Evaluation of the Nexus Between Oil Production and its Overall Effect on Exchange Rate, Inflation and Economic Growth in Nigeria

Section A-Research paper

EVALUATION OF THE NEXUS BETWEEN OIL PRODUCTION AND ITS OVERALL EFFECT ON EXCHANGE RATE, INFLATION AND ECONOMIC GROWTH IN NIGERIA

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Abstract

The negative impact of oil theft has created a rippling effect as it crosses over into other sectors of the Nigerian economy. This paper aims at identifying the relationship between the level of oil production and its overall effect on exchange rate, inflation and economic growth. The reason for this study is the recent problems of oil production coinciding with the fluctuating exchange rate, high inflation and almost nonexistent economic growth within the country. Pooled regression analysis was adopted for this study with the result of the Hausman test recommending the random effect model as the most appropriate. Data was obtained from the central bank of Nigeria, and Nigeria bureau of statistics for ten years spanning from 2012 to 2021. The study found that exchange rate (ER) and oil production price (OP) are statistically significant with economic growth while inflation (INF) was insignificant with economic growth. Therefore, this study recommends diversifying the economy from its reliance on crude oil production to agricultural production and other real sector engagements involving industralisation would enhance the economic growth in the country.

Keywords: Inflation, economic growth, exchange rate, and oil price.

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Eur. Chem. Bull. 2023, 12 (S3), 5018 –5028

5018

Evaluation of the Nexus Between Oil Production and its Overall Effect on Exchange Rate, Inflation and Economic Growth in Nigeria

Section A-Research paper

1. INTRODUCTION

Since its discovery crude oil has made itself one of the most lucrative and sought-after resources that can be found within the borders of any given nation. With the technological advancements of the 21st century, came an increased dependence on crude oil and its subsequent bye-products and therefore a never-ending demand for its production. Like most non-renewable resources, it is relatively scarce; however, the various hindrances to its production are even more restricting than its scarcity. Crude oil mining requires many safety precautions to limit its negative effects on the surrounding area. The allure of the substance has also led individuals into stealing and vandalizing pipelines to get their hands on it. This coupled with the difficulty attached to finding crude oil helps understand why its production is difficult. The reported value of the crude oil stolen today amounts to about 36.7 million dollars. "An over-reliance on crude oil for over 90% of Nigeria's foreign exchange earnings makes the nation's balance of trade highly susceptible to oil price fluctuations (Bankole and Shuaiba, 2013)." Almost ten years into the future, Nigeria still relies on crude oil for 79.77% of the nation's foreign exchange (National Bureau of statistics, 2022). This is despite various attempts at diversifying the economy by successive governments at regular intervals since the 20th century (Osaru and Kanwanye, 2019). Over the last three years, the government has reduced the overall effect of oil on the Gross Domestic Product by 1.52%, a decrease from 7.93 in Q1 of 2020 to 6.41% in Q3 of 2020. Nigeria's inability to generate foreign exchange without crude oil is crippling the nation's ability to grow.

In Nigeria, the world's 7th largest producer of oil (Organization of the Petroleum Exporting Countries, OPEC, 2022), millions of barrels of oil are lost every year due to vandals and criminals. "An official statement released by Mele Kyari the Group Managing Director of the Nigerian National Petroleum Corporation (NNPCL) approximately 437,000 barrels of oil are stolen daily from both onshore and offshore pipelines within the Niger-Delta region due to the complicity of individuals within the system (Michael Odour, 2022)."

The negative impact of theft has created a rippling effect as it crosses over into other sectors of the Nigerian economy. The reported value of the crude oil stolen daily amounts to about 36.7 million dollars. "Over-reliance on crude oil for over 90% of Nigeria's foreign exchange earnings makes the nation's balance of trade highly susceptible to oil price fluctuations (Bankole and Shuaiba, 2013)." Fast forward almost ten years into the future Nigeria still relies on crude oil for 79.77% of the nations foreign exchange (National Bureau of statistics, 2022).

"This is despite various attempts at diversifying the economy by successive governments at regular intervals since the 20th century (Osaru and Kanwanye, 2019)." Over the last three years, the government has managed to reduce the overall effect oil has on the Gross Domestic Product by 1.52%, a decrease from 7.93 in Q1 of 2020 to 6.41% in Q3 of 2020. Nigeria's inability to generate foreign exchange without crude oil is crippling the nation's ability to grow. A barrel of crude oil's price finds itself ranging between $80-$90 (USD) for a few months now partly due to the Russia-Ukraine war. "However Nigeria's exportation of crude oil has nearly halved barrels within the space of the 2nd and 3rd quarter of 2022 dropping from around 0.95mbd (million per day) to 0.49mbd (million barrels per day) (National Bureau of Statistics). This has prevented the nation from capitalizing on the market situation. Instead of benefiting from the increased price economically, the rapid shrinkage of

Eur. Chem. Bull. 2023, 12 (S3), 5018 –5028

5019

Evaluation of the Nexus Between Oil Production and its Overall Effect on Exchange Rate, Inflation and Economic Growth in Nigeria

Section A-Research paper

Nigeria's foreign reserve has caused the Naira to fluctuate in terms of value. "In the long run the exchange rate of oil-producing nations are centered around money supply (inflationary or deflationary circumstances) real GDP, government expenditure, oil prices, and external debt (Eslamloueyan and Kai 2015)."

The current relationship between oil production and exchange rate has resulted in high inflation and stunted economic growth. With a reduced level of oil production and a subsequent increase in exchange rates, the resulting increase in the price of imported goods used in the production process have elevated the prices of local goods and services. Nigeria's Gross Domestic Product growth rate has averaged around 0.77% annually from 2010 up until 2022. It recorded an all time high of 12.12% in the third quarter of 2020. However, this was mainly due to the initial impact of COVID-19 deflating the previous quarters figures. The Gross Domestic Product growth rate recorded a low of -14.66% in the first quarter of 2022 which coincides with the drop of oil exportation to below 1mbpd (million barrels per day) (Trading economics)

2. LITERATURE REVIEW
2.1 Theoretical Framework
A multitude of factors determines oil production as such it is impossible to encapsulate it in a single theory. To prevent the inevitable inaccuracy of an econometric model it is essential to capture as many of the contributing factors and their relevant theories. Due to the fact that a single excluded variable can have immeasurable consequences on the outcome of this research, this study will be using a combination of four existing theories.

Decline Analysis Theory
To approximate the exact level to which the oil wells within Nigeria are supposed to be producing, ceteris peribus, it is vital to introduce a decline curve analysis model. Decline curve analysis (DCA) is used to predict the future oil and gas production (Arnold and Anderson, 1908).

There are three types of decline curve models namely exponential, harmonic, and hyperbolic decline curves. "The hyperbolic decline curve is known as the general model, and exponential and harmonic decline curves can be derived from it. The decline curve consists of three parameters [qi, Di, and b] that could be found from production data. (Mohammad Jamshidnezhad)."

Differential equation was used to define the three decline curve models:
$$d = (-1/q)(dp/dt) = Kq^b$$
- b – hyperbolic decline exponent
- K – proportionality constant
- D_i – decline rate
- q – quantity/production rate
- t – time

Bubble Theory of Economics
This is a theory based on the recognition that prices in commodity markets tend to undergo periods of rapid price increases as consumers begin purchasing that commodity at seemingly unreasonable prices. This usually occurs in anticipation of a shortage of the commodity. ''The study of this issue remains relevant because even increased regulation does not solve the problem of asset price bubbles (Versal, Balytska and Erastov, 2021)."

The stages of economic bubbles include:
- Displacement: When investors believe a new economic pattern arises eg. new technology, low interest rates etc.
- Boom: this is the period of inflated investment to ensure sufficient supply.
- Euphoria: Prices sky-rocket. This is linked to the "Greater-Fool" theory which assumes that there is always a scenario where a consumer will pay a

Eur. Chem. Bull. 2023, 12 (S3), 5018 –5028

5020

Evaluation of the Nexus Between Oil Production and its Overall Effect on Exchange Rate, Inflation and Economic Growth in Nigeria

Section A-Research paper

higher price than they are currently paying for a commodity

- Profit-taking: Institutional investors catch the warning signs and start pulling out and securing their profits
- Panic: the bubble bursts and individuals are no longer willing to pay the inflated price. Market price drops rapidly and supply greatly exceeds demand.

The announcement of the change in currency caused a displacement in the dollar market. This coupled with the reduced foreign exchange income caused a scarcity of dollars within the country. A period of Euphoria began and the price escalated at an exaggerated rate. Many private individuals who followed the trend of exchanging their Naira for Dollars were caught out by the panic period which brought the prices back to a realistic level. However, retail sellers who purchased their stock using the heightened dollar price abstain from reducing prices to avoid incurring a loss.

Empirical Review

Various researchers have attempted to define the relationship between oil production and exchange rate, inflation and economic growth. However, the three receiving factors have never been examined in tandem with one another. Some of the research that laid the groundwork for this study. Faruk, Bashir. (2020) examined the rate of which production affects the exchange rate of Nigeria using co-integration and Granger The study employs monthly time series data, from January 2006 to August 2018 and the result shows that oil production in the long has a co-integrating effect between domestic oil production and exchange rate and that the former granger effects the latter instead of vice-versa.

Tunyo, Delali & Armah, Mark & Cantah, William & Suleman, Shafic. (2021). Targeted their study at examining the impact of crude oil production in Ghana on microeconomic factors. Using data spanning from 2011-2018 they applied the structural vector autoregressive model. The results revealed that oil production didn't impact exchange rate and inflation, but, it did impact the manufacturing sector and fiscal balance. This study considered Ghana's economic situation which is highly different to that of Nigeria as their (Ghana) foreign exchange reserve is not earned primarily through the sale of crude oil.

Bala, Umar & Chin, Lee & Shivee, Ranjanee & Ismail, Normaz. (2017) aimed their study at examining oil exportation's impact on inflation in African members of OPEC ie. Nigeria, Angola, Algeria and Libya. Both Pedroni cointegration test and dynamic panel ARDL models were used to perform the study. The results of the study found that in the long-run the coefficient of exchange rate, oil exports and GDP have a positive relationship with inflation, but a negative one with food production.

Mohammed, Mikidadu. (2018). Examined the connection between oil production and economic growth in Angola between 1985-2015 using an autoregressive distributed lag model. The results exposed a cointegration between the two (oil production and economic growth) and a positive unidirectional causality from oil production to economic growth in the long run. The fact that the causality cannot be reversed shows Angola's heavy depends on oil exportation to drive its economy. This points to much-needed diversification.

Tamba, Jean Gaston. (2017). Likewise to the study conducted in Angola a similar study was conducted in Cameroon using data from 1977-2010 whilst applying tests for unit roots, the vector autoregressive (VAR) model, and the Wald test. No causal relationship was found in this case. However, it acknowledges that with better policies in the energy sector, oil production

Eur. Chem. Bull. 2023, 12 (S3), 5018 −5028

5021

Evaluation of the Nexus Between Oil Production and its Overall Effect on Exchange Rate, Inflation and Economic Growth in Nigeria

Section A-Research paper

will positively affect economic growth. Similar studies were also done by Lianbiao, Cui et al (2021), Jaiyeola, Afeez. (2016), and Bildirici, Melike & KayÄ±kÃ§Ä±, FazÄ±l. (2013). The location being the varying factor, and the results depend on whether or not the location in question has a high level of oil production and exportation.
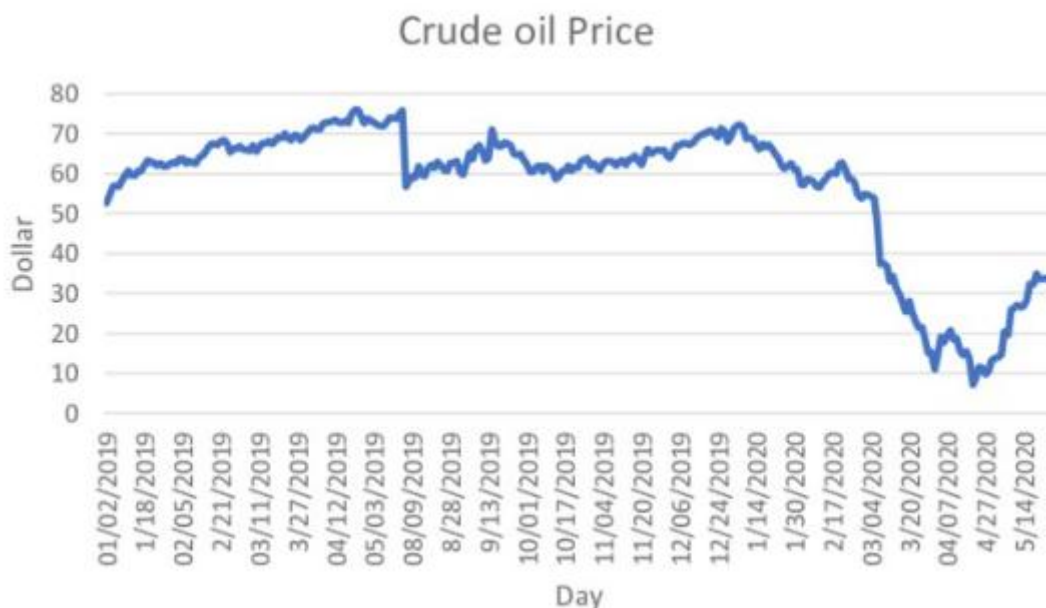

Figure 1. Crude Oil Price (1999 to 2014)

Source: Osuma et al (2019)

From Figure 1, it is observed that crude oil prices increased at an increasing rate until the global financial crisis in 2007 where it declined which was as a result of the mortgage crisis from the United States of America. Due to the integration of economy of the United States with other countries, it had an adverse contagion effect on the economic growth of other nations of the world. From Figure 1, it can also be deduced that from 2014 to 2016 the crude oil prices declined which was characterized by the global decline in the prices of crude oil

Figure 2. Crude Oil Price (COVID-19 era)

Eur. Chem. Bull. 2023, 12 (S3), 5018 –5028

5022

Evaluation of the Nexus Between Oil Production and its Overall Effect on Exchange Rate, Inflation and Economic Growth in Nigeria

Section A-Research paper

Source: Farayibi & Asongu (2020).
Despite the alignment with the Net Zero target on reduced carbon emission to achieving energy transition from fossil fuel to other sustainable sources in various parts of the word. Crude oil is still the most consumed source of energy globally. This has made crude oil to be a highly tradable asset in the international commodity market. Perifanis, and Dagoumas (2019) stated that over the years, crude oil prices has fluctuated as evidenced from Figure 1 and 2. Covid-19 came with a lot of disruptions especially supply chain disruptions. This disruptions significantly affected crude oil price as it plummeted from an average of $60 per barrel to below $20 per barrel during the peak of the pandemic in 2020 (see Figure 2).

3. METHODOLOGY

The methodology used in this study was adapted from the empirical work of Osigwe (2015) who examined the effects of oil prices and exchange rate fluctuations on the Nigerian economic performance. For this study the model's functional form is expressed as follows:

$$GDP_{it} = f(X_{it}, K_{it}, Z_{it}) \qquad (3.1)$$

The specification of the model for (3.1) is shown below

$$GDP_{it} = \delta_1 X_{it} + \delta_2 K_{it} + \delta_3 Z_{it_i} + U_{it} \qquad (3.2)$$

$$GDP_{it} = OP_1 + ER_2 + INF_{3_i} + U_{it} \qquad (3.3)$$

Where:
GDP = gross domestic product
OP = oil production price
ER = exchange rate
INF = inflation
U = error term
δ = intercept
i = observational units
t = time

Table 1. Summary statistics

	GDP	OP	ER	INF
Mean	346.0970	91.3	206.8874	10.302
Median	386.4700	110.8	155.5864	10.1
Maximum	546.6800	113.50	453.0800	12.8
Minimum	95.39000	44.45	118.5669	6.08
Std. Dev.	135.6216	28.5	106.8304	2.266095
Skewness	-0.566116	-0.04	1.106704	1.56
Kurtosis	2.195862	2.35	2.677510	2.4782
Jarque-Bera	1.607157	0.34	4.169316	2.8764
Probability	0.447724	0.84	0.124350	0.1482
Sum	6921.940	2.05E+11	4137.748	2.14E+21
Sum Sq. Dev.	349471.4	4.57E+2	216842.0	3.85E+2
Observations	40	40	40	40

Source: E-Views Output (2023)
Table 1 shows the summary statistics otherwise known as the descriptive statistics. It summarizes the characteristics of the data that was used for the study. In includes the measure of central tendency and measure of dispersion. Gross domestic product (GDP) has a mean value of 346.0970, median of 386.4700, standard deviation of 135.6216 maximum and

Eur. Chem. Bull. 2023, 12 (S3), 5018 –5028

5023

Evaluation of the Nexus Between Oil Production and its Overall Effect on Exchange Rate, Inflation and Economic Growth in Nigeria

Section A-Research paper

minimum of 546.6800 and 95.39000 respectively. The oil production price (OP) has a mean of 91.3, median of 110.8, standard deviation of 28.5, maximum and minimum of 113.50 and 44.45 respectively. Exchange rate (ER) have a mean of 206.8874, median of 155.5864, standard deviation of 106.8304, maximum and minimum of 453.0800 and 118.5669 respectively. Inflation (INF) has a mean score of 10.302, median of 10.1, standard deviation of 2.266, minimum and maximum of 6.08 and 12.8 respectively.

Table 2. Correlation Matrix

	OP	INF	ER
OP	1.000000		
INF	0.119277	1.000000	
ER	-0.573613	-0.086083	1.000000

Source: E-Views Output (2023)
Table 2 shows the correlation matrix table used to evaluate the relationship between the independent variables and to check if there is the possibility of multicollinearity in the variables. Table 2 shows a positive correlation between OP and INF and a negative correlation between OP and ER. INF is also negatively correlated with ER. From the values in table 2, it can be inferenced that there is no incidence of multicollinearity in the variables as none of the variables exhibits signs of multicollinearity. The findings of this study on the inverse relationship between inflation and exchange rate aligns with the study of Roncaglia de Carvalho, Ribeiro, and Marques (2018) which states that a country's inflationary rate is controlled by its Central Bank. However, a high rate of inflation usually produces an adverse impact on the exchange rate.

Table 3. Pooled Ordinary least Square Regression Output

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.673623	4.673625	1.063750	0.3234
OP	-0.66527	0.145398	-1.914532	0.0426
INF	1.082467	0.242341	4.214562	0.0005
ER	-0.076254	0.156742	-0.746198	0.4357
Durbin-Watson Test = 1.84	Adjusted R^2 = 0.52	R^2 = 0.68		

Source: *E-Views Output (2023)*
Table 3 is the pooled OLS regression output. It can be deduced that only inflation (INF) was statistically significant while oil production price (OP) and exchange rate (ER) were statistically insignificant. A unit increase in INF would lead to an increase of 1.082467 in GDP. A unit increase in OP and ER would lead to a decrease of -0.66527 and -0.076254 respectively in GDP respectively. The R-squared of 68% connotes that the model can explain 68% of the variation in the model.

Table 4. Fixed-Effect Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.336817	2.335291	2.285290	0.0354
OP	-0.463330	0.093399	-4.960754	0.0001
INF	0.082818	0.140118	0.591059	0.5623
ER	0.117455	0.064932	1.808904	0.0382

Eur. Chem. Bull. 2023, 12 (S3), 5018 –5028

5024

Evaluation of the Nexus Between Oil Production and its Overall Effect on Exchange Rate, Inflation and Economic Growth in Nigeria

Section A-Research paper

Durbin-Watson Test = 1.85	Adjusted R^2 = 0.56	$R^2 = 0.69$		

Source: E-Views Output (2023)

Table 4 shows that the probability values of oil production price (OP) and exchange rate (ER) were all significant at the 5% significance level, with probability values of 0.0001 and 0.0382 respectively. This indicates that the two independent variables substantially impacted on gross domestic product (GD,P) which measures the economic growth. Inflation (INF) had a probability value of 0.5623, which was statistically insignificant at the 5% level of significance.

INF and ER also exhibited positive indications against their coefficient values using the coefficient sign, indicating that their association with GDP was positive.

This means that a unit increase in both INF and ER would increase GDP by 0.082818 and 0.117455 respectively. The coefficient value of OP had a negative sign to show that the variable had a negative or an inverse association with GDP at -0.463330.

The R-squared coefficient of determination (R-squared) of the model under evaluation, which measures the model's goodness of fit, was 0.69. This means that all of the independent variables account for 69% of the variance in the dependent variable (GDP), the remaining 31% can be explained by outliers that is not captured in the model. Conclusively, the durbin-watson test resulted in 1.85, indicating that the model had no autocorrelation.

Table 5. Random-Effect Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.820281	1.783093	2.142502	0.0417
OP	-0.465158	0.081903	-5.679399	0.0000
INF	0.183356	0.092186	1.988971	0.0573
ER	0.100837	0.062394	1.616135	0.0181
Durbin-Watson Test = 1.77	Adjusted R^2 = 0.62	$R^2 = 0.66$		

Source: *E-Views Output (2023)*

At the 5% significance level, the probability values of OP and ER with values of 0.0000 and 0.0181 significantly influenced the dependent variable GDP, according to table 5. With a probability value of 0.0573, INF was not statistically significant at 0.05 level of significance.

In addition, OP has a negative coefficient value, which connotes that a unit increase in OP would lead to a decrease of -

0.465158. A unit increase in INF and ER would increase GDP by 0.183356 and 0.100837 respectively.

The R-squared also called the coefficient of determination (R-squared) of the model under evaluation is 0.66 (66%). This means that the independent variables explains 66% of the variance in the dependent variable (GDP). The durbin-watson value of 1.77, indicates that the model had no autocorrelation.

Table 6. Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	1.028407	3	0.7944

Source: *E-Views Output (2023)*

The Hausman test is a test carried out to determine the most appropriate regression

Eur. Chem. Bull. 2023, 12 (S3), 5018 –5028

5025

Evaluation of the Nexus Between Oil Production and its Overall Effect on Exchange Rate, Inflation and Economic Growth in Nigeria

Section A-Research paper

model (either fixed or random effect model) to use for the study. The rule of thumb states that if the probability value is statistically significant at 5%, the alternative hypothesis should be accepted while the null rejected. The alternative hypothesis in this case is the fixed effect model while the null hypothesis is the random effect model. From the probability value, 0.7944 is not significant at 5 percent level of significance. The significant result showed that the null hypothesis would be accepted meaning that the random-effect regression model would be used for the study's inferences.

<div align="center">Table 7. Breusch Pagan LM Test Result</div>

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	10.97096	3	0.3119

Source: *E-Views Output (2023)*

From the Breusch Pagan LM test output in Table 7, it is carried out to examine if there is heteroscedasticity in the model. The rule of thumb states that an output that has a probability output less than 5% connotes that heteroscedasticity is assumed and homoscedasticity is rejected. From the probability output in Table 7, it can be inferred that the model has no heteroscedasticity.

4. RECOMMENDATION AND CONCLUSION

The Nigerian economy is mainly import dependent due to the poor and dilapidated states of its refineries and other industries that have hindered production growth. The findings of this study aligns with the empirical study of Zoramawa, Ezekiel, and Kiru (2020) who stated that exchange rate is one of the key determinants for the growth of an economy. In line with this findings, the Central Bank of Nigeria (CBN) should ensure that a stable exchange rate is maintained because it enhances production, investments and increases other forms of economic activities.

The study concludes from its findings that exchange rate positively influences economic growth while it has a negative relationship with oil production as evidenced in table 2. Nigeria being a mono product economy has remained highly susceptible to fluctuations in the global prices of crude oil (Osuma, Babajide, Ikpefan, Nwuba, & Jegede, 2019). Therefore, this study recommends that diversifying the economy from its reliance on crude oil production to agricultural production and other forms real sector engagements that involves industralisation to enhance the economic growth in the country. By diversifying the economy from its crude oil reliance, it would have the capacity to withstand macro-external shocks such as 2016 global decline in oil price. As exchange rate had a positive and significant impact on economic growth, it connotes that the crude oil exploration, exportation and importation in Nigeria could positively affect the economy.

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5028