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Asymmetric Effects of Oil Price Shocks on Macroeconomic Variables in Nigeria

AKODE, Thomas Ojo., OGUNSAKIN, Sanya., ILESANMI, Oluwaseyi Joshua

Department of Economics, Faculty of the Social Sciences, Ekiti State University, Ado Ekiti, Nigeria

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***Corresponding Author:** AKODE, Thomas Ojo.

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Abstract **Original Research Article**

This study examined the asymmetric effect of oil price shocks on macroeconomic variables in Nigeria ween 1990q1 and 2023q4. The study employed quarterly data which was sourced from the World Energy Information Online database and the International Monetary Fund (IMF) online database. The data sourced were estimated by the Asymmetric Autoregressive Distributed Model, Vector Autoregressive Distributed Model and Pairwise Granger Causality Test. Results the unit root test revealed that variables of interest were integrated of mixed orders, that is I(0) and I(1). The examined result showed that there was long-run co-movement between oil prices and the selected macroeconomic variables during the study period. The results further revealed that both in the short run and long run, the response of the selected macroeconomic variables to shocks from positive oil prices was positive but not significant, which their response to the shocks emanating from oil prices was negative and significant. The result from the pairwise Granger causality test showed bi-directional causality between oil price, real output growth and gross fixed capital formation, while uni-directional causality running from oil price to inflation, real effective exchange rate and real interest rate was established. The study concludes that there is asymmetry in the relationship between oil price and macroeconomic variables in Nigeria. Based on these findings, the study recommends that there is a need for economic diversification to reduce overreliance of the Nigerian economy on income from oil. Also, there is a need to intensify efforts on alternative sources of energy, particularly renewable energy.

Keywords: Asymmetric, ARDL, Macroeconomic Variables, Oil Price and SVAR.

1. INTRODUCTION

Crude oil remains one of the most important natural resources is crude oil, which also has the biggest commodities market in the world. Over the past 60 years, oil has continued to be the most vital energy source in the world, with its byproducts being used to power homes, businesses, automobiles, and aeroplanes (Gabriel, 2020). Oil is one of the few or the only production inputs that can affect macroeconomic variables in both symmetric and asymmetric ways, in contrast to other products. To a great degree, price volatility can trigger a business cycle. The global oil market has seen significant volatility and swings in oil prices since the 1970s. Supply and demand were the main causes of these different changes (Aliyu, 2009). However, compared to the 1970s, the current oil price changes are more severe and noticeable, leading to unpredictable results (Bayond, 2017).

Crude oil has continuously made up the majority of Nigeria's exports during the last forty years. Because of this degree of reliance, it is expected that Nigeria's economy, which exports a significant amount of crude oil, will be able to sustain economic growth while shielding important macroeconomic indicators from the volatility of global oil price swings (Essarma-Nssah, 2007, as cited in Okon, 2021). The identification of asymmetry in the relationship between oil prices and macroeconomic performance is a crucial aspect of studying this relationship. Analysing how shocks to the oil price, both positive and negative, have varying effects on macroeconomic variables over both short and long time horizons is part of the asymmetry approach. A more sophisticated understanding of the scope and impact of oil price fluctuations on macroeconomic stability and performance is possible with this method (Okoro, 2021).

Nigeria ranks sixth among OPEC countries in terms of crude oil exports. Nigeria's economy has been dominated by oil since 1956, when it was discovered in commercial quantities (Umar & Abdulhgkgem, 2010), as cited by Okoro (2021). Crude oil is the mainstay of the Nigerian economy, which is heavily dependent on it. Nonetheless, oil's GDP contribution is comparatively low, averaging 8.09 percent, 10.04 percent, and 10.07 percent between 2020 and 2023 (C.B.N., 2023). Nigeria had made enormous foreign exchange profits from oil exports prior to the 2014 decline in the price of crude oil on the global oil market; nevertheless, this did not result in improved macroeconomic performance (Wit & Crookes, 2013; Zahran, 2019).

Moreover, the extent to which macroeconomic variables respond symmetrically or asymmetrically to oil price shocks remains a subject of empirical debate (Olomola, 2016; Baka, 2011; Obioma & Eke, 2015; Ogundipe & Ogundipe, 2013; Iyoha & Oiriaki, 2016). While several studies, such as Iyoha et al. (2018), report evidence of an asymmetric relationship between oil prices and macroeconomic fundamentals, others, including Ogunsakin & Oluwatuyi (2016), Ogundipe & Ogundipe (2013), and Abubaka (2011), suggest the relationship is symmetric.

In addition, Stephen (2019), Godwin (2020), and Abdulrasak (2018) identified inflation as the principal transmission channel through which oil price fluctuations affect the economies of oil-importing countries. Conversely, Omolade (2019), Olomola (2016), and Ogunsakin and Oloruntuyi (2016) demonstrated that in oil-exporting nations, the exchange rate serves as the key mechanism through which oil price variations influence economic performance. Similarly, Oladapo and Dasuki (2017) reported evidence of a symmetric relationship between oil prices and macroeconomic variables in developing economies both oil-importing and oil-exporting whereas Stephen and Khaled (2010) observed an asymmetric linkage between oil price dynamics and output growth in developing nations (Akpan, 2009; Olomale & Adejumo, 2010; Olayemi, 2017).

In oil-exporting economies, Obioma and Eke (2015) showed that oil prices have a strong predictive influence on exchange rate volatility, with exchange rates depreciating when oil prices fall and appreciating when prices rise. On the other hand, research by Akinbobola and Olagbaju (2016) and Atem et al. (2015) shows that while rising oil prices have little to no impact on exchange rate movements, dropping oil prices cause the currency rate to appreciate. Furthermore, depending on the size and direction of the shocks whether small, large, positive, or negative exchange rates and inflation both show asymmetric reactions to shocks to the oil price (Atems et al., 2015). Such asymmetry in macroeconomic reactions to changes in the price of oil has produced varying empirical results, which is in line with Hamilton's (2003) viewpoint. More recently, Khaled (2020) distinguished between economies that import and export oil and underlined that a nation's net oil trade position shapes the effect of fluctuations in oil prices on macroeconomic variables.

The main objective of this paper is to investigate the asymmetric effect of oil price on macroeconomic variables in Nigeria. This study is unique, considering the situation of the Nigerian economy being a net exporter of crude oil. That is, exporting crude oil and importing refined oil products. The study outcome will be helpful to policymakers to understand the rate at which macroeconomic variables respond to positive and negative oil prices. Therefore, this will guide policymakers in policy formation and implementation. The rest of the paper is structured thus. This introductory section is followed by a literature review. gu three deals with methodology. Chapter four centres on results and discussions, while section five concludes the paper.

2. LITERATURE REVIEW

A substantial body of research has examined the nexus between oil price fluctuations and macroeconomic performance across both developed and developing economies. Nevertheless, there remains no scholarly consensus on the precise nature of this relationship. To provide empirical grounding for the present study's adopted model, selected contributions from the literature are highlighted. For instance, Arouri (2011) analyzed the link between oil prices and economic growth among Gulf Cooperation Council (GCC) countries over the period 2005–2010. Utilizing a Vector Autoregression (VAR) framework, the study established the presence of significant return and volatility spillovers between global oil prices and GCC stock markets.

In support of this perspective, Basherr and Sadorsky (2006) investigated the relationship between oil price fluctuations and selected macroeconomic variables in emerging markets, employing co-integration and error correction models. Their findings provided strong evidence that oil price volatility exerts significant effects on macroeconomic indicators in these economies. Similarly, Park and Ratti (2007) explored the connection between oil prices and macroeconomic variables in the United States and 13 European countries using Vector Autoregression (VAR) and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) techniques. The study revealed that heightened oil price volatility substantially reduces real stock returns in European economies. Moreover, it demonstrated that the contribution of oil price shocks to variability in macroeconomic fundamentals in the United States and many of the selected European countries exceeds that of interest rate movements. The study further showed that increases in real oil prices significantly elevate short-term interest rates in the United States and in eight of the 13 European countries within a one- to two-month horizon. By contrast, for the European sample, no evidence was found of asymmetric effects of positive versus negative oil price shocks on macroeconomic variables.

Along similar lines, Stoneness (2023) applied an asymmetric Autoregressive Distributed Lag (ARDL) model to assess the impact of oil prices on macroeconomic variables in selected developing economies. The study's empirical evidence indicated that fluctuations in oil prices exerted a substantial influence on the examined macroeconomic indicators throughout the study period. Adding to this ongoing debate, Olorunsola and Duduosun (2023) employed pairwise Granger causality tests to explore the relationship between oil price shocks and investment in Nigeria. Their findings revealed a bi-directional causal relationship between oil prices and investment, alongside a uni-directional causality running from oil prices to other key macroeconomic variables.

Consistent with the findings of Gow and colleagues, Bounchaoutt and Ai-zeaud (2012) employed a Vector Error Correction Model (VECM) alongside a structural VAR framework to examine the impact of oil price volatility on the Algerian economy over the period 1980–2011. Their analysis indicated that, in the short run, oil price changes exerted only limited influence on most macroeconomic variables, apart from a positive effect on inflation and a negative effect on the overall exchange rate. In the long run, however, oil price fluctuations were found to have a positive impact on real GDP and inflation, while exerting a negative influence on unemployment and the effective exchange rate. Supporting this perspective, Part and Ratti (2022) applied a multivariate autoregressive approach to data from Norway covering the period 1990–2020. Their results revealed that oil price fluctuations accounted for approximately six percent of the volatility observed in key macroeconomic fundamentals.

Kilishi (2022) examined the effect of oil prices on macroeconomic variables in Nigeria over the period 2000–2020, employing a Vector Autoregression (VAR) model. The findings demonstrated that oil prices exert a significant influence on the selected macroeconomic indicators, namely GDP, money supply, and unemployment. Similarly, Wilson et al. (2012) utilized a modified ordinary least squares approach in conjunction with the Granger causality test to analyze the relationship between oil prices and macroeconomic performance in Nigeria from 1985 to 2010. Their empirical results confirmed a significant relationship between oil price volatility and key macroeconomic variables, including GDP, inflation, interest rate, and exchange rate.

Similarly, Asaolu (2023) used a vector error correction framework and co-integration to investigate the link. Godwin (2023) used GARCH estimating techniques to examine macroeconomic factors and oil price volatility in a few developing economies. The empirical findings showed that, despite the oil price's proven volatility, the chosen macroeconomic indicators throughout the period were not significantly impacted by it. In the similar vein, Waterloo (2022) used VAR to examine the relationship between macroeconomic performance in the UK from 2000 to 2014 and shocks to the oil price.

The results demonstrated that during the research period, there was neither a positive nor a significant reaction of macroeconomic performance as assessed by real GDP and cross-fixed capital formation to shocks originating from oil prices. Additionally, Mohhni: 2020) used VAR as an estimating approach to study the association between output growth in the USS between 1990 and 2016 and oil price instability. The study's conclusions showed that real GDP responded favourably but not significantly to shocks originating from changes in oil prices. Stonness (2020) employed the Generalized Method of Moments (GMM) to examine the relationship between oil price fluctuations and Japan's economic growth over the period 2018 to the present. The study revealed a strong association between the selected variables during the period under review. Complementing this evidence, Helper (2023) applied a Vector Autoregression (VAR) framework to investigate the impact of oil price changes on investment and economic development in Germany between 1990 and 2021. The findings indicated that both economic growth and investment responded significantly and positively to shocks arising from oil price fluctuations.

Carrywness (2020) investigated the connection between oil prices and stock market returns in the US from 2000 to 2018 using panel co-integration and panel structural VAR approaches. The findings showed that although oil price shocks had a beneficial impact on stock market returns, the effect was not statistically significant. In a related study, Owunenie (2020) used the Generalised Method of Moments (GMM) to examine how money demand functions, oil prices, and economic development interacted in Japan from 1996 to 2016. The findings demonstrated a significant relationship among the selected variables during the study period. Similarly, Volneyu (2020) utilized a structural VAR model to investigate the nexus between oil prices, economic growth, and investment in selected developed countries from 2000 to 2018, and the study revealed that economic growth responded positively, directly, and significantly to oil price shocks throughout the period.

Kevin (2018) examined the asymmetric impacts of oil price shocks on stock market returns in the period between 2000 and 2016 using panel non-linear ARDL. The results showed that during the study period, the oil price and the return on the US stock market had a substantial non-linear long-term relationship. Yuhuful (2018) investigated the relationship between the German exchange rate, gross fixed capital creation, and oil price using the YAR structure. The investigation's findings showed a clear, significant, and positive association between the variables that were chosen, and empirical data also suggested long-term co-movement during the study period. In a related contribution, Young (2023) investigated the connection between changes in oil prices and economic development in a few advanced economies using a panel VAR approach. According to the study, shocks to the price of oil have a favourable and considerable impact on economic growth. Similarly, Wonyee (2023) examined the asymmetric impacts of oil price shocks on economic development in developed countries using a non-linear ARDL model, non-linear ARTY, and panel structural VAR approaches. The results showed that oil prices and economic growth in the countries under examination had a non-linear long-term co-movement.

Nonetheless, the evaluated empirical literature covers a wide range of topics on the correlation between macroeconomic variables and the price of oil. The empirical review's findings appear to be at odds with one another. Two main sources of the conflict were the study's methodology and scope, which differed due to various estimation approaches. The estimating methods used by the prior researchers were not able to account for asymmetric relationships. Engel and Gropger or Johansen and Juselius with varying sample periods were utilised in the few studies that used co-integration and error correction models. Thus, a panel structural vector autoregressive model Granger causality test and an asymmetric autoregressive distributed lag that exhibits both linear and nonlinear interactions were used in the study to address the aforementioned issues.

3. METHODOLOGY

The aim of this study is to investigate the relationship between oil price and macroeconomic variables. Therefore, the model of this study is built on the Augmented Keynesian Phillips Curve.

In the original version of Phillips Curve

$$\pi_1 = \alpha - \gamma u_t \quad \ldots(3.1)$$

where and π_1 and u_t are inflation and unemployment respectively, α is the inflation where there is zero unemployment and γ is the rate at which inflation responds to unemployment. The Phillips curve was also developed in the United States by Paul Samuelson and Robert Solow in 1960. Politicians can utilise demand management strategies to boost output and lower unemployment by choosing from a range of trade-offs shown by the Phillip's curve. However, typical salaries rise when unemployment declines. Prices will rise as a result of the high nominal salaries

Friedman (1968) attacked the well-known Phillips curve for failing to account for expectations, arguing that expectations were created adaptively and that inflation expectations changed over time due to real prior experience. According to Friedman (1968), the inflation-unemployment tradeoff should be expressed as a "expectations-augmented" Phillips curve of the following type.

$$\pi_1 = -\gamma(u_t - u^*) + \pi_t^e \quad \ldots(3.2)$$

The Augmented Keynesian Phillips Curve rests on two fundamental assumptions: monopolistic competition among firms and price stickiness. Under monopolistic competition, each differentiated good is produced by a single firm, which independently determines the price of its output. Price stickiness, in contrast, arises from restrictions on firms' ability to adjust prices freely. Calvo (1983), for instance, postulated that only a subset of firms is able to modify their prices within a given period. In this framework, firms announce prices in advance and face prohibitively high costs of continuous adjustment, limiting their ability to change prices at will. Prices are set in terms of domestic currency, and adjustments occur only when a firm receives a price-change signal. Importantly, in any given period, only a fraction of firms is assumed to revise their prices, considering both the expected average price level and prevailing market conditions, including demand behavior and the degree of competition.

Model Specification

Building on the foregoing exposition of the Augmented Phillips Curve, and consistent with the framework of Salisu and Isah (2017), the model specified in Equation 3.3 is introduced to examine the relationship between oil prices and selected macroeconomic variables.

$$\Delta y_t = \beta_0 + \sum_{i=1}^{p-1} \lambda_i \Delta y_{i1}{}^{+}{}_{t-1} + \Delta y_{i2}{}^{-}{}_{t-1} + \sum_{i=0}^{q-1} \delta_1 \Delta X_{t-1} + (\varphi_1 Y_{i1_{t-1}}^{+} + \varphi_2 Y_{i2_{t-1}}^{-}) + \varphi_3 X_{t-1} + \varphi_4 X_{t-1} + \varphi_5 X_{t-1} + \varphi_6 X_{t-1} + \varphi_7 X_{t-1} + \varphi_8 X_{t-1} + \varphi_9 X_{t-1} + \varphi_{10} X_{t-1} + \varphi_{11} X_{t-1} + t \quad \ldots(3.3)$$

Where y_{i1} and y_{i2} respectively represent the positive and negative oil price shocks while others stand for macroeconomic variables.

The error correction version of equation 3.3 represents

$$(\varphi_1 Y_{i1_{t-1}}^{+} + \varphi_2 Y_{i2_{t-1}}^{-}) + \varphi_3 X_{t-1} + \varphi_4 X_{t-1} + \varphi_5 X_{t-1} + \varphi_6 X_{t-1} + \varphi_7 X_{t-1} + \varphi_8 X_{t-1} + \varphi_9 X_{t-1} + \varphi_{10} X_{t-1} + \varphi_{11} X_{t-1} + t \quad \ldots(3.4)$$

In the asymmetric panel ARDL framework, the long-run equilibrium relationship is represented by the error correction term (ECT). The coefficient of the ECT reflects the speed of adjustment, indicating the length of time required for oil prices and macroeconomic variables to return to equilibrium following a shock.

Estimation Techniques

The estimation techniques employed in this study were guided by the main objective of the study. The estimation techniques are Asymmetric ARDL, SVAR and the Pairwise Granger causality test.

Sources of Data

The data employed in the study were sourced from the World Energy Information online database and the International Monetary Fund (IMF) online database.

4. RESULTS AND DISCUSSION

In thig section, results obtained from various tests conducted are presented. The section starts with descriptive statistics that summarises the behaviour of variables employed in the study. Thereafter, unit root test results follow. What follows is the presentation of short-and long-run association between the variables of interest. The chapter ends with a discussion of findings. Descriptive statistics of the variables employed in the Study.

Table 1 Descriptive Statistics

Statistic	WOP+	WOP-	REER	GFCF	RIR	CPI	RGDP
Mean	5.326424	7.4506	47.14062	96.36618	11.51434	27.04426	14.3456
Median	4.640163	4.4789	40.114	97.28151	9.88775	28.16	20.1432
Maximum	14.22367	5.0624	108.34	133.0801	18.63655	32.18	21.6214
Minimum	1.58102	1.4502	-11.171	69.33152	6.211161	-21.31	-36.4241
Std. Dev.	2.064315	2.6233	30.17774	18.03611	3.104673	1.617638	28.2401
Skewness	1.046182	4.6274	0.547058	0.275551	0.30772	-0.21325	-11.4507
Kurtosis	3.117386	5.4621	1.164681	1.552405	1.080703	1.186121	18.6472
Jarque-Bera	6.363678	7.4231	2.013318	1.870202	1.758003	1.221674	20.46221
Probability	0.012715	1.4562	0.111442	0.114228	0.281671	0.412714	21.6214
N	30	30	30	30	30	30	30

Author's computation, 2025

From table if it is noted that not all the variables of interest are normally distributed, as shown by the Jarque-Bera test, except for the real effective exchange rate. This conclusion was arrived at by W rejection of the null hypothesis of normality at a 5% significance level. The global oil Sia gross fixed capital formation and real output growth are presented in their log forms, while inflation, real interest and real effective exchange rate are in rates.

The distribution of the inflation rate, measured by the consumer price index, is positively skewed and platykurtic, thereby exhibiting evidence of non-normality. In contrast, real output growth shows limited dispersion, as indicated in Table 1, yet its distribution is leptokurtic and negatively skewed, which accounts for the non-normality confirmed by the Jarque–Bera test. Similarly, oil prices considering both positive and negative movements are characterized as platykurtic and negatively skewed, suggesting that over the study period, oil prices were subject to more frequent negative shocks than positive ones. By comparison, the real effective exchange rate displays positive skewness, implying that it experienced a greater frequency of positive adjustments relative to negative ones during the same period. There is little variation in the gross fixed capital formation. The real interest rate is positively skewed, indicating that there were more positive than negative changes in the real interest rate for the time in question. In conclusion, these variables' deviation from the mean, normality in skewness, and kurtosis all point to their intrinsic non-normality, which affects the stability of the variables used in the research.

The Unit Root Test Results

It has been demonstrated that macroeconomic variables exhibit non-stationarity. Thus, the conclusion drawn from the series is considered bogus if a fad root test is not performed to demonstrate the degree of integration of variables of concern. This will be inaccurate and deceptive, particularly if any of the variables is (2). For this study's panel unit root test, we used Phillip Perron (PP), Zivot and Andrew (ZA), and Augmented Dickey-Fuller (ADF). The variables of interest included in the study are integrated of mixed orders, according to the findings of the many unit root tests that were performed. In other words, while some are stationary at level, others are stationary at I(0) and I(1), the first differences.

Table 2: Unit Root Test

Test / Specification	LWOP	LWOP*	LREER	RGDP_GFCF	RIR	CPI
Level / Intercept						
ADF	-2.64	0.45	0.84	0.95	-0.41	4.51
PP	-2.54	0.68	0.95	0.75	-0.88	6.11
ZA	-3.4	3.51	-1.23	-1.5	-4.23	-5.46
Level / Trend & Intercept						
ADF	-1.74	-2.61	-0.48	-1.36	-1.38	0.84
PP	-1.8	-2.34	0.27	0.81	-1.38	1.74
ZA	—	-3.78	-2.39	-2.82	-5.20**	-1.63
First Difference / Intercept						
ADF	-13.3	-9.39	-9.71	-9.65	-10.7	-9.26
PP	-13.3**	-9.40**	-8.03***	-7.95**	-10.7**	-9.33
ZA	-6.33	-9.66	-6.09	-7.65	-10	-11.2
First Difference / Trend & Intercept						

ADF	-13.5	-9.42	-9.78	-9.73	-10.7	-10.6
PP	-13.6	-9.42	-8.04	-7.93	-10.7	-10.6
ZA	NA	-9.64	-6.81	-8.27	-10.4	-11.2

Source: Author's computation, 2025

Table 3 presents the results of the lag order selection criteria for the nonlinear ARDL model. In line with the requirements of the nonlinear ARDL framework, different lag lengths may be specified by incorporating lagged values of both the dependent and independent variables in the time-series regression. Since the validity of the ARDL estimation depends on appropriate lag selection, the results indicate that the Akaike Information Criterion (AIC) serves as the most reliable guide among the available criteria. Ultimately, the chosen lag length reflects the unanimous outcome across all the selection criteria considered.

Table 3: Lag length Selection Criteria

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	174.1804	NA	0.156431	1.76064	12.10753	11.83237
1	-71.661	159.8322	0.001086	6.23075	7.65711	6.66611
2	-37.1351	40.81325	0.000561	5.55033	8.16616	6.35032

Source: Compiled by Author

Results on Table 4 show the asymmetric ARDL bounds testing approach results. The bound testing method is employed to establish the long-run relationship. The result in these outcomes of the asymmetric bound testing method at the 5% level of significance are displayed in Table 4. According to Table 4's results, the asymmetric bound testing approach's critical value at the 5% I(0) value is 3.81, and its I(1) value is 4.92. However, 15.6214 is the computed F-statistic value. In light of the findings, I(1) is greater than I(0). This suggests that the variables of interest are moving together over the long term.

Table 4: Asymmetric ARDL Bound Test

Test Statistics	**Value**	**K**
F-Statistics	15.6214	2

Table 5: Critical Bounds Value

Significance	**I(0)**	**I(1)**
10%	3.18	4.16
5%	3.81	4.92

Table 6: Asymmetric ARDL Long-term Coefficient

Variables	**Coefficient**	**Std. Error**	**t-Statistics**	**Prob.**
RGDP	0.057233	0.16712	-1.24562	0.034627
GFCF	0.034568	0.21693	0.962111	0.067871
REER	0.136245	0.621721	-0.14322	0.083111
CPI	0.383421	0.12342	0.6345	0.062411
RIR	-0.11621	0.143211	-0.4467	0.07382
RGDP	-0.43462	0.101431	-0.73443	0.031231
GFCF	0.16241	0.114312	0.56221	0.063412
REER	0.623412	0.43622	0.66117	0.078241
CPI	-0.12341	0.6244	0.56333	0.03456
RIR	0.341123	0.3122	-0.822	0.06721

Table 6 presents the result of the asymmetric long-run coefficients. Macroeconomic variables (RGDP, EXR, IFK, MS, GFCF, and ITR) are used as dependent variables, while global oil prices are employed as independent variables. As presented in Section Three under model specification, oil price is decomposed into a sum of positive and negative components to effectively capture the asymmetric effect of oil price changes on selected macroeconomic variables. The results reveal that positive oil price changes have a positive but insignificant impact on the selected macroeconomic variables, while negative oil price changes have a negative and significant impact on all the selected macroeconomic variables. During periods of negative oil prices, there was a negative and significant connection between the macroeconomic variables and oil prices. Specifically, a positive oil price leads to a 1% increase in oil price, which positively affects inflation rate, exchange rate, real output growth, and gross fixed capital formation by an average of 2.5%. Conversely, negative oil prices decrease the macroeconomic variables by an average of 30%. This implies that a decline in oil prices increases the cost of living and raises the exchange rate because the economies of the selected African countries depend heavily on oil revenues. Consequently, a reduction in oil price increases production costs and reduces the savings of normal investors.

Table 7: Asymmetric ARDL Short-run coefficients

Variables	**Coefficients**	**Std. Error**	**Prob.**
D(RGDP(-1))	0.114321	0.169431	0.083621
D(RGDP(-2))	0.638121	0.004621	0.09628
D(GFCF(-1))	0.04621	0.046341	0.063482
D(GFCF(-2))	0.116781	0.596211	0.06834
D(REER(-1))	0.83412	0.331181	0.03456
D(REER(-2))	0.60341	0.130061	0.063412
D(CPI(-1))	-0.67422	0.011602	0.04321
D(CPI(-2))	-0.86341	0.346211	0.062141
D(MS(-1))	0.673113	0.46834	0.13462
D(MS(-2))	0.834122	0.163421	0.43831
D(RIR(-1))	0.634	0.1734	0.06431
Constant	**11.63112**	**58.32482**	**-**
D(RGDP(-1))	-0.63442	0.568341	0.044321
D(RGDP(-2))	-1.45661	0.114621	0.06341
D(GFCF(-1))	-3.45661	0.318214	0.07382
D(GFCF(-2))	-3.46631	0.634462	0.088211
D(REER(-1))	-0.14892	0.345621	0.093214
D(REER(-2))	-0.11456	0.443382	0.13433
D(CPI(-1))	-0.66331	0.41821	0.09432
D(CPI(-2))	-0.46721	1.46721	0.010412
D(RIR(-1))	0.43321	0.45621	0.063248
D(RIR(-2))	0.4633	0.6245	0.073123
Constant	-1.34321	0.14331	51.06241

Table 8: Diagnosis Statistics for Asymmetric ARDL Long-run Coefficients R-Square

R-Square 0.6124	**Adjusted R Square 0.5432**
Akaike Information Criterion -0.4162	1.7214
Durbin-Watson statistics 2.1314	1.8251
F-Statistics (30.8214(0.000)	78.1432(0.0000)

According to the diagnostic statistics presented in Table 8, global oil prices account for roughly 61% and 54% of the fluctuations in the chosen macroeconomic variables during positive and negative oil price regimes, respectively.

Table 9: Dianostic Test

Test	Null Hypothesis	F-Statistics	Prob. Value	Conclusion
Jarque-Bera	Residuals are normally distributed	1.000614	0.604952	Fail to reject Null
Breusch-Godfrey	No serial correlation	1.382811	0.0531	Fail to reject Null
Breusch-Pagan	No heteroskedasticity	3.184331	-	Fail to reject Null
Harvey	No heteroskedasticity	1.56331	-	Fail to reject Null
White	No heteroskedasticity	1.762114	-	Fail to reject Null
ARCH	No heteroskedasticity	3.32114	-	Fail to reject Null

Source: Author's compilation, 2025

Panel Granger Causality

The pairwise panel Granger causality test was employed to determine the direction of causality between oil price and macroeconomic variables in African oil-producing countries. The results reveal a unidirectional causality between oil price and inflation, where oil price Granger-causes inflation but not vice versa. Bi-directional causality exists between real output growth and oil price. Similarly, a unidirectional causality is found between exchange rate and oil price, with oil price Granger-causing exchange rate, and exchange rate not Granger-causing oil price.

Table 10: Panel Pairwise Granger Causality Test Recruits

	Null Hypothesis	Obs	F-Statistic	P-Value	Decision
1	WOP does not Granger cause CPI	28	3.34521	0.0413	Reject Null Hypothesis
2	CPI does not Granger cause WOP	28	1.53014	0.31411	Accept Null Hypothesis
3	WOP does not Granger cause RGDP	28	4.31412	0.05312	Reject Null Hypothesis
4	RGDP does not Granger cause WOP	28	7.3142	0.04123	Reject Null Hypothesis
5	WOP does not Granger cause REER	28	5.3412	0.03412	Reject Null Hypothesis
6	REER does not Granger cause WOP	28	3.2114	0.14562	Accept Null Hypothesis
7	WOP does not Granger cause GFCF	28	6.2314	0.06142	Reject Null Hypothesis
8	GFCF does not Granger cause WOP	28	2.4314	0.2167	Accept Null Hypothesis

Author's computation, 2025

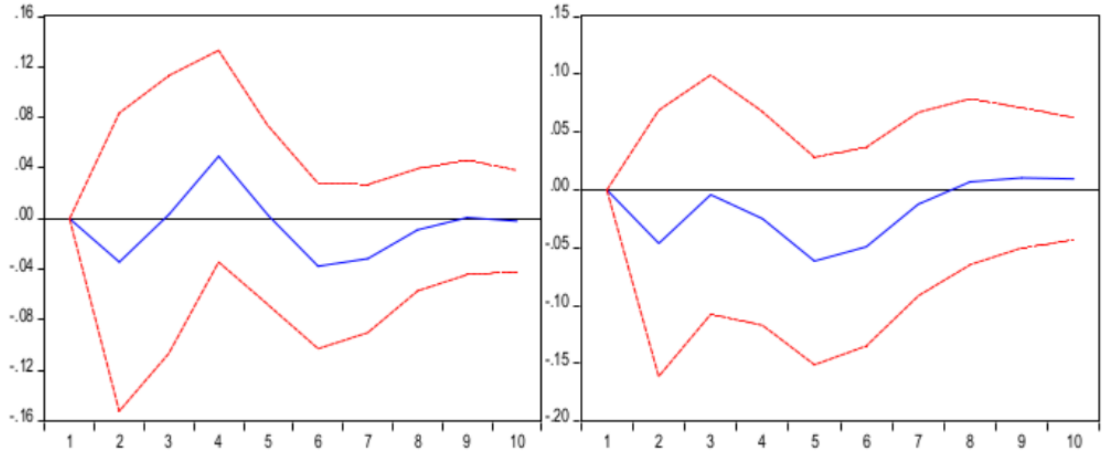
Impulse Response Function

In this sub-section, the impulse response function generated from the estimated SVAR models is presented. From Figure 1, for the first few periods, real output growth did not show much response to oil price shocks, but after the third period horizon, a progressive positive response was recorded up to the tenth period. This implies that real output growth responds to oil price shocks sluggishly. For the response of the exchange rate to oil price shocks, the real effective exchange rate (REER) was employed in the analysis instead of the official exchange rate. The result shows that REER responded mildly to a positive oil price shock in the first and second months. From the third month to the last period, however, a progressive negative response of REER was recorded. This shows that a positive oil price initially brings appreciation to the selected currencies, but this effect is only temporary. Figure 2 presents the response of GFCF to a unit shock in oil price. From the first period horizon, GFCF exhibited a progressive positive response to shocks in oil price up to the fourth month. Thereafter, the response became negative, indicating that prolonged increases in oil price negatively affect capital formation.

Figure 1: Results of Impulse Response Function

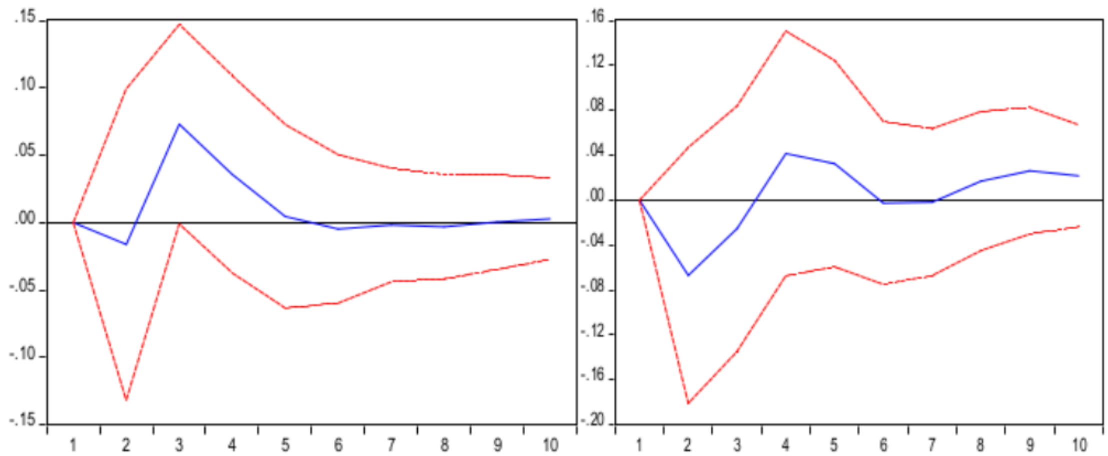
Response of LCPI to LOP Innovation Using Cholesky (d.f. adjusted) Factors

Response of LCPI to INTR Innovation using Colesky (d.f. adjusted) Factors



Response of LCPI to LEXCH Innovation Using Cholesky (d.f. adjusted) Factors

Response of LCPI to LUNEMP Innovation using Colesky (d.f. adjusted) Factors



The forecast error variance in world oil price is explained by its own innovations as well as by inflation, exchange rate, money supply, gross fixed capital formation, and real interest rate. As shown in Table 11, the study considers a five-year horizon to elaborate on the variance decomposition. In the second year, 88.3% of the forecast error variance in oil price is accounted for by its own shocks. This indicates that a disturbance in oil price can result in an 88.3% variation in its volatility. By the fourth year, oil price shocks were responsible for 76.9% of fluctuations in macroeconomic variables. Table 11 presents the variance decomposition of the real effective exchange rate, inflation rate, and gross fixed capital formation. Evidence from the first panel shows that Nigeria's exchange rate is largely exogenously determined. The major driver of changes in the inflation rate is its own shock, which explains about 82% of variations over a ten-year period. This suggests that factors outside the model variables play a major role in determining the exchange rate. Furthermore, the findings indicate that positive changes in oil price contribute very little to explaining the exchange rate. The main shock to the exchange rate from oil prices comes from negative oil price changes, which account for more than 6% of the variation. This reflects the reality of the Nigerian economy: while increases in oil prices have not significantly strengthened the exchange rate (as appreciation would normally be expected), periods of oil price decline have severely affected the economy through rapid exchange rate depreciation. Such periods are also typically associated with high inflation. In addition, inflation, real output growth, and real interest rate are important in explaining exchange rate fluctuations, contributing about 17% to the variation.

Table 11 also highlights the contributions of exchange rate and other variables to changes in inflation. The evidence confirms earlier results that inflation in Nigeria is endogenously determined, as the variables in the model account for nearly all the observed changes. Specifically, the exchange rate, real output growth, and gross fixed capital formation emerge as important determinants of inflation. For example, the exchange rate alone accounts for about 5% of the variation. Consistent with earlier observations, positive oil price shocks play a relatively minor role in influencing inflation, contributing only about 1% of the changes. The major impacts on inflation come instead from negative oil price shocks. When combined with the evidence on exchange rate, the findings suggest a consistent pattern: a fall in oil prices poses a serious challenge to the Nigerian economy, as it negatively affects both inflation and the exchange rate.

Table 11: Variance Decomposition of Asymmetric effect of oil price on Macroeconomic Variables

Period	LWOP+	LWOP-	LRGDP	LRIR	LREER	LCPI	GFCF
1	0.717597	7.338314	10.43111	2.46245	-	-	-
4	4.031062	1.158607	0.000009	72.85415	8.838923	2.567694	3.478922
8	2.462634	3.393067	6	7.70262	10.08211	2.415678	10.43467
12	2.920728	4.455746	2.640641	1	10.71318	4.67842	1.683411
16	3.180457	3.671723	1.837768	8.53504	12.85241	5.9344	0.45626
20	2.474321	2.686741	1.709816	76.95133	-13.98834	6.48933	0.72456
1	3.679443	0.769933	0.860116	91.61893	0	0.63452	3.623411
4	4.981727	2.293824	4.277577	90.11103	0.444811	0.76352	4.24562
8	5.01933	3.713216	6.235318	83.96532	3.058712	2.73412	6.456221
12	7.141948	2.453272	6.099162	82.51612	3.777602	4.55621	3.143234
16	9.41535	4.474793	4.938434	77.84777	5.334691	6.47812	-0.18322
20	11.75578	2.664537	4.732457	83.32633	6.341916	0.4689	1.45624

5. DISCUSSION OF FINDINGS AND POLICY IMPLICATIONS

The study's conclusions have significant and far-reaching consequences for empirical and policy directions about the relationship between Nigeria's macroeconomic factors and oil prices.

First of all, it should be mentioned that the findings of the variance decomposition and impulse response function indicated that the exchange rate responded most strongly to shocks originating from changes in the price of oil. Nigeria is a net exporter of oil, therefore when oil prices rise, her currency gains as well, allowing more foreign currency to enter their economies. Although this has appeared relatively good for their economy, it, however, has serious economic implications for the macroeconomic policy of those reliant on their economies for foreign inputs. This finding is compatible with Olomola (2006), Iyoha & Oriakhi (2013) and Omojolabi & Egwaikhide (2012). The introduction of structural adjustment programmes in the 1980s marked a new exchange rate policy of a flexible and floating regime where forces of demand and supply were being allowed to determine the exchange rate. After the introduction of this policy, the Nigerian economy experienced a steady depreciation of her currency. The cost of production increased relative to other non-oil-producing countries. The reason for this is that the dollar value of imported (both intermediate and final) technology required for production in terms of her currency was extremely high. Nigeria has now become a dumping ground for substandard products which were cheaper than indigenous-made goods.

Second, the results of the variance decomposition and impulse response function demonstrated that the real GDP response was not substantial or positive. Additionally, the percentage of real gross domestic product that was affected by changes in oil prices was not the largest. Economically speaking, the shock to the price of oil has a little effect on the Nigerian economy. This demonstrates that drops in oil prices have a detrimental and substantial influence on the Nigerian economy's macroeconomic performance, and that rising oil prices do not always translate into better macroeconomic outcomes. This result supports the views of Ahmed & Saleh (2015), Aliyu (2010), and Akpan (2009). This further demonstrates that the exchange rate, rather than actual gross domestic product, is the primary conduit via which the volatility of oil prices is transmitted in the chosen nations.

Thirdly, the outcome demonstrated that the consumer price index is significantly impacted by changes in the price of oil. Nigeria's overall price level is significantly impacted by changes in the price of oil. This indicates that global oil prices have a significant impact on the average cost of goods and services. This result is consistent with Lukwani & Lukman (2014), Olomola (2006), and Muhammad (2013).

Another interesting aspect of the findings is the estimation techniques employed by some of the researchers on this particular topic. For instance, Iyoha & Oriakhi (2013), which used estimation periods of 1970, and Omojolabi & Egwaikhid (2013), with estimation periods of 1990 and 2010, showed an insignificant impact of oil price changes on macroeconomics, while Akpan (2009) and Aliyu (2009) showed a significant impact of oil price on macroeconomics in Nigeria. The implication of this is that the period considered for the estimation determines to some extent the reason for the variations in the findings of these researchers.

Finally, the empirical result for this study shows that macroeconomic variables in Nigeria are grossly determined by what is obtained in the international world oil market.

6. CONCLUSION

The asymmetric impact of oil prices on Nigerian macroeconomic indicators from 1990Q1 to 2023Q4 is examined in this study. The study used both linear and non-linear models to empirically examine the link. The analysis found that the oil price and macroeconomic factors had both symmetric and asymmetric connections. In other words, symmetric macroeconomic variables respond positively and considerably to positive oil prices, whereas asymmetric macroeconomic variables respond adversely but significantly to negative oil price shocks. Consequently, the analysis concludes that there is ambiguity (symmetric and asymmetric) in the link between macroeconomic factors and the price of oil. Based on these findings, the study therefore recommends that diversification is required in the Nigerian economy to reduce its overreliance on oil as the main source of foreign exchange earnings.

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