Covid-19 and Oil Price Volatility in Nigeria

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Abstract

With the current economic challenges facing the global economy consequent to the outbreak of the COVID-19 pandemic, economic activities of countries on the globe had been seriously affected. This paper seeks to investigate impact of COVID-19 pandemic on Oil Price volatility in Nigeria. We adopt the univariate GARCH class of models, and create a dummy for the COVID-19 pandemic with a view to examining its effect on the volatility of Nigeria's Oil Price. The results have revealed high persistence of volatility shocks in the Oil Price series of Nigeria and that the COVID-19 pandemic has had significant effect on volatility of the series. Based on the results, the paper recommends a more optimal diversification policy in order to mitigate the effects and lessen the macroeconomic risks associated with down of Oil Price volatility in Nigeria.

KEYWORDS*: COVID-19, Oil Price Volatility, Global Economy, GARCH.*

Introduction

The shocking consequence of the Coronavirus (COVID-19) pandemic which was first discovered in Wuhan, China, on 1 December 2019, has affected the global economy in diverse and incalculable measures through its impact on economic, social, cultural and religious activities. With the World Health Organisation (WHO) declaring COVID-19 a pandemic on 11 March 2020, economic experts predict that global growth could decline by 0.5% for the year 2020 while others forecast that the global economy may experience recession in 2020 (African Union, 2020). While the number of infections and deaths arising from the pandemic has raised globally, the economic consequence of the pandemic are numerous – international oil price decline, exchange rate depreciation, dismal stock market performance and changes in global financial conditions. The decline in oil price from about 72.18 USD per barrel in early January 2020 to 11.03 USD per barrel in April 2020 was occasioned by low demand and excess supply – low demand due to low usage of oil resulting from almost shutting down of economic activities globally and oil supply disputes with Saudi Arabia.

The collapse of the oil price plummeted global stocks as the decline in oil price affected the performance of transnational oil corporations (such as Chevron, Shell and Exxon Mobil) listed on the stock exchange. More so, the stoppage of production activities through economic lockdown and movement restrictions of both human and non-human commodities in all countries in trying to curtail the spread of the virus (with exception to essentials) affected the performance of transnational non-oil firms (such as Unilever, Nestle, Guinness, Procter &

Gamble Co., British Airways) which led to the decline of the use of crude oil in the world. Therefore, the demand for crude oil is reduced due to lockdown policy embarked by many countries in the world in order to curtail the spread of the pandemic which led to the fall in oil price globally.

Nigeria's economy was significantly damaged by the COVID-19 pandemic; among other things, falling oil prices caused a reduction in daily crude oil production. In the last ten years, the nation's confirmed reserves amounted to over 37 billion barrels of crude oil (bbl). Additionally, the resources had recently deteriorated, going from 37.5 billion barrels of crude oil in 2017 to 36.9 billion barrels in 2020 (Olujobi et al, 2019). It has been widely reported that COVID-19 caused unprecedented disruptions in the global supply of crude oil, a drop in crude oil prices, turmoil in the global financial markets, restrictions on transcontinental travel, and the end of major global events (Okediya, 2020). Fluctuations in the price of oil are a major worry for Nigerian economies, and the effects they have on the development of the nation present problems for those who make decisions on national budgets and economic policies. The Federal Government's economy and policies have been impacted by this crucial issue because the entire country depends on oil earnings. By neglecting other crucial industries like technology, solid minerals, manufacturing, and agriculture, which could have complemented the Federal Government's revenues during the decrease in world oil pricing regimes, this has impeded the development and progress of the country. This has exposed the economy of the nation to a variety of threats or shocks, since Nigeria currently faces a lack of US dollars as a result of the drop in crude oil prices (Coulibaly and Madden, 2020). Due to its excessive dependence as the main source of the country's national income and foreign exchange, oil and gas have transformed the economy into a single-merchandise economy, making it vulnerable to economic shocks like the COVID-19 pandemic, low global oil prices, and other unanticipated economic contingencies.

In addition, the decline in global oil price has far reaching consequences for an oil dependent economy like Nigeria, which include:

i. reducing the feasibility of the 2020 national budget which was predicted on US$57 per barrel (pb) oil benchmark;
ii. reduction in sector as well as state budgetary allocations
iii. increase in national and international debt;
iv. decline in foreign exchange earnings and foreign reserves; and
v. depreciation of the domestic currency.

The domestic currency was officially devalued from ₦306.5/ 1$ to ₦360.5/1$ in March 2020, further to ₦381/1$ in June 2020. The domestic currency was also devalued against other major currencies of the world such as Pound Sterling (£) and Euro (e).

The pandemic created huge preponderance of economic calamity in the globe which led to shut down all economic activities in the world. The cumulative effect of the COVID-19 pandemic on the Nigerian economy is predicted to snowball into a negative annual GDP growth rate of -5% to -10% by the end of 2020 (Akpata and Nevin, 2020) due to fall of oil price in the world. Such negative growth with an uncertain prolong period of economic recovery plan might worsen the fragile economic structure as firms adjust to new economic realities. Therefore, given the decline in crude oil price globally, this paper seeks to assess the COVID-19 pandemic on oil price volatility in Nigeria.

Literature review and Theoretical Framework

The background of this research is based on the theory of Dutch-Disease. The phrase "Dutch Disease" was initially used in the Netherlands when many were worried that the manufacturing sector was about to collapse when natural gas was discovered there in the 1960s. After the Netherlands discovered significant natural gas reserves in the North Sea in the 1960s, the Dutch s Disease Theory was created. Increased export revenues resulted in significant capital inflows, which raised demand for the Dutch Florin and ultimately increased the value of the Dutch currency. The manufacturing industry found it difficult to compete in global markets as a result of this appreciation (Benkhodja, 2014). Only four of the 65 nations that fall under the category of having abundant natural resources were able to achieve both (a) long-term investment exceeding 25 percent of GDP on average from 1970 to 1998, which is comparable to other successful industrial nations without access to raw materials, and (b) per capita GNP growth exceeding 4 percent per year on average during the same time period. These four countries are Botswana, Indonesia, Malaysia, and Thailand. The three Asian countries achieved this success by diversifying their economies and by industrializing; Botswana, rich in diamonds, without doing so. In East Asia, the countries with few raw materials (Hong Kong, Singapore, South Korea, and Taiwan) have done even better than the resource-rich ones, that is, Indonesia, Malaysia, and Thailand (Gylfason, 2001).

Nigeria became one of the top oil exporters in the world after oil was discovered there in the 1950s, dominating the country's economy. Nigeria has kept up with the peaks and troughs of the global oil market. When resource prices peaked, oil exports increased which increased the real exchange rate and raised real wages for employees while lowering exports of other things like agricultural products that would promote economic growth. Repeated booms and busts would make the currency rate unstable, which would lead to a decrease in overall exports (Gylfason, 2001). Contrary to popular belief, the nation is also home to some of the world's poorest people, with as many as 69% of the population or 112.47 million Nigerians, living below the poverty line (NBS, 2010).

When a country uses the discovery of natural riches to fulfil its constitutional commitments to the people, it truly becomes blessed. As a result, the Dutch disease theory describes a scenario in which a boom in an export sector triggers a shift in production factors in favour of the booming sector and an increase in the costs of non-tradable goods and services. Consequently, this harms the remaining trade goods industry (Bature et al, 2013). A problem like corruption could emerge as a result of the resource boom, which would then result in a decline in the standard of the governmental institutions and subpar economic performance. Poorly governed nations are more likely to lose from the resource boom than benefit from it. Aside from that, the earnings from the resource boom are more likely to flow toward government spending rather than other profitable ventures, typically in those nations with low savings rates. Additionally, this will have a detrimental impact on the nations' economic growth (Brunnschweiler, 2008; Cavalcanti, Mohaddes and Raissi, 2011). If resource rent is not properly managed, such as through investing in physical and institutional infrastructure, including education, then the exploitation of natural resources would not maintain economic growth (Douangngeune, Hayami and Godo, 2005).

Empirical Literature

Few studies have recently analysed the impact of global current health pandemic (COVID-19) on macroeconomic variables such as stock market performance, oil price and exchange rate amongst other variables. For instance, Nwosa (2020) examine the impact of COVID-19 pandemic on oil price, exchange rate and stock market performance, and the implications for Transnational Corporations (TNCs) and Foreign Direct Investment (FDI) inflow in Nigeria. The study used daily data over the period 1 December 2019 to 31 May 2020. The study employed descriptive and causality techniques. The studies reveal that COVID-19 had adverse effects on oil price, exchange rate and stock market performance in Nigeria. The study concluded that impact of COVID-19 pandemic on oil price, exchange rate and stock market performance had implications for TNCs and FDI inflow in Nigeria.

Qing, Liu, Wang and Yu (2020) examined the direct and spill-over impacts of COVID-19 on stock markets using daily data spanning 1 June 2019 to 16 March 2020. The study covered stock markets in China, France, Germany, Italy, Japan, South Korea, Spain, and the United State of America. Using conventional t-tests and non-parametric Mann- Whitney tests, the study observed that COVID-19 had an adverse but short-term effect on stock markets of affected countries. More so, the study showed bi-directional spill-over effects of COVID-19 on stock markets among Asian countries, European countries and the United States of American. Furthermore, the study showed no evidence that COVID-19 negatively affects these countries' stock markets more than it does the global average.

Baker et al. (2020) analysed the unprecedented impact of COVID-19 on stock market. The study observed that government restrictions on commercial activity and voluntary social distancing accounted largely for the significant and adverse impact of COVID-19 pandemic on the US stock market. More so, the study observed thatCOVID-19 pandemic had more impact on the US stock market compared to previous health pandemics such as the Spanish Flu (1918–1919), Asian Flu (1957–1958) and the Hong Kong Flu (1968). Ozili (2020) appraised the effects of COVID-19 pandemic on the Nigerian economy. The study noted that the current economic crisis is the fallout of the ravaging COVID-19 pandemic and identified five channels through which the pandemic spilled over to Nigeria. This includes the inability of borrowers to service loan, oil demand shocks, global supply chain shocks, impaired national budget, and the declined stock market performance. More so, the study noted that movement restriction, economic lockdown, fear of contacting the virus and weak institutional quality deepened the impact of the COVID-19 pandemic on the Nigerian economy.

John et al (2020) examined the impact of COVID-19 outbreak on the Nigerian stock exchange performance. Using EGARCH estimation technique and daily data from 2 January 2020 to 16 April 2020, the study showed that COVID-19 had adverse and significant on stock market performance in Nigeria. UNCTAD (2020) analysed the global effects of COVID-19 pandemic. Specifically, the study analysed the effect of the disruption of China's exports of intermediate inputs on different countries and economic sectors of the world during COVID-19 health pandemic. The study observed that even if the COVID-19 outbreak is contained within China, the fact that China's exports are critical for many industries around the world implies that any disruption in China's export will be mostly felt outside China's borders. More so, the study noted that the spill-over effects of a disruption in Chinese supply will be diverse across economic sectors, depending on the geographic localization of the COVID19 outbreak and of the containment measures within China. The African Union, (2020) noted that COVID-19 had harmful socio-economic impacts on the African countries which are exogenous and endogenous effects. The exogenous impacts occur through direct trade links between Africa and partner continents such as Asia, Europe and the United States. These include decline in tourism, Diaspora remittances, FDI, official development assistance, illicit financing flows and domestic market tightening. The endogenous impacts happen through the spread of the COVID-19 virus in African countries, which include rising morbidity and mortality rate resulting from the spread of COVID-19, destruction of economic activities, and decline in government revenue due to decline in oil and commodity prices. The study also observed the issue of exchange rate depreciation and increase in public expenditure to safeguard human health and support economic activities. Olaniyi (2020) analysed the socio-economic impact of COVID 19. The study noted that the economic implications of COVID-19 are detrimental to both the health and economic sectors which include trade and travel, food and agriculture industries, various market types and retail chains, among others.

Methodology

Source of Data

The data for this research is mainly secondary obtained from the U S Energy Information Administration (EIA) (2021) for oil price. The period of the study covers from 2nd January, 2019 to 20th September, 2021. However, the dummy variable of the COVID–19 was formed by the coding 1 when the infections were high and zero otherwise over the sample period.

The Pre- estimation Tests

The pre-estimation tests include Unit Root tests, namely Augmented Dickey Fuller without break and with break. The unit root tests were carried out to ascertain order of integration of the series and to avoid statistical mis-specification of the model.

The Augmented Dickey-Fuller Tests

The Augmented Dickey-Fuller (ADF) unit root tests without breaks have been carried out. The tests are based on the equations below:

$$\Delta y_t = \mu + \delta t + \rho y_{t-1} + \sum_{i=1}^{p-1} \pi_i \Delta y_{t-i} + \varepsilon_t \qquad (3.1)$$

$$\Delta y_t = \mu + \rho y_{t-1} + \sum_{i=1}^{p-1} \pi_i \Delta y_{t-i} + \varepsilon_t \qquad (3.2)$$

$$\Delta y_t = \rho y_{t-1} + \sum_{i=1}^{p-1} \pi_i \Delta y_{t-i} + \varepsilon_t \qquad (3.3)$$

The unit root presence is in each case tested based on the null hypothesis of a unit root, i.e., whether the parameter $\rho = 0$ or otherwise in the three equations above. If ρ equals zero, the series contains a unit root and if it is not, the series is referred to as stationary. In equation (3.1) the ADF-test with both a constant and time trend is specified. Equation (3.2) specifies the ADF-test with a constant only and no time trend, and equation (3.3) specifies the ADF-test with no constant and no time trend respectively. Hence, the set of hypotheses corresponding to equations (3.1) to (3.3) to be tested are:

$H_0 : \delta = \rho = 0$ (The series has a unit root with no time trend.)

$H_1 : \delta \neq 0$; $\rho < 0$ (The series is stationary with a deterministic trend.)

$H_0 : \mu = \rho = 0$ (The series has a unit root with no constant and no time trend.)

$H_1 : \mu \neq 0$, $\rho < 0$ (The series is stationary with a non-zero mean.)

$H_0 : \rho = 0$ (The series has a unit root.)

$H_1 : \rho < 0$ (The series is stationary with a zero mean and no time trend.)

We have tested for also tested for unit root in presence of breaks as mentioned earlier and the test is based on the following equation:

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-1+i} + \mu D_t + \varepsilon_t \tag{3.4}$$

The breaks are captured by the term D_t in the equation. It is noteworthy that interpretations remain the same for testing the unit root hypothesis in the two models (with break and without break). Also the ADF tests with break were carried out with innovation outlier.

3.3 The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) Model

Many economic and financial time series / variables exhibit periods of volatility. The GARCH models allow the conditional variance of a series to depend on the past realizations of the error process (Enders, 2010). The GARCH model was developed by Bollerslev (1986) and takes the following econometric specification:

$$Y_t = \alpha + \beta' X_t + u_t \tag{3.5}$$

$$u_t \,|\, \Omega \sim iid\, N(0, \sigma_t^2)$$

$$\sigma_t^2 = \gamma_0 + \sum_{i=1}^{p} \delta_i \sigma_{t-i}^2 + \sum_{j=1}^{q} \gamma_1 u_{t-j}^2 \tag{3.6}$$

Conventionally, the econometric specification of the GARCH models has two mathematical equations, namely the conditional mean and conditional variance equations. The conditional mean equation is the predictability equation which provides information about the conditional mean of the series while the conditional variance equation provides information about the conditional volatility of the series and hence it is termed as the volatility equation i.e, the equation that provides information about volatility in the series. In this paper an attempt was made to investigate effect of the COVID-19 Pandemic on the oil price volatility. For the purpose of this paper, we have the following econometric specification of the model:

$$OP_t = \alpha_0 + \alpha_1 OP_{t-1} + u_t \tag{3.7}$$

$$\sigma_t^2 = \gamma_0 + \gamma_1 \sigma_{t-1}^2 + \gamma_2 u_{t-1}^2 + \gamma_3 DUM\_COVID_t \tag{3.8}$$

It is noteworthy that equation (3.7) is the specification used for the conditional mean, and, equation (3.8) is the conditional variance/volatility specification used in this paper. It is worth noting also that a dummy variable was created and included as part of the regressors in the conditional variance specification with a view to capturing the effect of the Pandemic on volatility of the series.

Results and Discussion

Pre-estimation Tests

Unit Root Test

It is statistically instructive in time series data to investigate the stationary of a series so as not run into such statistical problems as mis-specification and hence spurious regression. Based on this, ADF unit root tests without break and with break are carried out to determine the order of integration of the series. Table 4.1 presents the result of ADF unit root test without break and the paper found that the oil price is not stationary at level but stationary at first difference. This indicates that the variable is integrated of order one that is I (1).

Table 4.1 ADF Unit Root Test without Break

Variable	ADF at Level		ADF at First Difference	
	t-Statistic	Prob.*	t-Statistic	Prob.*
OP	-1.315656	0.8831	-28.13199	0.0000*

*Note: * shows statistical at 1% level of significant*

Source: Researchers' computation 2022

The ADF test does not accommodate information about unknown structural break(s) dates inherent and this could weaken the statistical power of unit root tests. To overcome this shortcoming, ADF unit root test with break has been employed in this paper and the results are reported in table 4.2.

Table 4.2 Unit Root with Break

Variable	ADF at Level		Break period	ADF at First Difference		Break period
	t-Statistic	Prob.*		t-Statistic	Prob.*	
OP	-3.507386	0.6879	1/06/2020	-29.94794	< 0.01**	3/09/2020

*Note: ** shows statistical at 5% level of significant*

Source: Researchers' computation 2022

Table 4.2 above reports the result of ADF unit root with break(s) and it has been found that the oil price series is stationary at first difference with a break occurring at the date of 3/09/2020.

Estimates of the GARCH Model

Since we have known the order of integration of the series we can forge ahead and estimate the GARCH model. Table 4.3 presents the result of GARCH model and it in cooperate the COVID–19 dummy variable in the variance equation.

Table 4.3 GARCH Result

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.006449	0.009762	0.660579	0.5089
OP(-1)	1.001412	0.000766	1307.656	0.0000*
	Variance Equation			
C	0.102770	0.018789	5.469754	0.0000*
RESID(-1)^2	0.109295	0.012824	8.522944	0.0000*
GARCH(-1)	0.852366	0.013005	65.54352	0.0000*
C_19	0.064182	0.018487	3.471717	0.0005*
R-squared	0.986964		Mean dependent var	52.57704
Adjusted R-squared	0.986964		S.D. dependent var	12.88166
S.E. of regression	1.470749		Akaike info criterion	3.375832
Sum squared resid	1507.683		Schwarz criterion	3.408413
Log likelihood	-1173.166		Hannan-Quinn criter.	3.388428
Durbin-Watson stat	2.128229			

*Note: * shows statistical at 1% level of significant*

Source: Researchers' computation 2022

The results from table 4.3 indicate a very high persistence of volatility shocks in the oil price series for Nigeria as the sum of the coefficients of the ARCH and GARCH term is close to unity that is (0.109295+ 0.852366=0.96). However, the coefficient of the dummy variable for the COVID–19 is 0.06 which is positive and statistically significant at 1% level. This suggests that the COVID -19 pandemic has had a positive and significant effect on oil price over the sample period. The log-likelihood statistic of the model is higher than the values obtained from other alternative specifications the Residual Sum of Squares statistic and the information criteria statistics, namely the AIC, SIC and HQ have been found to be much lower than the values obtained from alternative results. This has motivated the Authors to select this specification and to conveniently refer to the model as a good fit of the data

Diagnostic Tests

The ARCH-LM Test

The results in table 4.4 report the ARCH – LM test for remaining GARCH effects in the series which has been carried out on the residuals of the model and the results indicate absence of remaining GARCH effects in the series which implies that the model is statistically adequate (see Enders,2010). Furthermore, tests for serial correlation were carried out on the residuals of the model at both the conditional mean and conditional variance levels to make sure that the model is correctly specified.

Table 4.4 ARCH-LM Diagnostic Test

Heteroskedasticity Test: ARCH

F-statistic	2.077321	Prob. F(1,695)	0.1500
Obs*R-squared	2.077091	Prob. Chi-Square(1)	0.1495

Source: Researchers' computation 2022

Serial Correlation Test

The two tests for serial correlation based on Q-statistics and Correlogram squared residuals were carried out to make sure that the conditional mean and conditional variance components of the model are correctly specified and that the residuals are white noise. It can be observed from tables 4.5 and 4.6 that the results indicate non rejection of the null hypothesis that the errors are not serially correlated. This implies that there is no serial correlation in residuals.

Table 4.5 Q-Statistics Test

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
.|. |	.|. |	1	0.012	0.012	0.1023	0.749
.|. |	.|. |	2	-0.024	-0.025	0.5233	0.770
.|. |	.|. |	3	-0.032	-0.031	1.2444	0.742
.|. |	.|. |	4	-0.027	-0.026	1.7409	0.783
.|. |	.|. |	5	0.055	0.054	3.8757	0.567
.|. |	.|. |	6	0.014	0.010	4.0049	0.676
.|. |	.|. |	7	-0.012	-0.011	4.1006	0.768
.|. |	.|. |	8	0.011	0.014	4.1809	0.840

Source: Researchers' computation 2022

Table 4.6 Corrologram Squared Residuals Test

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
.|. |	.|. |	1	0.055	0.055	2.0883	0.148
.|. |	.|. |	2	-0.033	-0.036	2.8433	0.241
.|. |	.|. |	3	-0.005	-0.001	2.8616	0.413
.|. |	.|. |	4	-0.022	-0.022	3.1890	0.527
.|. |	.|. |	5	-0.020	-0.018	3.4833	0.626
.|. |	.|. |	6	-0.024	-0.024	3.8937	0.691
.|. |	.|. |	7	-0.017	-0.016	4.1018	0.768
.|. |	.|. |	8	0.024	0.024	4.5104	0.808

Source: Researchers' computation 2022

The post-estimation diagnostic tests have revealed that the model is statistically adequate and hence, the results obtained can be referred to as robust.

Conclusion and Recommendation

Conclusion

The major finding of this paper is that the COVID–19 pandemic has had a positive and a significant effect on oil price in Nigeria. This implies that any increase of the COVID–19 pandemic in Nigeria leads to high persistence of volatility shocks in the oil price series in country. Therefore, the paper concludes that, an increase in the number of confirmed cases of the COVID–19 pandemic induces a high persistence of volatility shocks in the oil price series for Nigeria.

Recommendations

Based on the results, the paper recommends a more optimal diversification policy in order to mitigate the effects and lessen the macroeconomic risks associated with the high oil price volatility with down of Oil Price volatility in Nigeria.

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