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EXCHANGE RATE AND AGRICULTURAL EXPORTS IN NIGERIA

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Abstract

This study examined the effect of exchange rate on agricultural exports in Nigeria, utilizing annual time series data from 1970 to 2020. The estimation technique employed for this study was the Auto-Regressive Distributed Lag (ARDL) technique. Result of the coitegration test based on the Bounds testing approach showed that there was a long run relationship among the variables. Result of the long run estimate showed that exchange rate has a negative and significant effect on agricultural export in Nigeria. Result of the short run estimate showed that exchange rate has an instantaneous negative and significant effect on agricultural exports in Nigeria. On the other hand, result showed that exchange rate has significant positive effect on agricultural exports in Nigeria with some periods lagged. Other results of the study showed that agricultural land, agricultural labour force, agricultural machineries, bank loans and advances to agriculture, and average world price of agricultural commodities have positive and significant effect on agricultural exports in Nigeria, while oil price exerted negative and significant effect on agricultural exports in Nigeria. Based on the results, the study recommended that government should take steps to stabilize the exchange rate so as to facilitate agricultural sector performance in Nigeria.

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

INTRODUCTION

In Nigeria prior to and after independence and even up until 1970, agriculture was the dominant economic activity. Statistics have shown that the share of agriculture in total output was about 63.5 percent in 1960, making it the dominant economic activity during that decade (CBN, 2009). However, this dominant role played by agriculture has since diminished following the discovery and subsequent exploitation of oil in commercial quantities, especially beginning from 1970. The diminished role of agriculture in Nigeria has been blamed on several factors including exchange rate policy. This is so because exchange rate is an important economic variable as its appreciation or depreciation affects the performance of other macroeconomic variables in any economy (Zubair, Burney, Sarwat & Mubin, 2014). The deep attention paid to variations in exchange rate also stems from the fact that its movement has far-reaching implications on the real sector and hence aggregate output in an economy (Enekwe, Ordu & Nwoha, 2013).

Before the adoption of the structural adjustment programme (SAP) in 1986, the Nigerian naira was overvalued under the then fixed exchange rate system. The overvaluation of the naira relative to the major global currencies during the fixed exchange rate regime resulted to balance of payments disequilibrium, capital flight and a drain in the country's external reserves. The fixed exchange rate system also affected the performance of agricultural exports in Nigeria. Evidence from statistics showed that the share of agricultural exports in total exports declined from 29.94% in 1970 to 4.68% in 1975 and further to 2.40% in 1980 (CBN, 2011). However, following the implementation of structural adjustment programme (SAP) in 1986, exchange rate was liberalized in line with the cardinal objectives of SAP. The liberalization of the exchange rate led to the devaluation of the Nigerian naira against other world currencies. The goal of liberalization of the exchange rate was meant to enhance the external sector of the Nigerian economy through expansion of exports, particularly agriculture export. However, statistics have shown that in spite of the liberalization of the exchange rate that the share of agriculture in total exports has remained at a dismal level. Statistical information indicated that the share of agriculture in total exports was 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 2018 (CBN, 2018).

Theoretically, it is argued that depreciation of the exchange rate do promote exports as it makes exports cheaper relative to import. The flow of foreign income arising from increase in exports increases domestic investment which in turn leads to increase in overall productivity. On the other hand, appreciation of the exchange rate increases imports and decreases exports, which ultimately leads to a fall in the overall economic performance. As observed by Joseph and Akhanolu (2011), exchange rate stability has a positive impact, while exchange rate instability

has a destabilizing and negative impact on the overall economic performance. But considering the abysmal performance of the agricultural exports even in the face of various exchange rate reforms/regimes, it would be pertinent to ask a general question as: what is the effect of exchange rate on agricultural exports in Nigeria? Understanding the perceived effect of exchange rate policy on agricultural exports is indispensable in formulating appropriate exchange rate policy that will boost domestic production for export in Nigeria.

On the empirical ground, studies have investigated the effect of exchange rate on agricultural exports in Nigeria but findings from these studies have showed mixed results. For instance, studies such as Adubi and Okunmadewa (1999), Akinniran and Olatunji (2018) and Akinbode and Ojo (2018), among others, showed from their results that exchange rate has a significant negative effect on agricultural exports in Nigeria. On the other hand, studies such as Ettah, Akpan and Etim (2011), Gatawa and Mahmud (2017), among others showed that exchange rate has a significant positive impact on agricultural exports in Nigeria. These mixed results have created serious debate on the effect of exchange rate on agricultural exports in Nigeria. Whether or not exchange rate policy has enhanced or inhibited agricultural sector performance in Nigeria has remained an empirical puzzle. This is because, in spite of the crucial role played by exchange rate, there have been intense arguments as to the nature of its on agricultural sector performance in Nigeria.

The broad objective of this study is to examine the impact of exchange rate on export trade in Nigeria. Specifically, the study investigated the effect of exchange rate on agricultural exports in Nigeria. Furthermore, the study examined the structural change effect of exchange rate on agricultural exports both in the pre-deregulated and post-deregulated periods in Nigeria. This study has immense significance in that it provides an insight into how variations in the exchange rate affect the agricultural sector in Nigeria. This will aid the government when formulating exchange rate policy that will be of benefit to the agricultural sector in Nigeria. This study is segmented into five sections. The preceding section is the introduction. Theoretical framework and literature review is the focus of section two. Section three presents the methodology of the study. Analysis of empirical results is carried out in section four, and section five concludes the study and makes policy recommendations.

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Theoretical framework

The theoretical anchor of this study is eclectic in nature, namely the Heckscher-Ohlin factor endowment theory and the elasticity theory. The Heckscher-Ohlin factor endowment theory was developed by Eli Heckscher and Bertil Ohlin in 1933. This theory holds that

countries should produce and export commodities that they can produce using their cheap and abundant factor(s) of production and import commodities that use their scarce factors of production. The basic feature of this theory is that countries tend to differ from one another based on possession of factors of production. Also, commodities differ from each other based on the factors that are required in producing them. Given this scenario, the theory posited that a country would be able to produce at a lower cost those commodities that their production requires relatively large amounts of the factors of production, such as labour, land, capital and natural resources with which the country is relatively endowed (Jhingan, 2005). This theory has a practical application in this study in that the Nigerian economy tends to be abundant in the use of factors of production such as land, labour and natural resources, which she can utilize effectively for domestic production. In particular, agriculture being one of the dominant economic activity in Nigeria should utilize the abundant factor inputs such as land, labour, capital, and natural resources in the country for the production of agricultural commodities for exports.

The elasticity theory was developed independently by two economists namely, Marshall (1923) and Lerner (1944), to explain the outcome of policy actions on balance of payments. In specific terms, the theory prescribes the condition under which the devaluation of currency may lead to an improvement in the trade balance of a country, particularly countries experiencing balance of payments disequilibrium (Caporale, Gil-Alana & Mudida, 2012). The theoretical explanation of the elasticity theory is anchored on the Marshall- Lerner condition, which holds that devaluation of currency can lead to an improvement in the trade balance whenever the sum of price elasticities of supply for exports and demand of imports in absolute terms is greater than one (Jhingan, 2005). This implies that as soon as this condition is achieved in any country, exchange rate devaluation may be beneficial to the devaluing country in terms of significant improvement in the trade balance (Ajakaiye, 1985, Nyong, 2005). Mathematically, the Marshall Lerner condition can be expressed as follows:

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

Where:

e_x = Supply elasticity of exports

e_m = 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. $e_x + e_m < 1$, 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 $e_x + e_m = 1$, 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.

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

The theoretical anchor of the model for this study is eclectic in nature. The model is anchored on the Heckscher-Ohlin factor endowment theory and the elasticity theory. Based on the theoretical postulates, the equation for this study is formulated and specified. The dependent variable is aggregate agricultural exports. The independent variables included exchange rate, agricultural land, agricultural labour force, agricultural machineries, bank loans and advances to agriculture, oil price and average world price of agricultural commodities. Exchange rate was derived from the elasticity theory. Agricultural production resources such as agricultural land, agricultural labour force, agricultural machineries, were derived from the Heckscher-Ohlin factor endowment theory. Several other factors known to affect the export of agricultural exports such as bank loans and advances to agriculture, oil price and average world price of agricultural commodities were captured and included in the model alongside the aforementioned agricultural export determinants.

In line with the Heckscher-Ohlin factor endowment theory, production capacity is a crucial factor influencing agricultural export performance. This means, countries abundant in factors of production such as land, labour and capital should specialize in producing commodities that requires such abundant resources. Thus, abundance of agricultural land, agricultural labour force and agricultural machineries should lead to an increase in agricultural production for export. Institutional agricultural support provides incentives for increased agricultural productivity. Hence, institutional agricultural support by way of granting loans and advances to farmers is capable of boosting agricultural productivity, thereby promoting agricultural export. Exchange rate derives from the elasticity theory and represents the main independent variable of this study. Oil price is included given the oil dependent nature of the Nigerian economy. Movements in oil price tend to have serious implication on agricultural sector exports in Nigeria. An increase in oil price would shift export dependence from agriculture to oil, thereby causing a decrease in agricultural production as well as agricultural exports and vice

versa. The average world price of agricultural commodities is included in the model as an important factor influencing export of agricultural commodities. An increase in the average world price of agricultural commodities could act as incentive for farmers to produce more for export. This is premised on the law of supply. Thus, farmers are motivated to produce more for export when export price of agricultural commodities increases and vice versa.

Given these determinant factors and following from Gatawa and Mahmud (2017) and Tadesse and Badiane (2018) models but with slight modifications, the functional form of the equation can be expressed as follows:

$$AGXP = f(AGL, ALF, AGM, BLA, EXR, OLP, WPA) \quad \text{..... (2)}$$

Where:

AGXP = aggregate agricultural exports in Nigeria (in billion naira)

AGL = agricultural land in Nigeria (in square kilometers)

ALF = agricultural labour force in Nigeria (in millions)

AGM = agricultural machineries, represented by number of tractors in Nigeria (in absolute number)

BLA = bank loans and advances to agriculture in Nigeria (in billion naira)

EXR = exchange rate in Nigeria (units of naira per US dollar)

OLP = oil price in Nigeria (in dollars per barrel)

WPA = average world price of agricultural exports commodities in Nigeria (naira per ton)

Equation (2) in its explicit form can be written as follows:

$$AGXP_t = \phi_0 + \phi_1 AGL_t + \phi_2 ALF_t + \phi_3 AGM_t + \phi_4 BLA_t + \phi_5 EXR_t + \phi_6 OLP_t + \phi_7 WPA_t + U_t \quad \text{..... (3)}$$

The log form of equation (2) can be expressed as:

$$\ln AGXP_t = \phi_0 + \phi_1 \ln AGL_t + \phi_2 \ln ALF_t + \phi_3 \ln AGM_t + \phi_4 \ln BLA_t + \phi_5 \ln EXR_t + \phi_6 \ln OLP_t + \phi_7 \ln WPA_t + U_t \quad \text{..... (4)}$$

The theoretical a priori expectations about the signs of the coefficients of the parameters are as follows: $\rangle_1$, $\rangle_3$, $\rangle_4$, $\rangle_7$ >0; $\rangle_5$, $\rangle_6$ <0

It is expected that agricultural land, agricultural labour force and agricultural machineries should have positive effect on agricultural exports in line with the Heckscher-Ohlin factor endowment theory. Thus, an increase in agricultural land, agricultural labour force and agricultural machineries should lead to an increase in agricultural production and hence agricultural exports. In line with the elasticity theory, the devaluation of currency should lead to an improvement in the trade balance, provided that the sum of price elasticities of supply for exports and demand of imports in absolute terms is greater than one. This means that the

devaluation/depreciation of the exchange rate should bring about an increase in agricultural exports, while the appreciation of the exchange rate should lead to the deterioration of agricultural exports. However, given the low price elasticity of supply for agricultural commodities export, it is suggested that exchange rate movements may not exert positive effect but negative effect on agricultural exports. Bank loans and advances to agriculture is expected to have positive impact on agricultural production and hence agricultural exports. This is because an increase in bank loans and advances to agriculture increases agricultural investment and agricultural production, resulting in an increase in agricultural exports. Meanwhile, oil price should have a negative effect on agricultural export. This is because for an oil-dependent economy such as Nigeria, an increase in oil price tends to shift export dependence from agriculture export to oil export to take advantage of increase in the oil price. This would result in a decrease in agricultural production vis-à-vis agricultural exports. Lastly, average price of agricultural commodities should have positive effect on agricultural exports in line with the law of supply. An increase in world price of agricultural commodities provides an incentive for farmers to increase agricultural production so as to earn higher income arising from the increase in the price of agricultural commodities.

Data Sources

Secondary sources were used for data collection in this study. These sources include the Central Bank of Nigeria statistical bulletin (Various years), Central Bank of Nigeria (CBN) Annual Reports and Statements of Accounts (various years), and the World Bank Datasheet. Data were collected on annual basis from 1970 to 2020.

Estimation method and procedures

The study employed the Autoregressive Distributed Lag (ARDL) estimation technique developed by Pesaran, Shin and Smith (2001) in estimating the specified equation. The rationale for using the ARDL technique is the fact that it is suited for studies having mixed integrating order, that is, a mixture of I(0) and I(1) integrating order. Put differently, the ARDL technique is employed without taking into consideration as to whether the series is either integrated of order I(0) or order I(1) or mutually integrated. Secondly, it is also suited for studies with small sample size (Latif, Abdullah & Razdi, 2015).

Several estimation procedures were followed to arrive at the final result for this study. The unit root test was conducted to determine the integrating order of the variables in the model. The test was necessary to avoid estimating a spurious regression given the time series nature of the variables used. The unit root is tested using the Augmented Dickey-Fuller (ADF)

test and the Phillips-Perron (PP) test. The unit root test based on the Augmented Dickey-Fuller (1979) specification can be written as:

$$\Delta y_t = \alpha_0 + \alpha_1 \Delta y_{t-1} + \sum_{j=1}^{j} \beta_i \Delta y_{t-1} + \varepsilon_t \quad \text{..... (5)}$$

Similarly, using the Phillips-Perron (1988) test, the following equation is also specified as:

$$y_t = \delta_0 + \phi y_{t-1} + \upsilon_t \quad \text{..... (6)}$$

Where: e_t and υ_t = the error terms; and α_0, α_1, β_i and δ_0 are the parameters to be estimated. If $\alpha_1 = 0$ and $\phi = 1$, then the null hypothesis of non – stationary is accepted. But if $\alpha_1 < 0$ and $\phi < 1$, then the null hypothesis of non-stationarity is rejected.

The cointegration test was aimed at determining the existence or otherwise of a long run relationship among the variables in the specified model. The test was conducted using the Bounds testing method developed by Pesaran *et al.* (2001), which is specified based on equation (2) as follows:

$$\begin{aligned}\Delta \ln AGXP_t &= \alpha_0 + \alpha_1 \ln AGXP_t + \alpha_2 \ln AGL_t + \alpha_3 \ln ALF_t + \alpha_4 \ln AGM_{t1} + \alpha_5 \ln BLA_t + \alpha_6 \ln EXR_t \\ &+ \alpha_7 \ln OLP_t + \alpha_8 \ln WPA_t + \sum_{i=1}^{k} \alpha_9 \Delta \ln AGXP_{t-i} + \sum_{i=1}^{k} \alpha_{10} \Delta \ln AGL_{t-i} + \sum_{i=1}^{k} \alpha_{11} \Delta \ln ALF_{t-i} + \sum_{i=1}^{k} \alpha_{12} \Delta \ln AGM_{t-i} \\ &+ \sum_{i=1}^{k} \alpha_{13} \Delta \ln BLA_{t-i} + \sum_{i=1}^{k} \alpha_{14} \Delta \ln EXR_{t-i} + \sum_{i=1}^{k} \alpha_{15} \Delta \ln OLP_{t-i} + \sum_{i=1}^{k} \alpha_{16} \Delta \ln WPA_{t-i} + U_1\end{aligned} \quad \text{..... (7)}$$

Where: α_0 to α_{16} are the parameters to be estimated and U_t is the error term. The right hand side of equation (7) with parameters, α_0 to α_8 is the log run estimates, while the part with parameters, α_9 to α_{16} is the short run estimates. The null and alternative hypotheses for the co-integration based on equation (7) are stated as follows:

H0: αi= 0; (There is no co-integration, and hence no long – run relationship)

H_A: αi ≠ 0; (There is co-integration, and hence long – run relationship).

To reach an acceptable inference, the Bounds test based on the F- statistic test is applied. If the computed F-statistic value is greater than the upper critical bound value, then there is existence cointegration among the variables. But, if the computed F-statistic value is lesser than the lower critical bound value, then there is no existence of cointegration among the variables. Meanwhile, if the computed F-statistic value lies in-between the upper and the lower critical bound values, then the result is rendered inconclusive.

The ARDL error correction model is specified for the estimation of the short run dynamics of the model. The short-run dynamics based on equation (2) can be expressed as error correction mechanism (ECM) as follows.

$$\Delta \ln AGXP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_1 \Delta \ln AGXP_{t-i} + \sum_{i=1}^{k} \alpha_2 \Delta \ln AGL_{t-i} + \sum_{i=1}^{k} \alpha_3 \Delta \ln ALF_{t-i} + \sum_{i=1}^{k} \alpha_4 \Delta \ln AGM_{t-i}$$
$$+ \sum_{i=1}^{k} \alpha_5 \Delta \ln BLA_{t-i} + \sum_{i=1}^{k} \alpha_6 \Delta \ln EXR_{t-i} + \sum_{i=1}^{k} \alpha_7 \Delta \ln OLP_{t-i} + \sum_{i=1}^{k} \alpha_8 \Delta \ln WPA_{t-i} + \theta ECM_{t-i} + U_{t1} \quad \ldots\ldots\ldots (8)$$

Where: U_t is the white noise error term; and ECM is the error correction variable.

ANALYSIS AND 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	AGL	ALF	AGM	BLA	EXR	OLP	WPA
Mean	164009.4	620962.2	12522080	16968.24	126.2888	79.25451	36.09843	3373.123
Median	7961.400	653674.4	12308274	16650.00	25.28000	21.89000	27.01000	3501.400
Maximum	3210000.	691234.5	22924572	30825.00	1049.678	358.8100	109.4500	10347.70
Minimum	172.0000	472190.0	3308579.	2900.000	0.010000	0.550000	1.210000	30.00000
Std. Dev.	510937.8	68677.19	5933813.	8517.403	229.0210	98.24881	29.43774	3291.694
Skewness	4.878942	-0.893521	-0.057193	0.027310	2.255000	1.184590	1.104905	0.386677
Kurtosis	27.67279	2.435528	1.991098	1.753127	7.744663	3.561129	3.252691	1.768822

The maximum 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 ₦3210,000.0 billion, 691234.5 square kilometers, 22924572.0 million, 30825.0 thousand, ₦1049.68 billion, ₦358.81:$1, $109.45 dollars per barrel and ₦10347.70 per ton, respectively. The minimum 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 ₦172.0 billion, 472190.0 square kilometers, 3308579.0 million, 2900.0 thousand, ₦0.01 billion, ₦0.55:$1, $1.21 dollars per barrel and ₦30.0 per ton, respectively.

Analysis of skewness showed that distributions for agricultural exports, agricultural machineries, bank loans and advances to agriculture, exchange rate, oil price and average world price of agricultural commodities were rightly skewed or tailed, given the positive skewness values taken by the variables. This indicated that these distributions are asymmetric in nature. On the other hand, the distributions for agricultural land and agricultural labour force were negatively skewed. Analysis of kurtosis showed that the distributions for agricultural exports, bank loans and advances to agriculture, exchange rate and oil price were leptokurtic, given that their kurtosis values were at least 3. However, the distribution for agricultural land, agricultural labour force, agricultural machineries, and average world price of agricultural commodities were platykurtic, given that their kurtosis values were less than 3.

Unit root test

The results of the unit root test using the Augmented Dickey-Fuller (ADF) and the Phillips-Peron (PP) tests are presented in Tables 2 and 3. The result of the Augmented Dickey-Fuller (ADF) test showed that agricultural machineries and oil price were stationary at the level, while other variables were stationary after their first difference. On the other hand, result of the Phillips-Peron (PP) test showed that agricultural machineries, bank loans and advances to agriculture and oil price were stationary at the level, while the remaining variables were stationary after their first differences. The unit root test results clearly showed that the variables were integrated of mixed integrating order. This permitted the use of the ARDL Bounds testing approach for cointegration test.

Table 2: Augmented Dickey Fuller (ADF) test

Variable	ADF statistics				
	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)
LAGL	-1.576899	-2.933158	-2.438182	-2.925169	I(1)
LALF	-1.483177	-2.921175	-7.21391	-2.922449	I(1)
LAGM	-17.26484	-2.921175	-	-	I(0)
LBLA	-2.239542	-2.921175	-7.50709	-2.922449	I(1)
LEXR	-0.255813	-2.921175	-5.67399	-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

Variable	PP statistics				
	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)
LAGL	-0.970609	-2.921175	-7.39264	-2.922449	I(1)
LALF	-1.597721	-2.921175	-7.563448	-2.922449	I(1)
LAGM	-10.56387	-2.921175	-	-	I(0)
LBLA	-3.536153	-2.921175	-	-	I(0)
LEXR	-0.344891	-2.921175	-5.667251	-5.844898	I(1)
LOLP	-3.196474	-2.921175	-	-	I(0)
LWPA	-1.379257	-2.921175	-6.593349	-2.922449	I(1)

Cointegration (Bounds) test

The results of the bounds test for the existence of long run relationship among the variables is depicted in Table 4. From the result, the computed F-statistic value of about 4.46 is greater than the upper critical bound value of 3.50 at the 5% level of significance. This showed that there is long run equilibrium association 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
LALF	1.247007	0.807112	1.545024	0.1609
LAGM	1.761077	0.153742	11.45473	0.0000
LBLA	1.880335	0.117644	15.98325	0.0000

LEXR	-1.424545	0.199643	-7.135468	0.0001
LOLP	-0.936591	0.120941	-7.744176	0.0001
LWPA	0.393448	0.074305	5.295048	0.0007

Table 5…

The results in Table 5 showed that agricultural land has a significant positive long run impact on agricultural exports in Nigeria. This means that an increase in agricultural land would increase agricultural production, leading to an increase in agricultural exports in the long run. In real term, a 1% increase in agricultural land resulted in an increase in agricultural exports by about 5.47%. Agricultural labour force exerted positive long run impact on agricultural exports in Nigeria. In real term, an increase in agricultural labour force by 1% led to an increase in agricultural exports by about 1.24%. Furthermore, agricultural machinery exerted a long run positive and significant effect on agricultural export in Nigeria. This means that application of machines in agriculture increases agricultural productivity and leads to an increase in agricultural exports. In real term, an increase in agricultural machinery by 1% resulted in an increase agricultural exports by approximately 1.76%. In the same vein, bank loans and advances to agriculture exerted significant positive long run impact on agricultural exports in Nigeria. This means that institutional support to agriculture increases agricultural investment and agricultural output, leading to an increase in agricultural exports. Hence, a 1% increase in bank loans and advances to agriculture led to about 1.88% increase in agricultural exports in Nigeria, ceteris paribus. Meanwhile, exchange rate and oil price have significant negative long run impact on agricultural exports in Nigeria. This means that a 1% appreciation in exchange rate and 1% increase in oil price brought about a decrease in agricultural exports by about 1.42% and 0.94%, respectively. Average world price of agricultural commodities exerted positive and high significant effect on agricultural exports in Nigeria in the long run. This means that an increase in average world price of agricultural commodities could act as incentives for farmers to produce more for exports and earn more income. In real term, an increase in the average world price of agricultural commodities by 1% resulted in an increase in agricultural exports by about 0.39%.

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 of 0.801 showed that about 80% of the total variation in the agricultural exports has been accounted for by its determinants. This implies that the estimated agricultural export equation has a very good fit and high explanatory power. The F-statistic value of 7.009570 with its low probability value of 0.000122 showed that the overall model is statistically significant at the conventional 5% level of significance. This means that the independent variables (agricultural land, agricultural labour force, agricultural machineries, bank loans and advances to agriculture, exchange rate, oil price and average price of agricultural export commodities) have joint impact on the dependent variable (agricultural exports). The Durbin-Watson statistic value of 2.26 showed that there is no issue of auto-correlation in the model. This means that the residuals are not correlated and the model is well behaved.

Analysis of the short run coefficients showed that exchange rate in the current period has a significant negative impact on agricultural exports in Nigeria. This is not surprising, as appreciation of the exchange rate will put a heavy cost on farmers, given the fact that most non-labour agricultural inputs are imported. In real term, a 1% appreciation in exchange rate in the current period led to a decline in agricultural export by about 0.82%. This finding is in line with Akinniran and Olatunji (2018). In their study, Akinniran and Olatunji (2018) examined the effects of exchange rate on agricultural exports in Nigeria and found that exchange rate has a significant negative effect on agricultural exports in Nigeria. On the other hand, exchange rate exerted positive and significant effect on agricultural exports after some time lag. This, in real term means that a 1% appreciation in exchange rate in one, two and three periods lagged resulted in an increase in agricultural exports by about 2.98%, 2.17% and 1.62%, respectively. The result is in agreement with the result obtained by Gatawa and Mahmud (2017). Employing the Auto-Regressive Distributed Lag (ARDL) technique, Gatawa and Mahmud (2017) investigated the effect of exchange rate on agricultural exports in Nigeria and established that exchange rate has positive impact on agricultural exports in Nigeria.

Other results of this study showed that agricultural land has a significant positive effect on agricultural export in Nigeria. This means that an increase agricultural land increases aggregate agricultural production for both domestic consumption and for exports. In real term, a 1% increase in agricultural land in the current period, one period and two periods lagged of agricultural land led to an increase in agricultural export by about 9.49%, 2.06% and 8.28%, respectively. Similarly, agricultural labour force has a positive and significant relationship with agricultural export in Nigeria in line with a priori expectation. This implies that an increase in the number of agricultural labour force increases agricultural productivity for domestic market and for exports. In numerical term, a 1% increase in agricultural labour force in the current period, one period, two periods and three periods lagged resulted in an increase in agricultural export

by about 1.36%, 2.75%, 2.75% and 3.33%, respectively. Furthermore, agricultural machineries exerted positive and significant effect on agricultural exports in Nigeria. The increase in the number of agricultural machineries increases agricultural productivity, leading to an increase in agricultural output for domestic market and for export. In real term, an increase of 1% of agricultural machineries in the current period, one period, two periods and three periods lagged resulted in an increase in agricultural exports by approximately 2.51%, 5.28%, 4.07% and 3.26%, respectively. Result also showed that bank loans and advances to agriculture exerted positive and significant impact on agricultural exports in Nigeria in accordance with a priori expectation. This means that institutional support by way of loans and advances brought about an increase in agricultural investment, which ultimately resulted in an increase in agricultural productivity and export. In numerical terms, a 1% increase in bank loans and advances to agriculture in the current period, one period, two periods and three periods lagged resulted in an increase in agricultural exports by approximately 0.11%, 3.97%, 3.16% and 0.63%, respectively.

Meanwhile, oil price in the current period has negative and significant impact on agricultural export at the 5% level of significance. This result is true for an oil-dependent economy such as Nigeria. As oil price increases, oil-dependent economies would try to shift export dependence from agriculture export to oil export to take advantage of increase in the oil price. This would result in a decrease in agricultural production vis-à-vis agricultural exports. The coefficient of the oil price in the current period of about -0.42 showed that a 1% increase in oil price in the current period resulted in a decrease in agricultural export by about 0.42%. On the other hand, one, two and three period lagged of oil price exerted positive effect on agricultural exports in Nigeria. In real terms, result showed that a 1% increase in one, two and three period lagged of oil price resulted in an increase in agricultural exports by about 2.48%, 2.09% and 1.50%, respectively. Lastly, the average world price of agricultural product has a positive and significant impact on agricultural export in Nigeria in line with a priori expectation. An increase in world price of agricultural commodities provides an incentive for farmers to increase agricultural production so as to earn higher income arising from the price increase. In real term, a 1% increase in average world price of agricultural products in the current period, one, two and three periods lagged led to an increase in agricultural export by about 1.98%, 2.38%, 2.17% and 0.72%, respectively.

Diagnostic checks

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.

Structural breakpoint test

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 test

Chow Breakpoint Test: 1986 Equation Sample: 1970 2020			
Null Hypothesis: No breaks at specified breakpoints			
Varying regressors: All equation variables			
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 POLICY RECOMMENDATIONS

This study undertook an empirical investigation on the effect of exchange rate on agricultural exports in Nigeria. The effect of exchange rate movements on trade balance has continued to occupy the central issue in international economics. This is so because exchange rate is an important economic variable as its appreciation or depreciation affects the performance of exports as a whole and agricultural export in particular. Based on this assertion, this study was carried out to investigate the effect of exchange rate on agricultural export in Nigeria. The results of the study showed that exchange rate has an instantaneous negative and significant effect on agricultural exports in Nigeria. On the other hand, result showed that exchange rate has significant positive effect on agricultural exports in Nigeria with some periods lagged. Other results of the study showed that agricultural land, agricultural labour force, agricultural machineries, bank loans and advances to agriculture, and average world price of agricultural commodities have positive and significant effect on agricultural exports in Nigeria, while oil price exerted negative and significant effect on agricultural exports in Nigeria.

Based on the result, the study recommended that the government should implement appropriate exchange rate policy that will ensure domestic production of agricultural commodities for export in Nigeria. For this reason, there is need to stabilize the exchange rate so as to facilitate agricultural sector performance in Nigeria. The current devaluation of the naira if effectively managed can stimulate domestic agricultural production and increase agricultural exports in Nigeria. However, care must be taken not to over-devalue the naira as this can also affect the import of agricultural machineries and raw material required by farmers for domestic agricultural production. This can have negative effect on productivity in agricultural sector in Nigeria.

Meanwhile, an examination of the specified equation showed that the study concentrated its analysis on the effect of exchange rate on aggregate agricultural export. To close the gap on this limitation, we suggest that more studies should be carried out by disaggregating agricultural exports into individual agricultural export commodities. Undertaking a

disaggregating analysis will enable us to ascertain how changes in exchange rate affect individual agricultural export commodities in Nigeria.

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