Determinants of Wheat Price Fluctuation in Nigeria (1981-2013)

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Abstract-The marketing of agricultural commodities has experienced not only price fluctuations from year to year but also price volatility. This study examines the influence of exchange rate, per capital income, per capital wheat output, price of cassava (as substitute commodity) and inflation on wheat price in Nigeria. Time series data used for the study were sourced from Food and Agricultural Organization of the United Nations statistical database, Central Bank of Nigeria statistical bulletin / reports and the National Bureau of Statistics. The result shows that real price of wheat fluctuates over the study period and the estimated intrinsic rate of price growth for wheat commodity is found to be equal to 0.0238. Moreover, per capita income was found to be significant upward drivers of wheat commodity prices in the country while wheat and cassava behave as complimentary goods in the short run but turn out to be substitute goods in the long-run.

Keywords: Price Determinants, wheat, price fluctuation, wheat price

I. INTRODUCTION

Nigeria Agriculture comprises of four major sub-sectors which include: Crop, Livestock, Forestry and Fishing. Crop production formed the largest activity in the agricultural sector. It was also the key driver of growth of the agricultural sector in the country, contributing 85.39%, 85.91% and 90.13% to growth in the first, second and third quarters in 2014 respectively (National Bureau of Statistics, 2014).This shows that crop production sub sector is still the main source of national income, the nation food basket source and large avenue that provide jobs to unemployed people than any other agricultural sub-sector. 0The country's prevailing food crops are Cereals (rice, wheat, maize, millet and sorghum), Legumes (groundnut, cowpeas), Tubers (yam, cassava) and Others (vegetables). Wheat of all the staple crops has risen to a position of prominence of which it has certainly become one of the utmost important agricultural commodities in need of accelerated local production due to the huge consumption gap needed to be filled. Muhammad-Lawal and Atte (2006) reported that Nigeria spent USD $635 billion on wheat imports and USD $356 billion on rice imports making expenditure on wheat about doubling that of rice. Nigeria has been importing huge amounts of food most especially wheat from the international market although it has sufficient resources to produce its own food.

Going down history, Nigerian government efforts to increase wheat production led to the ban of wheat importation in 1987 and Accelerated Wheat Production Programme (AWPP) was implemented to encourage local production (Haruna *et al*., 2017). Nigeria wheat production rose from 50,000MT to 450,000MT within three years of the programme. In 1990, wheat importation ban was lifted and AWPP ended with failure as Nigerian wheat agricultural millers reluctantly patronize locally produce wheat. The production of wheat further on fall between 1991 to 1993 when farmers switched to the production of other crops

such as maize, rice, cassava, yam and vegetables. Other programmes launched in the country to boost wheat production vary from Agricultural Transformation Agenda (ATA), Green Alternative and The International Center for Agricultural Research in the Dry Areas (ICARDA) to cut down the cost of food importation by African countries and Technology for African Agricultural Transformation (TAAT) mainly to scale up technology generated by ICARDA in recent period.

Price is a significant factor in markets and food security analysis for the reason that it serves as an indicator for food availability and food access. According to Kirimi *et al.* (2011) agricultural marketing and trade plan in Nigeria is still conquered by the challenge of how to effectively deal with food price stability, as a result of middlemen activities who try to take away all the gains and create artificial scarcity, poor pricing policies, non-efficient food commodity regulatory bodies for food crops, seasonal price fluctuations, inadequate of good roads among others. In recent time, the high price trend of international commodities has aroused curiosity of literate minds to thoughtfully study spatial market integration of domestic markets with international or with other domestic ones while only but few studies have revealed why prices of important food crops fluctuate from year to year. The urgent needs to analyze price trend and causes of price fluctuation of food crops cannot be over-stretched, this is because information from the study will help to gain understanding of how per capita income, exchange rate, inflation among other factors influence wheat price in Nigeria.

A. Specific Objectives

- To examine the pattern of wheat price movement in Nigeria between 1981 to 2013.
- To estimate growth rate in the level of wheatprice over the years and

- To investigate the short-run and long-run determinants of wheat prices in Nigeria.

II. METHODOLOGY

A. Study Area

The study was carried out in Nigeria. The country is located in West Africa and has a total area of 923,768 km² (356,669 sq mi). It shares border with Benin, Niger, Chad, and Cameroon. Nigeria lies between latitudes 4° and 14°N, and longitudes 2° and 15°E. Nigeria is rich in culture and is blessed with more than 250 ethnic groups. There are two seasons applicable to Nigeria; the dry season and the rainy season. Agricultural sector is still the main employer of labour despite Nigeria dependency on crude oil.

B. Sources of Data

The data used for this study was secondary data. The data were sourced from National Bureau of Statistic (NBS), Food and Agricultural Organization of the United Nations statistical database (FAOSTAT) and Central Bank of Nigeria Annual Statistical Bulletin. The time series data based on prices and output of wheat in Nigeria from 1981-2013 were used for the analysis.

C. Analytical Framework
C₁. Graph

The first objective was analyzed using graph to examine the trend in the movement of wheat price in Nigeria.

C₂. Exponential growth curve

One basic characteristic of price which can be described is its long run growth pattern. Despite the short run up down movement, it is possible that price may exhibit a clear cut upward trend. A simple growth model used to analyze objective 2 is:

$$Y_t = Ae^{rx} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where Y_t = Price in time t, r = intrinsic growth rate and x = time variable

The parameter A can be easily estimated by transforming to linear equation by taking a logarithm of both sides, that is,

$$\log Y_t = \text{Log } A + rx \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

C₃. Autoregressive Distributed Lag (ARDL) to Cointegration Approach

The study applied the autoregressive distributed lag (ARDL) approach to cointegration also known as bound testing procedure developed to examine the co-integration relationship between wheat price and its determinants in short-run and long-run respectively.

D. Model Specification

The form of model specification for this study is specified as

$$LP_i = \beta_0 + \beta_1 LQ_i - \beta_2 LPS_i + \beta_3 LY + \beta_4 LER + \beta_5 LINF + E \ldots\ldots\ldots\ldots\ldots\ldots \ldots\ldots. \quad (1)$$

Where:

LP_i = Natural log of wheat price (₦ per tones)

LQ_i = Natural log of wheat per capital output (₦ per tones)

LPS_i = Natural log of prices of cassava used as substitute (₦ per tones)

LY = Natural log of per capita income (₦)

LER = Natural log of exchange rate ($=₦)

$LINF$ = Natural log of inflation rate (%)

E = Error

III. RESULTS AND DISCUSSION
A. Movement of real price of wheat in Nigeria

The real price of wheat in Nigeria from Figure 1 slightly falls from 1981 to 1983 because there was massive wheat importation and the sale of fertilizer for wheat production has been heavily subsidized in early 1980s. However, the increase in real price of wheat from 1984 to 1988 was as a result of large demand for wheat products in the country, particularly in urban areas. Furthermore, Nigeria in 1985 resolved to reduce wheat importation and encouraged consumption of its indigenous (which is so expensive to produce) in its place, so as to beset increasing debts and stagnancy export revenue. The producer price of domestic wheat increase by staggering 650% between 1986 and 1988 could further suggest reason for increased wheat real price within that period. In 1989, there was a noticeable fall in real price of wheat in the country. The fall in real price of wheat during that time was as a result of policy made that all Nigerian northern states have wheat

cultivation programmes under way and a federal task force was formed in 1988 to encourage wheat production.

The real price of wheat rises in 1990 and peaked in 1992 before falling significantly in 1994 because farmers switched to production of other crops such as rice, maize and vegetables leading to an 87% fall in wheat production to 60,000MT in 1991 to 1993. From 1995 to 1998, the real price of wheat rises slightly due to the fact that the producer price index for wheat increased by 15.2 % in United States of America (U.S.A.) bearing in mind that Nigeria is among the world's largest importers of U.S.A. wheat. In addition, there was 6% drop in wheat production despite robust foreign demand for the product which might be another cause of price increase experienced during that period. But from 1999 to 2001, the real price of wheat was relatively stable. Moreover, there was hike in real price of wheat in the country in 2002 because of world wheat price increase, but from 2003 to 2007 wheat real price falls appreciably. However, the real price of wheat increases from 2008 to 2013 due to large demand for wheat product and the local production is faced with insurgency related problems which force many wheat farmers out of production.
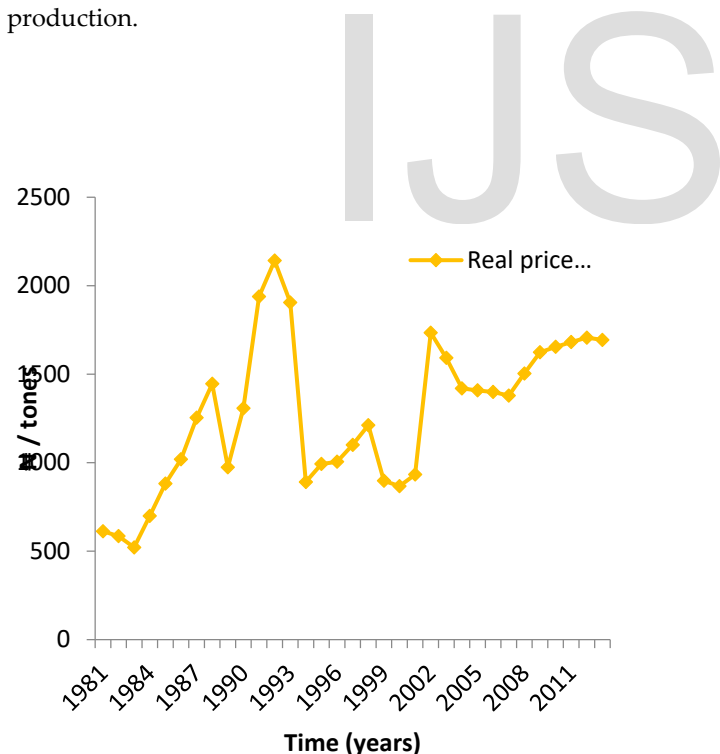

Figure 1 : Graph of movement of real prices of wheat in Nigeria

B. **Exponential growth rate results for wheat price in Nigeria**

Figure 2 showed the long-run exponential long-run curve for price of wheat in Nigeria over 32 years' period. The commodity price over time was stable up to 2001 after which price sharply skyrocketed. It is worthy to note that import tariff fluctuation and petrol subsidy removal has been on since 2000 till date and could be a reason why understudied commodities prices began to rise sharply since 2001(Adagba, Ugwu and Ema , 2012).

The intercept (constant) compares the initial take up levels of price for the wheat commodity. The respective initial take up point for wheat is 1170.8 naira per tones. The estimated intrinsic price growth rate coefficient of 0.2165 for the exponential curve compares the rate of increase in price of wheat. Moreover, the coefficient of determination (R^2) of 0.954 explained the relative effect of time over the commodity price and indicates that the regression prediction perfectly fit the data.
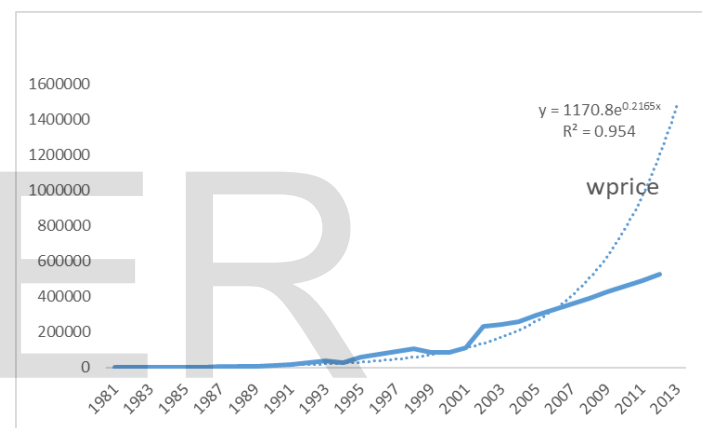
Figure 2 Wheat price exponential growth curve

C. **Projected wheat price in Nigeria**

The projected price for wheat commodity in Nigeria took an upward trend. This implies that the price of wheat would be on an increase as the year increases. Table 1 showed projected price trend (2014-2023) of wheat price in Nigeria in Naira per tones. The projected price of wheat in naira per tonne in 2019 tripled projected price in 2014 and year 2023 also tripled that of 2019. This suggests that demand for wheat in the country outgrows its supply as year increases. It also means that Nigeria may not be wheat self-sufficient at the end of 2023 due to likelihood of population explosion, insurgency, banditry, Fulani herdsmen's related crises that still persist in the most of the northern wheat producing states. Moreover, the projected price result also revealed that time is coming when poor and an average Nigerian may find it so hard to purchase wheat food crop due to likelihood of price hike as the year increases.

Table 1: Projected wheat price in Nigeria from 2014 to 2023

Years	Projected price (₦ per tonnes)
2013	566900.5
2014	700352.4
2015	865219.7
2016	1068898
2017	1320523
2018	1631382
2019	2015420
2020	2489863
2021	3800099
2022	4694667
2023	5799820

Source: Data analysis, 2017

D.   Stationary Test

The ARDL co-integration approach although does not necessarily require unit root tests, all the same we need to conduct unit root test to make sure that none of the variables are the integrated of order 2, that is, I(2). However, one limitation of the ARDL method is that it cannot be estimated with I(2). This is because in case of I (2) variables, ARDL procedures will make no sense. Furthermore, the computed F-statistics, as produced by Pesaran *et al.*(2001) and Narayan (2005) can no longer be valid if a variable is found to be I(2).

Table 2 shows the Augmented Dickey-fuller unit root test. The unit root tests were conducted for the following variables under consideration; the inflation (INF), per capita income (LY), exchange rate (LER), price of wheat (LPw), and per capita output of wheat (LQw). The null hypothesis is that the series contains one or more units' root, that is, the series is non-stationary. The null hypothesis can only be rejected if test statistics is more negative than the critical value and then the time series tested could be said to be stationary (that is time series do not contain unit root). Comparing the test statistics of estimated variables with critical value at 1%, all variables become stationary after first difference. In other words, the order of integration of variables is one that is I(1).

Table 2: Augmented Dickey-fuller unit root test variable result

Variable	Level	First difference	Order of integration
INF	-4.107	-5.487	1
LY	-1.360	-7.954	1
LER	-2.858	-4.389	1
LQw	-2.890	-5.278	1
LPw	-3.644	-6.125	1

Source: Data analysis, 2017
Critical value 1%= -4.284
             5%= -3.562
             10%=-3.215

E.   ARDL of wheat prices cointegration test for long -run relationship

The computed F-statistics in Table 3 is equal to 3.145 which is higher than critical value of 3.06 at 10% significance level. The computed F-statistics was compared with the value from the Pesaran test as reported in Table 3. According to the computed F-statistics, the null hypothesis can be rejected (There is no significant relationship between price of wheat and the specified independent variables in the long-run in Nigeria). By implication, the alternative hypothesis (There is significant relationship between price of wheat and the specified independent variables in the long-run in Nigeria) is accepted.

In other words, it has been proved that per capital income (LY), inflation (INF) , exchange rate (LER), per capital wheat output (LQW) and price of cassava used as substitute (LPc) are bound together in the long run (co integrated) when price of wheat (LPW) is made the dependent variable.

Table 3: ARDL wheat cointegration test for long -run relationship

Critical values	LPW = (LY,INF,LERLQW,LPC)	F statistic = 3.145
	Lower bound I(0)	Upper bound I(1)
1%	2.79	4.10
2.5%	2.48	3.70
5%	2.22	3.39
10%	1.95	3.06

Source: Data analysis, 2017.

F.   Static long run and short run Error Correction results of the determinants of wheat prices in Nigeria

The results of the solved static long- run equation for the determinants of wheat price variation in the country as well as its short run equation are given in the Table 4. As the per capita income increases by 1 unit, wheat market price will increase by 4.358 and 0.421 units in short-run and long-run respectively. This is consistent with the aprior expectation and owing to the great importance of wheat as a staple food which is a good source of vitamins, minerals and protein usually made into flour to make breads, cakes, cookies, noodles, pastas and even beer. Its demand tends to

be high as per capita incomes of people improve. Hence result shows that the price of wheat in the country will increase as per capital income increases even though, both were statistically significant both in short-run and long-run.

Inflation by definition implies a sustained increase in the cost of living or the general price level leading to a fall in purchasing power of money. The result from table4 reveals that inflation coefficient had a negative sign both in long-run and short-run but is only statistically significant in the long-run. It is expected that the price of wheat should increase as inflation rises. But the result shows an inverse relationship between inflation and wheat market price in Nigeria in the long-run. The indication of this result is that as the inflation increases by 1 unit, the market price of wheat in the country will decrease by 0.724 units in the long-run. The result suggests that there is mitigation measure taken presently against inflation in the country that could lead to reduction in market price of wheat over a long period in the country. For example, government policy on inclusion of cassava in wheat flour and trying to discourage massive wheat importation through boosting local wheat production by providing adequate incentives to wheat farmers over time alongside initiating various wheat programme like Agricultural Transformation Agender (ATA), Green alternative, International Center for Agricultural Research in the Dry Areas (ICARDA) project and Technologies for African Agricultural Transformation (TAAT) may enable the country to be wheat self-sufficient in the long-run.

Nigeria imports over 90% of her wheat from the US. Until recently, Nigeria used to be the number one destination in the World for US wheat. Even, now that Nigeria has dropped to the third position, she remains the most consistent and loyal consumer of US wheat (Nicely, Rondon and David, 2011). It should be noted that other control measure in checking inflation in the long-run is liberalization of import or restructuring of tariff. This will increase domestic supply and therefore check inflation by excess demand in the long-run.

The exchange rate coefficient has negative sign both in the short-run and long-run simultaneously. This implies that there is inverse relationship between the exchange rate and price of wheat in Nigeria. The result reveals that a unit increase in exchange rate will lead to 0.770 and 0.522 unit decrease in price of wheat in the short-run and long-run in the country. It is a natural phenomenon that as exchange rate increases, the import becomes more expensive and this is a way of curtailing excess demand placed on wheat and moreover improves local wheat production in Nigeria. In lieu with this, the

result is consistent with aprior expectation that as the exchange rate increases, demand for imported wheat will reduce, local wheat production will improve and in turn reduce price of wheat in the country. More importantly, with the effort of the African Development Bank (AfDP) funded support to Agricultural Research for Development of Strategic Crops (SARD-SC) of which wheat is among specified crops in Nigeria. There is possibility of price reduction in wheat price in both short-run and long-run as specified by the result due to more incentives and more concentration given to wheat production in the country.

The result shows that 1-unit increase in per capital output of wheat (LQW) will lead to 1.129 units decrease in the price of wheat in the long-run and it is statistically significant at 1%. By implication, the price of wheat falls as output that led to wheat supply increases. More so, this is consistent with the aprior expectation in the long run., The same inverse relationship exists between per capital output of wheat and the price of wheat in short-run and long-run in the country. But in the short-run, it was statistically insignificant.

The result from Table 4 reveals that wheat and cassava were complimentary goods in the short run rather than a substitute good in the long run. Results showed that if the price of cassava increases by 1 unit the price of wheat in the short-run will reduce by 0.488 units. This indicates that as the price of cassava increases there will be less demand for wheat and as the demand for wheat drop there is likelihood of the price of wheat to also drop. The example of this scenario can be seen in the cassava inclusion level policy in the flour industries in Nigeria. But in the long-run, as the price of cassava used as substitute increases, it increases the demand for wheat which will eventually increase the price of wheat as more is demanded over a long period of years.

The R^2 value is 0.923 for the ECM in Table 4 and this shows that the overall goodness of fit of the ECM is satisfactory. The coefficient of error correction term (ECM) carries the expected negative sign and it is significant at 1%. The significance of the ECM supports co-integration and suggests the existence of long– run steady state equilibrium between price of cassava and other determining factors in the specified model. The ECM coefficient value of -0.481 suggested that the deviation of cassava price from the long-run equilibrium level is corrected by about 48% in the current period.

Furthermore, other diagnostic tests like Heteroscedasticity test, normality test and serial correlation test were conducted to validate the estimates. The Autoregressive Conditional Heteroscedasticity (ARCH)

was used to test for the presence of heteroscedasticity in the error process in the model. The F-statistic result of 0.850 was statistically insignificant. This suggests that there is no heteroscedasticity in the model. The Breusch-Godfrey serial correlation Lagrange Multiplier (LM) test for higher order – serial correlation with an F-statistic of 2.950 also was statistically insignificant could not reject the null of absence of serial correlation in the residuals. The Jacque – Beraχ^2 – statistic of 7.407 for the normality in the distribution in the error process shows that the error process is normally distributed. From the set of diagnostic tests presented above, 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.

Table 4: Long-run and Short- run ECM of the determinants of wheat prices in Nigeria.

Static Long-run equation		Parsimonious Short-run equation	
Constant	11.508 (1.924)*	Constant	-0.877 (-5.030)***
LY	0.421 (1.761)*	Δ LY	4.358 (5.102)***
INF	-0.724 (-3.469)***	Δ LY(-1)	1.075 (1.258)
LER	-0.522 (-2.452)**	Δ INF	-0.188 (-0.910)
LQW	-1.129 (-3.960)***	Δ LER	-0.770 (-4.567)***
LPC	0.353 (4.756)***	Δ LQW	-0.071 (-0.486)
		Δ LQW(-1)	-1.012 (-4.671)***
		Δ LPC	-0.488 (-2.718)**
		Δ LPC(-1)	1.219 (4.368)***
		ECM(-1)	-0.481 (-4.244)***
		R^2	=0.923
		AR LM F	=2.950 (0.137)
		ARCH F	=0.850 (0.646)
		Normality χ^2	=7.407 (0.125)

Source: Data analysis, 2017. *** *means significant at 1%, ** means significant at 5%,* *means significant at 10%,*

IV.   CONCLUSION

The study concluded that pattern of real wheat price movement in Nigeria fluctuate over studied periods. Nigeria wheat industry experience growth rate in its price. More importantly, per capita income, exchange rate and cassava used as substitute among other variables were found to be significant drivers of wheat prices in Nigeria.

V.   RECOMMENDATION

The study recommended that fiscal and monetary policies that can help increase local wheat production and keep its price within the reach of a common man should be pursued by government and other stakeholders in the Nigerian agricultural sector.

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