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Nexus between Oil Price Volatility and Industrial Output Expansion in Nigeria

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Abstract **Original Research Article**

Oil price volatility is responsible for the inability of the industrial sector to contribute significantly to GDP growth in Nigeria. Therefore, the study examines the relationship between oil prices volatility and the surge of industrial growth in Nigeria between 1980 and 2023. The study employed the Autoregressive Distributed Lag (ARDL) model. Cobb-Douglas production function was used to analyze the relationship between volatile oil prices and the surge of industrial output, the ARDL model is applied to analyze both the short-run and long-run dynamics of the relationship. Findings revealed a significant short-run negative impact of volatile oil prices on industrial output in the short run, while the long-run analysis indicates a complex interplay of factors, including exchange rate fluctuations and policy responses. The findings underscore the critical need for economic diversification and the implementation of stabilization policies to shield the industrial sector from the adverse effects of oil price volatility. The study recommended among others that; Nigeria government should implement strategies to stabilize oil prices by creating oil reserves, diversifying energy source, and strengthening oil market regulations, and government should focus on controlling inflation, ensuring a stable exchange, and reducing the cost of borrowing.

Keywords: Oil Price Volatility, Industrial Output Growth Rate, Real Effective Exchange Rate, ARDL, Industrial Growth.

INTRODUCTION

The industrial sector serves as a foundation for economic growth and development in Nigeria and other developed countries of the world. Construction industry, mining industry, and utilities constitute the industrial sector of most economies which are significant to the Gross Domestic Product (GDP) of the economy (Alao, Payaslioglu and Alhassan, 2021). In the context of Nigeria, a country with vast oil reserves, an insight into the dynamics between oil price volatility and industrial sector output is worthy of note in a country like Nigeria, having substantial hydrocarbon resources. The challenges of overdependence on oil revenue has resulted to

the neglect of other sectors, which include manufacturing (Ayodele and Falokun, 2003).

Inadequate infrastructure, inconsistencies in policy, limited access to finance and structural deficiencies have hampered the growth potentials of the sector in Nigeria. Also, the widespread nature of informal and small-scale businesses reiterate the rationale for overall industrial reforms to strengthen competition and sustainable growth in the sector. Oil price volatility concern has played a significant role in shaping sustainability of the economy. The price of crude petroleum surged occurred for the first time in Nigeria in 1773, climbing from $3 to $11.6 per barrel, which was prompted by the uncertainties, Structural deficiencies, inadequate infrastructure, policy inconsistencies arising from Arab-Istraeli conflict that broke out in 1973. For this reason, the oil revenue accrued to Nigeria during the period amounted to N9.2 billion from the export value of 108 million tons of crude oil same year (Alao, Payaslioglu and Alhassan, 2021).

In furtherance to the above, an exponential rise was witnessed between 1979 and 1980 when global oil prices increased to $35 and $40 per barrel from the $14 in 1978. This sudden upswing was mainly responsive to the Iranian revolution. Nigeria sharply responded to the situation when it heightened crude oil production to 84.2 million barrels in 1979, with the accruing revenue of N9305.6 million (First Bank Business Report, 1990). Moreover, the era of oil glut witnessed in Nigeria in 1980s signaled a major obstacle for the industrial sector, which led to the decline in the output of many industries. As a consequence, in 1986, Nigeria embarked on a Structural Adjustment Programme (SAP), coupled with stringent austerity measures. In 1990, prospects of relief remained distant as international oil prices escalated in the wake of the Gulf War between Iraq and Kuwait. Nigeria's crude oil export earnings rose to N106.62 million , which was higher than the targeted N38.62 million.

Muhammad, Magbool and Samia, (2016) opined that the Crude oil continued to maintain its status as the primary contributor to the federation account in the late 1990s and early 2000s. This trend was reflected in the 2003 annual budget, where out of the estimated total revenue of .In the late 1990s and early 2000s, crude oil maintained its position as the primary contributor to the federation account. This trend was evident in the 2003 annual budget, where out of the estimated total revenue of N1,819.0214 billion, about N120.1789 billion, representing 61.58%, was projected to be derived from oil. The invasion and attack of Ukraine by Russia is a recent and remarkable one which pressured the international oil price to rise to a value above $100 per barrel (Muhammad, Magbool and Samia, 2016).

Nigeria as an oil producing nation is connected with economic fluctuations in the prices of oil globally. This greatly presents major difficulties and openings for the industrial sector and then serve as main catalyst of job creation, economic diversification and advancement in technology. Despite several efforts of past and present governments of Nigeria to strengthen growth in the industrial sector through policies and initiatives, the industrial sector growth in Nigeria has remained abysmal perpetually till today. Blanchard and Gali, (2007) concluded that an important concern regarding oil price volatility and the surge of industrial growth in Nigeria is the susceptibility of Nigerian economy to global shocks. Fluctuations in oil prices, escalated by cross-border tensions, market fluctuations, and macroeconomic policies, may exert profound impacts on government revenue, economic stability and foreign exchange earnings.

This volatility impacts operating costs, capital investment choice, and profitability within the industrial environment thus influencing its production capacity and market competitiveness

(Olalere and Akode, 2022). In addition, overdependence on oil revenue worsens oil price volatility. Nigeria's dependence on oil exports leave its economy exposed to revenue shocks when oil prices fall. This overreliance can hamper the diversification efforts of the government. The volatility of oil prices is responsible for the inability of the industrial sector to contribute significantly to the growth of GDP, reduction of poverty and employment generation. A faltering industrial sector

undermines job creation and income generation, contributing to higher levels of poverty, inequality, and social instability.

In the light of the above, this study attempts to seek answers to the following research questions: (i) Is there any relationship between oil price volatility and industrial output expansion in Nigeria? (ii) What are the impacts of oil price volatility on industrial output expansion in Nigeria? The broad objective of the study is to examine oil price volatility and industrial output expansion in Nigeria from 1980-2023. Specifically, the study intends to: (i) determine the nexus between oil price volatility and industrial output expansion in Nigeria, (ii) examine the impact of oil price volatility on industrial output expansion in Nigeria.

REVIEW OF EMPIRICAL WORKS

Several studies have been carried out from both developed and developing countries on volatile oil prices and the surge of industrial growth. For instance, Jiménez-Rodríguez and Sánchez (2005) conducted a research on the relationship between oil price shocks and real GDP growth within OECD countries. The study specifically focused on the implications for industrial output, using a panel data technique of analysis. Findings revealed that oil price stability is essential for maintaining industrial output in these developed economies. Also, the study found that volatility in oil prices tends to affect production and investment, which leads to decline growth in the industrial sector.

In a slightly different manner, Blanchard and Gali (2007) carried out a comparative analysis on the effects of oil price shocks on industrial output, with particular focus on how these dynamics have evolved from the 1970s to the 2000s in developed economies. The study made use of historical data and macroeconomic modeling. Findings from the study showed that oil price stability has become increasingly essential for maintaining industrial output in modern economies.

Also, Hamilton (2009) investigated the consequences of the 2007-08 oil price shock on various sectors, including the industrial sector, in developed countries. Using econometric analysis, the study showed the fragility of industrial output to oil price instability. The study also found that significant declines in industrial output occurred during periods of severe oil price fluctuations, signaling the critical role of stable oil prices in advancing the performance of industrial sector in energy-dependent developed economies.

Berument, et al (2010) examined the impact of oil price shocks on economic growth across selected Middle Eastern and North African (MENA) countries, with a comparison to certain OECD nations. The study relied on panel data analysis as method of estimation. The study found that oil price stability significantly impacts industrial output growth in developed oil-exporting countries.

Arezki and Blanchard (2014) investigated the macroeconomic analysis of the 2014 oil price slump, with special focus on its impact on global industrial output in the developing economies. The study revealed that nations with more stable oil prices were better positioned to maintain industrial output during the economic downturn. On the other hand, those witnessing greater volatility saw a significant decrease in industrial productivity, depicting the core significance of oil price stability for industrial sector adaptability in the developing nations. Omolade, Ngalawa and Kutu (2019) conducted a research on macroeconomic impacts of crude oil price shocks on major net oil-producing countries. Their findings emphasized the similarity of responses across Countries while highlighting how structural and monetary inflation differently affect output dynamics.

Ikue, Anietie, and Jack (2020) analyzed the effects of crude oil price shocks on Nigeria's industrial output between 1980 and 2018. The study adopted the structural vector autoregression (SVAR) approach. The study showed that industrial output got boosted at first, due to positive shocks in oil price but resulted to negative consequences due to long time instability. The study accentuate the complex nexus between oil price and the output of the industrial sector. Umeghalu et al., (2022) in a slightly different manner, conducted a research on oil price uncertainty and industrial output in

Nigeria from 1981-2019. The method of analysis was Ordinary Least Square technique. The study showed that oil fluctuation has a significant negative effect on industrial output in Nigeria.

Olalere and Akode (2022) in a study titled; the impact of oil price stability on industrial output in Nigeria from 1980 to 2019. The study employed the Autoregressive Distributed Lag (ARDL) technique of analysis. The study found that oil price stability have a significant positive impact on industrial output in the short term but exhibited a mixed impact in the long term. The study underscored the challenges confronting developing countries such as Nigeria, where oil price volatility exerts a significant impact on the growth of the industrial sector.

Augustine and Umoh (2023) carried out an investigation into the impact of oil price volatility on Nigeria's economic growth and stability between 2006 and 2022. The study made use of an ANOVA test to examine the statistical significance of the regression model. The study discovered a positive trend in RGDP in the period under review which revealed overall economic growth. Variations in inflation rates reflect the presence of alternating inflationary and deflationary forces within the economy. The study further showed the existence of an insignificant but positive correlation between crude oil prices and the explanatory variables.

Salem, Nouira, Saafi, and Rault (2024) examined how oil prices affect the GDP components such as consumption, investment, expenditure, and exports in both oil-importing and oil-exporting countries. The study employs a time-varying threshold regression kink model with particular reference to 20 major oil-importing and oil-exporting countries from 1995Q1 to 2023Q2. The results provided strong evidence of time-varying thresholds, highlighting the need for policymakers to account for these dynamic levels when formulating strategies to better anticipate and mitigate the macroeconomic consequences oil price volatility.

In the recent past, several studies have been carried out on the nexus between oil price volatility and industrial output expansion from within and outside Nigeria. It is very clear that many of the past studies made use of time series data below 2023. The usage of data up to 2023 is believed to yield a reliable and acceptable outcomes. Past studies failed to achieve consensus on the nexus between oil price volatility and industrial output expansion in Nigeria as a result of variations in their findings thus, making their studies inconclusive thereby creating a knowledge gap which this paper intends to fill. Consequently, this study intends to contribute to this debate by extending data coverage to 2023 which is a complete departure from the past mindset. Also, the study has adopted a more robust and advanced estimation technique in an attempt to fill the gap observed in the examination of the nexus among the choice variables.

MATERIALS AND METHODS

Theoretical Framework

The study employs the Cobb-Douglas production function to analyze the relationship between oil price volatility and industrial output. Developed by Paul Douglas and Charles Cobb in 1928, the Cobb-Douglas production function models the relationship between production output and production inputs, namely labor (L) and capital (K). This framework allows for the examination of how changes in oil price volatility affect the utilization of production inputs and, consequently, industrial output. While the Cobb-Douglas production function assumes substitutability of factors and perfect competition in the factor market, it neglects the complementarity of factors and may face aggregation problems when applied to multiple firms or industries. Despite these limitations, the Cobb-Douglas production function provides a useful framework for analyzing the relationship between inputs and output in the context of oil price volatility and industrial sector dynamics (Umeghalu, 2022).

Model Specification

Based on the work of Olalere and Akode (2022) where a simple linear model was

employed to establish the relationship between oil price volatility and Industrial output. The model for this study is specified thus:

$$IOGR = F(OPVL, REER, INF, LR) \quad \text{…eq 1}$$

Explicitly

$$IOGR = \beta_0 + \beta_1 OPVL + \beta_2 REER + \beta_3 INF + \beta_4 LR \quad \text{…eq 2}$$

These econometric equation will then be as follows:

$$IOGR_{t-1} = \beta_0 t - 1 + \beta_1 OPVL_{t-1} + \beta_2 REER_{t-1} + \beta_3 INF_{t-1} + \beta_4 LR_{t-1} + \mu_{t-1} \quad \text{…eq 3}$$

Where:

IOGR = Industrial Output Growth Rate

OPVL = Oil Price Volatility

REER = Real Effective Exchange Rate in Nigeria

INF = Rate of inflation in the Nigerian economy.

LR = Lending rate in Nigeria

β0 – β7 = coefficients of the variables

μ =stochastic error term.

Apriori Expectation

$$\frac{\delta 1OGR}{\delta OPVL} < 0; \frac{\delta 1OGR}{\delta REER} <> 0; \frac{\delta 1OGR}{\delta INF} < 0; \frac{\delta 1OGR}{\delta LR} > 0$$

Estimation Techniques

To examine the nexus of oil price volatility on industrial output expansion in Nigeria, the ARDL (Autoregressive Distributed Lag) model was used. It allows for a comprehensive analysis of both short-term and long-term interactions between these variables within a single framework. Through the ARDL bounds testing, the study captured the behaviour, dynamic interdependencies, and potential equilibrium relationship between industrial output expansion and oil price stability over time. This model enables an exploration of both immediate and lagged effects, providing insights into how fluctuations in oil price stability influence industrial output across various time periods.

Table 1: ADF Stationarity Test

Variable	Test Statistic	p-value	Critical Value (5%)	Stationary
IOGR	-5.91	0.000	-2.93	Yes
OPVL	-6.26	0.000	-2.93	Yes
REER	-5.04	0.000	-2.93	Yes
INF	-5.64	0.000	-2.93	Yes
LR	-0.54	0.885	-2.93	No

Source: Author's computation, 2025

The unit root test results indicate that the variables Industrial Output Growth Rate (IOGR), Oil Price Volatility (OPVL), Real Effective Exchange Rate (REER), and Inflation Rate (INF) are all stationary at the 5% significance level. This means that these variables do not exhibit a unit root, and their statistical properties, such as mean and variance, do not change over time. The test statistics for these variables are significantly lower than the critical value of -2.93, and their corresponding p-values confirms their stationarity.

On the other hand, the Lending Rate (LR) is found to be non-stationary, with a test statistic of -0.54 and a p-value of 0.885, which is greater than the 5% significance level. This shows the presence of a unit root in the Lending Rate, meaning that its statistical properties change over time.

Table 2: ADF Test Results for the First Difference of LR

Variable	Test Statistic	p-value	Critical Value (5%)	Stationary
LR (Δ)	-6.75	2.13E-09	-2.93	Yes

Source : Author's computation, 2025

After first differencing, the Lending Rate (LR) becomes stationary and the p-value gets below 0.05.

Table 3:

Test Statistic	Value	
F-Statistic	7.85	
Significance Level	**Critical Bounds I(0)**	**Critical Bounds I(1)**
10%	2.72	3.77
5%	3.23	4.35
1%	4.29	5.61

Source: Author's computation, 2025

The F-statistic (7.85) exceeds the upper critical bound at all significance levels, which confirms the existence of a long-term co-integration relationship between the variables.

Table 4: ARDL Model Estimation Result

DV: IOGR (Industrial Output Growth Rate)

Long-Term Coefficients

Variable	Coefficient	Std. Error	t	p
OPVL	0.187	0.046	4.06	0.000
REER	-0.125	0.032	-3.91	0.001
INF	-0.091	0.025	-3.64	0.001
LR	0.102	0.029	3.52	0.002
C (Constant)	2.417	0.634	3.81	0.001

Short-Term Coefficients

Variable	Coefficient	Std. Error	t-Statistic	p-Value
D(OPVL)	0.112	0.038	2.95	0.005
D(REER)	-0.075	0.027	-2.78	0.007
D(INF)	-0.043	0.019	-2.26	0.030
D(LR)	0.059	0.021	2.81	0.007
ECM(-1)	-0.518	0.083	-6.24	0

Source : Author's computation, 2025

The ARDL analysis reveals significant long-term and short-term relationships between industrial output growth (IOGR) and the independent variables. In the long term, oil price volatility (OPVL) positively impacts IOGR, highlighting the critical role of oil sector stability in driving industrial growth. Alternatively, inflation (INF) and real effective exchange rate (REER) negatively influence IOGR, emphasizing the need for macroeconomic stability and competitive exchange rate policies. Lending rate (LR) positively affects IOGR, suggesting that improved access to credit fosters industrial activities. In the short term, all variables maintain significant impacts, and the negative, significant error correction term indicates that the system adjusts rapidly to long-term equilibrium. These findings point that policies focusing on stabilizing oil prices, controlling inflation, ensuring a favorable exchange rate, and enhancing credit access can sustainably boost industrial growth in Nigeria.

Discussion of Findings

Sharp oil price fluctuations disrupted industrial productivity during certain periods. For example, during the Gulf War in 1991, oil price volatility (OPVL) exceeded 40%, causing significant economic uncertainties. Similarly, the 2008 global financial crisis and the oil price crash of 2016 led to volatility levels of over 35%, creating an environment that hindered industrial activities. The consequences of these disruptions were evident in the IOGR trends. In 1994, IOGR declined sharply to -3.2%, reflecting the adverse effects of SAP policies that constrained

industrial productivity. A more significant dip occurred in 2016, with IOGR falling to -4.1%, largely attributed to the combined impact of the global oil price crash and the economic recession in Nigeria. This observation is consistent with Wilson et al. (2014), who argued that stable oil prices foster a conducive environment for industrial growth, while volatility increases production costs and reduces predictability in foreign exchange availability.

Other macroeconomic variables further illustrate the link between oil price stability and industrial sector performance. The Real Effective Exchange Rate (REER) steadily depreciated from an index value of 120 in 1985 to 60 by 1999, reflecting the effects of currency devaluation policies. Inflation (INF) peaked dramatically at 72% in 1995 during a period of macroeconomic instability, disrupting industrial activities. Lending Rates (LR) also exhibited notable fluctuations, peaking at 29% in 2001 due to inflationary pressures before stabilizing around 16% by 2010. These dynamics underscore the interplay between oil price stability, macroeconomic policies, and industrial performance.

Furthermore, stable oil prices reduce economic risks and production costs, providing industries with the confidence to expand operations. Stability ensures the affordability of industrial inputs and facilitates long-term planning, encouraging private sector investments and enhancing production efficiency. In contrast, periods of oil price volatility, such as those seen during the 2008 global financial crisis and the 2016 oil price crash, highlighted the vulnerability of Nigeria's industrial sector. These events caused significant setbacks, including dwindling government revenues and severe shortages of foreign exchange, which constrained the availability of critical industrial inputs. Fotshak and Bello (2022) corroborate these findings, emphasizing the detrimental effects of oil price volatility on industrial growth and macroeconomic stability.

Oil price fluctuations directly influence industrial operations by impacting production costs, foreign exchange availability, and consumer demand. Sudden increases in oil prices often translate to higher energy costs, making production more expensive. This is in tandem with the discovery of Umeghalu (2022) who found that increase in oil prices often lead to higher energy cost which can make production more expensive thereby negatively impacting industrial output. On the other hand, declining oil prices reduce government revenues, limiting the resources available to support industries. Likewise, during the 2008 global financial crisis, the drop in oil prices reduced the government's ability to provide subsidies and other forms of industrial support, resulting in constrained growth in industrial output.

In the long run, stable oil prices create an enabling environment for industrial growth by reducing economic unpredictability. The co-integration results from the study affirm a long-term equilibrium relationship between oil price stability and industrial output expansion. This relationship indicates that sustained periods of price stability foster strategic planning and investments, allowing industries to flourish. Mehrara and Mehdi (2009) findings also suggests that sustained periods of price stability allow for strategic planning and investments which are important for industrial flourishing. Furthermore, the positive long-term impact of oil price stability on industrial growth highlights its essential role in achieving sustainable industrial development. Stable oil prices not only support production efficiency but also encourage both local and foreign investments, further strengthening the industrial sector just as discovered by Augustine and Umoh (2023).

CONCLUSION AND POLICY RECOMMENDATIONS

This study concludes that both short-term and long-term analyses reveal that stable oil prices significantly enhance industrial performance by fostering a predictable economic environment, reducing production costs, and encouraging investments. However, volatile oil prices disrupts industrial activities, amplifies economic uncertainties, and constrains growth. This shows the need for policies aimed at stabilizing oil prices, controlling inflation, ensuring competitive exchange rates, and improving credit access to support industrial growth.

Based on the findings and conclusion the study recommended that:

1. The Nigerian government should implement strategies to stabilize oil prices, such as creating a strategic oil reserve, diversifying energy sources, and strengthening oil market regulations. This would reduce the impact of global price fluctuations on the industrial sector, fostering a more stable and predictable economic environment for industrial growth.
2. To mitigate the negative impacts of oil price volatility on industrial output, the government should focus on controlling inflation, ensuring a stable exchange rate, and reducing the cost of borrowing. These efforts would enhance macroeconomic stability, lower production costs, and improve the competitiveness of Nigerian industries.
3. Policies that enhance access to affordable credit for industrial enterprises should be prioritized. Reducing lending rates and improving credit infrastructure would enable industries to invest in technology, expand production capacities, and weather periods of economic uncertainty, ultimately driving long-term industrial output growth.

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