Nexus of Exchange Rate Deregulation and Agricultural Share of Gross Domestic Product in Nigeria

Oyakhilomen Oyinbo [1], Falola Abraham [2] and Grace Z. Rekwot [3]

The kernel of this study was to examine the causal relationship between exchange rate deregulation and the agricultural share of gross domestic product in Nigeria from an econometric perspective using time series data spanning a period of 26 years (1986 – 2011). Data on exchange rate and gross domestic product were analysed using augmented dickey fuller unit root test, unrestricted vector autoregression, pairwise granger causality and vector error correction model. The results showed the existence of unidirectional causality from exchange rate to agricultural share of gross domestic production and also, exchange rate deregulation had negative influence on agricultural share of gross domestic production in Nigeria. This implies that market driven exchange rate policy has been having undesirable influence on the trend in agricultural share of gross domestic production in Nigeria.

1.0   Introduction

The agricultural sector is one of the leading sectors in the Nigerian economy 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 (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).

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[1] Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. Email: ooyinbo@abu.edu.ng

[2] Department of Agricultural Economics and Farm Management, University of Ilorin, Kwara State, Nigeria.

[3] National Animal Production Research Institute, Ahmadu Bello University, Shika-Zaria, Kaduna State, Nigeria.

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 with a specific objective to fill the gap in research by providing empirical information on the causal relationship between exchange rate deregulation and agricultural share of gross domestic product in Nigeria. The major thesis of this paper is that there is no relationship between exchange rate and agricultural share of gross domestic product in Nigeria.

2.0   Literature Review

A review of relevant empirical studies (Mundell, 1995, Ghosh *et al.,* 1997; Levy-Yeyati and Sturzenegger, 2002; Bailliu *et al.,* 2003; Talvas, 2003; Eichengreen and Leblang, 2003; Edwards and Levy-Yeyati, 2003; Hernandez-Verme, 2004; Huang and Malhotra, 2004; Cavalho, 2005; Garofalo, 2005; Tyers *et al.,* 2006; Bleaney and Francisco, 2007, Rodrick, 2008; Darvas, 2011; Chen, 2012) has 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.

There are also divergent views on exchange rate in Nigeria. Oriavwote and Omojimite (2012) in a study on empirical investigation of exchange rate pass-through into domestic prices in Nigeria opined that volatility of exchange rate has significant impact on domestic prices in Nigeria than the shocks from domestic price itself and therefore, exchange rate volatility should be given important consideration when implementing policies on stabilizing domestic inflation.

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 lose out to imports that become more competitive as a result of currency appreciation.

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

Alao (2010) in a study on interest rates determination in Nigeria found out that exchange rate adjustment is positive and significant in influencing interest rate spread in Nigeria. The resulting effect on interest rate spread affects agricultural production.

Amassoma *et al.* (2011) in a study on the Nexus of interest rate deregulation, lending rate and agricultural productivity in Nigeria noted that a decline in exchange rate implies reduction in the cost of imported agricultural inputs and consequently stimulating current agricultural output.

Wafure and Nurudeen (2010) in examining the determinants of foreign direct investment in Nigeria the revealed that exchange rate is significant in explaining changes in foreign direct investment and that 1 per cent depreciation in exchange rate causes FDI to increase by approximately 0.02.

Olubanjo *et al.* (2009) in a study on economic deregulation and supply response of cocoa farmers in Nigeria found out that exchange rate have a negative effect on output or cause decrease in output as their magnitudes increase. Unsurprisingly, increased exchange rate signifies Naira appreciation and hence represents price disincentive for local (cocoa) production.

3.0 Methodology

3.1 Description of Data

Time series data on exchange rate (Naira per US Dollar) and agricultural share of real gross domestic product (Naira) 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) and National Bureau of statistics (NBS, 2010).

3.2 Analytical Procedure

Augmented Dickey Fuller (ADF) test, unrestricted vector autoregression (VAR) pairwise granger causality test and vector error correction model were employed using Eviews 7.2 econometrics package to analyse the data. The model of the Augmented Dickey Fuller (ADF) with the constant term and trend is as follows:

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

Where:

ΔY_t = first difference of Y_t
Y_{t-1} = lagged values of Y_t
ΔY_{t-1} = first difference of Y_{t-1}
β = test coefficient
e_t = white noise
a_1 = constant
a_2 = coefficient of time variable

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 (τ) is higher than the absolute value of the critical values, we reject the hypothesis which shows that the series is stationary. However, if this value is lower than the critical values, the time series is not stationary (Gujarati, 2003). 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:

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

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

Where:

X_t, Y_t = regressands of models 2 and 3 respectively
β_0, γ_0 = constant terms of models 2 and 3 respectively
β_i, α_j = coefficients of the regressors of model 2
γ_i, δ_j = coefficients of the regressors of model 3
μ_{1t}, μ_{2t} = error terms of models 2 and 3 respectively

It is assumed that the disturbances μ_{1t} and μ_{2t} are uncorrelated. Thus there is unidirectional causality from X to Y if $\alpha_j = 0$ and $\delta_j \neq 0$. Similarly, there is unidirectional causality from Y to X if $\delta_j = 0$ and $\alpha_j \neq 0$. The causality is considered as mutual (bilateral causality) if $\delta_j \neq 0$ and $\alpha_j \neq 0$. Finally, there is no link between X and Y (independence) if $\delta_j = 0$ and $\alpha_j = 0$.

3.3   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:

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

$$AGDP_t = \beta_0 + \sum_{i=1}^{p} \beta_i AGDP_{t-i} + \sum_{j=1}^{p} \varphi_j EXR_{t-j} + \epsilon_{2t} \qquad (5)$$

In order to estimate the short-run relationship between the variables, the corresponding error correction equation was estimated as:

$$\Delta lnAGDP_t = c_0 + \sum_{i=1}^{p} c_i \Delta lnEXR_{t-1} + \psi ECM_{t-1} + \epsilon_{3t} \quad (6)$$

where:

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

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

α_0, β_0, c_0 = Constant terms in models 4, 5 and 6 respectively

α_i, φ_j, c_i = Estimated coefficients of exchange rate in models 4, 5 and 6 respectively

ω_j, β_i = Estimated coefficients of agricultural share of real gross domestic product in models 4 and 5 respectively

$\epsilon_{1t}, \epsilon_{2t}, \epsilon_{3t}$ = Gaussian white noise error terms in models 4, 5 and 6 respectively

p = optimal lag length

Δ = Difference operator

ECM = Error correction term

ln = Natural logarithm

4.0 Results and Discussion

4.1 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 (EXR) and agricultural share of gross domestic product ($AGDP$) under study are given in Table 1. EXR is positively skewed, platykurtic and the probability value(0.17) of its Jarque Bera statistic(3.50) denotes that its errors are normally distributed. $AGDP$ is positively skewed, platykurtic and its errors are normally distributed based on the Jarque Bera statistic (3.46). The trend in exchange rate and agricultural share of gross domestic product in Nigeria is shown in Figures 1 and 2 respectively.

4.2 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.

Table 1: Descriptive statistics of EXR and AGDP in Nigeria (1986 – 2011)

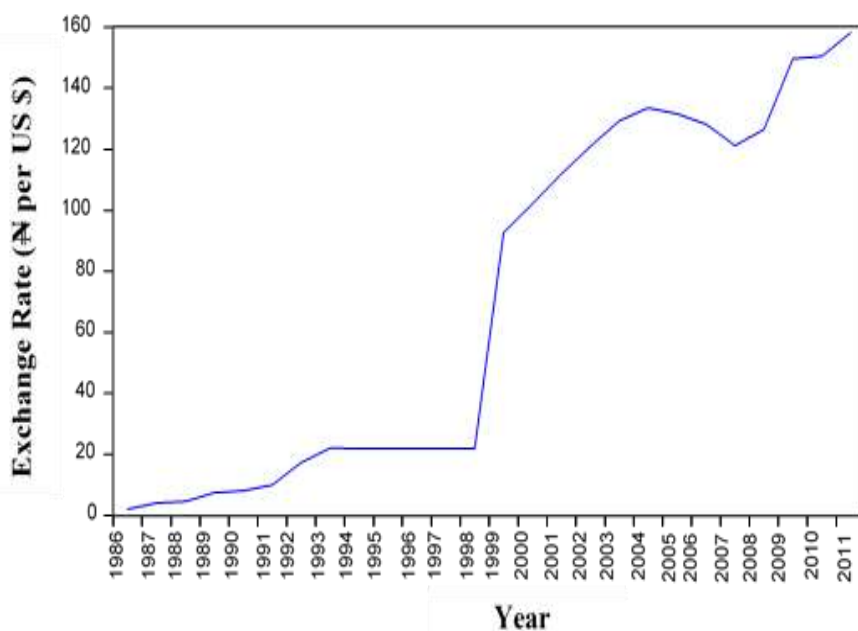| Statistic	EXR(Naira/US Dollar)	AGDP(Naira' million)
Mean	70.8186	157700.8000
Median	57.3723	111692.4000
Maximum	158.2300	335400.0000
Minimum	2.0200	69608.0600
Std. Dev.	59.4457	87890.6400
Skewness	0.1096	0.7476
Kurtosis	1.2165	2.0208
Jarque-Bera	3.4980	3.4608
Probability	0.1739	0.1772
Sum	1841.2840	4100221.0000
Observations	26	26

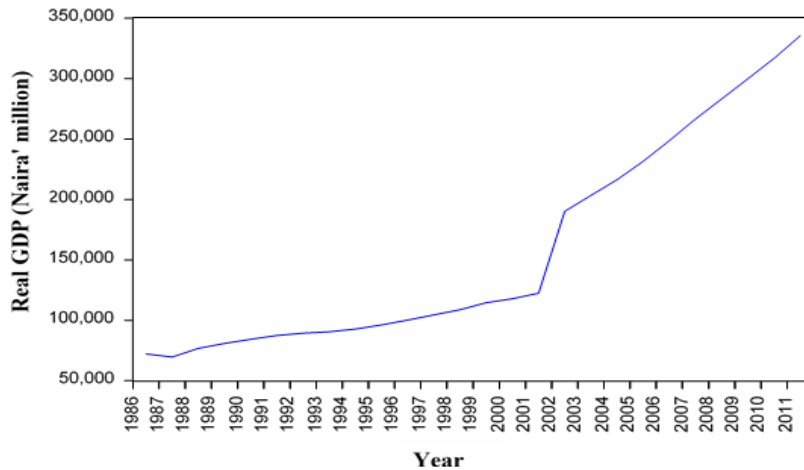Figure 1: Trend of Exchange Rate in Nigeria (1986 – 2011)

Figure 2: Trend of Agricultural Share of GDP in Nigeria (1986 – 2011)

Table 2: Result of Augmented Dickey Fuller Test

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				
ΔlnEXR	-5.247509	0	-3.690814	Stationary
ΔlnGDP	-4.866667	0	-3.612199	Stationary

NB: Lag length selection was automatic based on Schwarz information criterion (SIC)

Table 3: **VAR Lag Order Selection Result**

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

NB: * indicates lag order selected by the criterion
LR: Likelihood ratio, FPE: Final prediction error, AIC: Akaike information criterion.

4.3   Vector Autoregression (VAR) Lag Order Selection Criteria

Granger causality test is known to be sensitive to lag length (Foresti, 2006; Afzal, 2012, 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 LR, FPE and AIC.

4.4   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 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 to monitor the trend in exchange rate depreciation so as to avoid excessive devaluation of the naira that could lead to price distortions.

Table 4: Result of Pairwise Granger Causality Test

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

NB: * Implies significant at 1% probability level

4.5   Vector Error Correction Estimate

The result of the vector error correction as presented in Table 5 contains the long run estimates, short run estimates and diagnostic statistics. The long run estimates revealed that the estimated coefficient of exchange rate was -1.932 and was significant at 1% probability level which implies that exchange rate deregulation had negative influence on the agricultural share of gross

domestic product over the period of 1986 to 2011. This result suggests that a unit increase in exchange rate will decrease the agricultural share of gross domestic product by 1.932 *ceteris paribus*. Also, the short run estimates gave similar result in line with the long run estimates as the estimated coefficient of the first lagged value of exchange rate was -0.086291 and significant at 10% probability level.

Table 5: Vector Error Correction Estimates

Variable	Coefficient	Standard Error	t-statistic
Long run estimates			
Constant	19.09639		
lnGDP(-1)	1.000000		
lnEXR(-1)	-1.931569*	0.42364	-4.55946
Short run estimates			
Constant	0.104648	0.03044	3.43775
ΔlnGDP(-1)	-0.085077	0.20132	-0.42260
ΔlnGDP(-2)	-0.160531	0.19827	-0.80967
ΔlnEXR(-1)	-0.086291***	0.05191	-1.66232
ΔlnEXR(-2)	-0.060837	0.05130	-1.18579
ECM(-1)	-0.084327*	0.03075	-2.74218
Diagnostic Statistics			
R-squared	0.331543	Log likelihood	29.64405
Adj. R-squared	0.134938	Akaike AIC	-2.056005
Sum sq. resids	0.102271	Schwarz SC	--1.759789
S.E. equation	0.077563	Mean dependent	0.064118
F-statistic	1.686341	S.D. dependent	0.083393

NB: * denotes p< 0.1, *** denotes p < 0.01

This implies that agricultural share of gross domestic product will decrease by 0.086291 as exchange rate increases by one unit. The nature of the long run and short run relationship between exchange rate deregulation and agricultural share of gross domestic product could be attributed to 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). The error correction coefficient(-0.084327) of the model had the expected negative sign and was significant at 1% confirming the existence of long run relationship between exchange rate and gross domestic product. The error correction coefficient indicates a feedback of about 8% per cent of the previous year's disequilibrium from the long run value of exchange rate.

5.0   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 and also, negative influence of exchange rate on gross domestic product. Therefore, exchange rate deregulation has not been favourable to agricultural production. In the light of this finding, it is recommended that the Central Bank of Nigeria should carefully monitor the movement of the market determined exchange rate. This will ensure 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 in line with the Agricultural Transformation Agenda.

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