Abstract

This paper investigates the (a)symmetric response of inflation in Nigeria to the boom-and-bust cycle of oil price in the framework of the linear autoregressive distributed lag (ARDL) and non-linear ARDL models respectively using monthly data from 1995M1 to 2019M12. Both models are estimated taking into consideration the possibility of structural breaks and trends in the data series. For the ARDL model, we find no evidence that changes in oil prices significantly affect inflation. However, the results of the NARDL model suggest that positive changes in oil prices have positive and significant effects on inflation while negative changes in oil prices yield insignificant negative effects in almost all the specifications. In light of our empirical findings and recognizing the potential deleterious effect of inflation on the welfare of the citizens of Nigeria given that it erodes their purchasing power, we, therefore, suggest that government should put in place safety net measures that can help cushion the adverse effects of inflation emanating from oil price fluctuations.

Keywords: Crude Oil Prices, Inflation, Nonlinear Autoregressive Distributed Lag Method (NARDL)

∗All correspondence concerning this paper should be forwarded to Obianuju O. Nnadozie at obianuju.onwukeme@uniben.edu

1. Introduction

The significance of energy for macroeconomic stability and development cannot be overemphasized. Agricultural and industrial activities can barely thrive without energy, and crude oil remains a predominant source of energy for most developed and developing countries. Several studies (LeBlanc and Chinn, 2004; De Gregorio et. al., 2007; Cerra, 2019) affirm that it is not only the presence of crude oil that affects economic activities, but the frequent price fluctuations arising from changing demand and supply conditions. An over-dependence on pipelines, especially in developing countries, makes oil price swings a major stabiliser or destabiliser of such economies.

Researchers generally agree that some variations in inflation move in response to oil price changes, at least over the short and medium runs with the effect largely dependent on whether the country in question is an oil importer or exporter (Baharumshah, Sirag and Nor, 2017). From a theoretical perspective, changes in oil price can impact inflation through fiscal and cost channels. The fiscal mechanism operates through government spending funded by oil revenues or allocated to oil purchases while the cost channel works *via* the change in the price of refined products used by households or the cost of production of goods and services which employ crude and refined oil products as factor inputs (Alvarez et al, 2011; Baharumshah, Sirag and Nor, 2017).

The preponderance of evidence from statistical data from major oil-importing economies such as the US, India, the UK and the Euro area reveals that a downward slide in the price of oil results in low inflation while pushing others into deflation. The weakened inflation occasioned by the fall in oil prices over the past several years has strengthened the popular perception that oil prices and inflation are very much related (Castro, Jerez and Barge-Gil, 2016; Baffes et. al., 2015). Contrarily, there are a few economies, like Nigeria, where inflation seems to be relatively stable in the face of falling oil prices. Hence, a clearer comprehension of the nature of the nexus between oil prices and inflation is vital in such contexts.

This paper, therefore, contributes to the literature on the link between oil price and inflation in Nigeria, a country with a unique feature of being both an oil exporter and importer. First, we account for asymmetry in the oil price-inflation nexus by adopting a relatively recent estimation technique – the Non-linear Autoregressive Distributed Lag (NARDL) proposed by Shin, Yu and Greenwood-Nimmo (2014) which is an asymmetric extension of the widely received ARDL model (Nnadozie, 2017). The NARDL technique can handle time series of different orders of integration and can determine short-run and long-run asymmetries simultaneously.

Second, we account for structural breaks in the underlying time series data. This has largely been ignored in the literature. However, it has been reported that the detection and adjustment of structural changes in time series data are essential for obtaining unbiased and reliable estimates (Salisu and Oloko, 2015; Javid, 2019). Specifically, Olofin and Salisu (2017) underscore the importance of accounting for structural breaks when analyzing the oil price-inflation nexus. In sum, our paper jointly captures both asymmetries and structural breaks: empirical studies in this regard are hard to find. We also employ higher frequency data for this analysis.

The rest of this paper proceeds as follows. Sections 2 and 3 present the literature review and methodology, respectively. Section 4 contains the empirical results and section 5 concludes the paper with relevant policy recommendations.

2. Review of Literature

The nature and magnitude of the impact of oil price movements on inflation depend on the underlying source and direction of the changes in prices. Changes in oil prices tend to affect inflation by shifting aggregate demand and supply. From the supply side, a decline in oil price will lead to a fall in production costs. This reduction may further be passed to the consumer, thereby lowering inflation, indirectly. Additionally, the reduced production cost could also help to boost investment (Baffes et. al., 2015; Kilian, 2009; Blanchard and Gali, 2009). On the demand side, a rise in consumers' real income following a fall in oil price could translate to increased spending (Cashin, Mohaddes and Raissi, 2014; Kilian, 2009; Hamilton, 2009; Edelstein and Kilian, 2009). This also has the tendency to sustain or even raise inflation.

Over time, the extent of pass-through from oil price to inflation has declined[1]. This is a result of the reduced dependence on oil for economic activities, as well as a better anchoring of inflation expectations, which in turn has considerably diminished the second-round effects of oil price changes on core inflation (Baffes et. al., 2015; Blanchard and Gali, 2009; De Gregorio et al, 2007; Hooker, 2002).

Theoretical explanations for the relationship between oil price fluctuations and the general price level have been advanced in the literature[2]. A creditable justification put forward by Cologni and Manera (2008) is that the effect of oil price changes on inflation is both direct and indirect. An explanation for the direct effect is that an increase in the price of crude oil will result in a rise in the price of energy-related items such as household fuels, motor fuel, gasoline, and electricity amongst others. The indirect effect stems from the behavioural responses of firms and workers. Firms usually respond to the rise in the price of crude oil, which raises their cost of production by charging higher prices for their goods and services. Also, workers will respond to the high price level by demanding higher wages owing to the higher cost of living. Rising wages invariably put an upward pressure on prices – the typical wage-price spiral argument.

[1] Hamilton (2009) gives a comprehensive survey of the literature that reveals the downward trend.
[2] Razmi et al. (2016) and Dillon and Barret (2016) also provide a theoretical link between oil prices and inflation.

To distil the direct effect channel of this pass-through phenomenon, Alvarez, Sanchez and Urtasun (2017) used a simple contemporaneous interaction of oil price model with monthly data for the period 2002-2016 to show that the transmission from variations in crude price to the consumer price index (CPI) is swift. The indirect effect results from variations in the behavioural responses of firms due to changes in oil price although the transmission through this channel is slower and more difficult to measure than what is obtainable in the direct effect[3]. Besides, the second-round effects may arise as a result of the interactions of the first two channels which may affect the expectation-forming process of economic agents. These effects[4] may be strengthened by the presence of indexation arrangements in relation to inflation (Mohaddes and Pesaran, 2017; Álvarez et. al, 2017; Cologni and Manera, 2008).

In his classical work, Huntington (1985) compiled some estimates of the relationship between oil price changes and inflation from an Energy Modelling Forum (EMF)[5] which he used to analyse the impacts of output, inflation and unemployment during the four years after a hypothetical oil price change in the 1980s. Results from the EMF reveal that a movement in oil price is associated with an immediate short-run variation in inflation, which is significantly diminished by the third and fourth years. Precisely, a sustained 50 per cent rise in oil price would raise inflation in the US by about 2 per cent in the first year, and by another 1 per cent in the second year, but these effects begin to wane by the third year. He further highlighted that while a very considerable part of the first-year effect originates with the price increases experienced directly by households, the indirect price effect plays a more prominent role by the second year.

Using the impulse response functions based on a vector autoregressive model of the US economy, Brown, Oppedahl and Yucel (1995) analysed how oil price shocks pass-through

[3] See Álvarez and Sanchez (2017) for the different empirical approaches used in estimating the indirect effects of oil prices on inflation.
[4] See Sussman and Zohar (2015) for the empirical analysis of these effects.
[5] Huntington (1985) compared the responses of 14 major models of aggregate economy (13 US models and 1 Canadian model) to changes in oil prices.

major channels of the economy to inflation. With the aid of time series data from 1970 to 1994, they showed that the impact of shocks in oil price on domestic price level is permanent: however, this appears to depend on a forecast that such shock grows over time.

For India, Bhattacharya and Bhattacharyya (2001) reported the existence of a bidirectional causality between oil and non-oil inflation. They arrived at this conclusion after examining monthly data from April 1994 to December 2000 and using a four-equation VAR model to analyse the transmission mechanism of an upsurge in oil price on oil and non-oil inflation.

LeBlanc and Chinn (2004) used an augmented Philips curve model to evaluate the impact of oil price changes on inflation for the US, UK, France, Germany, and Japan. Their results suggest that a rise in current oil price will likely exert only a moderate effect on inflation in the US, Japan and Europe. Specifically, as much as a 10 percent increase in oil price will raise inflationary pressure by about 0.1 to 0.8 percentage points.

In an attempt to investigate the impact of oil price variations on both economic activities and consumer price index (CPI), Cunado and de Gracia (2005) sampled six Asian countries over the period 1975Q1 to 2002Q2 using bivariate cointegration and Granger Causality approaches. Their results show that the effect of oil price on both economic activity and CPI is significant only in the short run, and this effect becomes more pronounced when oil price changes are denominated in local currencies. Furthermore, they found that the relationship is asymmetric for some Asian countries.

Cologni and Manera (2008) used a structural cointegrated VAR model and data from the G7 countries to examine the direct effects of movements in oil price on output and domestic prices from the first quarter of 1980 to the fourth quarter of 2003. Some of their main findings reveal that oil price shocks impact directly on the inflation rate for all the countries except Japan and the UK. Also, for most countries, the effect of fluctuations in oil price on prices is instantaneous but temporary.

In another related work, Baffes et. al. (2015) used standard Philips curve and simple vector autoregressive (VAR) models, plus monthly data for G20 countries for the period 2001 to 2014 to estimate the impact of oil price changes on inflation. Their results reveal that the pass-through to headline inflation is modest in most scenarios. Specifically, a 10 percent decline in the price of oil will result in about a 0.3 percent fall in inflation. They concluded that the pass-through of oil price fluctuations to global inflation is in essence one-off, peaking after three to five months before gradually fading away.

Sussman and Zohar (2015) examined the relationship between oil prices and expected inflation for the USA, the Euro area, Israel and the UK. Regressing five-year breakeven inflation rate on oil prices and controlling for a different response for pre - and post-global crisis, their results showed a reinforced positive relationship between oil prices and medium-term inflation expectations after the inception of the global crisis.

Moazam and Kemal (2016) used quarterly data from the second quarter of 1980 to the fourth quarter of 2014 to analyse the determinants of inflation in Pakistan using price as a function of oil prices, money supply and GDP. Basing their model on the quantity theory of money and the Johansen cointegration approach, they showed that only money matters in the long run and that change in oil prices is only a short-run phenomenon. They further argued that changes in money supply which results from a change in demand for foreign exchange due to change in world oil prices will allay the seeming effect of oil prices on domestic prices in the long run. They concluded by stating that inflation is a monetary phenomenon.

Razmi, Azali, Chin and Shah (2016) examined the direct and indirect effects of oil price on consumer price index in the ASEAN-4 (Indonesia, Malaysia, Philippines, and Thailand) countries. By applying the Structural Vector autoregression (SVAR) method, their findings indicate that a positive shock leads to a decline in CPI in Indonesia, raises CPI in the Philippines and Thailand, and has no significant effect on CPI in Malaysia. More recently, using a simple linear regression model, Banikhalid (2017) examined the nature of the impact of oil prices on the inflation rate for G7 countries for the period 1986 to 2016. He found a statistically significant, nonlinear relationship between the variables. He further revealed that the inflation rate is affected inversely only if oil prices are below $34.5 per barrel. Above this price level, the relationship turns out positive.

In the case of Nigeria, Oriakhi and Osaze (2013) utilising quarterly data from 1970 to 2010 and a VAR model found that oil price volatility affects inflation through other variables, especially real government expenditure. Also, Ani et al (2014) employed Granger causality and simple regression approaches to examine the nature of the relationship between oil prices and key macroeconomic variables in Nigeria. The result obtained from using time series data spanning 1980-2010 shows that there is no evidence of Granger-causality in any direction between oil prices and inflation.

A large body of studies has examined the relationship between oil price and inflation. However, the focus has largely been on the linear effects. The relatively few studies that accounted for asymmetry in the relationship mostly employed vector autoregression (VAR) method or its variants and the empirical findings are mixed. For instance, Mordi and Adebiyi (2010) applying the SVAR technique, analyzed in a unifying model, the asymmetric impact of oil shocks on output and price. Using monthly data for Nigeria spanning 1999:01 to 2008:12, their results reveal that the impact of oil price shocks on output and prices is asymmetric; with the impact of oil price decrease significantly greater than that of oil price increase. Similarly, Bala and Chin (2018) in their investigation of the asymmetric impacts of oil price changes on inflation in Algeria, Angola, Libya, and Nigeria find that both positive and negative oil price changes positively influenced inflation although the impact was found to be more significant when oil prices dropped.

Similarly, utilizing a Markov regime-switching VAR model and data for India spanning 1991 to 2009, Ghosh, and Kanjilal (2013) provide evidence that oil price shocks have an asymmetric impact on inflation in India – an oil-importing emerging economy. Specifically, their results revealed that the effects of negative price shocks are more pronounced compared to positive price shocks. In addition, using the structural vector autoregressive (SVAR) technique and data from the first quarter of 1970 to the fourth quarter of 2008, Chuku (2012), focusing on the supply side, wealth transfer, inflation and real balance linear and asymmetric effects of oil price shocks on the Nigerian economy, finds that oil price shock is not a key factor in determining the behaviour of macroeconomic variables in Nigeria.

In modeling the role of asymmetries in the oil price-inflation relationship for selected oil exporting and importing countries, Salisu et al, (2017) report the following findings: oil price has a greater influence on inflation in net importing countries than in net exporting countries, in the long run, asymmetries matter more for oil-exporting nations than oil-importing nations and the relationship between oil price and inflation is unstable over time irrespective of whether the country is an oil exporter or importer. Zmami and Ben-Salha (2019) utilizing the NARDL approach find that there is a long-run asymmetry in the nexus between oil prices (Brent and WTI) and overall food price index. However, this applies only when there is a rise in oil prices. A fall in oil prices does not affect food price.

3. Methodology

3.1 Model Specification

The basic empirical long-run model for examining the oil price-inflation nexus is specified as follows:

$$cpi_t = \phi_0 + \phi_1 oil_t + \phi_2 rgdp_t + \phi_3 reer_t + \phi_4 ms_t + \varepsilon_t \qquad (1)$$

where cpi_t is the consumer price index at time t, used as a proxy for inflation, oil_t is the oil prices at time, t (Brent and WTI); $rgdp_t$ is the real gross domestic product at time t, used to capture the effect of aggregate demand; $reer_t$ is the real effective exchange rate at time t; ms_t is the money supply at time t; and ε_t is the error term, assumed to be normally distributed with zero mean and constant variance ($\varepsilon_t \sim N(0, \delta^2)$).

The a priori expectation is that oil price changes, real gross domestic product and money supply will have a positive effect on inflation while real effective exchange rate could have either a positive or negative effect on inflation.

Given that the objective of this study is to examine the response of inflation to oil price changes using the ARDL and NARDL models with structural break and trend, we first specify an ARDL model from equation 1 by incorporating a short-run dynamic into it and also account for a structural break and time trend as follows:

$$\Delta cpi_t = \phi_0 + \phi_1 cpi_{t-1} + \phi_2 oil_{t-1} + \phi_3 rgdp_{t-1} + \phi_4 reer_{t-1} + \phi_5 ms_{t-1} + \lambda t + \vartheta D + \sum_{i=1}^{m1} \beta_i \Delta cpi_{t-1} + \sum_{i=0}^{m2} \delta_i \Delta oil_{t-1} + \sum_{i=0}^{m3} \varphi_i \Delta rgdp_{t-1} + \sum_{i=0}^{m4} \eta_i \Delta reer_{t-1} + \sum_{i=0}^{m5} \gamma_i \Delta ms_{t-1} + \varepsilon_t \quad (2)$$

$$t = 1, 2, ..., T$$

Δ is the difference operator; t denotes time trend; D is the dummy variable that captures the structural break; ϕ_0 is a constant denoting a drift component; ϕ_1 to ϕ_5 represent long term parameters; λ and ϑ are the coefficients of the time trend and dummy variable respectively while β_i, δ_i, φ_i, η_i, and γ_i are short-run parameters. Other variables are as previously defined.

The null and alternative hypotheses of the long-run of ARDL model are stated below as:

Null hypothesis: $\phi_1 = \phi_2 = \phi_3 = \phi_4 = \phi_5 = 0$

Alternative hypothesis: $\phi_1 \neq \phi_2 \neq \phi_3 \neq \phi_4 \neq \phi_5 \neq 0$

The error correction model of ARDL that shows the speed of adjustment from the short-run disequilibrium towards the long-run can be formalised as:

$$cpi_t = \phi_0 + \lambda t + \vartheta D + \sum_{i=1}^{m1} \beta_i \Delta cpi_{t-1} + \sum_{i=0}^{m2} \delta_i \Delta oil_{t-1} + \sum_{i=0}^{m3} \varphi_i \Delta rgdp_{t-1} + \sum_{i=0}^{m4} \eta_i \Delta reer_{t-1} + \sum_{i=0}^{m5} \gamma_i \Delta ms_{t-1} + \pi_i ect_{t-1} + \varepsilon_t \quad (3)$$

where π is the coefficient of the error correction term which must be negative, less than 1 and statistically significant to establish that there is a long-run equilibrium from the short-run distortion in the economy.

3.1.2 NARDL Model Specification

The long-run form of the NARDL model which shows the asymmetric response of inflation to oil price changes is specified as:

$$cpi_t = \phi_0 + \phi_1^+ oil_t^+ + \phi_2^- oil_t^- + \phi_3 rgdp_t + \phi_4 reer_t + \phi_5 ms_t + \varepsilon_t \quad (4)$$

where $\phi_0, \phi_1^+, \phi_2^-, \phi_3$, ϕ_4 and ϕ_5 are a vector of long-run coefficients to be estimated; oil_t^+ and oil_t^- are positive and negative oil price changes respectively. The oil_t variable is decomposed into positive and negative values of oil price changes as follows:

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

$$oil_t^- = \sum_{j=1}^{t} \Delta oil_j^- = \sum_{j=1}^{t} \min(\Delta oil_j, 0) \quad (5)$$

Equation (4) can be formalised into NARDL form as follows:

$$\Delta cpi_t = \alpha_0 + \alpha_1 cpi_{t-1} + \alpha_2^+ oil_{t-1}^+ + \alpha_3^- oil_{t-1}^- + \alpha_4 rgdp_{t-1} + \alpha_5 reer_{t-1} + \alpha_6 ms_{t-1} + \lambda t + \vartheta D + \sum_{i=1}^{n1} \beta_i \Delta cpi_{t-1} + \sum_{i=0}^{n2} \delta_i^+ \Delta oil_t^+ + \sum_{i=0}^{n3} \delta_i^- \Delta oil_t^- + \sum_{i=0}^{n4} \varphi_i \Delta rgdp_{t-1} + \sum_{i=0}^{n5} \eta_i \Delta reer_{t-1} + \sum_{i=0}^{m5} \gamma_i \Delta ms_{t-1} + v_t \quad (6)$$

where Δ is the first difference operator, α_2^+ and α_3^- are parameters of long-run asymmetry, δ_i^+ and δ_i^- are parameters of short-run asymmetry. Other variables are as previously defined.

Equation (6) is the non-linear autoregressive distributed lag (NARDL) model which incorporates both long run and short asymmetry. The long-run asymmetric effects are derived by the estimates of $\alpha_2 - \alpha_6$ normalized on α_0. $\delta^+$and δ^- measure the short-run influence of positive and negative oil price changes respectively while the coefficient estimates of the first-differenced variables capture short-run asymmetric impact (Nnadozie, 2017). All the variables are naturally logged.

The error correction model for NARDL is specified as follows:

$$\Delta cpi_t = \alpha_0 + \lambda t + \vartheta D + \sum_{i=1}^{n1} \beta_i \Delta cpi_{t-1} + \sum_{i=0}^{n2} \delta_i^+ \Delta oil_t^+ + \sum_{i=0}^{n3} \delta_i^- \Delta oil_t^- + \sum_{i=0}^{n4} \varphi_i \Delta rgdp_{t-1} + \sum_{i=0}^{n5} \eta_i \Delta reer_{t-1} + \sum_{i=0}^{m5} \gamma_i \Delta ms_{t-1} + \theta ect_{t-1} + v_t \quad (7)$$

where ect_{t-1} is the error correction term and θ is the coefficient of error correction term which is expected to be negative, less than 1 and statistically significant before it can be said that there is an adjustment from the short-run disequilibrium towards the long-run equilibrium.

3.2 Data Sources

This study employed monthly data spanning 1995m1 to 2019m12. Crude oil prices, Brent and WTI, were sourced from the World Bank Commodity Price database. Real effective exchange rate, real GDP, CPI and money supply were all obtained from the Central Bank of Nigeria database. Figure 1 represents the trend of CPI and oil prices over time.

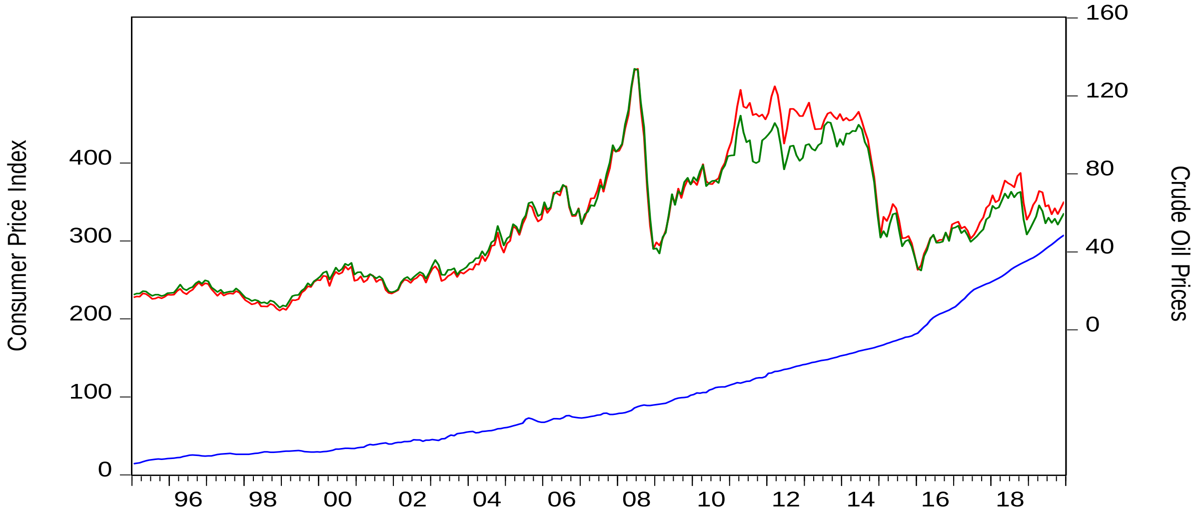
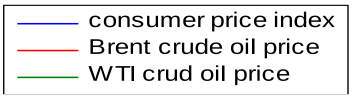


Figure 1: Evolution of CPI, Brent Crude Oil Price and WTI Oil Price



4.0 EMPIRICAL RESULTS

Before the estimation of the ARDL and NARDL models, some preliminary analyses (summary statistics of variables, correlation analysis, unit root and cointegration tests) were conducted and their results are presented and discussed in this section.

Three distinctive unit root tests – the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Zivot-Andrew (ZA) unit root tests – were employed to ascertain the stationarity properties of the variables to detect and possibly avoid series that are integrated of order 2, that is, I(2) series. Both the ADF and PP tests assume that the variables contain a unit root and the null hypothesis of unit root is usually tested against the alternative that the variables are stationary. However, PP differs from the ADF in terms of addressing the problems of serial correlation and heteroscedasticity in the error terms. Specifically, PP tests for serial correlation and heteroscedasticity in the error term of the regression by modifying relevant test statistics, especially t-ratio. Both tests do not consider the possibility of structural breaks but the ZA unit root test accounts for structural break endogenously when testing the stationarity property of the data.

In addition, the Gregory-Hansen residual-based cointegration test with structural break was carried out. Gregory and Hansen (1996) cointegration test is an extension of the Engle and Granger (1987) cointegration test with a null hypothesis of no cointegration against the alternative hypothesis of cointegration with a single structural break that occurs at an unknown date which is endogenously determined. Gregory and Hansen (1996) performed the cointegration test with the possibility of a structural break occurring at constant, trend and regime. The decision to reject or accept the null hypothesis of no cointegration with a single structural break at an unknown date is based on the values of three statistical tests, namely: ADF test, Zt test and Zα test. Assuming we choose Zt test, the null hypothesis of no cointegration can be rejected, if and only if, the computed value of Zt test is greater than 5% of critical value, otherwise the null hypothesis cannot be rejected.

Preliminary Results

4.1 Descriptive Statistics

The summary statistics of the variables are presented in Table 1. We observe that the mean CPI, a proxy for inflation, stood at 102.94% with a range from 14.36% to 307.47%. This suggests that inflation has been on the increase during the period under consideration. Several factors have been responsible for the observed upward trajectory in inflation over time. The most important of these factors is the rising prices of food items which is directly driven upward by the rise in the prices of raw materials and refined petroleum products, especially the price of Premium Motor Spirit. Similarly, it can also be observed from the table that the prices of crude oil have risen substantially in the international market. The Brent crude oil price has a minimum value of $9.80 per barrel and a maximum value of $133.87 per barrel with an average price of about $55.22 per barrel. Similarly, WTI crude oil price for the period rose from $11.31 per barrel to about $133.93 per barrel with an average price of $53.18 per barrel.

With regards to economic performance – measured using the real gross domestic product (RGDP) - the Nigerian economy recorded an impressive growth performance until the second quarter of 2016 when the economy relapsed into a recession. As shown in the table, RGDP averaged about ₦44.71 trillion with a minimum value of ₦20.11 trillion and a maximum value of ₦71.73 trillion. The average real effective exchange rate (reer) stood at 115.86 with a minimum of 63.85 and maximum of 283.37. This shows that the value of Nigeria's currency (Naira) has weakened against the basket of currencies of its trading partners over the years.

Table 1: Descriptive Statistic Results

Variables	Obs	Mean	Std.Dev.	Min	Max	p1	p99	Skew.	Kurt.
cpi	300	102.937	77.680	14.360	307.47	16.255	300.185	0.951	2.896
oilBrent	300	55.217	32.873	9.800	133.873	10.990	124.432	0.516	2.132
oilWti	300	53.183	29.054	11.31	133.927	12.725	120.826	0.473	2.203
roilBrent	300	0.561	0.292	0.130	1.327	0.146	1.220	0.616	2.278
roilWti	300	0.545	0.258	0.150	1.335	0.169	1.210	0.616	2.454
rgdp	300	44712.7	18449.83	20107.16	71733.63	20199.18	71458.83	0.084	1.456
reer	300	115.859	51.050	63.848	283.373	65.188	277.549	1.820	5.541
m2	300	8980000	8800000	255000	2.88e+07	277000	2.81e+07	0.687	2.104

Note: the letter "r" in oilBrent and oilWti represents real.
Source: Authors' compilation

4.2 Correlation Analysis Results

Correlation analysis shows the degree or strength of association between variables and can be a useful pointer to the problem of multicollinearity. Table 2 shows the result of the correlation analysis. From the results, it is evident that real crude oil prices (Brent and WTI) are moderately and positively associated with CPI. Similarly, the correlation between money supply, real GDP and CPI are positive and statistically significant. However, the real effective exchange rate is negatively and significantly correlated with CPI. A cursory look at correlation among the regressors shows that there is no likelihood of multicollinearity. Only the Brent crude oil price and WTI crude oil price are highly correlated. However, both variables are not used in the same model, as they are used for a different purpose in the main analysis. While Brent crude oil price is used for the main analysis, the WTI crude oil price is used for sensitivity analysis to test the robustness of the main analysis.

Table 2: Pairwise Correlation Analysis

Variables	1	2	3	4	5	6
(1) lcpi	1.000					
(2) lroilBrent	0.669*	1.000				
(3) lroilWti	0.611*	0.992*	1.000			
(4) lrgdp	0.984*	0.743*	0.690*	1.000		
(5) lreer	-0.177*	-0.281*	-0.306*	-0.170*	1.000	
(6) lm2	0.983*	0.745*	0.695*	0.992*	-0.244*	1.000

***** shows significance at the 0.05 level***

Note: the letter "l" before all the variables is used to denote natural log.

Source: Authors' compilation

4.3 Unit Root Test Results

Unit root test is used to determine the stationarity properties of the variables to avoid some sort of spurious regressions. The results of the ADF and PP unit root tests are presented in tables 3A while the result of the ZA unit root test which endogenously accounts for a structural break in the series is shown in Table 3B below.

From Table 3A, we observe that real Brent crude oil price, real WTI crude oil price, real GDP, real effective exchange rate and money supply all contain unit root that is, they are not stationary at levels. They, however, become stationary after being first differenced. Hence, all the series are integrated of order 1 whether we test their stationary properties with respect to constant, with constant and trend or without constant and trend. Nonetheless, in the case of CPI, we observe that when we consider unit root with constant and trend, it is stationary at the 10% level for the ADF unit root test and at the 1% level for the PP unit root test. Concerning the ZA unit root test, the results reported in Table 3B suggests that the series are a mixture of I(0) and I(1) variables with the break occurring at different dates irrespective of whether the unit root is tested with the break in constant, trend or both.

In this study, we would trace the economic events that may have led to the breaks in the two main series of focus, namely CPI and crude oil prices. In 2003, the Central Bank of Nigeria

(CBN) targeted inflation rate at 9%, however, at the end of the year 2003, the inflation rate soared to a staggering 23.5%. According to the CBN economic report for that year, the inability of the monetary authority to actualise some of the monetary policy targets was mostly due to fiscal policy dominance. Apart from this, the rising rate of inflation was also attributed to an increase in aggregate demand, the depreciation of the naira against major currencies, particularly the US Dollar and the British Pound, and increase in the prices of petroleum products such as Premium Motor Spirit, Automobile Gas Oil, Aviation Turbine kerosene and Dual-Purpose Kerosene which led to increasing of costs of transportation and domestic production (CBN, 2003).

In the case of crude oil prices, the structural break occurred in the 7th month of 2014 for Brent and the 8th month of the same year for WTI. It is on record that in the second quarter of 2014, crude oil price suddenly fell from over $100 per barrel to about $50 per barrel (see Aminu and Raifu, 2019; Raifu, Aminu and Folawewo, 2020). That sudden fall in the crude oil prices has been attributed to several factors, including the slowdown of economic growth in China and other emerging economies, which resulted in low demand for crude oil. In the face of dwindling demand for crude oil, its supply increased as the major suppliers (the US, Saudi Arabia and Russia) loaded the world with crude oil. This created oil glut which led to the sudden decline in the prices of crude oil (Our World, 2015, Baffes, et al, 2015; Stocker, et al., 2018)

Table 3A: Phillips-Perron and Augmented Dickey-Fuller Unit Root Test Results

				UNIT ROOT TEST TABLE (PP)			
				At Level			
		lcpi	lroilBrent	LroilWti	lrgdp	lreer	lm2
With Constant	t-Statistic	-1.719	-1.835	-1.952	-1.285	-2.158	-2.073
With Constant & Trend	t-Statistic	-5.659***	-1.953	-1.995	0.202	-2.105	-0.138
Without Constant & Trend	t-Statistic	7.612	-1.488	-1.394	6.709	-0.188	7.007
				At First Difference			
		d(lcpi)	d(lroilBrent)	d(lroilWti)	d(lrgdp)	d(lreer)	d(lm2)
With Constant	t-Statistic	-11.951***	-14.273***	-13.493***	-8.923***	-16.824***	-22.638***
With Constant & Trend	t-Statistic	-11.996***	-14.265***	-13.483***	-9.265***	-16.811***	-23.361***

Without Constant & Trend	t-Statistic	-9.958***	-14.285***	-13.547***	-4.005***	-16.852***	-19.894***

UNIT ROOT TEST TABLE (ADF)							
At Level							
		lcpi	lroilBrent	lroilWti	lrgdp	lreer	lm2
With Constant	t-Statistic	0.282	-1.879	-2.058	-1.464	-2.006	-2.290
With Constant & Trend	t-Statistic	-3.261*	-2.060	-2.194	-1.464	-1.945	-0.141
Without Constant & Trend	t-Statistic	4.196	-1.497	-1.444	1.277	-0.185	2.768
At First Difference							
		d(lcpi)	d(lroilBrent)	d(lroilWti)	d(lrgdp)	d(lreer)	d(lm2)
With Constant	t-Statistic	-5.142***	-14.273***	-13.497***	-1.728	-16.820***	-14.863***
With Constant & Trend	t-Statistic	-5.055***	-14.264***	-13.489***	-2.021	-16.807***	-15.145***
Without Constant & Trend	t-Statistic	-2.615***	-14.285***	-13.512***	-1.038	-16.848***	-2.098***

Notes: ***, ** and *** denote 10%, 5% and 1% levels of significance respectively***

Source: Authors' computation

Table 3B: Zivot-Andrews Unit Root Test Results

	Break (Intercept)		**Break (Trend)**		**Break (Both)**	
Variable	**Level**	**First Difference**	**Level**	**First Difference**	**Level**	**First Difference**
Lcpi	-6.446***	-12.221	-5.520***	-12.600***	-6.472***	-13.002***
	(2003m4)	(2005m9)	(2016m2)	(1998m11)	(2003m4)	(2000m2)
lroilBrent	-4.545	-14.472***	-3.590	-14.286***	-4.264	-14.544***
	(2014m7)	(1999m1)	(2011m2)	(2004m6)	(2014m10)	(1999m1)
lroilWti	-4.722*	-13.688***	-3.809	-13.507***	-4.480	-13.722***
	(2014m8)	(2008m7)	(2010m11)	(1999m10)	(2014m10)	(1999m1)
Lrgdp	-2.657	-5.740***	-3.202	-4.528**	-3.144	-5.783***
	(2015m2)	(2001m2)	(2012m5)	(2002m2)	(2012m2)	(2001m2)
Lreer	-13.365***	-17.047***	-4.343**	-17.042***	-16.122***	-17.993***
	(1999m1)	(1998m12)	(1999m10)	(1999m2)	(1999m1)	(1999m3)
lm2	-2.170	-22.656***	-4.404*	-22.529***	-5.659***	-22.733
	(2006m3)	(2008m10)	(2009m12)	(2000m4)	(2006m3)	(2006m3)

Source: Authors' computation

****, ** and *** denote 10%, 5% and 1% levels of significance respectively***

4.4. Gregory-Hansen Cointegration Test Results

The results of the Gregory-Hansen cointegration residual base test reported in Table 4 indicate that there is cointegration among the variables in the inflation-real Brent oil price and inflation-real WTI oil price models. This implies that there is a long-run relationship among the variables in the model, albeit with a break. Based on the absolute values of the Zt test, we find that structural break occurs at the trend in the 11th month of 2001 in the inflation-real Brent oil price model and in the 8th month of 2001 in the inflation-real WTI price model. Given these dates, we generate a dummy variable and incorporate it into the ARDL and NARDL models.

Table 4: Gregory-Hansen Cointegration Results

	Inflation-real oil Brent Model			**Inflation-real oil WTI Model**		
	Brea k(Level)	Break (Trend)	Break (Regime)	Break (Level)	Break (Trend)	Break (Regime)
ADF	-5.18	-6.80***	-7.44***	-5.22	-6.86***	-7.37***

	(2016m3)	(2012m9)	(2007m11)	(2016m3)	(2012m12)	(2007m11)
Zt	-5.51*	-8.89***	-7.80***	-5.59**	-8.85***	-7.81***
	(2016m3)	(2001m11)	(2007m11)	(2015m12)	(2001m8)	(2007m11)
Za	-30.64	-54.17	-76.65*	-30.88	-54.75	-75.08
	(2016m3)	(2001m11)	(2007m11)	(2015m12)	(2001m8)	(2007m11)

Source: Authors' computation

****, ** and *** denote 10%, 5% and 1% levels of significance respectively***

4.5. ARDL and NARDL Results

Before modelling the oil price-inflation nexus in the ARDL and NARDL framework, we conduct a vector autoregression (VAR) based lag selection to determine the optimal lag length for the estimation. Based on the Akaike information criterion, three maximum lag lengths are selected for both models. As stated earlier, we generate a dummy variable which captures the breakpoints as shown in Gregory-Hansen cointegration results.

The results of the ARDL and NARDL models on the link between oil price and inflation are reported in Table 5. Both models are estimated in two ways – first, without a structural break but with the trend and second, with a structural break and trend. We begin with the presentation of the results of ARDL and NARDL in which we account for the trend without a structural break. First, ARDL results show that irrespective of the proxies for oil prices (Brent or WTI), real oil prices have a positive but insignificant effect on inflation. The ARDL is a symmetric model which assumes that the impact of positive and negative oil price changes on inflation is identical. However, the NARDL allows for asymmetric impact. That is, it distinguishes the effect of an increase and a decrease in oil price on inflation.

From Table 5, the NARDL results show that an increase in oil prices (Brent or WTI) has a positive and significant effect on inflation. Specifically, a 1% rise in the price of Brent and WTI crude oil will increase the inflation rate by 0.016% and 0.013% respectively in the short run and 0.139% and 0.132% respectively in the long-run. Similarly, a decline in the price of crude oil leads to a decline in inflation. While the negative effect is statistically significant for Brent crude oil price, it is not so for WTI crude oil price both in the short run and long run. Our findings are in line with the existing literature. For instance, Ibrahim (2015) found a positive effect of an increase in oil prices on food inflation in Malaysia while a decline in oil prices did not yield any significant effects on food inflation. The study by Belke and Dreger (2015) on MENA countries also shows that global oil prices influence the inflation rate in MENA countries in the long-run. The implication of our findings, especially the effect of a positive change in the prices of crude oil on inflation, is that such increase inflation would have direct and indirect effects on the welfare of Nigerians through the channels of commodity prices, costs of production and wage increment.

We present other important findings. First, it can be observed that the coefficients of the trend component in the ARDL and NARDL models are statistically significant. This implies that incorporating the trend into the oil price-inflation model is vital. Also, the negative and significant coefficients of the error correction term indicate that there is an adjustment towards the long-run equilibrium from the short-run disequilibrium. This is corroborated by the results of the ARDL and NARDL bounds testing approach to cointegration as shown by the F-statistics. The asterisks on the values of the “ARDL bounds test” in table 5 indicate that cointegration exists among the variables in both the linear and nonlinear ARDL models at the 1% level of significance. Thus, there is a long-run relationship between the variables.

With respect to the results of the ARDL and NARDL models with structural break and time trend, it can be observed that the inclusion of a structural break dummy does not change the signs and significance of the coefficients although it improves the coefficients in the short-run. Concentrating on the NARDL model, when we do not account for a structural break, we find that the estimated coefficients of positive change in the real oil prices (Brent and WTI) were 0.016% and 0.013% in the short-run and 0.139% and 0.132% in the long-run respectively. However, when we account for the structural break the coefficients of positive effects of an increase in oil prices on inflation were at 0.020% and 0.022% in the short-run and 0.128% and 0.153% in the long-run respectively.

We also find that when we account for a structural break, a decline in real Brent oil price leads to a decline in inflation by 0.04% in the long-run. However, a decline in real WTI oil price has a negative, albeit statistically insignificant, effect on inflation in the short-run. The statistically significant coefficients of the dummy variables in all the models highlight the importance of accounting for a structural break when modelling the link between oil price and inflation (see Olofin and Salisu, 2017).

Furthermore, the coefficients of the error correction term and bounds test remain the same as in the ARDL and NARDL models where we account for trend alone without a structural break. This suggests that there is an adjustment towards long-run equilibrium from the short-run distortions in the economy and there is a long-run relationship among the variables. Lastly, we find that changes in oil prices only have a long-run asymmetric effect on inflation. Thus, there is no evidence to support the short-run asymmetric effect of changes in oil price on inflation in all the models, whether we account for a structural break and trend or trend alone.

For other explanatory variables, we find mixed results across the models. For instance, we found that real GDP has insignificant positive effects on inflation in ARDL and NARDL models with the trend while it has negative effects on inflation in ARDL and NARDL models with structural break and trend in the long-run (the negative effect is significant only in the ARDL model with structural break and trend). The real effective exchange rate has positive effects on inflation in the long-run which is most statistically significant in the models with structural break and trend. In the case of money supply, our findings show that money supply has negative effects on inflation in most cases in all the models except the ARDL model with structural break and trend where money supply has a positive insignificant effect on inflation.

We also perform some diagnostic tests such as normality test, ARDL LM test for heteroscedasticity, Breusch-Pagan serial correlation test, and the Ramsey-RESET test for functional model specification. The results are mixed which could be as a result of the data generation process. While the models fail the normality test, they however passed all other tests such as the serial correlation test, the heteroscedasticity test as well as the Ramsey-RESET test. This shows the model can to an extent, be reliable and used for policy formation and analysis. CUSUM tests reveal that almost all the models are stable while CUSUM square tests show otherwise. As said previously, this may be because of the data generation process, but it does not cast a doubt on the reliability of our models.

Table 5: ARDL and NARDL Empirical Results

	ARDL and NARDL Models without Structural Break but Trend				**ARDL and NARDL Models with Structural Break and Trend**			
	CPI-Brent Model		**CPI-WTI Model**		**CPI-Brent Model**		**CPI-WTI Model**	
	ARDL	**NARDL**	**ARDL**	**NARDL**	**ARDL**	**NARDL**	**ARDL**	**NARDL**
SHORT-RUN MODEL								
lcpi(-1)*	-0.092***	-0.117***	-0.093***	-0.098***	-0.129***	-0.158***	-0.126***	-0.142***
lroilBrent**	1.24E-05				0.004			
lroilBrent_pos**		0.016***				0.020***		
lroilBrent_neg**		-0.009**				-0.007		
lroilwti**			0.001				0.003	
lroilwti_pos**				0.013**				0.022***
lroilwti_neg**				-0.005				-0.005
lrgdp**	0.018	0.015	0.016	0.014		-0.023	-0.020	-0.031
d(lrgdp)					-0.621*			
lrgdp(-1)					-0.036			
lreer**	0.002	0.008**	0.002	0.004	0.009**	0.016***	0.008***	0.013***
lm2**					0.001			
lm2(-1)	-0.003	-0.018**	-0.003	-0.008		-0.019**	-0.002	-0.011
d(lcpi(-1))	0.337***	0.329***	0.338***	0.320***	0.315***	0.312***	0.317***	0.324***
d(lcpi(-2))					0.108*	0.093*	0.086	
d(lm2)	0.031*	0.023	0.031*	0.029*		0.012	0.022	0.020
@trend	0.001***	0.0004**	0.001***	0.0003	0.001***	0.001***	0.001***	0.001**
dum**						0.015***		
d(dum)					0.008		0.010	0.015
dum(-1)					0.018***		0.014***	0.018***
d(dum(-1))					0.036**		-0.010	-0.009
d(dum(-2))							-0.044**	-0.044***
C	0.125	0.393**	0.147	0.239	0.679***	0.867***	0.558***	0.801***
ect(-1)	-0.092***	-0.117***	-0.093***	-0.098***	-0.129***	-0.158***	-0.126***	-0.142***
LONG-RUN MODEL								
lroilBrent	0.0001				0.035*			
lroilBrent_pos		0.139***				0.128***		
lroilBrent_neg		-0.077**				-0.040**		
Lroilwti			0.007				0.023	
lroilwti_pos				0.132***				0.153***
lroilwti_neg				-0.053				-0.037
Lrgdp	0.195	0.125	0.176	0.148	-0.278*	-0.145	-0.155	-0.217
Lreer	0.021	0.072**	0.022	0.037	0.068***	0.098***	0.065**	0.090***
lm2	-0.028	-0.153**	-0.031	-0.082	0.015	-0.123**	0.016	-0.074
@trend	0.009***	0.004**	0.009***	0.004**	0.136***	0.006***	0.010***	0.005***
Dum					0.136***	0.095***	0.111**	0.131***
ardl bounds test	5.514***	6.4791***	5.522***	5.686***	6.505***	7.373***	5.972***	6.797***

Wald test (lra)		11.1135***		6.082***		12.933***		12.8219***
R-squared	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997
Adj. R-squared	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997
F-stat.	124695.9	114720.8	124716.5	112809.3	85269.35	96237.04	78960.19	81832.27
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dub-Wat.	2.052	2.063	2.051	2.048	1.938	1.989	1.984	2.046
DIAGNOSTIC TESTS								
	186.762	200.807	186.833	203.532	169.000	170.534	175.186	221.068
Jarque–Bera	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
B-G serial corr.	0.788	1.185	0.784	0.769	1.813	0.051	0.227	0.986
LM test	(0.455)	(0.307)	(0.458)	(0.464)	(0.165)	(0.951)	(0.797)	(0.374)
	1.202	1.191	1.179	1.211	2.541	2.604	2.868	2.756
Het. LM test	(0.274)	(0.276)	(0.279)	(0.272)	(0.112)	(0.108)	(0.091)	(0.098)
	1.454	0.873	1.407	0.236	2.339	1.419	2.046	0.901
Ramsey-reset test	(0.149)	(0.383)	(0.161)	(0.814)	(0.098)	(0.159)	(0.131)	(0.369)
Cusum test	Stable	Stable	Stable	Stable	Stable	Unstable	Stable	Stable
Cusum square test	Unstable	Unstable	Unstable	Unstable	Unstable	Unstable	Unstable	Unstable

Source: Authors' computation

****, ** and *** denote 10%, 5% and 1% levels of significance respectively***

5. CONCLUSION AND POLICY RECOMMENDATIONS

This study examined the response of inflation to the boom-bust cycle of oil price in the framework of linear (symmetric) autoregressive distributed lag (ARDL) and Non-Linear autoregressive distributed lag (NARDL) models using monthly data for the period from 1995 to 2019.

Our results based on the Gregory-Hansen cointegration test show that the variables in the model (real oil prices (Brent and WTI), inflation (CPI), real GDP, real effective exchange rate and money supply) are cointegrated with a structural break. The results of the bounds testing approach to cointegration support the Gregory-Hansen cointegration results, thereby confirming the evidence of the long-run relationship among the variables.

From ARDL results, we find that even though changes in oil prices (Brent and WTI) have positive effects on inflation, it is nonetheless statistically insignificant whether we account for trend alone or trend and structural break. However, from the NARDL results which distinguish between the effects of positive and negative changes in oil prices on inflation, we find that positive changes in oil prices (oil boom) have a positive and significant effect on inflation in the short-run and long-run in almost all the models. On the other hand, negative changes in oil prices, in most cases lead to insignificant effects on the inflation rate. Our results further show that only a long-run asymmetric effect exists in all the models.

The results have serious policy implications for the Nigerian economy. Nigeria runs a monocultural economy that is heavily oil-dependent. Specifically, oil alone accounts for 40% of Nigeria's GDP, 70% of its budget revenues and 95% of foreign exchange earnings and the country remains the only OPEC member that imports 95% of refined petroleum for domestic use (Emediegwu and Okeke, 2017). Hence movements in the international oil market affect local food prices in these markets *vis-à-vis* changes in local fuel prices. Eventually, the burden of higher costs of food production, storage, and transport is passed on to the consumers in the form of higher costs of living.

It is high time the country focused on diversification and industrialization to rouse economic growth, and effectively transform the economy from being an oil exporter to a manufacturing exporter. Thus, the call for the revival and restoration of other viable sectors of the economy that are either ailing or, altogether, abandoned.

However, in the short-run, strategies need to be developed to protect citizens from inflationary tendencies, especially in the face of rising global fuel and food prices owing from the ongoing war in Ukraine. As an average Nigerian household spends 56.4% of its income on food (Emediegwu, 2022), government at all levels must intensify efforts to ensure that more people are not pushed into the food poverty trap. There must be an aggressive effort to revamp the agricultural sector and strengthen food supply chain in Nigeria. Farmers should be incentivised through appropriate subsidies to produce more food at government-controlled prices. Besides, safety nets measures should be provided for fixed-income earners in order to cushion the effect of a fall in real income.

REFERENCES

Alvarez LJ, Sánchez I, Urtasun A (2017) The effect of oil price fluctuations on Spanish inflation. *Economic Bulletin* Banco de Espana, issue June, pp 1 - 8.

Alvarez, LJ, Hurtado S Sanchez, I Thomas C (2011) The impact of oil price changes on Spanish and euro area consumer price inflation. *Economic Modelling* 28, 422–431.

Aminu, A, Raifu IA (2019) Dynamic Nexus between Oil Revenues and Economic Growth in Nigeria. *Economics Bulletin*, *39*(2), 1556-1570.

Ani, W, Ugwanta D, Inyiama O, Eneje B (2014) Oil price volatility and economic development: Stylized evidence in Nigeria. *Journal of Economics and International Finance, 6*(6), 125–133.

Arezki, R, Ismail K (2013) Boom–bust cycle, asymmetrical fiscal response and the Dutch disease. *Journal of Development Economics* 101, 256–267

Baffes, J, Kose M.A, Ohnsorge F, Stocker M (2015) The Great Plunge in Oil Prices: Causes, Consequences and Policy Responses. Koc University-TUSAID Economic Research Forum Working Papers 1504.

Baharumshah, AZ, Sirag A, Nor, NM (2017) Asymmetric Exchange Rate Pass-through in Sudan: Does Inflation React Differently during Periods of Currency Depreciation? *African Development Review* 29(3), 446–457.

Bala, U, Chin L (2018) Asymmetric Impacts of Oil Price on Inflation: An Empirical Study of African OPEC Member Countries. *Energies*, 11, 1- 21.

Banikhalid, HH (2017) The Impact of Oil Prices on the G7's Inflation Rate: An Empirical Study for the Period (1986-2016). *International Journal of Economics and Finance,* 9(6), 167-173.

Belke, A, Dreger C (2015) The transmission of oil and food prices to consumer prices. *International Economics and Economic Policy*, *12*(1), 143-161.

Bhattacharya, K, Bhattacharyya I (2001) Impact of increase in oil prices on inflation and output in India. *Economic and Political Weekly*, 4735-4741.

Blanchard, OJ, Gali, J (2009) *The Macroeconomic Effects of Oil Shocks: Why are the 2000s so different from the 1970s?* in Gali, Jordi and Mark Gertler (eds) International Dimensions of Monetary Policy, University of Chicago, 373 -428.

Brown, SP, Oppedahl DB Yücel, MK (1995) *Oil prices and inflation* (No. 9510). Federal Reserve Bank of Dallas.

Cashin, P, Mohaddes K, Raissi M, Raissi M (2014) The Differential Effects of Oil Demand and Supply Shocks on the Global Economy. *Energy Economics*, 44, 113—134.

Castro, C, Jerez M, Barge-Gil A (2016) The deflationary effect of oil prices in the Euro Area. *Energy Economics*, *56*, 389-397.

Cavallo, M. (2008) Oil prices and inflation. *FRBSF Economic Letter*, (oct3).

Central Bank of Nigeria (2003) CBN Annual Report & Statement of Accounts for the Year ended 31st December 2003. pp 49-101.

Cerra, V (2019) How can a strong currency or drop in oil prices raise inflation and the black- market premium? *Economic Modelling*, 76, 1 - 13.

Chuku AC (2012) Linear and asymmetric impacts of oil price shocks in an oil-importing and exporting economy: the case of Nigeria. *OPEC Energy Review*, 413-443.

Cologni, A, Manera M (2008) Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G-7 countries. *Energy Economics*, *30*(3), 856-888.

Cunado, J, De Gracia FP (2005) Oil prices, economic activity and inflation: evidence for some Asian countries. *The Quarterly Review of Economics and Finance*, *45*(1), 65-83.

De Gregorio, J, Landerretche O, Neilson C, Broda C, Rigobon R (2007) Another pass-through bites the dust? Oil prices and inflation [with comments]. *Economia*, *7*(2), 155-208.

Dillon, BM, Barrett CB (2016) Global oil prices and local food prices: Evidence from East Africa. *American Journal of Agricultural Economics*, *98*(1), 154-171.

Edelstein, P, Kilian L (2009) How sensitive are consumer expenditures to retail energy prices? *Journal of Monetary Economics*, *56*(6), 766-779.

Emediegwu, LE (2022) How is the war in Ukraine affecting global food security? *URL: https://www.economicsobservatory.com/how-is-the-war-in-ukraine-affectingglobal-food-security/ (accessed June 15, 2022)*

Emediegwu, L., & Okeke, A. (2017) Dependence on oil: What do statistics from Nigeria show? *Journal of Economics and Allied Research*, 2(1), 110-125.

Engle, RF, Granger CW (1987) Co-integration and error correction: representation, estimation, and testing. *Econometrica: Journal of the Econometric Society*, 251-276.

Ghosh, S Kanjilal K (2013) Oil price shocks on Indian economy: Evidence from Toda Yamamoto and Markov regime-switching VAR. *Macroeconomics and Finance in Emerging Market Economies*, 7, 122–139.

Gregory, AW, Hansen, BE (1996) Residual-based tests for cointegration in models with regime shifts. *Journal of Econometrics*, *70*(1), 99-126.

Hamilton, JD (2009) Causes and Consequences of the Oil Shock of 2007-08. *Brookings Papers on Economic Activity, Economic Studies Program, The Brookings Institution,* 40 (1), 215—283.

Hooker, MA (2002) Are oil shocks inflationary? Asymmetric and nonlinear specifications versus changes in regime. *Journal of Money, Credit, and Banking*, *34*(2), 540-561.

Huntington, HG (1985) Oil prices and inflation. *Annual Review of Energy*, *10*(1), 317-339.

Ibrahim, MH (2015) Oil and food prices in Malaysia: a nonlinear ARDL analysis. *Agricultural and Food Economics, 3*(1), 1-14.

Javid, M (2019) Public and Private Infrastructure Investment and Economic Growth in Pakistan: An Aggregate and Disaggregate Analysis. Sustainability, 11, 1-22.

Kilian, L (2009) Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market. *The American Economic Review*, 99 (3), 1053-1069.

LeBlanc, M, Chinn MD (2004) Do high oil prices presage inflation? The evidence from G-5 countries. Business Economics 39 (2), 38–48.

Moazam, M, Kemal MA (2016) *Inflation in Pakistan: Money or Oil Prices* (No. 2016: 144). Pakistan Institute of Development Economics.

Mohaddes, K, Pesaran, MH (2017) Oil prices and the global economy: is it different this time around? *Energy Economics*, 65, 315–325.

Mordi, CNO, Adebiyi MA (2010) The Asymmetric Effects of Oil Price Shocks on Output and Prices in Nigeria using a Structural VAR Model. *Central Bank of Nigeria Economic and Financial Review*, 48(1), 1-32.

Nnadozie, OO. (2017) Asymmetric Effects of Exchange Rate on Nigeria's Trade Balance: A Non-Linear Autoregressive Distributed Lag (NARDL) Approach, *West African Financial and Economic Review* 17(2), 23–44.

Olofin, SO, Salisu AA (2017) Modelling oil price-inflation nexus: The role of asymmetries and structural breaks. Centre for Econometric and Allied Research, University of Ibadan Working Papers Series, CWPS 0020.

Oriakhi, DE, Osaze ID (2013) Oil price volatility and its consequences on the growth of the Nigerian economy: An examination (1970-2010). *Asian Economic and Financial Review*, *3*(5), 683 - 702.

Our World (2015) Will Collapse in Oil Price Cause a Stock Market Crash? United Nations University. https://ourworld.unu.edu/en/will-collapse-in-oil-price-cause-a-stock-market-crash#:~:text=Demand%20for%20oil%20declined%20unexpectedly%20in%202014.&text=The%

20world's%20largest%20producers%20of,causing%20a%20fall%20in%20prices. (accessed on 16th September, 2020).

Pesaran, MH Shin Y, Smith, RJ (2001) Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289-326.

Raifu, IA, Aminu A, Folawewo AO (2020) Investigating the relationship between changes in oil prices and unemployment rate in Nigeria: linear and nonlinear autoregressive distributed lag approaches. *Future Business Journal*, *6*(1), 1-18.

Razmi, F, Azali M., Chin L, Shah HM (2016) The role of monetary transmission channels in transmitting oil price shocks to prices in ASEAN-4 countries during pre- and post-global financial crisis. *Energy 101*, 581–591.

Salisu, A, Isah KO, Oyewole OJ, Akanni LO (2017) Modelling oil price-inflation nexus: The role of asymmetries, *Energy*, DOI: 10.1016/j.energy.2017.02.128.

Salisu, AA, Oloko, TF (2015) Modeling oil price–US stock nexus: A VARMA– BEKK–AGARCH approach. *Energy Economics*, 50, 1–12.

Shin, Y, Yu B, Greenwood-Nimmo M (2014) Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework, Festschrift in Honor of Peter Schmidt: Econometric Methods and Applications, eds. by R. Sickels and W. Horrace: Springer, 281-314.

Stocker, M, Baffes J, Vorisek D (2018) What triggered the oil price plunge of 2014-2016 and why it failed to deliver an economic impetus in eight charts. https://blogs.worldbank.org/developmenttalk/what-triggered-oil-price-plunge-2014-2016-and-why-it-failed-deliver-economic-impetus-eight-charts (accessed on 16th September 2020)

Sussman, N, Zohar O (2015) Oil prices, inflation expectations, and monetary policy. *VoxEU blog, September*.

World Bank (2016) World Bank Indicators. *The World Bank Group*.

Zivot, E, Andrews DWK (2002) Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of Business & economic statistics*, *20*(1), 25-44.

Zmami, M, Ben-Salha O (2019) Does oil price drive world food prices? Evidence from Linear and Nonlinear ARDL Modelling. *Economies*, 7(12), 1-18.