It wasn't until 1976 that initiatives like the Agricultural Development Programme, the River Basin Development Authority, and Operation Feed the Nation came into being. Although the World Bank Agricultural Development Projects (ADP) were established before 1976, they were originally conceived as an all-encompassing programme for rural development. The Agricultural Credit Guarantee Scheme (1977), Rural Banking Programme (1977), Green Revolution (1979), Directorate for Food, Roads, and Rural Infrastructure (1986), National Fadama Development Project (1990), National Special Programme on Food Security (NSPFS) (2000), Community-Based Agricultural and Rural Development Schemes (2003-2008), and Root and Tuber Expansion Programme (RTEP) (2004) are all examples of government initiatives in the agricultural sector (Eniekezimene, Oluwabusayo & Ekiye, 2020).

Although the government has taken steps to improve agriculture, the sector's performance over the years has been dismal. Agriculture's contribution to GDP is lower than that of industry and services, and there is a clear divergence between agriculture and the manufacturing sectors. Foreign reserves are depleted and the exchange rate is weakened because of the country's reliance on imports of agricultural items such as rice, frozen chicken, iced fish, and plywood, to name a few. The government has banned over 40 categories of imports, most notably food products, and these items have since been removed off the list of recognised commodities that may be purchased with foreign exchange, but the situation has not improved. Additionally, considering the need to relinquish complete reliance on crude oil and to emphasize on the non-oil sector in driving economic growth in Nigeria, it has become imperative to re-examine the effect of exchange rate asymmetry on productive sectors like the agriculture in Nigeria. As a result, the purpose of this research is to examine the impact of fluctuating exchange rates on agricultural output in Nigeria between the years 1981 and 2021. The major objective of this research is to analyse the impact that the naira's exchange rate during the study period had on agricultural output in Nigeria. The specific objectives of this paper include to examine the impact of average manufacturing capacity utilization rate on agricultural output in Nigeria and to study the impacts of inflation and interest rates on agricultural production in Nigeria.

The sample period used in this study was found to follow a normal distribution when degrees of freedom were taken into account. Therefore, a 41-year period, beginning in 1981 and ending in 2021, was selected for analysis. From an empirical perspective, this time frame encompasses the vast majority of exchange rate fluctuations experienced by Nigeria after it gained independence. The following are components of the research's later stages: The second section reviews the relevant literature and theory, while the third discusses methodology in detail. In section four, we provide a detailed review of the data and the findings. Section five concludes with some last thoughts and suggestions for follow-up study.

2. Theoretical Framework and Empirical Literature Review

The Dutch Disease Syndrome model created by Corden in 1984 was employed in this study, following the example of Adekunle, Kehinde, & Taiwo (2019). The model assumes three sectors: non-tradable (N), which is analogous to Nigeria's service industry; lagging (L), which is analogous to Nigeria's agriculture sector; and booming (B), which is analogous to Nigeria's oil and gas firm. Furthermore, the model assumes that sectors B and L exist, as they are the ones responsible for producing commodities that are traded at standard world prices. Third, a multiskilled workforce that can work across all three industries to keep costs down while yet contributing to each one's production and unique characteristics.

In addition, factor price is not static worldwide, which brings us to our fourth and last reason. Based on these projections, the model creates two distinct consequences of a boom in B: the spending impact and the resource migration effect. As a result, the starting wages of the first generation of factor employees have increased. The price of non-traded products (N) will increase relative to the price of traded goods if some of the additional money created by B is spent, either by factor owners or by the government in the form of taxes. This is an example of sincere thanks. To achieve this result, one must reallocate resources from B and L into N and reverse the flow of demand from N to B and L. Consequences of redistributing wealth: Since the marginal product of labour in B has gone up because of the boom, workers in L and N are leaving in pursuit of better job security and a more consistent income in terms of traded products. This finding may be broken down into two parts: When employees from L are moved to B, production in L falls. This might be seen as direct de-industrialization because there is no demand for a real appreciation of the currency rate and no market for N. Workers in N may easily migrate to B since the real exchange rate is stable. The transfer of resources boosts real appreciation, and the resulting spending impact raises N's excess demand. As a result, the deindustrialization caused by the cost impact intensifies as more people move from L to N in search of work. Indirect deindustrialization describes this secondary effect.

2.1 Empirical Literature Review

While this may be true, the relationship between the exchange rate and agricultural output has been the subject of several empirical studies, both globally and domestically. In order to stay abreast with the empirical results and advancements, this section evaluated a few of these investigations, beginning with those conducted abroad and concluding with those conducted in the United States. For instance, Reuben and Alala (2014) used time series data from 1970 to 2008 to analyse the effect of currency rate fluctuation on the prosperity of Kenyan tea exports. The ADF and Johansen Cointegration were used to guarantee series stationarity and the long run relationship of the variable, and then the ECM approach was used to examine the empirical model. Results demonstrated that exchange rate volatility harmed tea exports.

Sirikul, Chanchai, and Somchai (2015) analysed the effect of monthly exchange rate variations on Thai rice and rubber exports using primary and secondary data from 2002 to 2014. Using a combination of survey data and in-depth interviews, they determined that fluctuations in the value of the currency exchange rate dampened demand for both types of agricultural exports. The study found that exporters and firms might benefit from hedging their risk of currency rate fluctuations.

Kafle and Kennedy (2015) investigated how the real exchange rate affects agricultural exports from the United States to the nations of the Organisation for Economic Cooperation and Development (OECD). The consequences of free trade agreements and embracing the Euro as a national currency were also studied. From 1970 to 2010, bilateral trade flow panel data were analysed using the Gravity Model. Both agricultural and non-agricultural trade flows were demonstrated to be negatively affected by fluctuations in the real exchange rate. The export-dependent non-agricultural businesses are particularly vulnerable to variations in the exchange rate.

In their 2018 study, Wagan, Chen, Seelro, and Shah looked into how changes in monetary policy affected expansion, inflation, and job creation. Using a factor-augmented vector autoregressive model established by Bernanke et al. (2005), researchers analysed agricultural data for Pakistan and India from 1995 to 2016 and found that restrictive monetary policy dramatically increased rural unemployment while significantly reduced food inflation and agricultural productivity. Mashinini, Dlamini, and Dlamini (2019) studied the effects of monetary policy on agricultural output in Eswatini from 1980 to 2016. Researchers employed a technique known as the vector error correction model (VECM). Statistics show that currency rate, interest rate, inflation rate, money supply, and agricultural loans all have a detrimental effect on agricultural output. However, in the near run, agricultural output benefited from these causes.

Kipruto and Nzai (2018) studied the results of government investment on agricultural output in Kenya from 1980 to 2016. When measured with the autoregressive distributed lag (ARDL) technique, government spending increases agricultural production.

Gatawa and Mahmud (2017) looked at the long- and short-term effects of currency rate changes on the volume of Nigeria's agricultural exports between 1981 and 2014. The study used estimation strategies like generalised autoregressive conditional heteroskedasticity (GARCH) and autoregressive distributed lag (ARDL) to determine the relationship between the exchange rate, agricultural loan amounts, and agricultural export relative prices and the volume of agricultural exports. Long-term agricultural output was shown to be favourably influenced by the exchange rate and agricultural loans, whereas short-term agricultural output was negatively impacted by the relative pricing of export agricultural commodities. Long-term results were similar, with the exception of agricultural exports, which were significantly impacted negatively by the official exchange rate.

Akinbode and Ojo (2018) utilised GARCH and ARDL to examine the relationship between the exchange rate and Nigeria's agricultural exports from 1980 to 2015. Inflation, GDP growth, inflation, and global pricing were shown to have a significant positive influence on agricultural exports, whereas the short- and long-term effects of exchange rate fluctuations on agricultural production were found to be minimal. The dynamic impact of exchange rate fluctuations on agricultural output in Nigeria was studied by Adekunle, et al (2019) using the non-linear autoregressive distributed lag (NARDL) approach between 1981 and 2018. Although the bounds test indicated that there was no long-term relationship between the dependent and set of independent variables, their findings indicated that real exchange rate appreciation and depreciation, as well as the set of explanatory variables, had a significant impact on agricultural output in the short run. Alegwu, Aye, and Asogwa (2018) examined the correlation between the fluctuation of the Nigerian currency and agricultural exports from 1970 to 2013 using the vector error correction model (VECM). The data showed that fluctuations in currency exchange rates had a negative impact on agricultural exports over the long run but had no impact over the short term.

Ochalibe, Okoye, and Enete (2019) used the Granger Causality approach to analyse the impact of the currency rate and the interest rate on agricultural output growth in Nigeria from 1980 to 2018. The findings indicated a unidirectional relationship between the interest rate and the exchange rate and agricultural progress. The impact of the exchange rate policy tool was positive by 2.85%, but interest rates considerably hampered agricultural development.

Ikpesu and Okpe (2019) examined the relationship between capital flows, currency rates, and agricultural output in Nigeria using the autoregressive distributed lag (ARDL) method between 1981 and 2016. A decline in currency value, the study revealed, has both short-term and long-term negative effects on agricultural output. Abubakar (2019) looked explored the correlation between Nigeria's interest rates and agricultural output between 1999 and 2016. The numbers showed that when interest rates rose, agricultural output fell.

Awolaja and Okedina (2020) examined how changes in exchange rates affected agricultural output in Nigeria. In this study, the authors employed non-linear auto-regressive distributed lags (NARDL) technique. Long-term agricultural output was shown to be greatly increased by a real exchange rate appreciation, whereas agricultural output was significantly decreased by a real exchange rate depreciation. Another finding from the forecasts was that agricultural output is more vulnerable to increases in the real exchange rate than decreases in the same variable.

This study, in line with the work of Adekunle et al (2019), used exchange rate appreciation and depreciation alongside interest rate, inflation rate, and average manufacturing capacity utilization rate to examine the asymmetric influence of exchange rate on agricultural production in Nigeria. However, the current study focused on monetary policy variables (interest rate and inflation) and agricultural FDI to determine the impact

on agricultural output, in contrast to the work of Adekunle et al (2019) who used exchange rate appreciation and depreciation alongside fiscal and monetary policies as well as the industrial sector capacity utilization rate as explanatory variables.

3. **Methodology and Model Specification**

This study employed the non-linear autoregressive distributed lag (NARDL) method. The time-varying impact of changes in independent variables on the dependent variable is more accurately captured by the nonlinear autoregressive distributed lag (NARDL) than by the more frequent autoregressive distributed lag (ARDL). Time series data for the variables were gathered from the Central Bank of Nigeria (CBN) Statistical Bulletin from 1981 to 2021, and stationarity was tested using the ADF unit root test, and long run correlations were determined using the Bounds test for cointegration. Therefore, the operational model for this study is:

ARGDP =f(NER, INR, INFR, MCU)   (3.1)

The econometric form of equation (3.1) which considers the dynamics of exchange rate is as follows:

$$LARGDP_t = \beta_0 + \beta_1^+ NER_t^+ + \beta_1^- NER_t^- + \beta_2 INR_t + \beta_3 INFR_t + \beta_4 MCU_t + \mu_t \qquad (3.2)$$

The asymmetric impact of exchange rate on agricultural output using NARDL and by following the approach of Shin, Yu and Greenwood-Nimmo (2014), yields;

$$\Delta ARGDP_t = \gamma[ARGDP_t + \beta_1^+ NER_{t-1}^+ + \beta_1^- NER_{t-1}^- + \beta_2 INR_{t-1} + \beta_3 INFR_{t-1} + \beta_4 MCU_{t-1} +$$
$$\sum_{j=0}^{q1-1}\delta_j^+\Delta NER_{t-j}^+ + \sum_{j=0}^{q2-1}\delta_j^-\Delta NER_{t-j}^- + \sum_{j=0}^{q3-1}\lambda_j INR + \sum_{j=0}^{q4-1}\pi_j\Delta INFR_{t-j} + \sum_{j=0}^{q5-1}\phi_j\Delta MCU_{t-j} + \mu_t$$
(3.3)

Equation (3.3) can be re-parameterized to derive the unrestricted error correction version below;

$$\Delta ARGDP_t = \gamma\left[ARGDP_{t-1} - \left(-\frac{\beta1}{\gamma}NER_{t-1}^+ - \frac{\beta1}{\gamma}NER_{t-1}^- - \frac{\beta2}{\gamma}INR_{t-1} - \frac{\beta3}{\gamma}INFR_{t-1} - \frac{\beta4}{\gamma}MCU_{t-1}\right) +$$
$$\sum_{i=1}^{p-1}\theta_i\Delta ARGDP_{t-i} + \sum_{j=0}^{q1-1}\delta_j^+\Delta NER_{t-j}^+ + \sum_{j=0}^{q2-1}\delta_j^-\Delta NER_{t-j}^- + \sum_{j=0}^{q3-1}\lambda_j INR + \sum_{j=0}^{q4-1}\pi_j\Delta INFR_{t-j} +$$
$$\sum_{j=0}^{q5-1}\phi_j\Delta MCU_{t-j} + \mu_t \qquad (3.4)$$

By letting,

$$\mathcal{E}_{t-1} = ARGDP_{t-1} - \beta_1^+ NER_{t-1}^+ - \beta_1^- NER_{t-1}^- - \beta_2 INR_{t-1} - \beta_3 INFR_{t-1} - \beta_4 MCU_{t-1} \qquad (3.5)$$

Where,

$$\beta_1^+ = -\frac{\alpha1}{\gamma}, \beta_1^- = -\frac{\alpha1}{\gamma}, \beta_2 = -\frac{\alpha2}{\gamma}, \beta_3 = -\frac{\alpha3}{\gamma}, \beta_4 = -\frac{\alpha4}{\gamma} \qquad (3.6)$$

Equation (3.4) then, becomes,

$$\Delta LARGDP_t = \gamma\mathcal{E}_{t-1} + \sum_{i=1}^{p-1}\theta_i\Delta ARGDP_{t-i} + \sum_{j=0}^{q1-1}\delta_j^+\Delta NER_{t-j}^+ + \sum_{j=0}^{q2-1}\delta_j^-\Delta NER_{t-j}^- + \sum_{j=0}^{q3-1}\lambda_j INR_{t-j} +$$
$$\sum_{j=0}^{q4-1}\pi_j\Delta INFR_{t-j} + \sum_{j=0}^{q5-1}\phi_j\Delta MCU_{t-j} + \mu_t \qquad (3.7)$$

Where:

Δ = first difference operator;
t = time period;
LARGDP = Logged share of agriculture in real GDP;
$\mathcal{E}_{t-1}$ = error correction term
NER = nominal exchange rate; NER^+ = Positive changes in nominal exchange rate (representing depreciation); NER^- = Negative changes in nominal exchange rate (representing appreciation);

INR = Interest rate (a proxy for the role of monetary policy in the agricultural sector development)

INFR = Inflation rate (as a control variable)

MCU = Average manufacturing capacity utilization % (to account for intersectoral linkage)

θ_i, δ_j^+, δ_j^-, λ_j, π_j, ϕ_j, are short run parameters, while β_1,………, β_4 are long run parameters.

p is the lag length for the dependent variable, while $q^1,\ldots,q^4$ are the lag lengths associated with the explanatory variables, and μ = random error term.

3.1 A priori Expectations/Expected Results

The preposition of economic theory regarding the relationship between each of the characteristics of the explanatory factors and the dependent variable serves as the foundation for the a priori expectations. The short run and long run relations of these parameter coefficients are respectively shown as:

$\delta^{+}_j > 0$ or < 0, $\delta^{-}_j > 0$ or < 0, $\lambda_j < 0$, $\pi_j > 0$, $\phi_j > 0$,

$\beta^{+}_1 > 0$ or < 0, $\beta^{-}_1 > 0$ or < 0, $\beta_2 < 0$, $\beta_3 > 0$, $\beta_4 > 0$,

Theoretical speculation suggests that an increase or reduction in agricultural output may result from an appreciating currency. Devaluation or appreciation of a currency's exchange rate has similar effects on agricultural production. As the cost of borrowing money rises, it is anticipated that agricultural output would fall as a result of an increase in interest rates. Higher prices for agricultural produce are anticipated to boost production and supply, therefore increasing the inflation rate. Similarly, an increase in average manufacturing capacity utilization is expected to increase agricultural productivity because of the link between the agricultural sector and the manufacturing sector.

4 Empirical Analysis

4.1 Descriptive Statistics

The descriptive statistics for the five variables in this study are summarised in Table 4.1, which spans the years 1981 through 2021 and represents 41 years of data. The average value of the exchange rate is close to 116.52%, whereas the average value of the log of agricultural real GDP is close to 8.8%. Standard deviations of the series from their respective means show that the exchange rate was the most volatile (approximately 108.78%), and the log of real agricultural GDP was the least volatile (approximately 0.73%).

Table 4.1: Summary of Descriptive Statistics

Variable	No of Obs.	Mean	Maximum	Minimum	Std. Dev
LARGDP	41	8.7989	9.8383	7.7422	0.7271
NER	41	116.5188	403.0000	0.6100	108.7793
INR	41	17.2517	29.8000	7.7500	4.6270
INFR	41	18.9334	72.8400	5.3800	16.6654
MCU	41	11.7708	14.1637	8.2316	1.9702

Source: Author's computation

4.2 Unit Root Test Result

The assumption behind the unit root test is, of course, that a series has a unit root. Table 4.2 shows that the only variable that passed the Augmented Dickey Fuller (ADF) unit root test and remained stable at levels was the inflation rate (INFR). When we differentiated the dependent variable, the other four variables (agricultural real GDP, average manufacturing capacity utilization, the nominal exchange rate, and the interest rate) remained unchanged.

Table 4.2: ADF Unit Root Test Result

Variable	ADF Statistics			Probability		I(d)
	5% Critical val	Levels	First Difference	Levels	First Difference	
ARGDP	-3.526609	-1.918614	-5.619461***	0.6263	0.0002	I(1)
NER	-3.526609	-0.368921	-5.285607***	0.9855	0.0006	I(1)
INR	-3.526609	-0.368921	-5.285607***	0.9855	0.0006	I(1)
INFR	-3.529758	-4.097623***	Ψ…….	0.0133	Ψ…….	I(0)
MCU	-3.529758	-1.608017	-3.568379***	0.7715	0.0082	I(1)

Please take notice that ***, **, and * indicate that the unit root hypothesis was rejected at the 1%, 5%, and 10% levels, respectively. The number of iterations via differentiation that must occur until a series becomes stationary is denoted by the order of integration, I(d). Only intercept models are considered.

Source: Author's computation

4.3 The ARDL Bounds Test for Cointegration Results

After learning about the time series, we validated the long-term connection. The null hypothesis of no cointegration between the variables underlies the Bounds test for cointegration. Using the Autoregressive Distributed Lag (ARDL) model and the Bounds test, we checked for long-term correlations between the series. Because it influences the outcome of the ARDL processes, the lag time was selected with care. This research followed the recommendation of Pesaran et al. (2001) and used AIC to establish the time lag. Therefore, the selected ARDL model (2,3,4,4,3) was used to investigate the long-term relationship between each variable. Non-linear findings from the Bounds test for cointegration between agricultural production and its possible drivers (positive and negative changes in exchange rate, FDI, interest rate, and inflation rate) are shown in Table 4.3. The long-term relationship between agricultural production and its causes is supported by the fact that the F-statistic of 5.607080 is larger than the upper I(1) critical bound of 4.37 at the 1% level of significance.

Table 4.3: ARDL Bounds Test for Cointegration Result

F-statistic = 5.607080; No. of Parameters K = 4		
	Critical Bounds Values	
Level of Significance	Lower Bounds I(0)	Upper Bounds I(1)
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

Source: Author's computation

4.4 Estimation and Discussion of Results

4.4.1 Long Run Estimate of the NARDL Model

After confirming the existence of a long-term relationship between the variables, we proceeded to estimate the long-run coefficient estimates in Equation (3.2). We evaluated long-run elasticities using the AIC. Table 4.4 displays the results of NARDL's long-term estimations of the model's parameters. There was a dissection of the exchange rate's ups and downs. Table 4.4 shows that at the 5% level (0.0354), the positive coefficient of 0.001100 for the exchange rate denoting depreciation or devaluation of the Naira over the U.S. dollar is statistically significant. This indicates that RAGDP benefited greatly from the decline of the currency over time. This finding accords with what one would expect from a purely economic standpoint. However, the exchange rate was judged to be statistically significant at the 5% level (-0.087991), indicating that the Naira had appreciated against the US dollar. This indicates that a higher exchange rate was the long-term driver of a higher RAGDP. The precise figure is an 8.8 percent increase in real agricultural GDP for every unit decline in the exchange rate. At the 5% significance level, the interest rate coefficient was positive (0.391737), but the t-test showed no significant relationship (0.6104). Contrary to what may be assumed a priori, an increase of one percentage point in interest rates resulted in a 0.39173% increase in agricultural real GDP. High lending rates in Nigeria appear to have contributed to the long-term expansion of the agricultural real domestic product in that nation. There was no statistically significant relationship between the inflation rate and its negative coefficient (-.092174) at the 5% level (0.5772). The result conforms to what was expected going in, and it shows that inflation decreases agricultural GDP by 0.9% per unit increase in inflation over the long run. Manufacturing capacity utilization was positive (0.013067) and statistically significant at the 5 percent level of significance (0.0351) based on the coefficient and probability value respectively. This implies that a unit increased in manufacturing capacity utilization increased real agricultural GDP by 1 percent in the long run.

Table 4.4: Long Run Regression Result

Dependent Variable: LARGDP				
Variable	Coefficient	Std. Error	t-Statistics	Probability
NER_POS	0.001100	2.67E-05	41.21086	0.0154
NER_NEG	-0.087991	0.003326	-26.45765	0.0241
INR	0.391737	0.753849	0.519649	0.6104
INFR	-0.092174	0.161960	-0.569120	0.5772
MCU	0.013067	0.000722	18.10486	0.0351
C	14.64121	17.53933	0.834765	0.4161

Source: Author's computation

4.4.2 The Error Correction Regression Model

Short-term and long-term projections for the ARDL and ECM are displayed in Table 4.5, respectively. The ECM is represented by the notation CointEq(-1). The ECM model examines the rate of adjustment in response to deviations from the long-run equilibrium and aims to capture the short-term dynamics of exchange rate and agricultural production. When about 43% of the long-run disequilibrium is rectified by lag-period error shocks, the coefficient of the error correction component is negative and statistically significant. Adjusted $R^2 = 0.965652$ indicates that about 97% of the variance in ARGDP was well captured by the model's explanatory factors.

The inclusion of a negative autoregressive coefficient, or lag coefficients, for the agricultural output share indicated that the computation of the agricultural element of real GDP was not adaptive. At the 5% level of significance, all of the coefficients are significant. Real agricultural output has a major negative influence on itself in the short to medium term. Exchange rate depreciation was negative in the reporting year and the first, second, and third lags (-0.000852, -0.001620, -0.003691, and -0.000101, respectively), with the exception of the third lag, which was significant at the 10% level.

The study indicated that a drop in the value of one currency compared to another had a significant negative impact on agricultural GDP in the short run. During the reporting period, the first lag was 0.108603, the second lag was -0.046579, the third lag was -0.076781, and the fourth lag was -0.084302 (p=0.0044, p=0.0082, p=0.0042, and p=0.0049, respectively), in contrast to the negative exchange rate. This result suggests that short-term negative exchange rate coefficients had a larger beneficial influence on real agricultural GDP in the reporting year than long-term positive exchange rate coefficients.

Table 4.5 displays the negative impact on agricultural real GDP in the first, second, and third lag years due to a shift in interest rates. According to these numbers, real GDP or output in agriculture dropped by nearly 4% for every unit rise in interest rates in the first and second lag years, and by about 2% in the third lag year. Table 4.5 shows a similar trend, showing that higher inflation rates had a moderately negative effect on agricultural real GDP in the current year, but a substantially more severe effect in the first, second, and third lagged years. This finding suggests that for every one-unit rise in inflation, agricultural real GDP or output declined by around 0.6% in the first and second lagged years and by about 0.2% in the third lagged year. Manufacturing capacity utilization was found negative in the reporting year as well as the first and second lags (-0.008120, -0.010035, and -0.020543) respectively and were all statistically significant at the 5 percent levels of significance (0.0098, 0.0127 and 0.0057) respectively. This result connotes that manufacturing capacity utilization had significant negative impact on agricultural output in the short run. This also means that, there is negative inter-sectoral linkage between manufacturing and agricultural sectors in Nigeria in the short run. This outcome could be attributed to other factors not covered in this study, such as poor electricity supply and other government policies bedevilling the manufacturing sector in Nigeria.

With respect to the post estimation results, since all of these post-estimation outcomes had probabilities over the 0.05 criterion, we may conclude that the model did not display non-serial correlation in the residuals, non-normality of the residuals, or non-constant residual variance. This means that the asymmetric effect model is sufficient for making policy suggestions.

Table 4.5: Short Run Error Correction Regression Result

| Dependent Variable: LRAGDP				
Variable	Coefficient	Std Error	t-Statistics	Probability
D(LARGDP(-1))	-0.358112	0.149040	-2.402788	0.0288
D(NER_POS)	-0.000852	1.57E-05	-54.37188	0.0117
D(NER_POS(-1))	-0.001620	2.62E-05	-61.85776	0.0103
D(NER_POS(-2))	-0.003691	2.89E-05	-127.5422	0.0050
D(NER_POS(-3))	-0.000101	1.69E-05	-5.951011	0.1060
D(NER_NEG)	0.108603	0.000746	145.6576	0.0044
D(NER_NEG(-1))	-0.046579	0.000601	-77.50932	0.0082
D(NER_NEG(-2))	-0.076781	0.000508	-151.1548	0.0042
D(NER_NEG(-3))	-0.084302	0.000651	-129.4751	0.0049
D(INR)	-0.000455	0.004876	-0.093402	0.9267
D(INR(-1))	-0.038183	0.007329	-5.210208	0.0001
D(INR(-2))	-0.039572	0.007248	-5.460035	0.0001
D(INR(-3))	-0.024967	0.005602	-4.457091	0.0004
D(INFR)	-0.000238	0.000861	-0.276746	0.7855
D(INFR(-1))	-0.005562	0.001482	-3.753005	0.0017
D(INFR(-2))	-0.006240	0.001557	-4.006883	0.0010
D(INFR(-3))	-0.001935	0.000948	-2.040804	0.0581
D(MCU)	-0.008120	0.000124	-65.23956	0.0098
D(MCU(-1))	-0.010035	0.000199	-50.30550	0.0127
D(MCU(-2))	-0.020543	0.000185	-111.2717	0.0057
CointEq(-1)*	-0.428397	0.015525	-16.4216	0.0041
Adjusted R^2	0.965652			
F-statistic	191.9985[0.000000]			
Breusch-Godfrey Serial Correlation LM test	0.2624 [0.4000]			
Breusch-Pagan-Godfrey Heteroskedasticity test	0.1142 [0.0824]			
Wald test for asymmetry	0.9739 [0.3409]			

Source: Author's computation
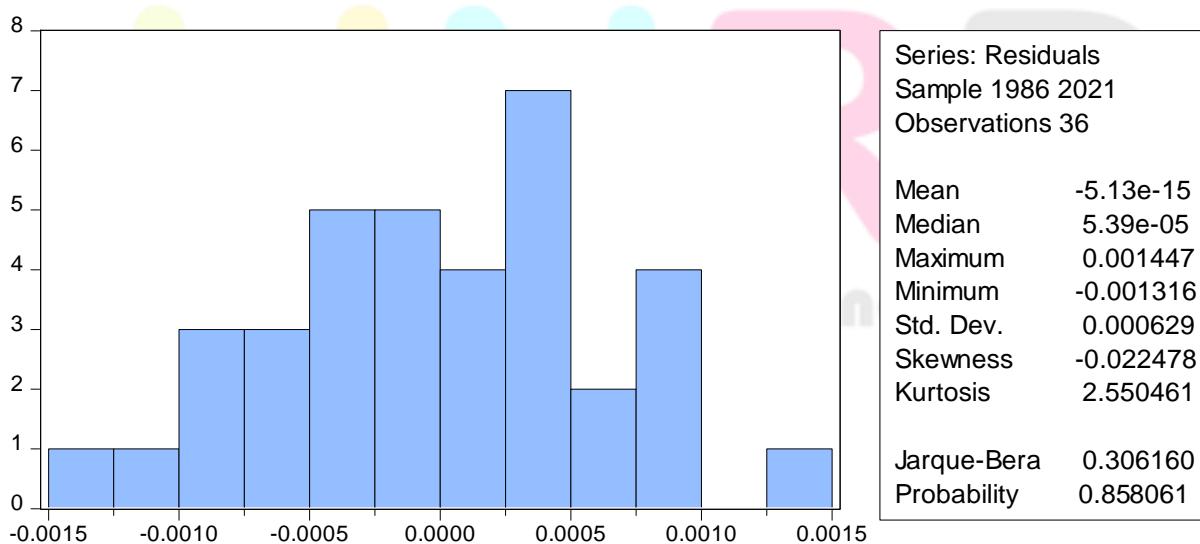
Figure 4.1 Jarque-Bera Test for Residual Normality

In figure 4.1 the Jarque-Bera result of 0.306160 with a probability value of 0.858061 > 0.05 requires the retention of the null hypothesis of normality of the residuals. Thus, the parameter estimates of NARDL model used in this study are suitable for forecasting.

5 Conclusion

The agricultural sector is vital to the nation's economy. It serves several functions in Nigeria, including food supply for the populace, a source of income for a sizable section of the domestic labour force, a supplier of raw materials for industrial production, and a generator of foreign exchange revenues for the government. However, due to the country's abundance of natural resources like crude oil, the agriculture sector is vulnerable to the fluctuations in the exchange rate caused by international financial markets. This analysis looked at how changes in the value of the naira relative to dollar affects agricultural production. In order to contribute to the current body of information for the time period between 1981 and 2021, this study employed the Dutch Disease Syndrome theoretical framework through the use of the non-linear autoregressive distributed lag (NARDL) method for Nigeria. This research shows that while the long-term effect of the exchange rate on agricultural output in Nigeria is symmetrical, the short-term effect is asymmetrical.

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5.1 Recommendations

following the findings of this study, the following recommendations for policy options could be pertinent:

(i) It is suggested that, as part of its efforts to diversify the economy, the Nigerian government investigates the sector's increased competitiveness. Exchange rates have a positive long-term influence on agricultural productivity. In other words, the agriculture business may provide a method for the government to diversify its revenue sources.

(ii) Local raw material procurement should be prioritised in order to absorb the beneficial spill over inherent in forward and backward inter-sectoral connections; doing so will cut imported inflation, total inflation in Nigeria, and the strain on foreign exchange.

(iii) Genuine farmers should be eligible for low-interest loans and inputs from the Nigerian government at all levels. Inputs and financial facilities should be available at the appropriate times and in the appropriate quantities through agricultural cooperatives. This is because, in the past, most of the Nigerian government's agricultural operations had failed owing to insufficient money and input supply. Furthermore, the participation of ghost farmers in such programmes would be confirmed and prevented by utilising legal, pre-existing farmers' cooperatives. This will raise agricultural output, reduce food inflation, and increase agriculture's contribution to national GDP.

(iv) Interest rates should not be permitted to fall below a specific level in order to allow for the influx of both local and international direct savings and investment in the agricultural sector. This would assist to maximise the sector's potential via competition, which will encourage agricultural enterprises to list on the Nigerian market (NGX) and strengthen the relationship between agriculture and manufacturing in Nigeria.

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