OIL SUPPLY NEWS AND DYNAMICS OF EXCHANGE RATES IN OIL-EXPORTING COUNTRIES

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Abstract

Most sub-Saharan African (SSA) countries have benefited and also suffered from the consequences of oil price fluctuations. The suffering of these nations has reverberated especially from the influencing power of exchange rate volatility, high inflation as well as an adverse impact on other macroeconomic variables. Therefore, this study estimated the magnitude of the effects of oil supply news shocks on the dynamics of exchange rates and also, the impact of exchange rate dynamics on oil supply news shocks in oil-exporting countries of West Africa (WA) countries. We implemented a panel non-linear autoregressive distributed lag (P-NARDL) model. The finding of the study indicates that rising fluctuations in oil prices caused by Organization of the Petroleum Exporting Countries (OPEC) news of oil supply disruption significantly induce exchange rate devaluation. Unambiguously, a 1 percent increase in oil supply news shocks stimulated 1.59432 percent appreciation while the same-size decrease in oil prices led to 0.86397 percent devaluation. These validate asymmetrical presence in exchange rate behaviour concerning the oil market. Also, we found 1.09452 percent devaluation and 0.25371 percent appreciation in the exchange rates of oil-producing African nations following a 1 percent rise and fall in inflation rates indicating a symmetric relationship between inflation rate and exchange rates. Oil-producing countries of WA should utilize foreign exchange (FX) from oil export to acquire capital-intensive projects.

Keywords: Crude Oil Price Shocks, Oil Exporting Countries, Asymmetric Effects, Exchange Rate Dynamics, Panel Non-Linear Autoregressive Distributed Lag Model

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1. INTRODUCTION

Most sub-Saharan Africa (SSA) countries have benefited as well as suffered from the consequence of oil price shocks. The suffering of these nations has reverberated especially from the swaying volatile nature of the exchange rate, and its adverse impact on other variables including the ability to finance development projects (Adi et al., 2022; Onodje et al., 2022; Otoakhia, 2020; Nouira et al., 2018). The above scenario has continually threatened the effectiveness of policy and policymakers of African countries entrusted with the responsibilities of stabilizing and growing their respective economies. The last two decades have witnessed an unprecedented fluctuation in the global oil markets; the outcome of the surprising oil market shocks has resulted in a global economic slowdown which may also be partly due to the global economic meltdown. Like most economic arrangements, the oil market is highly dynamic hence, it affects the world economy. Trung and Vinh (2011) observed that prices of oil can alter the economic activities of nations. For oil-producing countries of African nations whose main source of income is from oil such as Nigeria, this has made them very susceptible to unpredictable movements in the global oil market.

According to Ehikioya et al. (2019), exchange rate volatility has been identified as one of the most devastating consequences of oil market stocks because of its ability to diffuse into other macroeconomic variables. Adeola et al. (2022) reported that the upward demand for oil by the industrialized and other consuming countries due to seasonal factors enhances the favourable terms of trade of oil-producing countries of West Africa (WA). Inappropriately, this had also led exchange rate appreciation of such countries. The legal tender in which goods are priced has central consequences for exchange rate pass-through (ERPT) and best exchange rate policy (Gopinath et al., 2010). The evolution of the impact of ERPT on the domestic price level and the general economy depends on the source of crude oil market shock hitting the economy (García-Schmidt & Garcia-Cicco, 2018). In Africa, there is a particular question that requires a complete answer and that is, what is the effect of shocks arising from oil supply interruption announcements of Organization of the Petroleum Exporting Countries (OPEC) on exchange rate dynamics of oil-producing WA countries? Going forward, therefore, this paper estimates the effects of oil supply news shocks on the dynamics of exchange rates and also, the impact of exchange rate dynamics on oil supply news shocks in oil-exporting countries of WA. Accordingly, the contribution and novelty of this research can be explained as follows. Previous research provided observed findings as regards the relationship between oil price shocks and macroeconomic activities as well as the ERTP effect on domestic price level inflation measured mostly as consumer price index (CPI). Unfortunately, there are different sources of crude oil market shocks in relation to price. These include the supply-side shock, demand-side shock, and speculative shock. In all, oil price shock is exogenous. The inability of previous research done for Africa to identify the source of oil price shock is a limitation that damaged the model specification of such studies. To cover this gap, our study takes attention to oil supply news shocks which cause disruption to oil production. The empirical findings of the study contributed to the long- and short-run asymmetric impact of crude oil market shocks on exchange rate movements in oil-producing African countries.

The paper is structured as follows. Section 2 reviews the literature. Section 3 involves the theoretical framework, model specification, and estimation techniques and data source. Section 4 takes care of data analysis and finally, Section 5 contains the conclusion.

2. LITERATURE REVIEW

The first strand of literature is a review of the effect of oil price shock regardless of the source of shock on macroeconomic performance, foreign reserve holdings, industrial output, and economic variables including the exchange rates movements in terms of devaluation and appreciation (Umoru, Effiong, Ugbaka, Akhor, et al., 2023; Umoru, Effiong, Ugbaka, Iyaji, et al., 2023). The second strand of literature is devoted to the review of ERPT to price level domestically.

2.1. Theoretical review of relevant literature

In the first strand of the review, we have classified the theoretical literature into five different channels, namely, the *Renaissance growth theory*, the *oil-price shocks transmission channel*, *theory of real business cycle* (RBC), *asymmetry growth theory* and the *symmetric growth channel*, that link the effects of oil price shock to the overall economy. These include the *Renaissance growth theory* which emphasizes that oil price shock produces harmful effects on economic growth (Ogboru et al., 2017). This is the supply-side transmission channel linking oil price shock to the economy. According to this channel, since crude oil represents the basic input used in production, rising oil prices affects adversely growth of national output as informed by the cost of production. These combined effects reduce productivity in the country (Cross & Nguyen, 2017; Herrera & Rangaraju, 2020). This is also the *oil-price shocks transmission channel* whereby oil price shocks affect the exchange rate of a country (Marquez, 2022; Khraief et al., 2021; Baek, 2021; Musau & Veka, 2020; Dramani & Frimpong, 2020; Baek et al., 2019). The channel comes with a wealth transfer effect whereby the positive income effect is reflected in the trade balance and investment of oil-exporting nations. Enriching the trade balance, the domestic currency appreciates while that of the oil-importing region weakens and its currency devalues accordingly (Baek, et al. 2019). *Theory of real business cycle* advanced by Kydland and Prescott (De Vroey, 2016). Accordingly, RBC upholds those variations in the level of economic activities are caused by technological and oil shocks.

Asymmetry growth theory explained the non-linear impact of oil price shocks on growth (Rahman & Serletis, 2012) in terms of sectoral hocks, policy uncertainly, and counter-inflationary monetary policy action (Umar et al., 2021a; Sharma & Shrivastava, 2021). In line with this channel, a rise in the price of crude oil causes domestic inflation to rise (Sultan et al., 2020). The *symmetric growth channel* contends that an inverse link exists between oil price shocks and gross domestic product (GDP) (Hamilton, 1983, 2019). In other words, external shocks in the international crude oil market adversely influenced economic growth domestically. According to Baek (2021), high fluctuations in oil prices had a negative impact on exchange rates in Indonesia. Sharma and Shrivastava (2021) also found negative exchange rate effects of oil price variations. Dramani and Frimpong (2020) found significant shocks in oil prices on the exchange rate between Ghanaian cedi and euro (GHS/EUR). In China and India, Khraief et al. (2021) reported asymmetric exchange rate effects on oil prices. Pham and Sala (2020) found a greater macroeconomic effect on the real exchange rate following the oil price shock in Vietnam.

According to Kim and Vera (2022), the real GDP effect of oil shocks is negative in the U.S., while shocks of aggregate demand impact CPI positively. In the overall analysis, canvased for identification of the correct source of fluctuation in oil prices. According to Baumeister and Hamilton (2019), fluctuations in oil prices had a momentous influence on the U.S. real GDP. According to Ji et al. (2020), while aggregate demand shocks appreciated the exchange rates of oil-exporting nations, oil supply shocks significantly depreciated the exchange rate. Dada et al. (2022) reported that shocks in oil prices impeded economic growth in oil-producing African nations. The opposing effect could be worrisome given the Dutch disease syndrome prevalent in Africa whereby the oil-producing countries had neglected other sectors because of crude oil.

Both Alenoghena (2020) and Ho (2022) reported positive exchange rate effects of oil price shocks. Umar et al. (2021b) argued that oil price shocks differently impacted markets because the source of the shock differs. According to Ahmed et al. (2019), each of the SAARC[1] economies was significantly sensitive to oil price volatility. In Azerbaijani, Yildirim and Arifli (2021) reported that oil price shock negatively affected the trade balance. Zulfigarov and Neuenkirch (2020) reported that the exchange rate responded to the decline in oil prices in Azerbaijan. Yıldız et al. (2022) found no substantial influence of demand and supply shocks on exchange rates.

According to Gao et al. (2022), the effect of oil prices on exchange rates is direct and positive. In addition, the authors found a nonlinear bidirectional link between both variables in India and Bangladesh whereas, for the economies of Sri Lanka and Pakistan, the oil price movement unidirectionally stimulates exchange rates. According to Taofeek et al. (2022), international oil prices demonstrated a high persistence level beyond seventy percent but the length of persistence differs between short and long-term periods. Kisswani et al. (2022) found asymmetric outcomes of exchange rates for Malaysia, Singapore and Indonesia in the long run. According to Adi et al. (2022), historical shocks and volatilities considerably determined the current exchange rate and West Texas Intermediate (WTI) oil price markets. Correspondingly, Adi et al. (2022) found that the impact of own shock and volatility on present-day volatility in brent oil prices and the exchange rate was significant. According to Onodje et al. (2022), negative and positive oil price shocks significantly decreased the exchange rates.

Other researches, namely, Omolade et al. (2019), Umar and Bossman (2023), Koroma et al. (2023), Chatziantoniou et al. (2023), Güney et al (2023), Umoru, Effiong, Umar, Okpara, et al. (2023), Gao et al. (2022), Taofeek et al. (2022), Zorgati (2023), Candila et al. (2021), Chkir et al. (2020), Geng and Kun (2022), Bagchi and Paul (2023), Huang and Li (2022), Isah and Ekeocha (2023), Ji et al. (2019), Wang et al. (2022), Edwards and Cabezas (2022), Geiger and Scharler (2019), Tien and Hung (2022), Yildirim and Arifli (2021), Nonejad (2020), Bouri et al. (2020), Känzig (2021), Zulfigarov and Neuenkirch (2020), Khraief et al. (2021), Amiri et al. (2021), Zakaria et al. (2021), Pham and Sala (2020), have all explored the link between oil price shocks, exchange rates and other macroeconomic fundamentals notwithstanding the source of shock as well as the reactions of stock returns to asymmetric changes in oil prices and exchange rates. According to Nagengast et al. (2021), high ERPT is qualified on consumer prices with rising demand elasticities. According to the research findings of Osbat et al. (2021), ERPT is often reduced in the presence of greater market concentration. Ozdogan (2022) reported incomplet ERPT with respect to the inflation rate of the Turkey's economy having based analysis on the vector autoregressive (VAR) modeling framweork. Kocoglu et al. (2023) supported the heterogeneous influence of oil price shocks on the exchange rate at diverse time limits with the implication that pooled movements of exchange rates and oil prices offer healthier insights to investors in terms of the shock transmission mechanism. Recently, Umoru, Effiong, Umar, Eleh, et al. (2023) found negative covariance effect of the interaction between exchange rate devaluation and oil price shock on the West African Monetary Zone (WAMZ) economies while inflation that was used a control variable also reported adverse impact. In a related study, Umoru, Effiong, Okpara, et al. (2023) reported that oil-producing and exporting countries have exchange rates oscillate marginally due to varying oil prices. In particular, the authors noted that higher oil prices stimulate identical pattern of exchange rate reaction.

2.2. Review of relevant empirical literature

In the second component of the literature, we reviewed several studies that have found a higher level of ERPT in small emerging and developing nations whereas, in developed nations, the ERPT effect is very low with almost zero medians. These studies include Balcilar et al. (2019), Ha et al. (2020), Kurtović et al. (2018) and Frankel et al. (2012), and Jiménez-Rodríguez and Morales-Zumaquero (2016) which report that emerging and developing nations have a faster rate of ERPT compared to developed countries. Kabundi and Mlachila (2019) noted that in South Africa, ERPT was very low as a result of the low volatility of the monetary policy target. Pham (2019) and Vo et al. (2019), found an incomplete ERPT effect on domestic prices in Vietnam in the same year, and for the same country, Kassi et al.

[1] The South Asian Association for Regional Cooperation (SAARC) was established on December 8, 1985 by eight member countries (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri-Lanka).

(2019) found a nonlinear ERPT. Oktay (2022) found heterogeneity in ERPT to consumer prices in Switzerland where pass-through could be up to 0.8 for some commodity prices whereas the overall pass-through was just 0.12. In India, Swapnil (2022) found incomplete ERPT with variations across price indices. Obeng et al. (2022) found that ERPT to CPI resulted in 81% depreciation of the cedi as against 74% appreciation of the Ghanaian cedi. With micro-price data analysis, Yilmazkuday (2022) estimates show the exchange rate shock of 1% devaluation induced a 0.73%, 0.8%, and 0.83% drop in the welfare of the lowest, average, and highest income consumers in Turkey.

Hong et al. (2022) found a significant ERPT effect on CPI in Vietnam in the short- and long-term periods. Nasir et al. (2020), reported high ERPT in the United Kingdom and New Zealand. Similarly, Kassi et al. (2019) reported that in emerging Asian countries ERPT was higher than the ERPT in developing countries. Contrary studies by Caselli and Roitman (2019) found low ERPT. Abdulqadir and Chua (2020) found significant asymmetric ERPT to wages in SSA countries once inflation exceeded 15.12%. Gopinath et al. (2010) found a large difference in the ERPT effect based on the currency in which commodities were priced. In particular, the authors' ERPT of 25% for goods priced in US dollars for goods priced in non-USD, the pass-through was 95%.

Soon et al. (2018), Amoah and Aziakpono, (2018) reported non-linear and asymmetric ERPT to consumer prices in emerging markets, and Ghana respectively. Anderl and Caporale (2022) estimated significant nonlinear ERPT to consumer and import prices in inflation targeting Australia, the UK, New Zealand and Canada, Sweden than non-targeting U.S., euro-area and Switzerland. Kassi et al. (2019) found significant long-run asymmetric ERPT in emerging and short-run asymmetric ERPT effects in developing countries. Pham et al. (2020) found evidence of asymmetric ERPT and oil price shocks on inflation in the Association of Southeast Asian Nations (ASEAN). Olamide et al. (2022) reported that unpredictability in the exchange rate exacerbated the negative link between inflation and the growth of the Southern African Development Community (SADC). According to Morina et al. (2020), low volatility in exchange rates propels growth in Central and Eastern European countries. Hoang et al. (2020) recounted an adverse impact on GDP growth via ERPT to domestic inflation in Vietnam. In Zimbabwe, Mahonye and Zengeni (2019) found that the exchange rate devaluation of the Zimbabwean dollar (ZWD) is inflationary. Ha et al. (2020) estimated a significant ERPT effect on inflation and this negatively affected GDP. In 45 emerging countries, Barguellil et al. (2018) obtained a negative growth effect of volatility in exchange rates under a flexible exchange rates system. In the same year, Ozcelebi (2018) estimated the positive impact of volatility in the exchange rate for the OECD nations. This positive outcome was attributed to the fallen interest rate during the period of study.

Rudolf and Seiler (2022), Edwards and Cabezas (2022), Gautier et al. (2022), Breinlich et al. (2022), Freitag and Lein, (2022), Johnson (2017), Fleer et al. (2016), Auer et al. (2021) have all adduced different factors for differences in estimated values of ERPT. These include the import share of goods, invoice currency for boundary goods, and global trade ability. Samir et al. (2022) reported that information regarding oil prices strongly impacted the forecasting of exchange rates. According to Olayeni et al. (2020), in Nigeria, there is an unwavering direct link between oil exchange rates and oil price movements, whereas, to Manasseh (2019), and Asaleye et al. (2021), varying degrees of association exists between the exchange rate of the national currency and oil prices. Jung et al. (2020) found an asymmetrical interactive association between USD/CAD exchange rate and oil prices. According to Umoru et al. (2018), changes in oil prices heighten exchange rate volatility. Surprisingly, Olayungbo (2019) reported that oil price does not stimulate movements in the exchange rate. On their part Omolade et al. (2019) found from a panel vector auto-regressive (VAR) analysis an insignificant exchange rate effect of positive oil price shock in Economic Community of West African States (ECOWAS). The selected exchange rates chosen by the five members of ECOWAS were those of Nigeria naira (NGN), Liberian dollar (LRD), the West African CFA franc (XOF), and the Ghanaian cedi (GHS). According to Nouira et al. (2018) a decline in oil price translates to lesser units of importing nation's currency to purchase the same volume of oil it purchased in the past. This stimulates currency appreciation. The reverse would be the case whenever there was a rise in oil prices. In sum, the reviewed literature demonstrated that exchange rate policy varies in its effects on the macroeconomic performance of countries given the presence of high volatility in the exchange rate under a flexible system than a fixed regime of the exchange rate.

3. RESEARCH METHODOLOGY

Numerous econometric techniques can be deployed in this research. These include the VAR method, Markov-switching models, structural vector auto-regression (SVAR) with incomplete identification, quantile-on-quantile regression method, wavelet analysis, VAR-AGARCH model, dynamic stochastic general equilibrium modeling (DSGE), panel threshold regression, smooth transition regression model, dynamic fixed effect, general equilibrium modelling scheme, etc. In most cases, these alternative econometrics methodology results in mixed and inconclusive empirical findings. Hence, we found it desirous to implement the panel non-linear autoregressive distributed lag (P-NARDL) modelling approach. The estimation technique adopted in this study is the panel NARDL, unlike the traditional co-integration methods, yields better co-integration relations in small samples (Pesaran et al. 2001; Shin et al., 2014). In what follows, we tested for order of integration to be sure of a mixture of $I(0)$ or $I(1)$ variables based on ADF-Fisher Chi-square, Levin, Lin, & Chu (LLC) and Breitung t-statistics. In effect, we avoided $I(2)$ variables in our ARDL model estimation for the purpose of not making the bounds F-statistic invalid. The general-to-specific methodology was adopted to arrive at the parsimonious NARDL model specification. This was done to avert the inclusion of insignificant lagged coefficients in the final output of Eviews 10.0 estimation of the bounds co-integration test was conducted based on Wald F-statistic under our null hypothesis that: $\partial_1 = \partial_2 = \partial_3 = \partial_4 = 0$ as against $\partial_1 \neq \partial_2 \neq \partial_3 \neq \partial_4 \neq 0$. Analysis of long-run and short-run asymmetrical connections between exchange rate dynamics and the crude oil market was made.

With particular reference to Sanusi (2020), Onodje et al. (2022), Sa'ad et al. (2023), Allen and McAleer (2021), and Li et al (2021), this study implemented a P-NARDL model which makes crude oil market shocks to be dependent on exchange rate dynamics on one hand and the other hand, exchange rate dynamics to be dependent on crude oil market shocks). Taking from the modelling approach of Shin et al. (2014) and Pesaran et al. (2001), our asymmetric long-run equation of oil prices is specified thus:

$$OilPShock_t = \phi_0 + \phi_1 INFL_t + \phi_2 EXCH_t^+ + \phi_3 EXCH_t^- + u_t \tag{1}$$

where, *OilPShocks* is oil supply news shocks; *INFL* is inflation which captures consumer prices; *EXCH* is exchange rate dynamics; and $EXCH^+$ is a positive effect of exchange rate dynamics, while is $EXCH^-$ a negative effect of exchange rate dynamics; ϕ_1, ϕ_2, ϕ_3 are long-run parameters. Exchange rate dynamics are explained by Eq. (2) and Eq. (3) respectively.

$$EXCH^+ = \sum_{i=l}^{T} \Delta EXCH_i^+ = \sum_{i=l}^{T} Max\,(\Delta EXCH_i, 0) \tag{2}$$

$$EXCH^- = \sum_{i=l}^{T} \Delta EXCH_i^- = \sum_{i=l}^{T} Min\,(\Delta EXCH_i, 0) \tag{3}$$

The rise in exchange rate dynamics and oil supply news shocks in the long term is measured by ϕ_2 while measures oil supply news shocks and exchange rate decrease is measured by ϕ_3. The theoretical expectation $\phi_2 > 0, \phi_3 > 0,\ \phi_2 > \phi_3$ In effect, both dynamics of exchange rates are expected to go in the same direction. This is an asymmetric conjecture. Taking from the specification of Shin et al. (2014), our asymmetric long-run Eq. (1) was further specified into an ARDL equation. Accordingly Eq. (4) is the model of oil supply news shocks depending on exchanger rate dynamics.

$$\Delta OilPShock_t = \partial_0 + \partial_1 OilPShock_{t-1} + \partial_2 INFL_{t-1} + \partial_3 EXCH_{t-1}^+ + \partial_4 EXCH_{t-1}^- + \sum_{i=1}^{p} \phi_i\, \Delta OilPShock_{t-i} + \sum_{i=0}^{q} \tau_i\, \Delta INFL_{t-1} + \sum_{i=0}^{s} (\beta_i^+\, \Delta EXCH_{t-1}^+ + \beta_i^- EXCH_{t-1}^-) + u_t \tag{4}$$

where, p is the lag size of oil supply news shock, and q is the lag size of *INFL*, and exchange rate dynamics respectively. Asymmetric dynamics (increase and decrease in exchange rates) on the crude oil market are measured as $\phi_2 = -\partial_3/\partial_1$, $\phi_3 = -\partial_4/\partial_1$. Similarly, short-run impacts of exchange rate increases and decreases on oil supply news shocks are given as $\sum_{i=0}^{+} \beta_i^+ \,\&\, \sum_{i=0}^{+} \beta_i^-$. Asymmetrically, the cumulative dynamic multiplier consequence of a one percent the change in exchange rate was respectively measured as:

$$\omega_z^+ = \sum_{j=0}^{z} \frac{\partial INFL_{t+j}}{\partial EXCH_{t-1}^+}, \omega_z^- = \sum_{j=0}^{z} \frac{\partial INFL_{t+j}}{\partial EXCH_{t-1}^-} \tag{5}$$

where, $z = 0, 1, 2, 3, 4, 5, 6 \dots T$.

The modelling approach of Shin et al. (2014) brings up our asymmetric long-run equation of oil supply news shocks is specified thus:

$$EXCH_t = \gamma_0 + \gamma_1 INFL + \gamma_2 OilPShocks^+ + \gamma_3 OilPShocks^- + u_t \tag{6}$$

where, *INFL* is the inflation rate, $OilPShocks$ is oil supply news shocks, which capture oil price shock, and $OilPShocks^+$ and $OilPShocks^-$ measure positive and negative effects of oil supply news shocks, $\gamma_1, \gamma_2, \gamma_3$ are long-run parameters. Eq. (7) and Eq. (8) further capture shocks from oil production or supply news respectively.

$$OilPShocks^+ = \sum_{i=1}^{T} \Delta OilPShocks_i^+ = \sum_{i=1}^{T} Max\,(\Delta OilPShocks_i, 0) \tag{7}$$

$$OilPShocks^- = \sum_{i=1}^{T} \Delta OilPShocks_i^- = \sum_{i=1}^{T} Min\,(\Delta OilPShocks_i, 0) \tag{8}$$

$$INFL^+ = \sum_{i=1}^{T} \Delta INFL_i^+ = \sum_{i=1}^{T} Max\,(\Delta INFL_i, 0) \tag{9}$$

$$INFL^- = \sum_{i=1}^{T} \Delta INFL_i^- = \sum_{i=1}^{T} Min\,(\Delta INFL_i, 0) \tag{10}$$

where, $\gamma_2$and γ_3 capture the effects of an increase and decrease in oil supply shock on exchange rate movements. Theoretically, $\gamma_2 > 0, \gamma_3 > 0, \gamma_2 > \gamma_3$ the asymmetric postulations are such that both dynamics of crude oil market shocks are expected to go in the same direction. Following the specification of Shin et al. (2014), our asymmetric long-run equation becomes Eq. (11). In effect, Eq. (11) is the model of exchange rate dynamics depending on crude oil market shocks.

$$\Delta EXCH_t = \lambda_0 + \lambda_1 EXCH_{t-1} + \lambda_2 INFL_{t-1} + \lambda_3 OilPShocks^+_{t-1} + \lambda_4 OilPShocks^-_{t-1} + \beta_1 INFL^+_{t-1} + \beta_2 INFL^-_{t-1} + \sum_{i=1}^{p} \eta_i \Delta EXCH_{t-i} + \sum_{i=0}^{s} [\Theta_i^+ \Delta OilPShocks^+_{t-1} + \Theta_i^- \Delta OilPShocks^-_{t-1}] + \sum_{i=0}^{s} [\Theta_i^+ \Delta INFL^+_{t-1} + \Theta_i^- \Delta INFL^-_{t-1}] + u_t \quad (11)$$

Asymmetric long-run effects of crude oil market shocks (increase and decrease) on exchange rate dynamics are measured as $\gamma_2 = -\lambda_3/\lambda_1$, $\gamma_3 = -\lambda_4/\lambda_1$. Similarly, short-run impacts of oil supply new shocks increase and decrease on exchange rate movements are given as $\sum_{i=0}^{+} \Theta_i^+ \& \sum_{i=0}^{+} \Theta_i^-$. Similarly, the asymmetric cumulative effects of a one percent change in the exchange rate were respectively measured as:

$$\Omega_z^+ \sum_{j=0}^{z} \frac{\partial EXCH_{t+j}}{\partial OilPShocks^+_{t-1}}, \Omega_z^- \sum_{j=0}^{z} \frac{\partial EXCH_{t+j}}{\partial OilPShocks^-_{t-1}} \quad (12)$$

where, $z = 0, 1, 2, 3, 4, 5, 6 \dots T$.

In this analysis, annual data on exchange rates of currencies of Nigeria, Algeria, Egypt, Gabon, Equatorial Guinea, Angola, Libya, Sudan, Cameroun, Congo, and Chad against USD from 1980 to 2022 were collected from the databases of International Monetary Fund (IMF) and World Bank. Data on oil production was sourced from OPEC while oil supply news shocks were calculated as the variation in oil futures prices based on OPEC crude oil production announcements. The inflation rate was proxied by the CPI while GDP was measured as by the growth rate of national output.

4. RESULTS AND DISCUSSION

The estimates of the descriptive statistics for the study are presented in Table 1.

Table 1. Descriptive results

Measures	*OilPShock*	*INFL*	*EXCH*
Mean	70.77438	405.8069	211.0817
Median	67.11000	417.9200	158.0245
Maximum	99.67000	568.5000	403.6000
Minimum	39.68000	222.7900	118.5460
Std. dev.	19.72283	90.54109	85.86096
Skewness	0.078088	-0.332031	0.756959
Kurtosis	1.690007	2.483025	2.247522
Jarque-Bera	55.69517	22.66374	91.46151
Probability	0.000000	0.000012	0.000000
Sum	54354.72	311659.7	162110.7
Sum sq. dev.	298355.3	6287627.	5654404.
Observations	768	768	768

Note: Calculated using Eviews 10.0.

The test for the presence or absence of unit root to determine the stationarity of the chosen variables for this analysis is carried out using both the Augmented Dickey–Fuller (ADF) and Phillip Perron (PP) test as presented in Table 2.

Table 2. Stationarity level of both ADF and PP test

Method	*Statistic*	*Probability*	*Cross-sections*
Levin, Lin & Chu t*	-13.8349	0.3480	8
Breitung t-stat	-625713	0.2360	8
Im, Pesaran, & Shin W-stat (IPS W-test)	-14.8333	0.0000	8
ADF-Fisher Chi-square	156.947	0.0000	8
PP-Fisher Chi-square	194.482	0.0000	8

Note: Calculated using Eviews 10.0.

From Table 2 it can be observed that there is no unit root among all the variables taken together using both the Levin, Lin & Chu and Breitung t-stat tests. On the other hand, the IPS W-test further confirms the absence of unit roots in our analysis.

From Table 3, one can conclude that there is a long-run connection between our dependent variable and the independent variables with the F-stat value of 2.595 which is greater than the 5% level of significance on the 10 bounds.

Table 3. ARDL bounds test results

Test statistic	*Value*	*k*
F-statistic	2.575445	4
Critical value bounds		
Significance	*I(0) bound*	*I(1) bound*
10%	1.9	3.01
5%	2.26	3.48
2.5%	2.62	3.9
1%	3.07	4.44

Note: Calculated using Eviews 10.0.

Table 4. Non-linear ARDL estimation results

Co-integrating form				
Variable	*Coefficient*	*Std. error*	*t-Statistic*	*Prob.*
D(INFL_POS)	0.68918	0.134250	5.133550	0.0000
D(INFL_NEG)	-0.11867	0.010998	-10.79052	0.0000
D(EXCH_POS)	-0.04103	0.0031319	-13.10062	0.0000
D(EXCH_NEG)	0.00051	0.000475	1.073229	0.5432
CointEq(-1)	-0.44539	0.077696	-5.732470	0.0000
Long-run coefficients				
Variable	*Coefficient*	*Std. error*	*t-statistic*	*Prob.*
INFL_POS	0.66578	0.116385	5.720504	0.0000
INFL_NEG	-0.16200	0.023508	-6.891149	0.0000
EXCH_POS	-0.02314	0.000208	-11.12478	0.0000
EXCH_NEG	0.15260	0.016850	9.056318	0.0000

Note: Dependent variable: OilPshocks. Calculated using Eviews 10.0.

Table 4 shows the association between oil supply news shocks and the dynamics of ERPT in the long run with crude oil market shocks serving as the dependent variable. From the estimates, it is found that a one-percent rise in the exchange rate which is our main independent variable leads to an insignificant 0.0001% decrease in oil supply news shocks while a one percent drop in the exchange rate also led to an insignificant 0.0012% decrease in oil supply news shocks. These findings are symmetric and indeed further imply that changes in the exchange rate had no significant impact on oil prices. In effect, oil prices are exogenously determined. This is similar to the findings of Sekmen and Topuz (2021), and Wang (2013).

For *INFL* it can be seen that a percent increase in inflation rate leads to a 0.67 increase in crude oil-market supply news shock while a percent decrease in inflation induces 0.162 reduction in crude oil market supply news shocks among the selected oil-producing countries. The crude oil market supply news effect of exchange rate changes and inflation is signficant. Moreover, the results of the long-term are similar to those obtained for the short-term period. According to the results in the long-term period, a rise in exchnage rate, that is an appreciation induces some reduction in crude oil market supply news shock up to the tune of 0.023. On the other hand, a fall in the exchnage rate (devaluation) stimulates 0.153% rise in the crude oil market supply news shock. The crude oil market suply news effect of a devaluation policy is insignificant. The reason for this insignificant relationship may be a result of the fact that oil-producing African economies are confronted with different exchange rates rather tham maintain a unifying exchange rate system that gives benefit to market forces. By implication, these set of economies are yet to adapt to the new realities regarding exchnage rate system (IMF, 2023). The co-integration value of 0.44 shows that in the long run, it will take about three years to arrive at equilibrium. A significant link between oil supply news shocks and ERPT exists. This is in line with the findings by Sekmen and Topuz (2021).

Table 5. Panel non-linear ARDL estimation results

Co-integrating form				
Variable	*Coefficient*	*Std. error*	*t-statistic*	*Prob.*
D (INF_POS)	0.07330	0.00060	-121.0809	0.0000
D (INF_NEG)	-0.26916	0.029273	9.194740	0.0000
D (OilPShocks _POS)	-1.03108	0.158926	6.487783	0.0000
D (OilPShocks _NEG)	0.54278	0.050319	10.78671	0.0000
CointEg (-1)	-0.46852	0.224011	-2.091497	0.0042
Long-run coefficients				
Variable	*Coefficient*	*Std. error*	*t-statistic*	*Prob.*
INF_POS	1.09452	0.506750	2.15988	0.0065
INF_NEG	-0.25371	0.085618	2.96326	0.0002
OilPShocks_POS	-1.59432	0.538039	-2.96320	0.0003
OilPShocks _NEG	0.86397	0.122922	7.028591	0.0000
C	0.21301	0.065149	-3.26959	0.0002

Note: Dependent variable: EXCH. Calculated using Eviews 10.0.

Table 5 shows the association between oil supply news shocks and the dynamics of the exchange rate with the exchange rate serving as the dependent variable. The major finding of the results of Table 5 is that exchange rate movement is activated by non-linear crude oil market supply news. This shed light with the findings of shock-dependent ERPT as reported by Comunale (2020) and An et al (2021). From the estimates, it is found that a 1% increase in oil supply news shocks which is our main independent variable leads to a 1.59432% decrease in exchange rates which is appreciation while a one percent decrease in oil prices (*OilPShocks_NEG*) leads to 0.86397% devaluation. The implication is that rising fluctuations in oil prices that are associated with OPEC announcements about impending oil supply interruptions (news of oil supply disruption) significantly induce exchange rate appreciation. In effect, when the price of crude oil is high attributable to a shortage in supply by OPEC, oil-producing countries embrace a favourable trade balance which most often leads to surplus budgeting in those countries. The positive and the negative effects are significant at the 5% threshold level. These estimates uphold the finding established by Sekmen and Topuz (2021), Miyamoto et al. (2022) and García-Schmidt and Garcia-Cicco (2018). García-Schmidt and Garcia-Cicco (2018) based analysis on DSGE modelling; and found that the evolution of the impact of the exchange rate passes through to the domestic price level and the general economy was a function of the source of crude oil market shock hitting the economy. This is in line with a similar finding by Asadullah (2017). The co-integration value of -0.46852 shows that it takes about 46% per month to arrive at equilibrium with the implication of a significant link between oil supply news shocks and ERPT dynamics among the selected African oil-producing countries. This corroborates the results of Sekmen and Topuz (2021).

The results show that a 1% increase in the inflation rate leads to 1.09452% depreciation in exchange rate dynamics while a 1% decrease in the inflation rate leads to 0.25371% appreciation in the exchange rates among the selected oil exporting countries in Africa indicating a symmetric relationship between inflation rate and exchange rates. To determine if the values are serially correlated, we utilized the Breusch-Godfrey serial correlation Lagrange Multiplier (LM) test. From Table 6 presented below with an F-stat of 1.19665 and Prob. of 0.3102, we conclude that our variables are not serially connected. From Table 6, given the F-stat of 0.73920 and a p-value of 0.66, the model is not heteroscedastic.

Table 6. Breusch-Godfrey serial correlation LM test

Breusch-Godfrey (BG) test			
F-statistic	1.196646	Prob. F(2,53)	0.3102
Obs * R-squared	2.656529	Prob. Chi-square (2)	0.2649
Breusch-Pagan-Godfrey test			
F-statistic	0.739200	Prob. F(8,54)	0.6600
Obs * R-squared	6.000039	Chi-square prob. (8)	0.0001
Explained sum of squares	3.000005	Chi-square prob. (8)	0.0007

Note: Calculated using Eviews 10.0.

5. CONCLUSION

The study examined the link between oil supply news shocks and the dynamics of exchange rates in oil-producing Nigeria, Algeria, Egypt, Gabon, Equatorial Guinea, Angola, Libya, Sudan, Cameroun, Congo, and Chad. From our P-NARNL model it can be seen first, that the selected variables are adequate for the analysis. Essentially, both positive and negative dynamics in exchange rate generated insignificant effects on crude oil market shock. This is in line with similar findings by Sekmen and Topuz (2021). The findings of this study indicate that a decrease in oil supply news shocks fuels a lesser long-run impact on ERPT compared to the impact on ERPT caused by an increase in oil supply news shocks of the same size. The implication is that when the price of crude oil is high attributable to a shortage in supply by OPEC, oil-producing countries embrace a favourable trade balance which most often leads to surplus budgeting in those countries. GDP exhibited an asymmetric relationship with oil supply news shocks as well. This supports the conclusions of Sheikh et al. (2020).

From the result of the estimates, we found a significant asymmetric link between oil supply news shocks and exchange rate movements among the countries used in this study in line with studies by Liu et al. (2022) for the Chinese economy, Cheikh and Zaied (2020) for the EU member states, Ha et al. (2020), Forbes et al. (2018, 2020), Comunale (2020) in Russia. Equally, an increase in exchange rate among the selected oil-producing counties in West Africa leads to an insignificant impact on oil supply news shocks. This renders support to the conclusions made by Beckmann and Czudaj (2013a), Beckmann and Czudaj (2013b), Beckmann et al. (2016), and Beckman et al. (2017). Efforts should be made by OPEC to ensure more stability in the prices of crude oil to stamp out the ERMT as a result of oil supply news shocks. Efforts should be made by the oil-producing countries of Africa to ensure that the scarce foreign exchange (FX) is not further used in importing non-economic or productive equipment. Finally, the government of the selected oil-producing African countries should not lose sight of the inflation rate. Once again, the case of oil price stability comes into play. Considering the smallness of the research sample, our results could be seen as preliminary pending when a comparative analysis is done between oil a larger sample of producing developing countries and oil-producing advanced countries with the use of the Markov-switching regression method.

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