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Oil Price Fluctuations and Inflation Rate in Nigeria

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Abstract

This study examined effects of oil (crude and premium motor spirit (PMS)) price fluctuations on inflation rate in Nigeria using annual time series data spanning from 1980 to 2023.Augmented Dickey Fuller (ADF) test was used for unit root test to avoid spurious regression estimates. In addition, the study employed Nonlinear Autoregressive Distributed Lag Model (NARDL) Bound test within the ARDL framework to capture asymmetries effects of oil price fluctuations on inflation rate. The study further employed Granger causality test to assess for causal relationship among the variables. The NARDL Bound test of cointegration confirmed long-run relationships between oil price fluctuations and inflation rate. The result of NARDL revealed that positive fluctuation in crude oil price has negative relationship with inflation in Nigeria both in the long-run and short-run while negative fluctuation in crude oil price has positive relationship with inflation in the long-run but has negative relationship with inflation in the short run. Similarly, positive and negative fluctuations in the price of PMS have positive relationship with inflation in the long run and negative in the short run. The short run negative fluctuation in the price of PMS reduced inflation in the short run. Granger causality test indicated bi-directional relationship between price of PM S and inflation rate in Nigeria. In line with the findings, the study recommended that, Nigerian national petroleum company and government should intensify effort to increase national petroleum refining capacity, attract more private investors to build more refineries and promote indigenous modular refineries, promote local contents, reverse the subsidy removal and technically remove it in phases.

Keywords: *Price Fluctuation, Crude oil, PMS, Inflation rate, Granger causality, NARDL,*

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Background to the Study

The relationship between oil price both crude and refined with inflation in global economy is a thing of concern. According to Mehmood, et al (2021), oil remains the most important sources of energy supply regardless of the advancement in technology and the availability of other renewable sources of energy supply. Oil is the main source of transportation, production, including other economic activities concerning the growth and development of world economies. The importance of oil has made oil more susceptible to the forces of demand and supply resulting to the variations in the prices of oil both in local and international oil markets (Shao &Hua 2022) Jelilov, et al (2020) noted that rise and fall in the prices of oil are the domineering source of economic instabilities, in which the consequential effect leads to international shocks, affecting numerous economic activities instantly. This shock is known typically to have a comparable impact due to incidences like a drop-in growth rate, increase in unemployment rate, high inflation rate and unpredictability in the exchange rate. In contrast, the degree of the effect of these shocks may differ depending on the position of the given economy.

Nigeria is not exceptional because she is a developing economy which is not just an exporter of crude oil but also an importer of refined oil products. Hence, the over-dependence of the Nigerian economy on oil earnings as the major source of revenue can subject key macroeconomic variables such as GDP, inflation rate, exchange rate and unemployment to fluctuations and uncertainty at the slightest world oil price shocks (Musa, Gabriel & Sesan 2021).

Nigerian economy is a less diversified economy. Hence, a large inflow from oil export causes resource pulls effect and spending effect on the economy. The excessive government spending in the booming sector transferred labour from agricultural and service sectors to the oil sector resulting to direct de-industrialization (Budina & Wijnbergen, 2008; Alhassan & Kilishi 2016; Miero& Ramos, 2010; & International Monetary Fund, 2022).Also, the revenues from oil are spent on the importation of refined oil products and payment of subsidies which captures the paradox of a nation suffering among plenty (Julia, 2022; Okechukwu,2022).

The Nigerian economy experienced several inflationary pressures due to fluctuations oil price (Julia, 2022). Yearly average inflation was up to 17.0 per cent in 2021, contrary to 13.2 per cent in 2020 and beyond the central bank's 6 to 9 per cent target. Inflation was driven by food price increases at the beginning of the year and attributed to an increase in the exchange rate (CBN, 2022). This contemporary account on the position of inflation rate in Nigeria is troublesome and causes alarm. Given these worrying results, this study was inspired using annual data from 1980 to 2022 to investigate the effects of oil price fluctuations on inflation rate in Nigeria.

Literature Review

In view to investigate the effect of oil price fluctuation on inflation in Nigeria, the study reviewed some work done by previous researchers. For example, ThankGod (2017)

investigated the relationship between inflation and oil price fluctuations in Nigeria using quarterly secondary data from 1980 to 2015. The study employed the Vector autoregressive model, the Impulse Response Function and the Forecast Error Variance Decomposition techniques, the study discovered that the response of inflation to changes in oil price is that as prices of petroleum drop, inflation decreases leading to a stable and positive petroleum price, which brings about a stable negative inflation rate; thus, the relationship between inflation and oil price fluctuation is negative.

Abatcha (2021) employed an autoregressive distributed lag model on regular-month interval data from 1991 to 2019 to analyse the impact of fluctuations in oil prices on inflation in Nigeria. The study showed that in the long run, oil price positively influences the inflation rate in Nigeria over time, which means that as oil price increases, the inflation rate rises. In the short run, oil price also shows a positive relationship with the inflation rate, following the long-run result. Finally, the study focused its analysis on crude oil prices and inflation. In an attempt to investigate if structural breaks matter in analyzing the response of inflation to oil price shocks, Joseph, Okanta and Augustine (2019) employed the Zivot-Andrews unit root test with a structural break to compare the unit root result with the conventional ADF result while the local projection impulse response function (LPIRF) was utilized to examine the response of inflation dynamics to oil price shocks in Nigeria between 1981 and 2016. The LPIRF results suggested that inflation responds significantly to shocks in oil prices and that a higher persistent level of oil price shocks exists in the exchange rate than inflation. Also, the counterfactual result conditioned on global oil market behaviour showed that inflation responded significantly to oil prices due to global oil market behaviour.

Wale-Awe and Sulaiman (2020) employed ARDL and causality techniques for analysis of inflation as a dependent variable, while Premium motor spirit (PMS), which is also known as petrol, automotive gas oil (AGO), which is commonly called diesel, and dual-purpose kerosene (DPK) as independent variables with time series data from 1980 to 2018 to examine the effect of PMS pricing on inflationary dynamics in Nigeria. The study found that the price of PMS increases inflationary tendencies in the country. At the same time, the causality test showed the absence of causality between PMS pricing and inflationary dynamics in Nigeria. Hence, the study recommended that the government stabilize the price of PMS and align it with the wage rate.

Eregha, Mesagan and Olawale (2015) examined the relationship between Petroleum Products Prices and Inflationary Dynamics in Nigeria. The study found price of Premium Motor Spirit was stable till the entry of the military into the administration of the country and increased the prices of petroleum products. The result also showed a highly positive relationship between the prices of PMS, AGO and inflation in Nigeria. The study concluded that rises in petroleum product prices, particularly PMS and AGO, significantly impact inflation in Nigeria. Therefore, the study recommended that the government should shelve the suggestion of stopping subsidies on fuel prices for now and should focus on deregulating the downstream sector to attract private investment to encourage local refining of petroleum products instead of importing them.

Ekpeyong (2021) used the data from 1980 to 2020 to examine the impact of adjusted, refined oil prices on the inflation rate in Nigeria. It was also discovered that a positive relationship exists between the prices of PMS (premium motor spirit) and inflation in the short run in Nigeria. We, therefore, conclude that rises in petroleum product prices significantly impact inflation in the short run in Nigeria. Therefore, the study recommended that the government should ignore the idea of removing subsidies on PMS for now and should focus on partnering with private individuals on the building of local refineries, which boost production and prevent imported inflation as a result of the import which will, in turn, reduce national prices for petroleum products and consequently inflation.

Bawa, Abdullahi, Tukur, Barda, and Adams (2020) examined the impact of shocks in oil prices on Nigerian inflation on quarterly data spanning 1999Q1 to 2018Q4; a Nonlinear Autoregressive Distributed Lag (NARDL) approach was used. The findings revealed that rising oil prices caused an increase in Nigeria's headline, core, and food inflation measures. However, a drop-in oil price resulted in a drop in the marginal cost of production, culminating in the moderation of domestic inflation. Furthermore, when the exchange rate is removed from the models, adverse oil price shocks result in higher inflation in Nigeria, showing that the exchange rate absorbed the impact of prices oil drops previously, as lower oil prices resulted in lower external reserves, naira depreciation, and ultimately higher inflationary pressures. Furthermore, core inflation tends to respond more to increases in oil prices than food inflation.

Bala and Chin (2018) used the dynamic panels ARDL to investigate the impacts of changes in oil prices on inflation in Algeria, Angola, Libya and Nigeria. This study applied three different oil price data: the OPEC reference basket oil price, the actual spot oil price of individual countries, and an average of the Brent, WTI and Dubai oil prices. The dynamic panels ARDL were used to estimate the short and long-run impacts. Further, the research divided oil prices into positive and negative changes to capture asymmetric impacts and discovered that both the positive and negative oil price fluctuations positively affected inflation. At the same time, the impact was more significant when oil prices declined. The study also revealed that GDP, money supply and the exchange rate positively show a relationship with inflation. However, food production is negatively associated with inflation.

Lacheheb and Sirag (2016) examined the relationship between oil price changes and the inflation rate in Algeria from 1970-2014. The study method that can capture asymmetries in the association between oil price and inflation is nonlinear autoregressive distributed lags (NARDL). The estimated model revealed the nonlinear effect of oil prices on inflation. Specifically, they found a significant relationship between oil price increases and inflation rate, whereas a significant relationship between oil price reduction and inflation was absent.

Malik (2016) estimates the effects of oil price changes on inflation in Pakistan using an augmented Phillips curve framework. Their results suggest a strong oil price-inflation relationship, significantly when oil prices have risen continuously over the past year. Agbo (2020) examined the effect of oil price changes on Nigeria's monthly inflation rate using a nonlinear autoregressive distributed lag framework. An ex-post facto research design was employed. The data comprised a Brent spot series and monthly inflation rates from January 1997 to August 2020. The study suggests that both positive and negative movements in oil prices have adverse and non-significant effects on Nigeria's inflation rate and the absence of asymmetric effects between the variables.

Tubotamuno and Ewubare (2022) Used Impulse Response Function (IRF) on annual time series data ranging from 1980-2019 and established there is an asymmetric shock between crude oil price and inflation rate but a symmetric shock between crude oil price and gross domestic product in Nigeria. This implies a negative response between crude oil prices and the inflation rate but a positive response between crude oil prices and GDP. Likewise, Adesete and Bankole (2020) employed structural vector autoregressive (SVAR) methodology and evaluated the relationship between unexpected changes in oil prices and some considered macroeconomic indicators in Nigeria. The impulse response functions were applied and examined the impact of petroleum price shocks on the Nigerian economy over different periods. The SVAR result showed that oil price shock hurts import, economic growth, investment, exchange rate and Inflation, except export in the long term. Daniel (2018) analyzed the impact of fluctuations in fuel prices on Inflation and GDP in South Africa as a substitute for fuel importing less developed nations. This research applied a quantitative approach with data ranging from 2001 to 2018. The impact of fluctuations in the price of fuel on Inflation and economic growth was examined using Johansen cointegration and Granger causality econometric models. The results showed long and short-run associations among variables. The Granger causality tests found that causality was from fuel price fluctuations to economic output and Inflation. The scope of the study needed to be more robust for the econometrics tests. The study was concerned with refined oil prices and completely ignored crude oil prices. In addition, the study should have included South Africa's exchange rates for its analysis. This study filled these gaps by considering refined and crude oil prices and including exchange rates for its analysis in Nigeria.

Ukangwa, Ikechi and Ben (2022) **e**mployed cointegration and error correction mechanism (ECM) as the econometric methods on Time series data from 1986- 2015 to analyze the prices of Automotive Gas Oil (AGO), Dual Purpose Kerosene (DPK) and Premium Motor Spirit (PMS) on Real Gross Domestic Product (RGDP), Unemployment and Inflation. The finding showed that RGDP was significantly related to the prices of Dual-Purpose Kerosene (DPK) and Premium Motor Spirit (PMS); Inflation has an insignificant relationship with the price of Dual Purpose Kerosene (DPK) and price of Premium Motor Spirit (PMS) respectively while unemployment has a significant relationship with the price of Automotive gas oil (AGO) and price of Premium Motor Spirit (PMS) and also the price of Dual Purpose Kerosene (DPK). Based on the findings, the study recommended

that oil prices of DPK, AGO and PMS as important economic variables should be strictly monitored in order to achieve a stable petroleum product market in Nigeria, and the government should diversify the economic base from oil to non-oil sector as a necessary condition for sustainability and growth.

Research Methodology

This study examines the effect of oil prices on inflation rate in Nigeria by employing nonlinear autoregressive distributed lag (NARDL) and granger causality method. The advantages of NARDL model is its ability to capture asymmetric effects of oil price fluctuation on inflation rate, and to test for cointegration when the variables are I(0) or I(1) or both (Phong, Bao& Van, 2017). It also produces statistically significant results with a small sample size. In addition, unlike other cointegration techniques, ARDL allows individual variable to take different lags length (Pesaran, Shin & Smith, 2001)

Model Specifications

The model used in this study followed the work of Onakoya and Agunbiade (2020), who examined oil Sector Performance and Nigerian macroeconomic variables. Hence, we situate the relationship between inflation rate and oil price (crude and premium motor spirit) by stating the model that inflation rate is a function of oil:

$INF = f(OP, PMS, RGDP, RER)$……. (1).

Eq (1) is stated in mathematical form below;

$INF_t = \beta_o + \beta_1 OP_t + \beta_2 PMS_t + \beta_3 RGDP_t + \beta_4 RER_t$…… (2)

But eq (2) are exact or deterministic in nature. In order to allow for the inexact relationship among the variables as in the case of most economic variables and express it in econometric form, given that other variables not in the model might influence the dependent variables, the stochastic error term "μ_t is added to eq (2). Thus eq (2) is restated in econometric form as follows:

$INF_t = \beta_o + \beta_1 OP_t + \beta_2 PMS_t + + \beta_3 RER_t + \mu_t$…… (3)

Where;
INFt = Inflation Rate measured in rate
OLP_t= Crude Oil Price measured in naira
PMS_t = Premium Motor Spirit measured in naira
RER_t = Real Exchange Rates measured in naira
μ_t= stochastic error term

Eq (3) is restated in unrestricted linear autoregressive distributed lag (ARDL)form as follows:

$$\Delta(INF_{t)}) = \delta_0 + \delta_1(INF_{t-1})) + \delta_2(LOG(OLP_{t-1})) + \delta_3(LOG(PMS_{t-1)}) + \delta_4(RER_{t-1}) + \sum_{i-1}^{p} \Upsilon_1 \Delta(INF_{t-1})) \sum_{i-1}^{q} \Upsilon_2 \Delta(LOG(OP_{t-1})) + \sum_{i-1}^{r} \Upsilon_3 (LOG(PMS_{t-1)}) + \sum_{i-1}^{r} \Upsilon_4 \Delta(RER_{t-1}) + \S ecm_{t-1} + \varepsilon_t \ldots\ldots (4)$$

After determining the ARDL model's stability and dependability is validated, short-run and long-run estimates can be implemented.

Consequently, to test the asymmetric effects of the oil price fluctuations on the inflation rate, the NARDL model proposed by Shin et al. (2014), which decomposes the oil price into its positive (OP^+) and negative (OP^-) partial sums, will be employed. The decompose oil price is stated below:

$$(OP_t^+) = \sum_{i-1}^{t} \Delta(OP_t^+) = \sum_{i-1}^{t} MAX(\Delta OP_i),0) \ldots\ldots (5)$$
$$(OP_t^-) = \sum_{i-1}^{t} \Delta(OP_t^-) = \sum_{i-1}^{t} MIX(\Delta OP_i),0)$$

Where OP_t^+ and OP_t^- are the partial sum of the positive (or increases) and negative (or decreases) shocks on the oil price respectively. Equation (5) can be revised to account for an asymmetric level relationship as follows;

Where;

$$\Delta(INF_{t)}) = \delta_0 + \delta_1(INF_{t-1})) + \delta_2(OP_{t-1}^+) + \delta_3(OP_t^-) + \delta_4(LOG(PMS_{t-1)}) + \delta_5(RER_{t-1}) + \sum_{i-1}^{p} \Upsilon_1 \Delta(INF_{t-1})) + \sum_{i-1}^{q} \Upsilon_2 \Delta(OP_{t-1}^+) + \sum_{i-1}^{q} \Upsilon_3 \Delta(OP_{t-1}^+) + \sum_{i-1}^{r} \Upsilon_4 (LOG(PMS_{t-1)}) + \sum_{i-1}^{r} \Upsilon_5 \Delta(RER_{t-1}) + \S ecm_{t-1} + \varepsilon_t \ldots\ldots (6)$$

Where$\Delta(INF_{t)})$ and Δ remain as previously defined in equation (4). (OP_{t-1}^+) and (OP_{t-1}^-) is the negative and positive lag of the oil prices decomposed into the partial sums of the positive and negative shocks. $\psi_t \sim IN(0,\sigma^2)$. The lag orders of the variables are denoted by p and q respectively. The p represents the lag order of positive partial while q negative partial sum lag oil price fluctuations. The first part of Equations (6) shows the long-run relationship between oil prices and exchange rate, and the second part is the associated short-run of the relationship.

Unit Root Test Results

The unit root test was conducted to determine the stationary conditions of the series and also to know their order of integration. The results of these tests are given in tables 1 using Augmented Dickey-Fuller (ADF) unit root test.

Table 1: Stationarity Test

Variables	ADF Test Statistic	5% Critical Value	Prob.	Order of Integration
EXR	-6.44047	-2.935	0.0000	I(1)
INF	-6.33567	-2.93316	0.0000	I(1)
LnOLP	-4.05146	-2.96041	0.0038	I(1)
LnPMS	-6.53685	-2.94115	0.0000	I(1)

Source: Extracts from E-Views 9.0, 2024

The variables in table 1 above are stationary at first difference I(1) series. These results suggest the use of ARDL bound test. The ARDL can be used whether the variables are a mixture of I(1) and 1(0) or the same level so far as the none of the variables are I (2).The stationarity tests are necessary to guard against spurious regression and to ensure no variable is integrated of order two. The test was based on Akaike Information Criterion (AIC) which was selected automatically.

The NARDL Analysis

The essence of conducting the NARDL is to assess the non-linearity of oil price fluctuation on economic growth in Nigeria. It gives the impact of the positive and negative effects of oil prices fluctuation on the economics of Nigeria over the period of study. The table 4.2 presents the NARDL bounds testing approach to co-integration results for the model to investigate the long-run relationship between oil price fluctuations on economic growth in Nigeria.

Table 2: NARDL Bounds Test

Test Statistic	Value	K
F-statistic	12.3391	4
	Critical Value Bounds	
Significance	**I0 Bound**	**I1 Bound**
10%	2.12	3.23
5%	2.45	3.61
2.50%	2.75	3.99
1%	3.15	4.43

Source: Extracts from E-Views 9.0, 2024

From the results of the NARDL bounds test approach to co-integration the computed F-statistic is12.3391. The f-statistics for this bound test which is 12.3391is greater than both values of the upper bound and lower bound of 3.61and 2.45at 5% significance level. Therefore, the null hypothesis of no long run relationship is strongly rejected at the 5% level of significance. Hence, this shows that there is long-run relationship between Inflation Rate (INF_t), Real Exchange Rate (RER_t), Oil Prices (OP_t), and Premium Motor Spirit (PMS_t) over the study period in Nigeria.

NARDL Long-Run Coefficients Analysis

The NARDL long-run coefficients were estimated to examine the long-run effect of the independent variables on the endogenous variable having established that, long run relationship exist among the variables. The estimated result of the NARDL long-run coefficients is presented in Table 3.

Table 3: NARDL Long-Run Estimates

Variables	Coefficient		Std. Error		t-Statistic		Prob.
LNOLP_POS	-0.01898		0.011969		-1.5853		0.1738
LNOLP_NEG	0.04241		0.009273		-4.57327		0.0060
LNPMS_POS	1.81105		0.950352		1.90566		0.1150
LNPMS_NEG	0.995864		0.721251		1.380747		0.0000
EXR	1.346977		0.461915		2.916071		0.0332
C	15.11163		1.978445		7.638136		0.0006
Adj. R^2	0.96373	F-stat.	4.151738	F -Prob.	0.04867	D-W	2.14276

Source: Extracts from E-Views 9.0, 2024

Table 3 indicated the result of NARDL estimated model which sought to investigate the effect of oil price fluctuation (crude and PMS) on inflation (INF) in Nigeria for the study period and reveals that, LNOLP_POS affects INF negatively but not significant while LNOLP_NEG, LNPMS_POS, LNPMS_NEG and EXR affect INF positively. Putting differently, as LNOLP_POS, increases, INF is expected to decrease. However, an increase in LNOLP_NEG and LNPMS_POS, LNPMS_NEG and EXR also increase INF in the economy. The result further reveals that, only EXR conforms to a priori expectation base on economic theory. Contrary, LNPMS_POS, LNPMS_NEG, LNOLP_POS and LNOLP_NEG do not conform to a priori expectation.

In addition, under the null hypothesis that the true population value of each regression coefficient individually is zero, this means that the coefficients for LNOLP_NEG, LNPMS_NEG and EXR in the INF model are statistically significant. The p values of other variables are statistically different from zero. This means that the coefficients for LNOLP_POS and LNPMS_POS are not statistically significant within the study period. The results of estimated NARDL model for the INF further suggest that, the NARDL model successfully captures asymmetries in the responses of the rate of inflation to crude oil while it is symmetry to PMS Prices. The responses to negative are stronger than positive in both crude oil price (OLP) and Premium motor spirit (PMS) respectively. This is apparent in values of long-run coefficients presented in the model in which the coefficient negative crude oil price (LNOLP_NEG) is -0.04241 while the coefficient of positive of crude oil price (LNOLP_POS) is -0.01898 or less by triple amount. Similarly, the coefficient of positive price for Premium Motor Spirit (LNPMS_POS) is 1.81105 while the coefficient of negative of price for Premium Motor Spirit (LNPMS_NEG) is 0.995864 or less by almost double the amount.

The estimated mode further shows that, 0.01898 is the partial regression coefficient of LNOLP_POS and tells us that, with influence in EXR, OLP (-) and PMS (+ & -) held constant, as any responses to positive price of crude oil (LNOLP_POS) increases by 1% on average, inflation is reduce by approximately 2%. Similarly, the coefficient of LNOLP_NEG suggests that, other variables held constant, a 1% increase negative price of crude oil will increase inflation by approximately 4%. Furthermore, the coefficient for LNPMS_POS shows that increase in positive price of Premium Motor Spirit by 1% increase inflation in Nigeria approximately by 181%. In the same vein, the coefficient for LNPMS_NEG shows that increase in negative price of Premium Motor Spirit by 1%, rises inflation in Nigeria approximately by 99.6%.

In the same vein, LNEXR coefficient is 1.346977 suggest 1% increase in exchange rate on average other things being equal, will engender a 135% increase in inflation in Nigeria. The intercept value is 15.11163 means that if the value for all the variables include in the model were fixed at zero, the average level of Inflation in Nigeria will rise approximately by 151%. The adjusted R^2 value of 0.96373 means that about 96% of the variation in inflation is explained by EXR, OLP (+&- responses) and PMS (+&- responses). This is quite strong considering that the maximum value of R^2 can at most be 1. This shows that the regression line highly fits the data. The coefficient of about 96% shows that exchange rate, economic growth, positive and negative price of crude and premium motor spirit and inflation rate are strongly positively correlated. The Durbin-Watson (D-W) test of autocorrelation shows the absence of serial correlation. The inflation model shows the estimated d to be 2.14276, d_l =1.287 and d_u =1.776 at 5 per cent significance level. Since the computed d value of 2.14276 lies between the limit (i.e d_l<d<4- d_u), we conclude that, there is no autocorrelation either positive or negative.

NARDL Short-Run Form

The study further ascertains the short-run dynamics of the estimated model having established long-run relationship and effect of the exogenous variables on endogenous variable. The short-run NARDL coefficients are presented in Table 4.

Table 4: NARDL Short-Run Dynamics

Variables	Coefficient	Std. Error	t-Statistic	Prob.
D(INF(-1))	1.673437	0.324654	5.154529	0.0036
D(INF(-2))	0.776619	0.206604	3.758975	0.0132
D(INF(-3))	0.137838	0.184295	0.747917	0.4882
D(LNOLP_POS)	-0.018107	0.013795	-1.312527	0.2464
D(LNOLP_POS(-1))	0.089376	0.018476	4.837344	0.0047
D(LNOLP_POS(-2))	-0.021606	0.017289	-1.249707	0.2667
D(LNOLP_POS(-3))	-0.028707	0.012560	-2.285543	0.0710
D(LNOLP_NEG)	-0.108336	0.032857	-3.297227	0.0215
D(LNOLP_NEG(-1))	-0.029115	0.024561	-1.185398	0.2891
D(LNOLP_NEG(-2))	-0.126937	0.024229	-5.239096	0.0034
D(LNPMS_POS)	-0.333326	1.086204	-0.306872	0.7713
D(LNPMS_POS(-1))	-0.430151	0.885099	-0.485992	0.6475
D(LNPMS_POS(-2))	2.998601	0.856096	3.502646	0.0172
D(LNPMS_POS(-3))	2.676793	1.445962	1.851219	0.1234
D(LNPMS_NEG)	-1.946103	1.464453	-1.328894	0.2413
D(LNPMS_NEG(-1))	-12.072183	2.640728	-4.571535	0.0060
D(LNPMS_NEG(-2))	-10.536696	2.944584	-3.578331	0.0159
D(LNPMS_NEG(-3))	-3.363124	1.720033	-1.955267	0.1079
D(EXR)	0.306701	0.286713	1.069715	0.3336
D(EXR(-1))	-2.189578	0.466682	-4.691797	0.0054
D(EXR(-2))	-1.026556	0.620327	-1.654862	0.1589
CointEq(-1)	-3.128079	0.433333	-7.218650	0.0008

Source: Extracts from E-Views 9.0, 2024

Table 4 shows the NARDL short run coefficients which provided short-run dynamics of the asymmetric effect of oil price fluctuation (Crude and PMS) on inflation in Nigeria for the study period. It reveals that; real level of 1 year lagged, 2 year lagged and 3 year lagged of INF have negative effect on current year inflation (INF). The coefficient for the 1 year lagged and 2 year lagged INF are statistically significant while the coefficient for the 3-year lagged INF is not statistically significant. This is an indication that as 1 and 2 year lagged inflation increase; current year inflation also increases for the study period.

It further reveals that the coefficients for current year, 2 year lagged, and 3 year lagged LNOLP_POS are negative an indication that, any responses to positive changes in current year, 2 year lagged and 3 year lagged price of crude (LNOLP_POS) reduce inflation in Nigeria for the study period. The coefficients for the current year, 2 year lagged, and 3 year lagged LNOLP_POS were however not found to be statistically significant. On the other hand, the coefficients for 1 year lagged LNOLP_POS is positive and statistically significant. This implies that, any responses to positive changes in 1 year lagged price of crude oil (LNOLP_POS) had increasing effect on inflation for the period of the study in Nigeria. On the contrary, the coefficients for current year and 2 year lagged LNOLP_NEG are negative and statistically significant while the coefficient for 1 year lagged LNOLP_NEG is also negative but not statistically significant, an indication that, any responses to negative changes in current year, 1 year lagged and 2 year lagged price of crude (LNOLP_NEG) reduces inflation in Nigeria for the study period.

In a related development, the coefficients for the current year and 1 year lagged LNPMS_POS are negative and statistically insignificant indicating that, any responses to positive changes in the current year and 1 year lagged price of premium motor spirit (LNPMS_POS) reduces inflation in Nigeria for the study period. However, the coefficients for the 2-year lagged and 3 year lagged LNPMS_POS are positive; while the coefficients for the 2-year lagged is statistically significant, the coefficient for the 3-year lagged LNPMS_POS is not statistically significant to make an informed empirical decision. This implies that, any responses to positive changes in the 2-year lagged and 3 year lagged price of premium motor spirit (LNPMS_POS) increase inflation in Nigeria for the study period.

Interestingly, the coefficients for the current year, 1 year lagged, 2 year lagged and 3 year lagged LNPMS_NEG are shown to be negative indicating that, any responses to negative changes in the current year, 1 year lagged 2 year and 3 year lagged price of premium motor spirit (LNPMS_NEG) reduces inflation in Nigeria for the study period. Nevertheless, the coefficients for the 1 year and 2 year lagged LNPMS_NEG are statistically significant while the coefficient for the current year and 3 year lagged LNPMS_NEG are not statistically significant. Similarly, the coefficient for the current year EXR is shown to affect inflation positively in the short-run while 1 year lagged and 2 year lagged EXR indicated negative effect on inflation rate in Nigeria for the study period. The coefficient for the 1 year lagged EXR was found to be statistically significant while the coefficients for the current year and 2 year lagged EXR were found to be statistically insignificant.

Granger Causality Test

The granger causality test is used to determine causal relationship between oil price (crude and premium motor spirit) fluctuations and inflation in Nigeria. In other words, the granger causality is used to test if the series of crude oil price, price of premium motor spirit, inflation and real exchange rate are useful in forecasting each other trend. The result of granger causality test is shown in Table 5.

Table 5: Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
EXR does not Granger Cause INF	44	0.54612	0.5839
INF does not Granger Cause EXR		0.29978	0.7428
LNOLP does not Granger Cause INF	44	0.57142	0.5698
INF does not Granger Cause LNOLP		0.01001	0.9900
LNPMS does not Granger Cause INF	44	0.87337	0.4264
INF does not Granger Cause LNPMS		0.16733	0.8466
LNOLP does not Granger Cause EXR	44	0.05697	0.9447
EXR does not Granger Cause LNOLP		8.36171	0.0010
LNPMS does not Granger Cause EXR	44	3.96542	0.0280
EXR does not Granger Cause LNPMS		3.94814	0.0284
LNPMS does not Granger Cause LNOLP	44	5.15619	0.0109
LNOLP does not Granger Cause LNPMS		1.31120	0.2824

Source: Extracts from E-Views 9.0, 2024

Table 5 reveals that the series of price for premium motor spirit is useful in forecasting future trends of real exchange rate. In turn the series of real exchange rate is useful in forecasting future trends of price of premium motor spirit in Nigeria. This is because the associated probability values are less than 5% implying that the null hypothesis of each of the combination can be rejected. Thus, there is a bi-directional relationship between the two variables.

In a related development, Table5reveals that the series of real exchange rate is useful in forecasting future trends of price of crude in Nigeria. This is because the associated probability value is less than 5% implying that the null hypothesis of the combination can be rejected. However, the series of price of crude oil is not useful in forecasting future trends of real exchange rate in Nigeria. This is because the associated probability value is more than 5% implying that the null hypothesis of the combination cannot be rejected. Thus, there is a uni-directional relationship between the two variables.

Also, Table5reveals that the series of price of premium motor spirit is useful in forecasting future trends of price of crude in Nigeria. This is because the associated probability value is less than 5% implying that the null hypothesis of the combination can be rejected. However, the series of price of crude oil is not useful in forecasting future trends of price of premium motor spirit in Nigeria. This is because the associated probability value is more than 5% implying that the null hypothesis of the combination cannot be rejected. Thus, there is a uni-directional relationship between the two variables. However, Table 5reveals further that the series of real exchange rate and inflation rate, price of crude oil and inflation rate as well as price of premium motor spirit and inflation rate are not useful in forecasting future trends of each other output in Nigeria. This is because the associated probability values are more than 5% implying that the null hypothesis of the respective combination cannot be rejected. Thus, no causal relationships exist among the variables.

Diagnostic Tests

The tests for serial correlation, heteroscedasticity, model misspecification and stability were conducted for the three estimated models. The results for residual tests are presented in Table 6 and figure 1.

Table 6: Residual Tests

Test	Prob.
Breusch-Godfrey Serial Correlation LM Test	0.5649
Breusch-Pagan-Godfrey Heteroscedasticity Test	0.9875
Ramsey Reset Test	0.7557

Source: Extracts from E-Views 9.0, 2024

Table 6indicated the outcome of Breusch-Godfrey Serial Correlation LM Tests for the estimated models. It reveals the acceptance of null hypothesis of no Serial Correlation as the F-statistical probability values for the model was significance at 5% level. Similarly, the Breusch-Pagan-Godfrey heteroscedasticity Test reveals the acceptance of the null hypothesis that disturbance terms exhibit the equal variance assumption of homoscedasticity for the estimated model. This is because the probability of F-statistic was statistically significant at 5% level.

In the same vein, the estimated result of the Ramsey RESET Test for model specification reveals the acceptance of the null hypotheses that, the model has no omitted variables as F-statistic for all the estimated model was significant at 5% level. The NARDL CUSUM test is also adopted to test for parameter stability. The NARDL CUSUM adopted is based on cumulative sum of the recursive residuals. This option plots the cumulative sum together with the 5% critical lines. The test finds parameter instability if the cumulative sum goes outside the area between the two critical lines. The significance of any departure from the zero line is assessed by reference to a pair of 5% significance lines, the distance between which increases with increase in the subsamples. Figures 1 showed the NARDL CUSUM tests for the estimated model.

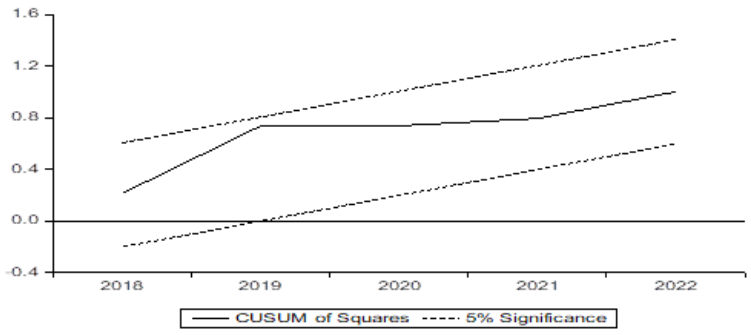

Figure 1: CUSUM Test for the Estimated Model
Source: Extracts from E-Views 9.0, 2024

Discussion of Results

The result of NARDL successfully captures asymmetry effect in inflation rate to fluctuation in the crude oil and symmetry PMS prices fluctuation. The asymmetric effect of oil price fluctuations in Nigeria shows that positive fluctuation in crude oil price has negative relationship with inflation rate in Nigeria both in the long-run and short-run. In other words, positive fluctuation in crude oil price exerts the desire effect in tackling the conundrum of inflation in Nigeria. On the contrary, negative fluctuation in crude oil price has positive relationship with inflation in Nigeria in the long-run and indicated negative relationship in the short-run. This implies that negative fluctuation in crude oil do not exert the desire effect in tackling the conundrum of inflation in Nigeria in the long-run.

The effect of negative fluctuation is stronger than positive fluctuation for crude oil price (OLP) as a percentage increase in negative fluctuation in crude oil price will increase inflation by 4% in the long-run while a percentage increase in positive fluctuation in crude oil price reduces inflation by 2%. This result clearly shows that, Nigeria's inflation experience has largely reflected developments in crude oil prices over the years. The analysis showed that negative crude oil price fluctuation has been followed by declining foreign exchange inflows and reserve accumulation, subsequently leading to exchange rate instability and rising inflationary pressures. However, positive or rising crude oil prices culminated in stable exchange rates and a moderation in inflation. This largely indicates that positive and negative oil price fluctuations have distinct effect on inflation in Nigeria. The result of this study is similar to Bala and Chin (2018) and Abatcha (2021), that is, both positive and negative oil price fluctuations positively influenced inflation in the long run, oil price exerts a positive influence on the rate of inflation in Nigeria. It however contrasts with Agbo (2020) which suggested that both positive and negative movements in oil prices have adverse and non-significant effects on Nigeria's inflation rate and the absence of asymmetric effects between the variables.

The result reveals symmetric effect of Premium Motor spirit on inflation in Nigeria, that is, positive fluctuation in price of Premium Motor Spirit increase inflation in Nigeria in the long-run while in the short-run, inflation in Nigeria fluctuate significantly due to positive fluctuation in price of premium motor spirit. In other words, positive fluctuation in the price of premium motor spirit exacerbate inflation in Nigeria in the long-run While in the short-run, real rate of inflation fluctuates (rise and fall) due to positive fluctuation in price of premium motor spirit. In the same vein, negative fluctuation in price of Premium Motor Spirit increase inflation in Nigeria in the long-run. Interestingly, negative fluctuation in the price of premium motor spirit reduces inflation in Nigeria in the short-run.

The effect of positive fluctuation is however stronger than negative fluctuation in PMS Price, as a percentage increase in positive fluctuation in price of premium motor spirit increase inflation by 181% while a percentage increase in negative fluctuation in price of premium motor spirit increase inflation by 99.5%. This disparity between the long-run and short-run positive and negative effects of the price of premium motor spirit

fluctuations on inflation in Nigeria could be attributed to the complex nature of business cycle in explaining the nature and movement of price of premium motor spirit in the international market amidst financial crisis and over dependency on imported refined oil due to lack of functional refineries that will refined PMS for domestic use in Nigeria. The finding agrees with Wale-Awe and Sulaiman (2020), Eregha, Mesagan and Olawale (2015), Ekpeyong (2021) who find that the price of PMS increases inflationary tendencies in the country. Granger causality indicated bi-directional relationship between price for premium motor spirit and real exchange rate in Nigeria. This suggests that, price for premium motor spirit is useful in forecasting future trends of real exchange rate in Nigeria and vice versa. On the contrary, uni-directional relationship was found in Nigeria for the period of the study; from real exchange rate to price of crude and price of premium motor spirit to price of crude oil.

Conclusion and Recommendations

In line with finding, the study concludes that positive responses in the price of crude oil exert the desired effect in tackling the conundrum of inflation in Nigeria. In contrast, negative changes in crude oil prices do not effectively tackle the conundrum of inflation in Nigeria in the long run. However, positive and negative responses to the price of premium motor spirit do not effectively tackle the conundrum of inflation in Nigeria in the long run. This finding implies that the nature and movement of price of premium motor spirit in the international market amidst financial crisis and over-dependency on imported refined oil have tremendous consequences on inflationary pressure on the Nigerian economy.

Government should workout modalities through public-private partnership to increase petroleum products refining capacity of Nigeria so as to become a major exporter of refined oil products rather than depending on crude oil export. This will enable the nation benefit maximally even at any slightest oil price fluctuation in the international market amidst financial crisis. In view of the fact that responses in the price of premium motor spirit increase inflationary pressure on the economy, monetary policy activities of the Central Bank of Nigeria should be concerned with taming core inflation in times of significant oil price upsurges, whereas strengthening its efforts at ensuring domestic sustainability in food production via its agricultural interference programmes to further minimize the impact of global oil prices on food inflation. In the same way, the fiscal authorities should ensure that the fiscal stance is not disproportionately pro-cyclical in periods of rising oil prices.

It is essential that government should reverse the decision of subsidy removal on PMS and technically remove the subsidy in phases and should focus on partnering with private individuals on the building of local refineries, which will boost local production of refined oil products and prevent imported inflation as a result of the import which will, in turn, reduce national prices for petroleum products and consequently inflation.

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