# Econometric Analysis of the Nexus of Exchange Rate Deregulation and Agricultural Share of Gross Domestic Product in Nigeria

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## Abstract

This study examined the relationship between exchange rate deregulation and the agricultural share of gross domestic product in Nigeria from an econometric perspective using time series data. The data were analysed using augmented dickey fuller unit root test, unrestricted vector autoregression and pairwise granger causality. The results of the data analysis revealed the existence of unidirectional causality from exchange rate to agricultural share of gross domestic production in Nigeria and this implies that market driven exchange rate policy has been significant in influencing the trend in agricultural share of gross domestic production in Nigeria. However, it is recommended that the monetary authority of Nigeria should closely monitor the movement of the market driven exchange rate so that exchange rate deregulation does not become counterproductive through unhealthy price distortions on agricultural production, international trade and foreign direct investment in the agricultural sector of Nigeria's economy.

## Key words

Correlation, technical efficiency, farm income, dietary diversity, Nigeria.

## Introduction

Nigeria's domestic economy is partly determined by agriculture which accounted for 40.9 per cent of its Gross Domestic Product (GDP) in 2010 (CBN, 2011) and the agricultural sector is one of the leading sectors in the country in terms of its contributions to income, employment, foreign exchange earnings and domestic food supply (Omojimite, 2012). Despite the immense potentials of agriculture in Nigeria, food production to meet local demand has been a challenge over the years and as noted by Oparaeke et al. (2009) who posited that if the current food production trend of 1.35 per cent is not increased to tally with or surpass the population growth rate, then the country will be in a for a turbulent future. In a bid to increase food production in Nigeria over the years, several policy reforms have been put in place by successive governments and one of such policy reforms in time past is the Structural Adjustment Programme(SAP) introduced in July 1986 (Oyinbo and Emmanuel, 2012). The Structural adjustment programme aimed at facilitating economic growth as a means of jump-starting the economy towards sustainable economic growth and development. The emergence of Structural adjustment programme

in Nigeria embraced exchange rate deregulation and thus, deregulation placed much emphasis on the market forces in determining the prices of goods and services and allocating the resources within the economy (Idowu et al., 2007). The exchange rate over-valuation prior to deregulation helped to cheapen imports of competing food items as well as agro-based and industrial raw materials and the result was rapid expansion in the importation of these goods to the detriment of local production of similar goods (Imimole and Enoma, 2011). This led to the abolition of the fixed exchange rate regime and the introduction of flexible exchange regime via the adoption of Structural adjustment programme. This new exchange rate policy helped to remove the over-valuation problem to the extent that the naira now became under-valued. The movement away from fixed to flexible exchange rate regimes allowing significant depreciation of Naira was aimed at enhancing export by making Nigerian goods cheaper (Shittu et al., 2007).

There has not been a consensus among academic economists regarding the impact of exchange rate variations on economic variables. However, the traditional view is that fluctuations in exchange rates affect relative domestic and foreign prices,

causing expenditures to shift between domestic and foreign goods (Obstfeld, 2002). Several economists and policy analysts to mention a few had focused considerable research attention on Nigeria's non-oil trade behaviours; a prominent feature of these studies has been a lack of consensus on the suitability of trade and exchange rate deregulation in the Nigerian case.

Since the inception of exchange rate deregulation in Nigeria, there have been fluctuations in the value of the naira. However, exchange rate of the naira to the US dollars was relatively stable in 2010 (CBN, 2010). The average exchange rate of the naira at the Whole Sale Dutch Auction System (WDAS) segment of the foreign exchange market in 2010 was 150.30 per US dollars; a depreciation of 0.9 per cent compared to the level in 2009. A market driven exchange rate policy is expected to be important in determining the importation of inputs for agricultural production and also, the export of agricultural produce through its influence on prices but it is worth noting that there exists a dearth of empirical information on the relationship between exchange rate deregulation and agricultural gross domestic product in Nigeria which is in line with Petreski (2009), who posited that the relationship between exchange rate and economic growth remains blurred and requires in-depth empirical investigation. This study was therefore, designed to fill the gap in research by providing empirical information on the relationship between exchange rate deregulation and agricultural share of gross domestic product in Nigeria. The hypotheses put forward were stated in the null and alternative forms:

Null form ($H_O$): There is no a significant relationship between exchange rate and agricultural share of gross domestic product in Nigeria.

Alternative form ($H_a$): There is a significant relationship between exchange rate and agricultural share of gross domestic product in Nigeria.

## Literature review

A review of relevant empirical studies (Aghion et al., 2009; Cho et al., 2002; Gala, 2008; Ghura and Greene, 2004; Jumah and Kunst, 2001; Kriesler et al., 2013) have indicated two school of thoughts with regards to the influence of exchange rate on economic growth (gross domestic product) and this is attributed to variations in data periods,

models and estimation methods. One school of thought posited that fixed exchange rate policy is significant in influencing economic growth while the other school of thought asserted that market driven exchange rate policy is significant in influencing economic growth.

Omojimite (2012) in a study on institutions, Macroeconomic Policy and Growth of Agricultural Sector in Nigeria found out that exchange rate was negative and significant in influencing agricultural production.

Chukuigwe and Abili, (2008) in a study on econometric analysis of the impact of monetary and fiscal policies on non-oil exports in Nigeria noted that considering the importance of the exchange rate as a major price that affects all sectors of the economy and all economic agents, it is imperative to monitor the movements in the real exchange rate in order to foster competitiveness and improve the supply of exports in the medium to long term and that The Central Bank of Nigeria should continue to intervene in the foreign exchange market to maintain stability.

Okhiria and Saliu (2008) in a study on exchange rate variation and inflation in Nigeria noted that Dutch disease results from an appreciation of the exchange rate, caused by the large inflows of petroleum revenues, which again leads to reduced competitiveness of various non-petroleum sectors of the economy. Dutch disease will often have particularly serious effects on the poor because traditional sectors such as agriculture and other production in rural areas will loose out to imports that become more competitive as a result of currency appreciation.

Imimole and Enoma (2011) in a study on exchange rate depreciation and inflation in Nigeria noted that theoretically, exchange rate is an important determinant of inflation rate. Although exchange rate depreciation may not directly control inflation, it helps to restructure the price mechanism of both import and export, such that Naira depreciation subtly tends to moderate prices in Nigeria, especially imported price inflation.

## Materials and methods

### Description of data

Time series data on exchange rate (Naira per US Dollar) and agricultural share of real gross domestic product(GDP) extending over the period

of exchange rate deregulation (1986 to 2011) were utilized in this study. The data were collected from various issues of Central Bank of Nigeria statistical bulletin and annual reports (CBN, 2008; 2011).

## Analytical procedure

Augmented Dickey Fuller (ADF) test, Unrestricted vector autoregression (VAR) and Pairwise granger causality test were employed using Eviews 7.2 statistical package to analyse the data in order to achieve the objective of the study. ADF test was used to ascertain the time series properties of all the variables so as to avoid spurious regression which results from the regression of two or more non-stationary time series data. Unrestricted VAR was employed to select the optimal lag length used in the granger causality test and finally, the pairwise granger causality test was used to determine the causal relationship between exchange rate and agricultural share of gross domestic product over the period of exchange rate deregulation. The model of the Augmented Dickey Fuller (ADF) with the constant term and trend is as follows:

$$\Delta Y_t = a_1 + a_2 t + \beta Y_{t-1} \sum_{i=1}^{n} \gamma_i \Delta Y_{t-1} + \varepsilon_t \quad (1)$$

The null hypothesis ($H_O$: $\beta = 0$) of the ADF test indicates that the series is not stationary and the alternative hypothesis ($H_1$: $\beta < 0$) indicates that the series is stationary. If the absolute value of calculated ADF statistic $(\tau)$ is higher than the absolute value of the critical values, we reject the hypothesis which states that the series is stationary. However, if this value is lower than the critical values, the time series is not stationary. The Granger causality test assumes that the information relevant to the prediction of the respective variables, X and Y, is contained solely in the time series data on these variables. The test involves estimating the following pair of regressions:

$$X_t = \beta_0 + \sum_{i=1}^{p} \beta_i X_{t-i} + \sum_{j=1}^{p} \alpha_j Y_{t-j} + \mu_{1t} \quad (2)$$

$$Y_t = \gamma_0 + \sum_{i=1}^{p} \gamma_i Y_{t-i} + \sum_{j=1}^{p} \delta_j X_{t-j} + \mu_{2t} \quad (3)$$

It is assumed that the disturbances $\mu_{1t}$ and $\mu_{2t}$ are uncorrelated. Thus there is unidirectional causality from X to Y if $\alpha_i = 0$ and $\delta_i \neq 0$. Similarly, there is unidirectional causality from Y to X if $\delta_i = 0$

and $\alpha_i \neq 0$. The causality is considered as mutual (bilateral causality) if $\delta_i \neq 0$ and $\alpha_i \neq 0$. Finally, there is no link between X and Y (independence) if $\delta_i = 0$ and $\alpha_i = 0$.

## Model Specification

To determine the relationship between exchange rate deregulation and agricultural share of gross domestic product in Nigeria, the pairwise granger causality test is modelled as bivariate vector autoregressive (VAR) model as follows:

$$EXR_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i EXR_{t-i} + \sum_{j=1}^{p} \omega_j GDP_{t-j} + \epsilon_{1t} \quad (4)$$

$$GDP_t = \beta_0 + \sum_{i=1}^{p} \beta_i GDP_{t-i} + \sum_{j=1}^{p} \varphi_j EXR_{t-j} + \epsilon_{2t} \quad (5)$$

The VAR model is expressed in matrix notation as:

$$\begin{bmatrix} EXR_t \\ GDP_t \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} + \begin{bmatrix} b_{11,1} & b_{12,1} \\ b_{21,1} & b_{22,1} \end{bmatrix} \begin{bmatrix} EXT_{t-1} \\ GDP_{t-1} \end{bmatrix}$$

$$+ \begin{bmatrix} b_{11,p} & b_{12,p} \\ b_{21,p} & b_{22,p} \end{bmatrix} \begin{bmatrix} GDP_{t-p} \\ EXR_{t-p} \end{bmatrix} + \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{bmatrix} \quad (6)$$

Where:

$EXR_t$ = Exchange rate in year t (Naira per US Dollar)

$GDP_t$ = Agricultural share of real gross domestic product in year t(Naira' million)

$a$ = Constant terms

$b$ = Estimated coefficients of exchange rate and agricultural share of real gross domestic product in year t

$\epsilon_{1t}, \epsilon_{2t}$ = Gaussian white noise error terms

$p$ = optimal lag length

## Results and discussion

### Descriptive statistics of variables

It is important to examine the summary statistics of the variables under study (exchange rate and agricultural share of gross domestic product). The basic features of exchange rate (ECR) and agricultural share of gross domestic product (GDP) under study are given in Table 1. ECR is positively skewed, leptokurtic and the probability value (0.17) of its Jarque bera statistic (3.50) denotes that its errors are normally distributed. GDP is positively skewed, leptokurtic and its errors are normally distributed based on the Jarque Bera statistic (3.46).

| Statistic | ECR (Naira per US Dollar) | GDP (Naira' million) |
|---|---|---|
| Mean | 70.81860 | 157700.8 |
| Median | 57.37225 | 111692.4 |
| Maximum | 158.2300 | 335400.0 |
| Minimum | 2.020000 | 69608.06 |
| Std. Dev. | 59.44565 | 87890.64 |
| Skewness | 0.109590 | 0.747625 |
| Kurtosis | 1.216498 | 2.020795 |
| Jarque – Bera | 3.497997 | 3.460836 |
| Probability | 0.173948 | 0.177210 |
| Sum | 1841.284 | 4100221 |
| Observations | 26 | 26 |

Source: own processing

Table 1: Descriptive statistics of Exchange Rate and GDP in Nigeria (1986 – 2011).

| Variable | ADF Statistic | Lag | Test Critical value (5%) | Decision |
|---|---|---|---|---|
| **Level** | | | | |
| lnEXR | -2.016752 | 0 | -3.603202 | Non-stationary |
| lnGDP | -1.873371 | 0 | -3.603202 | Non-Stationary |
| **First difference** | | | | |
| ΔlnAEXR | -5.247509 | 0 | -3.690814 | Stationary |
| ΔlnGDP | -4.866667 | 0 | -3.612199 | Stationary |

Note: ln = natural logarithm, Δ = difference operator
   Lag length selection was automatic based on Schwarz information criterion (SIC)
Source: own processing

Table 2: Result of Augmented Dickey Fuller Test.

## Augmented Dickey Fuller Unit root test

The result of the augmented dickey fuller test with the assumption of trend and intercept in Table 2 shows that lnEXR and lnGDP were non-stationary at level form (exhibit random walk) and therefore, needed to be differenced so as to avoid spurious result when the variables are used in their non-stationary form.

## Vector Autoregression (VAR) Lag Order Selection Criteria

Granger causality test is known to be sensitive to lag length (Oyinbo et al., 2012) and therefore, VAR model was fitted to the time series data in order to find an appropriate lag structure for the granger causality test. The result as shown in Table 3 indicates that the optimal lag length is four based on Likelihood ratio (LR), Final prediction error (FPE) and Akaike information criterion (AIC).

## Granger Causality Test

The result of the granger causality carried out using an optimal lag length of four is given in Table 4. The result indicates that there is unidirectional causality from exchange rate and the agricultural share of gross domestic product in Nigeria over the period of exchange rate deregulation and therefore, the hypothesis that exchange rate does not granger cause agricultural share of gross domestic product is rejected while the hypothesis that agricultural share of gross domestic product granger cause exchange rate is accepted. The result implies that deregulation of exchange rate has been significant in influencing the volume of agricultural share of the Nigerian gross domestic period over the period under study. This could be attributed to the influence of market determined exchange rate on importation of inputs for agricultural production and agricultural exports known to be contributing the largest share of non-oil export

| Lag | LR | FPE | AIC |
|---|---|---|---|
| **0** | NA | 0.064459 | 2.933882 |
| 1 | 84.62852 | 0.000860 | -1.386750 |
| 2 | 2.881067 | 0.001067 | -1.185864 |
| **3** | 4.347656 | 0.001185 | -1.115459 |
| 4 | 14.64704* | 0.000546 | -1.955094* |
| 5 | 3.039158 | 0.000660 | -1.878057 |

Note: * indicates lag order selected by the criterion
      LR: Likelihood ratio, FPE: Final prediction error, AIC: Akaike information criterion
Source: own processing

Table 3: VAR Lag Order Selection Result.

| Null Hypothesis ($H_0$) | Obs. | F- statistic | Prob. | Decision |
|---|---|---|---|---|
| GDP does not granger cause EXR | 22 | 0.02316 | 0.9988 | Accept $H_0$ |
| EXR does not granger cause GDP | 22 | 17.8745 | 3.E-05 | Reject $H_0$ |

Source: own processing

Table 4: Result of Pairwise Granger Causality Test.

and this is in consistent with Enoma (2011), who noted that exchange rate depreciation helps to restructure the price mechanism of both import and export, such that Naira depreciation subtly tends to moderate prices in Nigeria, especially imported price inflation. Therefore, it is imperative for the monetary authority of Nigeria to monitor the trend in exchange rate depreciation so as to avoid excessive devaluation of the naira that could be detrimental to the contribution of agriculture to the gross domestic product through its inflationary effect on trade (agricultural input importation and agricultural product exportation) and investment in the agricultural sector of Nigeria's economy. This is in line with the opinion that an attempt to over-stimulate the economy, by expansionary monetary policy or currency devaluation will result in higher rate of inflation, but no increase in real economic growth (Goldstein, 2002).

## Conclusion

Augmented dickey fuller unit root test, Unrestricted vector autoregression (VAR) and Pairwise granger causality were employed to analyse the time series data on exchange rate and agricultural share of gross domestic product over the period of economic deregulation in Nigeria in order to achieve the objective of the study. The key finding of this study is the presence of unidirectional causality from exchange rate to gross domestic product over the period under study. This placed an emphasis on the significant role of exchange rate deregulation on the agricultural share of gross domestic product in Nigeria. However, it is recommended that the central bank of Nigeria should carefully monitor the movement of the market determined exchange rate so that exchange rate deregulation does not become counterproductive through price distortions on agricultural production, trade (agricultural input importation and agricultural produce exportation) and investment in the agricultural sector of Nigeria's economy.

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