Energy Economics Letters
ISSN(e): 2308-2925
DOI: 10.18488/journal.82.2020.71.1.11
Vol. 7, No. 1, 1-11.

URL: www.aessweb.com

AN ASSYMETRIC EVALUATION OF OIL PRICE- INFLATION NEXUS: EVIDENCE FROM NIGERIA

Ahmed S. Alimi[1+]
Oladotun D. Olaniran[2]
Timothy Ayuba[3]

[1]*Federal Ministry of Women Affairs, Abuja, Nigeria.*
Email: ahmedshina8@gmail.com Tel: +2348138664353
[2]*Department of Economics, Obafemi Awolowo University, Ile-Ife, Nigeria.*
Email: olanirandotun@gmail.com Tel: +2347032407094
[3]*Department of Economics, University of Abuja, Abuja, Nigeria.*
Email: ayuba222@yahoo.com Tel: +2348067514585

(+ Corresponding author)

Article History
Received: 5 December 2019
Revised: 8 January 2020
Accepted: 12 February 2020
Published: 2 March 2020

Keywords
Oil price
Inflation
Nonlinear ARDL
Brent oil price
West texas intermediate oil price
Nigeria.

JEL Classification:
Q4; E31.

ABSTRACT

This paper investigates the asymmetric oil price-inflation nexus in Nigeria covering the period of 2009Q1 and 2018Q4. We adopt the Nonlinear Autoregressive Distributed Lags (NARDL) model approach. The result of the study indicates that there exists a nonlinear long run connection between international oil price and inflation in Nigeria which suggests that fluctuations in oil price influence domestic inflation in Nigeria asymmetrically. Further, the result of the study indicates that in the long run, both increase and decrease in global oil price exerts a negative effect on inflation, that is, rise and fall in global oil price will lead to decline in inflation. However, in the short run, increase in global oil price exerts a positive influence on inflation which implies that positive oil price shock is inflationary. The study therefore recommends that government need to source for alternative energy in order to minimize the influence of international oil price shocks on domestic price level.

Contribution/ Originality: This study contributes to the existing literature by examining the asymmetric effect of oil price on inflation in Nigeria. Using the Nonlinear Autoregressive Distributed Lags (NARDL) model, the study established that in the long run, both increase and decrease in global oil price exerts a negative effect on inflation in Nigeria.

1. INTRODUCTION

The role international oil price play in the economies of oil importing and oil exporting countries cannot be trivialized (Salisu, Isah, Oyewole, & Akanni, 2017). This is because oil price influences several macroeconomic variables and economic activities in the economy, ranging from the government's fiscal activities (revenue and expenditure), exchange rate stability (since oil price is determined in the world oil market in US dollars) and inflation (in terms of business activities and the value of money) to mention a few (Lacheheb & Sirag, 2019). Studies have argued that oil price instability affects industrial sector performance, stock market efficiency, price stability and overall economic growth (Kelikume, 2017; Muhammad, Suleiman, & Kouhy, 2012; Turhan, Sensoy, & Hacihasanoglu, 2014; Volkov & Yuhn, 2016).

Jammazi, Lahiani, and Nguyen (2017) argued that a country's vulnerability to oil price fluctuations depends largely on the existence, degree and duration of the country's oil profile and US dollar exchange rate volatility under a flexible exchange rate regime. Theoretically, the oil price-inflation nexus has been a longstanding debate in macroeconomics (Hammoudeh & Reboredo, 2018). For instance, the Keynesians are of the view that regulating the role of oil price fluctuations on the economy should be one of the primary responsibilities of the government and the monetary authorities in oil dependent countries (Long & Liang, 2018). The theoretical argument is that there should be a positive correlation between oil prices and inflation. This suggests that inflation is also expected to rise in the economy as oil is an integral input for finished goods producers when oil prices rise in the economy (see (Hamilton, 1983; Hammoudeh & Reboredo, 2018)).

Generally, the empirical analysis of oil price-inflation nexus has been a continuous subject of debate among economic researchers and policy makers (Salisu et al., 2017). The reason for this is that oil is very essential and crucial to economic activities such as transportation in the case of petrol and diesel for automobiles, kerosene for domestic activities of cooking and gasoline for jet engines, airplanes etc. (Liu & Tsang, 2008; Salisu et al., 2017). A positive shock in international oil price raises the cost of transportation and by implication, the cost of production of business firms (Kelikume, 2017; Muhammad et al., 2012; Volkov & Yuhn, 2016). This in turn generates inflation through the increase in the prices of goods and services in the economy. Beyond this, in an oil dependent economy like Nigeria, one important policy responsibility of the monetary authorities is to achieve the macroeconomic goal of price stability in the economy in order to preserve the value of the domestic currency.

Since variations in oil price is capable of exerting inflationary pressures on the economy, it becomes imperative to understand the nature of the connection between international oil price and inflation in Nigeria, as it will guide in making appropriate policies as regards the achievement of price stability in the economy. Furthermore, global economic occurrences such as the US terrorist attack in 2001, the attack on Iraq between 2002 and 2005 and the Global Financial Crisis (hereafter, GFC) of 2007 have far reaching effects on the price of crude oil in the international oil market (Kocaarslan & Soytas, 2019). Thus, changes in oil price (oil price increase and decrease) may significantly influence price stability differently in the economy (Long & Liang, 2018).

Empirically, previous empirical studies have examined the symmetric (linear) effect of oil price on inflation (see Kelikume (2017)) while few studies have examined the asymmetric (non-linear) oil price-inflation nexus is on regional basis within a panel framework (see (Meyer, Sanusi, & Hassan, 2018; Salisu et al., 2017; Sek, Teo, & Wong, 2015; Umar & Chin, 2018)). Beyond this, studies on the non-linear oil price-inflation nexus in Nigeria is still quite scanty when compared with those carried out in developed countries and other regions. This study assessed the asymmetric oil price-inflation nexus in the post-GFC era i.e. between 2009 and 201. Moreover, sudden and unexpected oil price fluctuations in the last decade and the continuous differentials in global flux and foreign exchange rates, as a result of global economic and financial contagion among countries, necessitates the need to investigate the asymmetric oil price-inflation nexus in an oil dependent country like Nigeria. In addition, little is known about the direction, magnitude and significance of asymmetric oil price-inflation nexus in Nigeria.

Thus, the main contribution of this study to the existing oil price-inflation nexus literature in Nigeria is its examination of the possible nonlinear relationship between variables using the nonlinear autoregressive distributed lag (NARDL) model propounded by Shin, Yu, and Greenwood-Nimmo (2014) to assess the short- and long-run nonlinear oil price-inflation nexus in Nigeria. It is important to take into account the asymmetric relationship because a positive or negative change in one variable does not have the same effect on the other. In addition, the existence of nonlinear nexus between oil price and inflation could be attributed to a number of factors, including the nature of the applied economic system and the processes producing the variables under research (Shahbaz, Van Hoang, Mahalik, & Roubaud, 2017). Also, the existence of asymmetric relationship between variables is traceable to a number of factors which notably includes the complexity of the economic system practiced and the mechanisms that generate the variables under study (Shahbaz et al., 2017). Beyond this, this analysis will follow the structural breakpoint unit root test to consider possible unidentified structural breaks that may occur in the time series being tested, as inflation remains a major macroeconomic variable that has been unsatisfactorily performing in Nigeria to date. Lastly, finally, the findings of this study will provide policymakers with insights into the course and magnitude of increase and decrease variations in oil prices on inflation in order to formulate effective policies to address thorns in oil prices. The remainder of the paper is structured as follows: Section 2 presents the review of empirical literature; Section 3 details methodology while empirical result and discussion is reported in section 4 and Section 5 presents the conclusion.

2. EMPIRICAL LITERATURE

The oil price-inflation nexus has been a subject of intense scrutiny in the empirical literature where studies attempt to establish whether oil price shocks upsurges or mitigates inflation in their studies. For instance, Kelikume (2017) analyzed the nexus amongst oil price, exchange rate and inflation in Nigeria spanning 2006 and 2016 and established that global oil price and exchange rate heighten inflation. Focusing on oil importing and exporting countries, Salisu et al. (2017) explores the asymmetric oil price-inflation nexus from 2000 to 2014 and established that oil price increase upsurge inflation and oil price decrease lower inflation in oil exporting countries whereas in oil importing countries, increase and decrease in oil price tend to be inflationary. Likewise, Meyer et al. (2018) utilized panel NARDL technique to evaluate oil price-food price nexus in 31 oil dependent nations spanning 2001 and 2014. The result revealed that in global oil price increase heightens food price but lower food price in the short run. In a related study, Umar and Chin (2018) discover that rise and fall in oil price money supply and exchange rate exert a positive role on inflation in Nigeria, Algeria, Angola and Libya.

Using quarterly data from 1998 to 2014 and NARDL estimation, Long and Liang (2018) established that oil price surges positively influence inflation while fall in global oil price marginally reduce inflation in China. Recently, Lacheheb and Sirag (2019) explored the asymmetric oil price-inflation nexus in Algeria. Using Nonlinear Autoregressive Distributed Lag (NARDL) model on yearly data from 1970 and 2014, the study find that positive oil price aggravate inflation whereas negative oil price lessen inflation. Gao, Kim, and Saba (2014) assessed the role of oil price shocks on consumer price in the US from 1974 to 2014 and discovered that oil price shock positively influences energy-intensive CPIs. With a sample of 26 countries spanning 1970–2017, Lòpez-Villavicencio and Pourroy (2019) evaluate the transmission mechanism of oil price fluctuations to inflation and find evidence that negative oil price shock heightens inflation than positive oil price. However, in a specific country study, Hammoudeh and Reboredo (2018) applied NARDL and established that U.S. market-based inflation heighten when international oil price rises beyond US $67/barrel. Also, Pal and Mitra (2019) evaluate the oil price-inflation nexus in US from Jan. 1990 to Jun. 2019. The study established that oil price rise aggravates consumer price index while consumer price index reacts slowly to a fall in oil price.

Xuan and Chin (2015) established that oil price positively influenced consumer price in Malaysia. Also, in Malaysia, the study of Ibrahim (2015) evaluate the nonlinear oil price-food price nexus between 1971 to 2012. The result of the NARDL indicates that oil prices increase upsurge food prices, while oil price decrease has no effect on food prices. The study of Sek (2017) consider the oil price-domestic price indices (proxied by consumer and producer prices, output and import price). The author discovered that rise in oil price leads to greater output growth, import, consumer and production prices. Lastly, in Gulf Cooperation Council Countries, Nusair (2019) applied NARDL to investigate oil price-inflation nexus and established that oil price increase intensifies inflation whereas oil price fall negatively influence inflation. From the literature review, it is evident that most of the prior studies have focused on the symmetric (linear) oil price-inflation nexus (see Kelikume (2017)) while the selected few that examined the asymmetric (non-linear) relationship between them did them on regional basis within a panel framework (see (Meyer et al., 2018; Nusair, 2019; Salisu et al., 2017; Umar & Chin, 2018)). Nevertheless, there is no single study that has investigated the asymmetric link between oil price and inflation in Nigeria in spite of being a major oil exporting and dependent country. Hence, this study investigates the asymmetric oil price-inflation in Nigeria by adopting the Nonlinear ARDL estimation technique developed by Shin et al. (2014).

3. METHODOLOGY

3.1. Model Specification

Following Pal and Mitra (2019) oil price-inflation nexus is model as:

$$CPI = f(OILP) \quad [1]$$

Where CPI is a proxy for inflation and $OILP$ is oil price.
The functional and log-linear form Equation 1 is expressed as:

$$InCPI_t = \sigma + \delta InOILP_t + \varepsilon_t \quad [2]$$

Where $InCPI$ represents log of inflation, $InOILP$ symbolize log of oil price and ε_t denote stochastic disturbance term at time t.

The standard linear ARDL model of Equation 2 is specified as:

$$\Delta InCPI_t = \sigma_0 + \sum_{j=1}^{p} \psi_j \Delta InInCPI_{t-j} + \sum_{j=0}^{q} \delta_j \Delta InOILP_{t-j} + \lambda_1 InCPI_{t-1} + \lambda_2 InOILP_{t-1} + \varepsilon_t \quad [3]$$

Where $InCPI$ represents log of inflation, $InOILP$ denote log of Brent oil price. In addition, first difference operator is denotes by Δ, the coefficients of the short run multiplier is signified by ψ and δ while long-run multipliers is denoted by $\lambda_1 - \lambda_2$ and ε_t is the stochastic disturbance term.

This study utilizes the Nonlinear Autoregressive Distributed Lag (NARDL) approach of Shin et al. (2014) to evaluate the asymmetric nexus between oil price $(OILP)$ on inflation (CPI) because the NARDL framework uses negative (decrease) and positive (increase) partial sum decomposition to model asymmetric relationship between variables (Shin et al., 2014). Also, it is appropriate when the order of integration of the variable of interest does not exceed one (Raza, Shahzad, Tiwari, & Shahbaz, 2016). Lastly, it provides better estimate/result in the case of small sample sizes (Kocaarslan & Soytas, 2019). In conformity with Shin et al. (2014) the nonlinear long-run model is specified as:

$$x_t = \phi^+ z_t^+ + \phi^- z_t^- + \varepsilon_t \quad [4]$$

Where x_t and z_t represents inflation (CPI) and oil price (OILP) respectively while ϕ^+ and ϕ^- are the long run estimate. z_t is the vector of $k*1$ exogenous variables expressed as:

$$z_t = z_0 + z_t^+ + z_t^- \quad [5]$$

Oil price ($OILP$) is apportioned into its increase $\Delta OILP_t^+$ and decrease $\Delta OILP_t^-$ partial sums such that:

$$\Delta OILP_t^+ = \sum_{m=1}^{t} \Delta OILP_m^+ = \sum_{m=1}^{t} \max(\Delta OILP_m, 0) \quad [6]$$

$$\Delta OILP_t^- = \sum_{m=1}^{t} \Delta OILP_m^- = \sum_{m=1}^{t} \min(\Delta OILP_m, 0) \quad [7]$$

The NARDL form of Equation 3 is specified as:

$$\Delta InCPI_t = \sigma_0 + \sum_{m=1}^{p} \psi_m \Delta InCPI_{t-m} + \sum_{m=0}^{q} (\delta_m^+ \Delta InOILP_{t-m}^+ + \delta_m^- \Delta InOILP_{t-m}^-) + \lambda InCPI_{t-1} + \phi_{oilp}^+ InOILP_{t-j}^+ + \phi_{oilp}^- InOILP_{t-1}^- + \varepsilon_t \quad [8]$$

The increase and decrease partial sums decomposition of Equation 6 and 7 is represented by (+) and (–) in Equation 8. From Equation 8, ϕ^+ and ϕ^- denotes the long-run asymmetry and the short-run asymmetry is represented by δ^+ and ϕ^-. The presence of long-run asymmetry is tested using the Wald test with null hypothesis that $\phi^+ = \phi^-$ where the positive long run coefficient is denoted by $L^+ = -\phi^+ / \lambda$ and the negative long run coefficient is represented by $L^- = -\phi^- / \lambda$. Similarly, Wald test is employed to determine the short run asymmetry with null hypothesis of $\delta^+ = \delta^-$.

Lastly, dynamic multipliers associated with the asymmetric responses of inflation to rise and fall change of the oil price is expressed as:

$$j_h^+ = \sum_{m=0}^{h} \frac{\partial \ln CPI_{t+m}}{\partial InOILP^+} \quad \text{and} \quad j_h^- = \sum_{m=0}^{h} \frac{\partial \ln CPI_{t+m}}{\partial InOILP^-} \quad [9]$$

Note that $h \rightarrow \infty$, then $j_h^+ \rightarrow L^+$, and $j_h^- \rightarrow L^-$ where L^+ and L^- are the asymmetric long-run coefficients calculated as $L^+ = -\phi^+ / \lambda$ and $L^- = -\phi^- / \lambda$.

3.2. Source of Data

The study utilizes quarterly data on oil price and inflation rate from 2009Q1 to 2018Q4. Data on inflation rate was sourced from International Financial Statistics whereas quarterly data on Brent oil price and West Texas Intermediate was sourced from the US Energy Information Administration (US EIA) respectively.

4. EMPIRICAL FINDING AND DISCUSSION

The empirical result for this study is organized as follows: (i) Stage one focuses on descriptive statistics and graphical analysis of oil price-inflation nexus in Nigeria; (ii) stage two concentrate on unit root tests using both traditional and structural break unit root tests to check the order of integration of the series employed; (iii) stage three entails cointegration test, NARDL result and diagnostics tests; and (iv) robustness check.

4.1. Descriptive Statistics

This section focuses on the preliminary analysis such as the descriptive statistic and the graphical analysis of oil price-inflation nexus in Nigeria over the period under consideration. Table 1 report the result of the descriptive statistic and the mean of Brent crude oil price per barrel is $79.28 and ranges between $118.49 and $33.69 while the average of inflation is 11.82 with maximum value of 18.45 and least value of 7.84. In addition, inflation is found to be the least volatile as indicated by the standard deviation while crude oil price exhibits the highest volatility over the study period. This implies that fluctuations in oil price in Nigeria are more pronounced than fluctuations in inflation in the post-GFC era, thereby revealing that oil price is more susceptible to shocks (domestic and external) than inflation in Nigeria during the period of study. Brent crude oil price and inflation are positively skewed and the kurtosis statistics shows that the distribution of both Brent oil price and inflation is less peaked relative to the normal distribution. The Jarque-Bera test result indicates the non-normality of Brent crude oil price and inflation.

As a way of further examining the dataset used in this paper, we employ the use of graphs see Figure 1 due to the fact that it enables us to visually examine the co-movement of oil price and inflation in Nigeria during the period of study. Oil price and inflation moved in different directions from the graph, indicating the absence of co-movement between the variables. However, the two proxies of oil price seemed to exhibit similar characteristics as they almost moved in the same direction during the period of study. Also, oil price is found to be more volatile than inflation in the post-GFC era, as it fluctuated more during the period of study. In addition, the graph revealed that inflation in Nigeria became significantly higher than oil price between 2014 and 2018. The reason for this is evident in the drastic fall in oil revenue experienced by the government during this period, which led to the recent economic recession experienced in Nigeria, which worsened the performance of key macroeconomic variables including inflation.

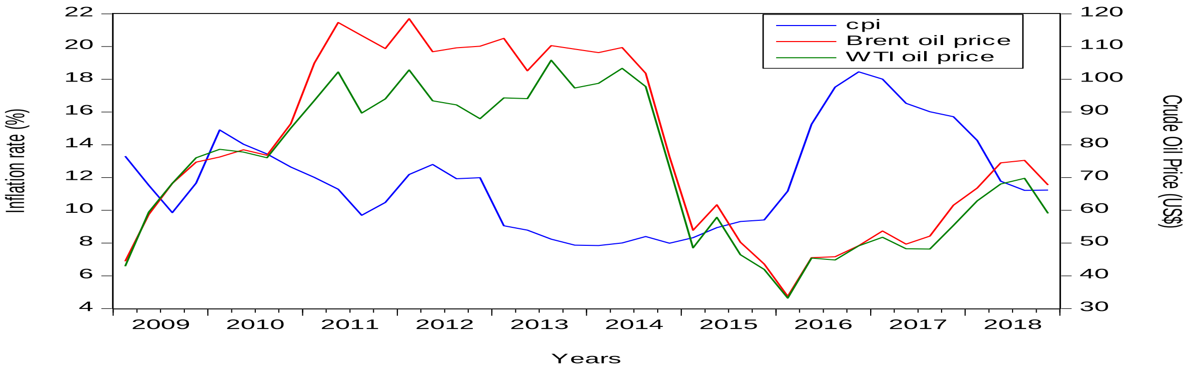

Figure-1. Trend of oil price (Brent and WTI) and inflation in Nigeria (2009Q1-2018Q4).

Source: Data on inflation rate was sourced from International Financial Statistics whereas quarterly data on Brent oil price and West Texas Intermediate was sourced from the US Energy Information Administration (US EIA) respectively

Table-1. Descriptive statistics.

	Mean	Max	Min	SD	SK	KTS	JB	Prob
CPI	11.82	18.45	7.84	3.01	0.53	2.37	2.53	0.28
OILP	79.28	118.49	33.69	26.45	0.05	1.54	3.56	0.16

Note: CPI and OILP represents inflation rate (proxy by consumer price index) and Brent oil price respectively.

4.2. Stationarity Test

We attempt to evaluate of the time series properties of the series employed in this study, both traditional unit root tests (Augmented Dickey and Fuller (ADF), Phillips and Perron (P–P) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS). The result of the unit root test is presented in Table 1 and disclosed that both inflation *(LCPI)* and global oil price (*LOILP)* series are stationary at first difference. However, the result of the KPSS unit root test revealed that both inflation *(LCPI)* and global oil price (*LOILP*) series are stationary in the level form.

However, the traditional unit root tests fail to accommodate structural break in the series which may lead to biased and spurious results. To overcome this problem, we employ Zivot and Andrews (ZA) and Lee and Strazicich LM unit root test to detect the structural break date of the variables employed. The result of Zivot–Andrews and Lee and Strazicich LM unit root test is presented in Table 3. The results showed that both inflation *(LCPI)* and global oil price (*LOILP)* series are stationary at first difference with most of the break occurring between 2014Q1 and 2017Q1. Thus, the structural breakpoint unit root test supports the findings of the traditional unit root tests, indicating that all the series are I(1). Hence, the order of integration of the variables supports the adoption of the nonlinear Autoregressive Distributed Lag (NARDL) model adopted in this study.

Table-2. Stationarity tests.

	ADF Test		PP Test		KPSS Test	
Variables	**Level**	**First Diff**	**Level**	**First Diff**	**Level**	**First Diff**
LCPI	-2.1955	-3.9927**	-1.8989	-4.0255**	0.1277**	0.0884
LOILP	-2.5368	-5.1419***	-2.5535	-5.1419***	0.1259**	0.2851

Note: CPI and OILP represents inflation rate (proxy by consumer price index) and Brent oil price respectively. Note 2: ***, **, * indicate statistical significance at 1%, 5% and 10% respectively.

Table-3. Zivot–Andrews and Lee and Strazicich structural break unit root test.

Variables Test	Zivot–AndrewsTest		Lee and Strazicich LM	
	T-Stat	**Break Date**	**T-Stat**	**Break Date**
LCPI	-3.0912	2014Q1	-4.0452	2015Q4
LOILP	-4.3764	2014Q4	-3.0774	2014Q2
ΔLCPI	-4.4476**	2017Q1	-4.6655**	2012Q2
ΔLOILP	-7.7705***	2016Q2	-5.9887***	2015Q3

Note : CPI and OILP represents inflation rate (proxy by consumer price index) and Brent oil price respectively. Note 2: ***, **, * indicate statistical significance at 1%, 5% and 10% respectively while Δ is the difference operator.

4.3. Cointegration Test

The result of the NARDL bounds test for asymmetric cointegration is reported in Table 4. From the result, the associated F-statistics is given as 5.806 with lower and upper bound value of 3.79 and 4.85 respectively at 5% level of significance. Since the F-statistics value of 5.053 exceed the upper bound value of 4.85 at 5% level of significance, which implies that there is asymmetric long run connection between Brent crude oil price and inflation in Nigeria. This finding lends credence to the significance of asymmetry in the link between oil price and inflation in Nigeria.

Table-4. Bounds test for nonlinear cointegration.

Model Specification	F-Stat	Lower Bound	Upper Bound	Conclusion
Nonlinear	5.053	3.79	4.85	Cointegration

Having confirmed the presence of nonlinear long run connection between oil price and inflation, we proceed to analyze the nonlinear oil price-inflation nexus in Nigeria. Table 5 reports the asymmetric result on oil price and inflation. The result indicates that both increase and decrease change in oil price is negatively related to inflation. This result indicates that both rise and fall in global oil price will decrease inflation by 0.14% and 0.18% respectively, that is, both hike and decline in global oil price are not inflationary in the long run. This result of the positive change in oil price negates the findings of Xuan and Chin (2015); Umar and Chin (2018) and Long and Liang (2018) who suggested that increase in oil price aggravate inflation whereas the finding of the negative shock in oil price corroborates the result of Salisu et al. (2017) and Nusair (2019) who established that negative oil price shocks lessen inflation in oil exporting countries.

In the short run, positive oil price shock (at lag 3, 4 and 5) are positively related to inflation which suggests that increase in oil price heighten inflation in the short run because upsurge in oil price increases production cost of goods and thereby leads to decrease in the quantity supply of other goods due to high cost of production. This result conforms with the finding of Lacheheb and Sirag (2019) who finds that oil prices aggravates inflation in the short run in Algeria. By contrast, the result shows that fall in global oil price (at lag 2) is negatively related to inflation in the short run. This outcome substantiates the findings of Salisu et al. (2017) whose study established a negative connection between decrease in oil price and inflation in oil dependent nations.

The result of the positive and negative long run variation in global price, that is, L^{+}_{Loilp} and L^{-}_{Loilp} indicate that both hike or drop in global oil price lessen inflation. Precisely, a 1% rise or fall in international oil price will decline inflation by 0.48% and 0.63% respectively. The Wald test is applied to assess the presence of asymmetric in the NARDL model. Since the probability value of the short and long run Wald test statistics reported in the third section of Table 5 is significant at 5%, the null hypothesis of short and long-run symmetry between the positive and negative oil price and inflation is rejected. Thus, there is asymmetric long and short run link in the oil price-inflation in Nigeria which suggests that disregarding asymmetric and nonlinearity in oil price-inflation nexus in Nigeria may lead to bias conclusion. Furthermore, the R^2 indicates that Brent oil price explains 77.34% of the variation in domestic inflation in Nigeria while the F-statistics (F=7.51) indicates that the estimated regression coefficient is statistically significantly different from zero.

In addition, in order to test the reliability and consistency of the NARDL model, we employ some diagnostic tests. The result of the diagnostic test in the last section of Table 5 shows that there is no serial correlation while the variance of the stochastic disturbance term is constant (homoscedasticity) and the NARDL model is specified correctly. Also, the CUSUM and CUSUMSQ Figures 2 and Figure 3 test statistics is applied to test the stability of the model. Since neither the CUSUM nor CUSUMSQ test statistics exceed the lower and upper bounds (represented by the two straight lines) at the 5% level of significance, we conclude the NARDL model is stable and efficient.

Table-5. NARDL Result on oil price-inflation nexus in Nigeria (BRENT).

Dependent Variable: LCPI				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Long run Estimate				
C	0.7337	0.1776	4.1291	0.0004***
LCPI (-1)	-0.2966	0.0827	-3.5837	0.0017***
$LOILP^+$	-0.1877	0.0996	-1.9837	0.0429**
$LOILP^-$	-0.1427	0.0617	-2.3110	0.0306**
Short run Estimate				
$\Delta LOILP^-$ (-2)	-0.2979	0.1563	-1.9054	0.0699*
$\Delta LOILP^+$ (-3)	0.5970	0.1735	3.4412	0.0023***
$\Delta LOILP^+$ (-4)	0.8114	0.1826	4.4420	0.0002***
ΔLCPI (-4)	-0.3104	0.1344	-2.3100	0.0306**
$\Delta LOILP^+$ (-5)	0.4341	0.1821	2.3829	0.0262**
Δ LCPI (-2)	0.4825	0.1602	3.0115	0.0064***
$\Delta LOILP^+$	0.4727	0.2366	1.9979	0.0582*
R^2	0.7734			
F-Statistics	7.5111			0.0000***
Long run coefficient and Asymmetric result				
L^+_{Loilp}	-0.6328			0.0411**
L^-_{Loilp}	-0.4811			0.0251**
$W_{LR,LOIP}$	3.9342			0.0443**
$W_{SR,LOIP}$	5.3837			0.0035***
Diagnostic Test	**Test Value**			**Prob.**
Normality	0.1730			0.9171
Serial Correlation	1.9316			0.3807
Heteroskedasticity	10.5662			0.3923
Ramsey Reset	0.0145			0.9052

Note : CPI and OILP represents inflation rate (proxy by consumer price index) and Brent oil price respectively. The positive and negative partial sum are represented by "+" and "-". Furthermore, L^+_{oilp} and L^-_{oilp} are the asymmetric long run coefficients associated with positive and negative variation in oil price. Lastly, $W_{LR,LOILP}$ denote the Wald test for the long run symmetry and $W_{SR,LOILP}$ signify Wald test for short run symmetry.

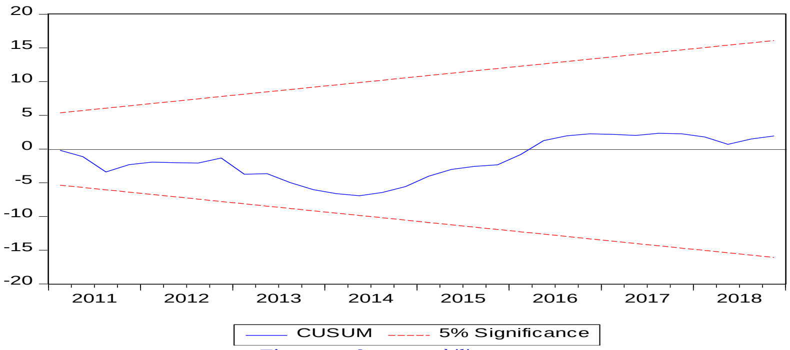

Figure-2. Cusum stability test.

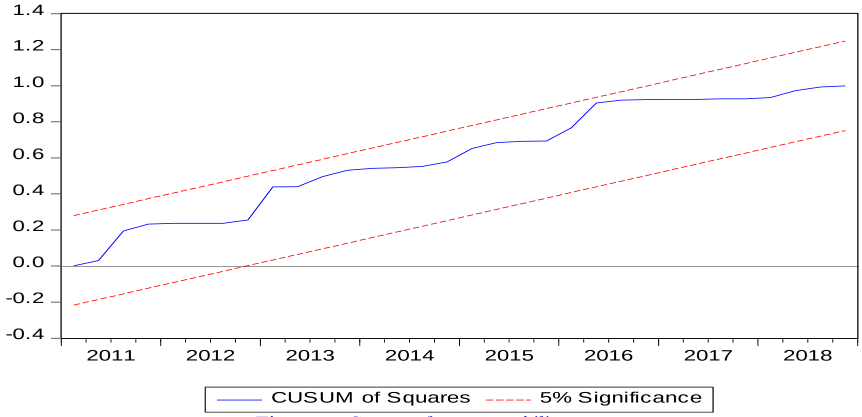

Figure-3. Cusum of square stability test.

Table-6. NARDL Result on oil price-inflation nexus in Nigeria (WTI).

Dependent Variable: LCPI				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Long run Estimate				
C	0.6272	0.1556	4.0307	0.0005***
LCPI (-1)	-0.2085	0.0624	-3.3412	0.0028***
$LWTI^{+}$	-0.3341	0.0920	-3.6298	0.0014***
$LWTI^{-}$	-0.2331	0.0630	-3.7010	0.0012***
Short run Estimate				
ΔLCPI (-4)	-0.4483	0.1461	-3.0684	0.0054***
$\Delta LWTI^{-}$ (-5)	-0.4668	0.1891	-2.4679	0.0215**
$\Delta LWTI^{+}$ (-3)	0.5454	0.1986	2.7451	0.0115**
$\Delta LWTI^{+}$ (-1)	0.5018	0.2002	2.5058	0.0197**
$\Delta LWTI^{+}$ (-5)	0.5731	0.2198	2.6073	0.0157**
$\Delta LWTI^{+}$ (-4)	0.6258	0.2208	2.8343	0.0094***
R^2	0.7146			
F-Statistics	6.4001			0.0001***
Long run coefficient and Asymmetric Estimate				
L^{+}_{LWTI}	-1.6023			0.0005***
L^{-}_{LWTI}	-1.1179			0.0004***
$W_{LR,LWTI}$	6.6580			0.0167**
$W_{SR,LWTI}$	5.1774			0.0040***
Diagnostic Test	**Test Value**			**Prob.**
Normality	0.6344			0.7281
Serial Correlation	3.7232			0.1554
Heteroskedasticity	10.2649			0.3295
Ramsey Reset	0.8830			0.3576

Note : CPI and OILP represents inflation rate (proxy by consumer price index) and WTI oil price respectively. The positive and negative partial sum are represented by "+" and "-". Furthermore, L^{+}_{oilp} and L^{-}_{oilp} are the asymmetric long run coefficients associated with positive and negative variation in oil price. Lastly, $W_{LR,LOILP}$ denote the Wald test for the long run symmetry and $W_{SR,LOILP}$ signify Wald test for short run symmetry.

4.4. Robustness Checks

In order to establish the validity of our findings, we use alternative proxy for the global oil price using WTI in place of Brent. The results of the WTI global oil price is reported in Table 6. Notably, the results did not differ from the main results in terms of signs and significance while the only difference is in terms of the extent of impacts which is anticipated. Thus, the result is insensitive to the oil price proxy.

5. CONCLUSION

This study examines the asymmetric oil price-inflation nexus in Nigeria spanning 2009Q1 to 2018Q4 using Nonlinear Autoregressive Distributed Lags (NARDL) model. The study finds an asymmetric long run connection between oil price and inflation which suggests that fluctuations in oil price influence domestic inflation in Nigeria asymmetrically. Further, the result of the study indicates that increase and decrease in global oil price lessen inflation in the long, that is, both hike and drop in global oil price will lead to decline in inflation in the long run. However, in the short run, increase in global oil price exerts a positive influence on inflation which implies that positive oil price shock is inflationary in the short run. Based on this result, the study recommended that government need to source for alternative energy in order to minimize the influence of international oil price shocks on domestic price level in Nigeria.

Funding: This study received no specific financial support.
Competing Interests: The authors declare that they have no competing interests.
Acknowledgement: All authors contributed equally to the conception and design of the study.

REFERENCES

Gao, L., Kim, H., & Saba, R. (2014). How do oil price shocks affect consumer prices? *Energy Economics*, *45*, 313-323.Available at: https://doi.org/10.1016/j.eneco.2014.08.001.

Hamilton, J. D. (1983). Oil and the macroeconomy since World War II. *Journal of Political Economy*, *91*(2), 228-248.Available at: https://doi.org/10.1086/261140.

Hammoudeh, S., & Reboredo, J. C. (2018). Oil price dynamics and market-based inflation expectations. *Energy Economics*, *75*, 484-491.Available at: https://doi.org/10.1016/j.eneco.2018.09.011.

Ibrahim, M. H. (2015). Oil and food prices in Malaysia: A nonlinear ARDL analysis. *Agricultural and Food Economics*, *3*(1), 1-14.Available at: https://doi.org/10.1186/s40100-014-0020-3.

Jammazi, R., Lahiani, A., & Nguyen, D. K. (2017). A wavelet-based nonlinear ARDL model for assessing the exchange rate pass-through to crude oil prices. *Journal of International Financial Markets, Institutions and Money*, *34*, 173-187.Available at: https://doi.org/10.1016/j.intfin.2014.11.011.

Kelikume, I. (2017). Do exchange rate and oil price shocks have asymmetric effect on inflation? Some evidence from Nigeria. *The Journal of Developing Areas*, *51*(4), 271-283.Available at: https://doi.org/10.1353/jda.2017.0101.

Kocaarslan, B., & Soytas, U. (2019). Asymmetric pass-through between oil prices and the stock prices of clean energy firms: New evidence from a nonlinear analysis. *Energy Reports*, *5*, 117-125.Available at: https://doi.org/10.1016/j.egyr.2019.01.002.

Lacheheb, M., & Sirag, A. (2019). Oil price and inflation in Algeria: A nonlinear ARDL approach. *The Quarterly Review of Economics and Finance*, *73*, 217-222.Available at: https://doi.org/10.1016/j.qref.2018.12.003.

Liu, L., & Tsang, A. (2008). Pass-through effects of global commodity prices on China's inflation: An empirical investigation. *China & World Economy*, *16*(6), 22-34.Available at: https://doi.org/10.1111/j.1749-124x.2008.00135.x.

Long, S., & Liang, J. (2018). Asymmetric and nonlinear pass-through of global crude oil price to China's PPI and CPI inflation. *Economic Research*, *31*(1), 240-251.Available at: https://doi.org/10.1080/1331677x.2018.1429292.

Lòpez-Villavicencio, A., & Pourroy, M. (2019). Inflation target and (a) symmetries in the oil price pass-through to inflation. *Energy Economics*, *80*, 860-875.Available at: https://doi.org/10.1016/j.eneco.2019.01.025.

Meyer, D. F., Sanusi, K. A., & Hassan, A. (2018). Analysis of the asymmetric impacts of oil prices on food prices in oil-exporting developing countries. *Journal of International Studies, 11*(3), 82-94.Available at: https://doi.org/10.14254/2071-8330.2018/11-3/7.

Muhammad, Z., Suleiman, H., & Kouhy, R. (2012). Exploring oil price—exchange rate nexus for Nigeria. *OPEC Energy Review, 36*(4), 383-395.Available at: https://doi.org/10.1111/j.1753-0237.2012.00219.x.

Nusair, S. A. (2019). Oil price and inflation dynamics in the Gulf Cooperation Council countries. *Energy, 181*, 997-1011.Available at: https://doi.org/10.1016/j.energy.2019.05.208.

Pal, D., & Mitra, S. K. (2019). Asymmetric oil price transmission to the purchasing power of the US Dollar: A multiple threshold NARDL modelling approach. *Resources Policy, 64*, 101508.Available at: https://doi.org/10.1016/j.resourpol.2019.101508.

Raza, N., Shahzad, S. J. H., Tiwari, A. K., & Shahbaz, M. (2016). Asymmetric impact of gold, oil prices and their volatilities on stock prices of emerging markets. *Resources Policy, 49*, 290-301.Available at: https://doi.org/10.1016/j.resourpol.2016.06.011.

Salisu, A. A., Isah, K. O., Oyewole, O. J., & Akanni, L. O. (2017). Modelling oil price-inflation nexus: The role of asymmetries. *Energy, 125*, 97-106.Available at: https://doi.org/10.1016/j.energy.2017.02.128.

Sek, S. K. (2017). Impact of oil price changes on domestic price inflation at disaggregated levels: Evidence from linear and nonlinear ARDL modeling. *Energy, 130*, 204-217.Available at: https://doi.org/10.1016/j.energy.2017.03.152.

Sek, S. K., Teo, X. Q., & Wong, Y. N. (2015). A comparative study on the effects of oil price changes on inflation. *Procedia Economics and Finance, 26*, 630-636.Available at: https://doi.org/10.1016/s2212-5671(15)00800-x.

Shahbaz, M., Van Hoang, T. H., Mahalik, M. K., & Roubaud, D. (2017). Energy consumption, financial development and economic growth in India: New evidence from a nonlinear and asymmetric analysis. *Energy Economics, 63*, 199-212.Available at: https://doi.org/10.1016/j.eneco.2017.01.023.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In: Horrace, W.C., Sickles, R.C. (Eds.), Festschrift in honor of Peter Schmidt: Econometric methods and applications (pp. 281–314). New York: Springer Science and Business Media.

Turhan, M. I., Sensoy, A., & Hacihasanoglu, E. (2014). A comparative analysis of the dynamic relationship between oil prices and exchange rates. *Journal of International Financial Markets, Institutions and Money, 32(C)*, 397-414.

Umar, B., & Chin, L. (2018). Asymmetric impacts of oil price on inflation: An empirical study of African OPEC member countries. *Energies, 11*, 1-21.Available at: https://doi.org/10.3390/en11113017.

Volkov, N. I., & Yuhn, K.-H. (2016). Oil price shocks and exchange rate movements. *Global Finance Journal, 31*, 18-30.Available at: https://doi.org/10.1016/j.gfj.2016.11.001.

Xuan, P., & Chin, L. (2015). Pass-through effect of oil price into consumer price: An empirical study. *International Journal of Economics and Management, 9(S)*, 143-161.