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THE ASYMMETRY OF SHOCKS IN CRUDE OIL PRICE IN NIGERIA

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ABSTRACT

While studies in Nigeria have focused on the consequences of oil price shocks on the economy, they implicitly assumed that oil price changes are symmetrical without specifically testing for asymmetry. This study concentrated on the shock asymmetries and crude oil price volatility in Nigeria. Used were time series data for the years 1981 to 2022 from the Statistical Bulletin of the Central Bank of Nigeria and the World Bank. The data were analyzed using the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) model, and the findings showed that there is a general tendency for oil price shocks to be around 1.83 percent bigger in declining oil prices than in rising prices. The asymmetric shocks to the price of oil completely dominate positive leverage. In order to minimize the economy's reliance on crude oil exports as its main export (and source of revenue), measures for export promotion and diversification should be put in place.

Keywords: Oil price, Crude oil, Asymmetry, EGARCH, Nigeria

INTRODUCTION

It is well known that, depending on whether they import or export crude oil, various nations are influenced by fluctuations in the price of oil in different ways. Because there are already enough protections in place to reduce their influence on monetary and fiscal policy, oil price shocks (dips) in industrialized countries have little to no impact on their diversified economies. Nigeria has recently seen consistent declines in oil income, requiring it to rely heavily on borrowing and perhaps recovered loot to fund the 2016 budget. Also, it is said that living conditions are continually falling in Nigeria. 60% of Nigeria's population, according to current living standards, earns less than $1 a day. There are times when governments are unable to implement its monetary and fiscal policies, which results in the economy stalling. While its advantages have not yet been realized, government established Sovereign Wealth Fund (SWF) in an effort to avoid oil

price shock caused by movement of crude oil in the worldwide market. Its negative repercussions include the continued struggle of the government to deal with the volatility of foreign exchange markets and budget deficit, as well as the daily loss of employment and incapacity of the public sector to pay salaries. With all of these obvious problems, it is imperative to look at how oil price shocks impact Nigeria's economic development.

The Nigerian economy has suffered significantly as a result of the current decline in oil prices, which began in 2014. There were high expectations prior to the shock for a robust continental economic expansion of roughly 7% yearly, which was in keeping with the average growth rate witnessed over the preceding two decades. Yet with the oil shock in 2015, growth rapidly halted, and the economy actually shrank in 2016. This extraordinary reduction accounts for a small fraction of the decline in oil output in 2016. Almost 90% of the whole economy's non-oil sector witnessed a substantial decline as well. This study examined Nigeria's crude oil price volatility and shock asymmetries in order to test the following hypothesis. Ho: There is no significant positive asymmetry in oil price shocks in Nigeria.

LITERATURE REVIEW

Asymmetry-in-Effects Theory of Economic Growth"

The link between crude oil prices and economic growth, according to this idea, "weakens until it is totally nonexistent in the US economy." In a study of a few African nations, Mork, Olsen, and Mysen (1994) confirmed the asymmetry in the link between the effect of oil price volatility and economic development. For them, "a rise in oil prices will have a detrimental effect on future GDP growth, but it's not obvious what will happen if oil prices fall."

The Linear/Symmetric Relationship Theory of Growth"

This hypothesis states that there is a negative and substantial correlation between GDP growth and changes in oil prices. It is supported by films like Hamilton (1983), Gisser and Godwin (1986), Hooker (1996), and Laser (1987). They "contended that the volatility in the price of oil is the main factor causing instability in the growth rate of output." They formulated their judgments based on the events in the oil market between 1948 and 1972 and how they affected the economies of oil-exporting and -importing countries, respectively. Hooker (2002) came to the conclusion that between 1948 and 1972, the level of the oil price and its volatility had a significant influence on the pace of rise in output. This was the result of extensive empirical study.

Renaissance growth model

This theory was created by a subset of the schools on symmetric and asymmetrical effects. Prominent supporters of this school Lee, et al. (1995) focused their theoretical work on attempting to distinguish between oil price movements and oil price volatility. They used the standard deviation over a certain time span to determine volatility. They contended that "both have negative effects on economic development, but in opposite ways: Volatility quickly has a negative and substantial impact, whereas the consequences of oil price changes took a year to appear." "Rather than oil price level, what has a large influence on economic growth is the volatility/change in crude oil prices," they concluded.

Empirical Literature

The relationship between changes in oil prices and economic activity has been the subject of several empirical studies using a variety of estimating approaches. For instance, Chuku (2012) examined the linear and asymmetric impacts of oil price shocks on the Nigerian economy during the period 1970 Q1–2008 Q4 using the VAR model and Granger causality test approach. Granger causality findings demonstrate that changes in the price of oil do not affect macroeconomic activity, and findings from nonlinear specification demonstrate that the effects of changes in the price of oil on the Nigerian economy are asymmetric. According to the results of the linear model, oil price shocks are not a significant factor influencing Nigeria's macroeconomic activity.

Katircioglu, Sertoglu, Candemir, and Mercan (2015) examined the relationship between changes in oil prices and changes in 26 OECD countries' GDP, CPI, unemployment rates, and other macroeconomic variables between 1980 and 2011. Using an econometric test known as the Durbin-H panel co-integration, they concluded that changes in the price of oil had an inverse connection with macroeconomic factors.

In their analysis of how the oil shock affected Qatar's GDP growth, Al-mulali and Sab (2010) found a favourable association between the price of crude oil and GDP. The Vector Error Correction Model (VECM), which was utilized in the study, was used to examine the impact of total trade value, oil price, and inflation rate on Qatar's GDP. In a study that is pertinent to the economy of Nigeria, Ogundipe and Ogundipe (2013) examined the relationship between oil price and exchange volatility in Nigeria. The link between the interest rate, the price of oil, and the foreign reserves and reserves was simulated in the study. Findings from the VECM show that the price of crude oil and currency rates are negatively correlated. Similar research was conducted in Russia by Izatov (2015), showing that the economy of the nation benefits from increased oil

prices. According to Kargi (2014) and Aparna (2014), oil prices have a detrimental effect on Turkey's and India's GDP levels.

Oriakhi and Iyoha (2013) examined how the volatility of oil prices (OPV) affected the growth of the Nigerian economy between 1970 and 2010. According to the study, of the six variables analyzed, OPV had an impact on real government expenditure, real exchange rates, and real imports directly as well as indirectly through other variables, most notably through government spending, on real GDP, real money supply, and inflation. According to this, the amount of government expenditure is determined by variations in the price of oil, which in turn determines how rapidly the Nigerian economy grows. Apere and Eniekezimene (2016) found a similar pattern in their investigation of Nigeria's economic growth, government expenditure, and oil price shocks. They found that whereas changes in oil prices have a considerable impact on real exchange rates, they have no effect on a country's BOP or human capital development index (2006).

In their research, which was based on an empirical review, Mgbame, Donwa, and Onyeokweni (2015) found a significant and positive correlation between oil price volatility and Nigerian economic progress. According to their argument, changes in the price of oil have an impact on government expenditure, the rate of inflation, and unemployment, all of which have an impact on how rapidly the Nigerian economy grows.

Akinlo and Apanisile evaluated the impact of oil price shocks on economic development in 20 Sub-Saharan African countries between 1986 and 2012 in a report published in 2015. Two groupings of these countries were created: Group A, which contained the exporting countries, and Group B, which contained the non-exporting countries. Using panel data for the analysis, the projected panel for the exporting countries showed that the OPV had a favourable and significant influence on their economic growth. The results for the non-exporting countries show a positive but insignificant impact on economic growth.

Nwanna and Eyedayi (2016) examined the impact of variations in crude oil prices on Nigeria's economic growth between 1980 and 2014. The results demonstrated a significant relationship between the price of oil and Nigeria's economic growth. They came to the conclusion that OPV did not have any positive economic impacts.

Benramdane (2017) examined how OPV affected Algeria's economic growth using annual data spanning the years 1970 to 2012. The results demonstrated that the negative effects of OPV outnumbered the positive effects of the oil boom.

The majority of studies conducted in Nigeria on the effects of oil price shocks on the economy have consequently implicitly assumed that fluctuations in oil prices are symmetrical rather than explicitly testing for asymmetry (see Nwanna & Eyedayi, 2016; Akinlo & Apanisile, 2015 and Oriakhi & Iyoha, 2013). This study fills the gap in the body of knowledge.

METHODOLOGY

Research Design

In this study, a longitudinal research strategy was used. A longitudinal research design entails the measurement of a single topic or research unit across a predetermined number of observations spread over the study period. Time series data collected on a particular topic may be analysed using longitudinal study methodology. It considers the potential correlation between observations made over time (Velicer & Fava, 2003).

Method of data collection and Sources

The data used in this study are secondary data since they are time series data. It was taken from World Bank Statistics and the Statistical Bulletins of the Central Bank of Nigeria (CBN) (many editions). The information spans the years 1981 through 2022. This time frame is deemed sufficient for the analysis and includes instances of dramatic declines in the price of crude oil on a worldwide scale, such as the 60% drop in the price of Nigerian crude Bonny Light between 2014 and 2016. The sample period also included instances when the price of oil increased, such in 2017.

Model Specification

Nelson (1991) created the EGARCH model, which was used in the study to achieve its goal. Karimo and Tobi (2013) examined the connection between Nigeria's macroeconomic unpredictability and the volatility of foreign portfolio investments using this model. In addition to capturing data asymmetries, the model explains why the conditional variance is always positive. The following average equation may be derived from the fact that y_t always follows an autoregressive process of order k:

$$y_t = \beta_0 + \sum_{i=1}^{k} \beta_i y_{t-i} + \varepsilon_t \quad . \quad . \quad . \quad (3.1)$$

Where y_t is crude oil prices (OILP) at time t. β_s are the coefficents, while ε_t is the error term, which is independently distributed with zero mean and a constant variance. The model in its complete form will have the following variance equation in addition to (3.1)

$$log\sigma_t^2 = \varphi + \sum_{i=1}^{q} \alpha_i log\sigma_{t-i}^2 + \sum_{i=1}^{p} \beta_i \left|\frac{\varepsilon_{t-i}}{\sigma_{t-i}}\right| + \sum_{k=1}^{r} \gamma_k \left(\frac{\varepsilon_{t-k}}{\sigma_{t-k}}\right) \quad . \quad . \quad . \quad (3.2)$$

On the left side of 3.2, the log of the conditional variance of the price of crude oil. The logarithmic variant of the EGARCH (p, q) model validates the non-negativity of the conditional variance without the need to limit the coefficients of the model. The word "t-i/t-i" is attached to reflect the asymmetric impact of positive and negative shocks (knowledge regarding sudden spike or decrease in oil prices). T-i/t-I is positive if k> 0 (0) volatility, which tends to increase or decrease in response to the lagged standardised shock, is present (negative). ,i=1-q-,-i gives the presence of volatility to the conditional variance.

This study could consider a special case EGARCH (1.1) model as follows:

$$log\sigma_t^2 = \varphi + \alpha log\sigma_{t-1}^2 + \beta \left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \quad . \quad . \quad . \quad (3.3)$$

For a positive shock, $\varepsilon_{t-1}/\sigma_{t-1}>0$ eqn. (3.3) becomes:

$$log\sigma_t^2 = \varphi + \alpha log\sigma_{t-1}^2 + (\beta + \gamma)\frac{\varepsilon_{t-1}}{\sigma_{t-1}} \quad . \quad . \quad . \quad (3.4)$$

and for negative shocks, $\varepsilon_{t-1}/\sigma_{t-1}<0$ it becomes:

$$log\sigma_t^2 = \varphi + \alpha log\sigma_{t-1}^2 + (\beta - \gamma)\frac{\varepsilon_{t-1}}{\sigma_{t-1}} \quad . \quad . \quad . \quad (3.5)$$

Therefore, the existence of a leverage effect can be tested by the hypothesis $\gamma=0$. There is an asymmetric if $\gamma\neq0$. In addition, the parameter α governs the existence of volatility (oil price shocks) for the EGARCH (1.1) model.

RESULTS AND DISCUSSION

The EGARCH model was estimated in order to get the oil price shocks and the asymmetry of shocks in Nigerian crude oil price in accordance with the goal of this study. The level form and differenced series of oil price were shown, albeit, prior to the model's estimation and analyzing the empirical distribution of oil price graph. Graphs of the data are shown in Figure 4.1. The oil price's level shape revealed a varying tendency. The price movements of the different series of oil are unpredictable and swift, and they might be defined as volatile (shocks). The researcher can quantify the influence of any shock on the variance by looking at how volatility varies over time in addition to evidence of clustering in oil price volatility. This is because a large shock is followed by a larger shock and a small shock is followed by a smaller shock, and so on. For instance, the price of crude oil fluctuated between relatively calm and crazy times (high volatility). As seen in the first quarter of 2010 till 2017 (Panel (b) Figure 4.1), the oil price experienced times of significant volatility (shocks) after being generally peaceful or sedate from the first quarter of 2000 to the last quarter of 2009.

Figure 4.1: Oil price level, Changes and Empirical Distribution.

Oil price series are not leptokurtic, as shown by the graph in the panel displaying their empirical distribution (c). The histogram's centre has a low peak, and the tail is comparatively light in comparison to the normal distribution, indicating that the series has an excessively high number of observations outside the average's range and a

significant number of observations outside the average.

The series are deemed suitable for ARCH modelling due to the oil price's periods of considerable volatility and times of comparatively calm behaviour. Despite the fact that the ARCH family of models have frequently targeted the oil price, this study fits a constant-only model using OLS and tests the ARCH impact on the oil price using Engle's Lagrange multiplier test. This is done to ensure that the EGARCH model fits the (oil price) data appropriately. Table 4.2 displays the outcome.

Table 4.2: Result of Engle's Lagrange multiplier test for ARCH effect in Oil Price

Table 4.2.: Result of a constant-only model by OLS used to test for ARCH effect				
D.LogOILP	Coefficient	Standard Error	t	P
Constant	3.9049	0.0416	93.90	0.000
LM test for autoregressive conditional heteroskedasticity (ARCH)				
chi2	128.797			
Prob.	0.0000			
Lags	2			
The lag length of 2 was empirically determined using the Akaike's final Prediction Error (FPE), and Akaike's information criterions				

Source: Author's computation

The p-value for the Engle's LM test was 0.0000, which is significantly below the threshold of 0.05. The null hypothesis that there are no ARCH effects at the 5 percent level is categorically rejected since the p.value < the 5 percent critical threshold. The price of oil has an ARCH influence as a result. Due to the proven ARCH effect, the EGARCH model was calculated, with the results displayed in Table 4.3. The outcome provided a tenuous proof of the leverage effect. The impact of a "negative shock" creates a bigger loss in returns compared to the profits from a "positive shock," according to the leverage effect. The outcomes also provided significant evidence for an unequal impact.

Table 4.3: Result of the EGARCH model

	Coefficient	OPG Standard Error	z-value	p-value
LogOILP				
Constant	3.5277	0.0118	298.83	0.000
ARCH				
earch(L2)	0.1452	0.2804	0.52	0.605
earch_a(L2)	1.8276	0.4031	4.53	0.000
egarch (L2)	0.8099	0.1019	7.95	0.000
Constant	-0.5873	0.3175	-1.85	0.064
The lag length was empirically determined using the Akaike's final Prediction Error (FPE), and Akaike's information criterions				

Source: Author's computation

Positive innovations, such as the unexpected rise in the price of crude oil, are more profitable than negative ones because of the positive EARCH (L2) coefficient (unanticipated decrease in the price of crude oil). The asymmetric oil price shocks, on the other hand, were discovered to have a positive coefficient of 1.8276 and a t-value of 4.53. The null hypothesis that Nigeria has not experienced any asymmetries in oil price shocks is categorically rejected since the t-value of 4.53 is significant at the 5% level. The null hypothesis rejection contains an insignificant mistake, which is further supported by the substantial probability value (0.000). As a result, Nigeria has experienced asymetrical oil price shocks. The positive asymmetry coefficient (1.8276) specifically indicates that there is a propensity for crude oil price shocks to be around 1.83 percentage points larger in decreasing oil prices than in increasing oil prices. The leverage impact is minor (0.1452, with a negligible t-value), and it is far lower than the asymmetry of crude oil price shocks, as can be seen when comparing the two (1.8276). The relative scales of the two coefficients specifically shown that the positive leverage is totally dominated by the asymmetric oil price shock.

When a GARCH model was applied to the price of crude oil, the EGARCH asymmetry coefficient result (0.8099) revealed the reverse of what was anticipated. The L2 coefficient of 0.809, in particular, indicates a dropping oil price with a favourable crude oil price shock. That is, lower oil prices cause more negative shocks than higher prices by the same amount.

The Oil Price Shocks”

We created the conditional variance of crude oil prices, which is plotted in Figure 4.2, in order to capture the shocks in the price of crude oil.

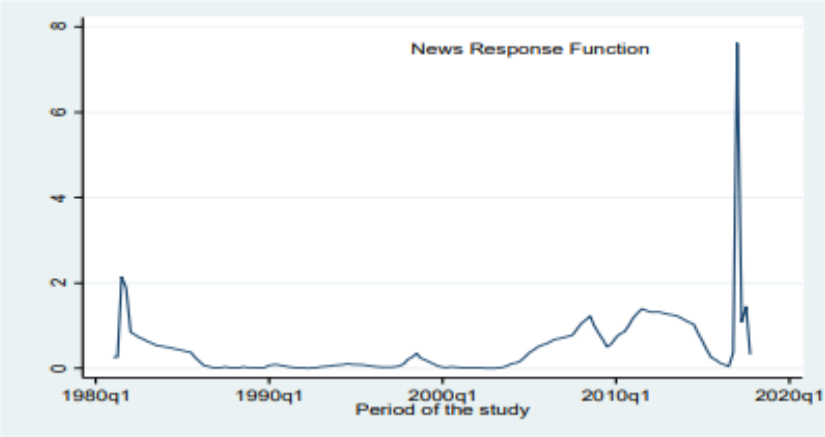

Figure 4.2: Conditional variance (Crude oil price shocks)

The results demonstrated that the pattern of the reaction to news regarding the function of crude oil price did, in fact, depend on positive asymmetry. The answer varies in accordance with good news regarding the price of crude oil. Between the first quarter of 1981 and the fourth quarter of 1983, crude oil prices were significantly more erratic, and from the first quarter of 1985 through 2003, they were quite stable. The early part of 2017 through the end of 2017 also saw significantly more erratic crude oil prices.

CONCLUSION AND RECOMMENDATIONS

This investigation comes to the conclusion that there is significant evidence for an asymmetric effect in respect to the study's goal. On the crude oil market, it was shown that shocks to oil prices tended to be 1.83 percent larger when prices were falling than when they were rising. Positive leverage is totally dominated by the asymmetric oil price shocks. Therefore, it is advised that policies for export promotion and diversification be put in place to guarantee that exports are diversified in order to lessen reliance on crude oil exports as the primary export (and source of income) in the economy. This will lessen the effects of crude oil price shocks, particularly from an unexpected drop in prices on the global market.

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