

How Do Trade and Domestic Policy Variables Stand among Influencers of Grain Price Volatility in Nigeria?

Shittu, A.M., Akerele, D., Haile, M. G., Edewor, S.E.

Department of Agricultural Economics and Farm Management

Federal University of Agriculture Abeokuta, Nigeria

Abstract

Food price volatility has become an issue of great concerns to researchers, policy makers, governments and development workers worldwide, Nigeria inclusive. Against the background of limited, and mixed findings on the nature, and drivers of price volatility in Nigeria (and some other African countries), developing effective policies to calm food price instability remains a speculation. Consequently, this study examined the potential roles of trade and domestic policies, including certain external and local factors on price volatility of specific grains in Nigeria. Time time series data from different secondary sources were used for analysis with a dynamic panel data (fixed effects) model as the main econometrics model. Except for domestic price of imported rice, price volatility in grain markets have not increased markedly in the wake of global food crises. Whereas tariffs and trade openness play insignificant role in explaining volatility in grain markets, political stability, narrow money supply, petrol price, interest and exchange rates, and volatile crude oil price, exerts significant influence, howbeit differently, on price volatility of specific grains. While challenging the idea of volatility increase in general food prices, and the notion that international price upsurge is the dominant drivers of food price volatility in Africa, the findings call for greater attention on domestic factors such as political stability, management of monetary policy, including exchange rates as well as definitive actions to ensure stable petrol price as important pathways to address short and medium-term food price volatility in Nigeria.

Introduction

Over the past decade, the world has been faced with myriads of shocks that have caused huge economic losses to different countries (von Braun and Tadesse, 2012). Notable among the problematic periods of shocks were the global food crisis of 2007/2008 and a resurgent in 2010/2011. The adverse effects of the shocks still linger on in many countries. Volatile food prices is one of the key indicators of food crises. Volatility is often regarded as variance and it is a measure of the dispersion of a random variable from its mean value. Thus, price volatility relates to the fluctuations (or instability) in price around its mean value over time or the risk of large, unexpected price changes (Omotosho and Doguwa, 2011; Tadesse *et al.*, 2014; Kalkuhl *et al.*, 2013).

Price volatility measures closer the risks endured by consumers and uncertainties by farmers in their decisions. It is a source of concerns for policy makers and other development workers on matters relating to the welfare of farmers and consumers. Trade liberalization is one of the common practices adopted by some developing countries to minimise price volatility. It is often done to boost trade and foster deeper integration by substantially liberalising trade through reduction in tariffs and non-tariff barriers.

Although trade liberalization is expected to enhance market efficiency and reduce price volatilities, it may have differential impacts on price volatility. The frequent tendency to use tariff and non-tariff measures to alter the structure of international trade flows under various disguises often tends to compromise market efficiency. Commodity prices can be directly or indirectly affected by trade and domestic policies/reforms. For instance, the imposition of tax on imported goods at the border may have a more direct influence on the prices of traded commodities while the indirect influence of tax will result in the domestic commodity price change (volatility) as a result of competition with import.

Several studies (Ivanic and Martin, 2008; Geman and Ott, 2014; Minot, 2014) have sought to examine the issues of food price changes (volatility) and policy response at the global level but very few studies exist in Africa, most especially in Nigeria. Available literature on Africa also seem no to converge as to whether food price volatility has increased or not in Africa (Nigeria inclusive). The current studies seeks to contribute to the ongoing issues of food price volatility in Africa (with specific focus on Nigeria)-shedding more light on disputing perspectives on the nature of price volatility (over years), and the possible effects of trade policy response (tariffs), degree of openness to trade, and certain domestic policies, and external factors on volatility of

staple food prices in the country. Consequently, the study sought to answer the following questions. Has food price volatility increased in Nigeria, and for which commodities? Having controlled for other local and international factors, how has trade and domestic policies, among other factors influence food price volatility in Nigeria?

This study hypothesized that: (i) the food price volatilities experienced prior to the 2007/2008 global food crises, are undistinguished from the volatilities experienced after the global food crises, and (ii) trade and domestic policies do not influence food price volatility transmission in Nigeria. The remainder of the study is divided into the following sections. Section II includes a stylized literature review; section III encompasses the research methodology; section IV presents the results, while section V holds the conclusion.

Literature Review: Some Stylized Facts

The concepts of price and price volatility transmission are a representative of the relationship that exists between prices. The relationship between prices could be for the same commodities or different commodities and it could also be at the same or different locations. Apergis and Rezitis (2003) defined price volatility transmission as the extent to which price uncertainty in one market affects price uncertainty in the others. Price variability is desirable up to a certain degree because it reveals what is occurring as the market condition changes with extremely low prices resulting into financial crisis while on the other hand, high prices will result to product substitution. Some internal factors have been identified as causing food price volatility among such is restrictive trade policies and declining world food stocks. Martin and Anderson (2012) and Headey (2011) have shown that restrictions placed on export and bans that have been implemented by countries such as China, Russia India, and Thailand have created pandemonium in the world markets and aggravated price increases. Often times, trade restrictions are embarked upon to curtail higher global prices effects on domestic prices as well as to protect consumers.

The factors responsible for food price volatility could either be from the demand or/and the supply side of the world food equation. In order to distinguish how these different factors affect price changes, three groups of potential causes have been singled out: exogenous shocks, also called “root” causes; “conditional” causes; and “internal” drivers. Root causes, such as extreme weather events, oil price shocks, production shocks, and demand shocks, are

independent core factors affecting food price fluctuations. They are exogenous because the possibility of a causal relationship going from the agricultural sector to root causes is minimal. The exogenous shocks are expected to generate food price spikes and volatility, and the magnitude of their impacts depends partly on the political and economic environment of a given country. In other words, a second group of factors related to specific political and economic conditions – labelled here as conditional drivers—can lower or increase the exogenous shocks. Some of these factors (such as a high concentration of production or low transparency in commodity markets) are rather time-invariant and difficult to measure; they are therefore not considered in the empirical analysis of this article. The third group of causes consists of factors that are triggered by the same price dynamics, and these internal causes are endogenous shock-amplifiers.

Methodology

Data Source

This study made use of secondary data on: (a) domestic retail prices of food commodity from 2001 to 2016 were obtained from the National Bureau of Statistics, for the 36 states of Nigeria. The data were supplemented with national aggregate consumer food price (CPI) from the Central Bank of Nigeria Statistical Bulletins; (b) average World Price (WP) of same/related commodities as in (a) obtained from the World Consumer Prices section of the International Financial Statistics (IFS) of the International Monetary Fund (IMF); and (c) monetary and trade policy variables, and other internal factors were collected. Monthly time series of policy variables: Monetary Policy Rates (MPR), official exchange rate of Naira to the US Dollar (EXR), domestic narrow money supply (M1); average tariff regime (ATR), trade openness (TO) gross domestic product (GDP) growth rates were extracted from CBN Statistical Bulletin and the World Integrated Trade Solution database. International transaction cost (proxy by Liner Shipping Connectivity Index) were obtained from UNCTAD. Food production variability was obtained from FAOSTAT, global beginning stock to use were obtained USDA while data on international crude oil price were from WTI. Where data were only available on annual basis, they were converted to monthly data through linear extrapolation.

Estimation Strategy

This study modelled price volatility of some selected food commodities in Nigeria. Price volatility is a measure of price dispersion from the mean which shows the risk that is related to price changes and signifies substantial long-term price movement. Food price volatility has been broadly assessed using the standard deviation of log price return (Balcombe, 2009; Kornher and Kalkuhl, 2013) and the coefficient of variation of the original price (Tadesse *et al.*, 2014; Geman and Ott, 2014). Volatility of log price return within months of a year as captured by Balcome (2009) can be specified as:

$$\sigma_{pt} = \sqrt{\left[\sum \frac{1}{N} (w_{mt} - \bar{w})^2 \right]} \quad (1)$$

where σ_{pt} is the realized volatility for year captured as the standard deviation of log returns of price over the year. $w_{mt} = \Delta \ln P_{mt}$ is the log of monthly price returns and $\bar{w} = \sum \frac{1}{N} w_{mt}$ is the mean of the log of monthly price return. An advantage of the Balcombe (2009) methods is that it provides a convenient way to circumvent unit roots/trend problem. In our volatility assessment (for this study), we employed Balcome's specification, but with some modifications. Rather than estimating volatility over marketing years with no overlapping observations) as it is in Balcombe (2009), our volatility estimates are with overlapping observations captured on 12 months interval, starting progressively from December of the last (current) year under consideration-year 2016 (through November of the same year) to the last month of the first/initial year (year 2001). By so doing, we are able to capture intra-annual volatility, and some elements of inter-year price variability.

Some Identified Potential Drivers of Domestic Food Price Volatility

This section presents insight into the nature of the independent variables and their relationship with the domestic food price volatilities. The explanatory variables used in this work were derived from following the work of Tadesse *et al.* (2014) and Kornher and Kalkuhl (2013) who compiled a wide list of variables that could be used to explain domestic food price upsurges. The variables are indicated below:

Beginning stock to use ratio: The beginning stock relative to use/consumption is captured using the global beginning stock to use ratio (available for grains). Stockholding reduces price

volatility in as much as stocks are piled-up in periods of excess supply and made available in times of excess demand. Higher stocks to use ensure adequate supply and prevent post-harvest prices from spiking, while they also off set inter-annual supply shocks (Deaton and Laroque, 1992; Tadesse and Guttormsen, 2011). All else equal, higher beginning stock relative to use is expected to calm price instability.

International food prices: Empirically studies have established positive relationship between international price and domestic price (Korhner and Kalkuhl, 2013). Hence upsurges (volatilities) in international food prices is anticipated to be transmitted to price of domestic commodities.

Exchange rates: Exchange rate can be referred to as what a country's currency will exchange for relative to a US dollar. Domestic price volatility has been known to increase as a result of a volatile exchange rate. Overall food supply–demand balance will not change despite the fact that exchange rate changes and this will further relocate purchasing power and price incentives across countries (Gilbert and Morgan, 2010). Nigerian consumers are expected to lose from the higher prices from the naira depreciation relative to the dollar while foreign consumers are faced with lower prices.

Crude oil price: Interest in international crude oil prices has risen over the years due to the use of certain staple food crop as sources of biofuel. The linkage between biofuel demand and domestic food prices is very crucial as a result of international oil price volatility. Authors such as Minot (2014); Tadesse *et al.* (2014); Gilbert and Morgan (2010) have been able to establish a link showing the growing positive correlation between agricultural prices and the oil price to demand for food commodities, most especially, with maize, sugar and vegetable oils, being used as biofuel feedstocks.

Gross domestic products: The volatility of commodity prices may be substantially affected by the growth rates or shocks in the gross domestic products (economic activities). For instance, stronger demand power is synonymous with a higher level of economic growth. A positive or negative change in the macro-factor will aid the spread across goods markets in Nigeria by affecting market prices differently. The variable GDP was used by Tadesse *et al.* (2014) on international food price spikes and volatility.

Consumer price index: A volatile consumer price index is likely to affect other crops short term demands or volatility spill over. An indication of market competitiveness is a low consumer price index. Price changes in specific food items can be caused by national/domestic

volatility of general food price index. The variables exchange rate and food price volatility were included in a study by Kornher and Kalkuhl (2013) to explain domestic food price volatility. The justification for the inclusion of these variables was that there was a marked difference between nominal exchange rate and real exchange rate and respective volatilities is weakly connected as compared with food price and exchange rate levels.

Transaction Costs: Domestic food price hikes and volatility have been linked to high transaction cost. The effect of inadequate or lack of domestic infrastructure or an inefficient market would result to high transaction and transport costs which can have an adverse effect on price transmission. Several studies have used different indices to represent infrastructure. A typical example was the multi-component index used by Kornher and Kalkuhl (2013) which included information on road infrastructure (percentage of paved roads), mobile phone penetration, economic freedom, and the existence of a commodity exchange as proxy for costs of domestic transaction and market performance. Difficulty exists in obtaining these information for Nigeria except for mobile penetration which is constant over the years. Another common index is the Linear Shipping Connectivity Index (LSCI). It has found wide usage as transaction cost in international trade. It is a measure how integrated a country is in the existing linear shipping network or the accessibility of a country to global trade. A higher index signifies a lower transaction cost implying that it is easier to access a high capacity global maritime freight transport system. Its effect on volatility is expected to be negative.

Monetary Policy rates: Monetary policy rates refer to the interest rates at which commercial banks lend from the Central Banks of Nigeria. Of keen interest to several studies is the issue of the linkage between the influence of interest rate on volatile prices and storage. When the interest rate is low, the cost incurred in financing stockpiles is lower than with the incidence of high interest rate. Seasonal/intra-year price variability is reduced as a result of lower interest rate. This reduction will further lower the opportunity cost of carrying inventories thus increasing commodities demand thereby leading to higher commodity prices, more especially if participants in the market speculates that shocks in the interest rate will continue to exist (Frankel, 2006). It will further lead to expenditure and investment expansion. Lower interest rate makes it seem effortlessly for investors to wager on assets that encompasses food item and in some cases, an upward pressure can be placed on future prices

Narrow money supply: Empirical studies on the effect of monetary conditions (and interest rates) on commodity prices have increased. Apergis and Rezitis, (2011) established a positive

influence of loose monetary policy or low interest rates on commodity price hikes. Commodity prices are expected to be driven up by an expansionary money (policy) supply and vice versa. Monetary policies will influence commodity prices through some of the following channels: interest rates, foreign exchange markets, stronger inflation expectation and economic growth. It can thus be concluded that despite the fact that shocks in monetary policy can aid in forecasting movements in commodity prices, they are often not the major causes of fluctuating prices.

Political stability: Political instability as a means of measuring the perceptions that governments may be destabilized by violent measures, motivated by political acts of terrorism or violence. Over the years, Nigeria has been faced with one form of political unrest or the other. Typical examples are that of the Boko Haram insurgency in the Northern part of the country and the Fulani herdsmen attacks all over the country.

It is a reflection of the quality of governance that exists from different parts of the globe that influences the experiences of individuals, firms, experts from the private and public sector and entrepreneurs. During the incidence of political unrest, it is expected that volatility will be low.

Per capita food production variability: The per capita food production variability refers to the net food variability per capita that is expressed in US dollars. The standard deviation of food production trend per capita is often used to calculate per capita food production variability. Production variability may arise as a result of changes in the area planted or weather shocks leading to variations in yield.

Petrol price: The volatility of commodity prices can be affected by the movement of petrol price and petrol price volatility. An increase in petrol prices will have a resultant effect on the transportation cost by increasing it thereby leading to rice hikes. Shittu *et al.* (2015), discovered that a key driver of rising food prices in Nigeria is petrol price hike as a result of subsidy withdrawal on petroleum products.

Openness to trade: This refers to the degree to which an economy is open to trade refers to trade openness. During the period low price volatility, an effective policy tool for food security promotion is openness to trade. Despite the role that restrictive trade policies can play in protecting domestic prices from volatility in the world market, it can also impact on domestic price volatility by increasing it due to domestic supply shocks which may arise as a result of unstable and unpredictable government policies (FAO, 2011). Trade openness creates an opportunity for regions of the world that have adequate supply of certain commodities to supply

areas with lack and vice versa. Generally, high import countries are majorly adversely affected by volatile international food prices as compared with what is obtainable in countries that are mainly exporters.

Trade Restriction: Several countries have put in place one or more barriers to trade in order to protect their economies with the degree of openness deferring from one country to another. The most obvious and stated reason for the restrictive measures may arise from a country's protection of her infant industries. In most countries, the most protected sector is the agriculture sector with little or no liberalization. Over the years, the Nigerian government has used several measures in order to protect her economy. A notable few includes, outright bans, one hundred percent taxation in form of import duties on commodities, more especially for goods that the country produces or manufactures. As far back as the early 2000s, the Nigerian government placed outright bans on the importation of certain commodities inclusive of live or dead poultry of any kind, some other live animals, fruit juice, and some pasta such as spaghetti or noodles, with a complete ban on importation of rice across the land borders. Martin and Anderson (2011) reported that the trade barriers utilized by each country are meant to reduce the domestic price volatility relative to international prices. The effect of price volatility is more often times felt by poor net food importing countries than countries that are net exporters.

Econometrics Estimation

As mentioned in the literature review, determinants of volatile domestic food prices can be linked with multiple and interconnected causes including market fundamentals, prices and gross domestic products (income), domestic macroeconomic variables, exchange rate, money supply, interest rates, and political environments including political stability, among others. Apart from these variables, price variability is subject to state and crop specific factors of which some are observable while others are related to a broader category (Kornher and Kalkuhl, 2013).

Model of Food Price Volatility

Generally, the dynamic difference or system generalized method of moment (GMM) has been applied to capture dynamic bias in panel data (Kornher and Kalkuhl, 2013). However, Roodman (2007) cautioned that the estimators are more appropriate (and should be used) for

cases involving small period (T) and large panels (N). He noted that when time (T) is large (as we have in this present study), dynamic panel bias becomes insignificant, and a more straightforward fixed effects estimator works. Besides, the approach also comes with estimation challenge in that the number of instruments in difference and system GMM tends to explode as time (T) becomes large (Roodman 2007). Given that we have a very long period (T) in this work; we therefore estimate the dynamic fixed effects (panel) regression model. We estimate to a dynamic fixed effects model (which include the lag of dependent variable as independent variable) on one hand, and a fixed-effects model with serial correlation on the other hand to compare results. The dynamic fixed effects model (with a lag of dependent variable as an explanatory variable) is presented as:

$$F_{ijt} = \theta F_{ijt-1} + \beta Z_{ijt} + \gamma D_{ij} + \alpha_{ij} + e_{ijt} \quad (i = 1, \dots, I; j = 1, \dots, J; t = 1, \dots, T) \quad (2)$$

The fixed effect model with autocorrelation is also given as follows:

$$F_{ijt} = Z_{ijt} + D_{ij} + \alpha_{ij} + e_{ijt} \quad (i = 1, \dots, I; j = 1, \dots, J; t = 1, \dots, T) \quad (3)$$

$$e_{ijt} = \rho e_{ijt-1} + u_{ijt} \quad (i = 1, \dots, I; j = 1, \dots, J; t = 1, \dots, T)$$

Where u_{ijt} are independently normally distributed with mean zero and constant variance. ρ is a measure of correlation between the empirical e_{ijt} and its lagged e_{ijt-1} . Similarly, F_{ijt} captures the realized volatility of price, and Z_{ijt} the non-stochastic time-varying regressors. We examined the presence of serially correlated (AR1) disturbance using Bhargava, Franzini, and Narendranathan (1982) Durbin–Watson statistic. Bhargava et al. (1982) noted that that in datasets with large panels, Durbin–Watson statistic estimates below 2 suggest rejection of the null hypothesis of serially independent errors. He noted however, that very low values may suggest that errors follow a random walk. Details of the variables used for volatility models are presented in Table 1.

Table 1: Description of Explanatory Variables

Variable Name	Descriptions
Dependent Variables	
Vdricek, vdimpricek, vdmaizek, vdsorgk, vdmilletk	Volatility of Log return of domestic monthly price of local rice, imported rice, maize, sorghum, and millet respectively
Explanatory variables	
vgricek, vgsorghum, vgmaize, millet	Volatility of log return monthly international price of rice, sorghum, maize, and millet. International price of imported rice was used as the corresponding price for local rice while the international price of coarse grain were used for sorghum, millet, and maize
vgmillet, vgyam, vgegg, vggarri	Volatility of Log return of international (composite) food price index.
Sturrice	Monthly beginning stock to use ratio for rice
Sturmaize, stursorghum and sturmillet	Monthly Beginning stock to use ratio for coarse grains. The is used respectively for maize, sorghum and millet
Exanratek, exratet	Volatility of USD to Naira exchange rate. Exanratek was computed based on standards deviation of log returns.
petrol	Pump price of petrol – we have this on monthly basis across states of Nigeria for some months, others are in annual level.
narrow22	Narrow money supply – reflecting government position to shrink the money in circulation
gdp growth rate	Monthly interpolated GDP growth rate
polistabi	Index of political stability
mprates	Monetary policy rates. Central Bank of Nigeria Government interest rate
volcpik	Volatile domestic consumer price index (monthly cpi)

Results and Discussion

Descriptive Results (Graphs)

Presented in Figures 1a-e are the graphs of grain price volatility over time. It can deduced from the graphs that except for domestic price of imported rice in which volatility appear to begin to rise progressively, and slight higher in post 2010/2011 (years after food crises resurgence) compared to the previous years, the patterns (and magnitudes) of price volatility in grain markets have not increased markedly during the periods of global food crises compared to the periods before the crises. The descriptive results appear to be fairly similar to what was reported by Minot (2014). Whether this holds true in the markets of other food commodities remains a matter of empirical investigation.

Determinants of Volatile Food Prices

The results of factors influencing food price volatility are presented in Tables 2A to C. The lag values of domestic price volatility, trade related variables such as tariff rates and openness to trade have no significant effects on food price volatility. The results revealed that volatility of international price of coarse grains is weakly linked with volatility of domestic price of grains in Nigeria, except for local maize (Table 2B) on which it is statistically significant and negative relationship. This is contrary to Huh *et al.* (2012) and Kornher and Kalkul (2013) who found significant and positive relationship between international food price volatility and volatility of national/domestic food price volatility. These findings question the idea that instability in international markets is the primary driver of food price volatility in Africa. The coefficient of beginning stock to use ratio is positive and statistically significant; suggestive that higher beginning stock to use ratio can escalate domestic price volatility of imported rice in Nigeria (Table 2A). The finding is counterintuitive. Where previous studies established a positive link, the relationship was insignificant (Tadesse *et al.*, 2014). Higher global beginning stock-to-use appears to be insignificant in explaining price volatility in most of the locally produced grains in the country.

While narrow money supply would calm volatility of sorghum price (Table 2B). Changes in money supply can influence agricultural prices through the mechanism of interest rates. Hence, by managing money supply through effective monetary policies, the country can also influence food price rise or volatility to a certain extent. Results consistently indicate inverse relationship between food price volatility and political stability. It follows therefore that ensuring political stability is crucial for food price stability in the country. Similarly evidences were documented by Lee and Park (2013) and Kornher and Kalkul (2013).

Higher monetary policy rates (interest rates) are responsible for the higher volatilities of few food commodities such as imported rice, local rice (Table 2A) and maize (Table 2B). Given that interest rate movements might impinge on commodity price movements (Frankel, 2006), the volatility or movement of interest rate can affect the volatility of commodity prices.

The effects of petrol price on volatility of food commodities were mixed-having for example, more escalating effects on imported rice, and dampening influence on volatilities of sorghum (Table 2B) and millet (Table 2C). The positive influence of petrol price on imported price volatility may be explained by the fact that rice is one of the major domestic staples that are widely consumed across many households in the countries. German and Ott (2014) noted that

both petrol price movements and the volatility of petrol prices can affect the volatility of commodity prices.

Volatile exchange rates (Naira to Dollars) has no significant relationship with price volatility of grains except that of millet on which it has calming effects. The USD exchange rate plays an important role for countries with import dependency because most contracts in international commodity trade are settled in USD (Kornher and Khalkhul, 2013). Exchange rate fluctuation (appreciation/depreciation) has severe impacts on prices (Gilbert and Morgan, 2010). Depreciation of price increases to producers and consumers in Nigeria but lowers prices to consumers outside the country. In their studies, Lee and Park (2013) and German and Ott (2014) established that appreciation of exchange rate (for local currency) can substantially lower volatility of domestic price.

We found GDP growth rates to have significant effect on the volatility domestic price of imported rice, local rice, suggesting that higher economic growth rates is unlikely to substantially lower domestic food price inflation and volatility in the country. This is contrary to some previous studies (Lee and Park, 2013; Tadesse *et al.*, 2014) which reported that higher GDP growth rates can significantly reduce food price volatility. This study finds that short-term upsurges (volatility) in the general domestic food price (CFPI) in Nigeria are strongly associated with volatility of some specific domestic food prices. For example, results show that a more volatile consumer food price index (CFPI) would significantly increase volatility of maize and millet prices.

The results indicate that volatility crude oil price depresses volatility of domestic price of rice and maize. The importance of oil prices in explaining food price volatility shows that rice, maize and crude oil markets have become more interwoven. More volatility crude oil price can result in higher demand for biofuel commodities such as maize, leading to higher price of the food commodities. Ordinary, increased demand for biofuel food commodities stimulates reallocation of production resources with the attendant impacts of production and prices of biofuel and non-biofuel food commodities (Tadesse *et al.*, 2014).

Food production variability has mixed effects on domestic price volatility-having tendency to calm domestic price volatility of imported rice, and increase price volatility of maize. It is largely believed that production variability is strongly linked to more extreme weather conditions as a result of global warming and changes in input supply and variations in area

planted (Haile *et al.*, 2013). The Liner Shipping Connectivity Index (*LSCI*) which measures transaction costs of international trade is positively related to price volatility of locally produced food commodities such as sorghum and millet. At the moment, the findings would suggest that the easier it is to ship these commodities to the rest of the world (greater access to global trade), the higher their price volatilities at the domestic market (Kornher and Kalkuhl, 2013).

The dummy variable (B42011) captures volatility experience prior to the 2002/2010/11 global food crises resurgence. The coefficient associated with post 2010/2011 dummy (B42011) are positive and statistically significant for price volatilities of imported rice. This suggests that the average volatility of maize price is higher after 2010 than the preceding years.

Conclusion

The challenge associated with food price volatility is a global problem that has been of concern to policy makers over the years. This concern is as a result of its debilitating effect on some economies and their citizenry. In-depth research into volatility has been ongoing for years but little is known and has been conducted in Nigeria to give a better understanding of how trade and domestic policy variables will influence price volatility and the welfare of the citizenry of the country. Thus the study investigated the factors determining price volatility in grain markets in Nigeria. Except for imported price, global food crises has not really resulted in substantial increase in grain price volatility in Nigeria. Volatile international grain prices is unlikely to heighten domestic grain price volatility in Nigeria. However, volatile crude oil price may escalate it. Volatility in domestic price of specific grains in Nigeria are more directly linked to local/internal factors and domestic policies such as political instability, macroeconomic policy variables, and higher petrol price than external/international factors. To reduce or calm instability of grain prices in Nigeria, efforts should be made to promote political stability, ensure petrol price stability and properly control/manage trade and monetary policies such as narrow money supply, interest rates and the exchange rates, among others.

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Patterns of Domestic Price Volatility in Typical Grain Markets across the Six Geopolitical Zones in Nigeria, 2001:1 – 2016:12 (Modified Balcombe Specification)

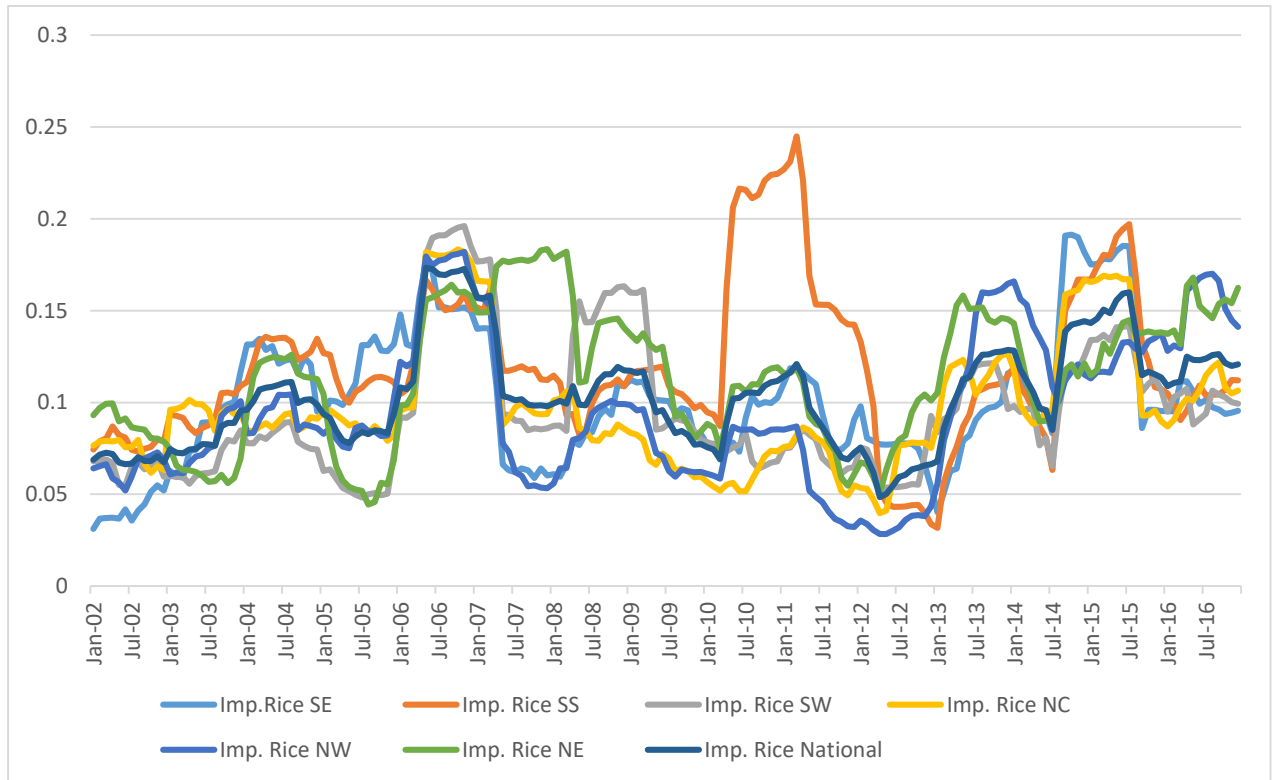


Figure 2a: Imported Rice Price Volatility (Modified Balcombe Specification)

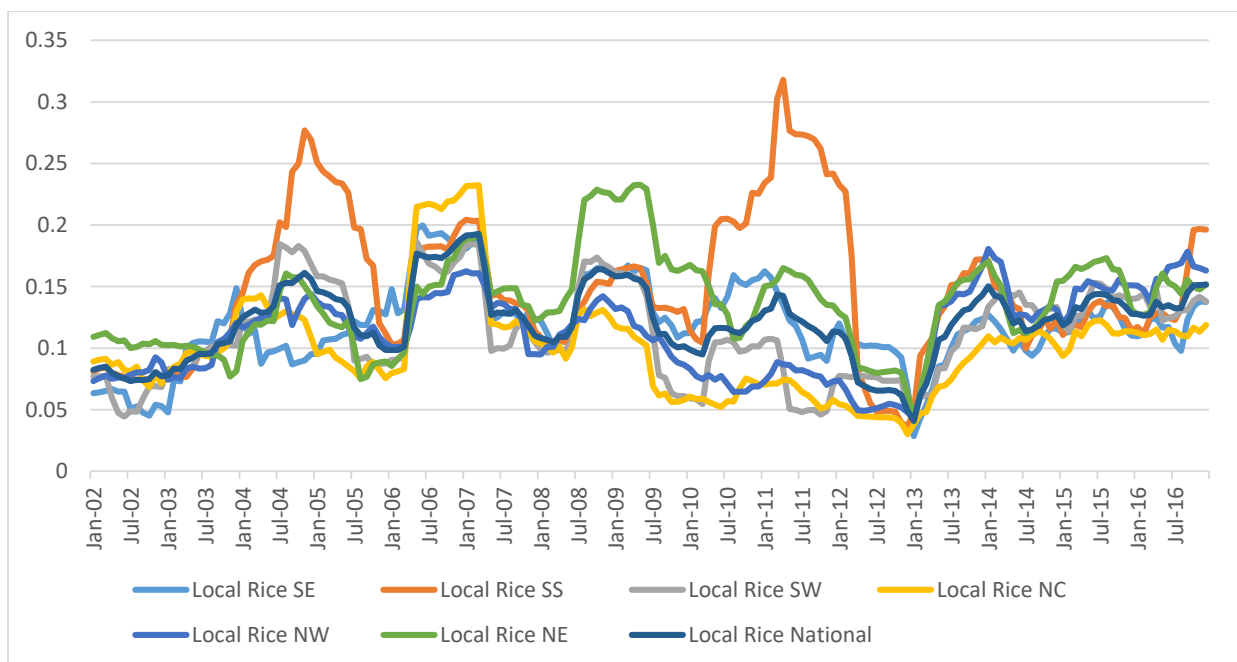


Figure 2b: Local Rice Price Volatility (Modified Balcombe Specification)

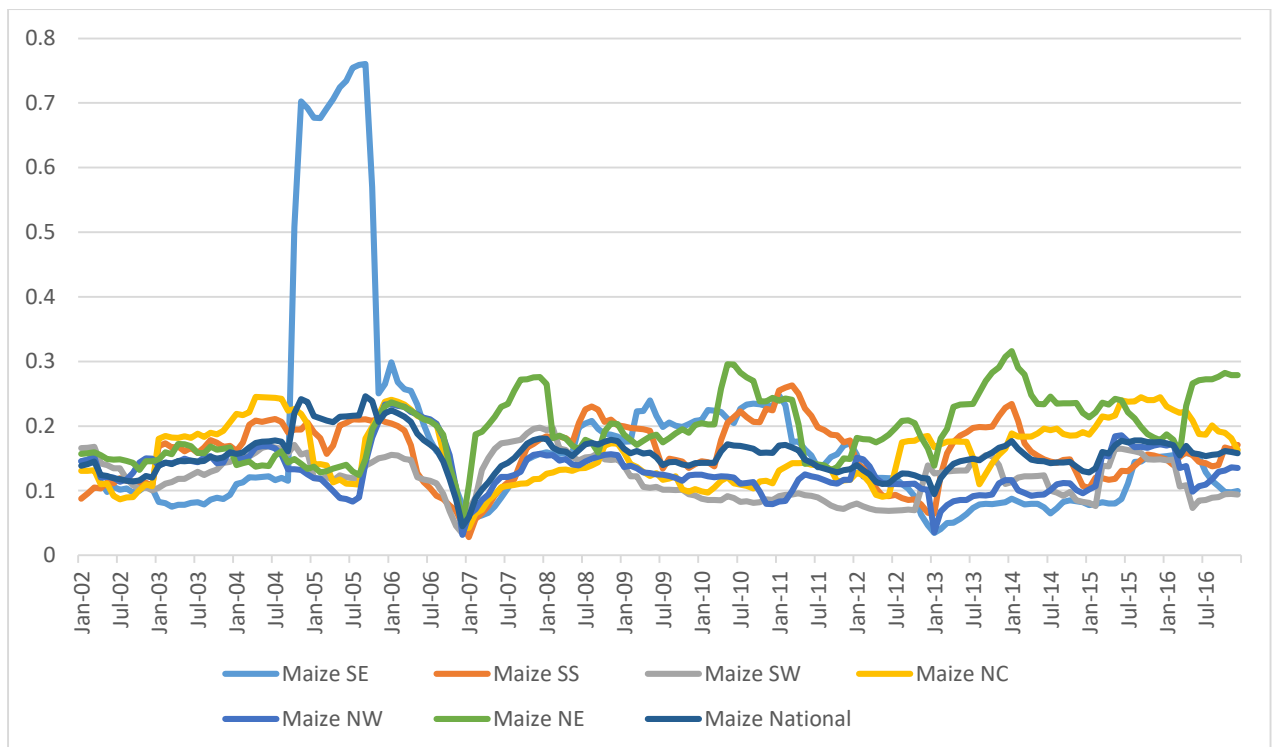


Figure 2c: Maize Price Volatility (Modified Balcombe Specification)

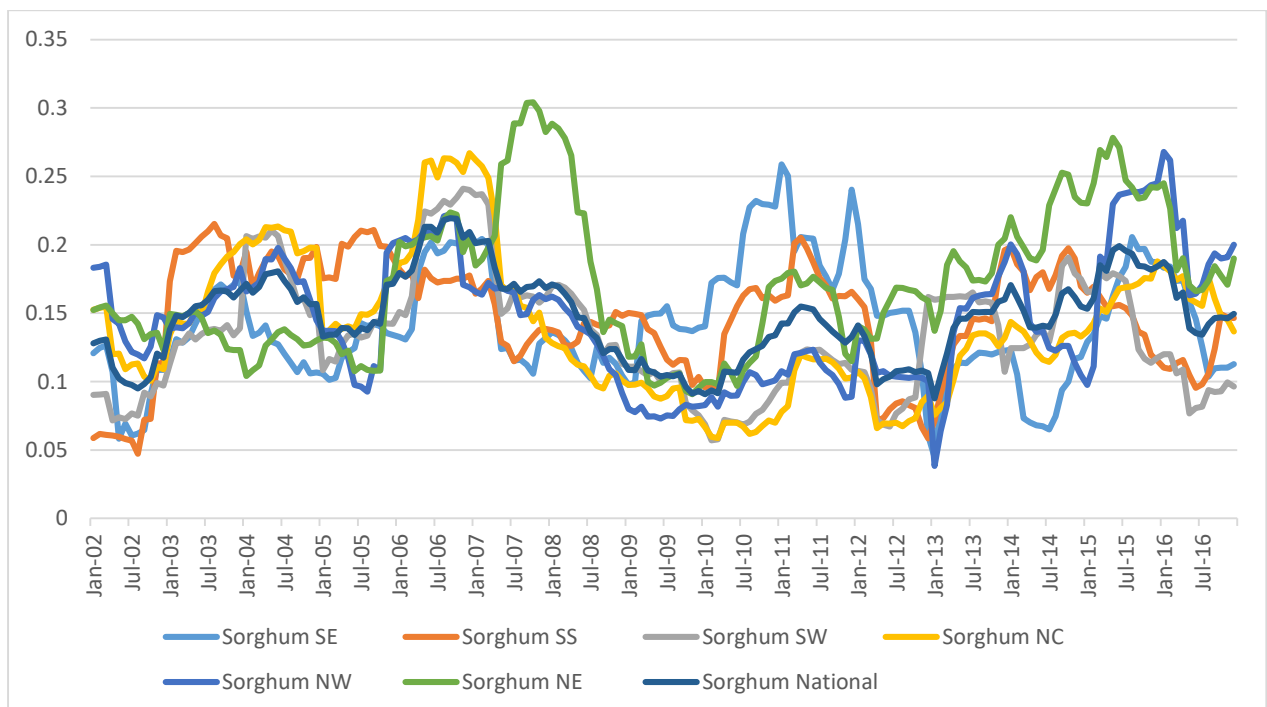


Figure 2d: Sorghum Price Volatility (Modified Balcombe Specification)

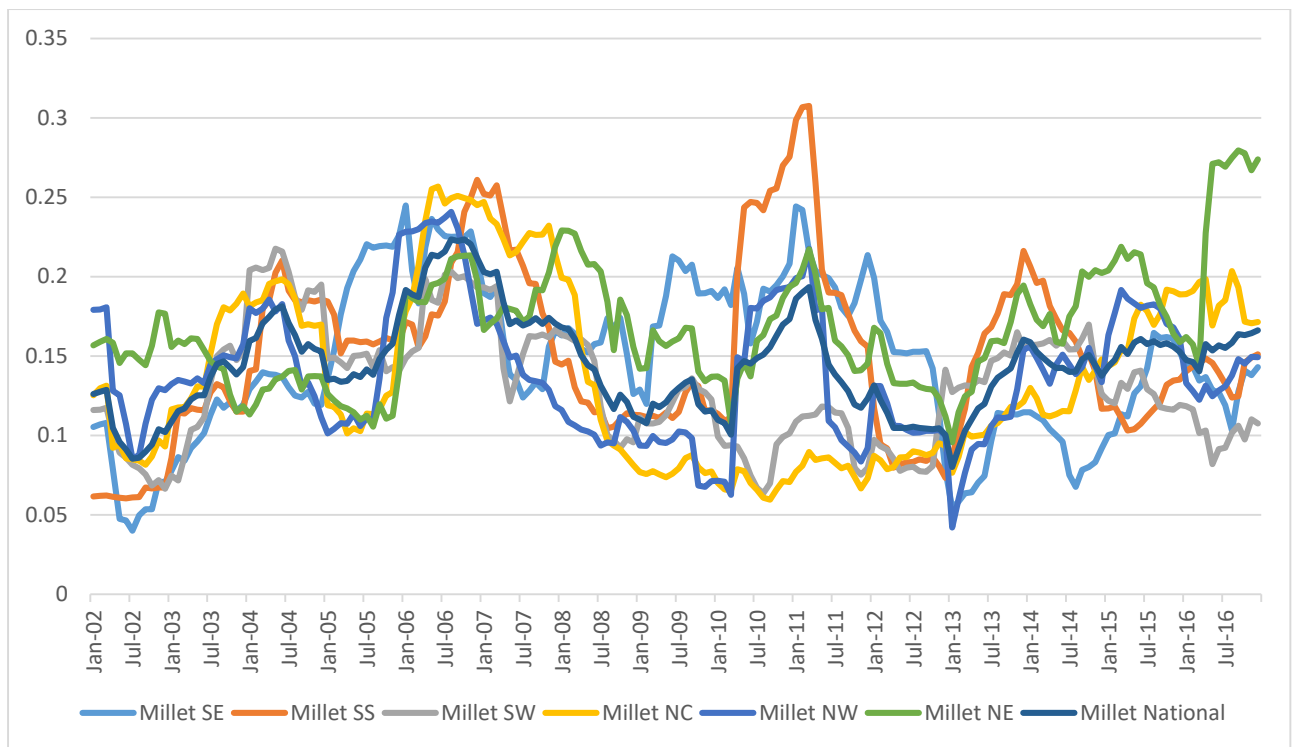


Figure 2e: Millet Price Volatility (Modified Balcombe Specification)

Table 2A: Domestic Price Volatility of Imported and Local Rice

	Imported Rice		Local Rice	
Variables	Fixed Effects model with dependent variable	Fixed Effects model with AR(1) process	Fixed Effects model with dependent variable	Fixed Effects model with AR(1) process
Lvdimpricek	0.0035 (0.28)	-	0.0062 (0.49)	-
vgricek	0.0000 (0.68)	0.0000 (0.67)	-0.0001 (-1.11)	-0.0001 (-1.24)
sturrice	0.0618*** (3.36)	0.0618*** (3.21)	-0.0106 (-0.48)	-0.0100 (-0.46)
exratek	-0.0004 (-0.13)	-0.0007 (-0.19)	-0.0010 (-0.25)	-0.0009 (-0.24)
Petrol	0.0002 3.10	0.0002*** (2.92)	-0.0001 (-0.81)	-0.0001 (-0.91)
narrow22	0.0010 (1.38)	0.0008 (1.10)	-0.0005 (-0.54)	-0.0004 (-0.57)
polistabi	-0.0984** (-2.08)	-0.0936* (-1.82)	-0.0043 (-0.07)	0.0058 (0.11)
mprates	0.0075** (2.41)	0.0073** (2.16)	0.0082** (2.18)	0.0074** (2.10)
gdpgrate	0.0058*** (2.65)	0.0060** (2.52)	0.0118*** (4.47)	0.0121*** (4.84)
volcpik	0.0981 (0.60)	0.0961 (0.55)	0.1699 (0.85)	0.1681 (0.89)
FPrdvar	-0.1926-*** (2.12)	-0.1947 ** (-1.99)	0.1239 (1.13)	0.1264 (1.21)
LSCI	0.0322 (0.54)	0.0384 (0.60)	0.0323 (0.45)	0.0282 (0.41)
voloilpk	-0.0795** (-2.45)	-0.0803** (-2.29)	0.0295 (0.75)	0.0280 (0.75)
OpenTrade	0.0009 (0.16)	-0.0003 (-0.04)	0.0091 (1.37)	0.0102 (1.38)
MFTRWPP	-0.0004 (-1.25)	-0.0004 (-1.18)	0.0005 (1.18)	0.0005 (1.31)
B42007	-0.0024 (-0.58)	-0.0020 (-0.45)	0.0027 (0.52)	0.0031 (0.65)
B2011	-0.0097* (-1.94)	-0.0089 (-1.64)	-0.0021 (-0.36)	-0.0023 (-0.39)
Constant	-0.2156 (-1.95)	-0.2048 (-1.86)	-0.0836 (-0.63)	-0.0565 (-0.42)
F-value	F(17,6355) = 2.75	F(16,6356) = 2.56	F(17,6355) = 1.87	F(16,6356) = 2.24
Prob > F	0.0001	0.0006	0.0161	0.0032
Durbin-Watson	-	1.8325	-	2.1135
Baltagi-Wu LBI	-	1.8547	-	2.1261

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ *T-values are in parenthesis*

Table 2B: Domestic Price Volatility of Maize and Sorghum in Nigeria

Variables	Maize		Sorghum	
	Fixed Effects model with dependent variable	Fixed Effects model with AR(1) process	Fixed Effects model with dependent variable	Fixed Effects model with AR(1) process
Lvdimpricek	-0.0157 (-1.19)	-	0.0001 (0.01)	-
vgricek	-0.2088** (-2.08)	-0.2247** (-2.18)	0.0318 (0.39)	0.0393 (0.48)
sturrice	-0.1085 (-1.51)	-0.1252* (-1.69)	-0.0606 (-1.02)	-0.0524 (-0.89)
exratek	-0.0042 (-0.83)	-0.0051 (-0.99)	-0.0029 (-0.66)	-0.0030 (-0.68)
Petrol	-0.0001 (-1.46)	-0.0001 (-1.46)	-0.0003*** (-3.09)	-0.0003-*** (3.17)
narrow22	-0.0002 (-0.17)	-0.0002 (-0.19)	-0.0019** (-2.03)	-0.0015* (-1.71)
polistabi	-0.1331* (-1.89)	-0.1356* (-1.87)	-0.0227 (-0.37)	-0.0290 (-0.48)
mprates	0.0110** (2.39)	0.0101** (2.14)	0.0048 (1.19)	0.0048 (1.20)
gdpgrate	0.0073** (2.25)	0.0072** (2.14)	0.0037 (1.30)	0.0037 (1.34)
volcpik	0.0770 (0.29)	0.0479 (0.18)	0.6668** (2.88)	0.6506*** (2.87)
FPrdvar	0.1485 (1.10)	0.1197 (0.86)	0.0840 (0.67)	0.0842 (0.69)
LSCI	0.0935 (0.90)	0.1133 (1.06)	0.2023** (2.22)	0.1725* (1.93)
voloilpk	0.1116** (2.16)	0.1231** (2.32)	0.0240 (0.47)	0.0215 (0.42)
OpenTrade	0.0025 (0.32)	-0.0047 (-0.50)	-0.0026 (-0.36)	0.0001 (0.02)
MFTRWPP	0.0002 (0.31)	-0.0001 (-0.18)	0.0002 (0.39)	0.0002 (0.45)
B42007	-0.0020 (-0.31)	-0.35 (-0.0023)	0.0066 (1.13)	0.0063 (1.11)
B2011	-0.56 (-0.0042)	-0.40 (-0.0031)	0.0103 (1.39)	0.0100 (1.36)
Constant	-0.2742 (-1.65)	-0.2584 (-1.56)	-0.0043 (-0.03)	-0.0154 (-0.11)
F-value	F(17,6355) = 1.92	F(16,6356) = 1.93	F(17,6355) = 1.48	F(16,6356) = 1.54
Prob > F	0.0125	0.0141	0.0902	0.0777
Durbin-Watson	-	1.9453	-	2.0517
Baltagi-Wu LBI	-	1.9553	-	2.0586

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ *T-values are in parenthesis*

Table 2C: Domestic Price Volatility of Millet Price in Nigeria

Variables	FE (Intra)	FE (AR1) Intra
Lvdmilletk	0.0105 (0.81)	-
vgmilletk	-0.0170 (-0.13)	-0.0050 (-0.04)
stumillet	-0.0241 (-0.35)	-0.0177 (-0.26)
exratek	-0.0117** (-2.28)	-0.0121** (-2.37)
petrol	-0.0004*** (-4.70)	-0.0004*** (-4.83)
narrow22	-0.0011 (-1.03)	-0.0007 (-0.69)
Polistabi	-0.1045 (-1.47)	-0.1012 (-1.45)
Mprates	0.0037 (0.79)	0.0030 (0.65)
Gdpgrate	0.0040 (1.22)	0.0034 (1.06)
Volcpik	0.9463*** (3.53)	0.9284*** (3.51)
FPrdvar	0.0874 (0.63)	0.0985 (0.72)
LSCI	0.2243** (2.14)	0.1910* (1.85)
Voloilpk	0.1474*** (2.68)	2.68*** (0.1460)
OpenTrade	-0.0053 (-0.65)	-0.0039 (0.42)
MFTRWPP	-0.0001 (-0.24)	-0.0001 (-0.15)
B42007	0.0036 (0.55)	0.0039 (0.61)
B2011	0.0209*** (2.83)	0.0211*** (2.86)
Constant	-0.1600 (-0.96)	-0.1394 (-0.84)
F(17,6355)	F(17,6355) = 4.12	F(16,6356) = 4.39
Prob > F	0.0000	0.0000
Durbin-Watson	-	2.0378
Baltagi-Wu LBI	-	2.0441

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ *T-values are in parenthesis*