International Journal of Food and Agricultural Economics
ISSN 2147-8988, E-ISSN: 2149-3766
Vol. 8, No. 4, 2020, pp. 367-380

FOOD PRICE VOLATILITY IN NIGERIA AND ITS DRIVING FACTORS: EVIDENCE FROM GARCH ESTIMATES

Toyin Benedict Ajibade
University of Ilorin, Department of Agricultural Economics and Farm Management, Ilorin, PMB 1515, Nigeria, Email: ajibade.tb@unilorin.edu.ng

Opeyemi Eyitayo Ayinde
University of Ilorin, Department of Agricultural Economics and Farm Management, Ilorin, PMB 1515, Nigeria, Email: ajibade.tb@unilorin.edu.ng

Tahirou Abdoulaye
International Institute for Tropical Agriculture, Ibadan Hubs and Headquarter, Ibadan, Nigeria.

Abstract

Food affordability is of critical concern to any nation, being a key component of food security. Price volatility phenomenon is linked with food affordability because escalating food prices reduces low-income earners' food access. With the COVID-19 pandemic, planting activities by farmers in Nigeria have been negatively impacted in the 2019/20 planting season. Hunger may therefore be looming in the coming periods because food production output will be lowered. Understanding volatility in the prices of food therefore becomes very important if any meaningful solutions are to be proffered. In this study, we sought to measure volatility in prices of important staple foods using the GARCH approach and then investigate the factors that drive them over the period 1970-2019. Our result revealed persistent volatility in food prices over the period under review. It was revealed that insurgency, political stability in neighbouring countries, trade liberalization, GDP per capita, inflation rate, government effectiveness, crop production, crude oil price and exchange rate were prominent drivers of volatility in food commodity prices. The study therefore recommends the pursuance of a peaceful nation that is capable of supporting sustainable and increased agricultural production. We as well recommend mechanisms that better regulates inter-border food trading activities whereas strategies of price stabilization policies and government interventions in the pre-liberalization era should be re-visited. It becomes necessary to embrace a holistic approach to economic planning given the tendencies for macroeconomic variables to drive volatility in food prices.

Keywords: *Agricultural prices, COVID-19, Food availability, Food Prices, Food supply, Hunger, Price volatility,*
JEL: *L1, Q11, Q13*

1. Introduction

Perhaps, one of the most intractable challenges developing countries such as Nigeria has continued to face is that of how to meet the food needs of the ever growing population. Despite empirical evidence available on the increasing food production in the nation coupled with rising food import bills, majority of the populace have continued to subsist below the food

security line. The narratives of food in Nigeria, for the most part of the population - the poor i.e. has therefore continued to be that of "Hunger in the midst of Surplus" which may be attributed to income inequality. On this basis, the resource-poor sect does not have access to the quality and quantity of food required to be food secure as a result of their inability to afford such given the incessant rising food prices in the nation through the years (Ajibade *et al.*, 2019). Food affordability is an issue of critical concern in Nigeria because, already, there are fundamental issues embattling the Nation. Hunger, in Nigeria, may likely worsen in the coming periods given how COVID-19 has deterred farmers from planting in 2019/20 planting season. The fact that agriculture in Nigeria is still largely climate-dependent also means that catch-up plans may not be in place for farmers that miss the planting season.

The 2017 Fragile State Index ranked Nigeria 13th most Fragile country which is not quite surprising given the country scores across the various indicators on the framework. Concurrently as individuals in the economy are being impacted by macroeconomic issues affecting the nation, they as well have to deal with such issues as related to low incomes earnings, market inefficiencies, uncertainties among others. For instance, the minimum wage in Nigeria still currently stands at 18,000 Nigerian Naira which is equivalent of $49.59 (based on the "official" exchange rate of $1: NGN363 as at February 13, 2020). Despite the fact that the wage had been upwardly reviewed on paper in the past 30 months, some State Governments have continued to hold their position of not being buoyant enough to honour such wage review despite industrial actions that workers have embarked on over time (Aljazeera, Vanguard 2019). Assuming a one-person household with no dependants, which is unrealistic in Nigeria hence laughable, the current minimum wage in Nigeria amounts to $1.66 per day for such "luckily employed" worker who automatically falls below the poverty line based on the World Bank benchmark yet fortunate not to be captured in the 33.50% unemployment rate (Q1 available data from NBS, 2020). Of a truth, Nigeria remains a country with high levels of poverty with more than three-quarters of the populace living below the lower middle income poverty line of NGN224.9 per day per capita (World Bank,2018).

Undoubtedly, food commodity prices have, in recent years, steadily moved higher into unprecedented levels (Enders & Holt, 2014, Gerard *et al.* 2011; Newbery, 1989), having effect on the consumers as well as producers (Lee, 2017; Apergis & Rezitis (2011). From consumers' perspective, issues of food volatility are important source of risk because food price volatility has long span and far reaching effects on household welfare and livelihood even beyond the immediate food insecurity challenge (Ajibade *et al.*, 2018; Zheng, Kinnucan and Thompson, 2008). Whereas, from the developing country's food producers' perspective, price volatility introduces output risks, impairs resource allocation cum investment decisions, places farmers at a disadvantage in dealing with shock events and in fact predisposes them to the effects of International agricultural market price instability to the extent that these instabilities are transmitted to local markets (Hachula and Hoffman, 2014; Baquedano, Liefert, & Shapouri, 2011; Baffes & Gardner, 2003; Moschini & Hennesy, 2001; Miranda & Helmberger, 1988; Binswanger and Rosenweig, 1986).

Against the background of economic hardships and challenging situations most low-income earning Nigerians subsist in, it is clear that the effect of volatile food prices is felt more by them (Garcia-German, Morales-Opazo, Garrido, Demeke, & Bardaji, 2013; Green *et al.*, 2013). It therefore becomes necessary to come up with mechanisms targeted at enhancing individuals' ability to afford food which is a basic necessity of life. Possibly, a starting point to being able to chart a course towards food affordability is to gain insight into the volatile nature of food prices in the country over the years and factors that drive such food price volatility. We focus on three staple crops which are maize, sorghum and yam. The choice of crops is informed by the fact that these are some of the most commonly consumed grains and tuber crops in Nigeria, which are well traded, contributing largely to the food basket. In this study, firstly, we sought to take a measure of volatility in the prices of the selected food crops.

Secondly, we investigate the factors that drive volatility in the crops over the period 1970-2019. We believe that gaining insight into the nature of volatility as well as their drivers will inform policies targeted at stabilizing food prices, enhancing food affordability and hence invariably bettering the livelihoods of the poor majority.

2. Materials and Methods

2.1. Study Area

The study was carried out in Nigeria located in West Africa on the Gulf of Guinea. Nigeria, sharing land borders with the Republic of Benin in the west, Chad and Cameroon in the east, and Niger in the north, has a total area of 923,768 km2 (356,669 sq mi). The nation is endowed with a diverse climate and landscape, ranging from the equatorial climate of the southern lowlands, through the tropical central hills and plateau, to the arid northern plains which mark the southernmost extent of the Sahara desert. Nigeria is Africa's most populous country and one of the ten most populous countries in the world. The population is growing rapidly, rising from 88.9 million in 1991 to 140 million in 2006 and 198.4 million in 2019 (NPC, 2019). The country is endowed with rich natural resources, of which oil and gas have been the mainstay of the economy in the last few decades, providing 20% of GDP, 95% of foreign exchange earnings, and around 65% of budgetary revenues (World Factbook, 2012). As of 2019/20, Nigeria is one of the worst hit countries by the falling crude oil prices resulting from the oil price wars and COVID-19 pandemic. The heavy reliance on oil has put the country in a dicey position in these unprecedented times, with so much borrowing for sustenance. Up to 70% of the population are however engaged in agricultural production.

2.2. Data Description

In this study, we theorize that prices of food commodities become volatile as a response to production factors, macroeconomic factors and institutional factors. We conjecture that there will be response of food price volatility resulting from volatilities in macroeconomic factors such as inflation rate, interest rate, exchange rate, crude oil price. This is because these variables have influence on money supply and invariably may affect disposable incomes of consumers. Given the civil unrest experienced by the country in recent times which has led to internal displacement of crop producers particularly in Northern Nigeria, insurgency occurrence becomes a variable of interest in this kind of study alongside political stability in the country and as well in neighboring countries considering the accompanying pressure of such nuances on food price volatility in a nation. We as well consider trade liberalization being an important strategy embedded in policies targeted at food price stabilization in Nigeria post-SAP. Government effectiveness may not be overlooked in investigating food price volatility since it serves to measure the quality of: public services, civil service and its independence from political pressures, policy formulation and implementation, and the credibility of the government's commitment to its stated policies – all of which are cogent to following through on food related policies.

This study relies on available annual data spanning 1970-2019 on producer prices of the selected food commodities, own crop production, crop world price, GDP per capita, inflation rate, interest rate, exchange rate, crude oil price, insurgency occurrence, trade liberalization, country political stability, political stability in neighboring countries and government effectiveness. Data were sourced from the Food and Agricultural Organization statistical database for the United Nations, Central Bank of Nigeria, World Bank and World Development Indicators database.

2.3. Analytical Techniques

Time series data requires preliminary examination to ascertain the order of integration of the variables being modeled. This study employed the augmented Dickey fuller test in checking for unit root in the variables included in our model and the ADF statistics revealed that the variables were not stationary at levels but all became stationary after the first differencing. The result also established that the variables were integrated after the order of 1 i.e I(1) a premise on which we were able to carry on with the analysis.

In order to investigate food price volatility in the selected food crops, the Generalized Auto Regressive Conditional Heteroscedasticity (GARCH) approach was used which involves testing the conditional variance of returns (Engle, 1982; Bollersler, 1986). The GARCH model has the advantage of allowing the variance of returns (and hence volatility) to change over time as a function of lagged squared residuals and lagged variance. This approach has been used by many researchers (Akpan *et al.* 2012; Gilbert and Morgan, 2010; Jordaan *et al*., 2007; Moledina *et al*., 2003) to study changes in (conditional) volatility in food prices and other variables.

GARCH model of form $GARCH(p,q)_t$ for which $(p,q) = 1$ was specified and used to generate volatility in the prices of the selected food commodities - maize, sorghum and yam. The annual own food crop price was assumed to follow a primitive first-order autoregressive (AR) (1) process given as equation 1 which is the mean equation:

$$\Delta Y_t = \lambda_0 + \lambda_1 \Delta Y_{t-1} + \nu_1 \quad (1)$$

Where, $\nu_1 \sim iid(0,1)$.

Where *Yt* is the selected food crop own price and υ is the stochastic error term. The basic assumptions taken in the model are homoscedasticity and that the error terms are not correlated.

The GARCH process derived from equation one is stated as follows:

$$PVol_{(t)} = \delta + \alpha \sum \mathcal{E}_{t-1}^2 + \beta \sum h_{t-1} \quad (2)$$

From equation 2, it can be seen that the conditional variance of the error term in the mean equation (equation 1) which is a proxy of price volatility *(PVol)* at t^{th} period is explained by two components which are the past shocks i.e square of error term (ARCH term i.e. $\mathcal{E}_{t-1}^2$) and past variance or volatility term (GARCH term i.e. h_{t-1}). The inclusion of lagged conditional variances captures some sort of adaptive learning mechanism (Bollersler, 1986; Yang et al., 2001).

For equation (2) to be stationary, then $\delta > 0$, $\alpha \geq 0$, $\beta \geq 0$ and the persistence of volatility shocks (α +β) should be less than 1. The closer α + β gets to 1, the more persistent volatility shocks become (Bollersler, 1986). The estimates derived from equation (2) were used to test the persistence of volatility in the selected food crop prices during the period under review.

To uncover the factors that drive food price volatility in Nigeria, Engel-Granger two-stage procedure was employed. The presence of cointegration would imply the existence of long run relationship between the dependent and independent variables indicating that at least one of the variables modelled react to deviations from the long-run relationship. Following establishing the presence of long run relationship among the variables, the error correction model was specified in order to determine the roles of the modelled independent variables in correcting for disequilibrium.

In order to identify the drivers of food price volatility in Nigeria in the long run, the following model was specified:

$$PVol_{(t)} = \delta_0 + \delta_1 LnCRPPrdtn_t + \delta_2 VolWRLDPrc_t + \delta_3 GDPpc_t + \delta_4 VolINTRT_t + \delta_5 VolINFL_t + \delta_6 VolEXCHRt_t + \delta_7 VolCRDOILPr_t + \delta_8 POLSTAB_t + \delta_9 POLSTABnc_t + \delta_{10} GOVTEff_t + \delta_{11} Dummy_{1t} + \delta_{12} Dummy_{2t} + Ut \quad (3)$$

Where, $PVol_{(t)}$ is the respective food crop price volatility, $CRPPrdtn_t$ – own crop production, $WRLDPrc_t$ – own crop world price, $GDPpc_t$ – GDP per capita, $INTRT_t$ – interest rate, $EXCHRt_t$ – exchange rate, $INFL_t$ – inflation rate , $CRDOILPr_t$ – crude oil prices, $POLSTAB_t$ – political stability, $POLSTABnc_t$ – political stability in neighboring countries, $GOVTEff_t$ – government effectiveness, $Dummy_{1t}$- trade liberalization (0 in pre-SAP, 1 in post-SAP), $Dummy_{2t}$- insurgency occurrences (1 for yes, 0 otherwise) and *Ut* - error term, $Ut \sim iid(0, \delta^2 u)$.

The Error correction model estimated for volatility in the selected food crop prices in Nigeria is specified as follows and with the variables similarly defined as earlier on:

$$PVol_{(t)} = \delta_0 + \delta_1 \Delta PVol_{(t-1)} + \delta_2 \Delta LnCRPPrdtn_{t-1} + \delta_3 \Delta VolWRLDPrc_{t-1} + \delta_4 \Delta GDPpc_{t-1} + \delta_5 \Delta VolINTRT_{t-1} + \delta_6 \Delta VolINFL_{t-1} + \delta_7 \Delta VolEXCHRt_{t-1} + \delta_8 \Delta VolCRDOILPr_{t-1} + \delta_9 \Delta POLSTAB_{t-1} + \delta_{10} \Delta POLSTABnc_{t-1} + \delta_{11} \Delta GOVTEff_{t-1} + \delta_{12} Dummy_{1t-1} + \delta_{13} Dummy_{2t-1} + \delta_{14} ECM_{t-1} + Ut \quad (4)$$

Results from the ECM estimates explains the drivers of volatility in food commodity prices in the short run period and as well indicates the speed of adjustment (convergence or divergence) as a response to departures from the long-run equilibrium.

3. Results and Discussion

Table 1 presents the result of GARCH models estimates for the selected food crops. The result revealed time-varying pattern of food crop price volatility given that the coefficients of the GARCH models across all three selected crops were significant.

The sum of α and β measures the persistence of food crop prices volatility. Price volatility persistence measured 0.9999, 0.9998 and 0.9999 for maize, sorghum and yam respectively at 5% significance level. Across the three crops being investigated, it could be observed from Table 1 that (α+β) was very close to unity which is an indication that the bulk of the price shocks to volatility are permanent in nature, implying a significant impact of volatility on escalating food prices in the future periods. The GARCH parameters were significant across all the three food crops being examined which gives credence to the fact that there exists persistence in volatility in prices of commonly consumed foods in Nigeria. This result is in tandem with the finding of Minot (2014) in a study investigating whether food price volatility has increased in sub-Saharan Africa in which volatility of wholesale and retail food prices in the eleven African countries examined were found to be quite high.

Table 1. GARCH Model Estimates for the Selected Food Crops Prices Volatility

Variable	**Maize**		**Sorghum**		**Yam**	
	Coeff.	*p-value*	*Coeff.*	*p-value*	*Coeff.*	*p-value*
Mean Equation						
Constant	0.1402* (0.0747)	0.0604	0.021683** (0.0686)	0.04720	0.2289** (0.1103)	0.0379
$FoodCropPrice_{t-1}$	0.4949*** (0.1188)	<0.0001	1.1888*** (0.0276)	<0.0001	0.8605*** (0.0334)	<0.0001
Variance Equation						
Ambient Volatility	0.0624* (0.0345)	0.0708	0.0248 (0.0182)	0.1722	0.1002 (0.0635)	0.1146
ARCH(α)	0.8073*** (0.1586)	<0.0001	0.6526*** (0.0976)	<0.0001	0.7337*** (0.1308)	<0.0001
GARCH(β)	0.1926** (0.0888)	0.0301	0.3472*** (0.0501)	<0.0001	0.2662*** (0.0788)	0.0007
Vol. Persistence (α+β)	0.9999		0.9998		0.9999	
Akaike criterion	241.65		272.0151		270.9976	
Hannan-Quinn	246.29		276.0562		275.0386	
Log-likelihood	−113.83		−130.0076		−129.4988	
Schwarz criterion	254.14		282.8551		281.8376	
Mean dep. Var	21.43		18.78089		24.33400	
S.D. dep. Var	25.08		22.50063		27.87242	
Chi-square	22.9015	<0.0001	24.5548	<0.0001	29.1177	<0.0001

Note: Using observations 1971-2019(T=49), Dependent variable: Selected food crop price, Standard errors based on Hessian, Asterisk * 10% **5% and ***1%

Results of the cointegration test carried out to examine factors driving food price volatility in Nigeria is as presented in Table 2. Diagnostics tests were carried out on the model to ascertain reliability of the parameter estimated. Durbin-Watson statistics of 1.99, 1.98 and 1.99 for maize, sorghum and yam respectively indicated there were no issues of autocorrelation in the specified model. The adjusted R squared values observed indicated that up to 94.4%, 93.1% and 94.2% of the volatility in prices of maize, sorghum and yam respectively were explained by the explanatory variables included in the model. There were no issues of heteroscedasticity nor multicollinearity in the specified model given the white test and variance inflation factors respectively as examined.

The result of co-integration regression shown in table 2 indicates that in the long run, volatility in prices of the food crops investigated were mainly driven by political stability in neighboring countries ($p \leq 0.01$ and positive), trade liberalization ($p \leq 0.05$ and positive), insurgency ($p \leq 0.05$ and positive), GDP per capita ($p \leq 0.01$ and positive) and volatility in inflation rate ($p \leq 0.10$ and negative). Specifically, own crop production ($p \leq 0.01$ and positive) and volatility in world own crop price ($p \leq 0.05$ and negative) significantly influenced volatility in the price of yam whereas volatility in price of sorghum was positively influenced ($p \leq 0.10$) by own crop production in the period under review.

Table 2. Co-integration Equation of Food Price Volatility in Nigeria (1970-2019)

Variables	Yam		Maize		Sorghum	
	Cofficient (Std. err)	**p-value**	**Cofficient (Std. err)**	**p-value**	**Cofficient (Std. err)**	**p-value**
Constant	−21.9512*** (5.18828)	0.0002	−2.86588 (2.29672)	0.2206	−13.4247** (5.72633)	0.0250
Annual Own Crop Production$_t$	3.08215*** (0.710363)	0.0001	0.000251450 (0.000158264)	0.1214	1.10987* (0.582598)	0.0653
Volatility in World price of Own Crop$_t$	−5.22022** (2.10789)	0.0184	−0.580339 (0.727987)	0.4309	1.93242 (2.30638)	0.4080
GDP per Capita$_t$	0.008572*** (0.0050206)	0.0496	0.0198201*** (0.00688461)	0.0069	0.022949*** (0.0051293)	<0.0001
Volatility in Inflation$_t$	−0.190872* (0.0992359)	0.0628	−0.184639* (0.128686)	0.0605	−0.236862* (0.121186)	0.0589
Volatility in Interest Rate$_t$	0.00133790 (0.0162655)	0.9349	−0.0274909 (0.0189497)	0.1560	−0.0149235 (0.0196142)	0.4520
Volatility in Exchange Rate$_t$	−0.313238 (0.207943)	0.1412	−0.180745 (0.234327)	0.4458	−0.179478 (0.230997)	0.4425
Volatility in Crude Oil Price$_t$	−0.237835 (0.221457)	0.2904	0.0279488 (0.283178)	0.9220	−0.163190 (0.277011)	0.5597
Insurgency Occurrences$_t$	0.620413** (0.314176)	0.0456	1.03663** (0.383762)	0.0107	0.717327** (0.374315)	0.0468
Trade Liberalization$_t$	1.09405*** (0.379839)	0.0068	1.43931** (0.782357)	0.0476	2.95119*** (0.312865)	<0.0001
Political stability$_t$	0.122319 (0.456753)	0.7905	0.635480 (0.536315)	0.2443	0.376963 (0.586484)	0.5247
Government Effectiveness$_t$	−0.382292 (1.65578)	0.8188	−1.38614 (1.99721)	0.4924	−3.63185 (2.40090)	0.1396
Pol. Stability in Neighboring countries$_t$	2.38470*** (0.738829)	0.0028	3.89171*** (1.06331)	0.0008	4.01397*** (1.02063)	0.0004
R-squared	0.943800		0.930916		0.941586	
Log-likelihood	−33.21859		−42.62768		−42.19152	
Schwarz criterion	116.4891		135.3073		134.4350	
Adjusted R-squared	0.923965		0.906533		0.920970	
P-value(F)	1.12e-17		3.50e-16		2.13e-17	
Akaike criterion	92.43718		111.2554		110.3830	
Hannan-Quinn	101.4881		120.3063		119.4339	
Durbin-Watson	1.993265		1.985469		1.993527	

Note: Using observations 1971-2019(T=49), Dependent variable: Volatility in Selected food crop price, Standard errors in parenthesis, Asterisk * 10% **5% and ***1%

It is plausible that volatility in the prices of food crops increased with political stability in neighboring countries. This may be attributed to the fact that stability in neighboring countries enhances their inter-border trading opportunities with Nigeria which in turn places pressure on the domestic availability which ultimately drives volatility upwards. Price volatility could be generally seen to increase in the post-market liberalization era which might be an indication that prices were better stabilized before government withdrew control from the commodity markets. It is not surprising that prices of food commodities were more volatile in the periods coinciding with the insurgency escalations in Nigeria because there were huge numbers of individuals actively engaged in agriculture that were internally displaced hence impairing their production capacities, placing pressure on food prices. GDP per capita could be observed to drive food price volatility upwards in the period under review. GDP per capita is a measure of economic well-being, although not of personal income, it could have a way of influencing the general price level in the economy. The result further revealed that volatility in inflation in Nigeria resulted in lowering volatility in food prices. Inflation is the general increase in prices and fall in the purchasing value of money which expectedly will reduce people's ability to purchase preferred food quantities hence constraining their demands. The theory of price explains how new prices will be determined at lower levels based on the falling demand of such food crops in a free market especially when supply remains the same or is even increased. This may therefore explain how volatility in inflation may result in decreasing food price volatility in the economy. Government effectiveness is one more interesting variable in the model which although was not significant still carried the expected negative sign across all the three crops being investigated. This implies that increasing government effectiveness has the tendency to reduce food price volatility which is consistent with apriori expectation given that an effective government is one which in part is free of political pressures, not only formulating but as well ensuring implementation of policies that may be targeted at food price stabilization, committing fully to its mandate of meeting food demands of its populace.

To estimate the error correction model for each of the three food crops investigated in this study, optimal lag lengths were determined and the lag length selection was premised on Akaike criterion (AIC), Schwarz Bayesian criterion (SBC) and Hannan- Quinn criterion (HQC) which revealed that the optimum lag lengths appropriate for generating an interpretable parsimonious ECM model for the cointegrating series were at the second lag for the food crops under study. As shown on table 3, with Durbin-Watson statistics of 1.91, 2.04 and 2.06 for yam, maize and sorghum respectively, there were no issues of auto correlation in the specified models. The adjusted R squared values also suggest that up to 99% of the volatility in food prices were explained by the models included in the variables. No variance inflation factor exceeded 10 in any of the models indicating the model is free of multicollinearity while the white test statistics reflected no challenge of heteroscedasticity. From Table 3, the error correction model estimates were negative (-0.996, -0.729 and -0.638 for yam, maize and sorghum respectively) and statistically significant ($p \leq 0.01$), showing the existence of a quick convergence to equilibrium in each period with intermediate adjustments captured by the differenced term. This finding validates the existence of long-run equilibrium relationships among the variables in the food price volatility models, confirming that food price volatility in Nigeria is sensitive to departure from equilibrium in the past periods. In the absence of variations in the exogenous variables in each of the models, the model's deviation from the long run relation will tend to be corrected by a 99.6% (yam), 72.9% (maize) and 63.8% (sorghum) increase in the volatility of the respective food crop price by the following year.

Table 3. Error Correction Model estimates of Food Price Volatility in Nigeria (1970-2019)

Variables	**Yam**		**Maize**		**Sorghum**	
	Cofficient (Std. err)	**p-value**	**Cofficient (Std. err)**	**p-value**	**Cofficient (Std. err)**	**p-value**
Constant	−22.2899*** (1.62241)	<0.0001	7.49798** (3.06406)	0.0401	−2.40899* (9.82892)	0.08126
Food Price Vol.$_{t-1}$	0.97415 (0.021932)	0.2014	0.000482947** (0.00085179)	0.0384	1.115872 (1.000921)	0.3742
Annual Own Crop Production$_{t}$	2.86295*** (0.419748)	0.0002	0.000459253** (0.000173078)	0.0291	0.565586 (1.09151)	0.6184
Annual Own Crop Production$_{t-1}$	0.0312448 (0.272271)	0.9119	0.000237839 (0.000188714)	0.2431	2.41563 (1.68515)	0.1896
Annual Own Crop Production$_{t-2}$	0.181709 (0.263310)	0.5124	5.11218e-05 (0.000183086)	0.7872	−1.68378 (1.72417)	0.3574
Volatility in World price of Own Crop$_{t}$	−5.58588*** (0.335565)	<0.0001	0.260708** (0.535759)	0.0469	8.74948** (3.22087)	0.0264
Volatility in World price of Own Crop$_{t-1}$	−0.160795 (0.351018)	0.6608	0.748454 (0.688617)	0.3087	9.57874* (4.62533)	0.0721
Volatility in World price of Own Crop$_{t-2}$	−0.152102 (0.305886)	0.6342	−0.531674 (0.612596)	0.4107	1.88892 (4.24985)	0.6685
GDP per Capita$_{t}$	0.008031*** (0.0022314)	0.0087	−0.0249563 (0.0205608)	0.2594	−0.0170308 (0.0286641)	0.5688
GDP per Capita$_{t-1}$	0.00287845 (0.0041978)	0.5150	0.0198358 (0.0294340)	0.5194	−0.0008794 (0.0387701)	0.9825
GDP per Capita$_{t-2}$	−0.00289512 (0.0032379)	0.4009	0.0145972 (0.0180329)	0.4417	0.0384592 (0.0218116)	0.1159
Volatility in Inflation$_{t}$	−0.19756*** (0.0160990)	<0.0001	−0.0409736* (0.114922)	0.07307	−0.175597* (0.150979)	0.7283
Volatility in Inflation$_{t-1}$	−0.0100468 (0.0139549)	0.4949	0.0355273 (0.104502)	0.7426	−0.0694077 (0.134460)	0.6197
Volatility in Inflation$_{t-2}$	−0.0129063 (0.0181034)	0.4990	0.148079 (0.121170)	0.2565	0.0682184 (0.162199)	0.6851
Volatility in Interest Rate$_{t}$	0.00257211 (0.0019065)	0.2193	−0.0127737 (0.0178254)	0.4940	0.00171713 (0.0232266)	0.9429
Volatility in Interest Rate$_{t-1}$	0.000530337 (0.0027003)	0.8499	−0.00276359 (0.0182961)	0.8837	−0.0168095 (0.0213212)	0.4532
Volatility in Interest Rate$_{t-2}$	0.000630023 (0.0020171)	0.7639	0.0196260 (0.0142926)	0.2070	−0.0089913 (0.0185489)	0.6409
Volatility in Exchange Rate$_{t}$	−0.30419*** (0.0361700)	<0.0001	−0.547383* (0.289358)	0.0952	−0.098355* (0.357813)	0.0904
Volatility in Exchange Rate$_{t-1}$	0.0409964 (0.0547440)	0.4783	−0.0577052 (0.429188)	0.8964	0.257309 (0.579716)	0.6689
Volatility in Exchange Rate$_{t-2}$	0.0182561 (0.0409018)	0.6688	−0.844296** (0.311071)	0.0265	−0.523239 (0.389700)	0.2162
Volatility in Crude Oil Price$_{t}$	−0.23349*** (0.0201879)	<0.0001	−0.199391 (0.185878)	0.3147	−0.390019 (0.257896)	0.1689
Volatility in Crude Oil Price$_{t-1}$	0.000503788 (0.0252603)	0.9846	−0.205070 (0.207369)	0.3517	−0.401903 (0.301188)	0.2188

Volatility in Crude Oil Price$_{t-2}$	0.0156157 (0.0272688)	0.5848	0.0394298 (0.203649)	0.8513	−0.0850562 (0.268917)	0.7599
Insurgency Occurrences$_{t}$	0.606746*** (0.0518568)	<0.0001	0.511029 (0.493795)	0.3310	0.0134737 (0.704473)	0.9852
Insurgency Occurrences$_{t-1}$	0.0558495** (0.0557543)	0.03498	1.59889*** (0.373845)	0.0027	1.44623** (0.503045)	0.0207
Insurgency Occurrences$_{t-2}$	0.0459924 (0.0442878)	0.3336	0.00395434 (0.338310)	0.9910	0.331786 (0.414664)	0.4467
Trade Liberalization$_{t}$	0.995422*** (0.0812499)	<0.0001	0.202350* (0.665837)	0.0796	1.86508** (0.772735)	0.0423
Trade Liberalization$_{t-1}$	−0.0329990 (0.0879806)	0.7187	−0.470948 (0.778919)	0.5622	0.0268422 (0.911389)	0.9772
Trade Liberalization$_{t-2}$	0.153094 (0.147751)	0.3346	−0.842888 (0.765783)	0.3030	0.920697 (0.951346)	0.3615
Political stability$_{t}$	−0.157855** (0.0571789)	0.0281	−0.492046 (0.506098)	0.3594	−0.170119 (0.656123)	0.8020
Political stability$_{t-1}$	−0.109859 (0.0966001)	0.2929	−2.62304** (0.899135)	0.0194	1.74777 (1.10102)	0.1511
Political stability$_{t-2}$	−0.0879138 (0.112632)	0.4606	1.24759 (0.813649)	0.1637	0.674843 (1.19328)	0.5872
Government Effectiveness$_{t}$	−0.466515** (0.191871)	0.0453	−0.232171* (1.60907)	0.0889	−0.837908* (2.09239)	0.0693
Government Effectiveness$_{t-1}$	−0.113807 (0.279092)	0.6956	1.17166 (1.79401)	0.5320	2.48672 (2.92747)	0.4203
Government Effectiveness$_{t-2}$	0.0342334 (0.241359)	0.8912	0.811889 (2.01923)	0.6982	3.38753 (3.80878)	0.3997
Pol. Stability in Neighboring countries$_{t}$	2.37642*** (0.124597)	<0.0001	3.37965** (1.10327)	0.0155	1.92975* (1.21741)	0.0516
Pol. Stability in Neighboring countries$_{t-1}$	0.0809188 (0.219242)	0.7230	−1.20093 (1.58896)	0.4714	−1.74403 (2.08467)	0.4271
Pol. Stability in Neighboring countries$_{t-2}$	−0.100496 (0.152935)	0.5321	−0.91584 (0.135741)	0.5386	−1.49874 (2.57214)	0.5148
ECM $_{t-1}$	−0.99559*** (0.0362867)	<0.0001	−0.728592*** (0.024747)	<0.0001	−0.6376*** (0.030154)	<0.0001
R-squared	0.999954		0.996398		0.994514	
Log-likelihood	129.1648		26.43124		14.26259	
Schwarz criterion	−113.6765		87.98402		112.3213	
Adj. R-squared	0.999711		0.980191		0.969828	
P-value(F)	1.93e-12		9.59e-07		5.03e-06	
Akaike criterion	−182.3296		21.13751		45.47482	
Hannan-Quinn	−156.7364		46.05722		70.39453	
Durbin-Watson	1.905658		2.040879		2.060136	

Note: Using observations 1971-2019, Dependent variable: Volatility in Selected food crop price, Standard errors in parenthesis, Asterisk * 10% **5% and ***1%

Results of error correction models revealed that the price volatility in all three selected food crops were positively and significantly influenced by political stability in neighboring countries, trade liberalization -both in the current period, and insurgency in the one-year lagged period. It could also be seen that price volatility of the crops were negatively influenced by government effectiveness in the current period, volatility in exchange rate in the current period and volatility in exchange rate in the one-year lagged period. Volatility in world price of own crop negatively influenced the volatility in yam prices whereas positively influenced volatilities in maize and sorghum prices. Volatility in the price of maize can be seen to be positively influenced by volatility in its price in the period t-1 and its annual production in the current period. Meanwhile it is negatively driven by volatility in the exchange rate in the two-year lagged period and in-country political stability in the one-year lagged period. Volatility in yam prices could be seen to be positively influenced by its annual production and GDP per capita in the current period as well as insurgency occurrences in the current period. Volatility in prices of yam is negatively influenced by volatility in crude oil prices in the current period as well as one year lag in-country political stability. Sorghum price volatility could be seen to be driven by volatility in its own world price.

Based on the result of both the cointegration and ECM, it may be concluded that volatility in world prices of the commodities investigated have very meager influence in driving volatility in the prices of those commodities in the domestic markets suggesting that domestic prices were somewhat insulated from what was going on in the international markets during the period under review. This may be supported by past studies which have found relatively low level of price transmission from international markets to African food markets (Baquedano & Liefert 2014; Minot, 2011; Conforti, 2004; Quiroz & Soto, 1995). Findings from this study support other studies (Ma, Xu and Dong 2015; Barahona and Chulaphan, 2017) that have shown that volatility in crude oil prices have very minimal effect on food prices indices. Volatility in inflation rate negatively driving volatility in prices of all the three cops examined supports the submissions (Davidson, Halunga, Lloyd, McCorriston, and Morgan, 2011; Gilbert, 2010) that food prices increase as a result of depreciation in a country's currency however contrasting that of Barahona & Chulaphan (2017) where they observed a positive relationship between consumer food price indices and exchange rate. A study in Ethiopia by Abebe *et al.* (2012) suggests that exchange rate had a negative and significant impact on food prices in the long run while it turns to be positive in the short run implying that higher exchange rate lowers inflationary pressure in the long run which they attributed to the fact that devaluation or depreciation may discourage import and encourage domestic production following the principle of import substitution. As could be seen, GDP per capita positively influenced volatility in yam price which is somewhat in line with the observation of Tadese *et al.* (2014) which indicated that GDP shocks positively influenced food price spikes.

4. Conclusion and Recommendation

The study concluded that there has been persistent volatility in the prices of food crops in Nigeria which unequivocally impairs the food security status as well as welfare of the low income earners in the nation. It was revealed that insurgency, political stability in neighbouring countries, trade liberalization, GDP per capita, inflation rate, government effectiveness, crop production, crude oil price and exchange rate were prominent drivers of volatility in food commodity prices. Based on the foregoing, the study therefore recommends the pursuance of a peaceful nation that is capable of supporting sustainable and increased production. Since political stability in neighbouring countries can be suggested to promote inter-border trade which eventually place pressure on the domestic demand, it becomes important to put mechanisms that better regulates such inter-border trade activities especially for staple foods. This is very critical in the post-COVID era when there may be multidimensional pressure on

food in the country and neighbouring nations. Trade liberalization has not proven to stabilize prices as the findings from this study indicates that volatility in food prices generally rose during the post market liberalization era. It is hence recommended that some of the price stabilization policies and government interventions in the pre-liberalization era should be re-visited. This study further recommends that more attention should be paid to strategic planning of the economy given the ability of macroeconomic variables such as inflation rate, GDP per capital, exchange rate to influence volatility in domestic food prices. It is also very important for Nigeria as a nation to continuously strive for improvements to the government effectiveness given its capacity to drive lower volatility in food prices.

References

Abebe A., Arega S., Jemal M. & Mebratu L. (2012). Dynamics of food price inflation in Eastern Ethiopia: A meso-macro modeling. *Ethiopian Journal of Economics.* 21(2): 1-32

Ajibade T.B., Ayinde O.E. & Abdoulaye T. (2019). Discovery of maize price and Food crop market dynamics in Nigeria. *Review of Agricultural and Applied Economics* 22 (1), 51-64 DOI: 10.15414/raae.2019.22.01.51-64

Ajibade T.B., Ayinde O.E., Abdoulaye T. & Ayinde K. (2018) Modeling the price of Maize and its Determinants in Nigeria: Error Correction Model Approach. *Albanian j. agric. sci.* 17 (4): 235-242.

Akpan, S.B., Udoh, E.J. & Umoren, A.A. (2012). Modeling the Dynamic Relationship between Food Crop Output Volatility and Its Determinants in Nigeria. *Journal of Agricultural Science.* 4(8): 36-47.

Apergis, N. & Rezitis, A. (2011) Food Price Volatility and Macroeconomic Factors: Evidence from GARCH and GARCH-X Estimates, *Journal of Agricultural and Applied Economics*, 43:1, 95–110.

Baffes, J., & Gardner, B. (2003). The transmission of world commodity prices to domestic markets under policy reforms in developing countries. The *Journal of Policy Reform*, 6, 159-180.

Baquedano, F. G., & Liefert, W. M. (2014). Market integration and price transmission of developing countries. *Food Policy*, 44, 103 - 114.

Baquedano, F. G., Liefert, W. M., & Shapouri, S. (2011). World market integration for export and food crops in developing countries: A case study for Mali and Nicaragua. *Agricultural Economics*, 42, 619 - 630.

Barahona, J. F., & Chulaphan, W. (2017). Price transmission between world food prices and different consumer food price indices in Thailand. *Kasetsart Journal of Social Sciences.* 30, 1-7 http://dx.doi.org/10.1016/j.kjss.2017.07.008

Binswanger, H.P. & Rosenzweig, M.R. (1986). Behavioural and Material Determinants of Production Relations in Agriculture. *The Journal of Development Studies* 22 (3): 503–39.

Bollersler, T. (1986), Generalized Autoregressive Conditional Heteroscedasticity. *Journal of Econometrics*, 31:307-327.

Conforti, P. (2004). Price transmission in selected agricultural markets. *FAO commodity and trade policy research* (Working Paper). Rome, Italy: FAO.

Davidson, J., Halunga, A., Lloyd, T. A., McCorriston, S., & Morgan, C. W. (2011). Explaining UK food price inflation (Working Paper). University of Exeter, UK: European Commission's Transparency of Food Pricing project.

Enders, W. & Holt, M.T. (2014). The evolving relationships between agricultural and energy commodity prices: A shifting-mean Vector Autoregressive analysis. In: Jean-Paul Chavas, David Hummels, Brian D. Wright (Eds) The Economics of Food Price Volatility. *Conference report National Bureau of Economic Research Conference Report*. University of Chicago Press. ISBN 022612892X, 9780226128924 Pp 135-192.

Engle, R. F. (1982) Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica*. 50:4, 987-1008.

Fragile State Index (2017). Published by the Fund for Peace Organization in partnership with The Cipher Brief. 1101 14th Street NW, Suite 1020 Washington, D.C. 20005

Garcìa-German, S., Morales-Opazo, C., Garrido, A., Demeke, M., & Bardajì, I. (2013). Literature review of impacts on consumers in developed and developing countries. Understanding and coping with food markets volatility towards more stable world and EU food systems (Working Paper). Madrid, Spain: ULYSSES.

Gerard, F., Alpha, A. Beaujeu, R. Levard, L., Maitre d'Hotel, E., Rouille d'Orfeuil, H., & Bricas, N., (2011). Managing Food Price Volatility for Food Security and Development. Groupe de Recherche et d'Echange sur la régulation des marchés agricoles (GREMA). <http://www.gret.org/wp-content/uploads/Livrevolatility-food-security-and-development-version-corr.pdf>.

Gilbert, C. L. (2010). How to understand high food prices. *Journal of Agricultural Economics*, 61, 398-425.

Gilbert, C. & Morgan, C., 2010. Food price volatility. *Philos. Trans. R. Soc. B* 357, 3023–3034.

Green, R., Cornelson, L., Dangour, A. D., Turner, R., Shankar, B., Mazzocchi, M., et al. (2013). The effect of rising food prices on food consumption: Systematic review with meta-regression. *BMJ, 346, f3703*.

Hachula, M., & Hoffman, S. (2015). The Output Effects of Commodity Price Volatility: Evidence from Exporting Countries, Diskussionsbeiträge, No.2015/29, Freie Universität Berlin, Fachbereich Wirtschaftswissenschaft, Berlin. http://hdl.handle.net/10419/121179

Jordaan, H., Grové, B., Joosteand, A., & Alemu, Z. G. (2007). Measuring the Price Volatility of Certain Field Crops in South Africa using the ARCH/GARCH Approach. *Agrekon, 46* (3).

Lee, Y.N. (2017). Commodity Price Volatility and Migration: Evidence from Rural Ethiopia. Being paper presented at the Centre for the Study of African Economies Conference, University of Oxford, 19-21 March.

Ma, Z., Xu, R., & Dong, X. (2015). World oil prices and agricultural commodity prices: The evidence from China. *Agricultural Economics - Czech*, 61, 564 - 576.

Minot, N. (2011). Transmission of world food price changes to markets in Sub-Saharan Africa Discussion Paper No. 01059. Washington, DC: *International Food Policy Research Institute*.

Minot, N. (2014). Food price volatility in sub-Saharan Africa: Has it really increased? *Food Policy.* 45, 45-56.

Miranda, M.J., & Helmberger, P.G. (1988). The Effects of Commodity Price Stabilization Programs. *The American Economic Review* 78 (1): 46–58.

Moledina, A. A, Roe, T. L., & Shane, M. (2003). Measurement of commodity price volatility and the welfare consequences of eliminating volatility. *Working Paper at the Economic Development Centre*, University of Minnesota.

Moschini, G., & Hennessy, D.A. (2001). Uncertainty, Risk Aversion, and Risk Management for Agricultural Producers. In *Handbook of Agricultural Economics, vol. 1A, ed. B.L. Gardner and G.C. Rausser*, 88–153. Amsterdam, The Netherlands: North-Holland.

National Bureau of Statistics (2020). Quarterly publication of the Bureau. Retrieved online from www.nigerianstat.gov.ng

National Population Commission (2019). *Publication of National Population Commission, Abuja, Nigeria*

Newbery D.M. (1989). The Theory of Food Price Stabilization. *The Economic Journal*, 99, 1065-1082.

Quiroz, J. & Soto, R. (1995). International Price Signals in Agricultural Prices: Do Governments Care? Documento de investigacion 88. Georgetown University, Santiago, Chile, ILADES Postgraduate Economics Program.

Tadesse G., Algieri, B., Kalkuhl, M. & von Braun J. (2014). Drivers and triggers of international food price spikes and volatility. *Food Policy.* 47, 117-128

World Bank (2018). Poverty and Equity Brief: Sub-saharan Africa – Nigeria. Available online at www.povertydata.worldbank.org

World Factbook (2012). retrieved online at http://www.cia.gov/library/publications/the-world-factbook/geos/ni.html Accessed July 14, 2016

Yang. J., Besslev, D. A., & Leatham, D. J. (2001). Asset storability and price discovery of commodity futures markets: a new look. *Journal of Future Markets*, *21*, 279-300. http://dx.doi.org/10.1002/1096-9934(200103)21:3<279::AID-FUT5>3.0.CO;2-L

Zheng, Y., Kinnucan, H. W., & Thompson, H. (2008) News and Volatility of Food Prices. *Applied Economics*, *40*, 1629-1635.

https://www.aljazeera.com/news/2019/01/nigeria-failing-implement-increased-minimum-wage-190108171913839.html

https://www.vanguardngr.com/2018/11/the-nlc-and-the-nationwide-strike-for-increased-minimum-wage/