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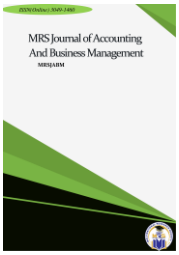

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IMPACT OF AGRICULTURE EXPORT ON EXCHANGE RATE IN NIGERIA (1986-2024)

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Abstract: This study analyzed the effect of exchange rate volatility on Nigeria's agricultural exports using annual time series data spanning 1986 to 2024. The Auto-Regressive Distributed Lag (ARDL) approach was applied for the analysis. The Bounds test for cointegration established a long-run relationship among the variables. Long-run results showed a significant negative impact of the exchange rate on agricultural exports. In the short run, the exchange rate had an immediate negative and significant effect, while lagged exchange rates exhibited a significant positive impact. The study also identified that agricultural land, labor force, machinery, bank loans to agriculture, and global agricultural commodity prices positively and significantly affect agricultural exports, whereas oil prices exert a significant negative influence. Based on these results, the study recommends that the government adopt policies to stabilize the exchange rate to boost the performance of Nigeria's agricultural sector.

Keywords: *Exchange rate, Agricultural export, World price of agricultural exports commodities, Agricultural machineries, Nigeria.*

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Introduction

Agriculture was the cornerstone of Nigeria's economy before and shortly after independence, contributing approximately 63.5% to total output in 1960 (CBN, 2019). However, the discovery and commercial exploitation of oil since the 1970s significantly reduced agriculture's dominance. Several factors, including exchange rate policies, have been cited as contributors to this decline. The exchange rate, a critical macroeconomic variable, influences other economic indicators, impacting overall economic performance (Adebayo & Ojo, 2022). Its fluctuations have profound effects on the real sector, including agricultural exports, due to their implications for trade balances and economic output (Omojolaibi & Egwaikhide, 2023).

Prior to the 1986 Structural Adjustment Programme (SAP), Nigeria operated a fixed exchange rate regime, leading to an overvalued naira. This overvaluation caused balance of payments issues, capital flight, and depletion of external reserves, adversely affecting agricultural exports. Data indicate that agricultural exports' share in total exports fell from 29.94% in 1970 to 4.68% in 1975 and 2.40% in 1980 (CBN, 2020). The SAP introduced exchange rate liberalization, devaluing the naira to boost export competitiveness, particularly in agriculture. Despite this, agricultural exports remained low, with shares of 5.23% in 1987, 2.21% in 1990, 1.63% in 1995, 0.48% in 2000, 0.61% in 2005, 1.18% in 2010, 1.85% in 2014, and 3.35% in 2020 (CBN, 2022).

Theoretically, currency depreciation should enhance exports by making them cheaper, increasing foreign income and domestic investment, thus boosting productivity. Conversely, currency appreciation increases imports, reduces exports, and hampers economic performance (Olayiwola & Okonkwo, 2021). Stable exchange rates are associated with positive economic outcomes, while volatility disrupts performance (Akinyemi & Adebayo, 2023). However, the persistent underperformance of agricultural exports despite exchange rate reforms raises questions about the effectiveness of these policies in Nigeria.

Empirical studies on the exchange rate's impact on Nigerian agricultural exports yield conflicting results. Some studies, such as Adebayo and Ojo (2022) and Omojolaibi and Egwaikhide (2023), find a significant negative effect, suggesting that exchange rate depreciation may not always benefit agricultural exports due to low price elasticity. Conversely, studies like Okon and Etim (2021) and Gatawa and Yusuf (2022) report a significant positive impact, indicating that depreciation can stimulate exports under certain conditions. These mixed findings highlight an unresolved empirical debate regarding the exchange rate's role in Nigeria's agricultural sector performance.

This study aims to investigate the impact of exchange rate fluctuations on Nigeria's export trade, with a specific focus on

agricultural exports. It also examines the structural effects of exchange rate policies during pre- and post-deregulation periods. The findings will provide insights into how exchange rate variations affect the agricultural sector, aiding policymakers in designing effective exchange rate strategies to enhance agricultural export performance. The study is organized into five sections: this introduction, followed by the theoretical framework and literature review, methodology, empirical analysis, and conclusion with policy recommendations.

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Theoretical framework

This study adopts an eclectic theoretical foundation, drawing on the Heckscher-Ohlin factor endowment theory and the elasticity theory to analyze agricultural exports in Nigeria.

Elasticity Theory

The elasticity theory, independently proposed by Alfred Marshall (1923) and Abba Lerner (1944), explains the impact of currency devaluation on a country's balance of payments, particularly in cases of trade imbalances (Obadan, 2022). Central to this theory is the Marshall-Lerner condition, which states that currency devaluation improves the trade balance if the sum of the absolute values of price elasticities of export supply and import demand exceeds one (Krugman, Obstfeld & Melitz, 2022). When this condition is met, devaluation makes exports cheaper and imports more expensive, potentially enhancing the trade balance. For Nigeria, this implies that exchange rate devaluation could boost agricultural exports by improving competitiveness, provided the elasticity condition is satisfied (Omojolaibi & Egwaikhide, 2023). Mathematically, the Marshall Lerner condition can be expressed as follows:

$$e_x + e_m > 1 \quad \text{- - - - - - - - (1)}$$

Where:

ex = Supply elasticity of exports em = Demand elasticity of imports

At any point, if the sum of price elasticities of supply for exports and demand for imports in absolute terms, is less than one, ie. ex + em < 1, then devaluation of currency may lead to a worsening balance of payments. However, if the sum of the price elasticities of supply for exports and demand for imports is equal to one, i.e ex + em = 1, then devaluation of currency has no impact on the trade balance (Jhingan, 2005).

From the theoretical exposition, devaluation of currency will cause import prices to rise, thereby making imports to fall and exports to increase. At the same time, exchange rate devaluation could stimulate domestic production for exports because of the increase in profitability of exports in domestic monetary terms. Thus, with the fall in imports and an increase in exports, the balance of trade is likely to improve (Nyong, 2005). However, the benefits of devaluation may not be instantaneous due largely to policy lag. Thus, there is agreement among economists that both demand and supply elasticities will be greater in the long run than in the short run. This is so because it will take some time for both consumers and producers to adjust fully to the policy actions of the government (Jhingan, 2005). This makes Marshall-Lerner condition to be satisfied in the long run rather than in the short run. In this way, devaluation of currency seems to have a worsening effect on the trade balance in the short run but improvement in the trade balance in the long run, thereby giving rise to the J-curve effect of devaluation (Jhingan, 2005). The elasticity approach to the balance of payments predicts that there is a short run negative effect of exchange rate on trade balance and a positive effect of exchange rate on trade balance in the long run.

Heckscher-Ohlin Factor Endowment Theory

Developed by Eli Heckscher and Bertil Ohlin in 1933, the Heckscher-Ohlin theory posits that countries should specialize in producing and exporting goods that utilize their abundant and cost-effective factors of production, while importing goods that require scarce resources (Salvatore, 2020). The theory emphasizes that countries differ in their endowments of production factors—such as labor, land, capital, and natural resources—and that commodities vary in the factor inputs needed for their production. Consequently, a country can produce goods more efficiently if they rely on its abundant resources. In the context of Nigeria, which is richly endowed with land, labor, and natural resources, this theory suggests that the agricultural sector, a key economic activity, should leverage these abundant factors to produce commodities for export (Appleyard & Field, 2021).

Conceptual Issues

Exchange Rate

The exchange rate represents the rate at which one country's currency can be exchanged for another's, serving as a critical indicator of a nation's economic health and its currency's purchasing power relative to others (Omojolaibi & Egwaikhide, 2023). It reflects the external value of a currency, influenced by factors such as inflation, interest rates, and overall economic conditions. For instance, a country with stable economic policies and low inflation typically has a stronger currency, facilitating predictable international trade transactions (Adebayo & Ojo, 2022).

In international trade, the exchange rate introduces a layer of uncertainty for traders, as it determines the value of foreign earnings when converted into domestic currency (Adubi & Okunmadewa, 2019). Fluctuations in exchange rates can significantly affect the profitability of exports and imports, impacting decisions on pricing, production, and market competitiveness. For agricultural exporters in Nigeria, exchange rate volatility can alter the revenue from foreign sales, making it a pivotal factor in trade performance (Okon & Etim, 2021).

Exchange rate policies, whether fixed or floating, shape a country's trade dynamics. In Nigeria, historical overvaluation of the naira under a fixed regime led to trade imbalances, while post-1986 liberalization aimed to enhance export competitiveness through devaluation (CBN, 2022). Understanding the exchange rate's role is essential for formulating policies that stabilize the economy and support sectors like agriculture, which rely heavily on export markets to drive growth (Akinyemi & Adebayo, 2023).

Agricultural Export

Agricultural exports refer to the trade of farm-produced goods, such as crops, livestock, and processed agricultural products, to international markets, often incentivized by government policies to boost economic growth and global trade participation (FAO, 2023). These exports are critical for countries like Nigeria, where agriculture remains a significant economic

sector despite the dominance of oil. Government support, such as subsidies or tax incentives, aims to enhance the competitiveness of agricultural products in global markets, encouraging farmers to produce for export (FTIS, 2021).

Support for agricultural exports can take various forms, including direct cash payments, subsidized inputs, or reduced transportation costs, all designed to lower production expenses and improve market access (World Bank, 2022). For instance, Nigeria's export promotion programs have historically included freight subsidies and incentives for commodities incorporated into exported goods, aiming to increase foreign exchange earnings. However, the effectiveness of these measures depends on factors like exchange rate stability and global commodity prices, which influence export profitability (Gatawa & Yusuf, 2022).

The promotion of agricultural exports is vital for economic diversification, particularly in oil-dependent economies like Nigeria, where over-reliance on oil has marginalized agriculture's contribution to export revenue (CBN, 2022). By fostering agricultural exports, governments aim to enhance rural development, create jobs, and improve trade balances. Yet, challenges such as inadequate infrastructure, limited access to credit, and global market fluctuations often hinder the sector's ability to achieve its full export potential (Omojolaibi & Egwaikhide, 2023).

Performance

Performance, in the context of firms or economic sectors, refers to the value generated from specific activities, reflecting the efficiency and effectiveness with which resources are utilized to achieve organizational goals (Taticchi, Balachandran & Tonelli, 2010). For agricultural firms or the broader agricultural sector in Nigeria, performance is measured by output, export volumes, and contributions to economic growth. High performance occurs when resources—such as land, labor, and capital—are optimally used to produce outcomes that exceed expectations, ensuring sustainability and competitiveness (Salvatore, 2020).

In competitive markets, performance is closely tied to a firm's ability to adapt to changing economic conditions, such as shifts in exchange rates or global demand for agricultural products (Krugman, Obstfeld & Melitz, 2022). Since the mid-1980s, firms have increasingly focused on performance metrics to navigate dynamic market environments, aiming to maximize profits and market share. For agricultural exporters, performance is enhanced by leveraging technology, improving productivity, and accessing global markets, all of which contribute to long-term viability (Adebayo & Ojo, 2022).

Understanding and measuring performance is critical for strategic planning and policy formulation. Firms that monitor performance indicators—such as export revenue, production efficiency, and market penetration—can better respond to challenges like policy shifts or economic volatility (Taticchi et al., 2010). In Nigeria's agricultural sector, performance is influenced by factors like government support, infrastructure, and exchange rate policies, making it essential to align these elements to achieve sustainable growth and enhance export contributions to the national economy (Okon & Etim, 2021).

Empirical studies

Numerous studies have been conducted to investigate the impact of exchange rate on agricultural exports using various methods. Oyejide (1986) examined effects of trade and exchange rate policies on Nigeria's agricultural export over the period 1960-1982 using Ordinary Least Squares (OLS) and concludes that appreciation of real exchange rate adversely influences to non-oil export especially during the oil boom. Employing the extended vector auto regressive (EVAR) as well as the ARIMA model, Adubi and Okunmadewa (1999) analyzed the effect of price and exchange rate volatility on Nigeria's agricultural trade flows, utilizing quarterly data covering the period 1986-2003. The results of the study showed that exchange rate volatility has a negative effect on agricultural exports in Nigeria. Employing the ordinary least square (OLS) regression method, Ettah, Akpan and Etim (2011) analyzed the effects of price and exchange rate fluctuations on agricultural exports in Nigeria with emphasis on export of cocoa. The results revealed that exchange rate volatility has a significant positive impact on export of cocoa in Nigeria. Babatunde and Shuaibu (2012) empirically examined the effect of real exchange rate on agricultural export in Nigeria using annual time series data covering the period 1980 to 2007. The study employed the Auto-Regressive Distributed Lag (ARDL) technique estimation technique. Results of the short run and long run estimates found that real exchange rate depreciation has a short run and long run positive relationship with agricultural exports while real exchange rate volatility has a negative relationship with agricultural exports in Nigeria. Employing the Auto-Regressive Distributed Lag (ARDL) technique, Gatawa and Mahmud (2017) investigated the effect of exchange rate on agricultural exports in Nigeria, using annual time series data from 1981 to 2014. Result of their study showed that exchange rate has positive impact on agricultural exports volume in Nigeria. Akinniran and Olatunji (2018) examined the effects of exchange rate on agricultural exports as well as the total agricultural export in Nigeria, using data from 1985 to 2010 and employing the Ordinary Least Squares (OLS) estimation technique. Result of the study showed that exchange rate has a significant negative effect on agricultural exports in Nigeria. Akinbode and Ojo (2018) evaluated the effect of exchange rate volatility on agricultural exports in Nigeria from 1980 to 2015 and employing the Auto-Regressive Distributed Lag (ARDL) technique. Results showed that exchange rate volatility has negative and insignificant effect on agricultural exports in Nigeria.

Researchers outside Nigeria have also investigated the effect of exchange rate on agricultural exports. Using structural vector autoregressive (VAR) estimation technique, Shane, Roe and Somwaru (2008) investigate the relationship between exchange rate, foreign income and the United States agricultural exports, utilizing annual time series data from 1980 to 2006. The VAR estimates showed that there is a significant negative effect of exchange rate on aggregate U.S. agricultural exports. Hashemi-Tabar and Akbari (2009) examined the link between agricultural exports and exchange rate volatility in Iranian economy using annual time series data covering the period 1956 to 2006. The authors employed the vector error correction (VEC) modeling technique and found that exchange rate volatility had an adverse effect on agricultural exports in Iran. Abule and Abdi (2012) investigated the impact of exchange rate variability on export of Ethiopia's agricultural products, utilizing annual time series data covering the period 1992-2010 and employing the Autoregressive Distributive Lag (ARDL) modeling technique. Results indicated the existence of a negative relationship between oilseeds and exchange rate variability. Using the granger causality analysis, Meusavi and Leelavathi (2013) examine the causal nexus between

exchange rates and agricultural exports in India, employing annual time series data from 1980 to 2010. The granger causality test showed no causality relationship between exchange rate and agricultural exports. This means that exchange rate does not predict significantly agricultural exports in India. Saeid and Leelavathi (2013) investigated the causal relationships between agricultural exports and real exchange rate in India, using time series data between 1980 and 2010 and employing the Granger causality analysis. The results revealed that there is no significant relationship between quantity of agricultural export and real exchange rate during the period under evaluation implying that both variables do not cause each other in either direction.

The preceding review of empirical studies showed that many studies have been carried out on the effect of exchange rate on agricultural exports within and outside Nigeria, using different methods and time frame. This study however used a longer time frame with recent data (1970-2020) for its investigation. Starting analysis from 1970 covers both the fixed exchange rate regimes and the liberalized/flexible exchange rate regimes. In addition, this study conducted breakpoint test to ascertain structural change effect of exchange rate on agricultural exports in Nigeria. This represents a departure from the previous studies.

METHODOLOGY

Empirical Model

This study's empirical model integrates the Heckscher-Ohlin factor endowment theory and the elasticity theory to analyze aggregate agricultural exports in Nigeria. The model specifies aggregate agricultural exports (AGXP) as the dependent variable, influenced by independent variables including exchange rate (EXR), agricultural land (AGL), agricultural labor force (ALF), agricultural machinery (AGM), bank loans and advances to agriculture (BLA), oil price (OLP), and the average world price of agricultural commodities (WPA).

The Heckscher-Ohlin theory posits that countries with abundant production factors (land, labor, capital) should specialize in commodities utilizing those resources, suggesting that increases in AGL, ALF, and AGM enhance agricultural production and exports. The elasticity theory informs the inclusion of EXR, where currency devaluation could improve trade balance if the sum of export supply and import demand price elasticities exceeds one, though low elasticity may lead to a negative effect on agricultural exports. BLA is expected to boost agricultural productivity and exports by increasing investment. OLP, reflecting Nigeria's oil-dependent economy, is anticipated to negatively impact agricultural exports, as rising oil prices shift focus to oil exports. WPA, aligned with the law of supply, incentivizes higher production for export when global prices rise.

Model Specification

Following Gatawa and Mahmud (2017) and Tadesse and Badiane (2018) with modifications, the functional form of the model is:

$$AGXP = f(AGL, ALF, AGM, BLA, EXR, OLP, WPA)$$

The explicit form is:

$$AGXP = \beta0 + \beta1AGL + \beta2ALF + \beta3AGM + \beta4BLA + \beta5EXR + \beta6OLP + \beta7WPA + \varepsilon$$

The logarithmic form is:

$$\ln(AGXP) = \beta0 + \beta1\ln(AGL) + \beta2\ln(ALF) + \beta3\ln(AGM) + \beta4\ln(BLA) + \beta5\ln(EXR) + \beta6\ln(OLP) + \beta7\ln(WPA) + \varepsilon$$

Where:

- AGXP = Aggregate agricultural exports (billion naira)
- AGL = Agricultural land (square kilometers)
- ALF = Agricultural labor force (millions)
- AGM = Agricultural machinery (number of tractors)
- BLA = Bank loans and advances to agriculture (billion naira)
- EXR = Exchange rate (naira per US dollar)
- OLP = Oil price (dollars per barrel)
- WPA = Average world price of agricultural commodities (naira per ton)
- ε = Error term

A Priori Expectations

- $\beta1, \beta3, \beta4, \beta7 > 0$: Increases in AGL, ALF, AGM, and WPA should positively affect AGXP.
- $\beta5, \beta6 < 0$: EXR depreciation may negatively affect AGXP due to low elasticity, and higher OLP shifts focus to oil exports, reducing AGXP.

Data Sources

Data were sourced from secondary databases, including the Central Bank of Nigeria (CBN) Statistical Bulletin (various years), CBN Annual Reports and Statements of Accounts (various years), and the World Bank Datasheet, covering 1986–2024 on an annual basis.

Estimation Method and Procedures

The Autoregressive Distributed Lag (ARDL) approach by Pesaran, Shin, and Smith (2001) was employed due to its suitability for mixed I(0) and I(1) integration orders and small sample sizes (Latif, Abdullah & Razdi, 2015).

Unit Root Tests

To avoid spurious regression, unit root tests were conducted using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The ADF test is specified as:

$$\Delta Xt = \alpha0 + \alpha1Xt\text{-}1 + \Sigma\beta i\Delta Xt\text{-}i + et$$

The PP test is specified as:

$$Xt = \delta0 + \delta1Xt\text{-}1 + \upsilon t$$

Where et and υt are error terms. If $\alpha1 = 0$ (ADF) or $\delta1 = 1$ (PP), the null hypothesis of non-stationarity is accepted; otherwise, it is rejected.

Cointegration Test

The Bounds test (Pesaran et al., 2001) assesses long-run relationships among variables, specified as:

$$\Delta\ln(AGXP)t = \alpha0 + \Sigma\alpha1\Delta\ln(AGXP)t\text{-}i + \Sigma\alpha2\Delta\ln(AGL)t\text{-}i + \Sigma\alpha3\Delta\ln(ALF)t\text{-}i + \Sigma\alpha4\Delta\ln(AGM)t\text{-}i + \Sigma\alpha5\Delta\ln(BLA)t\text{-}i + \Sigma\alpha6\Delta\ln(EXR)t\text{-}i + \Sigma\alpha7\Delta\ln(OLP)t\text{-}i + \Sigma\alpha8\Delta\ln(WPA)t\text{-}i + \alpha9\ln(AGXP)t\text{-}1 + \alpha10\ln(AGL)t\text{-}1 + \alpha11\ln(ALF)t\text{-}1 + \alpha12\ln(AGM)t\text{-}1 + \alpha13\ln(BLA)t\text{-}1 + \alpha14\ln(EXR)t\text{-}1 + \alpha15\ln(OLP)t\text{-}1 + \alpha16\ln(WPA)t\text{-}1 + Ut$$

Hypotheses:

- H0: $\alpha 9 = \alpha 10 = \alpha 11 = \alpha 12 = \alpha 13 = \alpha 14 = \alpha 15 = \alpha 16 = 0$ (no cointegration)
- HA: At least one $\alpha i \neq 0$ (cointegration exists)

The F-statistic determines cointegration: above the upper bound indicates cointegration, below the lower bound indicates none, and between bounds is inconclusive.

Error Correction Model

The short-run dynamics are modeled using the error correction mechanism (ECM):

$$\Delta \ln(AGXP)t = \alpha 0 + \Sigma \alpha 1 \Delta \ln(AGXP)t\text{-}i + \Sigma \alpha 2 \Delta \ln(AGL)t\text{-}i + \Sigma \alpha 3 \Delta \ln(ALF)t\text{-}i + \Sigma \alpha 4 \Delta \ln(AGM)t\text{-}i + \Sigma \alpha 5 \Delta \ln(BLA)t\text{-}i + \Sigma \alpha 6 \Delta \ln(EXR)t\text{-}i + \Sigma \alpha 7 \Delta \ln(OLP)t\text{-}i + \Sigma \alpha 8 \Delta \ln(WPA)t\text{-}i + \lambda ECMt\text{-}1 + Ut$$

Where λ is the error correction coefficient, and ECMt-1 captures the speed of adjustment to long-run equilibrium.

RESULTS

Descriptive Analysis

The descriptive statistics for the analysis of data information about the variables is presented in Table 1. As indicated in the table, the mean values of agricultural exports, agricultural land, agricultural labour force, agricultural machineries, bank loans and advances to agriculture, exchange rate, oil price and average world price of agricultural commodities were ₦164009.4 billion, 620962.2 square kilometers, 12522080 million, 16968.24 thousand, ₦126.28 billion, ₦79.25:$1, $36.09 dollars per barrel and ₦3373.12 per ton, respectively.

Table 1: Descriptive statistics

	AGXP	EXR	ALF	AGM	AGL	BLA	OLP	WPA
Mean	164209.4	79.26451	12532080	16978.24	621062.2	126.3888	36.10843	3374.123
Median	7962.400	21.91000	12318274	16670.00	653774.4	25.30000	27.03000	3503.400
Maximum	3210000.	358.8100	22924572	30825.00	691234.5	1049.678	109.6500	10349.70
Minimum	172.0000	0.551000	3308579.	2900.000	472190.0	0.010000	1.213000	30.03000
Std. Dev.	510937.8	98.24881	5933813.	8517.403	68677.19	229.0210	29.45774	3294.694
Skewness	4.878942	1.184590	-0.057193	0.027310	-0.893521	2.255000	1.106905	0.383677
Kurtosis	27.67279	3.561129	1.991098	1.753127	2.435528	7.744663	3.254691	1.769822

The maximum values for key agricultural metrics were as follows: agricultural exports reached ₦3,210,000.0 billion, agricultural land spanned 691,234.5 square kilometers, the agricultural labor force totaled 22,924,572.0 million, agricultural machinery amounted to 30,825.0 thousand units, bank loans and advances to agriculture hit ₦1,049.68 billion, the exchange rate peaked at ₦358.81:$1, oil prices reached $109.45 per barrel, and the average world price of agricultural commodities was ₦10,347.70 per ton. Conversely, the minimum values were: agricultural exports at ₦172.0 billion, agricultural land at 472,190.0 square kilometers, agricultural labor force at 3,308,579.0 million, agricultural machinery at 2,900.0 thousand units, bank loans and advances to agriculture at ₦0.01 billion, exchange rate at ₦0.55:$1, oil prices at $1.21 per barrel, and average world price of agricultural commodities at ₦30.0 per ton.

Skewness analysis revealed that the distributions of agricultural exports, agricultural machinery, bank loans and advances to agriculture, exchange rate, oil price, and average world price of agricultural commodities were positively skewed, indicating right-tailed asymmetry. In contrast, agricultural land and agricultural labor force distributions exhibited negative skewness. Kurtosis analysis indicated that the distributions for agricultural exports, bank loans and advances to agriculture, exchange rate, and oil price were leptokurtic, with kurtosis values of at least 3, suggesting peaked distributions. Meanwhile, the distributions for agricultural land, agricultural labor force, agricultural machinery, and average world price of agricultural commodities were platykurtic, with kurtosis values below 3, indicating flatter distributions.

Unit root test

The outcomes of the unit root tests, conducted using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) methods, are summarized in Tables 2 and 3. According to the ADF test results, agricultural machinery and oil price were stationary at their level, while the other variables achieved stationarity after their first differencing. Conversely, the PP test indicated that agricultural machinery, bank loans and advances to agriculture, and oil price were stationary at the level, with the remaining variables becoming stationary after their first differences. These unit root test results demonstrate that the variables exhibit mixed orders of integration, justifying the application of the ARDL Bounds testing approach for the cointegration analysis.

Table 2: Augmented Dickey Fuller (ADF) test

	Level	Critical value at 5% level	1st difference	Critical value at 5% level	Remarks
LAGXP	-0.942387	-2.921175	-6.977086	-2.922449	I(1)
LEXR	-0.255813	-2.921175	-5.67399	-2.922449	I(1)
LALF	-1.483177	-2.921175	-7.21391	-2.922449	I(1)
LAGM	-17.26484	-2.921175	-	-	I(0)

LAGL	-1.576899	-2.933158	-2.438182	-2.925169	I(1)
LBLA	-2.239542	-2.921175	-7.50709	-2.922449	I(1)
LOLP	-3.196474	-2.921175	-	-	I(0)
LWPA	-1.383163	-2.921175	-6.593349	-2.922449	I(1)

Table 3: Phillips-Peron (PP) test

Variables	Level	Critical value at 5% level	1st difference	Critical value at 5% level	Remarks
LAGXP	-1.671828	-2.921175	-7.00761	-5.844898	I(1)
LEXR	-0.344891	-2.921175	-5.667251	-5.844898	I(1)
LAGM	-10.56387	-2.921175	-	-	I(0)
LAGL	-0.970609	-2.921175	-7.39264	-2.922449	I(1)
LBLA	-3.536153	-2.921175	-	-	I(0)
LOLP	-3.196474	-2.921175	-	-	I(0)
LWPA	-1.379257	-2.921175	-6.593349	-2.922449	I(1)

Cointegration (Bounds) test

The bounds test results for the presence of a long-run relationship among the variables are shown in Table 4. The calculated F-statistic of approximately 4.46 exceeds the upper critical bound value of 3.50 at the 5% significance level, indicating a long-run equilibrium relationship among the variables in the estimated equation.

Table 4: Bounds test for cointegration

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	4.457260	10%	2.03	3.13
K	7	5%	2.32	3.50
		1%	2.96	4.26

Long run estimates

The result of the long run estimates of the agricultural export-exchange rate nexus equation is shown in Table 5.

Table 5: Long run estimates (Dependent Variable: D(LAGXP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LAGL	5.468819	1.198244	4.564027	0.0018
LEXR	-1.424545	0.199643	-7.135468	0.0001
LAGM	1.761077	0.153742	11.45473	0.0000
LALF	1.247007	0.807112	1.545024	0.1609
LBLA	1.880335	0.117644	15.98325	0.0000
LOLP	-0.936591	0.120941	-7.744176	0.0001
LWPA	0.393448	0.074305	5.295048	0.0007

The findings in Table 5 indicate that agricultural land has a significant positive long-run effect on agricultural exports in Nigeria. An expansion in agricultural land enhances agricultural production, thereby boosting exports over time. Specifically, a 1% increase in agricultural land leads to a 5.47% rise in agricultural exports. Similarly, the agricultural labor force positively influences agricultural exports in the long run, with a 1% increase in the labor force resulting in a 1.24% increase in exports. Additionally, agricultural machinery has a significant positive long-run impact on agricultural exports, as greater use of machinery improves productivity and, consequently, export volumes. A 1% increase in agricultural machinery corresponds to a 1.76% increase in exports. Likewise, bank loans and advances to agriculture significantly enhance agricultural exports in the long run by supporting agricultural investment and output. A 1% increase in such financial support leads to a 1.88% increase in exports, ceteris paribus.

Conversely, exchange rate appreciation and rising oil prices negatively affect agricultural exports in the long run. A 1% appreciation in the exchange rate reduces exports by approximately 1.42%, while a 1% increase in oil prices decreases exports by about 0.94%. On the other hand, the average world price of agricultural commodities has a significant positive long-run effect on Nigeria's agricultural exports. Higher global commodity prices incentivize

farmers to produce more for export, increasing their income. Specifically, a 1% rise in the average world price of agricultural commodities results in a 0.39% increase in agricultural exports.

ARDL error correction estimate

The result of the ARDL error correction equation of the exchange rate – agricultural exports nexus is presented in Table 6. The results as presented in the table showed that the error correction factor has the correct negative sign and is statistically significant as theoretically expected. The magnitude of its coefficient of 0.778 showed that about 78% of the disequilibrium in the estimated equation has been corrected within a year. This is a fast speed of adjustment from short run disequilibrium to long run equilibrium.

Table 6: ARDL error correction result

Dependent Variable: D(LAGXP) Selected Model: ARDL(4, 3, 4, 4, 4, 4, 4, 4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-223.0701	27.34954	-8.156263	0.0000
D(LAGXP(-1))	-3.270281	0.380241	-8.600553	0.0000
D(LAGXP(-2))	-2.293005	0.312580	-7.335733	0.0001
D(LAGXP(-3))	-1.492797	0.220279	-6.776843	0.0001
D(LAGL)	9.498505	2.648975	3.585728	0.0071
D(LAGL(-1))	2.056753	0.275244	7.472465	0.0001
D(LAGL(-2))	8.283699	2.239618	3.698711	0.0061
D(LALF)	1.358859	0.366675	3.705891	0.0060
D(LALF(-1))	2.751952	0.581814	4.729953	0.0015
D(LALF(-2))	2.754065	0.443178	6.214356	0.0003
D(LALF(-3))	3.333810	0.418638	7.963473	0.0000
D(LAGM)	2.512006	0.841184	2.986274	0.0174
D(LAGM(-1))	5.280232	0.761786	6.931383	0.0001
D(LAGM(-2))	4.078728	0.734376	5.554005	0.0005
D(LAGM(-3))	3.263942	0.607528	5.372500	0.0007
D(LBLA)	0.114612	0.203220	0.563979	0.5882
D(LBLA(-1))	3.972535	0.561172	7.078992	0.0001
D(LBLA(-2))	3.157013	0.464760	6.792784	0.0001
D(LBLA(-3))	0.629540	0.280820	2.241788	0.0553
D(LEXR)	-0.822280	0.179005	-4.593606	0.0018
D(LEXR(-1))	2.979768	0.429990	6.929861	0.0001
D(LEXR(-2))	2.174078	0.353838	6.144275	0.0003
D(LEXR(-3))	1.623185	0.215553	7.530322	0.0001
D(LOLP)	-0.418267	0.173997	-2.403873	0.0429
D(LOLP(-1))	2.484104	0.368428	6.742440	0.0001
D(LOLP(-2))	2.086374	0.293364	7.111900	0.0001
D(LOLP(-3))	1.496796	0.265221	5.643585	0.0005
D(LWPA)	1.978117	0.284081	6.963209	0.0001
D(LWPA(-1))	2.375325	0.320232	7.417514	0.0001
D(LWPA(-2))	2.169647	0.307209	7.062446	0.0001
D(LWPA(-3))	0.719818	0.162429	4.431580	0.0022
CointEq(-1)*	-0.778852	0.095252	-8.176729	0.0000
R-squared	0.935427	F-statistic		7.009570
Adjusted R-squared	0.801977	Prob(F-statistic)		0.000122

Durbin-Watson stat	2.260575

The adjusted R-squared value of 0.801 indicates that approximately 80% of the variation in agricultural exports is explained by its determinants, suggesting a strong fit and high explanatory power for the estimated agricultural export model. The F-statistic of 7.009570, with a low probability value of 0.000122, confirms the overall statistical significance of the model at the 5% level, indicating that the independent variables—agricultural land, agricultural labor force, agricultural machinery, bank loans and advances to agriculture, exchange rate, oil price, and average world price of agricultural commodities—collectively influence agricultural exports. The Durbin-Watson statistic of 2.26 suggests no autocorrelation in the model, indicating that the residuals are uncorrelated and the model is well-specified.

Analysis of short-run coefficients reveals that the exchange rate in the current period significantly and negatively impacts agricultural exports in Nigeria. This is expected, as exchange rate appreciation increases costs for farmers, given the reliance on imported non-labor agricultural inputs. Specifically, a 1% appreciation in the exchange rate reduces agricultural exports by about 0.82%, consistent with findings by Akinniran and Olatunji (2018), who confirmed a significant negative effect of exchange rate on agricultural exports. However, lagged exchange rates (one, two, and three periods) positively affect agricultural exports, with a 1% appreciation leading to export increases of approximately 2.98%, 2.17%, and 1.62%, respectively, aligning with Gatawa and Mahmud (2017), who used ARDL techniques to establish a positive impact of exchange rate on agricultural exports.

Other findings indicate that agricultural land significantly and positively affects agricultural exports, as increased land availability boosts production for both domestic and export markets. A 1% increase in agricultural land in the current period, one-period lag, and two-period lag leads to export increases of about 9.49%, 2.06%, and 8.28%, respectively. Similarly, the agricultural labor force has a positive and significant impact, enhancing productivity for domestic and export markets. A 1% increase in the labor force in the current period, one-, two-, and three-period lags results in export increases of approximately 1.36%, 2.75%, 2.75%, and 3.33%, respectively. Agricultural machinery also positively and significantly affects exports, with increased mechanization boosting productivity. A 1% increase in machinery in the current period, one-, two-, and three-period lags leads to export increases of about 2.51%, 5.28%, 4.07%, and 3.26%, respectively.

Bank loans and advances to agriculture have a significant positive impact, as institutional financial support enhances agricultural investment and output, thereby increasing exports. A 1% increase in such loans in the current period, one-, two-, and three-period lags results in export increases of approximately 0.11%, 3.97%, 3.16%, and 0.63%, respectively. Conversely, oil prices in the current period negatively and significantly affect agricultural exports at the 5% significance level, as oil-dependent economies like Nigeria shift focus to oil exports during price surges, reducing agricultural production and exports. A 1% increase in current-period oil prices decreases exports by about 0.42%. However, one-, two-, and three-period lagged oil prices positively affect exports, with a 1% increase leading to export rises of approximately 2.48%, 2.09%, and 1.50%, respectively.

Finally, the average world price of agricultural commodities has a positive and significant impact, incentivizing farmers to increase production for higher income. A 1% increase in the world price in the current period, one-, two-, and three-period lags results in export increases of about 1.98%, 2.38%, 2.17%, and 0.72%, respectively.

Diagnostic Tests

Several diagnostic tests were conducted to investigate the adequacy of the estimated equation. The Breusch-Godfrey serial correlation Lagrange Multiplier (LM) test, and the autoregressive conditional heteroscedastcity (ARCH) test were conducted to check for the existence of the normality of the estimated equation. The Ramsey RESET test was employed to ascertain the stability of the estimated equation. The result of the various diagnostic tests are summarized in Table 7.

Table 7: Diagnostic test

Test statistic	Value(prob.)
Breusch-Godfrey Serial Correlation LM Test	2.997894
	(0.1251)
Breusch-Pagan-Godfrey Heteroscedasticity Test	2.133684
	(0.1296)
Ramsey RESET test	1.660942
	(0.2384)

The Breusch-Godfrey serial LM test value of 2.997894 with a high probability value of 0.1251 showed that the there is no problem of autocorrelation in the estimated equation, hence the series is white noise. The Breusch-Pagan-Godfrey Heteroscedasticity test value of 2.133684 with a high probability value of 0.1296 revealed that there is absence of heteroscedasticity, hence the disturbance terms are normally distributed. The Ramsey RESET test value of 1.660942 with its high probability value of 0.2384 showed that the estimated equation is stable. Based on the various diagnostic tests, we can conclude that the estimated equation is adequate and well-behaved.

The structural change breakpoint test was conducted to ascertain whether exchange rate exerted or not exerted any effect on agricultural export both in the pre-deregulated period and in the post-deregulated period in Nigeria. The result of the structural breakpoint test based on the Chow test is depicted in Table 8.

Table 8: Structural breakpoint

F-statistic	0.533725	Prob. F(8,35)	0.8227
Log likelihood ratio	5.915031	Prob. Chi-Square(8)	0.6567
Wald Statistic	4.269803	Prob. Chi-Square(8)	0.8320

The result of the breakpoint test for structural change as indicated in the table showed that the computed F-statistic value of 0.533725 is less than the tabulated F-statistic of 2.18 at the 5% level of significance. Based on this result, the null hypothesis is accepted, indicating that there is no break at the specified breakpoint. This implies that the estimated parameters in the two sub-groups are equal. Hence, it can be concluded that exchange rate has an effect on agricultural exports both in the pre-deregulated period and in the post-deregulated period in Nigeria.

CONCLUSION AND RECOMMENDATIONS

This study empirically explored the impact of exchange rate fluctuations on agricultural exports in Nigeria. The influence of exchange rate movements on trade balance remains a pivotal topic in international economics, as exchange rate variations—whether appreciation or depreciation—significantly affect overall export performance, particularly in agriculture. Motivated by this, the study examined how exchange rates influence agricultural exports in Nigeria. Findings revealed that exchange rates have an immediate negative and significant effect on agricultural exports. However, with lagged periods, exchange rates positively and significantly impact agricultural exports. Additionally, the study found that agricultural land, labor force, machinery, bank loans and advances to agriculture, and the average world price of agricultural commodities positively and significantly affect agricultural exports, while oil prices have a negative and significant impact.

Based on these results, the study recommends that the government adopt suitable exchange rate policies to promote domestic production of agricultural commodities for export. Stabilizing the exchange rate is crucial to enhancing agricultural sector performance in Nigeria. Effective management of the current naira devaluation could stimulate domestic agricultural production and boost exports, but caution is needed to avoid excessive devaluation, which could hinder imports of essential agricultural machinery and raw materials, potentially reducing agricultural productivity.

The study's analysis focused on the effect of exchange rates on aggregate agricultural exports, which is a limitation. To address this, future research should disaggregate agricultural exports into individual commodities to better understand how exchange rate changes impact specific agricultural export products in Nigeria.

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