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On the Analysis of Food and Oil Markets in Nigeria: What Prices Tell Us from Asymmetric and Partial Structural Change Modeling?

Umar Muhammad Gummi[1,2]*, Yang Rong[2], Utiya Bello[1], Abdulhamid Sillah Umar[3], Asiya Mu'azu[1]

[1]Sokoto State University, Sokoto, Nigeria, [2]Xi'an Shiyou University, China, [3]International Business School, Xi'an Jiaotong-Liverpool University, Suzhou, China. *Email: muhammadgummiu@gmail.com

ABSTRACT

The relationship between energy price and food price has been dominated by co-movement debate among empirical submissions. However, these are widely criticized based on economic structure and uncertain economic events. In this paper, using data spanning from January 2000 to September 2019, we applied asymmetric and partial structural change models to examine the impact of oil price on food prices in Nigeria. Results from the asymmetric model showed that positive margins in crude oil price reduce the price of food, while negative margins co-move with food price in the long-run. The story is different in the short-run, where both positive and negative changes in oil price exert positive effects on food price. Thus, margins in the oil price are a source of incentives/disincentives to stabilize food price through supply channels in Nigeria. However, results of the partial structural change regression suggest that, in isolation, oil price co-moves with food price in regimes 1 and 4 (slump in oil price), while the impact is negative during regimes 2 and 3 (stable oil price). Therefore, the paper argues that the relationship between food price and oil price depends on timely events and the structure of the economy in question, and accounting for these events (regimes) improves timely and appropriate policies on food security and price stability.

Keywords: Food Price, Oil Price, Asymmetry, Breakpoints, Partial Structural Change Model
JEL Classifications: C1, Q02, Q41

1. INTRODUCTION

Food price fluctuation is among the most significant sources of concern for food security in both developing and developed economies (FAO 2011). The global food market has witnessed episodes of price shock in the last three decades with their resulting effects on individual economic agents (farmers, producers, retailers, and consumers) and governments. The global food price shocks of 2007/2008, the 2010/2011 resurgence of food price spikes, and rising food prices in 2014 have drawn the attention of international organizations, policy analysts, and researchers on issues related to price fluctuations as well as the drivers and triggers of food price shocks. Food prices have been quite high across many countries in the last decade (von Braun and Tadesse 2012; Minot 2014; Shittu et al., 2017). Accordingly, reports and projections of the World Bank in 2012 suggested that the pattern and trend in food prices will remain the same for most of the major food items over the next decade. The food price fluctuations of the past decade have also been linked to having substantial economic costs and exerted negative welfare impacts on many households, especially the poor, smallholder traders, and female-headed households in Africa and other developing regions (FAO, 2011).

Many factors have been attributed to fluctuations in food prices in recent years including policy shocks, monetary factors, extreme weather events, demand shocks, and energy prices, especially that of oil (Tadesse et al., 2016). However, Abbott et al., (2008, 2009) identified three key factors that drive food prices in the global market, namely, excess demand, energy prices, and value of the US dollar. The authors identified these three factors to be the significant drivers of food prices in the global market. In the same vein, Saghaian (2010), Fowowe (2016), and Pal and Mitra (2017, 2018) highlighted that the price of energy is the primary driver of agricultural commodity prices around the globe. Over the last decade, the macroeconomic effects of oil price fluctuations have been at the forefront of the policy debate among economists, policymakers, and financial analysts. Among others, the food price–oil price nexus has particularly received more consideration.

Incidences of spikes in food prices are not new in agricultural markets. However, the uniqueness of the current state of agricultural markets in Nigeria is the hike in prices of not only a few selected crops but nearly all major food and feed commodities (FAO 2016). Despite the high expectations on agricultural output in most parts of the country in 2016 and the increased number of small scale farmers especially in rural areas, the effect of a rise in food price has become a source of concern. To this end, such price movements are repellent to increased agricultural productivity and tend to intensify inflationary pressures. Tadesse et al. (2016) rightly observed that "food price fluctuation increases the uncertainty faced by households, farmers and agribusiness firms. In particular, price fluctuations affect farmers' investment decisions that have serious ramifications for the growing farm debt, farm incomes and productivity."

Extensive research efforts tried to understand the behavior of oil price fluctuations over the years in both developed and developing countries, including oil-exporting countries. The relationship between oil prices and inflation is confirmed, considering the secure link between energy consumption prices and oil prices. In contrast, a negative correlation of oil prices with gross domestic product (GDP) has been confirmed by Hamilton (2012), Eltony and Al-Awadi (2001), Mork (1989), and Mork et al. (1994), among others. However, the discourse on the statistical link between oil price and food price strengthened in 2006 (Aleksandrova 2016). Several studies concluded that higher and more unstable food prices would substantially hurt the poor because food is typically a large share of expenditure for the poor (Gilbert 2010; Gilbert and Morgan 2010; Alghalith 2010; Nazlioglu et al., 2013; Minot 2014; Abdlaziz et al., 2016). Other studies such as Baffes (2007), Harri and Hudson (2009), Baffes (2010), Chang and Su (2010), Alom et al. (2013), Du et al. (2011), and Bellemere (2015) identified the price volatility in individual food commodities. The findings of these studies were inconsistent even for individual commodities and the transmission mechanisms varied with time.

The rising price of food in recent years has raised the question of whether oil price (market) has any explanatory power on the recent upward trend in agricultural food prices (Nazlioglu et al.,

2013). The food–energy nexus has become a controversial issue, with many researchers believing that oil price fluctuations are the main factor behind the historic shock in the agricultural market (see Abbott et al., 2008; Yang et al., 2008; Collins 2008; Mitchel 2008). Nevertheless, others indicate that there is no direct linkage between oil price and agricultural commodity price (Zhang et al., 2010; Zhang et al., 2017). Nevertheless, Pieters and Swinnen (2016) opined that food price fluctuations could have a devastating impact on real purchasing power, even if they do not directly affect nominal income per se. Previous studies established a statistical link between oil price and food price. The positive impact of oil price on food price was recorded empirically by Nazlioglu and Soytas (2012), Pieters and Swinnen (2016), and Zmami and Ben-Salha (2019), amongst others. Conversely, empirical evidence on the negative relationship between oil price and food price was reported by Kargbo (2005) and Davidson et al. (2012).

The statistical link between oil price and food price strengthened in 2006 with convergent and divergent views. A significant number of empirical studies emphasized the symmetric (linear) relationship between oil and agricultural commodity markets. Nevertheless, others modeled oil price asymmetries and its potential impact on food prices (Ibrahim 2015; Abdl-Aziz et al., 2016; Coronado et al., 2018; Paris 2018; Zmami and Ben-Salha 2019). However, most of these studies failed to account for structural changes (breakpoints) in the series for oil and food prices which consequently left some questions unanswered.

Abdl-Aziz et al. (2016) and Zmami and Ben-Salha (2019) utilized an asymmetric approach to ascertain the impact of oil price on food price. However, their specifications fell short of some key macroeconomic factors that are critical to food price fluctuations (such as extreme weather events, supply shocks, production index, food policy). Not accounting for such factors makes it difficult to isolate the actual impact of oil prices on food prices either at global or domestic markets. Nevertheless, studies on the impact of oil price fluctuations on food price in Nigeria are very scarce, and research efforts have been made to understand the behavior and relationship between the prices of oil and food in Nigeria (Udoh and Egwaikhide 2012; Ojogho and Egware 2015; Nwoko et al., 2016; Shittu et al., 2017). Despite previous in-depth analyses and empirical findings, this study contributes to the literature on Nigeria by incorporating an asymmetric (non-linear) model to differentiate the impact of an increase in oil price (positive changes) from a decrease in oil price (negative changes) as it affects food price. Consequently, the main questions that motivated and guided this research are: How does oil price influence domestic food prices in different regimes (periods) due to structural change and uncertain economic events? How different is the impact of asymmetric from symmetric oil prices on Nigeria's food market? What implication does the impact of asymmetric oil price have on Nigeria's food market? These questions need practical answers for informed decisions and policies regarding price stability and food security.

Based on the preceding, the study seeks to examine the linear and non-linear effects of oil price on food price while accounting for

structural change in the data generating process. Our approach contributes to the current literature through isolating the impact of oil price on food price in periods of boom and burst in the oil market. The rationale is to account for breaks in the data generating process (DGP). We simultaneously modeled the root causes, exogenous shocks, and endogenous shocks that drive food prices to present a comprehensive framework that isolates the impact of oil price on domestic food prices. Furthermore, we utilized asymmetric and partial structural change (PSC) models to deeply understand the relationship and behavior of food and oil markets, and for comparative analysis of the empirical findings. This is pertinent for an effective policy because more is known from different regimes than when the whole sample is examined at a point in time. Accordingly, the choice of Nigeria as a unit of analysis is not arbitrary because Nigeria is among the few countries to have witnessed sustained upward movement in food prices over the past couple of decades, despite the recorded episodes of volatility and spikes in global food prices. As one of the largest oil exporters, fluctuation in oil price is a major source of concern for the country in recent years because oil affects every sector of the economy, especially the agricultural sector. Thus, Nigeria serves as a potential laboratory to revisit the long-established debate on the food price–oil price nexus. The rest of the paper is organized as follows: Section 2 reviews the relevant literature on the subject, Section 3 presents the method and procedure employed by the study to achieve its objectives, Section 4 discusses the findings and their implications, and Section 5 presents the concluding remarks and policy suggestions.

2. LITERATURE REVIEW

2.1. Macroeconomic Impact of Food Price Fluctuations
Variations in food prices have a significant inflationary effect on the macro-economy (Braun and Tadesse 2012). A 10% increase in world food prices causes as much as a 3% increase in headline inflation (Kargbo 2005). The pass-through impact is considerably different from country to country. It depends on the country's integration with the global food market, pricing and policy strategies, and its budgetary food allocation (share). The inflationary effect of higher food prices is higher in food-importing countries than in net exporting countries, and consequently, the damage is more significant for low-income countries, which are trapped by two problems: high inflation and unemployment rates (Nazlioglu et al., 2013). This problem is stark, especially for poor urban people who live on fixed incomes (Braun and Tadesse 2012). Economic development partly suggests providing food items for the working population at an affordable price which permits nominal wages. When there is a hike in food prices, wage rates tend to rise, and higher wages reduce the level of both public and private investments, which further induce relatively additional capital investment (Yu et al., 2011).

In the short-run, the consequence of food price fluctuations on public finance and balance of payments (BOP) is reflected in the governments' policy response (Braun 2007) to stabilize prices and prevent social unrest. It is important to note that in recent years, many countries embarked on safety net programs that expended enormous government resources. In addition, many countries banned exports of food items, especially during crises. Food price volatility extended the real income gap between the rich and poor, which affected different income groups, "Whereas the income of rich net sellers increases, the income of the poor net buyers declines" (Yu et al., 2011). However, prices of commodities and other resources do not move uniformly for both low-income and high-income countries, and more often than not, wages do not adjust as fast as food prices. Thus, incomes of civil servants, semi-skilled and low-skilled workers tend to be irresponsive to variations in the price level (Braun and Tadesse 2012).

Volatile prices of agricultural commodities limit potential growth in many countries, especially those that rely heavily on agricultural commodities trading for foreign exchange earnings. The growth and development framework of these countries to a significant extent depends not only on the volume and value of earnings from the foreign exchange but also on its stability (Harri et al., 2011). Initially, one might expect a positive change in foreign exchange earnings as a result of the short-term hike in global commodity prices. There is, however, a long-term hazard if the short term price hikes extend market-induced speculative actions (Tadesse et al., 2016). Furthermore, the socio-economic cost of food price fluctuations is not limited to direct effects like hunger and malnutrition but also macroeconomic instability. This is quite evident based on the knock-on effects, especially when governments intervene against the adverse effects of price hikes through market regulations. Domestic and international actions to control food price volatility may distort the food markets and lead to misallocation of resources if the wrong antidotes are applied to regulate the markets (Braun and Tadesse 2012).

Nevertheless, following the 2007–2008 food crisis and the subsequent political unrest, many countries' food supply was negatively affected and this prompted them to embark on some urgent policies such as setting price caps, banning food exports, and increasing subsidies, although without due consideration of the long- and short-term effects of their actions (Kalkuhl et al., 2016). In the short-run, the gains from these policies may be higher than the welfare losses, but in the long-run, serious unintended effects may set in to distort the market. "Both domestic and global markets distortions can create disincentives to investment through the crowding-out effect" (Shitu et al., 2017) Moreover, when the government offensively responds to shocks, consumers will start to rely solely on government actions rather than on the workings of the market. Such actions also create government-related risks that affect traders and investors in the food market (Yu et al., 2011).

2.2. Status Analysis at Global and Domestic Markets
The historical trends of food price and oil price in the global market are closely related and follow nearly the same path. In 2008, when the oil price suddenly fell from $97 to $39, food prices also followed the same trend (correspondingly decreased), and when the price of oil went up in 2009, food prices steadily began to rise. To be more precise, oil price co-moved with inflation in general and food price in particular. In the global market, the price of major food items sharply increased between 2007 and 2008. There is a resurgence of price hikes as much during the historic 1974 food price crisis (WFP 2017). At their peaks in 2008Q2, global food price indices were

three times higher than at the beginning of the 2000s. Global food prices spiked again starting in 2010Q3. Since then the food price index of the Food and Agriculture Organization (FAO) has stayed high marginally until the emergence of a new cycle in 2015Q2 when the oil market witnessed another episode of price shock (slump) which started in the second quarter of 2014 (Figure 1).

However, the upward trend in food witnessed in recent years is influenced by some factors, whose combined effect has led to price movement (Tadesse et al., 2016). "First, cereal production fell by 3.6 per cent in 2005 and 6.9 percent in 2006 due to unfavourable weather in major producing countries. Second, low stock levels to complement food consumption. For instance, the ratio of world cereal ending stock in 2007/2008 to the trend in world cereal utilization is estimated at 18.7 per cent lowest in three decades. Many of the economic buffers that allowed countries to withstand the 2003 and 2005 oil price shocks and the initial increase in food prices of 2007 have been shattered. Third, oil prices and food prices are highly correlated. The rapid rise in petroleum prices exerted an upwards pressure on food prices; as fertilizer prices nearly tripled and transport costs doubled over the crisis period. Fourth, increased demand from the biofuel sector. Fifth, economic growth in some large developing countries is leading to changes in diet and increased demand for foodstuff"(Braun and Tadesse, 2012).

Furthermore, recent oil price fluctuation was motivated initially by demand-driven tightening of market equilibriums; but later was further fueled by a combination of supply concerns and financial factors. Market tightening is expected to persist because of a sluggish supply response. From the last quarter of 2016, demand pressures eased as global output growth slowed, owing mainly to the global market crises. However, oil prices are likely to remain volatile, arising from low stocks, limited spare capacity, supply disruptions, and uncertainty over exploiting new reserves and the development of non-oil sources (Kimberly 2017).

Nigeria's food situation became worrisome in the last decade (Figure 2), and the country occupies an important place in Africa's food markets as well as global food markets. As the largest producer of cassava in the world, the country is one of Africa's largest producer of rice, and ironically the largest importer of rice in the world (FAO, 2017). Hence, food price fluctuations in the country are likely to be transmitted to other countries in Africa and beyond. At the same time, the country is more likely to be affected by changes in regional and global food prices. This alone justifies the fact that Nigeria is a suitable laboratory for investigation on food price fluctuations.

3. METHODS

3.1. Data and Variables

The study used monthly data spanning from January 2000 to September 2019. Data on oil price (OP) and monetary policy factors (MPF) are sourced from the Statistical Database of the Central Bank of Nigeria. In contrast, data on domestic food price (DFP), global supply shock (GSS), food trade balance, and global food price (GFP) were sourced from the Food and Agriculture Organization (FAO) data portal. However, series on demand shock (DS) is sourced from the International Monetary Fund (IMF) data portal. The choice of the study period is justified by data availability on the variables of interest and the shocks in both global food and petroleum markets witnessed after the global financial crises in 2007–2008. The keen desire is to explore the upward trend (hike) in the price of food items in Nigeria which deviate from the famous co-movement debates in the empirical literature.

The variables captured in the study are defined and measured as follows:

Domestic food price (DFP): this is measured using the FAO's Food Price Index (measuring the changes in the prices of major food items in a country as utilized by Abdlaziz et al. (2016) and Olayungbo and Hassan (2016).

Oil price (OP): Brent crude oil average price per barrel measured in US $ and source from the IMF's database on the Primary Commodity Price System (PCPS). Nazlioglu and Soytas (2012), Tadesse et al. (2016), and Shittu et al. (2017) examined the food price–oil price nexus using this series.

Global food price (GFP): this is the average price of food in the global market and is measured by the FAO's global food price index capturing the changes in the price of food items as paid by consumers across the globe. Tadesse et al. (2016) and Shittu et al. (2017) stressed the potential impact of price cycles in the global market and their potential impact on the domestic market both in the short-run and long-run phenomena.

Figure 1: Trend in global oil price
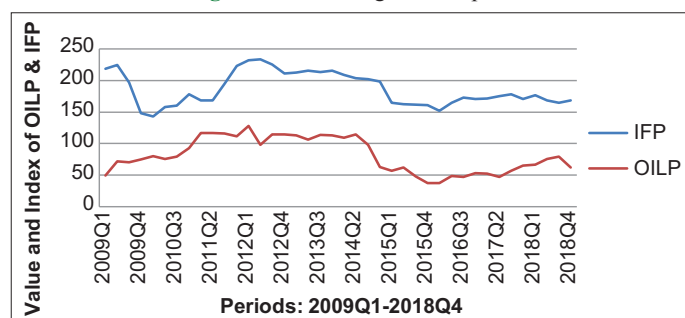
Source: modified data from International Monetary Fund's (IMF) Primary Commodity Price System (PCPS) and the Food and Agriculture Organization (FAO)

Figure 2: Trend in Nigeria's food price index
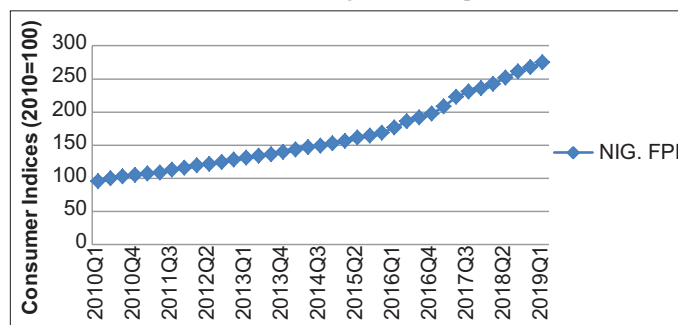
Source: modified data from the Food and Agriculture Organization of the United Nations

Global food supply shocks (GFSS): measure the fluctuations in the global market supply curve. It is measured using the FAO's GSS index reflecting the ups and downs of food supply from the global food market. The study follows Tadesse et al. (2016) to examine the potential impact of global food supply on domestic food prices, mainly when countries rely heavily on food imports to satisfy domestic demand. Nigeria's food import is quite worrisome, and any supply shocks in the global market will likely affect the price of food items in the country.

Food trade balance (FTB): this is the difference between food exports (stock of food going out of the country) and food imports (stock of food coming into the country) based on trade in the global markets. It measures the food capacity and availability of food items in the country, as in Shittu et al. (2017).

Monetary Policy Factors: these are some critical monetary aggregates that affect the behavior of farmers, agro-firms, and household demands. The study concentrates on the following:

- Exchange rate (EXCR): measures the Naira exchange rate to the US dollar in Bureau de Change (BDC) or the market rate of exchange. It is sourced from the Central Bank of Nigeria (CBN) data portal.
- Narrow money supply (M1): this includes stock of real money (coins and currency, bank deposits and easily accessible monies held in accounts). Under normal circumstances, M1 has a direct relationship with commodity prices.
- Interest rate: is referred to as the cost of borrowing. Shittu et al. (2017) measured it using the monetary policy rate (MPR) which is the official interest rate fixed by the monetary policy committee of the CBN to stabilize money supply, prices, and target inflation.

Demand shock: this is the change in demand condition of food and other commodities in an economy captured by the growth rate of per-capita GDP (GRPGDP) which measures the growth of income and demand condition in an economy, as in Kargbo (2005) and Tadesse et al. (2016).

Government policy actions (GP dummies): in its efforts to mitigate frequent food price hikes, the Government in Nigeria responded to the 2007/2008 food crisis and its resurgence in 2010/2011. Therefore, for the sake of this study, the period 2008–2011 reflects food policy regime in the form of gradual trade liberalization, subsidies to farmers, monetary expansion, and immediate release of reserved food stocks. The period 2016–2018 witnessed yet another policy regime in the agricultural sector.

Extreme weather events (EWE seasonal dummies): this is the dummy variable used to capture the seasonal influence on food prices. Fourth quarter (October to December) and first quarter (January to March) represent early harvest or surplus/post-harvest period for most food items in the country. However, the second quarter (April to June) and third quarter (July to September) represent the post-planting season and coincide with the onset of leans. Food price falls during the post-harvest season and rises in the post-planting period.

Nevertheless, the nature and properties of the variables defined exhibit an unstable trend based on the preliminary scatter plot drawn on individual variables (Figure 3). Data on domestic food price (DFP) depict a linear, smooth, and upward trend. Oil price (OP) and international food price (IFP) data follow the same path with periods of upward and downward movements in the series, which represent the volatile nature of food and oil markets. In a nutshell, the two markets respond quickly to sudden economic events. Table 1 describes the statistical properties of the series based on the probability values of the Jarque–Bera statistics; all the series are distributed normally at 5% significance level except government policy and exchange rate.

Government policy is a dummy variable and ranges from 0 to 1 with an average value of 0.52. Both GFSS and MPR exhibit true values as reflected in Figure 3. However, the nature and properties of the series, as well as their trends, create suspicion of breaks in some of them, especially oil prices, international food prices, and demand shock. Accordingly, the study resorts to the structural breaks test proposed by Perron and Vogelsang (1992) to confirm if structural breaks exist in some of the series.

3.2. Empirical Models and Specification
### 3.2.1. Linear Autoregressive Distributed Lag (ARDL) Model
The ARDL model deals with series that are stationary at the level value I (0) after taking the first difference I (1) or a combination of the two mutually. It can generate robust and reliable results even if the number of observations is relatively small, and estimation at different lag order of the dependent variable and explanatory variables is valid. Most importantly, it can generate short-run and long-run dynamics simultaneously (Pesaran et al., 2001; Kripfganz and Schneider, 2016; Zmami and Ben-Salha 2019).

The general form of the ARDL (a, b) representation is expressed as

$$\Delta y_t = \alpha + \delta y_{t-1} + \beta x_{t-1} + \sum_{i=1}^{b-1} \theta_i \Delta y_{t-1} + \sum_{i=0}^{a-1} \rho \Delta x_{t-1} + \varepsilon_t \tag{1}$$

where Δ is the first difference operator, α, δ, β, θ_i and ρ_i are parameters to be estimated, and b and a are the optimal lag length to be used in the estimation. Theoretically, the absence of co-integrating relationships between y and x is confirmed if $\delta = \beta = 0$. In order to decide whether there is a long-run equilibrium relationship among the variables, the computed F_{PSS} statistic obtained from Equation (1) is compared with the asymptotic critical value bounds of Pesaran et al. (2001). The authors provide two different sets of asymptotic critical values: a lower bound critical value and an upper bound critical value. If the F-statistic is higher than the upper bound, we reject the null hypothesis of no cointegration.

The null hypothesis of the previous model $H_0^1 = \delta = \beta = 0$ expresses that there is no long-run association among the variables while $H_0^2 = \theta = \rho = 0$ states that there is no significant short-run relationship between the variables of interest. If F-statistics is higher than the upper critical value, then the decision will be to

Figure 3: Trend in the variables
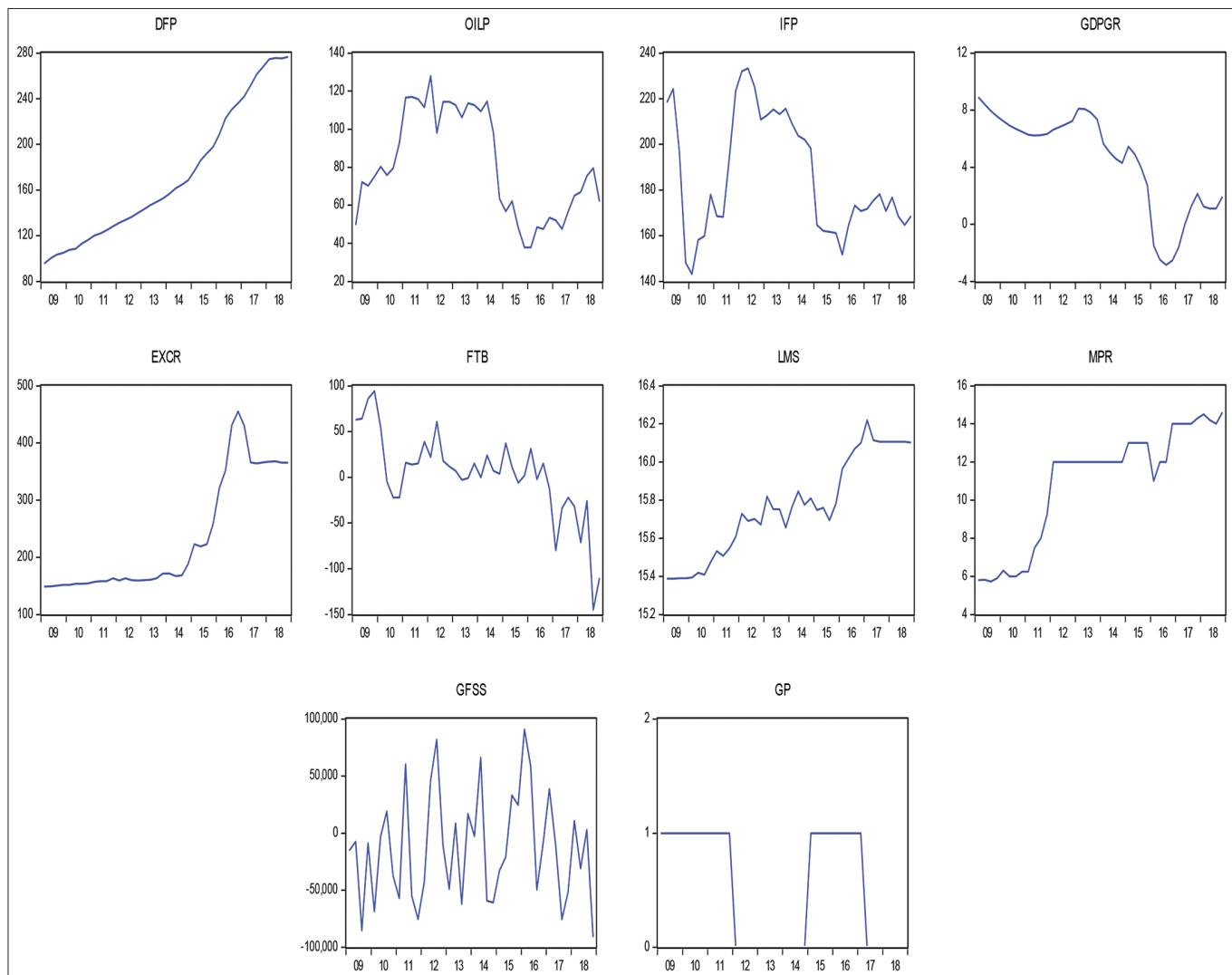
Source: modified data from FAO, IMF, and Central Bank of Nigeria (CBN)

Table 1: Statistical properties of the variables

	DFP	OILP	IFP	DS	EXCR	FTB	LMS	MPR	GFSS	GP
Mean	172.63	80.95	185.95	4.467	232.93	2.925	15.76	10.93	−12896.5	0.520
Median	154.64	75.59	176.05	5.926	167.90	7.000	15.75	12.00	−10776.0	1.000
Maximum	276.87	128.00	233.40	8.909	455.26	94.00	16.21	14.60	90909.0	1.000
Minimum	95.707	37.760	143.10	−2.843	148.60	−145.00	15.38	5.730	−91013.0	0.000
Std. Dev.	59.218	27.349	26.07	3.465	101.76	47.08	0.258	3.089	47767.4	0.503
Skewness	0.5311	0.1133	0.320	−0.781	0.879	−0.890	0.086	−0.701	0.37490	−0.105
Kurtosis	1.9061	1.5926	1.754	2.365	2.130	4.760	1.836	1.955	2.294468	1.010
Jarque-Bera	3.874	3.386	3.301	4.782	6.416	10.453	2.305	5.099	1.766	6.666
Probability	0.144	0.183	0.191	0.091	0.040	0.057	0.315	0.078	0.413	0.035
Observations	225	225	225	225	225	225	225	225	225	225

We used the natural log of the money supply. We failed to reject the null hypothesis that the variables are normally distributed based on the probability values of the Jarque–Bera normality test at a 5% level of significance. DFP = domestic food price; OILP: Oil price, IFP: International food price, DS: Demand shock, EXCR: Exchange rate, FTB: Food trade balance, LMS: Log of money supply, MPR: Monetary policy rate, GFSS: Global food supply shocks, GP: Government policy

reject the null hypothesis of no long-run relationship. At the same time, if it falls below a lower critical value, then we fail to reject the null, and if it falls within these two critical bounds, then the result is inconclusive.

3.2.2. Non-linear autoregressive distributed lag (NARDL) model

Unlike the conventional methods of estimating the relationship among economic and financial variables that assume observations to be the same (constant or symmetry) throughout the sample periods, Shin et al. (2014) developed a non-linear approach that isolates positive changes from negative changes in a series. The NARDL model proved to be suitable for analysis of series that are prone to fluctuations, especially in the short-run (Zmami and Ben-Salha 2019). Both oil and food markets witnessed a series of fluctuations in the last two decades, and the study drew its inspiration from the volatile oil market and its non-linear

effect on the food market. The authors proposed a procedure to decompose the primary explanatory variable into positive and negative changes thus;

$$x_t = x_o + x_t^+ + x_t^-$$

Where x_t^+ and x_t^- are the partial sums of positive and negative changes in x_t which are obtained using the following procedures:

$$x_t^+ = \sum_{j=1}^{t} \Delta x_j^+ = \sum_{j=1}^{t} \max(\Delta x_j, 0)$$

$$x_t^- = \sum_{j=1}^{t} \Delta x_j^- = \sum_{j=1}^{t} \max(\Delta x_j, 0)$$

The study further specifies the following non-linear asymmetric long-run equilibrium relationship taking into account the positive and negative changes in the explanatory variable;

$$y_t = \beta^+ x_t^+ + \beta^- x_t^- + u_t \tag{2}$$

$\beta^+ \beta^-$ are the asymmetric long-run parameters associated with positive and negative changes in x_t oil price, respectively. Combining Equations (2) and (3), we obtain the following NARDL (n, m) model:

$$\Delta y_t = \alpha + \delta y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \sum_{i=1}^{n-1} \varphi_i \Delta y_{t-1} +$$

$$\sum_{i=1}^{m-1} (\rho_i^+ \Delta x_{t-1}^+ + \rho_i^- \Delta x_{t-1}^-) + \varepsilon_t \tag{3}$$

Where θ^+ and θ^- represent the asymmetrically distributed lag parameters, $\beta^+ = \dfrac{\theta^+}{\delta}$ and $\beta^- = \dfrac{\theta^-}{\delta}$ are the related asymmetric long-run parameters.

The null hypothesis for the non-linear model is specified as

$$H_0^1 = \delta = \theta^+ = \theta^- = 0 \text{ (For long-run coefficients)}$$

$$H_0^2 = \varphi = \rho^+ = \rho^- = 0 \text{ (For short-run coefficients)}$$

Following Shin et al. (2014), Equation (4) can be written in the following error correction form:

$$\Delta y_t = \rho y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \sum_{j=1}^{n-1} \gamma_j \Delta y_{t-1} +$$

$$\sum_{j=0}^{m-1} (\varphi_j^+ \Delta x_{t-j}^+ + \varphi_j^- \Delta x_{t-j}^-) + \varepsilon_t \tag{4}$$

$$= \rho \xi_{t-1} + \sum_{j=1}^{n-1} \gamma_j \Delta y_{t-1} + \sum_{j=0}^{m-1} (\varphi_j^+ \Delta x_{t-j}^+ + \varphi_j^- \Delta x_{t-j}^-) + \varepsilon_t$$

where $\rho = \sum_{j=1}^{n} \varphi_j - 1$, $\gamma_j = -\sum_{i=j+1}^{p} \varphi_i$ for

$$j = 1, \ldots, p-1, \theta^+ = \sum_{j=0}^{n} \theta_j^+, \theta^- = \sum_{j=0}^{n} \theta_j^-$$

$$\varphi_0^+ = \theta_0^+, \varphi_j^+ = -\sum_{i=j+1}^{m} \theta_j^+ \text{ For } j=1,\ldots,q-1$$

$$\varphi_0^- = \theta_0^-, \varphi_j^- = -\sum_{i=j+1}^{m} \theta_j^- \text{ For } j=1,\ldots,q-1$$

$\xi_t = y_t - \beta^+ x^+ - \beta^- x^-$ is the non-linear error correction term (ECT). Furthermore, Shin et al. (2014) re-arranged Equation (5) to combine some of the properties of the fully modified ordinary least squares (FMOLS) and ARDL dynamic framework to arrive at the following error correction model (ECM):

$$\Delta y_t = \rho \xi_{t-1} + \sum_{j=1}^{n-1} \gamma_j \Delta y_{t-1} + \sum_{j=0}^{m-1} (\pi_j^+ \Delta x_{t-j}^+ + \pi_j^- \Delta x_{t-j}^-) + e_t \tag{5}$$

Three alternative specifications are possibly identified in Equation (6). Firstly, dynamic short-run asymmetries can be analyzed in the response of food price to oil price fluctuations by implicitly imposing the long-run symmetry restrictions $\theta^+ = \theta^- = \theta$. Second, an asymmetric long-run relation can be examined by imposing short-run symmetry restriction ($\pi_i^+ = \pi_i^-$, for all $i = 0, \ldots, m-1$). Lastly, when the analysis assumes both symmetric short-run and long-run adjustment, Equation (1) represents the most restrictive specification (Shin et al. 2014; Bayramoglu and Yildirim 2017; Zmami and Ben-Salha 2019).

3.2.3. Partial structural change model

The methodology proposed by Bai and Perron (1998, 2003) describes the general specifications and treatments of issues where multiple breaks occur both in the coefficients and the error variances at possibly different periods. The main framework can be explained by the following multiple linear regressions with m breaks or $m+1$ regime in the conditional mean equation:

$$y_t = x_t' \beta + z_t' \delta_j + u_t, \ t = T_{j-1}^c + 1, \ldots, T_j^c \tag{6}$$

for $j = 1, \ldots, m+1$. Where y_t is the observed dependent variable at period t, both $x_t (p \times 1)$ and $z_t (q \times 1)$ are vectors of covariates, β and $\delta_j (j = 1, \ldots, m+1)$ are corresponding vectors of coefficients. The breakpoints or dates $(T_1^c, \ldots, T_m^c)$ are treated as unknown explicitly. The purpose is to estimate the unknown coefficients together with breakpoints when T observations on (y_t, x_t, z_t) are given. This is what Perron and Qu (2006) referred to as the 'partial structural change model' since the parameter β is not subject to shift and is estimated using the entire sample.

However, Perron and Yamamoto (2015) confirmed the possibility of merely estimating the break dates and tested for structural change using the usual ordinary least squares (OLS) framework directly. They deviated from the instrumental variable (IV) method

formulated by Bai and Perron (1998) as modified by Perron and Qu (2006). The idea is quite simple yet convincing because except for extreme or knife-edge case, changes in the exact parameters of the model imply a change in the probability limits of the OLS parameter estimates, which is equivalent in the leading case of regressors and errors that have a homogeneous distribution across segments. In addition, one can reformulate the model with the probability limits as the necessary parameters in a way that the regressors and errors are contemporaneously uncorrelated (Perron and Yamamoto 2015).

More significantly, the proposed OLS framework involves the original regressors, while the IV framework involves the projected regressors based on the original regressors and space spanned by the instruments. The authors further implied that "the generated regressors in the IV procedure have less quadratic variation than the original regressors. Hence, in most cases, a given change in the true parameters will cause a larger change in the conditional mean of the dependent variable in the OLS framework compared to the corresponding change in an IV framework". Accordingly, OLS conveys consistent estimates of the breakpoints and tests with the normal limit distributions and also improves the efficiency of the estimates and the power of the tests in most cases. The hypothesis testing problems as proposed by Perron and Yamamoto (2015) are specified based on the following:

- $H_0 : \langle m = n = 0 \rangle$ versus $H_1 : \langle m = 0, n = n_a \rangle$

- $H_0 : \langle m = m_a, n = 0 \rangle$ versus $H_1 : \langle m = m_a, n = n_a \rangle$

where m_a and n_a are positive numbers chosen a priori, n is the number of observations, and the null hypothesis presupposes that there is no significant relationship between the variables given the number of observations and breakpoints in the series while the alternative hypothesis suggests a significant relationship.

The study adopts this procedure to account for structural breaks in the series, especially the critical variables of interest (food price and oil price). Food and oil markets witnessed fluctuations within the period covered, and this is confirmed by the Perron–Vogelsang (PV) unit root test as proposed by Perron and Vogelsang (1992) for structural breaks.

4. RESULTS AND DISCUSSION

4.1. Unit root test
The empirical analysis begins with a unit root test to ensure that the series is stationary at the level or after taking the first difference to validate the use of the ARDL model estimation. The results are presented in Table 2.

Results of the augmented Dickey–Fuller (ADF) unit root tests show that none of the series is stationary at level except GFSS and EWE, but all the series were stationary after taking the first differences. In the same vein, results from Perron–Vogelsang (1992) structural break unit root tests suggest that domestic

food price (DFP), international food price (IFP), exchange rate, monetary policy rate, and global supply shock are stationary at level. The rest of the series are stationary after we measured their first differences. Breaks in data occurred in 2014 for DFP, OP, and IFP, which signaled to crisis episodes in the oil market that snowballed to the global and domestic food markets. The reasons are not far-fetched from the sudden fall in oil price due to demand shock, the debt crisis in the European Union (EU), and other geopolitical factors (Aleksandrova 2016).

Moreover, for oil-exporting countries like Nigeria, it is terrible news to hear because the revenue shortfall may easily manifest into a low investment, production, supply, and price instability. On the contrary, it is a cost-saving advantage for most of the oil-importing countries because more often than not, oil is used as input in the production process. To this end, a sudden change in the price of oil is likely to cause variation in food prices at both domestic and international markets based on different phenomena.

From this view, evidence of structural breaks was confirmed and justified based on real economic situations that affect the food and oil markets. In a volatile macroeconomic environment, events occur without clear signals, especially in these two markets with a long history of volatility and spike in both output and price. Therefore, the use of an appropriate model to accommodate the identified breaks is paramount. Before then, the study measured the symmetric and asymmetric impact of oil price on food prices using the LARDL and NARDL models, respectively.

4.2. ARDL and NARDL Results
The study discusses the findings from the ARDL and NARDL estimation simultaneously for simplicity and to concisely compare and reflect the dynamics of the regressors on the outcome variable in the models. Table 3 presents a summary of results from the ARDL model, while the results of the NARDL model are presented in Table 4. The study found evidence of cointegration among the series based on the bound test significant F-statistics values of 21.23 and 15.7071 for ARDL and NARDL, respectively. Results of the dynamic long-run and short-run coefficients show that the increase in a crude price reduces the price of food, while decreases in the price of oil co-move with food prices in the long-run. The story is different in the short-run, where both positive and negative changes in oil price impacted food prices positively in Nigeria. The result implies that oil was the primary source of revenue for the country, and an increase in its price in the global market raised the value of oil revenues (through foreign exchange earnings). Further increases in the level of income, expenditure on food production and imports caused a reduction in the price of food due to a supply shift.

However, a 1% change in positive oil price, decreases food price by 0.1% in the long-run and increases food price by almost the same margin in the short-run, while negative changes in oil price co-move with food price by 0.21% and 0.07% in the long-run and short-run, respectively. These mixed results are peculiar only to some extents and economic structure, because the

Table 2: Results of unit root tests

Variables	ADF		PV			
	Level	1st Dif.	Level	Break Date	1st Dif.	Break Date
DFP	−3.04	−3.06**	−5.28**	Jan. 2014	−6.17***	2015M10
OP	−2.40	−6.14***	−4.67	Oct. 2014	−7.47***	Apr. 2014
IFP	−1.84	−4.27***	−5.73**	Apr. 2011	−5.19**	Mar. 2014
DS	−2.47	−3.40**	−4.69*	Nov. 2015	−6.11***	Jan. 2016
EXCR	−2.42	−3.47**	−5.45***	Sept. 2015	−6.42***	Mar. 2016
LMS	−2.72	−6.74***	−3.95	Nov. 2014	−7.36***	Jan. 2017
MPR	−1.63	−5.77***	−5.63***	Jun. 2011	−7.67***	Jul. 2012
GFSS	−5.22**	−6.02***	−5.76***	Mar. 2017	−6.64***	Dec. 2012
FTB	−3.34	−8.58***	−4.44	Feb. 2018	−9.09***	Aug. 2018
GP	−1.86	−5.97***	−4.73	Apr. 2014	−7.22***	Jan. 2015
EWE	−6.51**	−16.2***	−5.85**	Apr. 2017	−5.60***	Feb. 2018

ADF and PV are the augmented Dickey–Fuller test and Perron–Vogelsang (1992) unit root with structural breaks test, respectively. The optimal lag length is determined using the Akaike lag length selection criteria. *, **, and *** denote the rejection of the null hypothesis at 10%, 5%, and 1% significance levels, respectively

Table 3: The autoregressive distributed lag (ARDL) estimation results

Variables	Coefficients	t-Statistic	p-value
Dependent Variable: ΔDFP			
Long-run dynamics			
OP_{t-1}	−0.1244***	−3.6782	0.0078
IFP_{t-1}	0.0655***	2.0403	0.0014
DS_{t-1}	1.1953**	6.9796	0.0001
$EXCR_{t-1}$	−0.0581***	−3.7111	0.0013
LMS_{t-1}	7.5159	0.9749	0.3407
MPR_{t-1}	−0.0679	−0.1617	0.8734
$GFSS_{t-1}$	0.0139	0.9600	0.3491
FTB_{t-1}	−0.5982*	−1.8419	0.0811
GP_{t-1}	−0.0468**	−2.6891	0.0145
EWE_{t-1}	1.5095*	2.1349	0.0460
Short-run dynamics			
ΔOP_{t-1}	−0.5377***	−3.5580	0.0024
ΔIFP_{t-1}	0.0519*	1.9919	0.0627
ΔDS_{t-1}	0.6290*	1.9078	0.0734
$\Delta EXCR_{t-1}$	−0.0569***	−3.2391	0.0048
ΔLMS_{t-1}	10.7646**	2.3142	0.0334
ΔMPR_{t-1}	0.0466	0.1295	0.8985
$\Delta GFSS_{t-1}$	0.00012**	2.8821	0.0103
ΔFTB_{t-1}	−0.0240***	3.1352	0.0060
ΔGP_{t-1}	2.7613*	2.6705	0.0161
ΔEWE_{t-1}	−0.1226	−0.2951	0.7715
ECM_{t-1}	−0.0461***	−8.1657	0.0000

Co-integration test statistics F_{PSS} = 21.23 ***. F_{PSS} denotes the F-statistic proposed by Pesaran et al. (2001). *,**, and *** denote the statistical significance at 10%, 5% and 1% levels, respectively

Table 4: The non-linear autoregressive distributed lag (NARDL) estimation results

Variables	Coefficients	t-Statistics	p-value
Dependent Variable: ΔDFP			
Long-run dynamics			
OP^{+}_{t-1}	−0.1025***	−5.7035	0.0010
OP^{-}_{t-1}	0.2178***	3.3430	0.0048
IFP_{t-1}	0.1025**	2.3883	0.0316
DS_{t-1}	1.0080**	0.5150	0.6819
$EXCR_{t-1}$	−0.0584*	−2.0104	0.0641
LMS_{t-1}	5.5911	0.5099	0.6180
MPR_{t-1}	0.2271	0.7115	0.4948
$GFSS_{t-1}$	0.00012***	3.6940	0.0050
FTB_{t-1}	−0.1847***	−3.7152	0.0023
GP_{t-1}	−0.7999	−0.3216	0.7525
EWE_{t-1}	0.1739	0.1516	0.8883
Short-run dynamics			
ΔOP^{+}_{t-1}	0.1238***	3.5875	0.0059
ΔOP^{-}_{t-1}	0.0732***	4.7252	0.0011
ΔIFP_{t-1}	0.0651***	2.8832	0.0181
ΔDS_{t-1}	0.6372**	2.2987	0.0471
$\Delta EXCR_{t-1}$	−0.0712*	−2.0446	0.0602
ΔLMS_{t-1}	17.5944***	4.1657	0.0024
ΔMPR_{t-1}	0.0304***	4.5416	0.0014
$\Delta GFSS_{t-1}$	0.00031	0.1385	0.8918
ΔFTB_{t-1}	0.0245***	3.4713	0.0037
ΔGP_{t-1}	2.9536***	3.4095	0.0078
ΔEWE_{t-1}	−0.0732***	−4.5416	0.0014
ECM_{t-1}	−0.0349***	−10.2566	0.0000

Co-integration test statistics F_{PSS} = 15.7071 ***. F_{PSS} denotes the F-statistic proposed by Pesaran et al. (2001). *, **, and *** denote the statistical significance at 10%, 5%, and 1% levels, respectively

classical agricultural market often exhibits a fixed supply curve (perfectly inelastic supply curve) in the short-run. No matter the market expectations, food supply can only be increased through available stocks saved in the warehouse. If the supply still failed to accommodate the rising demand for food, oil price may become less significant to explain the behavior of food price in the short-run. In Nigeria, positive changes in oil prices represent an income allowance in the form of resource rents. The rising level of income is a fertile ground for increasing levels of investment, agricultural production, and food supply, which further stabilize food price marginally in the country.

The short-run co-movement result is in line with Zmami and Ben-Salha (2019), Tadesse et al. (2016), Abdlaziz et al. (2016),

and Alghalith (2010) who found oil price to be among the key drivers of food price in the short-run. However, long-run results were peculiar and contradicted the famous views of the positive relationship between oil price and food price (see Gilbert 2010; Gilbert and Morgan 2010; Alghalith 2010; von Braun and Tadesse 2012; Nazlioglu et al. 2013; Minot 2014). Though most of the studies used the symmetric approach without isolating positive changes in oil prices from negative changes, this alone can justify the discrepancies in the results not to talk of the influence of economic structure and business cycles.

International food price exerts a positive impact on domestic food prices by 0.06% and 0.05% margins in the long-run and short-run,

respectively. It is due to the country's heavy reliance on food imports from the international food markets (Shittu et al. 2017) and the potential spillover effects from international to domestic agricultural commodity markets especially during crisis episodes (Tadesse et al. 2016). The influence of the US dollar exchange rate on Nigeria's food price is inverse and significant both in the short-run and long-run. Appreciation of the US dollar raises commodity prices in the global market because the US dollar is considered as vehicle currency generally accepted for international exchanges (Harri et al. 2011). Nevertheless, when domestic currency strengthens over the dollar, the story may change as extra income may be available for the country to purchase the same amount of commodities at a lower cost. It may lead to a stable supply and moderate price of food items in the country.

However, demand shock drives the domestic food price higher at least in the short-run with a 0.68% margin, which confirms the conventional axiom that 'the higher the demand, the higher the price ceteris paribus', as well as the empirical submissions of Kargbo (2005), Olayungbo and Hassan (2016), and Tadesse et al. (2016), among others. An increasing food demand in the country, which on many occasions exceeds food supply, provides a fertile ground for food price hikes. Supply shock in the global food market is also another source of concern both in the symmetric and asymmetric estimations. In times of crisis, food supply management is a critical policy tool to reduce the negative impact of the crises because supply shortfalls increase the food supply–demand gap. Ultimately, it affects the price of food items in both domestic and international markets. As food trade balance increases, food prices tend to decrease because the domestic food supply is augmented. This is evident from both the LARDL and NARDL results in Tables 3 and 4, respectively. However, there is a slight deviation in the short-run dynamics of the NARDL estimation, where there is an inverse relationship between food trade balance and domestic food price. It is partly due to the economic structure (rigidity) and cycles in food production during the period covered.

Furthermore, the error correction term (ECT) in both the LARDL and NARDL models is significant at 1% level confirming evidence of adjustment mechanism from short-run distortions to long-run stability (equilibrium) in the models. In the linear model, distortions caused due to a 10% change in oil price were adjusted automatically towards a long-run equilibrium (stability) at a speed of 0.46% every month. At the same time, for the NARDL, the

rate of adjustment in the system was 0.34% due to positive and negative changes in oil price.

4.3. Results of the Partial Structural Change Model

To further confirm the empirical link between food price and oil price in Nigeria, the study utilizes the partial structural change model that accounts for multiple structural breaks and isolates the impact of oil price on domestic food price at different regimes. It is quite significant as the relationship may differ due to uncertain events that transmitted from within or outside the system. The data generating process is therefore affected by these uncertainties leading to breaks and creating regimes overtime. Accordingly, the study concentrates on the critical variables in this model to examine the potential impact of oil price on domestic food prices in Nigeria at different breaks and regimes. Logically, the study chooses variables that recorded multiple breaks in the DGP based on the global information criteria and the maximum number of breaks included (Perron and Yamamoto 2015).

Results of the regression identified four potential breaks in the series: June 2003, March 2008, July 2011 and October 2014. The break in 2003 corresponds to the global food market crises as a result of supply shocks that led to price hikes. These crises trickle down to most of the domestic markets as the demand for food commodities almost doubled and widened the existing gap between the supply of food and the demand for it. The 2008 global economic and financial crisis occupies a crucial phase in the history of the global economy and without doubt, affected all commodity markets such as the food and oil markets. Therefore, the identified breakpoint in 2008 is not a surprise considering the scope and impact of the crisis on both domestic and global markets that led to a downward trend in economic activities and slowing down of the financial markets and employment of resources as well as production capacity and low return on investments. Both food and oil markets witnessed a price spike during the crisis, while prices exhibited a downward trend in the international food market. However, the story was different in some domestic markets like Nigeria.

In Table 5, oil price co-moved with food price in regimes 1 and 4 while the impact was negative during regimes 2 and 3. It shows that in isolation, the relationship between the food and oil market is clearly explained than when considering the whole sample (series) during analysis. However, the asymmetric result on the food price and oil price nexus in Nigeria was also confirmed by

Table 5: Results of the partial structural change model (PSCM)

Variables	Regime 1	Regime 2	Regime 3	Regime 4	Regime 5
Dependent Var. DFP					
C	7.1373***	28.0283***	23.8433***	11.9542***	19.9489
	(3.6657)	(6.4663)	(4.9592)	(4.7844)	(1.2901)
OP	0.3787***	−0.1896*	−0.0818*	1.0790***	0.7342
	(5.7581)	(−1.8799)	(−1.7364)	(3.0036)	(1.5333)
IFP	0.0180	−0.5672***	−0.3850***	0.1121	−0.0537
	(0.3985)	(−4.9958)	(−7.7683)	(0.4885)	(−0.0718
Regimes Duration	Mar. 2003–Jun. 2006	Nov. 2006–Feb. 2011	Jul. 2011–Apr. 2014	Jul. 2014–Mar. 2017	Jun. 2017–Jul. 2019
N	50	56	33	44	35

Adj. R^2 = 0.8123. F-stat. = 40.2470 ***. The results are based on global information criteria and Newey and West (1987) procedure. The procedure produced heteroskedasticity and autocorrelation consistent standard errors that correct for both heteroskedasticity and autocorrelation. * and *** represent levels of statistical significance at 10% and 1%, respectively

the PSC regression result. When the oil price increases steadily, food prices tend to marginally decrease as depicted in regime 2 and 3 with 0.18% and 0.08% fall in price, respectively. Inversely, when oil price exhibits a downward trend in the global market, food prices respond with a positive margin of about 0.37% and 1.07% as in regimes 1 and 4, respectively. Moreover, international food prices impacted positively on domestic food price in regimes 1 and 4, and inversely impacted on food price in regimes 2 and 3. To be more precise, domestic food prices co-move with international food prices, therefore, confirming the spillover effect from the international food market to domestic food markets.

From this view, the reason analysis of the findings in different regimes is that, over time, economic events shape the direction of the link between food and oil markets. These events simply represent periods of stable and rising oil prices (regimes 2 and 3) and periods of the slump in the oil market (regimes 1 and 4). So, for Nigeria, a stable oil market provides incentives to earn marginal revenues from the oil trade, which adds up to the country's national output (income) ceteris paribus. It further raises the country's capacity to invest in productive sectors, especially agriculture, and import food commodities that are in short supply, thus aligning demand for and supply of food at reasonable and stable prices. In a nutshell, oil prices inversely impact food prices in Nigeria through the supply channels (food production and imports) when the price of oil is stable marginally in the global market. Moreover, regimes 1 and 4 signal to the fact that the country's economy slumped when the oil market bursts, and consequently led to the revenue shortfall, disinvestment, low output and productivity from various sectors including agriculture. These episodes transcend into food supply shock and imbalances between demand, supply, and price of food items in the country.

Implicitly, the empirical results uncovered mixed outcomes on the link between food and oil markets. For Nigeria, the asymmetric model provides us with ample evidence that the relationship between oil price and food price provides more explanation in isolation than when series are assumed to be constant throughout the sampled period. Both short-run and long-run dynamics suggest that positive changes (increase) in oil price are an incentive for Nigeria to stabilize food price through supply channels. In contrast, negative changes (decrease) in oil price are a disincentive for the country in the form of a revenue shortfall, reduction in public expenditure and investment in agriculture, leading to low productivity and output, hence, food supply shocks and worsening price hikes.

5. CONCLUSIONS

The co-movement debates on food price–oil price nexus have received more attention among researchers over the past decade but were lately criticized due to different economic structures and uncertain economic events. Using sub-samples and isolated data from Nigeria, this paper uncovers yet another important conclusion due to uncertain economic events that cause breaks in the data. These events are not new in both markets, and when they cause a boom in the oil market, food prices adjust towards equilibrium because of the rising economic capacity in the country. Conversely,

when these events cause a slump in the oil market, food price often fluctuates and diverges from the market equilibrium through the supply channels. Accordingly, the transmission mechanism and effect of the international food market on the domestic market signals to the heavy reliance of the domestic food market on the global market.

However, the challenges of food price fluctuations are more of a short-run and long-run supply phenomenon. Though the demand side of the spectrum is also important, the supply side of the spectrum is more prone to shocks when it comes to fluctuations in the oil market.

From this view, in addition to the management of monetary and exchange rates, limiting food production variability and spillovers from international markets, this paper suggests a commitment to raise the resilience of all stakeholders in the food market to handle price fluctuations. Policymakers need to alter the supply and demand sides of the food equation. On the supply side, supporting contract farming and price insurance mechanisms will increase the supply of food. When the oil market is booming, the available stock of food needs to be increased to complement supply shortages during the crisis. While on the demand side, consumer orientation and persuasion of the importance of locally produced agricultural commodities will promote incentives for farmers to produce more output and maximize their return on investment. This will go a long way to checkmate the heavy reliance on imported food items that worsened Nigeria's food price hike.

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