The Impact of Exchange Rate Dynamics on Agricultural Output Performance in Nigeria

Adekunle, Wasiu and Ndukwe, Innocent

Centre for Econometric and Allied Research (CEAR), University of Ibadan, Ibadan, Nigeria, Department of Economics, University of Ibadan, Ibadan, Nigeria

2 June 2018

The Impact of Exchange Rate Dynamics on Agricultural Output Performance in Nigeria

Wasiu Adekunle[1*] Ndukwe, C. Innocent[2#]

[1]Centre for Econometric and Allied Research (CEAR), University of Ibadan, Ibadan, Nigeria
[2]Department of Economics, University of Ibadan, Ibadan, Nigeria
[*]Corresponding Author: wasiuademola10@gmail.com
[#]Co-author: emekan2001@yahoo.com

Abstract
The study investigated the possible asymmetric effect of real exchange rate dynamics on agricultural output performance in Nigeria over the period of 1981 to 2016 by collecting data from secondary sources. The study employed a combination of stationary and nonstationary variables as was found out through the ADF unit root test. Based on the Bounds test for cointegration, a long-run relationship was absent between real exchange rate and agricultural output, irrespective of specifications. Generally, the result of model estimation showed that the significant drivers of agricultural output are real exchange rate (log-levels), real appreciation and depreciation (after some lags), industrial capacity utilization rate, and government expenditure on agriculture (after some lags). ACGSF loan exerted positive and insignificant influence on agricultural output. In addition, though the effect of real appreciation was larger than that of real depreciation, the present study could not find any evidence in support of the asymmetric effect of real exchange rate dynamics on agricultural output performance in the Nigerian economy. It is therefore suggested that fiscal and monetary authorities in Nigeria should work in unison at ensuring that the full potentials of the agricultural sector are harnessed for the growth and development of the country.

Keywords: Real exchange rate, Agricultural output, and Asymmetry

1. Introduction

The Agricultural sector has been identified as the mainstay of the Nigerian economy since independence in 1960. Before the discovery and exploration of crude petroleum, the country depended on funds generated from agricultural export expansion for the development of other sectors of the economy. Owing to its important role in nation building, the agricultural sector has continued to be a target of government policies overtime (Eyo, 2008). The agricultural sector like any other sector remains largely affected by exchange rate fluctuations. This is usually in respect of the sector's importation of raw materials and other modern farm implements, and the exportation of its output. Changes in exchange rate policy, therefore, have significant consequences for a country's domestic relative prices and economic growth through their effects on the real exchange rate. The real rate is a measure of the terms of trade between the traded and non-traded sectors of the economy, which provides the signal for resource movements (Oyejide, 1986).

Theoretically, in economic development, agriculture is assumed to play a passive and supporting role such that as an economy develops, the relative importance of agriculture gets smaller. It is expected that as a country develops, the agricultural sector supplies excess labour

to the industrial sector, which only causes a fall in the relative and not the absolute contribution of agriculture to the country's gross domestic product (GDP). Specifically, the decline in agricultural output level and its contribution to the growth of the Nigerian economy does not mean that the sector has been displaced by the attractive oil sector, but has recorded low output due to neglect by the government as the oil sector became the major foreign exchange earner of the economy (Michael, 2017). From the 1970s, Nigeria's agriculture has been characterized by excess demand over supply due primarily to high population growth rates, stagnant or declining growth, high rate of urbanization, increased demand for agricultural raw materials by an expanding industrial sector and rising per capita income stimulated by an oil export revenue boom (Kwanashie et al, 1997).

A notable problem peculiar to a capital-deficit oil exporting country, like Nigeria, is that the high rates of capital inflows that normally accompany an oil boom tend to drive the real exchange rate down. In other words, rapid capital inflows tend to cause the currency to appreciate. A policy that keeps the exchange rate low impedes growth of tradable goods sector, particularly agriculture. For instance, between 1974 and 1978, Nigeria allowed the Naira to appreciate against the US dollar and the British Pound, and the resulting overvaluation substantially reduced production incentives for non-oil tradables, particularly agricultural products. This explains why some countries with an oil boom have adapted policies to prevent the tradable/non-tradable price ratio from continuing to fall as the oil boom proceeds (Oyejide, 1986). Moreover, the Nigeria's agricultural sector performance has been greatly affected by not just the nominal exchange rate (₦/$), but also by large swings in the real exchange rate. Owing to the calls from various quarters that the country should de-emphasize her focus from crude oil production to promoting non-oil production, there is need to conduct an empirical study to evaluate the impact of real exchange rate dynamics (depreciation and appreciation) on the agricultural sector in Nigeria, since the sector relies mostly on intermediate imports and exports of primary agricultural products.

To this end, the present study seeks to provide answers to the following research questions: (i) Do real exchange rate fluctuations have any influence on agricultural output in Nigeria? (ii) Is there a causal relationship between real exchange rate dynamics (depreciation and appreciation) and agricultural output in Nigeria? (iii) Are there intervening factors affecting the relationship between real exchange rate and agricultural output in Nigeria? The rest of the paper proceeds as follows: Section 2 highlights the stylized facts about the Nigeria's agricultural sector and the real exchange rate. Section 3 contains the review of the literature. Sections 4 and 5 entail the underlying methodology and empirical analysis, respectively. Lastly, section 6 concludes the paper.

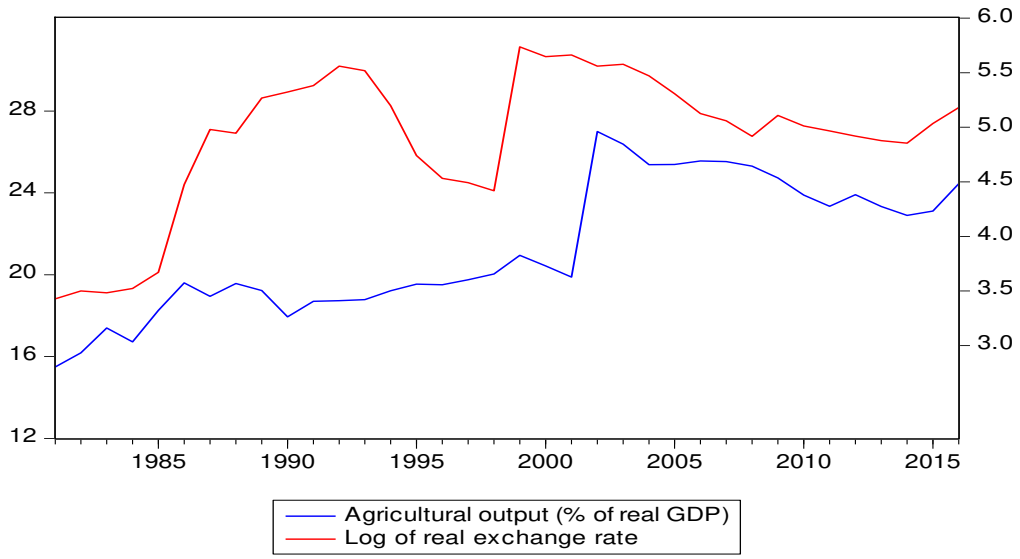
2. Stylized Facts about the Nigeria's Agricultural Sector and the Real Exchange Rate

2.1 Trends of Agricultural Output and Real Exchange Rate in Nigeria

Figure 2.1 below shows the movements in exchange rate and agricultural output over the period of 1981 to 2016. It can be observed that there is a positive co-movement between real exchange rate and the share of agricultural output in real GDP over the entire period. There was a consistent pattern of real exchange rate depreciation between 1989 and 1992. Over the same period the share of agriculture in real GDP fell in 1990 but rose to 18.73% in 1992. Similarly, real appreciation became consistent between 1993 and 1998, between 2004 and 2008, and between 2010 and 2014. Despite real appreciation, agricultural share of real GDP had an upward trend between 1993 and 1998 except that there was an expected decline in agricultural share by 0.024 percentage point between 1995 and 1996.

However, a real depreciation of 29.84% saw a rise in the share of agricultural in real GDP by 0.91 percentage point between 1998 and 1999. In the face of real exchange rate appreciation, agricultural share of real GDP had a constant rise between 2004 and 2006, but declined slightly to 25.53% in 2007. Owing to the 2008-09 global financial crisis, real exchange rate depreciated largely by 3.91 coupled with a fall in agricultural share of real GDP by 0.58 percentage point between 2008 and 2009. Between 2010 and 2011, the share of agriculture in real GDP declined by 0.84 and 0.54 percentage points, respectively, between 2009 and 2010, and between 2010 and 2011. As the real exchange rate appreciated fell from 0.95% in 2012 to 22.9% in 2014, agricultural share of real GDP fell from 23.91% to 22.9% over the same period. Lastly, real depreciations of 3.7 and 2.89% recorded, respectively, between 2014 and 2015, and between 2015 and 2016 were followed by a rise in agricultural share of real GDP by 0.21 and 1.34 percentage points over the same period.

Figure 2.1: Movements in Real Exchange Rate and Total Agricultural Output (1981-2016)



Source: Constructed by the Author

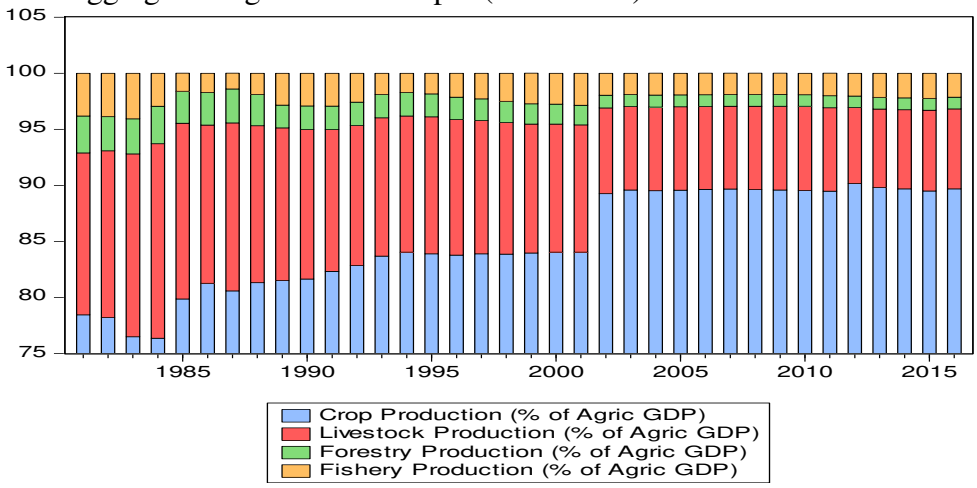
2.2 Composition of Agricultural Output in Nigeria

Figure 2.2 below shows the trend of agricultural output on a sub-sectoral basis over the period of 1981 and 2016. The sub-sectors are four, namely, crop production, livestock production, forestry and fisheries. It can be observed that over the entire period, the crop production sub-sector takes the lion share of agricultural output, followed by the livestock production sub-sector. Both forestry and fisheries sub-sectors have relatively similar shares over the same period. Crop production had its lowest share as 76.37% in 1984 and its highest share as 90.16% in 2012. By contrast, livestock production had its lowest share as 6.79% in 2012 and its highest share as 17.35% in 1984. Also, the contribution of forestry was highest (3.33%) in 1984 and lowest (1.03%) in 2016. Lastly, the highest contribution of fisheries was put at 1.41% in 1994 and its highest contribution at 4.07% in 1983.

According to the CBN (2016), agricultural activities in the fourth quarter of 2016 were dominated by harvesting of crops. In the southern part of the country, farming activities centred on harvesting of tubers, fruits and vegetables, while farmers in the Northern part engaged in the harvesting of late maturing grains, and pre-planting operations in preparation of dry season planting. In the livestock and fisheries sub-sectors, respectively, farmers engaged in the fattening of cattle and broilers in anticipation of the end of the year sales. The dominant contribution of crop sub-sector could be attributed to the large share of the sector in the

disbursement of Agricultural Credit Guarantee Scheme (ACGS) loan, followed by livestock and fisheries sub-sectors.

Figure 2.2: Disaggregated Agricultural Output (1981-2016)



Source: Constructed by the Author

3. Review of the Literature

In the Development Economics literature, the linkage between real exchange rate and agricultural output is best explained by the phenomenon of Dutch Disease Syndrome (DDS). In this paper, the core model of the Dutch Disease as developed by Corden (1984) is reviewed. The model assumes that (i) there are three sectors: the **booming sector (B)**, which is equivalent to the **oil and gas sector** in Nigeria; the **lagging sector (L)**, which is equivalent to the **agricultural sector** in the Nigerian case, and the **non-tradable sector (N)**, which is equivalent to the **services sector** in Nigeria; (ii) the first two sectors (B and L) produce traded goods facing given world prices; (iii) output in each sector is produced by a factor specific to that sector, and by labour, which is mobile between all three sectors and moves between sectors so as to equalize wages, and (iv) all factor prices are flexible and all factors are internationally immobile. Given the underlying assumptions, this model generates two distinct effects, namely the spending effect and the resource movement effect resulting from a boom in B. This boom has the initial effect of raising aggregate incomes of the factors initially employed there.

I. The spending effect: If some part of the extra income in B is spent, whether directly by factor owners or indirectly through being collected in taxes and then spent by the government, and provided that the income elasticity of demand for non-traded goods (N) is positive, the price of N relative to the prices of traded goods must rise. This is called **real appreciation**. This effect works by drawing resources out of B and L into N, as well as, shifting demand away from N towards B and L. **II. The resource movement effect**: In addition, the marginal product of labour rises in B as a result of the boom so that, at a constant wage in terms of traded goods, the demand for labour in B rises, and this induces a movement of labour out of L and out of N. This effect has two parts: (a) The movement of labour out of L into B lowers output in L. This can be called **direct de-industrialization**, because it does not involve the market for N, and thus does not require an appreciation of the real exchange rate. (b) There is a movement of labour out of N into B at a constant real exchange rate. The resource shift creates excess demand for N in addition to that created by the spending effect, and so brings about additional real appreciation. This therefore causes an additional movement of labour out of L into N, reinforcing the de-industrialization resulting from the spending effect. This second effect is termed **indirect de-industrialization**.

Moreover, the literature is replete in the investigation of the possible determinants of agricultural output/exports in Nigeria (see the Appendix for a summary of literature on agricultural output/exports and its determinants). A considerable number of previous studies are reviewed in this paper. Odior (2014) examined the effect of macroeconomic policy on Nigerian Agricultural performance between 1970 and 2012 by adopting one-step dynamic forecast analysis. Similarly, Imoughele and Ismaila (2015) analyzed the impact of exchange rate on non-oil exports in Nigeria between 1986 and 2013 also with the aid of OLS technique. Odior (2014) identified the significant determinants of agricultural GDP as including real monetary aggregate and technological change, whereas credit to agriculture and government expenditure on agricultural had insignificant effects on agricultural GDP in Nigeria. By contrast, Imoughele and Ismaila (2015) found that exchange rate, money supply, credit to private sector and real GDP have significant impacts on the growth of non-oil exports, whereas appreciation in exchange rate has negative impact on Nigeria's non-oil exports.

Brownson et al (2003) investigated the effect of macroeconomic variable fluctuation on agricultural productivity in Nigeria over the period of 1970 and 2010 using the techniques of cointegration and error correction model (ECM). In a similar vein, Akpan et al (2015) adopted the techniques of cointegration and error correction model (ECM) to quantify the role of macroeconomic variables on agricultural diversification in Nigeria over the period of 1960 to 2014. Brownson et al (2003) showed that in both long run and short run, real exports, real external reserves, inflation, and external debt have significant negative effects on agricultural productivity, whereas industrial capacity utilization and nominal exchange rate promote agricultural productivity in Nigeria. On the other hand, Akpan et al (2015) reported that long-run positive drivers of agricultural diversification include inflation, viable manufacturing sector, credit to agricultural sector, external reserves, per capita income, unemployment and energy consumption, whereas crude oil prices, lending capacity of commercial banks, FDI in agriculture, and non-oil imports constitute negative long-run drivers in the Nigerian economy.

Omojimite (2012) examined the role of institutions and macroeconomic policy on the growth of agricultural sector in Nigeria between 1970 and 2008 with the aid of fully modified ordinary least squares (FMOLS). On their own part, Oluwatoyese et al (2016) examined the macroeconomic factors affecting the Nigeria's agricultural sector between 1981 and 2013 using multivariate cointegration approach and vector error correction model (VECM). Omojimite (2012) found that the volume of credit to agricultural sector, deficit financing and institutional reform positively and significantly affect agricultural output. However, interest rate spread has negative and insignificant effect on agricultural output in Nigeria. Equally, Oluwatoyese et al (2016) showed that commercial bank loan to agriculture, interest rate and food imports are significant factors affecting agricultural output, whereas exchange rate, inflation rate and unemployment rate turned out to be insignificant factors driving Nigeria's agricultural output.

Udensi et al (2012) investigated the determinants of macroeconomic variables affecting agricultural production in Nigeria by adopting the technique of two-stage least squares (2SLS). In a similar study on Nigeria, Udah and Nwachukwu (2015) investigated the determinants of agricultural output growth between 1960 and 2010 using the technique of ordinary least squares (OLS). Udensi et al (2012) showed that all the determinants of agricultural production index examined in their study were positive and significant, except for world agricultural commodity prices and inflation rate that were negatively related to agricultural production index in Nigeria. In the same vein, agricultural labour, infrastructural development, and total factor productivity (TFP) had positive effect on agricultural GDP, whereas land area harvested, inflation rate and agricultural GDP in the previous were negatively related to agricultural GDP in Nigeria (Udah and Nwachukwu, 2014).

In another study by Akinlo and Adejumo (2014), the effect of exchange rate volatility on non-oil exports in Nigeria between 1986 and 2008 was examined using the error correction model (ECM) technique. Essien et al (2011) quantified the effects of price and exchange rate fluctuation on agricultural exports (specifically, cocoa exports) in Nigeria using the ordinary least squares (OLS) technique. Akinlo and Adejumo (2014) found that lagged foreign income and real exchange rate had positive and significant effects on non-oil exports. According to the authors, exchange rate volatility is only effect in the long run, but not in the short run. In addition, exchange rate fluctuations and agricultural export credit affect cocoa exports positively, whereas relative price of cocoa was negatively and insignificantly related to cocoa exports in the Nigerian economy (Essien et al, 2011).

In addition, Obayelu and Salau (2010) applied the techniques of cointegration and VECM to response of agricultural output to price and exchange rate between 1970 and 2007. Olarinde and Abdullahi (2014) examined the implications for food security of the role of macroeconomic policy in agricultural sector performance in Nigeria over the period of 1978 to 2011 by employing the VECM technique. Obayelu and Salau (2010) reported that in the short run and long run, total agricultural output responds positively to increases in exchange rate (that is, exchange rate depreciation), but begatively to increases in food prices. On the other hand, Olarinde and Abdullahi (2014) found that the long-run determinants of agricultural output include government spending, agricultural credit, inflation rate, interest rate and exchange rate. On their own part, Oyinbo et al (2014) examined the nexus between exchange rate deregulation and Agricultural share of gross domestic product in Nigeria over the period 1986-2011 by employing Granger causality test and VECM. The authors found that there was unidirectional causality from exchange rate to agricultural share of real GDP. They also showed that exchange rate deregulation has negative influence on agricultural share of real GDP.

From the above review, it can be observed that literature abounds on the relationship between agricultural output and macroeconomic aggregates, such as, inflation, loans/credit, fiscal and monetary policy instruments. The present study differs from previous studies by investigating the possible role of movements in real exchange rate (positive and negative changes in real exchange rate) on agricultural output having controlled for some other significant factors already documented in the literature. The study also extends the coverage period till year 2016 so as to capture the recent happenings in the Nigerian economy; an instance is the fall out of the economic recession in the second quarter of 2016.

4. Methodology and Model Specification

The study adopts the framework of non-linear autoregressive distributed lag model (NARDL) for the following reasons. *First*, NARDL model (as in eq. 4.3 above) allows for both the static and dynamic effect(s) of the independent variable(s) on the dependent variable unlike a static model that accounts for static or fixed effect(s) only. *Second*, NARDL framework offers a technique for checking the existence of a long-run relationship between variables, and that is referred to as the *Bounds test*. Bounds test is flexible as it accommodates both stationary and integrated series unlike other tests of cointegration, such as, Engle-Granger and Johansen tests, which considers only non-stationary series that are integrated of the same order. *Lastly*, NARDL allows one to capture the dynamic effect of both positive and negative changes in an explanatory variable on a particular dependent variable.

Before model estimation using the ordinary least squares (OLS) technique, it is important to check the time-series properties such as unit root and cointegration tests to avoid estimating spurious regression. To achieve this, the present study adopts the Augmented Dickey-Fuller (ADF) unit root test and the Bounds test for cointegration. The ADF unit root test is conducted

to check if series are stationary or not. The null hypothesis is that a series has a unit root or is nonstationary. If the ADF tau stat is greater, in absolute terms, than the MacKinnon critical values at any chosen level of significance, the null hypothesis is rejected; otherwise, we will fail to reject the null hypothesis of a unit root. Similarly, the Bounds test for cointegration tests the null hypothesis that there is no cointegration between agricultural share of real GDP and real exchange rate, after controlling for other factors, such as, Agricultural Guarantee Credit Scheme Fund (AGCSF) loan, maximum lending rate, average industrial capacity utilization rate, and government expenditure on agriculture in the Nigerian context. To conclude the presence or absence of cointegration, there is need to compare the computed F-stat with the critical bound values, that is, I0 bound (the lower bound) and I1 bound (the upper bound) at any chosen level of significance. If the F-stat is less than the I0 critical value at any chosen level of significance, then there is no cointegration. However, if the F-stat is greater than the I1 critical value at any chosen level of significance, then there is cointegration. However, if the F-stat lies between the I0 and I1 critical values at all levels of significance, then the test result is inconclusive.

Having tested for cointegration, the present study seeks to examine the direction of causality between real exchange rate dynamics (appreciation and depreciation) and agricultural output with the aid of Granger-causality test. The test has the null hypothesis that two variables do not cause each other. Acceptance or rejection of this null hypothesis at conventional levels is based on the value of the restricted F-statistic. If the probability associated with the F-stat is greater than 0.1, then the null hypothesis of no causality is accepted, otherwise the null hypothesis is rejected given that the probability is less than or equal to 0.1.

In addition, the estimated models would be subject to post-mortem tests to check if they are adequate for valid and reliable statistical inferences to be made therefrom. In the light of this, the present study would investigate whether some assumptions underlying the CLRM hold or not, specifically, linearity, normality, serial correlation, and heteroscedasticity tests would be conducted. The associated null hypotheses are, respectively, that the estimated model is linear, have residuals that follow normal distribution, does not suffer from non-serial correlation in the residuals, and does not suffer from non-constant residual variance. The decision rule is that if the probabilities associated with the test statistics of all the tests are greater than 0.1, then the estimated models do not suffer from inadequacy, otherwise, they are said to be inadequate for policy prescription. Of major interest is the test for asymmetry (short-run and/or long-run) using the Wald test. The null hypothesis in this case is that both exchange rate appreciation and depreciation have similar effects on agricultural share of real GDP. The decision rule is that if the probability associated with the Wald test is greater than 0.1, then null of no asymmetry is not rejected. Conversely, if the associated probability is less than or equal to 0.1, then there is evidence of asymmetric effects of exchange rate appreciation and depreciation on agricultural share of real GDP in Nigeria.

To this end, this paper adopts and modifies the model of Obayelu and Salau (2010) so as to account for the asymmetric effect of real exchange appreciation and depreciation on the share of agriculture in real gross domestic product as follows:

$$AGDP_t = \beta_0 + \beta_1^+ RER_t^+ + \beta_1^- RER_t^- + \beta_2 ICU_t + \beta_3 MLR_t + \beta_4 LOAN_t + \beta_5 GEXP_t + \mu_t \quad (1)$$

Based on the works of Shin et al (2014), the nonlinear ARDL version of the effect of real exchange rate dynamics on agricultural output is expressed as:

$$\Delta AGRIC_t = \gamma AGRIC_{t-1} + \alpha_1^+ RER_{t-1}^+ + \alpha_1^- RER_{t-1}^- + \alpha_2 ICU_{t-1} + \alpha_3 MLR_{t-1} + \alpha_4 LOAN_{t-1} + \alpha_5 GEXP_{t-1} + \sum_{i=1}^{p-1} \theta_i \Delta AGRIC_{t-i} + \sum_{j=0}^{q_1-1} \phi_j^+ \Delta RER_{t-j}^+ + \sum_{j=0}^{q_2-1} \phi_j^- \Delta RER_{t-j}^- + \sum_{j=0}^{q_3-1} \pi_j \Delta ICU_{t-j} + \sum_{j=0}^{q_4-1} \rho_j \Delta MLR_{t-j} + \sum_{j=0}^{q_5-1} \delta_j \Delta LOAN_{t-j} + \sum_{j=0}^{q_6-1} \psi_j \Delta GEXP_{t-j} + \mu_t \quad (2)$$

Eq. (2) can be re-parameterized to derive the unrestricted error correction version as follows:

$$\Delta AGRIC_t = \gamma [AGRIC_{t-1} - \left(-\frac{\alpha_1^+}{\gamma} RER_{t-1}^+ - \frac{\alpha_1^-}{\gamma} RER_{t-1}^- - \frac{\alpha_2}{\gamma} ICU_{t-1} - \frac{\alpha_3}{\gamma} MLR_{t-1} - \frac{\alpha_4}{\gamma} LOAN_{t-1} - \frac{\alpha_5}{\gamma} GEXP_{t-1}\right) + \sum_{i=1}^{p-1} \theta_i \Delta AGRIC_{t-i} + \sum_{j=0}^{q_1-1} \phi_j^+ \Delta RER_{t-j}^+ + \sum_{j=0}^{q_2-1} \phi_j^- \Delta RER_{t-j}^- + \sum_{j=0}^{q_3-1} \pi_j \Delta ICU_{t-j} + \sum_{j=0}^{q_4-1} \rho_j \Delta MLR_{t-j} + \sum_{j=0}^{q_5-1} \delta_j \Delta LOAN_{t-j} + \sum_{j=0}^{q_6-1} \psi_j \Delta GEXP_{t-j} + \mu_t \quad (3)$$

By letting,

$$\varepsilon_{t-1} = AGRIC_{t-1} - \beta_1^+ RER_{t-1}^+ - \beta_1^- RER_{t-1}^- - \beta_2 ICU_{t-1} - \beta_3 MLR_{t-1} - \beta_4 LOAN_{t-1} - \beta_5 GEXP_{t-1} \quad (4)$$

Where,

$$\beta_1^+ = -\frac{\alpha_1^+}{\gamma}, \beta_1^- = -\frac{\alpha_1^-}{\gamma}, \beta_2 = -\frac{\alpha_2}{\gamma}, \beta_3 = -\frac{\alpha_3}{\gamma}, \beta_4 = -\frac{\alpha_4}{\gamma}, \beta_5 = -\frac{\alpha_5}{\gamma} \quad (5)$$

Eq. (3), then, becomes

$$\Delta AGRIC_t = \gamma \varepsilon_{t-1} + \sum_{i=1}^{p-1} \theta_i \Delta AGRIC_{t-i} + \sum_{j=0}^{q_1-1} \phi_j^+ \Delta RER_{t-j}^+ + \sum_{j=0}^{q_2-1} \phi_j^- \Delta RER_{t-j}^- + \sum_{j=0}^{q_3-1} \pi_j \Delta ICU_{t-j} + \sum_{j=0}^{q_4-1} \rho_j \Delta MLR_{t-j} + \sum_{j=0}^{q_5-1} \delta_j \Delta LOAN_{t-j} + \sum_{j=0}^{q_6-1} \psi_j \Delta GEXP_{t-j} + \mu_t \quad (6)$$

Definition of Terms

Δ = first difference operator; t = time period; AGRIC = Share of agriculture in real GDP (%);
ε_{t-1} = error correction term with the adjustment coefficient γ being expected to be negative, less than one in absolute value and be statistically significant;
RER = a linear measure of real exchange rate; RER^+ = Positive changes in real exchange rate (representing real depreciation); RER^- = Negative changes in real exchange rate (representing real appreciation);
ICU = Average industrial capacity utilization% (to account for intersectoral linkages);
MLR = Maximum lending rate (%), which is a proxy for the role of monetary policy;
LOAN = Natural log of Agricultural Guarantee Credit Scheme Fund (AGCSF) loan
GEXP = Natural log of Government expenditure on agriculture (a proxy for the role of fiscal policy in the agricultural sector development)
θ_j, ϕ^+_j, ϕ^-_j, π_j, ρ_j, δ_j, and ψ_j are short-run parameters, while $\beta_1,\ldots,\beta_5$ are long-run parameters
p is the lag length for the dependent variable, while $q_1,\ldots,q_6$ are the lag lengths associated with the explanatory variables, and μ = random error term.

A priori Expectations/Expected Results

$\phi^+_j > 0$ or < 0, $\phi^-_j > 0$ or < 0, $\pi_j > 0$, $\rho_j < 0$, $\delta_j > 0$, $\psi_j > 0$

$\beta^+_1 > 0$ or < 0, $\beta^-_1 > 0$ or < 0, $\beta_2 > 0$, $\beta_3 < 0$, $\beta_4 > 0$, $\beta_5 > 0$

- Real exchange rate appreciation and depreciation both have ambiguous and opposing effects on agricultural output depending on whether the demand side (finished goods) or the supply side (inputs) is affected;

- Average industrial capacity utilization is expected to have a positive effect on agricultural output via the forward and backward linkages that exist between agricultural sector and other sectors in the economy;
- The higher the cost of borrowed as measured by the maximum lending, the lower the investment in the agricultural sector as prospective farmers would be discouraged to borrow;
- The higher the amount of loanable funds available to prospective farmers, the greater is the output of the agricultural sector;
- Government expenditure on agricultural sector is expected to raise agricultural output as government provides/supplies agricultural inputs at subsidized rates.

5. Empirical Analysis

5.1 Data Description and Sources

The study is limited to Nigeria and seeks to collect annual data on the variables to be used covering the period between 1981 and 2016, due to limited data constraints, from various sources. The data on the share of agriculture in real GDP, Agricultural Guarantee Credit Scheme Fund (AGCSF) loan, maximum lending rate, average industrial capacity utilization rate, and government expenditure on agriculture were collected from the Central Bank of Nigeria's Statistical Bulletin (CBN, 2016) and CBN Quarterly Reports, while real exchange rate were obtained from variables including official exchange rate, Nigeria's GDP deflator and United States' GDP deflator, upon which data were collected from the World Bank's World Development Indicator (WDI, 2016).

5.2 Descriptive Statistics

Table 1 presents the summary statistics on the eight variables used throughout this study collected for the period between 1981 and 2016, implying a totality of 36 observations. The variable with the highest mean is the average industrial capacity utilization rate (47.01%), whereas the variable with the lowest mean is the positive changes in real exchange rate (2.06%). In terms of range (the difference between maximum and minimum values), series with outliers include, positive and negative changes in real exchange rate, average industrial capacity utilization rate, and maximum lending rate. In terms of the deviation of the series from their means, the most volatile series is industrial capacity utilization rate with the highest standard deviation of 10.96%, while the least volatile series is the natural log of real exchange rate with the lowest standard deviation of 0.66%.

Table 1: Summary of Descriptive Statistics

Variable	No. of Observation	Mean	Maximum	Minimum	Standard Deviation
$AGDP$	36	21.2545	26.9948	15.4959	3.2179
RER	36	4.9016	5.737	3.4277	0.6591
RER^{+}	36	2.0551	5.737	0.0000	2.5143
RER^{-}	36	2.7512	5.6479	0.0000	2.5217
ICU	36	47.0058	73.3	29.29	10.9558
$GEXP$	36	21.3805	24.9038	16.3626	2.9236
$LOAN$	36	13.2254	16.3377	10.1127	2.1477
MLR	36	21.3747	36.09	10	5.8599

***Source**: Author's Computation*

5.3 The Unit Root Test Result

Table 5.2 shows the result of the Augmented Dickey-Fuller (ADF) unit root test. Results indicate that only three variables including, positive and negative changes in real exchange rate, and maximum lending rate are stationary at levels, implying that they are integrated of order zero, and do not require differencing. The remaining five variables including, the agricultural share of real GDP, natural log of real exchange rate, industrial capacity utilization rate, government expenditure on agriculture, and ACGSF loan, however, became stationary after first differencing, implying that they are integrated of order one.

Table 2: Result of the ADF Unit Root Test

Variable	Level			First Difference			I(d)
	A	b	C	A	B	c	
$AGDP$	-2.434	-1.762	0.820	-6.454***	-6.501***	-6.378***	I(1)
RER	-2.033	-2.405	0.637	-4.877***	-4.782***	-4.753***	I(1)
RER^{+}	-5.396***	-5.181***	-1.369	……†	……	……	I(0)
RER^{-}	-5.229***	-4.786***	-1.346	……	……	……	I(0)
ICU	-3.153	-2.419	-0.695	-2.823	-3.149**	-3.192***	I(1)
$GEXP$	-2.174	-1.921	2.113	-6.269***	-8.168***	-7.321***	I(1)
$LOAN$	-2.089	-0.566	2.207	-5.573***	-5.678***	-4.947***	I(1)
MLR	-3.112	-2.926*	0.607	……	……	……	I(0)

Note: ***, **,* indicate the rejection of the null hypothesis of a unit root at 1%, 5% and 10%, respectively; I(d) is the order of integration and it refers to the number of differencing required for a series to become stationary; †implies that a series that is stationary at levels does not require its first difference being reported; a, b and c denote models with intercept and trend, with intercept only and with none, respectively.

***Source**: Author's Computation*

5.4 The ARDL Bounds Cointegration Test Result

Table 3 shows the result of Bounds test for cointegration performed on two models estimated in this study (linear and non-linear effect specifications). Since the F-statistic associated with the first model is less than the lower I0 critical bound at 5% level of significance, it can be concluded that all the variables in Model I are not cointegrated, or do not have a long-run relationship. Accounting for the asymmetric effect of real exchange rate on agricultural output in Model II did not change the conclusion that cointegration is absent among the series, since the associated F-statistic is less than the lower I0 lower bound at the 5% level. The absence of cointegration warrants the estimation of a linear and a non-linear autoregressive distributed lag models, respectively, in each of both cases.

Table 3: Result of ARDL Bounds Cointegration Test

Model I: Linear relation between real exchange rate and agricultural output		
F-stat	2.5164	
Critical Values		
Significance levels	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68
Model II: Non-linear relation between real exchange rate and agricultural output		
F-stat	2.0984	
Critical Values		
Significance levels	I0 Bound	I1 Bound
10%	2.12	3.23
5%	2.45	3.61
2.5%	2.75	3.99
1%	3.15	4.43

***Source**: Author's Computation*

5.5 The Granger Causality Test Result

Table 4 presents the result of Granger-causality test to examine the direction of causality between real exchange rate dynamics (appreciation and depreciation) and agricultural share of real GDP. Results showed that there is a unidirectional causality running from both real appreciation and real depreciation to agricultural share of real GDP at 10% level of significance. By implication, it can be concluded that movements in real exchange rate drive agricultural sector performance in output terms. This result paralleled the findings of Oyinbo et al, (2014) that there is unidirectional causality between exchange rate and agricultural share of real GDP in Nigeria

Table 4: Result of Granger-causality Test

Null Hypothesis	Obs.	F-statistic	Prob.
RER^{+} does not Granger Cause $AGDP$	31	2.2371	0.0979
$AGDP$ does not Granger Cause RER^{+}		0.9488	0.4548
RER^{-} does not Granger Cause $AGDP$	31	2.2399	0.0976
$AGDP$ does not Granger Cause RER^{-}		0.9059	0.4776

***Source**: Author's Computation*

5.6 The Regression Results

This sub-section presents and discusses the results of model estimation to examine both the linear and non-linear impacts of real exchange rate dynamics on agricultural output in Nigeria over the short term since there is no long-run relationship between real exchange rate and agricultural output irrespective of specifications. Tables 5 and 6 report, respectively, the results of linear and non-linear relations between real exchange rate and agricultural output in Nigeria. The two estimated models are interpreted as follows.

***Model 1**: Short-run Linear Relation between Real exchange rate and Agricultural output*

There is a positive association between the current share of agriculture in real GDP and its immediate previous value, and the autoregressive coefficient (0.5007) is statistically significant at 1% level of significance. This implies that agricultural output determination is adaptive in nature. Also, there is a positive relationship between real exchange rate and agricultural share of real GDP, as the impact coefficient (1.6111) implies that for every 1% depreciation in real exchange rate, agricultural output share increases on average by (1.6111/100) 0.01611 percentage point, keeping other variables constant. The coefficient is also significant at the 1% level. By implication, the increase in agricultural output as a result of real depreciation was due to the competitiveness of the sector's product relative to imported agricultural products.

Industrial capacity utilization rate boosts the share of agricultural real GDP as the impact coefficient (0.0232) implies that for every 1 percentage point increase in capacity utilization rate, agricultural output rises on average by 0.0232 percentage point, keeping other variables constant. The coefficient is, however, not significant at 10% level of significance. This result can be attributed to the fact that the Nigeria's agricultural sector is yet to explore the positive spill-overs from the possible backward and forward linkages between it and other sectors in the economy. Similarly, government expenditure on agriculture has an overall positive effect on agricultural output share, though after some lags, since the current value and the previous values (lags one, two, and three) of the former have opposing effects on the latter. Government expenditure on agriculture does not become a positive driver of agricultural output until after the third lag, even though the former has a negative instantaneous effect on the latter. While the coefficients on the current value and first lag of government expenditure are not statistically significant at the 10% level, the coefficients on the second and third lags are both significant at 1% level of significance. This therefore springs up the conclusion that agricultural output

responds with a considerable amount of lag to increases in government spending on the agricultural sector.

There is an unexpected negative relationship between Agricultural Credit Guarantee Scheme Fund (ACGSF) loan and agricultural share of real GDP, as the impact coefficient (-0.1027) implies that for every 1% increase in loanable funds, agricultural output share declines on average marginally by approximately 0.0011 percentage point, keeping other variables constant. The coefficient is, however, not statistically significant at the 10% level. It can therefore be inferred that the loan is not easily assessed by genuine farmers, or that the loanable funds are insufficient to stimulate output in the sector; hence the attendant negative effect on agricultural output performance. Moreover, there is an expected negative relationship between maximum lending rate and agricultural output share, as the impact coefficient -0.1359 implies that for every 1 percentage point increase in the lending rate, agricultural output share decreases on average by 0.1359 percentage point, keeping other variables constant. The coefficient is also significant at 5% level of significance. By implication, the high cost of borrowing through the deposit-money banks discourage prospective farmers from investing in the agricultural sector, and by extension, agricultural output is expected to decline.

In addition, the adjusted R^2 of 0.9014 implies that approximately 90% of the total variation in agricultural output share of real GDP is being explained by real exchange rate, industrial capacity utilization rate, government expenditure on agriculture, ACGSF loan, and maximum lending rate, having accounted for the number of number of degrees of freedom. The very high F-stat of 33.4926[0.0000] implies that all the partial slope coefficients on the explanatory variables listed above are jointly statistically significant at the 1% level; hence, the overall model is significant. Lastly, results of diagnostic/post-estimation tests showed that the model did not suffer from non-linearity, non-normality of the residuals, non-serial correlation in the residuals, and non-constant residual variance, since the probabilities associated with the various test statistics are greater than 0.1. It can therefore be concluded that the symmetric model is adequate for policy prescription.

Table 5: Short-run Linear/Symmetric Effect of Real exchange rate on Agricultural output

Dependent variable	$AGDP_t$
$AGDP_{t-1}$	0.5007*** (0.1442)
RER_t	1.6111*** (0.5414)
ICU_t	0.0232 (0.0461)
$GEXP_t$	-0.0648 (0.3050)
$GEXP_{t-1}$	-0.3892 (0.2859)
$GEXP_{t-2}$	-0.7685*** (0.2693)
$GEXP_{t-3}$	1.5823*** (0.3081)
$LOAN_t$	-0.1027 (0.3654)
MLR_t	-0.1359** (0.0533)
C	-0.9794 (1.883)
Adjusted R^2	0.9014
F-stat	33.4926[0.0000]
Ramsey RESET linearity test	0.2508[0.8043]
Jarque-Bera normality test	3.6567[0.1607]
Breusch-Godfrey serial correlation LM test	1.4342[0.2597]
ARCH LM heteroscedasticity test	0.1973[0.6601]

Note: ***, **, * indicate the statistical significance of coefficients at 1%, 5% and 10% respectively; the values in parentheses and block brackets are, respectively, the standard errors and the probabilities

***Source**: Author's Computation*

Model 2: *Non-linear Relation between Real exchange rate and Agricultural output*
The determination of agricultural share of real GDP was found to be adaptive as the overall autoregressive coefficient (that is the sum of coefficients of first, second, third and fourth lags of agricultural output share) is positive. The coefficients are also statistically significant at the conventional levels (1%, 5%, and 10%). Similarly, as expected, industrial capacity utilization is positively related to agricultural output share, as the impact coefficient (0.1358) implies that for every 1 percentage point increase in capacity utilization rate, agricultural output share increases on average by 0.1358 percentage point, keeping other variables constant. The coefficient is also significant at 5% level of significance. This implies that accounting for the asymmetric effect of real exchange rate on agricultural output improves significantly the forward and backward linkages between the agricultural sector and other sectors in the economy.

There is an expected positive relationship between government expenditure on agriculture and agricultural output share, as the impact coefficient (0.3437) implies that for every 1% increase in government expenditure, agricultural output increases on average by (0.3437/100) 0.003437 percentage point, keeping other variables constant. The coefficient is however not statistically significant at the 10% level. By implication, government expenditure on agricultural sector is yet to produce the desired outcomes in the sector. In the same vein, there is an expected positive relationship between the ACGSF loan and agricultural share of real GDP, as the impact coefficient (0.0866) implies that for every 1% increase in the amount of loanable funds, agricultural output share increases on average by (0.0866/100) 0.00086 percentage point, keeping other variables constant. The coefficient is not significant at 10% level of significance, implying that the loan provided by the scheme is yet to significantly stimulate agricultural production in Nigeria.

Likewise, there is an expected negative relationship between maximum lending rate and agricultural output share, as the impact coefficient (-0.1294) implies that for every 1 percentage point increase in the lending rate, agricultural output share decreases on average by 0.1294 percentage point, keeping other variables constant. The coefficient is also significant at 10% level of significance. By implication, the high cost of borrowing through the deposit-money banks discourage prospective farmers from investing in the agricultural sector, and by extension, agricultural output is expected to decline. Moreover, there is an overall positive impact of real depreciation (that is, positive changes in real exchange rate) on agricultural share of real GDP, as the coefficients current value and lags of real depreciation take opposite signs. In other words, real depreciation increases domestic agricultural production. While the coefficient on current real depreciation is not statistically significant at the 10% level, the coefficients on the first and second lags are significant at 10% and 5%, respectively. This result indicates that agricultural output does not respond instantly to real depreciation, but it does after some lag. Real depreciation makes domestic agricultural products competitive relative to its imported substitutes.

In the same vein, there is an overall positive relationship between real appreciation (that is, negative changes in real exchange rate) and agricultural output share, as the coefficients on the current value, first and second lags of real appreciation take opposite signs. In other words, real appreciation is harmful to the agricultural sector. Just with real depreciation, the coefficient on current real appreciation is not statistically significant at the 10% level, whereas the coefficients on the first and second lags of real appreciation at 10% and 5%, respectively. By implication, agricultural output responds with lags to negative changes in real exchange rate (that is, real appreciation). Real appreciation makes domestic agricultural product lose international competitiveness relative to imported substitutes; hence the shift in demand from domestic agricultural products to imported ones, and its attendant negative impact on agricultural sector

performance in Nigeria. The overall positive impact of real appreciation outweighs the overall positive impact of real depreciation, implying the effectiveness of the former over the latter.

In addition, the adjusted R^2 of 0.8784 implies that approximately 88% of the total variation in agricultural output share of real GDP is being explained by positive and negative changes in real exchange rate, industrial capacity utilization rate, government expenditure on agriculture, ACGSF loan, and maximum lending rate, having accounted for the number of number of degrees of freedom. The very high F-stat of 16.9986[0.0000] implies that all the partial slope coefficients on the explanatory variables listed above are jointly statistically significant at the 1% level; hence, the overall model is significant. Lastly, results of diagnostic/post-estimation tests showed that the model did not suffer from non-linearity, non-normality of the residuals, non-serial correlation in the residuals, and non-constant residual variance, since the probabilities associated with the various test statistics are greater than 0.1. It can therefore be concluded that the asymmetric-effect model is adequate for policy prescription. Of important interest is the result of Wald test for short-run asymmetry. Since the associated probability is greater than 0.1, the null hypothesis of a symmetric effect of real exchange rate on agricultural output cannot be rejected. In other words, real exchange rate dynamics (appreciation and depreciation) have no asymmetric impacts on agricultural output performance in Nigeria.

Table 6: Non-linear/Asymmetric Effect of Real exchange rate on Agricultural output

Dependent variable	$AGDP_t$
$AGDP_{t-1}$	0.6491*** (0.1741)
$AGDP_{t-2}$	-0.6921*** (0.2134)
$AGDP_{t-3}$	0.4412* (0.2166)
$AGDP_{t-4}$	-0.3361* (0.1637)
ICU_t	0.1358** (0.0589)
$GEXP_t$	0.3437 (0.3443)
$LOAN_t$	0.0866 (0.6084)
MLR_t	-0.1294* (0.0633)
RER_t^+	1.6586 (1.3658)
RER_{t-1}^+	-2.5753* (1.3644)
RER_{t-2}^+	2.2700** (0.9192)
RER_t^-	1.8759 (1.4538)
RER_{t-1}^-	-2.8905* (1.4157)
RER_{t-2}^-	2.5315** (0.9299)
C	1.0346 (2.7547)
Adjusted R^2	0.8784
F-stat	16.9986[0.0000]
Ramsey RESET linearity test	1.3155[0.2069]
Jarque-Bera normality test	0.3509[0.8391]
Breusch-Godfrey serial correlation LM test	0.5329[0.5976]
ARCH LM heteroscedasticity test	0.9402[0.3403]
Wald test for short-run asymmetry	-0.6835[0.5035]

Note: ***, **, * indicate the statistical significance of coefficients at 1%, 5% and 10%, respectively; the values in parentheses and block brackets are, respectively, the standard errors and the probabilities.

***Source**: Author's Computation*

6. Conclusions

The present study investigated the asymmetric effect of real exchange rate dynamics on agricultural output performance in Nigeria over the period between 1981 and 2016. The variables employed in this study include, agricultural share of real GDP, real exchange rate (computed from the data on official exchange rate, Nigeria's GDP deflator and United States' GDP deflator), ACGSF loan, maximum lending rate, industrial capacity utilization rate, and government expenditure on agriculture, upon which data were collected from the Central Bank

of Nigeria's statistical bulletin (CBN, 2016), CBN Quarterly Reports, and World Bank's World Development Indicator database (WDI, 2016). Generally, the result of model estimation showed that the significant positive drivers of agricultural output share are natural log of real exchange rate, real appreciation and real depreciation (after some lags), industrial capacity utilization, and government expenditure on agriculture (after some lags). While maximum lending rate is the only significant negative driver of agricultural output, the ACGSF loan does not become a positive determinant of agricultural output share until the asymmetric effect of real exchange rate movement was accounted for, though the loan has not yet yielded the desired outcome. As far as the linear relation between exchange rate and agricultural output/exports is concerned, these results gave empirical support to the previous findings of Obayelu and Salau (2010), Omojimite (2014), Akpan et al (2015). In addition, though the effect of real appreciation is larger than the effect of real depreciation, the present study could not find any evidence in support of the asymmetric effect of real exchange rate dynamics on agricultural output performance in the Nigerian economy.

Based on the findings of this study, the following policy options could be found useful: (i) Since real exchange rate exerts positive effect on agricultural production, it is suggested that the Nigerian government explores the increased competitiveness of the sector in its economic diversification efforts. In other words, the agricultural sector could provide an avenue to expand the revenue base of the government; (ii) Much emphasis should be laid on local sourcing of raw materials so that the positive spill-over effects that is embedded in forward and backward inter-sectoral linkages could be absorbed; (iii) The Nigerian government at all levels should provide inputs and loan facilities to genuine farmers at subsidized rates. The inputs and loan facilities should also be available at the right time and in right amounts at the door-steps of prospective farmers. This is because lack of insufficient funds and inadequate input provision had been the major source of failure for most of the agricultural policies of the Nigerian government in the past, and (iv) The CBN should, through its monetary policy tools, such as, the monetary policy rate (MPR) and selective credit control, ensure that loans through the deposit-money banks are made accessible to genuine and credit-worthy farmers at the lowest possible cost. This would in turn stimulate investment in the agricultural sector with the attendant positive effect on the sector's output performance.

Appendix

Table A: Summary of Literature Review

Author(s) and Year	Scope of Coverage	Variables	Estimation method(s)	Findings
1. Odior (2014)	Nigeria (1970-2012)	Agricultural GDP, real monetary aggregate, exchange rate, inflation, nominal interest rate on loan, credit to agricultural sector, government expenditure on agriculture and time trend (a proxy for technological change over time)	One-step dynamic forecast analysis	Real monetary aggregate and technological change play a crucial role in affecting agricultural GDP. However, credit to agriculture and government expenditure on agriculture have insignificant impact on agricultural performance
2. Brownson, et al (2003)	Nigeria (1970-2010)	Agricultural GDP, real exports, real external reserves, inflation rate, real per capita GDP, industry's capacity utilization rate, external debt, lending rate, domestic savings, oil revenue, exchange rate	Techniques of cointegration and error correction model (ECM)	In both long-run and short-run, real exports, real external reserves, inflation, and external debt have significant negative relationship with agricultural productivity, whereas industry's capacity utilization rate and nominal exchange rate have positive relationship with agricultural productivity in both periods.
3. Omojimite (2012)	Nigeria (1970-2008)	Index of agricultural production, interest rate spread, real exchange rate, credit to agricultural sector, institutional framework dummy, deficit financing, and inflation rate	Fully modified OLS	Volume of credit to the agricultural sector, deficit financing and institutional reform positively and significantly affected agricultural output. However, interest rate spread has a negative and insignificant effect on agricultural output
4. Udensi, et al (2012)	Nigeria (1997-2007)	Index of agricultural production, cumulative foreign private investment in agriculture, total credit to farmers, nominal exchange rate, total government expenditure in agriculture, lending rate, inflation rate, index of world agricultural commodity prices, liquidity ratio, cash reserve ratio and minimum rediscount rate and time trend	Two-stage least squares (2SLS)	All the determinants of index of agricultural production were positively significant except for world agricultural commodity prices and inflation rate that were negatively related to index of agricultural production

Author(s) and Year	Scope of Coverage	Variables	Estimation method(s)	Findings
5. Akpan et al (2015)	Nigeria (1960-2014)	Agricultural diversification index, oil price, per capita GNP, inflation rate, FDI in agriculture, unemployment rate, index of energy consumption, and index of manufacturing production	Techniques of cointegration and error correction model (ECM)	In the long run, inflation, viable manufacturing sector, credit to agricultural sector, external reserves, per capita income, unemployment and energy consumption are positive drivers of agricultural diversification. Conversely, crude oil prices, lending capacity of commercial banks, FDI in agriculture, and non-oil imports are long-run negative drivers
6. Oluwatoyese et al (2016)	Nigeria (1981-2013)	Agricultural output, exchange rate, food imports, commercial loan on agriculture, unemployment rate, inflation rate and interest rate	Multivariate cointegration approach and vector error correction model (VECM)	Commercial bank loan to agriculture, interest rate and food imports are significant factors affecting agricultural output, whereas exchange rate, inflation rate and unemployment rate are insignificant factors
7. Udah and Nwachukwu (2014)	Nigeria (1960-210)	Agricultural GDP, agricultural capital, labour force in agriculture, land area harvested, average rainfall, agricultural export, inflation rate, infrastructural development, total factor productivity (TFP), and lagged value of agricultural GDP	Ordinary Least Squares (OLS)	Agricultural labour, infrastructural development, and TFP had positive relationship with agricultural GDP. However, land area harvested, inflation rate, and agricultural GDP in the previous period were negatively related to agricultural GDP
8. Akinlo and Adejumo (2014)	Nigeria (1986-2008)	Real non-oil exports, real foreign income, real intermediate imports, real exchange rate, and real exchange rate volatility	ECM	Lagged foreign income and real exchange rate have positive significant effects on non-oil exports. Results suggest that exchange rate volatility is only effective in the long run, but not in the short run.
9. Essien et al (2011)	Nigeria	Cocoa exports, lagged real GDP, relative price of cocoa, agricultural export credit and exchange rate volatility	OLS	Exchange rate fluctuations and agricultural export credit affect cocoa exports positively. However, relative price of cocoa is negatively and insignificantly related to cocoa exports

Author(s) and Year	Scope of Coverage	Variables	Estimation method(s)	Findings
10. Imoughele and Ismaila (2015)	Nigeria (1986-2013)	Non-oil exports, exchange rate, real GDP, inflation rate, trade openness, credit to private sector and broad money supply	OLS	Exchange rate, money supply, credit to private sector, and real GDP have significant impacts on the growth of non-oil exports. Also, appreciation in exchange rate has a negative impact on non-oil exports
11. Obayelu and Salau (2010)	Nigeria (1970-2007)	Aggregate agricultural output, real exchange rate, real price of domestic food crop, and real price of export crop	VECM	In the short run and long run, total agricultural output responds positively to increases in exchange rate, but negatively to increases in food prices.
12. Olarinde and Abdullahi (2014)	Nigeria (1978-2011)	Agricultural output, government recurrent expenditure on agriculture, agricultural credit to farmers, inflation rate, average official exchange rate and interest rate	VECM	In the long run, agricultural output is responsive to changes in government spending, agricultural credit, inflation rate, interest rate and exchange rate
13. Oyinbo, Abraham and Rekwot (2014)	Nigeria (1986-2011)	Exchange rate and agricultural share of real GDP	Granger causality test and VECM	There is unidirectional causality from exchange rate to agricultural share of real GDP. Also, exchange rate deregulation had negative influence on agricultural share of real GDP

***Source**: Author's Compilation*

References

Akinlo, A.E. and Adejumo, V.A. (2014). "Exchange rate volatility and Non-oil exports in Nigeria: 1986-2008". *CSCanada International Business and Management*, vol. 9, no. 2, pp. 70-79

Akpan, S.B., Udoka, S.J. and Patrick, I.V. (2015). "Roles of Macroeconomic variables on Agricultural Diversification". *American Journal of Economics and Business Administration*, vol. 7, no. 2, pp. 77-93

Brownson, S., Vincent, I., Emmanuel, G. and Etim, D. (2012). "Agricultural Productivity and Macroeconomic Variable Fluctuation in Nigeria". *International Journal of Economics and Finance*, vo. 4, no.8, pp. 114-125

Central Bank of Nigeria (CBN). *Quarterly Report for Quarter 4 of 2016*

Corden, W.M. (1984). "Booming Sector and Dutch Disease Economics: Survey and Consolidation". *Oxford Economic Papers, New Series*, vol. 36, no. 3, pp. 359-380

Essien, E.B., Dominic, A.O. and Sunday, E.R.(2011). "Effects of Price and Exchange rate Fluctuation on Agricultural Exports in Nigeria". *International Journal of Economic Development Research and Investment*, vol. 2, no. 1, pp. 1-10

Eyo, E.O. (2008). "Macroeconomic environment and Agricultural Sector Growth in Nigeria". *World Journal of Agricultural Sciences*, vol. 4, no. 6, pp. 781-786

Imoughele, L.E. and Ismaila, M. (2015). "Impact of Exchange Rate on Non-oil exports". *International Journal of Academic Research in Accounting, Finance and Management Sciences*, vol. 5, no. 1, pp. 190-198

Kwanashie, M., Garba, A. and Ajilima, I. (1997). "Policy Modelling in Agriculture: Testing the Response of Agriculture to Adjustment Policies in Nigeria". AERC Research Paper Series 57

Michael, E.O. (2017). "Agricultural Sector Performance and Nigeria's Economic Growth". *Asian Journal of Agricultural Extension, Economics and Sociology*, vol. 15, no. 1, pp. 1-13

Obayelu, A.E. and Salau, A.S. (2010). "Agricultural Response to Prices and Exchange Rate in Nigeria: Application of Cointegration and VECM". *Journal of Agricultural Science*, vol.1, no. 2, pp. 73-81

Odior, E.S. (2014). "The Macroeconomic Policy Effect on Nigerian Agricultural Performance: One-Step Dynamic Forecasting Analysis". *International Journal of Economics and Finance*, vol. 6, no. 9, pp. 190-198

Olarinde, M.O. and Abdullahi, H. (2014). "Macroeconomic Policy and Agricultural output in Nigeria: Implication for Food Security". *American Journal of Economics*, vol. 4, no. 2, pp. 99-113

Oluwatoyose, O.P. Applanaidu, S.D., Abdul Rasak, N.A. (2016). "Macroeconomic Factors and Agricultural Sector in Nigeria". *Procedia Social and Behavioural Sciences*, vol. 219, pp. 562-570

Omojimite, B.U. (2012). "Institutions, Macroeconomic Policy and the Growth of the Agricultural Sector in Nigeria". *Global Journal of Human Social Science*, vol. 12, issue 1, pp. 1-8

Oyejide, T.A. (1986). "The effects of trade and exchange rate policies on Agriculture in Nigeria". International Food Policy Research Institute (IFPRI) Research Report 55

Oyinbo, O., Abraham, F. and Rekwot, G.Z. (2014). "Nexus of Exchange Rate Deregulation and Agricultural Share of Agricultural Share of Gross Domestic Product in Nigeria". *CBN Journal Applied Statistics*, vol. 15, no. 2, pp. 49-64

Shin, Y., Yu, B. and Greenwood-Nimmo, M. (2014). "Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework" In R.C. Sickles and W.C. Horrace (eds.), Festschrift in Honour of Peter Smidht: Econometric Methods and Applications, DOI 10.1007/978-1-4899-8008-3_9, Chapter 9, pp. 281-314

Udah, S.C. and Nwachukwu, I.N. (2015). "Determinants of Agricultural GDP Growth in Nigeria". *International Journal of Agricultural Research and Review*, vol. 3, no. 3, pp. 184-190

Udensi, A.I., Orebiyi, J.S., Ohajianya, D.O. and Eze, C.C.(2012). "Determinants of Macroeconomic variables that affect Agricultural Production in Nigeria". *International Journal of Agricultural and Rural Development*, vol. 15, no. 3, pp. 1169-1173