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Food Commodities Prices and Its Implication on Food Security In Nigeria: (1970-2012)

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ABSTRACT

This study examined the movements in prices of the selected food crops over the period of 1970-2012 in Nigeria. Data from secondary sources such as Central Bank of Nigeria Statistical Bulletin and the Food and Agricultural Organization of United Nations Statistical online database were used in the study. The data used include; Nigeria's estimated per capita food production figures, per capita income, exchange rate, and the real retail prices of the three food crops studied which are Rice, Maize, and Wheat. Unit root test, autoregressive distributed lags modeling approach to cointegration were employed for the empirical data analysis.

The unit root test shows that all the variables have unit root except for maize price, wheat price and per capital income which are all stationary at levels. Examination of the cointegration properties of the variables for both rice and wheat real prices show that all the variables specified in each of the models are cointegrated. Error correction modeling of rice and wheat real prices show that real exchange rate, inflation, per capita output, per capita income and inflation are the main determinants of real prices of rice and wheat in Nigeria. While the error correction mechanism (ECM) was found to have values of 0.819 and 0.652 which were both significant at 1%, rice, wheat and maize were found to be close substitute food crops in Nigeria.

Keywords: Rice, Wheat, ARDL, Cointegration, Price

I. INTRODUCTION

According to Talukder *et al* (2000), agricultural price changes affect both producers and consumers of food products in a complicated manner. Since a large number of producers are also net buyers of food, they are affected by rising prices, while the relatively large farmers reap the benefits of higher prices. On the other hand, small farmers, because of various debt obligations, have to sell out their products immediately after harvest when prices are generally low.

Analysis of past and future pattern of price movements is important for producers, consumers and public policy makers. Price information is a key element in making production plan by farmers. Consumers can allocate and reallocate their family budget based on price information. The task of the public authority is to carefully watch the past and future price movement patterns so that appropriate stabilization measures can be taken to combat price fluctuations (Talukder *et al*, 2000). Agricultural prices greatly influence the pace and direction of agricultural development. Prices also serve as incentives to direct the allocation of economic resources and to a large extent they determine the structure and rate of economic growth. The liberalization of agricultural markets implies accepting potentially substantial variation in prices across time, space and product form. This price variation is necessary if agricultural markets are to perform its marketing functions (Tschirley, 1995).

The volatility in price of agricultural commodities in Nigeria has been attributed to various factors including variances in bargaining power among consumers, cyclical income fluctuations among sellers and consumers, natural shocks such as flood, pests, diseases, and inappropriate response by farmers to price signals

(Gilberts, 1999). Short- run fluctuations in agricultural commodity prices occur between production seasons (Cashin and Pattillo, 2000). During the harvesting period, farmers offer to the market the minimum price for their products. In the offseason, prices become high due to reduced production and seasonal changes (Akpan, 2002). Product price instability among agricultural commodities is a regular phenomenon in markets across Nigeria (Akpan, 2007). Instability in commodity prices among markets could be detrimental to the marketing system and the economy as a whole. It could cause inefficiency in resource allocation among sellers and consumers depending on the source of variability (that is whether it is induced by supply or demand side or both). It could also increase poverty level among low income earners in the society (Polaski, 2008).

Hence, agricultural commodity price is one of the major determinants of quantity of commodities supplied by farmers and demanded by consumers. Product price instability among agricultural commodities is a regular phenomenon in markets across Nigeria (Akpan, 2007). On the order hand, a unified product price among markets is not a rational policy to pursue in a developing country like Nigeria. This is because of the deteriorating marketing infrastructures, increase in cost of externalities and the nature of most agricultural products which often resulted in significant differences in the total variable costs incurred by sellers and consumers in these markets.

Prices of food commodities in recent years have been on the increase due to continuous fall in agricultural food production relative to population increase (for example, the contribution of the food section to the national GDP has not only been fluctuating but also falling). Ladipo and Adesinmi (1979), explained that in countries such as Nigeria, where agriculture is predominant, the increment of agricultural prices can have a ramifying effect on the economy. The findings of various studies according to Ladipo and Adesinmi (1979), point in this direction. In one of such studies, it was argued that the prices of food crops and the movement of such prices explain to a large extent the skewness of a nation's income distribution especially as regards the rural sector. Olayemi (1976), buttressed this point by showing empirically how higher food prices paid by consumers are not being paid back to farmers in significant proportions. He opined that for some crops in some parts of Nigeria, upward rising product price movement would (soon) cease to be an incentive for increased production since expected net returns would not increase. Thus the frequency and amplitude of food price fluctuation ir very important in farm production decision-making. As Tisdel (1976) pointed out, establishing the price of farm products can affect sales and may actually raise demand for such products, while wide fluctuations in price can affect the incomes and profit of farmers in an adverse way.

The world witnessed dramatic increases in the prices of major agricultural commodities from 2006 to 2009. Commonly referred to as the global food crisis, the food price surge in 2007–2008 was phenomenal, registering an increase of more than 60% in 2 years. The crisis did not end there, as the global food price rose again sharply in 2010—surpassing the 2008 peak before moderating a bit beginning in the last quarter of 2011. Surging food prices in recent years have raised concerns about food security, especially with their impact on the most vulnerable, i.e., poor households and their children. The upward trend of food prices is likely to persist for some time, while the increased volatility of food prices presents an additional challenge.

A number of studies have identified the causes and consequences of surging food prices. Trostle (2008) argues that the rapid expansion in global demand, rising crude oil prices, the depreciation of the United States (US) dollar, and other microeconomic factors have all contributed to rising prices. Various actions taken by both exporters and importers in an attempt to moderate domestic food price inflation have worsened the situation by tightening market conditions. Gilbert and Morgan (2010) suggest additional factors—namely, rapid economic growth, especially in the People's Republic of China (PRC) and other Asian economies, and the speculative trade in agricultural commodities—that play in such price dynamics. Headey and Fan (2008),

Regardless of the causes of the food price increase in recent years, the implications for the economy and poverty are clear. Headey and Fan (2008) note that, at the macro level, the elevated global food prices would have an impact on the size of food and fuel import bills, exchange rate movements and foreign exchange reserves, pattern of food consumption, trade and marketing policies, and so on. Although the net effects on the domestic economic welfare would depend on whether or not the economy is a net food importer or exporter, among various other country-specific factors, the impact would be nonetheless very large.

Between 1999 and 2003 alone, prices of petroleum products have been increased more than five times, hence subsequent rises in food prices. The importance of this study lies in the attempt to examine whether the agricultural cycle theory applies to Nigeria food industry. Information from the study will help to understand the pattern of how the food sector works, forecast at least for some period ahead what is likely to happen to the food sector of the economy, afford policy makers the opportunity of knowing the impact of food prices on household consumption and or overall national development. The results of this study could also serve as a tool for the right macro -economic policies to arrest the inflationary trend in the food sub-sector of the economy.

II. METHODS AND MATERIAL

2.1 Analytical Framework - Determinants of Food Commodities Prices

In order to examine the relationship between the various factors affecting food price movement, the model for these analyses was arrived at in two stages. First it is assumed that changes in price of a particular commodity during a period can be explained by its price and present changes in the price of close substitutes. This implies that determination of the current price of commodity R is influenced by current price of W, a close substitute.

This can be translated into two simple equations thus:

$$LP_{Ri} = f(P_{Ro}) \text{ ……….. (1)}$$

$$LP_{Ri} = f(P_{Ro}, P_{wi}) \text{ ………. (2)}$$

Where P_{Ri} is the current price of R, P_{Ri} is the immediate past price of R and P_{wi} is the current price of W. To adjust for changes in price level, all prices were deflated by the Consumer Price Index.

The second step will involve the consideration of other variables which may affect the behavior of prices. Meanwhile, since it is not always possible to include all relevant explanatory variables, those that were considered were quantity, income variables and some other explanatory variables considered to be of importance to food price determination. Both the quantity and income estimate were adjusted for changes in population. Quantity estimates refer strictly to output of the food commodity while the income estimate is the per capita GDP.

2.2 ARDL Analytical Framework and Model Specification

The study utilizes the autoregressive distributed lag (ARDL) also known as bound testing procedure developed to examine the determinants of selected food commodities prices in Nigeria. As obtained in Binuomote *et al* (2012), the choice of this test is based on the following considerations. Firstly, unlike most of the conventional multivariate co integration procedures, which are valid for large sample size, the bound test is suitable for a small sample size study. The sample size used is limited with a total of 45 observations. Secondly, the bounds test does not require the pretesting of the variables included in the model for unit roots unlike other techniques such as the Johansen approach. It is applicable irrespective of whether the regressors in the model are purely I (0), purely I (1) or mutually co integrated. The procedure will however crash in the presence of I (2) series. Thirdly, the bound test is simple as opposed to other multivariate co integration techniques such as Johansen and Juselius (1990), it allows the co integration relationship to be estimated by OLS once the lag order of the model is identified. Following Pesaran et. al. (2001) as summarized in Choong et. al. (2005), we apply the procedure by modeling the long run equation (5) as a general Vector Autoregressive (VAR) model of order p, in

$$z_t = \beta t + \sum_{i=1}^{p} \phi_i z_{t-i} + \varepsilon_t \text{ , t = 1,2,3,...,T .... (3)}$$

with c_o representing a (*k+1*)-vector of intercepts (drift) and β denoting a (*k+1*)-vector of trend coefficients. Pesaran *et al*,(2001) further derived the following vector equilibrium correction model (VECM) corresponding to:

$$\Delta z_t = c_0 + \beta t + \pi z_{t-1} + \sum_{i=1}^{p} \Gamma_i \Delta z_{t-i} + \varepsilon_t \ ,$$

t = 1,2,3,...,T .... (4)

Where the (k+1)*(k+1) matrices $\prod = I_{k+1} + \sum_{i=1}^{p} \psi_i$

and $\Gamma_i = - \prod = \sum_{j=i+1}^{p} \psi_i \ , i = 1, 2, ..., p-1$

contain the long-run multipliers and short-run dynamic coefficients of the VECM. Z_t is the vector of variables y_t and x_t respectively. y_t is an I(1) dependent variable defined as $\ln Y_t$ and

$LP_{it} = (LQ_i , LER, LP_j , LP_o , LINF , LY ,)$ is a vector matrix of 'forcing' I(0) and I(1) regressors as already defined with a multivariate identically and independently distributed (*i.i.d*) zero mean error vector $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t})$ and a homoskedastic process. Further assuming that a unique long-run relationship exists among the variables, the conditional VECM of interest can be specified as:

$$\begin{aligned} \Delta LP_i = {} & \delta_0 + LP_{it-1} + \delta_1 LER_{t-1} + \delta_2 LP_{o\,t-1} \\ & + \delta_3 LP_{jt-1} + \delta_4 LINF_{t-1} + \delta_5 LY + \delta_6 LQ_i + \\ & \sum_{i=0}^{p} \phi \Delta LP_{t-i} + \sum_{j=0}^{q} w \Delta LER_{t-1} + \sum_{m=0}^{q} \eta \Delta LPo_{t-1} + \\ & \sum_{n=0}^{q} \psi \Delta LP_{jt-1} + \sum_{l=0}^{q} \alpha \Delta LINF_{t-1} + \sum_{z=0}^{q} \sigma \Delta LY_{t-1} + \sum_{s=0}^{q} \upsilon \Delta LQ_{t-1} + \varepsilon \end{aligned}$$

...... (5)

where δi are the long run multipliers, c_0 is the drift and ε_t are white noise errors.

There are 3 steps in testing the co integration relationship between the supply of wheat and its explanatory variables. First, we will estimate equation above by ordinary least square (OLS) technique. The presence of co integration can be traced by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables. That is, the null hypothesis

H_0 : $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = \delta_8$ 0 against the alternative.

Ha: δ_1 or δ_2 or δ_3 or δ_4 or $\delta_5$or δ_6 or δ_7 or $\delta_8 \neq 0$.

If the computed F- statistic is less than lower bound critical value, then we do not reject the null hypothesis of no co integration. Conversely, if the computed F-statistic is greater than upper bound critical value, then we reject the null hypothesis and conclude that there exists steady state equilibrium between the variables under study. However, if the computed F - value falls within lower and upper bound critical values, then the result is in conclusive. The appropriate critical values for the F-tests are obtained. Critical values for the I(0) series are referred to as the upper bound critical values while the critical values for the I(1) series are referred to as lower bound critical values.

Second, assuming a unique long run relationship exists among variables of interest, we specify a conditional ARDL (P, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8) long run model for LP_t based on equation 2 as

$$\begin{aligned} LP_{it} = {} & C_0 + \sum_{x=0}^{q} \alpha_1 LP_{t-1} + \sum_{j=0}^{q} \alpha_2 LER_{t-1} + \sum_{m=0}^{q} \alpha_3 LPo_{t-1} + \sum_{n=0}^{q} \alpha_4 LP_{jt-1} + \sum_{l=0}^{q} \alpha_5 LINF_{t-1} \\ & + \sum_{z=0}^{q} \alpha_6 LY_{t-1} + \sum_{s=0}^{q} \alpha_7 LQ_{t-1} + \sum_{h=0}^{q} \alpha_8 LM_{t-1} + \varepsilon. \end{aligned}$$

...... (6)

The lags length in the ARDL model is selected based on Schwarz Bayesian criterion (SBC) and Akaike information criterion. For wheat, a maximum of 4 lags will be selected.

In the final text, we obtain the short-run dynamic elasticities by estimating an error correction model associated with the long run estimates. This is specified as follows –

$$\begin{aligned} LP_{it} = \alpha + {} & \sum_{i=0}^{p} \phi \Delta LP_{t-i} + \sum_{j=1}^{q} w \Delta LER_{t-l} + \sum_{m=1}^{q} \eta \Delta LPo_{t-1} \\ & + \sum_{n=1}^{q} \psi \Delta LP_{jt-s} + \sum_{l=1}^{q} \alpha \Delta LINF_{t-r} + \sum_{z=1}^{q} \sigma \Delta LY_{t-v} + \sum_{s=1}^{q} \upsilon \Delta LQ_{t-u} \\ & + \lambda ECM_{t-1} \end{aligned}$$

………………. (7)

Where $\phi, w, \eta, \psi, \alpha\, \upsilon, \sigma$ are the short-run dynamic elasticities of the model's convergence to long-run equilibrium and λ is the speed of adjustment. Δ represents first difference operated and ECM_{t-1} is the one period lagged error correction term. The coefficient measures the speed of adjustment to obtain equilibrium in the event of shocks to the system. General – to – specific modeling technique of Hendry and Erricson (1991) is followed in selecting the preferred ECM. This procedure first estimate the ECM with different lag lengths for the difference terms and, then, simplify the representation by eliminating the lags with insignificant parameters.

A correctly indicated ECM model has to pass a series of diagnosed tests. These include the Autoregressive LM (Lagrange multiplier) test and/or Durbin-Watson test for serial correlation in the residual, the Autoregressive LM test for normality distribution of the residuals in a regression model, the ARCH and the White test for heteroscedasticity in errors. These tests were conducted to ensure reliability of results.

2.3 Model Specification.

The form of model specification for this study is specified as

$$LP_i = \beta + \alpha LP_{it-1} + \delta_1 LER_t + \delta_2 LP_{o\,t} + \delta_3 LP_{jt} + \delta_4 LINF_t + \delta_5 LY + \delta_6 LQ_i + \varepsilon \quad \ldots\ldots (8)$$

Where:

LP_i = Price of selected food commodity

LP_j = Price of close substitute commodity ($\delta_1 > 0$)

$LINF$ = Inflation rate ($\delta_2 > 0$)

LER = Real Exchange Rate ($\delta_3 > 0$)

LP_O = Price of Crude oil ($\delta_4 < 0$)

LY = Per capita income ($\delta_5 > 0$)

LQ = Per capita output of selected food commodity ($\delta_6 < 0$)

T = Trend ($\delta_6 > 0$)

2.4 Source of Data

The data for this study is a time series data at macro level spanning from 1960 to 2008. Data on Nigeria Agricultural GDP and Government expenditure on agriculture were sourced from various editions of Central Bank of Nigeria statistical bulletin. Data on agricultural land and fertilizer were sourced from the Food and Agriculture Organization (FAO) statistical data base while the data on exchange rate were taken from Penn world data of the University of Pennsylvania.

III. RESULT AND DISCUSSION

3.1 Result of Unit Root Test

The Augmented Dickey Fuller (ADF) test was employed to study the unit root properties of the data as shown in the table below. Wheat Price (LP_w), Per Capital Income (LY) are stationary at levels i.e they have order of integration of zero I(0) but Rice Price (LP_r), Rice Per Capital Output (LQ_r),Wheat Per Capital Output (LQ_w) and Exchange rate (LEX , have unit root properties i.e. they are all stationary at first differencing which implies they have order of integration of I(1). In using these series for regression, analysis each variable was brought into the analysis at the level at which they became stationary. It is observed from the unit root test that none of the variables have order of integration of 2 that none of them is I (2). This implies that all the variables can be used for the ARDL modeling approach to cointegration.

Table 1 : Result Augmented Dickey Fuller Unit Root Test

Variables	**t-statistics**	**t-statistics**	
	Levels	**1st Differential**	**Order Of Integration**
LP_r	-2.691	-5.049	1
LQ_r	-1.989	-4.761	1
LP_w	-3.823	-5.704	0
LQ_w	-2.954	-4.212	1
LEX	-2.130	-3.846	1
LY	-3.463	-4.845	0
$LINF$	-2.122	-4.996	1
LP_o	-1.997	-3.877	1

Source: Data Analysis, 2016

*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

3. 2 ARDL Bounds Test for Co Integration Analysis

Applying the steps, enumerated above, OLS regression is estimated for the first differences part of equation (1) and then test for the joint significance of the parameters of the lagged level variables when added to the first regression. The computed F-statistics from the Pesaran test is reported in table 2, according to the computed F-statistics, we can reject the null hypothesis of the no cointegration at 5% significance level for rice import demand. The computed F-statistics for $LP_{it} = (LQ_i, LER, LP_j, LP_o, LINF, LY,)$ = 10.598 which is higher than the upper bound critical value of 3.9 at the 1% significance level. This indicates that the alternative hypothesis of the existence of a unique cointegration relationship between rice price and its determinants can be accepted for Nigeria in this case. In other words, it has been proved that rice price, crude oil price, exchange rate, wheat price, maize price, Per-capita income, per capita ouput of rice, inflation rate, are bound together in the long -run (cointegrated) when rice price is made the dependent variable.

In was also observed from table 3 also that the computed F-statistics for

$LP_w = (LQ_i, LER, LP_m, LP_r, LP_o, LINF, LY,)$ = 6.883 which is higher than the upper bound critical value of 3.9 at the 1% significance level. This indicates that the alternative hypothesis of the existence of a unique cointegration relationship between wheat price and its determinants can be accepted for Nigeria in this case. In other words, it has been proved that rice price, crude oil price, exchange rate, maize price, rice price, per- capita income, per- capita ouput of wheat, inflation rate, are bound together in the long -run (cointegrated) when wheat price is made the dependent variable.

Table 2 : ARDL bounds test for co integration analysis for Rice price.

Critical values (F-Statistics) for the bounds test (Intercept and trend)						
	1% level		5% level		10% level	
K	1 (0)	I (1)	I (0)	I (1)	I (0)	I (1)
7	2.73	3.9	2.17	3.21	2.73	3.9
$LP_r = (LQ_i, LER, LP_m, LP_w, LP_o, LINF, LY,)$ Computed F. Statistics = 10.598 **						

Source: Data analysis, 2016

Notes – Critical values are extracted from Pesaran et al (2001) Critical values for bounds test: case III. K is the number of regressors.

Table 3 : ARDL bounds test for co integration analysis for Wheat price.

Critical values (F-Statistics) for the bounds test (Intercept and trend)						
	1% level		5% level		10% level	
K	1 (0)	I (1)	I (0)	I (1)	I (0)	I (1)
7	2.73	3.9	2.17	3.21	2.73	3.9
$LP_w = (LQ_i, LER, LP_r, LP_m, LP_o, LINF, LY,)$ Computed F. Statistics = 6.883 ***						

Source: Data analysis, 2016

Notes – Critical values are extracted from Pesaran et al (2001) Critical values for bounds test: case III. K is the number of regressors.

Having established unique cointegrations for the two food commodities, the static long run and the short-run error correction model for the two food crops are presented in the section below.

3.3 Results of Error Correction Modeling of Selected Food Prices.

This study employed an ARDL approach to estimate and validate the long-and short-term determinants of real price of rice and wheat in Nigeria. Applying the ECM version of the ARDL model shows that the error correction coefficient, which determines the speed of adjustment, has an expected and highly significant negative sign. The results indicate that deviation from the long-term real prices of rice and wheat are corrected by approximately by about 82% and 65% in the following year for real prices of rice and wheat respectively. The estimated model passes a battery of diagnostic tests and the graphical evidence (CUSUM and CUSUMQ graphs) indicate that the model is fairly stable during the sample period. The analysis of the stability of the long-run coefficients together with the short-run dynamics, the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUM) point to the in-samples stability of the model (see CUSUM and CUSUMQ in Figures 1 to 4).

3.3.1 Determinants of Real Prices of Rice in Nigeria

The R^2 value of 0.826 for the ECM in table 4 above shows that 82.6% variation in wheat production in Nigeria is explained by the variables in the specified model is well fitted. However, a number of other diagnostic tests were also carried out in order to test the validity of the estimates in the ECM for wheat production and their suitability for policy discussion. The Autoregressive Conditional Hetoroscedasticity (ARCH) test for testing heterscedasticity in the error process in the model has an F-statistic of 0.512, which is statistically insignificant. This attests to the presence of homoscedasticity in the model. The Breusch – Godfrey Serial correlation Langrange Multiplier (LM) test for higher order - serial correlation with an insignificant calculated F – statistic of 2.268 confirms the absence of serial correlation in the residuals. The Jargue – Bera Normality test on the residuals has a statistic of 1.930 and it is insignificant. This shows that the error process is normally distributed. From the battery of diagnostic tests presented and discussed above, this study concludes that the model is well estimated and that the observed data fits the model specification adequately, thus the residuals are expected to be distributed as white noise and the coefficient valid for policy discussions.

It could be observed from the results in table 4 that the coefficient of error correction term (ECM) carries the expected negative sign and it is significant at 5%. The significance of the ECM supports cointegration and suggests the existence of long – run steady state equilibrium between the real price of rice and other determining factors in the specified model. The coefficient of -0.819 indicates that the deviation of rice output from the long-run equilibrium level is corrected by about 81.9% in the current period.

The result in table 4 above shows that the real exchange rate (LER) has a positive impact on real price of rice with the coefficient 0.035 in the long-run but it is insignificant. In the short-run, it has a coefficient of -0.121 and it is significant at 5%. The result suggests that a unit increase in the real exchange rate in the short run will reduce rice price by 0.121units. The result is in line with theoretical expectation, as the devaluation of the nation's currency, which is one of the components of SAP, is expected to reduce importation of rice and encourage local rice producers thereby reducing the price of rice. A proper implementation of SAP policy will decrease imports in the long-run and encourage local production through liberalization of inputs and output market.

An increase in the price of crude oil is expected to raise the real price of rice. The coefficient for price crude oil (LPo) in Nigeria in the long-run is -0.110 and it is significant at 1%. It suggests that a unit increase in crude oil will result in 0.110 unit decrease in real price of rice. The result in the long run is contrary to a-priori expectation, since one will expect the prices of food commodities to increase as prices of crude oil increase. It is expected that increase in price of crude oil will (cause a shift away from rice production) discourage local production of rice, consequently raising its price and thereby leading to food insecurity The result obtained in the long run will however make sense if the government in Nigeria ploughs back the earnings from the petroleum sector into agricultural production. This will increase productivity and consequently reducing the prices of food commodities. In the short-run, the coefficient for crude oil price (LPo) in Nigeria is 0.052 and it is statistically significant at 10%. The results shows that in the short run, increase in prices of crude oil results in significant increase in the real price of rice in Nigeria

Inflation rate (LINF) has a coefficient of 0.097 in the long run and is significant at 5%. In short run, it is 0.075 which is significant at 1%. The result suggests that Inflation has a negative and significant effect on the real prices of rice which is in line with theoretical expectation and is significant in both long run and short run. As the general inflation level increases, general price level of essential commodities also rises.

Per capita output of rice (LQr), the coefficient in the long run is 0.318 and is statistically significant at 1%. It has a coefficient of 0.082 in the short run which is not significant. The result suggests that a unit increase in per capital output of rice reduces the real price. This result is in line with theory of production since a significant increase in per capita output is expected to cause a fall in real price of rice price due to excess supply over demand. The result obtained in the short run could however be on the account of high demand for rice over its supply in the short run.

Per capita income (LY) the higher the income level, the higher the price food commodity. In the long run, the coefficient is 0.377 which is in line with theory but statistically insignificant and -0.111 in the short run. Both are not statistically significant.

Real price of maize was fitted into the model as a substitute to examine the relationship it has with real price of rice. The result in table 4 shows that the coefficient of real price of maize is -0.354 in the long run and 0.245 in the short run and both are significant at 1% level. The results suggest that a unit rice in the price of maize will reduce the price of rice by 0.354 and 0.245 significantly in the long run and short run respectively. The foregoing result largely reveals that rice and maize are substitute crops in Nigeria.

Wheat is another important crop to the economy of Nigeria and actually one of the most consumed food crops alongside maize and rice. The real price of wheat was also fitted into the model to examine its relationship with rice in Nigeria. The result shows that the coefficient of real price of wheat in the long run is -1.173 and it is significant at 5%. In the short run however, it has a coefficient of -1.157 and it is significant at 1%. The real price of wheat in the immediate past period also has a positive and significant coefficient of -0.234 in the short run. The results suggest that largely reveals that rice and wheat are close substitute crops in Nigeria.

Table 4 : ARDL Static long –run and Short-run error correction model estimate for determinants of real prices of rice in Nigeria. *Selected Model: ARDL (2,1,1,1,0,0,2)*

Static Long – run equation	**Parsimonious Short – run equation**
Constant -3.910(-1.281)	Constant 0.021(1.728)
LEX 0.035(0.807)	$\Delta LP_r(-1)$ -0.128(-1.992)
$L\rho_o$ -0.110(-4.888)***	ΔLEX -0.121(-2.950)**
LQr -0.318(-4.395)***	ΔLP_o 0.052(1.624)
LY 0.377(1.646)	ΔLQ_r 0.082(1.519)
$LINF$ 0.097(2.224)**	ΔLY -0.111(0.263)
LP_m -0.354(-4.515)***	$\Delta LY(-1)$ -0.633(-4.157)***
LP_w 1.173(12.503)***	$\Delta LINF$ -0.075(4.490)***
	ΔLP_m -0.245(-3.816)***
	ΔLP_w -1.157(-15.496)***
	$\Delta LP_w(-1)$ -0.243(-4.006)***
	$\Delta ECM(-1)$ -0.819(-11.775)**
	R^2 = 0.826
	AR LM F = 2.268(0.128)
	ARCH F = 0.512(0.475)
	Normality X^2 = 1.930(0.381)

Source: Data Analysis, 2016

*NB: * indicate significant at 10% level, ** indicates significant at 5% level*
**** indicates significant at 1% level*

3.3.2 Determinants of Real Prices of Wheat in Nigeria

The R^2 value of 0.648 for the ECM in table 5 shows that 64.8% variation in wheat production in Nigeria is explained by the variables in the specified model. Meanwhile, a number of other diagnostic tests were also carried out in order to test the validity of the estimates in the ECM for real price of wheat and their suitability for policy discussion. The Autoregressive Conditional Hetoroscedasticity (ARCH) test for testing heterscedasticity in the error process in the model has an F-statistic of 0.147, which is statistically insignificant. This attests to the absence of heteroscedasticity in the model. The Breusch – Godfrey Serial correlation Langrange Multiplier (LM) test for higher order - serial correlation with a calculated F – statistic of 2.304 confirms the absence of serial correlation in the residuals. The Jargue – Bera Normality test on the residuals has a – statistic of 0.724 and it is significant. This shows that the error process is normally distributed. From the battery of diagnostic tests presented and discussed above, this study concludes that the model is well estimated and that the observed data fits the model specification adequately, thus the residuals are expected to be distributed as white noise and the coefficient valid for policy discussions.

It could be observed from the results in table 5 that the coefficient of error correction term (ECM) carries the expected negative sign and it is significant at 1%. The significance of the ECM supports cointegration and suggests the existence of long – run steady state equilibrium between wheat price and other determining factors in the specified model. The coefficient of -0.652 indicates that the deviation of the real price of wheat from the long-run equilibrium level is corrected by 65.2% in the current period.

The result in table 5 shows that the real exchange rate (LER) has a significant effect on real price of wheat in the short-run. It has a coefficient of 0.128 and it is significant at 1%. The result suggests that a unit increase in the real exchange rate in the short run will increase the real price of wheat by 0.128 units. Although Nigeria is a producer of wheat, in the long run, Nigeria is a net wheat importer as the nation consumes wheat far more than what we consume. The results suggest that devaluation of Nigeria's currency if care is not taken will aggravate the food insecurity problem and it will lead to drastic increase in wheat prices.

The real rice of wheat in the immediate past period is however found to be negatively related current price of the wheat. The coefficient of real price of wheat in the immediate past period is -0.223 and it is significant at 1%. This might be due to excess quantity of wheat in the country especially in the immediate past period. An increase in the producer price of wheat is expected to raise price of wheat.

Coefficient of crude oil price (LPo) is -0.032 in the long-run and it is statistically insignificant. In the short-run, the coefficient is 0.052 and it is significant at 10%. Increased price of crude oil will increased the foreign exchange earning into the country. This will in turn increase the capacity of the country to import as a result of increased foreign reserve. As more wheat is imported into the country, it will no doubt reduce the real price of wheat in the market.

Inflation rate (LINF) has a coefficient of 0.038 in the short run and it is significant at 1%. Inflation has a positive relationship with the real price of wheat and this is in line with theoretical expectation. As the general price level increases, production is expected to reduce due to high cost of inputs. The low production level will result in high price of wheat.

Per capita output of wheat (LQw) has a coefficient of -0.072 in the long run but it is statistically insignificant. In the short run however, the coefficient is -0.023 in the short run which is also not significant. These results suggest that per capita output of wheat in Nigeria is not sufficient enough to drive the price of wheat. Though Nigeria produces wheat, the amount is not sufficient enough to meet local demand

Per capita income (LY) the higher the income level, the higher the price food commodity. In the long run, the coefficient is 0.126 which is in line with theory but statistically insignificant and 0.476 in the short run. Both are not statistically significant.

Real price of maize and real price of rice which were fitted into the model to examine their relationship with the real price of wheat both have significant and negative coefficients. The coefficient of rice is -0.064 and it is significant at 1% while the coefficient of real price of maize is -0.364 and it is also significant in the short run at 1%. In the long run, the two commodities halso have negative and significant coefficients which were both significant 1% level. This result show that rice, wheat and maize are largely close substitute food crops among Nigerians.

Table 5: ARDL Static long –run and Short-run error correction model estimate for determinants of real prices of wheat in Nigeria.
Selected Model: ARDL (2,1,0,2,2,1,0,0,0)

Static Long – run equation	Parsimonious Short – run equation
Constant -5.883(-1.005)	Constant 0.073(1.421)
LEX -0.050(0.735)	$\Delta LP_w(-1)$ -0.223(-4.964)
$L\rho_o$ -0.032(-0.621)	ΔLEX 0.128(-3.627)**
LQ_w -0.072(-0.860)	ΔLP_o 0.052(1.624)*
LY 0.126(0.358)	$\Delta LP_o(-1)$ 0.083(2.357)**
$LINF$ 0.050(1.072)	ΔLQ_w -0.023(-0.548)
LP_m -0.574(-4.746)***	ΔLY 0.476(3.274)***
LP_r -0.182(-2.570)**	$\Delta LY(-1)$ 0.607(4.555)***
	$\Delta LINF$ 0.038(2.223)***
	ΔLP_m -0.364(-10.061)***
	ΔLP_r -0.064(-3.194)***
	$\Delta ECM(-1)$ -0.652(-8.926)**

	R^2 = 0.648
	AR LM F = 2.304(0.134)
	ARCH F = 0.147(0.703)
	Normality X^2 = 0.724(0.696)

Source: Data Analysis, 2016

*NB * indicate significant at 10%; ** indicate significant at 5%; *** indicate significant at 10%,*

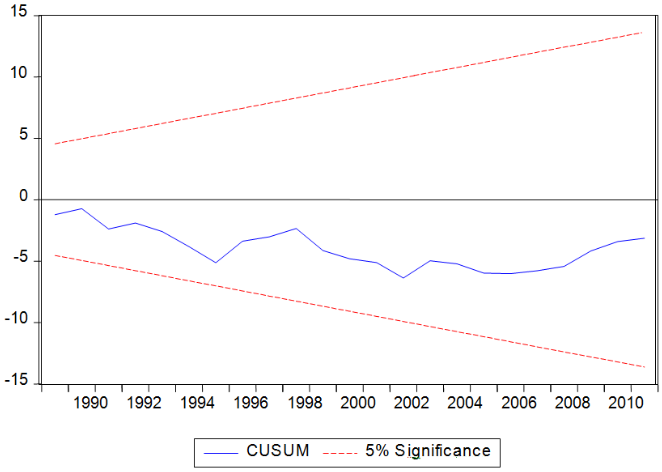

Figure 1. Plot of CUSUM statistics for coefficients in Real Prices of Rice in Nigeria

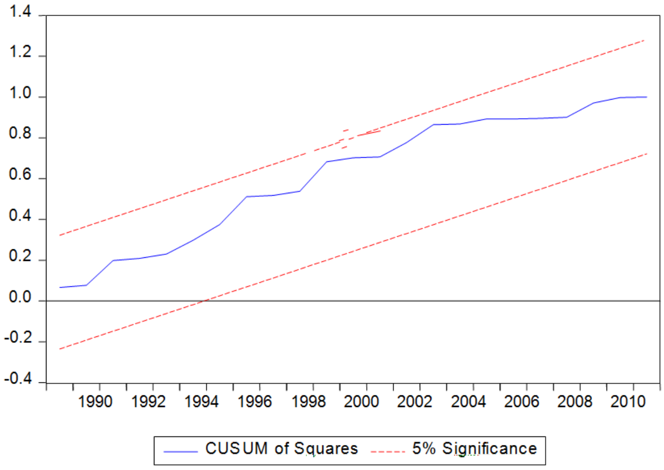

Figure 2. Plot of CUSUM Q statistics for coefficients in Real Prices of Rice in Nigeria

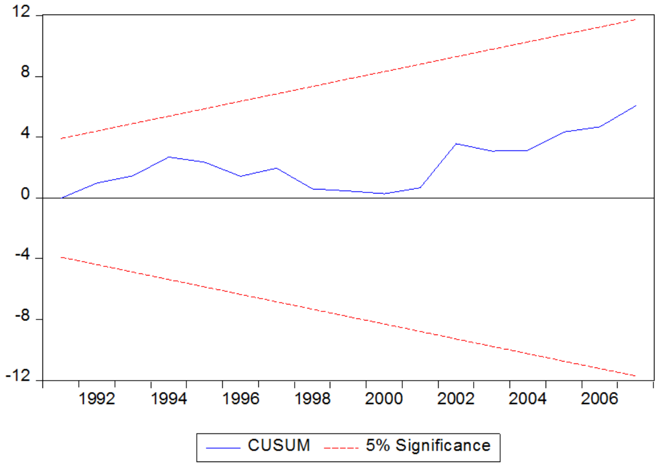

Figure 3. Plot of CUSUM statistics for coefficients in Real Prices of Wheat in Nigeria

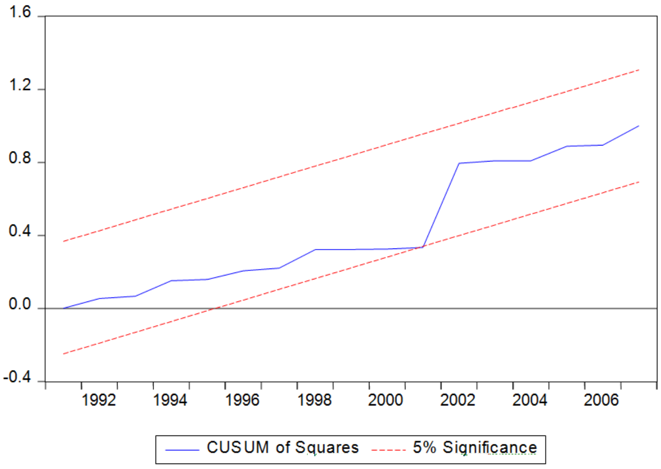

Figure 4. Plot of CUSUMQ statistics for coefficients in Real Prices Wheat in Nigeria

IV. CONCLUSION AND POLICY RECOMMENDATIONS

This study shows that real exchange rate, inflation, per capita income and per capita output are the three major determinants of real prices of food commodities in Nigeria. Based on the findings of this study, the following recommendations were made: Government, Non-Governmental Organizations and Agricultural Research Institutes should actively establish and carry out buffer stock operations for food staples. This includes effective processing and storage of food crops to prevent excessive high price increases especially during the off-seasons. As much as possible, government should maintain exchange rate regime and monetary policies which will favour food production in abundance as well as keep general price levels at a level that is available to the common man in Nigeria. These policies if maintained will help ensure food production in abundance and prevent food crisis and consequent insecurity.

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