

# Oil Price Fluctuations and Sustainable Development in Nigeria

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## **Abstract**

*This study examined the effect of oil price fluctuations on sustainable development in Nigeria. Essentially, sustainable development was measured using the United Nations Development Programme (UNDP) Human Development Index (HDI) comprising Nigeria's average achievements in three basic aspects of human development such as health, education and standard of living. Thus, the objectives are to determine the effects of Brent crude oil price, West Texas Intermediate crude oil price and exchange rate on HDI in Nigeria. Annual time series data on each of the variables were obtained from the UNDP Human Development Report, Central Bank of Nigeria (CBN) Statistical Bulletin and Energy Information Administration (EIA) between 1990 and 2022. This study employed econometric techniques of unit root, cointegration and parsimonious error correction model (ECM), among others for the analysis. The unit root test results showed that all the variables are integrated of order one,  $I(1)$  at the 5% significance level. The Johansen cointegration test result established evidence of a long-run relationship between the HDI and the explanatory variables. The parsimonious ECM showed that Brent crude oil price positively and significantly affects HDI. This highlights the fact that export earnings increase as the Brent crude oil price rises, thus creating an opportunity for improving human development through investments in education, health and economic activities. On the contrary, the West Texas Intermediate crude oil price and exchange rate adversely affected the HDI. This suggests that fluctuations in West Texas Intermediate crude oil price and exchange rate are detrimental to human development in Nigeria. The error correction coefficient showed that the model can adjust from the short to the long run at a speed of 37.72%, thus corroborating the evidence of a long-run relationship between HDI and oil price fluctuations. Thus, this study recommends that the government should optimise the benefits associated with the Brent crude oil price increase in terms of increase in export earnings by investing in critical areas of human development to foster sustainable development in Nigeria.*

**Keywords:** Oil prices, sustainable development, Brent crude oil, West Texas Intermediate, HDI and Nigeria

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## **1. Introduction**

The relatively volatile nature of oil prices has continued to arouse the interest of researchers and policymakers in understanding the direction and extent of the relationship between oil price fluctuations and sustainable development. According to Abdul-Mumuni *et al.* (2023), the fluctuations in crude oil prices affect economies that export or import oil differently. They further explained that an increase in the price of crude oil is expected to benefit the economy of a country that exports oil whereas rising crude oil prices will adversely affect economies that import oil. Oil exporting nations face more fiscal management challenges since their governments rely substantially on the oil sector, which tends to be very volatile and may reduce long-term growth rates and social spending (Oduyemi and Owoeye, 2020). It is also argued

that variations in oil prices tend to generate a spill-over effect on economic activities as well as human development.

As a crucial commodity in all areas of production and services, changes in oil prices tend to exert substantial influence on the industrial and transportation sectors following the spill-over effects on the cost of production, output and income level. Nwoba, Nwonu and Agbaeze (2017) posit that fluctuation in crude oil prices causes economic anxiety which undermines the standard of living of the population. Again, the pro-cyclicality of government spending in oil-exporting countries which undermines social investments for sustainable development has been linked to the instability in the crude oil prices. and ultimately lower human development. This follows the understanding that fluctuations in oil prices often create uncertainty about future oil revenues and overall export earnings, thus prompting changes in aggregate expenditure. The borrowing capacity of oil-exporting countries also varies following fluctuations in oil prices. For instance, a decline in oil prices often reduces the creditworthiness of oil-exporting countries, thus reducing their capital to invest in critical economic and social services to engender sustainability of the development goals.

Notably, Nigeria's economy is heavily dependent on crude oil for revenue generation, export revenues, and the building of external reserves. As a result, annual budgets are often planned and linked to a specific predicted price and level of crude oil output. This has put the economy in a vulnerable position and exposed it to the vagaries in the international oil market. As oil revenue accounts for a sizable amount of Nigeria's export earnings, fluctuations in oil prices pose a threat to fiscal sustainability. Yusuf (2015) contends oil is an important factor in the implementation of Nigeria's fiscal in terms of meeting the revenue and expenditure targets as well as shaping the borrowing capacity. This is consistent with Kamer's (2023) recognition of Nigeria's position as a major oil-producing and oil-exporting country in Africa. This has renewed the interest in the development implications of oil price fluctuations in Nigeria following the dominant share of the oil sector in the country's gross domestic product (GDP) and export earnings in the past three decades. Therefore, it becomes imperative for this study to explore how oil price fluctuations have contributed to sustainable development with a focus on the human development index (HDI).

## **2. LITERATURE REVIEW**

### **2.1 Theoretical Literature**

The resource curse theory was proposed by Auty (1993) in his groundbreaking work "Sustaining Growth in Mineral Economies." The theory is predicated on the idea that nations endowed with an abundance of natural resources, especially non-renewable resources like oil— frequently face economic difficulties and underdevelopment. This is attributed to a range of factors, such as over-reliance on resource exports, volatile commodity prices, corruption, poor governance, and Dutch disease (a situation where a resource boom causes currency appreciation, damaging other sectors of the economy). According to Collier and Hoeffler (2002), conflicts within society are frequently sparked by the availability of natural resources, as various groups and factions compete for their rightful share. The efficient and best use of resources to promote social and economic development with more chances for enhanced human development is generally undermined by this. Because of this, the planned and anticipated development objectives associated with resource plenty in resource-rich countries are unrealistic because of lower rates of economic growth and stability, authoritarianism, conflict, and bad institutions.

The resource curse may make it difficult for countries to diversify their economies, making them more susceptible to shocks from the outside world and impeding long-term progress.

Once more, the existence of valuable resources can fuel political unrest and aid in the rise of authoritarianism as strong players vie for control and advantage over them. Generally, measures that promote economic diversity, enhance governance, fight corruption, and support sustainable development are put into place to address the resource curse. Furthermore, a resource-dependent economy might benefit from transparent resource revenue management through the use of instruments like sovereign wealth funds, which can lessen its negative effects. According to Auty (1998), the resource-curse theory explains why countries endowed with an abundance of natural resources were unable to apply their wealth to develop their economies.

Often, these countries have slower rates of economic growth than those with limited natural resources. An example of this would be the Dutch Disease syndrome, which produces an environment that impedes economic diversification and generally threatens non-oil operations. One limitation of the resource curse theory is its implicit negative link between economic performance and the availability of natural resources. Thus, the hypothesis does not explain certain countries that have managed to escape the resource curse. This suggests that there may be some important conditions missing from the resource curse idea. One of these essential preconditions could be the state of the institutions, the economic system, or some other element.

## **2.2 Empirical Review**

Abdul-Mumuni *et al.* (2023) employed annual time series data to explore the effects oil price changes on human development in Ghana between 1971 and 2019. Essentially, the study employed the structural equation modelling approach to ascertain the specific effects of oil price changes on various human development components. The findings showed evidence of a negative and significant effect of oil price changes on school enrolment and GDP per capita. The results further showed a negative but insignificant relationship between oil price changes and life expectancy at birth. Based on the findings, the study recommended that the government should develop alternative sources of energy such as natural gas, solar power plants and biofuels to reduce the large dependence on oil resources.

Musa, Mairiga and Yakubu (2022) analysed the impact of crude oil prices on the standard of living in Nigeria. The study relied on dynamic ordinary least squares (DOLS) and fully modified ordinary least squares (FMOLS) to analyse the time series data on crude oil income, inflation, and exchange rates. The findings showed that crude oil price and crude oil revenue negatively affected the standard of living. The results further showed that inflation has a negative impact on the standard of living while the exchange rate positively affects the standard of living. Owing to the findings, this study advocated for an effective utilization of the crude oil revenue to improve the living conditions of the population.

Oduyemi (2020) utilised time series data spanning from 1980 to 2017, and the vector autoregressive model (VAR) estimates to examine the impact of oil price fluctuations on health outcomes in the Nigerian economy. It was found from the results that shocks oil price shocks do not pose any threat to health outcomes. This reinforces the fact that oil price shocks are neither necessary nor sufficient to explain changes that happen in health outcomes in this country. It is the way the government spends its resource windfalls and the way it adjusts spending during a downturn that is accountable for the poor health outcomes in the Nigerian economy. Thus, the study recommended for strategic policies that support fiscal prudence, minimize macroeconomic distortions and improve health outcomes.

Chan and Dong (2022) theoretically examined the effects of oil price uncertainty shocks on the unemployment rate using a dynamic stochastic general equilibrium model incorporating a search-and-match component. They found that an unexpected increase in oil price volatility

leads to a persistent increase in the unemployment rate. Comparing the oil price uncertainty shock with supply and demand uncertainty shocks in the final goods market, they observe that the oil price uncertainty shock has effects analogous to those of the supply uncertainty shock. In addition, they demonstrate that oil as a production input mitigates the adverse effects of uncertainty shocks on the final goods market's supply and demand sides.

Uchenna, Kalu and Kenneth (2022) evaluated the impact of oil exploration on the incidences of poverty and unemployment in the Niger Delta region. The study adopted the dependency theory as its framework of analysis. The data were gathered through the documentary method and were analyzed using content analysis based on logical deduction. It found that in spite of the various interventions by the federal government and the oil companies the negative consequences of oil extraction in the Niger Delta, unemployment and high poverty level have continued undiminished. The paper advocated for an integrated community-based approach that would include stakeholders' commitment to enhance their strategies establish contingency plans to deal with oil spills and follow ecologically friendly safety measures during oil exploration.

### 3. Methodology

#### 3.1 Research Design

Following the nature of this study, an ex-post facto research design was adopted. The choice of an ex-post facto research design resonates with the fact that the study relies on existing secondary data which cannot be manipulated.

#### 3.2 Model Specification

The model for the study was anchored on the resource curse theory, which is based on the assumption that countries with an abundance of natural resources, particularly non-renewable resources like oil tend to experience economic challenges. The model for this study closely followed the work of Abdul-Mumuni, Insaideo, Musah and Akotoa (2023). but with an improvement following the focus on HDI and the introduction of West Texas Intermediate crude oil price. The function specification of the model is as follows:

$$HDI = f(BCP, WTI, EXH) \quad (3.1)$$

Where: HDI = Human development index, BCP = Brent crude oil price, WTI = West Texas Intermediate crude oil price, EXH = Exchange rate

The linear econometric model of the functional equation is provided below:

$$HDI_t = \alpha_0 + \alpha_1 \text{LOG}(BCP)_t + \alpha_2 \text{LOG}(WTI)_t + \alpha_3 \text{LOG}(EXH)_t + U_{1t} \quad (3.2)$$

Where:  $\alpha_0$  = Intercept,  $\alpha_1 - \alpha_3$  = Slope parameters to be estimated, LOG = Natural log notation,  $U_{1t}$  = Disturbance term,

The error correction model (ECM) of the equation is specified as follows:

$$\Delta HDI = \beta_0 + \sum_{i=1}^K \beta_1 \Delta HDI_{t-i} + \sum_{i=1}^K \beta_2 \Delta \text{LOG}(HDI)_{t-i} + \sum_{i=1}^K \beta_3 \Delta \text{LOG}(WTI)_{t-i} + \sum_{i=1}^a \beta_4 \Delta \text{LOG}(EXH)_{t-i} + \pi ECT_{t-1} + \mu_{1t} \quad (3.3)$$

Where:  $\beta_0$  = Constant parameter to be estimated,  $\beta_1 - \beta_4$  = Coefficients of the lagged explanatory variables, K = Maximum lag length for the variables,  $\Delta$  = First difference operator, ECT = Error correction term and  $\pi$  = Error correction coefficient

#### 3.3 Method of Data Analysis

In this study, the augmented Dickey-Fuller (ADF) test proposed by Dickey and Fuller (1981) was used for the analysis. A cointegration test was performed as a follow-up to the unit root test to ascertain whether the variables have a long-term relationship. Essentially, the cointegration test method was chosen based on the results of the cointegration test. The Johansen (1988) method for cointegration was used in this study. The error correction mechanism (ECM) was used for the data analysis process. This approach has the advantage of

allowing the model to be re-parameterized to assess the dynamic effects of oil prices on sustainable development, especially HDI based on the proposition of Engel and Granger (1987). Additionally, the ECM enables the estimation of the speed adjustment, which sheds light on the model's process of converging to a long-run equilibrium position. The data analysis techniques also include descriptive statistics which covered the mean distribution, standard deviations and normal distribution of each of the variables over the study period. The Breusch-Godfrey (BG) test method introduced by Breusch (1978) and Godfrey (1978), was adopted for the serial correlation test. The BG test approach tests the null hypothesis that there is no serial correlation in the error terms at the 5% significance level. Similarly, White's (1980) test of heteroskedasticity was employed to test the null hypothesis that the variance of the error terms is constant.

#### 4. Results and Discussion

##### 4.1 Descriptive Statistics

The descriptive statistics for this study are presented in Table 1.

**Table 1: Descriptive statistics for the variables**

Statistics	HDI	BCP	WTI	EXH
Mean	0.487424	51.18333	49.50545	146.5576
Median	0.475000	43.67000	43.29000	129.3565
Maximum	0.540000	111.6300	99.06000	423.1660
Minimum	0.443000	12.80000	14.39000	8.037808
Std. Dev.	0.032013	32.35554	28.67539	116.3360
Jarque-Bera	4.029908	3.053157	3.065847	3.805262
Probability	0.133327	0.217278	0.215904	0.149176
Observations	33	33	33	33

**Source: Computed from E-views Software**

The descriptive statistics revealed that HDI averaged 0.487, indicating that, on average, Nigeria is classified under the low human development category between 1990 and 2022. This could be attributed to the relatively poor public investments in education and health and low living standards as evidenced in available statistics. The results further showed that the average prices of Brent crude and West Texas intermediate were US\$51.18 and US\$49.505 per barrel respectively during the study period. It is also evident from the results that the exchange rate averaged 146.56 naira per dollar during the study period. The standard deviation for each variable is greater than the corresponding mean value. This finding implies that the observations for each variable are clustered around their corresponding mean values. In addition, the results showed that the probability value of the Jarque-Bera statistic for each variable is greater than 0.05, indicating that all the variables are normally distributed at the 5% level. The evidence of normal distribution in each of the variables is impressive as provides the basis for estimating the model.

##### 4.2 Unit Root Test

For this study, the unit root test was based on the Augmented Dickey-Fuller (ADF) method. The results are presented in Table 2.

**Table 2: ADF Unit Root Test Result**

Variable	ADF stat. at levels	ADF stat. at 1 <sup>st</sup> diff.	Critical Value at 5%	Decision I(d)
$HDI_t$	-0.1024	-6.325***	-2.96	I(1)



$Log(BCP_t)$	-0.909	-5.019***	-2.96	I(1)
$Log(WTI_t)$	-0.975	-5.141***	-2.96	I(1)
$Log(EXH_t)$	-1.895	-5.246***	-2.96	I(1)

Source: Computed from E-views Software

Note: \*, \*\* and \*\*\* denote Significant at 10%, 5% and 1% levels respectively

The ADF unit root test results showed that all the variables are nonstationary given that their corresponding ADF statistics are greater than the 5% critical value. Thus, the null hypothesis of unit root (nonstationary) process cannot be rejected for all the variables. With evidence of nonstationary process, the variables were subjected to the first difference test and the results showed that they become stationary at first difference. In other words, all the variables are integrated of order one, I(1) which necessitated the test for cointegration among the variables.

#### 4.3 Cointegration Test

As earlier stated, the Johansen maximum likelihood approach to cointegration was applied in this study to ascertain the evidence of cointegration based on the evidence of I(1) from the ADF unit root test results. The results are presented in Table 3.

Table 3: Johansen cointegration test results

Series: HDI LOG(BCP) LOG(WTI) LOG(EXH)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.889326	105.1350	47.85613	0.0000
At most 1 *	0.546651	43.50220	29.79707	0.0007
At most 2 *	0.507244	21.35159	15.49471	0.0058
At most 3	0.053340	1.534829	3.841466	0.2154
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.889326	61.63277	27.58434	0.0000
At most 1 *	0.546651	22.15061	21.13162	0.0359
At most 2 *	0.507244	19.81676	14.26460	0.0060
At most 3	0.053340	1.534829	3.841466	0.2154

Source: Computed from E-views Software

Note: \* denotes rejection of the hypothesis at the 0.05 level

The results showed that all three cointegrating equations exist in the trace test results. Similarly, evidence of three cointegrating equations was equally established in the maximum eigenvalue test results. Given these findings, the null hypothesis of no cointegration is rejected at the 5% significance level. This implies that a long-run relationship exists between HDI and the independent variables, thus providing the basis for representing the relationship between the variables in an error correction model as advocated by Engel and Granger (1987).

#### 4.4 Model Estimation

The summary of the estimated parsimonious ECM for this study is presented in Table 4.

**Table 4: Parsimonious ECM**

Dependent Variable: D(HDI)				
Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003604	0.001530	2.356013	0.0288
D(HDI(-1))	0.267451	0.175992	1.519675	0.1442
DLOG(BCP)	0.07706**	0.034463	2.236102	0.0369
DLOG(BCP(-1))	-0.066442	0.043322	-1.533679	0.1408
DLOG(WTI)	-0.086407**	0.036246	-2.383921	0.0272
DLOG(WTI(-1))	0.066092	0.043118	1.532810	0.1410
DLOG(EXH(-1))	-0.010607**	0.005157	-2.056944	0.0530
ECT(-1)	-0.3772***	0.124025	-3.041532	0.0064
R-squared	0.686789	Mean dependent var		0.002621
Adjusted R-squared	0.581504	S.D. dependent var		0.007669
S.E. of regression	0.006501	Akaike info criterion		-6.984702
Sum squared resid	0.000845	Schwarz criterion		-6.560368
Log-likelihood	110.2782	Hannan-Quinn criter.		-6.851806
F-statistic	5.371290	Durbin-Watson stat		2.001521
Prob(F-statistic)	0.000124			

Source: Computed from E-views Software

**Note: \*, \*\* and \*\*\* denote Significant at 10%, 5% and 1% levels respectively**

The findings showed that Brent crude oil prices contributed positively to HDI. The significant positive contribution of Brent crude oil price to human development explains the implication of the Brent crude oil price on export earnings which provides the basis for investments in critical sectors and services to foster sustainable development. This finding corroborates the findings of Oduyemi (2020) who established that crude oil price improves the health condition in Nigeria. However, it is contrary to the previous results by Ologunde, Kapingura and Sibanda (2020), Abdul-Mumuni *et al.* (2023) and Musa, Mairiga and Yakubu (2022) who reported that crude oil revenue adversely affected education, life expectancy, living standard and over sustainable development. The implication of this finding that an increase in Brent crude oil price offers opportunity for improving the level of human development. The results further showed that the effect of West Texas Intermediate crude oil price on HDI is negative and significant at the 5% level. This finding implies that the rising price of West Texas Intermediate crude oil does enhance the level of human development. This finding supports the findings of Abbas (2022) and Manasseh *et al.* (2019) who found that changes in oil prices do not improve the well-being of the Nigerian population. In addition, the results showed that the exchange rate has a negative and significant effect on HDI. This implies that an increase in exchange rate decreases the value of the naira with adverse implications on the value of the naira. This is contrary to the findings of Asuquo (2021) who found that exchange rates contributed positively to sustainable human development in the sub-Saharan Africa. The coefficient (-0.3772) of the error correction term showed that the model can adjust from the short to the long run at a speed of 37.72%. This finding further authenticated the evidence of cointegration among the variables. The adjusted R-squared (0.581504) showed that the oil price indicators and exchange rate jointly accounted for 58.15% of the total variations in HDI over the study. The results further showed that the probability value (0.0001) of the F-statistic (5.3712) is less than 0.05,

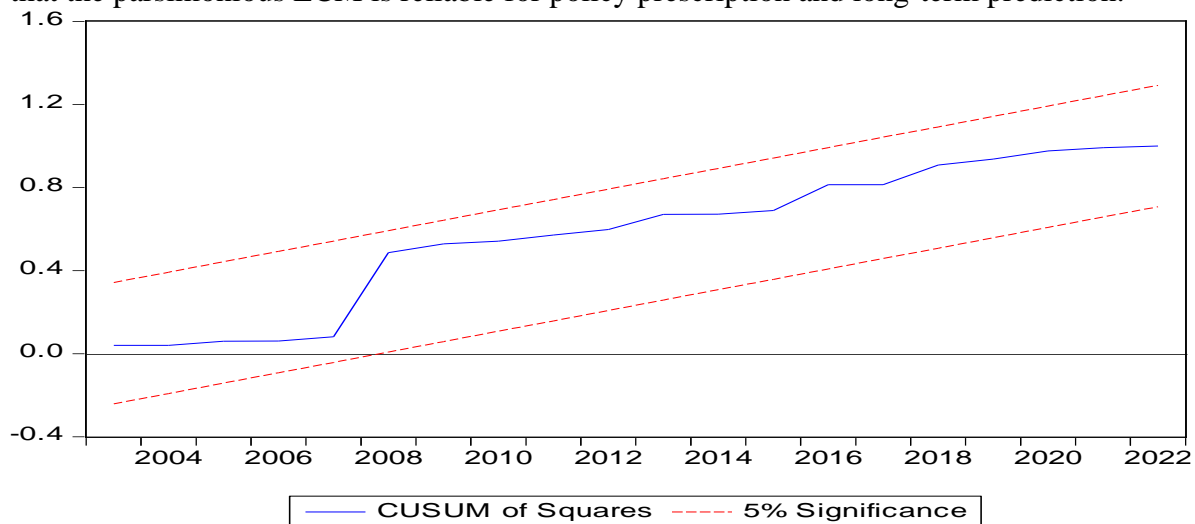
meaning that the explanatory variables are collectively significant in explaining changes in HDI.

**Table 4.1: Post-estimation test results**

Test Type	Test Stat.	Prob
Breusch-Godfrey Serial Correlation LM Test	0.00074	0.9782
White's heteroscedasticity test	7.5889	0.4746
Ramsey RESET	0.3152	0.8141

**Source: Computed from E-views Software**

As observed from the results, the null hypotheses of serial independence and homoscedasticity of the residuals were accepted at the 5 per cent significance level. This is based on the fact the test statistics are associated with probability values which are greater than 0.05. In addition, the results showed that there is no specification error in the model given that the F-statistic (0.3152) is associated with a high probability value (0.8141). Therefore, it followed from the findings that the parsimonious ECM is reliable for policy prescription and long-term prediction.



**Figure 1: Cumulative sum (CUSUM) of squares graph**

It is evident from Figure 1 that the CUSUM of the squares graph is within the two critical bounds at the 5% level. This finding explains that the estimated parameters are stable over the study period.

## 5. Conclusion and Recommendations

The thrust of this study is to deepen the understanding of the sustainable development implication of oil price fluctuations in Nigeria with a focus on the HDI. This followed the growing concern about the dynamics of oil prices in the global market and the continuous depreciation of the naira in the foreign exchange market. To this end, this study investigated how Brent crude oil price, West Texas Intermediate crude oil price and exchange rate contributed to HDI in Nigerian. The findings showed that Brent crude oil price significantly improved the HDI in Nigeria. This highlights the fact that export earnings increase as the Brent crude oil price rises, thus creating an opportunity for improving human development through investments in education, health and economic activities. On the contrary, West Texas Intermediate crude oil price and exchange rate adversely affected the HDI. This suggests that fluctuations in West Texas Intermediate crude oil price and exchange rate are detrimental to human development in Nigeria. In view of the findings, this study concludes that Brent crude



oil price fluctuations have the potential of stimulating sustainable development in Nigeria through improvements in the HDI. Thus, it is recommended that government should optimise the benefits associated with Brent crude oil price increase in terms of increase in export earnings by investing in critical areas of human development to foster sustainable development in Nigeria. Again, policymakers should be cautious of the fluctuations in the West Texas Intermediate crude oil price and strengthen their domestic mechanisms to mitigate the adverse effect on sustainable development.

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