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Agricultural Response to Prices and Exchange Rate in Nigeria: Application of Co-integration and Vector Error Correction Model (VECM)

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ABSTRACT The response of agriculture to changes in relative prices and exchange rates is an important factor in the success of any reform programme in agricultural sector of Nigeria. This study estimated the response of aggregate agricultural output to exchange rate and price movements of food and export crops in Nigeria using available time series data that span about 37 years from the Central Bank of Nigeria (CBN) Annual Reports. This study through the Augmented Dickey Fuller (ADF) and unit root test found that the variables used in the model are integrated of the same order.Using maximum likelihood estimation results also shows that the entire variables cointegrated. The results of the Vector Error Correction Model (VECM) for the estimation of short run adjustment of the variables toward their long run relationship showed a linear deterministic trend in the data and that food and export prices as well as the real exchange rate jointly explained 57% of the variation in the Nigeria aggregate agricultural output in the short run and 87% variation in the long run. Total agricultural output responds positively to increases in exchange rate and negatively to increases in food prices both in the short and long run. The significance of food crop prices and exchange rate at 5% and 1% respectively both in the short and long run suggest that changes in these variables are passed immediately to agricultural output.

INTRODUCTION

The response of agricultural supply to price movements has been the subject of long and vigorous discussion, going back to Nerlove's classic treatment of the long-run supply elasticity for corn, cotton and wheat in the United States (Nerlove 1979). Estimates of supply elasticity (short-run and long-run) based on the Nerlove model vary widely by crop and region, leading some to argue that the Nerlovian model is inadequate for deriving the long-run response. This study, however, used Cointegration and vector error correction model (VECM) to examine the effects of some economic variables in both the short and long runs on agricultural supply in Nigeria.

In view of the poor performance of the agricultural sector in recent years and the impact of most of the economic reform programmes on agricultural supply in Nigeria, most commentary on the impact of adjustment on agriculture points to the fact that the reforms are showing the desired outcomes, but others think otherwise. Price reform is a necessary but insufficient condition for increased output (Chibber 1989; Duncan and Howell 1992). While supply response for food or export crops can be significant, aggregate supply response may be comparatively low, suggesting that at least some increased output might have occurred through switching of resources between them, with changing price incentives. The theoretical case that price reforms will lead to supply response is weak, especially in relation to food production, where policy biases are limited. Food prices may fall in relative terms. Price variability affects supply response, but in no standard direction. For the past two decades, while population grew at a rate between 2.5% and 3% per annum, food production grew at a rate of about 2.5% per annum (CBN 1999; World Bank 2001). The pressure on domestic price levels persisted as the consumer prices, which reached very high levels at the end of 1993 increased further. Data from the federal office of statistics (FOS 1998) showed that the average all-items composite consumer price Index (CPI) for the first half of 1994 stood at ₦1105.10 This represents an increase of 41.5% and 121.3% over the levels in the corresponding periods of 1993 and 1992 respectively (CBN 1994). The CBN (1994) report further confirmed that the food components, which accounted for 69.1% of the expenditure bracket, recorded a dampening effect on the rate of price increase. Consequently, there are declining per capita production, high and rising food prices, increased food import and a growing deterioration in the nutritional status of the average Nigerian.

Specifically the study seeks to test whether the agricultural outputs in Nigeria respond positively to prices as well as exchange rate, and to make policy recommendations based on findings.

Theoretical Framework

There are divergences of views on the impacts of some macroeconomic variables on agricultural supply response. One reason may be the method of evaluating the outcomes of the reforms. The most objective approach would be to present the theoretical issues clearly, use sound macroeconomic reasoning and formulate a scientific means of evaluation. As the reforms are many and varied, evaluations have to be done by considering one issue at a time. The long-run policy response of agriculture to structural adjustment may not be discernible with regression analysis, especially in models with the simple lag structures such as those characterizing the Nerlove model. How does agriculture respond in the short run to changes in prices and exchange rates?

The tight linkage between cointegration and ECM stems from the Granger representation theorem. According to this theorem, two or more integrated time series that are cointegrated have an error correction representation, and two or more time series that are error correcting are cointegrated (Engle and Granger 1987). In short, the two concepts are isomorphic, as each implies the other. The concept of cointegration and ECM are introduced to avoid spurious regression (Lauridsen 1998).While the theory of cointegration was developed by Granger (1983) and Granger and Weiss (1983), ECM was introduced by Phillip (1954) and was first used in economics by Sargan (1964). It have been observed that since the application of ECM by Davidson et al. (1978), ECM have been playing an important role in the dynamics of both short-run (change) and long-run (levels) adjustment processes. The cointegration and ECM takes account of the dynamics adjustment to steady state targets by including in the short-term dynamics a measure of how far from equilibrium the variables were at the start of the period.

The VECM which employs cointegration is used in the analysis of the model specified for this study. A prerequisite for the VECM estimation is the determination of the characteristics of the time series variables in the model as to whether they are stationary or non-stationary. The VECM is a restricted vector autoregression (VAR) designed for use with non stationary variables that are known to be co-integrated. VECM specification restricts the long run behaviour of the endogenous variables to converge to their co-integrating relationships while allowing for short-run adjustment dynamics. Vector error-correction models (VECMs) are widely used to model economic variables that are non-stationary individually but linked by long-run relationships. A "standard" VECM assumes that these variables follow a linear adjustment process towards their long-run equilibrium. Engle and Granger (1987) showed that if the variables, say Xt and Yt is found to be cointegrated, there will be an error representatives which is linked to the said equation, which gives the implication that changes in dependent variable is a function of the imbalance in cointegration relation (represented by the error correction term) and by other explanatory variables.

According to Hendry and Juselius (2000), the use of the VECM is facilitated when variables are first differenced stationary and cointegrated. Determination of stationarity is important in that it ascertains the order of integration and if not present, the number of times a variable has to be differenced to make it stationary. Cointegration is a restriction on a dynamic model, it is inherently multivariate, since a single time series cannot be cointegrated and it is testable. A method of classification for non- explosive processes is that, variables that are stationary processes are denoted by I(0), those that become stationary processes by taking first, second differences are designated as I(1), I(2) respectively. So the expression I(d) means " integration of order d". The statistical tests to determine whether each of the economic variables is I(0) or I(1) are: the Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) tests. The DF and ADF procedures are based on the standard t-test. The DF test (Fuller, 1976, Dickey and Fuller, 1979) can be carried out by applying a regression such as: $x_t = ax_{t-1} + c_t d u_t$. On the variable and comparing the t- value with Fuller (1976)'s distribution table, if the t-value is significantly negative, the variable is regarded as I(0) instead of I(1). The ADF test allows for more dynamics than the DF and the number of lags can be varied. But in situation where the ADF test proves inconclusive, the graphical representation of the data in levels and first differenced may be relied upon (Koekemoer 1999). In the ADF test, a regression such as equation 1 is applied

$$X_t = a\, X_{t-1} \sum_{i=1}^{n} bi\, \Delta\, u_{t-i} + e_t$$

Cointegration vectors are of considerable interest when they exist, since they determine I(0) relations that hold between variables which are individually non-stationary. Such relations are often called 'long-run equilibria', since it can be proved that they act as 'attractors' towards which convergence occurs whenever there are departures there from (see e.g., Granger 1986; Banerjee et al. 1993,). Hendry and Juselius (2000) states that when data are non-stationary purely due to unit roots (integrated once, denoted I(1)), they can be brought back to stationarity by the linear transformation of differencing, as in x_t -x_{t+1}= Δx_{t-}

To find out which variables adjust, and which do not adjust, to the long-run cointegration relations, an analysis of the full system of equations is required. According to Hendry and Juselius (2000), the constant terms, $ð_i$, can both describe an intercept in the cointegration relations and linear trends in the variables and empirical analysis can be used to estimate both effects. However, a rank (r) determination for cointegrating vectors can be based on the maximum likelihood approach proposed by Johansen (1988).In this, the first, and most crucial step is to discriminate empirically between zero and non-zero eigenvalues when allowing for sample variation, and then to impose an appropriate cointegration rank restriction r on the ð matrix.

Literature Review

Agricultural prices are used as a major policy tool in developing countries to change levels of production (Ghafoor et al. 2009), and there is a continuously growing literature on agricultural response to prices and exchange rate. Over the last couple of years agricultural producers are observed to be more sensitive and interested in the role of exchange rates in commodity prices (Kristinek and Anderson 2002). It is therefore very imperative to review the literature on the relationship between exchange rates and agricultural prices.

Numerous researchers such as Johnson et al. (1977), Schwartz (1986), Bradshaw and Orden (1990), Denbaly and Torgerson (1992), Babula et al. (1995), Kiptui (2007), Aliyu (2008), Oyinlola (2008) have examined the influence of exchange rate movements on agricultural trade (prices, supplies, and demands), but there still remain some disagreements on the magnitude of the effects.

Johnson, et al. (1977) compared the impact of exchange rate versus the impact of foreign commercial policy in the pricing of United States (U.S) wheat. Johnson et al. employed a deterministic short run forecasting model to examine the international pricing of wheat, their results show that foreign commercial policy created to insulate consumers from increasing prices was more influential in the domestic price of wheat than U.S. policy.

Schwartz (1986) compared the effects of changes in the exchange rate (and other macroeconomic variables) in a simple competitive versus a non-competitive market for wheat. In the simple competitive case and under a floating exchange rate, a change in exchange rate in one country will cause a short run adjustment in price, output, trade, market share of exports and export volume for two countries competing with one another.

Bradshaw and Orden (1990) tested the Granger Causality of exchange rates on agricultural prices and exports. Their results show that detecting Granger causality from the exchange rate to flexible agricultural prices is more difficult than Granger Causality to export sales volume. They also observed that agricultural prices respond more quickly than manufacturing prices to a shock in money supply.

Denbaly and Torgerson (1992) used a cointegration methodology that links the long run relationship between relative wheat price and its determinants with a short run dynamic equation, known as an error correction model (ECM). The results of the elasticity value of -1.27 obtained implies that expansionary monetary policy disproportionately benefits wheat producers, relative to non-commodity sectors, in the short run and tight monetary policy hurts wheat producers in the short run.

Babula et al. (1995) found no cointegration between exchange rates, price, sales, and shipments with respect to United States corn exports. But estimates obtained using both structural econometric models and time series methods generally showed varying degrees of exchange rate impacts on agricultural prices and quantity traded.

Oyinlola (2008) empirically investigated the impact of exchange rate movements and tariff rate reduction on disaggregated import prices of an open economy like Nigeria undergoing structural change using ECM. The paper observes that in the short run, exchange rate exhibits positive and more than complete pass-through to significant import prices of consumer and capital product groups

Kiptui (2007) investigates the impact of the real exchange rate on the demand for Kenya's exports in an export demand framework which also includes economic activity for Kenya's major export categories: tea, coffee, horticulture and manufactured goods. Bounds testing and Auto-Regressive Distributed Lag (ARDL) approaches to the analysis of long-run relationships and error correction modeling are applied. The existence of long-run relationships is established for coffee, tea and horticulture exports but rejected for manufactured goods exports. The results indicate that the real exchange rate has positive effects in the short-run but the effects are found to be statistically insignificant.

Aliyu (2008) quantitatively assesses the impact of exchange rate volatility on non oil export flows in Nigeria through the use of Unit root tests and the Johansen cointegration tests. The empirical results show evidence of stationarity at level for some variables while for some at first difference. Evidence of cointegration among the variables was also established using the Johansen procedure. This implies that a stable long run equilibrium condition exists among the fundamental variables. Error correction variable from an estimated short run dynamic model showed reasonable speed of adjustment towards the long run equilibrium path.

METHODOLOGY

The study employed one unique data source on agricultural output, food and export prices indices as well as exchange rate. This was due to wide variation in the values when different data sources were considered. The available annual data which are secondary in nature were obtained from CBN publications spanning a range of 36 years (1970-2007).Standard econometric techniques such as Ordinary Least Square, 2 Stages Least Square or the Nerlovian type specifications cannot be applied to this data set because they produce spurious regression results, and cannot accurately estimate direct short-run and long-run price elasticities. The Eviews econometric software package was employed to analyse the data

Test for Unit Roots

As the VEC specification only applies to cointegrated series, it is neccesary to run the Johansen cointegration test prior to VEC specification. This allows us to confirm that the variables are cointegrated and to determine the number of cointegrating equations. To carry out the unit root test for stationary, the study uses the Augmented Dickey-Fuller (ADF) test to examine each of the variables for the presence of a unit root (an indication of non-stationary), since it can handle both first order and higher order auto-regressive processes, by including the first difference in lags in the test in such a way that the error term is distributed as white noise.

A variable is said to contain a unit root or is I(1) if it is non-stationary. The use of data characterized by unit roots may lead to serious error in statistical inference.

$$y_t = \beta y_{t-1} + \varepsilon_t \text{---} 1$$

In the equation 1, if â equal one, the model is said to be characterized by unit root (the equation becomes the random walk model), and the series is non-stationary. For a series to be stationary, â must be less than unity in absolute value. Hence stationarity requires that -1< â < 1

Dickey-Fuller Unit Root Test (DF)

By subtracting y_{t-1} from each side of the equation 1 we have:

$$y_t - y_{t-1} = \beta y_{t-1} - y_{t-1} + \varepsilon_t \text{--} 2$$

$$\Delta y_t = (\beta - 1) y_{t-1} + \varepsilon_t \text{--} 3$$

$$\Delta y_t = \delta y_{t-1} + \varepsilon_t \text{--} 4$$

Where Δ is the first difference operator and $\delta = \beta - 1$. Testing the hypothesis â = 1 is equivalent to testing the hypothesis ä $=0$. Dickey and Fuller (1979) consider three different regression equations that can be used to test for the presence of a unit root, regressions: with no constant and trend, with constant and with constant and trend. In each case the null hypothesis is H_0: $\delta = 0$ (unit root). The test statistics from the testing regressions are known as the statistics critical values τ, τ_μ and τ_τ (the type of statistics depends whether an equation contains trend and/or intercept), which were tabulated by Dickey and Fuller (1979). The regressions provide a t-statistic of the estimated δ. The t-statistic is then compared to the critical value t-statistic. If $t > \tau$ H_0 is rejected, it means the *yt* is stationary. If $t < \tau$, H_0 is not rejected, it means the y_t is non-stationary

$$\Delta y_t = a + \delta y_{t-1} \Sigma_{t=1}^{k} \lambda_j \Delta y_{t-i+1} + \varepsilon_t \text{ -------------------------- } 5$$

The Johansen's cointegration tests are very sensitive to the choice of lag length. Firstly, a VAR model is fitted to the time series data in order to find an appropriate lag structure. The Schwarz Criterion (SC) and the Likelihood Ratio (LR) test are used to select the number of lags required in the cointegration test. The lagged terms are included to ensure that the errors are uncorrelated. The maximum lag length begins with 3 lags and proceeds down to the appropriate lag by examining the AIC and Schwarz criterion (SC) information criteria. The number of lagged difference terms to be included can be chosen based on t-test, F-test or the Akaike's Information Criterion (AIC) (Greene 1993).

The null hypothesis is that the variable y_t is a nonstationary series (H_0: $\beta = 0$) and is rejected when â is significantly negative (Ha: $\beta<0$). The null hypothesis is that the variable y_t is a nonstationary series (H_0: $\beta = 0$) and is rejected when β is significantly negative (Ha: $\beta<0$). If the calculated ADF statistic is higher than McKinnon's critical values, then the null hypothesis (H_0) is not rejected and the series is non-stationary or not integrated of order zero I(0).

In order to test the long-run relationships, the following multivariate model was investigated in the study using the VECM (Equation 6 and 7).

For a bivariate VAR, where X and Y are I(1) and cointegrated

$$\Delta X_t = C_1 + \lambda_1 Z_{t-1} + \beta_1 \Delta X_{t-1} + \text{----} + a_1 Y_{t-1} + \text{------} + \varepsilon_{xt} \text{ -- } 6$$

$$\Delta Y_t = C_2 + \lambda_2 Z_{t-1} + \gamma_1 \Delta X_{t-1} + \text{-------} + \delta_1 Y_{t-1} + \text{-------} + \varepsilon_{xt} \text{ --- } 7$$

Where $(\varepsilon_{xy}, \varepsilon_{xy})$ is a bivarate white noise and

$Z_t = X_t + AY_t \rightarrow I(0)$, *and at least one* $\lambda_1 \neq 0$

Y_t = a measure of aggregate agricultural output in year t (Tonnes)

X_t = explanatory variables which are

ER = Exchange rate adjusted for inflation in Nigeria (₦ /$)

P^f = Price of domestic food crop in year t (₦ /tonne)

P^e = Price of export crop in year t (₦ /tonne)

Indices of producer prices were created using Laspeyres formula and then deflated by the consumer price index (CPI) series to achieve a measure of real price

RESULTS AND DISCUSSION

Stationarity Tests: For cointegration analysis, it is important to check the unit roots at the outset to ascertain whether modeled variables are I(1) at levels and I(0) at differences. Table 1 presents the results of the Unit Root Test using the Augmented Dickey-Fuller (ADF). The tests were applied to each variable over the period of 1970-2007 with a time trend at the variables level and at their first difference. The test results are compared against the MacKinnon (1991) critical values for the rejection of the null hypothesis of no unit root. Table 1 shows that all variables are integrated of order one I(1) in levels and of order zero I(0) in first differences, meaning that they are nonstationary in levels and stationary in first differences. This indicates that the variables are I (1) and any attempt to specify the dynamic function of the variable in the level of the series will be inappropriate and may lead to problems of spurious regression in line with Mesike et al. (2010). The econometric results of the model in that level of series will not be ideal for policy making (Yusuf and Falusi 1999) and such results cannot be used for prediction in the long-run. Johansen cointegration test therefore becomes appropriate for assessing the existence of long-run relationships among variables. The Schwartz Information Criterion (SIC) is used to select the optimal truncation lag length to ensure the errors are white noise in ADF. In this study, the Schwarz Criterion (SC) and the Likelihood Ratio (LR) test suggested that the value p = 2 is the appropriate specification for the order of VAR model.

Table 1: Unit root tests

Variables	*Statistics*	*ADF Tests* *Critical values* 1%	5%	10%	*Order of integration*
D(Y)	-2.4099	-4.2324	-3.5386	-3.2009	Non stationary in level I(0)
	-4.5254	-4.2412	-3.5428	-3.2032	Stationary at first difference I (1)
D(ER)	-1.3418	-4.2324	-3.5386	-3.2009	Non stationary in level I(0)
	-5.4582	-4.2412	-3.5428	-3.2032	Stationary at first difference I(1)
D (P^f)	-2.3746	-4.2324	-3.5386	-3.2009	Non stationary in level I(0)
	-3.6546	-4.2412	-3.5428	-3.2032	Stationary at first difference I(1)
D (P^e)	-3.0354	-4.2324	-3.5386	-3.2009	Non stationary in level I(0)
	-6.3217	-4.2412	-3.5428	-3.2032	Stationary at first difference I(1)

Key:
ADF = Augmented Dickey Fuller
I(1) = Stationary at first difference
I(0) = Non Stationary in level
Y = Aggregate agricultural output (Kg)
ER = Real exchange rate
P^f = Price of domestic food crops
P^e = Price of export crops

Cointegration Test: Table 2 shows the summary results of the Johansen's Maximum Likelihood co-integration test. The test relations were estimated with intercept and linear deterministic trend. The results, based on the both the trace test and maximum Eigen value test showed the existence of two cointegrating vectors and the rejection of the null hypothesis of r = 0. Thus, there is a unique long-run equilibrium relationship between the variable concerned in line with Hallam and Zanoli (1992) that state that where only one co-integrating equation exists, its parameters can be interpreted as estimate of long-run cointegrating relationship between the variables concerned. When the cointegration rank was tested based on the Maximum likelihood approach by Johansen (1988) (Johansen Trace test), it showed the existence of two cointegrating equations at 5 percent significance level implying that there is a common trends in the process. Test statistics from the maximum Eigen value are consistent in suggesting that there are two integrating vectors among the variables. This implies that the explanatory variables are cointegrated and have short run and long run relationships with the dependent variable.

Vector Error Correction Estimate: The existence of co-integration among the dependent variable and their fundamentals necessitated the specification of VECM for this study. Table 3 shows the results of the VECM estimates for agricultural outputs response to changes in prices and exchange rate in Nigeria. Both the short-run and long-run estimates as well as diagnostic statistics are shown. The model was chosen on the basis of the following criteria data coherence, parameter consistency with theory and goodness of fit. Empirical estimates for the total agricultural output regression are reported in Table 3 (short run effect) and Table 4 (long run effect). All the explanatory variables jointly

Table 2: Summary of cointegration test
Result of Johansen Trace Test
Hp : rank = P (No deterministic trend in the data)
Hr : rank r < P (cointegration relations)

Eigenvalue	*Likelihood ratio*	*5 percent critical value*	*1 percent critical value*	*Hypothesized No. of CE(s)*	*Null*	*Alternative*
0.674426	75.56993	47.21	54.46	None **	R =0	r = 1
0.472939	35.17201	29.68	35.65	At most 1*	r ≤ 1	r = 2
0.280608	12.11623	15.41	20.04	At most 2	r ≤ 2	r = 3
0.007187	0.259675	3.76	6.65	At most 3	r ≤ 3	r = 4

**(*) denotes rejection of the hypothesis at 5 %(1%) significance level
L.R. test indicates 2 cointegrating equation(s) at 5% significance level
Source: Data analysis

explained 57% and 87% of the variation in agricultural output in the short and long run respectively. The remaining 43% and 13% can be attributed to the influence of omitted variables such as weather, hectarage of cultivated land, etc. Most parameter estimates fell within reasonable ranges, and suggests relatively modest short-run supply response to prices and exchange rates. An increase in aggregate agricultural output in the short run will lead to a decrease in the price of food crops. Similarly, a decrease in aggregate output in the long run will lead to a decrease in the prices of food crops. An increase in the exchange rate in the short run leads to increase in aggregate production output. This is in line with Adubi and Okunmadewa study (1999).

Table 3: Result of Vector error correction model showing the short runs effects

Variable	*Coefficient*	*Standard error*	*t- value*
Constant	-0.926381	1.52607	-0.60703
D(Y1(-1)	0.227799	0.36961	0.61632
D(Y1(-2)	-0.383393	0.25919	-1.47920
D(ER)	1.080952	0.48561	2.22596**
D(PE)	0.000770	0.00144	0.53327
D(PF)	-0.003687	0.00183	-2.01694**
ECM_{t-1}	-0.859100	0.44994	-1.90936***
R-squared	0.571213		
Log likelihood	-111.8016		
Adj. R-squared	0.434002		
Akaike AIC	7.105978		
Sum sq. resids	1429.456		
Schwarz SC	7.510014		
S.E. equation	7.561630		
Mean dependent	-0.297941		
F-statistic	4.163009		

Note: ***, ** significance at 10% and 5% levels
Source: Data analysis

The coefficient of the error correction term which measures the speed of adjustment towards long-run equilibrium is negative, significant at 1% level and less than one, which is appropriate. The result justifies the use of ECM specification of the model. One important finding is the statistical significance of the ECM suggesting that agricultural supply adjust to correct long run disequilibrium between itself and its determinants. The coefficient on the ECM is greater than unity in the long run implying a high speed of adjustment towards equilibrium. The coefficient of the ECM revealed that the speed with which agricultural outputs adjust to prices and exchange rate

Table 4: Result of vector error correction model showing the long run effects

Variable	*Coefficient*	*Standard error*	*t- value*
Constant	2.520633	1.05905	2.38009
D(Y1(-1)	-0.653365	0.25650	2.54725*
D(Y1(-2)	-0.721660	0.17987	-4.01213*
D(ER)	0.152866	0.33700	0.45361
D(PE)	0.001335	0.00100	1.33215
D(PF)	-0.008796	0.00127	-6.93392*
ECM_{t-1}	1.437624	0.31225	4.60415*
R-squared	0.872481		
Log likelihood	-99.38054		
Adj. R-squared	0.831675		
Akaike AIC	6.375326		
Sum sq. resids	688.4188		
Schwarz SC	6.779362		
S.E. equation	5.247547		
Mean dependent	0.513824		
F-statistic	21.38117		

Note: * significance at 1%
Source: Data analysis

is about 86% in the short run and 144% in the long run. The result also shows that the coefficient of determination (R^2) of agricultural supply is 0.8725, thus the independent variables explain 87.25% of the variations in the dependent variable. The food price elasticity in the short-run is 0.003687 and it is significant at 5% level, while in the long-run, food price elasticity is -0.008796 and significant at 1% level. The result of the price elasticity shows that a 1% increase in the food price leads to 0.3% decrease in the aggregate agricultural output in the short-run while 1% increase would also decrease the output by 0.9% in the long-run. Low and negative short-run and long-run elasticities of supply indicate that agricultural supplier in Nigeria do not make significant short and long-run production adjustments in response to changes in expected prices. This may be due to price sustainability over time and the emergence of other supply determinants which are more relevant than prices. The exchange rate elasticity in the short run is 1.08095 and significant at 5% level. This shows that a 1% increase in the exchange rate will lead to a 108.10 increase in the aggregate agricultural output in the short-run.

CONCLUSION

Estimation of Nigeria's agricultural output was approached through cointegration and VECM. The cointegration test showed that all the variables are integrated of first order.

Evidence also suggests that while aggregate agricultural output responds negatively to increases in food prices, it responds positively to increases in the exchange rate, in the short run. A possible explanation is that increases in the exchange rate lead to increases in aggregate output probably due to more foreign exchange earnings by farmers through exportation of their products. The fairly weak relationship between food price in both short and long run is consistent with this explanation. The exchange rate is an important variable affecting aggregate output positively in the short run.

RECOMMENDATIONS

Findings from the results of this study suggest the importance of the Nigerian government to intensify price policy measures that will enhance increased agricultural output.

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