AN EMPIRICAL ANALYSIS OF THE IMPACT OF THE COVID-19 PANDEMIC ON THE NIGERIAN OIL INDUSTRY: EVIDENCE FROM IMPULSE RESPONSE AND VARIANCE DECOMPOSITION ANALYSIS

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Abstract

February 2020 to March 2021. Results indicated a significant decline in oil prices during the study period, with a slight recovery towards the end. The study found that oil prices responded positively to COVID-19 shocks, and remained low for the entire forecast horizon. COVID-19 cases had a 100% response rate to their shock, while deaths had a 69% response rate by the end of the forecast period. The study recommends that the Nigerian government should reduce its reliance on oil as the main source of foreign exchange due to its vulnerability to external negative impacts. Additionally, the study suggests that vaccination efforts be intensified to control the spread of the virus, and more research should be conducted to create an effective vaccine that would address the current controversies about vaccine effectiveness. The research highlights the importance of economic diversification as a means to prevent dependence on a single source of income.

Keywords: COVID-19 pandemic, Impulse Response Function, Oil price, Shocks, Variance Decomposition.

JEL Classifications Codes: E31, Q43

1. INTRODUCTION

The COVID-19 pandemic has caused unprecedented disruptions to the global economy, with many industries being adversely affected. Among these industries, the oil sector has been particularly hard hit due to a significant decline in global demand, leading to a remarkable decrease in oil prices. This has had far-reaching implications for oil-producing countries, including Nigeria, which heavily relies on oil as a major source of foreign exchange earnings. In this context, this paper presents an empirical analysis of the impact of the COVID-19 pandemic on the Nigerian oil industry. Despite significant scientific and technological progress made in the past century, biological threats such as pandemics continue to pose a persistent danger to society. The effects of COVID-19 are

not limited to the loss of human life and are impacting communities at both the regional and global levels.

According to Norouzi et al. (2020), The COVID-19 pandemic had various effects on the economy, society, and mental health of countries worldwide, with some being more affected than others. According to the National Bureau of Statistics of Nigeria (2020), the first case of COVID-19 in Nigeria was reported in February 2020, signalling that the country was not immune to the pandemic's effects. As a result, the Nigerian government instituted social distancing measures and lockdowns, which contributed to a decline in demand for oil, the country's main source of foreign exchange revenue, and a substantial decrease in global oil prices.

The emergence of COVID-19 created political unrest as governments grappled with its social and economic consequences. Some have attributed the situation to China's information asymmetry. Despite the varied impact of COVID-19 on different countries, it remains a genuine and lethal threat. Nigeria, like many other nations, was not spared from the pandemic, and in response, implemented a lockdown that led to a decrease in demand for oil and a significant reduction in oil prices.

The study aims to analyse the impact of COVID-19 on oil prices in Nigeria using the impulse response and variance decomposition method. The study's time frame is limited to 24 months, specifically from February 28, 2020, to March 28, 2021, due to limited data availability. The main objective is to assess the pandemic's influence on oil prices by measuring the shocks.

2.0 REVIEW OF RELEVANT LITERATURE

Many studies have looked into how COVID-19 affects oil prices, as the pandemic caused a significant shock to the global oil market. With travel restrictions and reduced economic activity, oil demand plummeted, leading to an unprecedented decline in prices. Empirical reviews of these studies have explored various aspects of this relationship, including the short- and long-term effects on prices, the impact on different types of oil, and the role of policy interventions in mitigating the effects. These reviews provide valuable insights into the complex and dynamic nature of the oil market during a global crisis.

Abidoye et al. (2021) examined the impact of COVID-19 on the Nigerian economy, with a specific focus on the oil and gas sector. The study employed the ARDL model and a Vector Autoregressive (VAR) model, using quarterly data from 2010 to 2020. The findings indicated that the pandemic had a significant negative impact on the Nigerian oil and gas sector, with a decrease in crude oil production, exports, and revenue. The study recommended the need for the Nigerian government to prioritize the diversification of the economy away from oil and gas and invest in other sectors, such as agriculture and technology.

Also, Ahmed et al. (2021) investigated the impact of COVID-19 on the global crude oil market and its transmission to the Nigerian economy. The study used monthly data from January 2000 to December 2020 and employed the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model and the Vector Error Correction Model

(VECM) to analyze the data. The results revealed that COVID-19 had a significant negative impact on global crude oil prices, which was transmitted to Nigeria through reduced demand and production. The study recommended the need for Nigeria to diversify its economy away from oil and gas and prioritize investments in sectors such as agriculture, technology, and manufacturing.

Ekpo and Effiong (2021) examined the effect of COVID-19 on Nigeria's crude oil prices using monthly data from January 2000 to December 2020. The study employed the ARDL model to analyze the data. The results showed that COVID-19 had a significant negative impact on Nigeria's crude oil prices, which was more pronounced in the short term than in the long term. The study recommended the need for the Nigerian government to reduce its dependence on crude oil exports and prioritize investments in other sectors such as agriculture, technology, and manufacturing.

Ajie and Nwokoro (2021) investigated the impact of COVID-19 on the Nigerian oil and gas sector using monthly data from January 2010 to December 2020. The study employed the ARDL model to analyze the data. The results showed that COVID-19 had a significant negative impact on Nigeria's oil and gas sector, which was more pronounced in the short term than in the long term. The study recommended the need for the Nigerian government to diversify its economy away from oil and gas and invest in other sectors such as agriculture, technology, and manufacturing.

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A study conducted by Oyakhilomen and Alabi (2021) investigated the impact of the COVID-19 pandemic on the Nigerian economy, with a particular focus on the oil and gas sector. The study employed a mixed-method research design, utilizing both primary and secondary data sources. The primary data were collected through structured questionnaires administered to stakeholders in the oil and gas sector, while the secondary data were obtained from relevant publications. The study found that the COVID-19 pandemic had a significant negative impact on the Nigerian economy, with the oil and gas sector being the worst hit. The study recommended that the government should diversify the economy away from the oil and gas sector and develop alternative sources of revenue to cushion the effects of future pandemics.

Another study conducted by Anyanwu et al. (2021) examined the impact of the COVID-19 pandemic on the Nigerian oil and gas sector using a Vector Autoregressive (VAR) model. The study utilized monthly data spanning from January 2019 to December 2020. The findings showed that the COVID-19 pandemic had a significant negative impact on the Nigerian oil and gas sector, leading to a decline in oil and gas production, as well as reduced revenue from exports. The study recommended that the Nigerian government

should implement policies aimed at reducing the country's dependence on oil and gas exports and promoting economic diversification.

In a similar study, Oladimeji et al. (2021) analyzed the impact of the COVID-19 pandemic on the Nigerian oil and gas sector using a VAR model. The study utilized monthly data spanning from January 2010 to December 2020. The findings revealed that the COVID-19 pandemic had a significant negative impact on the Nigerian oil and gas sector, leading to a decline in production, exports, and revenues. The study recommended that the Nigerian government should focus on promoting economic diversification and reducing the country's dependence on oil and gas exports.

A study conducted by Adedokun et al. (2021) investigated the impact of the COVID-19 pandemic on the Nigerian oil and gas sector, with a focus on the crude oil price dynamics. The study employed an ARDL model and utilized quarterly data spanning from 2010 to 2020. The findings revealed that the COVID-19 pandemic had a significant negative impact on the Nigerian oil and gas sector, leading to a decline in crude oil prices and revenues. The study recommended that the Nigerian government should focus on promoting economic diversification and developing alternative sources of revenue.

Another study conducted by Agbola et al. (2021) investigated the impact of the COVID-19 pandemic on the Nigerian oil and gas sector, with a focus on the price volatility of crude oil. The study utilized an EGARCH model and monthly data spanning from January 2010 to December 2020. The findings showed that the COVID-19 pandemic had a significant impact on the price volatility of crude oil in Nigeria. The study recommended that the Nigerian government should implement policies aimed at reducing the country's dependence on oil and gas exports and promoting economic diversification.

A study conducted by Oseni et al. (2020) investigated the impact of the COVID-19 pandemic on the Nigerian economy, with a focus on the oil and gas sector. The study utilized a qualitative research design and collected data through in-depth interviews with stakeholders in the oil and gas sector. The findings showed that the COVID-19 pandemic had a significant negative impact on the Nigerian oil and gas sector, leading to reduced production and revenues. The study recommended that the Nigerian government should develop policies aimed at promoting economic diversification and reducing the country's dependence on oil and gas exports.

Udoka and Ijirshar (2021) analyzed the impact of the COVID-19 pandemic on the Nigerian oil and gas industry. Their study focused on the period from January 2020 to December 2020 and employed a descriptive research design. The study found that the pandemic had a negative impact on the Nigerian oil and gas industry due to the decrease in demand and the resulting drop in oil prices. The authors recommend that the Nigerian government diversify its economy and reduce its reliance on oil revenue to mitigate the impact of future pandemics on the industry.

Fatile and Akeke (2021) explored the causal relationship between COVID-19 and crude oil prices in Nigeria. Their study covered the period from January 2010 to September 2020 and employed the Granger causality test. The study found that there was a bidirectional causal relationship between COVID-19 and crude oil prices in Nigeria. The

authors recommend that policymakers develop measures to mitigate the negative impact of pandemics on the oil industry and that the Nigerian government diversify its economy to reduce its reliance on oil revenue.

Afolabiet al. (2021) assessed the impact of the COVID-19 pandemic on the Nigerian economy. Their study focused on the period from January 2020 to December 2020 and employed a descriptive research design. The study found that the pandemic had a negative impact on the Nigerian economy, particularly the oil industry, due to the decrease in demand and the resulting drop in oil prices. The authors recommend that the Nigerian government develop policies to diversify its economy and reduce its reliance on oil revenue to mitigate the impact of future pandemics on the industry.

While these studies have contributed significantly to our understanding of the issue, several research gaps remain. One of the significant gaps is the limited usage of advanced methodologies. Thus, there is a need for more research using the impulse response and variance decomposition method. Addressing these research gaps could provide policymakers and industry players with crucial insights that could inform their decision-making.

3.0 METHODOLOGY

The research design used in the study was quantitative and involved the collection of daily high-frequency quantitative data from secondary sources. The data were obtained for the period between February 28, 2020, and March 28, 2021, and analysed using Impulse Response Function and Forecast Error Variance Decompositions techniques. These methods helped to provide a short-term response to each variable and predict current values by analysing past values. The techniques are widely used in economic analysis as they help to describe the mechanism by which variables are generated together.

Specifications of the Model

Impulse Response Functions (IRF)

The impulse response function is a useful technique used in analyzing how a shock affects the dependent variables in a model over a short period. It assesses the degree of responsiveness of each variable in the model to a unit shock that is applied to the error term of that variable's equation. By observing the effects of the shock over time, the impulse response function enables researchers to better understand how the variables interact with each other. Brooks (2008) explains that the impulse response function can be mathematically expressed in the following way:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots + A_p Y_{t-p} + s_t \quad \text{Eq. (1)}$$

then:

$$Y_t = C + s_t + T_1 s_{t-1} + T_1 s_{t-2} + \ldots = T(Q) s_t \quad \text{Eq. (2)}$$

The Ψ matrix has numbers that show how much a one-unit change in a variable at time t impacts the value of variable i at time t+1, assuming all other changes are constant.

Based on the factors mentioned earlier, the following model is formulated:

$$OLP_t = \beta_0 + \beta_1 CNC_t + \beta_2 CND + \varepsilon_t \qquad \text{Eq. (3)}$$

The model being estimated is presented in Equation (3) and includes variables OLP, CNC, and CND. OLP represents the oil price at time t, while CNC and CND represent the number of new COVID-19 cases and deaths in Nigeria, respectively. The intercept/constant is represented by β0,and the slopes of CNC and CND are represented by β1 and β2, respectively. The random error term is represented by εt.

Variance Decompositions

Variance Decompositions (VDCs) serve as valuable tests of causality outside the sample. The sequence of variables is crucial in computing VDCs and Impulse Responses. Failure to take into account correlated error terms can result in an incorrect representation of the system's dynamics. To address this problem, an orthogonalized Impulse Response technique is frequently used, and sensitivity is taken into account at every stage of the procedure.

Descriptive Analysis

The researchers used descriptive statistical tools to gain insights into the distribution of the data, specifically, they calculated measures of kurtosis and skewness to assess the shape of the data distribution and used the Jarque-Bera test to evaluate whether the data followed a normal distribution.

Unit Root Test Analysis

The Phillips and Perron (PP) test was utilized to determine if the variables were stationary or non-stationary. The null hypothesis to be tested is that there is a unit root, which is expressed as Ho: p = 1.

4.0 RESEARCH FINDINGS/RESULTS

Once multiple estimations were carried out to examine the effect of the COVID-19 pandemic on oil prices in Nigeria, the findings were obtained and examined. The section discusses these results in depth, including an explanation of the primary discoveries.

4.1 Graphical plot of the Variables

The preliminary test before estimating the model starts with a visual representation of the variables used in the research. Various series utilized in the analysis are graphed and explained as follows.

The graph presented in Figure 1 displays the changes in monthly oil prices between February 2020 and March 2021, exhibiting irregular fluctuations that correspond to the severity and easing of the pandemic. In particular, the oil price became more unstable in the period around April-May 2020, coinciding with the negative turn of WTI prices.

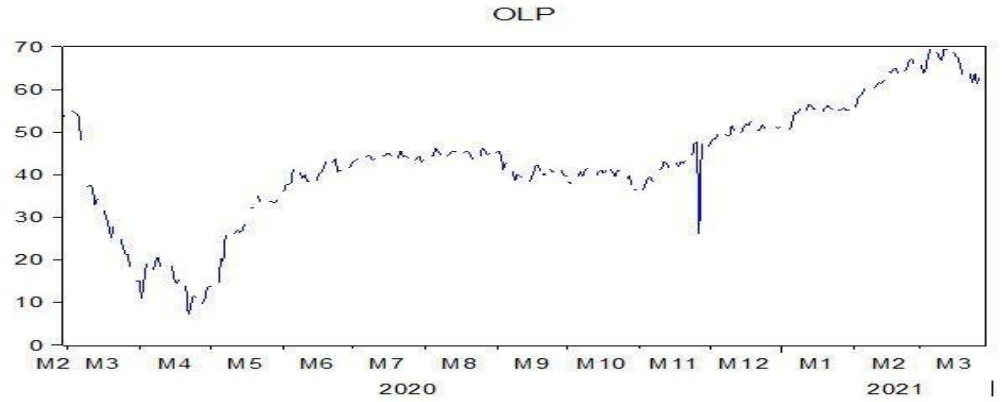

Figure 1: Visualization of Oil Price Trends

The summary highlights the temporal pattern of COVID-19 cases in 2020, with an initial rise and fall followed by a second wave that began in December2020. During the second and third quarters, lockdown measures were implemented, which helped to reduce the number of cases. However, cases increased again from September to October, leading to the second wave. Figures 2 and 3 depict the increase in cases and deaths during this period, with cases exhibiting a random fluctuation pattern.

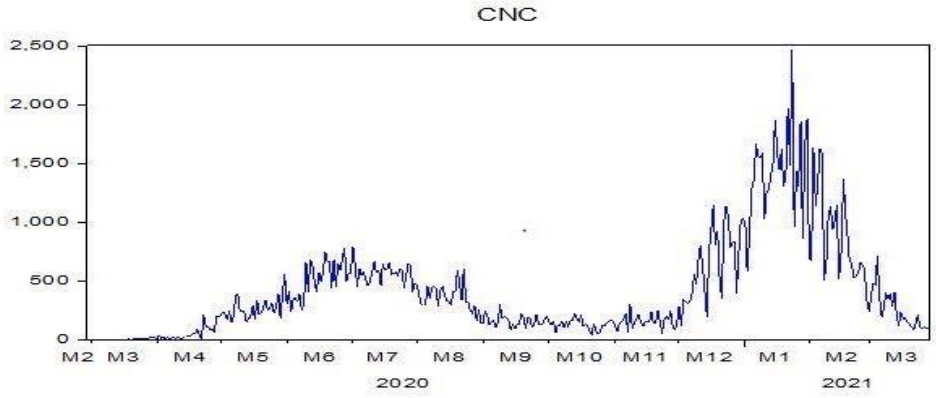

Figure 2: Graph depicting the number of new COVID-19 cases in Nigeria

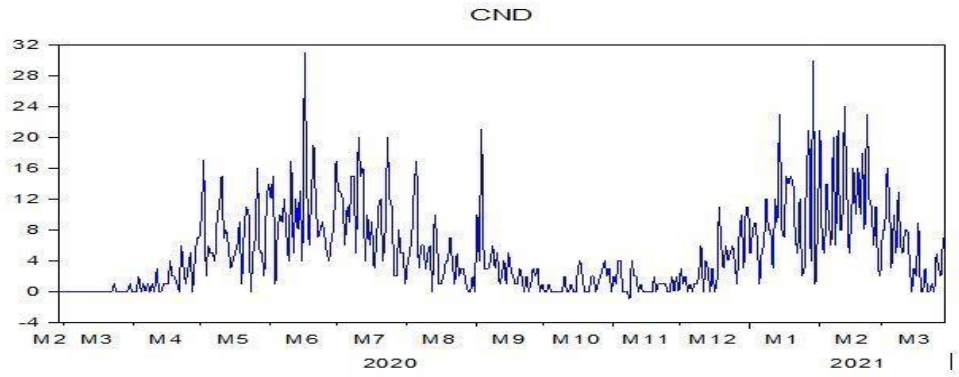

Figure 3: COVID-19 Mortality Trends in Nigeria

In Figures 2 and 3, the trend of COVID-19 deaths corresponds to that of COVID-19 cases, with both showing variations over time. As the number of COVID-19 cases goes up, so does the number of deaths, and at the same time, the price of oil falls because of decreased demand among other factors.

Table 1: Descriptive statistics of the Variables

	OLP	CNC	CND
Mean	43.208	429.693	5.446
Median	43.370	281.000	4.000
Maximum	69.410	1964.000	31.000
Minimum	7.150	0.000	0.000
Std. Dev.	13.795	428.243	5.867
Skewness	-0.412	1.477	1.472
Kurtosis	3.090	4.653	5.350
Jarque-Bera	7.753	129.413	160.157
Probability	0.021	0.000	0.000
Sum	11709.230	116447.000	1476.000
Sum Sq. Dev.	51378.950	49515920	9292.974
Observations	271	271	271

Source: Author's compilation from the data obtained from CBN & Our World in Data website

Table 1 provides descriptive statistics for the three variables OLP, CNC, and CND. The mean value of OLP is 43.208, with a standard deviation of 13.795, while CNC has a higher mean value of 429.693 with a larger standard deviation of 428.243. CND has the lowest mean value of 5.446 and a standard deviation of 5.867. The data is positively skewed for CNC and CND, indicating a higher number of values on the right side of the distribution. Kurtosis values for all variables indicate that the distributions are leptokurtic, meaning they are more peaked than a normal distribution. The Jarque-Bera test shows that the data for all three variables are not normally distributed, with p-values less than 0.05. Descriptive statistics provide a summary of the distribution of the data and can be useful in determining the appropriate methodology for analysis.

Table 2: Correlation Matrix of the variables

Variables	OLP	CNC	CND
OLP	1		
CNC	0.5103	1	
CND	0.3225	0.5310	1

Source: Author's compilation from the data obtained from CBN & Our World in Data website

Table 2 presents the correlation matrix between the variables, where a value above 50% indicates an average correlation and a value below 50% indicates a weak correlation.

Table 4: Results of Phillips & Perron Unit Root Tests (with intercept & trend)

	Phillips and Perron test		
Variables	Level	1st difference	Stationary Status
OLP	-3.533**	-18.337***	I(I)
CNC	-5.561***	-	I(0)
CND	-15.951***	-	I(0)

Note: The symbols *** and ** denote statistical significance at the 1% and 5% levels, respectively.

The test to see if the data is stable enough for calculations showed that all variables can be used for mathematical predictions, but they need different levels of adjustments. The oil price data needs to be modified once to make it stable, while COVID-19 cases and deaths do not need any modifications as they are already stable.

4.2 Impulse Response Function

In the study, the researchers used Cholesky's ordering and impulse response function to look at the connections between the variables. It is found that all variables react immediately to their shocks. It is also noticed that positive shocks in COVID-19 cases and deaths occur. However, COVID-19 cases have a negative effect on oil prices, and an increase in COVID-19 cases leads to a decrease in oil prices. Moreover, the examination of the ten-month projection indicates that oil prices are more affected by changes in the number of new COVID-19 cases than by the number of deaths. These results are consistent with a previous study by Wang et al. (2020).

Table 5: Impulse Response Table Result

Response of CNC:

Period	OLP	CNC	CND
1	14.32190	151.1100	0.000000
2	4.289681	80.05568	6.466684
3	9.019260	118.8240	-9.180157
4	6.922874	108.6748	-2.131485
5	6.626644	115.7835	-8.698448
6	6.692836	118.3313	-6.954831
7	5.641702	120.5286	-8.797384
8	5.665461	123.9567	-8.917772
9	4.844450	126.2616	-9.470218
10	4.586054	129.2459	-9.887693

Response of CND:

Period	OLP	CNC	CND
1	0.204373	0.338755	4.252355
2	-0.416600	-0.726133	0.700897
3	0.334321	1.199743	1.037167
4	-0.178767	0.332291	0.461067
5	0.186345	1.058984	0.213440
6	-0.020223	0.875691	0.164393
7	0.101770	1.043378	0.013035
8	0.035392	1.068577	0.007439
9	0.067985	1.102651	-0.047893
10	0.046242	1.148868	-0.057130

Cholesky Ordering: OLP CNC CND

Response of OLP:

Period	OLP	CNC	CND
1	2.512823	0.000000	0.000000
2	0.951127	0.228737	0.225351
3	1.833775	0.062588	0.166625
4	1.266579	0.331530	0.240589
5	1.562401	0.262320	0.224800
6	1.345859	0.445701	0.231468
7	1.436782	0.467043	0.226286
8	1.343165	0.593653	0.216240
9	1.361758	0.659037	0.208822
10	1.312326	0.762048	0.196397

4.3 Variance Decomposition

The study's analysis revealed that COVID-19 cases (CNC) and deaths (CND) had a bigger impact on the variables studied than oil prices. COVID-19 cases had a strong impact on their variations, while COVID-19 deaths had a 69% impact. This suggests that most of the changes in COVID-19 cases and deaths are due to internal factors. Moreover, the research found that the COVID-19 pandemic had a negative effect on oil prices, causing a decrease in prices during the pandemic. Other studies also reported a drop in oil prices due to COVID-19, such as Sakurai and Kurosaki (2020)

Table 6: Variance Decomposition Results

Variance Decomposition of OLP:

Period	S.E.	OLP	CNC	CND
1	2.512823	100.0000	0.000000	0.000000
2	2.705924	98.59187	0.714565	0.693563
3	3.273597	98.74226	0.524782	0.732956
4	3.533901	97.57713	1.330428	1.092447
5	3.879291	97.19630	1.561321	1.242383
6	4.136721	96.06046	2.533888	1.405656
7	4.409778	95.14820	3.351514	1.500287
8	4.652894	93.79812	4.638297	1.563587
9	4.897115	92.40836	5.998288	1.593355
10	5.130617	90.73101	7.670832	1.598155

Variance Decomposition of CNC:

Period	S.E.	OLP	CNC	CND
1	151.7872	0.890288	99.10971	0.000000
2	171.7804	0.757470	99.10081	0.141715
3	209.2684	0.696146	99.01593	0.287929
4	235.9151	0.633879	99.13140	0.234722
5	263.0234	0.573426	99.12837	0.298201
6	288.5772	0.530157	99.16403	0.305811
7	312.9108	0.483415	99.17744	0.339141
8	336.7343	0.445739	99.19127	0.362986
9	359.7849	0.408584	99.20417	0.387249
10	382.4506	0.375969	99.21448	0.409549

Variance Decomposition of CND:

Period	S.E.	OLP	CNC	CND
1	4.270720	0.229006	0.629171	99.14182
2	4.408075	1.108141	3.304104	95.58776
3	4.696594	1.482886	9.436072	89.08104
4	4.734233	1.601987	9.779282	88.61873
5	4.859494	1.667509	14.03056	84.30193
6	4.940542	1.614924	16.71562	81.66946
7	5.050556	1.585939	20.26314	78.15092
8	5.162488	1.522612	23.67842	74.79897
9	5.279587	1.472401	27.00162	71.52598
10	5.403641	1.412895	30.29637	68.29074

Cholesky Ordering: OLP CNC CND

4.4 Discussion of Results and Implications of Findings

The study's findings demonstrate the significant impact of the COVID-19 pandemic on oil prices in Nigeria, revealing a negative relationship between the two variables. The results further suggest that external factors, such as the pandemic, have a more prominent effect on oil prices than internal factors. Hence, policymakers and investors must adopt measures to address the adverse impacts of these external shocks and adjust

their investment strategies accordingly. These findings align with previous empirical studies by Sakurai and Kurosaki (2020), Tiwari et al. (2021), Wang et al. (2020), and Zhu et al. (2021).

5. CONCLUSION

This study aimed to investigate how COVID-19 affected the price of oil in Nigeria using monthly data collected from February 2020 to March 2021. The findings showed that when there was a significant increase in COVID-19 cases, the price of oil decreased. As time passed, the impact of new cases and deaths on oil prices became more apparent, with new cases having a stronger effect than deaths over a 10-month forecast. Additionally, the analysis revealed that COVID-19 cases and deaths had a more significant response to their shocks compared to oil prices. These results indicate that the COVID-19 pandemic had a considerable impact on the oil prices in Nigeria, highlighting the importance of policymakers and investors taking measures to reduce the adverse effects of external shocks and adjusting their investment strategies accordingly.

The results of the study offer advice to the Nigerian government. Firstly, it is recommended that the country reduces its reliance on oil as the primary source of foreign exchange because it is vulnerable to external shocks. Secondly, the government should enforce COVID-19 protocols and make an effort to vaccinate the population to limit the spread of the virus. These actions can help reduce the impact of external shocks and mitigate the negative effects of pandemics like COVID-19 on the Nigerian economy.

In conclusion, this research highlights the significant impact of the COVID-19 pandemic on oil prices in Nigeria, emphasizing the need for economic diversification and continued efforts to control the spread of the virus.

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