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Asymmetric effects of crude oil price fluctuations on exchange rate in Nigeria

*Taham Adamu Abubakar, Umar Bala and Salisu Ibrahim Waziri

Department of Economics, Faculty of Social Sciences, Sa'adu Zungur University, Bauchi State, Nigeria.

*Corresponding Author: tahamgiade@gmail.com

Abstract

This study examines the asymmetric effects of crude oil price fluctuations on exchange rate in Nigeria from 1980-2021. Using a non-linear autoregressive distributed lag (NARDL) model and analyze the effect of positive and negative oil price shocks on exchange rate. The findings revealed that oil price increases have positive effect on exchange rates in the long run. Likewise decreases in crude oil price have a negative effect on exchange rate in the long run. Conversely, oil price decreases have a negative effect on both exchange rates. Additionally, our results show that interest rate and control of corruption have positive effect on exchange rates both in the long run and short run, while governance effectiveness have negative effect on exchange rate in both long run and short run. We proposed policy recommendations to mitigate the adverse effects of oil price fluctuations by constructions more and up-to-date refineries, establishment and strengthen a sovereign wealth fund and ensuring transparency and accountability.

Keywords: Crude oil price fluctuations, exchange rate. NARDL model, asymmetric effects, Nigeria.

1. Introduction

Nigerian's economy is heavily reliant on oil exports, which generates a significant portion of government revenue despite oil's relatively small contribution to GDP. Since the era of oil discovery in Olaibiri, Bayelsa State, Nigeria in 1956 by Shell B.P, the oil has continually and significantly contributed the Nigerian economic and political landscape. The crude oil has helped to reduce poverty level in the country through provision of infrastructures which has speed the growth and development process. Indeed, the crude oil increase revenue generation, foreign exchange earnings and access account surplus over the years. (Ogbonna & Orlu, 2017)

Exchange rate is an imperative macroeconomic policy tool, variations in the rates of exchange have influential effects on trade and non-trade nation's activities through effects of comparative prices of goods and services. After independence in 1960, Nigeria has employed different exchange rate policies in an effort to achieve a realistic exchange rate that would guarantee efficient distribution of foreign exchange and agree to non-inflationary expansion of the economy. In the middle of 1974 and towards 1976, Nigerian monetary authorities made an effort and switched to independent exchange rate management policy that pegged the naira to whichever currency was stronger in the foreign exchange market, either the US dollar or British pound sterling (Ogiogio, 1996).

The Second Tier Foreign Exchange Market (SFEM) was established on September 26, 1986, as part of the

Structural Adjustment Programme (SAP). In order to eliminate the foreign exchange subsidies benefiting public sector users in the first tier segment, the first and second tiers were combined to create an enlarged foreign exchange market on July 2, 1987 (CBN, 2021). The Central Bank of Nigeria (CBN) deregulated the foreign exchange market and allowed the naira to float on March 5, 1992 (CBN, 1992). The Autonomous Foreign Exchange Market (AFEM) was launched in 1995 to promote the inflow of non-oil foreign exchange earnings into banks, aiming to ease demand pressure on the CBN. In 1999, the Inter-Bank Foreign Exchange Market (IFEM) replaced the Autonomous Foreign Exchange Market (AFEM), allowing authorized dealers (banks) to trade among themselves, were only CBN mediate.

Due to the inability of the flexible exchange rate mechanisms (the AFEM launched in 1995 and the IFEM launched in 1999) to maintain exchange rate stability, the Dutch Auction System (DAS) was reinstated on July 22, 2002. The purpose of the DAS was to address the parallel market premium, protect the dwindling external reserves, and establish a realistic exchange rate for the naira. On February 20, 2006, the CBN also implemented the Wholesale Dutch Auction System (WDAS). In 2016, a new exchange rate framework called the Foreign Exchange Primary Dealers (FXPDs) system was introduced, allowing designated Authorized dealers to trade forex directly with the CBN. This system is designed to let the dynamics of demand and supply determine the value of the naira.

2. Literature Review

CRUDE OIL PRICE FLUCTUATIONS, NIGERIAN EXCHANGE RATE, CONTROL OF CORRUPTION AND GOVERNANCE EFFECTIVENESS.

The relationship between crude oil price and exchange rare in Nigeria is a complex issue, as the Nigeria's economy is heavily relied on crude oil exports, which make nation susceptible to fluctuations in global oil prices. The Nigerian economy has consistently been influenced by fluctuations in crude oil prices, prompting the country to implement essential fiscal and monetary policies to mitigate the impact of these shocks on its financial affairs. Studies have demonstrated that variations in crude oil prices significantly affect Nigeria's exchange rate. When crude oil prices rise, Nigeria's exchange rate tends to appreciate, making the naira stronger. Conversely, when crude oil prices fall, the exchange rate tends to depreciate, making naira weaker. Between 2010 and 2016, the price of crude oil decreased from approximately US$79.47 per barrel to US$43.67, which resulted in a slowdown in economic growth, dropping from 8.6 percent in the last quarter of 2010 to 2.1 percent by the end of 2015. Additionally, the nominal exchange rate fell from N155/US$1 in 2010 to N199/US$1, while the parallel market rate fluctuated between N340 and N500/US$1 in 2015 (Muhammad et al., 2019). However, ineffective governance and corruption control have impeded economic performance, leading to a decline in institutional quality in Nigeria.

Figure 1.1 shows a visual depiction of the fluctuations in exchange rates, crude oil prices, corruption control, and governance effectiveness from 1980 to 2021. From the graph, oil prices (blue line), exchange rates a (red line), control of corruption (black line) and governance effectiveness (orange line). The Iranian revolution of

1979 and the followed outbreak of the Iran-Iraq war of 1980 pushed up the world oil prices dramatically from $13.65pb in 1978, $29.25pb in 1979 to $36.98pb of bonny light crude oil prices in 1980 and exchange rate is 0.54. The price of crude oil fell to US$27.75 per barrel between 1982 and 1985 as a result of OPEC'S attempt to stabilize the price through production quotas, the global economic slowdown and the illicit quotas produced by OPEC member nations. And in 1980 the value of exchange rate was 0.547kobo but the exchange rate kept depreciating from 0.618kobo in 1981 to 0.673kobo, 0.724kobo, 0.767kobo and 0.894kobo for 1982, 1983, 1984 and 1985 respectively. It is seen that despite swings in annual prices of crude oil, naira/dollar exchange rate was below one naira to a dollar from 1980-1985. From 1986 to 1993 as crude oil price changes, the naira depreciation relative to dollar become stable from 1994 to 1998 and continues to depreciate till 2015. The oil price experienced sharp decline after the global financial crises of 2008, falling to US$63 in 2009 but it did not last as the price began to rise reaching US$113.66 in 2012. Crude oil price then falls to US$44.02 per barrel in 2016 due to the increasing of oil supply from mostly NON-OPEC countries. And the sharp fall in the price of crude oil from US$111.36 per barrel in 2013 to US$100.85 per barrel in 2014, further depreciated the naira exchange rate from N157.311 per dollar to N158.553 per dollar respectively. Up to the year 2021 as crude oil price fluctuated the rate of exchange naira/dollar keep on decreasing as crude oil price is decreased. But on the part of institutional quality, like control of corruption and governance effectiveness there were negative due the weak performance of the Nigerian economy.

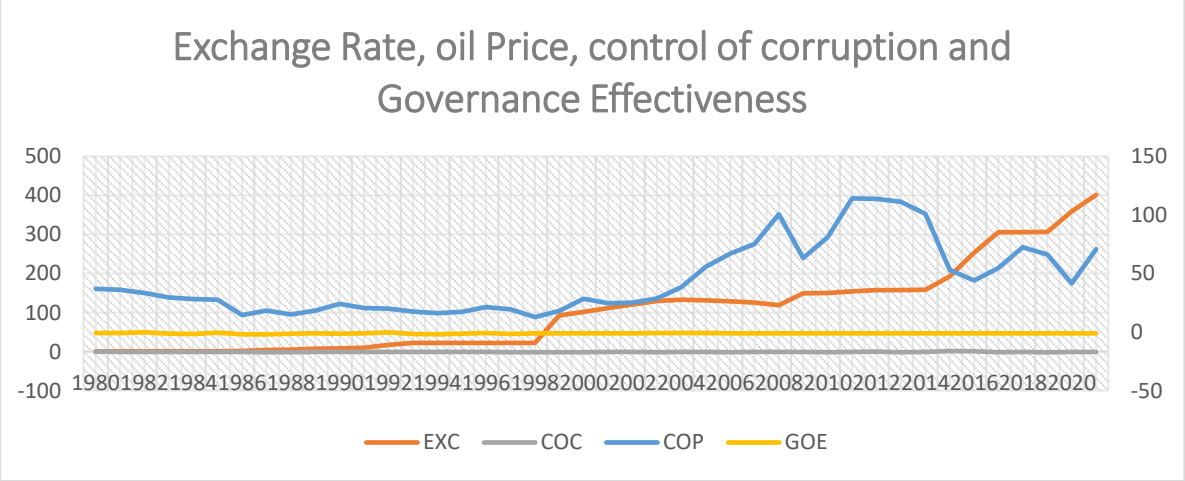


Figure 1. Crude oil prices, Exchange rates, Control of Corruption and Governance Effectiveness in Nigeria from 1980-2021
Source: world Bank online Data Base and OPEC data base.

THE EMPIRICAL STUDIES ON THE EFFECTS OF CRUDE OIL PRICE FLUCTUATIONS ON EXCHANGE RATE.

Tiwari et al. (2013) and Tiwari and Albulescu (2016), examined the impact of oil prices on real exchange rate of Romania, using Wavelet analysis. The findings indicated that the oil price has significant short and long run impact on

the exchange rate. likewise, Brahmasrene et al. (2014) and Bouoiyour et al. (2015) indicated, the connection between the imported oil prices in the United State and the Exchange rate. Using monthly data from 1990-2009, using vector autoregressive (VAR) Model and discovered exchange rate to Granger cause oil prices in the short term, but in the middle and long term oil price shocks was found to significantly impact exchange rate fluctuations. However, Basher et al. (2016) and Chen et al. (2016) demonstrated that oil demand shocks influence real exchange rates in oil-exporting nations, while supply shocks tend to have a lesser effect. Other studies, such as those by Ayodeji (2017), and Nelson et al. (2018), noted that oil prices, trade openness, capital flight and using Autoregressive Distributed Lag (ARDL) model and foreign borrowing all influence exchange rate behavior, through the direction and significance differ by country and period. Further evidences from studies by Henry (2019), Olayungbo (2019), Musa et al. (2019, 2020) and Bala and Abdullahi (2019) Showed that oil price and exchange rate fluctuations significantly impact economic growth and food prices in Nigeria. Asymmetric effects were highlighted by Saidi et al. (2019) and Elias (2021) who used NARDL and GARCH models to demonstrate that oil price volatility affects exchange rates differently in the short and long run. He and Hamori (2019) and Abubakar (2019) emphasized dependence structures and dynamic responses, revealing significant tail dependence and gradual currency appreciation after positive oil shocks. Other regional studies, such as those by Hlongwan (2022) in South Africa and Drebee and Razak (2022) in Iraq, linked weak exchange rate performance to oil price volatility, especially in contexts of poor economic management. Also, studies like Ajayi (2022), Korley and Giouvris (2022), Sanusi and Kapingura (2022) and Zhang et al. (2022) explored more complex dynamics, such as the joint effects of oil price and oil volatility indices (OVX), and revealed market conditions and economic policy uncertainty significantly shape the oil-exchange rate nexus.

Saenong et al (2020), engaging the autoregressive distributed lag (ARDL) and nonlinear autoregressive distributed lag (NARDL) models and examined the symmetric and asymmetric effects of crude oil prices and exchange rate on bond yield, from January 2007 to April 2019. The results of the test using the autoregressive distributed lag and nonlinear autoregressive distributed lag models show that in the long-run, neither the crude oil prices nor the exchange rate has symmetric and asymmetric effects on the bond yields, and (2) in the short-run, all of them have symmetric and asymmetric effects on the bond yields. From January 1995 to December 2019, Okere, Muoneke and Onuoha (2021), explored the linear and non-linear effects of Nigeria's oil price and exchange rate on stock market performance. The nonlinear ARDL result in the indicated a positive correlation between crude oil prices and Nigerian stock market in the short and long term, while the exchange rate showed a significant correlation in the short term but a negligible long term effect.The non-linear NARDL result indicated that the effect of positive shocks in crude oil price has a significant increasing effect on stock market performance in Nigeria, while negative shocks in crude oil prices have a significant increasing effect on stock market performance. The exchange rate has a negligible relationship with stock market performance both in short- and long run asymmetric test.

However, David (2024), investigate the level of corruption that oil price faced on

economic growth of oil-rich countries by employing dynamic heterogeneous panel estimation techniques and found out that, impact of oil prices on economic growth varies with the level of corruption. In another, term the marginal effect of oil price increases on economic growth is positive at low levels of corruption but it curbs immediate and long term growth at high levels of corruption. Shah and Siddiqui (2018), examines the impact of international oil price, and its volatility on profitability of top oil and gas companies: the role of exchange rate, governance institutions and human development of their origin country using panel regression analysis and found that oil prices showed significant and positive impact on profitability on top oil and gas companies and exchange rate, governance institutions played a significant role.

Table 1. **Data Table**

S/NO.	VARIABLE	MEASUREMENT	SOURCE OF THE DATA
1.	Crude Oil Price	Bonny Light	OPEC
2.	Exchange Rate	Official Exchange Rate.	WDI
3.	Interest rate	Real interest rate	WDI
4.	Control of corruption	Control of corruption	WGI
5.	Governance effectiveness	Governance effectiveness	WGI

3 Methodology

Empirically, the model of Non-linear autoregressive distributed lag (NARDL) of Shin et al. (2014) was used for analysis of the study. Annual data on each of the variable covering a period of 41 years were sourced from world development indicators (WDI) and organization of petroleum exporting countries (OPEC). The rate of exchange was proxied by official exchange rate (EXR), interest rate was proxied by real interest rate, crude oil price was also proxied by Bonny light crude oil price (OP), control of corruption was proxied by control of corruption estimation and governance effectiveness. The limitation faced was, the data on control of corruption and governance effectiveness from 1995-1980 using time series data was unavailable, so the remaining series was extrapolated. Going by the work of Azarhoushang and Rukavina (2015), noted that oil prices, institutional quality and economic performance using a comparative study and suggested that weak institutional quality have a significant effect on reach oil countries.

In order to capture the asymmetric effect of crude oil price fluctuations on exchange rate in Nigeria, the study adopted the model used by Nelson et al (2018) who studied the impact of crude oil price changes on economic growth in Nigeria, using a linear regression as follows:

$$RGDP = \beta_0 + \beta_1 COP + \beta_2 EXR + \beta_3 INF + \mu$$

Where;
RGDP= Real GDP
COP= crude oil price
EXR= exchange rate
INF= inflation.

On the strength of the above, this study is derived from the Nelson et al (2018) model to express the connection existed between the dependent variable (exchange rate), core independent variable (crude oil price) and the control variables (trade openness, economic growth and governance effectiveness).

The mathematical function of these relationship is as follows:

$$EXR = f(COP, INTR, COC, GOE)$$

1

These function then transformed in to the following econometric model in line with Nelson et al (2018) by carrying its parameters/coefficients.

$$EXR_t = \beta_0 + \beta_1 OP_t + \beta_2 INTR_t + \beta_3 COC_t + \beta_4 GOE_t + \mu_t$$

2

The econometric form of the model equation 2 is given in equation 3.

$$EXR_t = \beta_0 + \beta_1 OP_t + \beta_2 INTR_t + \beta_3 COC_t + \beta_4 GOE_t + \mu_t$$

3

Where *EXR* is the nominal exchange rate at time *t*, *OP* is the crude oil prices at time *t*, *INTR* is the interest rate at time *t*, *COC* is the control of corruption at time *t* and *GOE* is the governance effectiveness at time *t* in Nigeria. To capture the asymmetric effects of crude oil price fluctuations on exchange rate, the specify a non-linear model by decomposing the variable *OP* into positive and negative shocks as follows:

$$OP = OP_0 + OP_t^+ + OP_t^-$$

4

Where OP_0 is the constant term and OP^+ and OP^- are the partial sums of the positive and negative changes in OP_t, and are defined as follows:

$$\ln(OP)_t^+ = \sum_{i=1}^{n} \Delta \ln(OP)_i^+ = \sum_{i=1}^{n} \max(\Delta \ln(OP)_i^+, 0)$$

5

$$\ln(OP)_t^- = \sum_{i=1}^{n} \Delta \ln(OP)_i^- = \sum_{i=1}^{n} \min(\Delta \ln(OP)_i^-, 0)$$

6

Following Shin et al. (2014), the study replaces OP_t in equation 3 with OP_t^+ and OP_t^- to arrive at a non-linear ARDL model as stated below:

$$EXR_t = \beta_0 + \beta_1 \ln OP_t^+ + \beta_2 \ln OP_t^- + \beta_3 INTR_t + \beta_4 COC_t + \beta_5 GOE_t + \mu_{2t}$$

7

Where *EXR* is the nominal exchange rate at time *t*, $\ln OP_t$ is the log of crude oil prices at time *t*, $INTR_t$ is the interest rate at time *t* COC_t is the control of corruption at time *t* , GOE $_t$ is the governance effectiveness and μ_t is the white noise.

$$EXR_t = \alpha_0 + \sum_{i=1}^{q} \alpha_{1i} EXR_{t-1} + \sum_{i=0}^{q} \alpha_{2i} \ln OP_{t-1}^+ + \sum_{i=0}^{q} \alpha_{3i} \ln OP_{t-1}^- + \sum_{i=0}^{q} \alpha_{4i} INTR_{t-1} + \sum_{i=0}^{q} \alpha_{5i} COC_{t-1} + \sum_{i=0}^{q} \alpha_{6i} GOE_{t-1} + \mu_{2t}$$

8

Where model variables are as defined earlier, Δ is a first differenced operator, β_0 is an intercept term, β_1 to β_5 are short run coefficients, α_1 to α_5 are long run parameters and k being the optimal lag orders. Following Pesaran et al. (2001).

$$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5$$

$$H_1 : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5$$

Pesaran et al. (2001) computed the two critical values (CV) for the test. If the computed F-statistic is less than the lower bound CV, there is no cointegration. However, when computed F-statistic is higher than the upper bound CV, the null hypothesis of no cointegration is rejected. But, when the F-statistic is within the lower and upper bounds, the test is inconclusive.

The NARDL long run model can then be specified from equation 8 as follows:

$$EXR_t = \alpha_0 + \sum_{i=1}^{q} \alpha_{1i} EXR_{t-1} + \sum_{i=0}^{q} \alpha_{2i} \ln OP_{t-1}^+ + \sum_{i=0}^{q} \alpha_{3i} \ln OP_{t-1}^- + \sum_{i=0}^{q} \alpha_{4i} INTR_{t-1} + \sum_{i=0}^{q} \alpha_{5i} COC_{t-1} + \sum_{i=0}^{q} \alpha_{6i} GOE_{t-1} + \mu_{2t}$$

9

Where α_0 is the drift parameter, t is time trend (1990-2021), ln is the natural logarithmic sign, $\alpha_{1i} \ldots \alpha_{5i}$ are the long-run

parameters to be estimated, q is the maximum and $\sum$ is the summation or sigma, μ_{2t} is the error term and all other variables as defined in the previous equations.

The short-run error correction model associated with equation 8 is specified as follows:

$$\Delta EXR_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i} \Delta EXR_{t-i} + \sum_{i=0}^{k} \beta_{2i} \Delta \ln OP^{+}_{t-i} + \sum_{i=0}^{k} \beta_{3i} \Delta \ln OP^{-}_{t-i} + \sum_{i=0}^{k} \beta_{4i} \Delta INTR_{t-i} + \sum_{i=0}^{k} \beta_{5i} \Delta COC_{t-i} + \sum_{i=0}^{k} \beta_{6i} \Delta GOE_{t-i} + \theta ECM_{t-1} + \mu_{3t} \quad 10$$

Where $\beta_{1i} \ldots\ldots \beta_{5i}$ represents the short slopes parameters, Δ is the short-run sign or the difference parameter, $\sum$ is the summation sign, θ is the speed of adjustment parameter, while ECM is the residual series from the long run equation 9 and all other variables as defined in the previous equations.

4. Result and Discussion

4.1 Unit Root Test

ADF and PP tests were used to perform the unit root test and the test results are given in Table 2.

Table 2. Unit root test result

		Augmented Dickey Fuller(ADF)				Philips Perron (PP)			
Variables	**Order of integration**	**ADF Critical Values**			**Prob.**	**PP Critical Values**			**Prob.**
		1%	**5%**	**10%**		**1%**	**5%**	**10%**	
ΔEXC	I(1)	-4.205004	-3.526609	-3.194611	0.0001	-4.205004	-3.526609	-3.194611	0.0001
ΔLCOP+	I(1)	-4.219126	-3.533083	-3.198312	0.0008	-4.211868	-3.529758	-3.196411	0.0027
ΔLCOP-	I (1)	-4.211868	-3.529758	-3.196411	0.0000	-4.211868	-3.529758	-3.196411	0.0000
ΔINTR	I				0.0001				0.0000
ΔCOC	(1)	-4.211868	-3.529758	-3.196411	0.0034	-4.205004	-3.526609	-3.194611	0.0063
	I(0)	-4.205004	-3.526609	-3.194611		-4.198503	-3.523623	-3.192902	
ΔGOE	I(0)	**-4.211868**	**-3.529758**	**-3.196411**	**0.0075**	**-4.211868**	**-3.529758**	**-3.196411**	**0.0075**

Source: Author Computation 2024, Using E-views 9.

From the table 2. ADF and PP tests, indicate that one of the variable is stationary at level while others are stationary at first difference in both ADF and PP tests. This implies that there is mixture of I (0) and I (1) variables.

Thereby, indicating that, the variables may exhibit, the long run relationship. This is the reason why NARDL model is applicable as the method of estimating data.

4.2 NARDL Bounds Test

The NARDL bounds test was conducted to find the evidence of long-run cointegration among the variables. The result of the bound test is presented in table 3.

Table 3. Bounds Test Results

Model Equation	$EXR = f(LCOP^{+}, LCOP^{-}, INTR, COC, GOE)$	
Optimum Lag Combination	2,1,0,1,0,0	
F-Statistics	3.663614^{**}	
Critical Values	**Lower Bounds**	**Upper Bounds**
1%	3.06	4.15
5%	2.39	3.38
10%	2.08	3.00

Note: *** means 1% level of significance.

Hence, the hypothesis of no cointegration amongst the variables in the model was also rejected, as the estimated F-statistics value of **3.66** is above the **3.38** upper bound critical value at 5 percent level of significance. Therefore, the study finds the existence of asymmetric cointegration relationship between exchange rates and crude oil price in this study. To analyze the positive and negative shocks, following Shin et al. (2014) to capture asymmetric effects.

4.3 Non-linear ARDL Long Run Results

The study estimated the effect of positive and negative changes in crude oil prices on exchange rates in Nigeria using non-linear ARDL method.

Table 4. Non-linear ARDL Long Run Results

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**P-values**
$lnCOP^{+}$	0.591946^{**}	0.314363	1.883003	0.0694
$lnCOP^{-}$	-0.392968^{***}	0.125133	-3.140389	0.0038
INTR	0.037917^{***}	0.015170	2.499526	0.0181
COC	0.070088	0.072986	0.288933	0.1746
GOE	-0.056276	0.117806	-0.477703	0.0363
Constant	-0.105601	0.272761	-0.387155	0.7014

Note: $^{***, **}$ & * imply 1%, 5% & 10% significance levels.

From Table 4. The estimated long run model shows that the coefficient of crude oil price increase exert significant positive effect on exchange rate at 5 percent level in Nigeria. The result from the model reveals that 1 percent increase in crude oil price led to 59% increase in exchange rate in the long run. Abubakar, A.B. (2019), modelled the oil price and exchange rate nexus in Nigeria, using SVAR model and shows a growing recognition of naira in response to positive shocks to oil price. It is also supported by, Busayo, O. (2013), using the models to estimate the relationship between oil price changes and exchange rate. The econometric tests used include the unit root tests, Johansen co-integration technique and the Vector Error Correction Model (VECM). The long run relationship among the variables was determined using the Johansen Co-integration technique while the vector correction mechanism was used to examine the speed of adjustment of the variables from the short run dynamics to the long run. It was observed that a

proportionate change in oil price leads to a more than proportionate change in exchange rate volatility in Nigeria by 2.8%

Further, the results also indicate that the coefficient of crude oil price decline was also negative and statistically significant, at 1 percent significance level in affecting exchange rate in the long run. This implies that a 1 percent drop in crude oil price led to 39% decrease in exchange rate in the long run. This signifies the fact that, the impact of oil price shocks on oil exporting nations is expected to differ from that of oil importing countries. Nigeria is country that export crude oil it is even the 13th according OPEC bulletin 2022. Abed and colleagues (2016) observed that a rise in oil prices shifts wealth from countries that import oil to those that export it. An upward shift in oil prices is anticipated to result in a stronger exchange rate for oil-exporting nations due to enhanced foreign exchange earnings and an accumulation of foreign reserves, just as a drop in crude oil prices occurs in the global market. The current finding supports the results of Elias (2021), employed the Nonlinear Autoregressive Distributed Lag (NARDL) approach and examined the effect of oil price fluctuations on the Nigerian exchange rate movements from January 1997 to August; 2020.The outcome stated the existence of positive and negative shocks between oil price changes and exchange rate movements. So, also, Nandelenga and Simpasa (2020), using elliptic copula model, the results also reveal the significant symmetric dependence structure for all countries. The results confirmed that an increase (decrease) in oil price in net oil exporting (importing) country is associated with appreciation (depreciation) of the domestic currency against the US dollar.

Moreover, interest rate was a significant contributor to exchange rate in Nigeria, in the long run. This implies that a 1 percent increase in interest rate led to 3% increase in exchange rate in the long run.

In addition, the coefficients of control of corruption was positive and statistically significant effect on exchange rate in Nigeria over a long term, as 1 percent increase in control of corruption lead to 7% increase in exchange rate in Nigeria. Azarhoushang and Rukavina (2015), noted that oil prices, institutional quality and economic performance using a comparative study and suggested that weak institutional quality have a significant effect on reach oil countries.

So, also governance effective as one of the institutional quality exert a negative and statistically significant effect on exchange rate in Nigeria in the long run. As 1% decrease in governance effectiveness leads to 5% decrease in exchange rate in Nigeria in long run.

4.4 Non-linear ARDL Short Run and Error Correction Results

The estimated results from the non-linear ARDL short-run and error correction equations given in equation.9 on the Asymmetric effect of crude oil price fluctuation on exchange rate in Nigeria are presented in Table 5.

Table 5. Short Run and Error Correction Results

Variables	Coefficient	Std. Error	t-Statistic	P-values
$\Delta lnCOP^{+}$	0.667884**	0.932416	-0.176294	0.0493
$\Delta lnCOP^{-}$	-0.229252*	0.165709	-1.912358	0.0654
D(INTR)	0.073059**	0.066815	1.093451	0.0529
D(COC)	0.066664*	0.049711	1.341022	0.0894
D(GOE)	-0.08130*	0.270903	0.301697	0.0648
C	-0.599060*	1.381486	-0.433635	0.0654
ECT (-1)	-0.687762***	0.031776	-0.547464	0.0000
R-Squared	0.887296			
Adjusted R-squared	0.864517			
F-statistics		335.2788***		

Note: ***, ** & * imply 1%, 5% & 10% level of significance.

From Table 5., crude oil price increase exerts significant positive effect on exchange rate in the short run. As 1% increase in crude oil price leads to 66% increase in exchange rate in Nigeria in the short term.

Further, the results also indicate that the coefficient of crude oil price decline was also negative and statistically significant at 1 percent level in affecting exchange rate in the short run. This implies that a 1 percent drop in crude oil price led to 22% decrease in exchange rate in the short run.

In addition, interest rate as another control variable in equation 9 is having positive and significant effect on exchange rate at 5 percent level of significance in the short run, implying that at 1 percent increase in interest rate is connected to 7% increase in exchange rate in the short run period.

Additionally, control of corruption as a control variable in equation 9 has significant positive effect on exchange rate in the short run. As 1% increase in control of corruption lead to 6% increase in exchange rate in Nigeria in the short run.

Furthermore, governance effectiveness as another control variable has a negative and statistically significant effect on exchange rate in the short run as 1% decrease in governance effectiveness leads to 8% decrease in exchange rate in the short term.

Again, the ECT is less than one, negative and statistically significant at 1 percent level in the model, thereby providing further confirmation for the presence of long run asymmetric relationship among the variables in the model. The ECT coefficient of -0.687762, indicating that about 68 percent of the deviation from equilibrium arising from the model is corrected within one (1) year. Equally, the R-square value of 0.887296 reported in the lower part of Table 5. shows that 88 percent variations in exchange rate was jointly explained by increase and decrease in crude oil price, interest, control of corruption and governance effectiveness holding other factors constant, while the remaining 12 percent is explained by error term in the model.

4.5 Non-linear ARDL Diagnostic Test Results

The study also tested for serial correlation (autocorrelation), heteroskedasticity, normality, specification error and the stability problems in the estimated equations.

Table 6. Non-linear ARDL Diagnostic Checks Results

Tests	F-statistic	Obs*R-squared
Serial Correlation LM Test	0.185266[0.8319]	0.522417[0.7701]
Heteroskedasticity Test	0.124626[0.7261]	0.130921 [0.7175]
Normality Test	119.8085 [0.234]	Not Applicable
Ramsey RESET Test	2.432838[0.1297]	Not Applicable

Note: Numbers in parenthesis are the p-values.

From Table 6, the test for serial correlation produced an F-statistic and Obs*R-squared values of 0.1852 and 0.5224 at one lag with probability values of 0.83 (83%) and 0.77 (77%), implying that, there is no serial correlation problem in the estimated equations. Therefore, inferences from The null hypothesis indicating no serial correlation cannot be dismissed because the p-value exceeds 5%. nonlinear effect of crude oil price on exchange rate can be relied on.

Subsequently, the serial correlation test, the study tested for heteroskedasticity which revealed that the F-statistic value of 0.1246 with p-value of 0.72 (72%) and Obs*R-squared value of 0.1309 with p-value of 0.71 (71%) were not statistically significant, because the probability value is greater than five percent. This suggests that the null hypothesis of no heteroskedasticity was not rejected. Therefore, the estimated nonlinear model is free from heteroskedasticity hence can also be relied on.

The estimated Jarque-Bera value of 119.80 with p-value of 0.20(20%) was highly insignificant implying that the null hypothesis of the test that errors were normally distributed in the model could not be rejected. Hence there is no normality problem in the estimated nonlinear ARDL model.

The Ramsey RESET test value of 2.4328 has a probability value of 0.12 (12%) which suggests that the null hypothesis of no misspecification error is failed to be rejected in the model. Therefore, confirming that errors in the estimated nonlinear ARDL model were correctly specified.

The stability test results using CUSUM and CUSUMSQ were depicted in Figure1. And figure 2. Figure1 and.2 shows the CUSUM and CUSUM of squares statistics for stability of the relationship together with short run movement between crude oil price fluctuation and exchange rate. Figure 1 showed plot of CUSUM stays within critical 5 percent bounds. The result also revealed that the coefficients are changing systematically. However, CUSUMSQ plot in figure 2 do not exceed 5 percent critical bounds of parameter stability and therefore confirms the result obtained in the short run estimate. This indicates that relationship between crude oil price volatility and real exchange rate is stable and coefficients are changing suddenly.

Fig. 1and 2. Test of stability between crude oil price and exchange rate.

FIGU RE .1

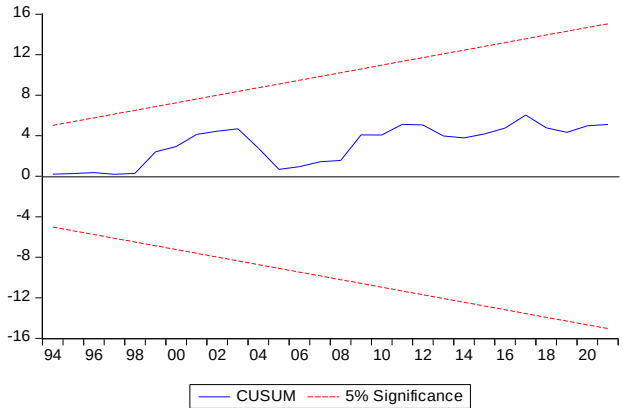
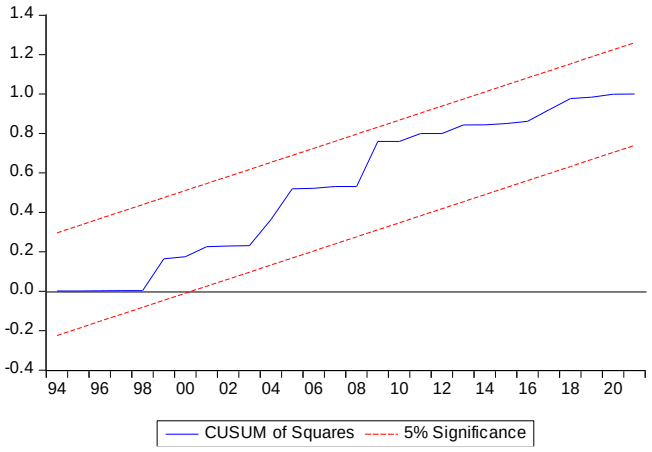


FIGURE 4.2



5. Conclusion and Recommendations

This further discusses the recommendation and policy implications of the study from the findings.

The result found that increase in Crude oil price (cop^{+}) has positive and significant effect on exchange rate in both short and long run estimate, also decrease in crude price (cop^{-}) has a negative and significant effect on exchange rate in both short run and long run. Additionally, our results show that interest rate and control of corruption have positive effect on exchange rates both in the long run and short run, while governance effectiveness have negative effect on exchange rate in the both long run and short run. Based on the findings of the study, following recommendation was made.

The construction of more refineries to increase domestic refining capacity in order to reduce reliance on imported refined petroleum products and to implement reforms to address the crises in the downstream sector, including deregulation, privatization and liberalization, this will help to address the issue of high crude oil prices as it increases import cost as it put pressure on the exchange rate, leading to depreciation of the naira.

The government should ensure transparency, effective governance and maintain strong voice and accountability, in order to mitigate the impact of crude oil price changes on exchange rate, because weak voice and accountability can affect the main objectives of exchange rate policy in Nigeria. Lack of transparency and accountability in management of oil price and the revenue generated can lead to inefficient allocation of resources but a better, sound, transparent and accountable government can manage the exchange rate, reducing the pass-through effect of crude oil price increases on domestic prices.

The policy makers should establish or re-strengthened a sovereign wealth fund, like Nigeria's excess crude account (ECA) to save a portion of the oil generated revenue during the periods of high prices. These funds can be invested in diversified Assets to generate returns and reduce dependency on oil exports and by maintaining fiscal buffer as mentioned earlier the government should also cushion the impact of low oil prices on the economy.

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