The Crude Oil Price Shock and its Conditional Volatility: The Case of Nigeria

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Abstract

The impact of the Nigerian crude oil price shock and its conditional volatility was tested in this paper by employing exponential Generalized Autoregressive conditional Heteroscedasticity (EGARCH) model. The result shows that negative shock significantly influences the future price of oil while the positive shock has insignificant influence on the future price of oil. The result agreed with the a priori expectations. The result suggests urgent need to stabilize the price of crude oil, and also concludes that oil price volatility contributes significantly to poor economic management since the revenue is based on oil price that is frequently fluctuating.

1. Introduction

The advent of oil boom has led to a decline in the contribution of the non-oil sectors in most of the oil exporting countries, a phenomenon referred to as the 'Dutch-Disease'. The world oil boom and bust is collectively known as the 'oil shock'. Starting in 1973, the world experienced an oil shock that rippled through Nigeria until the mid-1980s. The price of crude oil slumped in the world market during the first half of 1980s. The Nigeria's crude oil which sold at slightly above U.S$41 a barrel in early 1981, fell precipitously to less than U.S.$9 a barrel by August 1986 (Uwubanmen 2002). The price of oil fluctuated between $17 and $26 at different times in 2002, around $53 per barrel by October 2004, and around $89 per barrel in January 2008, and fell to around $54 in March the same year. In fact, the price of oil has witnessed noticeable fluctuations since the past three decades after the collapse of the Bretton Woods fixed exchange rate. The downturn in the oil prices after 1980 led to disastrous economic consequences in many oil exporting countries. There were large fiscal imbalances, poor export performance, high level of foreign balance of payment deficits, large and growing external debts, stagflation, large and rising unemployment and alarming deterioration of social and economic infrastructures (Jimenez and Sanchez 2003).

Petroleum production and export play a dominant role in Nigeria's economy and account for about 90% of her gross earnings. Thus, the economic activities in Nigeria react sharply to shocks emanating from crude oil price. The study equally, aims to determine the direction of the volatility of the crude oil price. The volatility of oil price has become one of the key determinants as well as one of the consequences of poor economic management in Nigeria (Needs 2005). It is therefore, the aim of this study to determine the impact of crude oil price shock and its conditional volatility in periods ahead.

This paper is organized as follows: Section 2 reviews related literature on oil price shocks, section 3 specifies the methodology, describes data set and sources of data, section 4 presents the estimation result and finally section 5 provides conclusions and policy implications.

2. Literature Review

Oil shocks are usually defined in terms of price fluctuations, but these may in turn emanate from changes in either the supply of or the demand for oil. In practice, it is unlikely for demand to grow rapidly enough to cause a price shock unless it is motivated by fears of supply shortages. Oil price shocks may of course be negative (a fall) or positive (a rise). There are at least, two important dimensions of a price shock. The first is the magnitude of the price increase, which may be measured in absolute terms or in percentage changes. The second aspect is one of timing: the speed and durability of price increases. Here, three cases may be identified: (i) a rapid (e.g. occurring within a few quarters) and sustained price increase (a 'break'), (ii) a rapid and temporary price hike (a 'spike') and (iii) a slower but sustained rise (a 'trend'). The speed of a shock is important as it affects the ability of economies to adjust, which is typically very restricted in the short run.(Wakeford,2006). Durability has obvious implications for the permanence and overall extent of the consequences.

Historically, there have been three eras in the determination of international crude oil prices. It was determined chiefly by multinational oil companies, until in 1970, the organization of petroleum Exporting countries (OPEC) asserted its capacity to influence the price of oil via its output decisions, and in late 1980s world oil prices were set by a market related pricing system which links oil prices to the 'market price' of a particular reference

crude (Farrel, Kahn and Visser 2001:69). But, the fundamental determinant of oil price is the demand/supply balance in the international market; each side of this market is in turn influenced by several factors. Over the long-term, the demand for oil is determined primarily by rates of economic growth in the major regions of the world, as well as by energy-related technological developments such as efficiency gains or new found uses for oil. For example, China's extra ordinary growth has had an increasingly significant effect on the world demand for oil, most notably in 2004. On the other hand, oil supply depends on the rates of extractions, depletion, and new discoveries, as well as developments in extractive technologies that allow enhanced recovery of oil. In the short-term, changes in OPEC production quotas and temporary supply disruptions due to technical or political factors or natural disasters can have important consequences for supply and hence oil prices. For instance, the conflict between Israel and Hezbellah exacerbated fears amongst oil traders in July/August 2006 (Wakeford 2006). As a consequence, the price of crude oil rose from around U.S$25 per barrel in 2003 to a high point of U.S$78 per barrel in July 2006 and about U.S$98 per barrel in January 2008, and fell to around U.S$54 in March the same year. This represents roughly four-times of oil price over four years which may be defined as a 'trend' oil price shock.

The use of time series data to study the velocity of oil price and how it determines its future changes and direction of its movement cannot be overemphasized. By knowing the nature and time-path of oil price, the policy makers and economic planners would be aided to make prompt policy adjustments. The study would equally contribute to literature by providing an expository study on the velocity of oil price and how it determines its future and direction of its movement.

3. Methodology

The method of the study is essentially econometric. We adopt, the Exponential Generalized Autoregressive Conditional Heteroscedasticity (EGARCH) model, which allows for asymmetric effect as specified.

$$\ln(h_t) = w + \alpha_1 Z_{t-1} \mp \gamma_1 \left(|Z_{t-1}| - E(|Z_{t-1}|)\right) + \beta \ln(h_{t-1}) \quad \ldots\ldots (1)$$

Where: $\ln h_t$ = the logarithm of conditional variance

Z_{t-1} = past shocks

w > O and α_1, γ_1 and β, are the parameters which have no restriction in order to ensure that h_{t-1} is non-negative (Engle 1982 and Bollerslev 1986)

Estimation Procedure

Equation (1) explains the relation between previous shocks and the logarithm of the conditional variance. In the model, there is no restriction on α_1, γ_1 and β_1 in order to ensure that the conditional variance (h_{t-1}) is non-negative. The properties of Z_t state that it has zero mean and is uncorrelated ie.

$$g(Z_t) \equiv \alpha_1 Z_t + \gamma_1 \left(|Z_t| - E(|Z_t|) \right) + \ldots\ldots (2)$$

The equation (2) is piece wise linear in Z_t and can be specified as:

$$g(Z_t) = (\alpha_1 + \gamma_1) Z_t / (Z_t > 0) + (\alpha_1 - \gamma_1) Z_t / (Z_t < 0) - \gamma_1 \left(E(|Z_{t-1}|) \right) + \ldots\ldots\ldots\ldots (3)$$

The negative shock impact on the log of conditional variance is $\alpha_1 - \gamma_1$ while that of positive shock is $\alpha_1 + \gamma_1$. We used News impact curve (NIC) to show how new information is incorporated into volatility. NIC shows the relationship between the current shocks, e_t and the conditional volatility of other periods ahead, h_{t-I}, holding constant all other past and current information. The asymmetric news impact curve (NIC) for the model is specified as:

$$\text{NIC}\left(e_t / h_t = \sigma^2\right) = \begin{cases} A\exp \dfrac{\alpha_1 + \gamma_1}{\sigma^* e_t} \text{ for } e_t > 0 \\ A\exp \dfrac{\alpha_1 - \gamma_1}{\sigma^* e_t} \text{ for } e_t < 0 \end{cases}$$

Where: $A = \sigma^2 \beta_1 \exp (w - \gamma_1 \left(2/\pi\right)^{1/2}$

The NICs are equal when e_t = O. It is pertinent to note that negative shocks in EGARCH model have larger effects on the conditional variance than positive shocks of the same size. In this case, as e_t increases, the impact on h_t becomes larger in the model.

Description of Data and Sources

We used quarterly data on international oil price for the period 1986 to 2008. The quarterly data were sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin and annual publications of the National Bureau of Statistics (NBS).

4. Empirical Result and Analysis

The estimation of the result is presented in table one below:

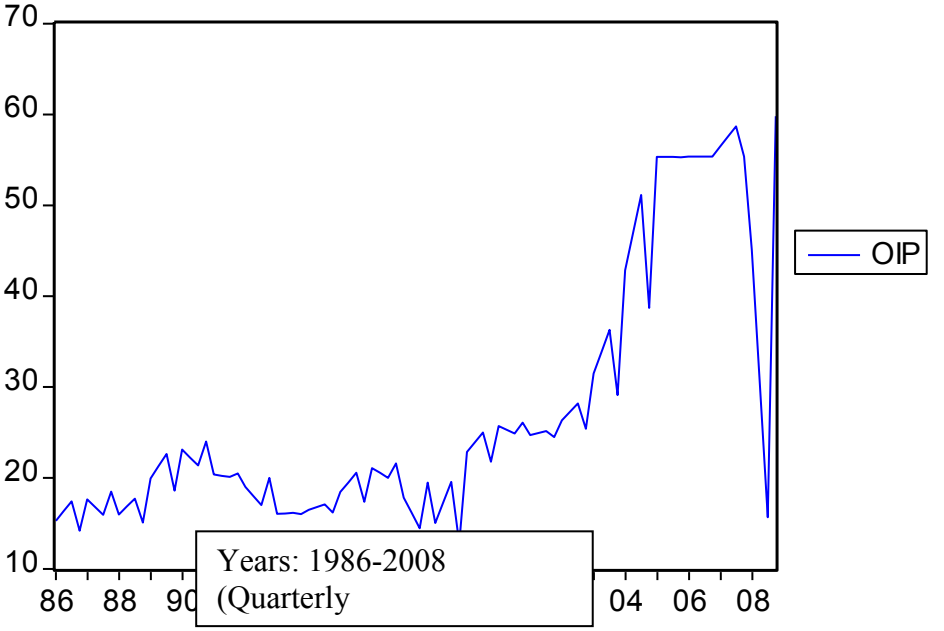
Table One: Variance Equation

Shocks	Coefficient	Std. Error	Z-statistic	Probability
C	0.267567	0.403905	0.662449	0.5077
$\lvert RES \rvert / SQR[GARCH](1)$	0.457670	0.192097	2.382493	0.0172
RES/SQR[GARCH] (1)	-0.470980	0.177542	-2.652780	0.0080
EGARCH (1)	0.603079	0.181042	3.331157	0.0009
EGARCH (2)	0.134982	0.177202	0.761741	0.4462

Source: Author's Estimation Using E-view Econometric Package.

The result of the negative shock in table one above shows that the coefficient of EGARCH was 0.603079 while the e_t of EGARCH was positively statistically significant with a Z-stalistic of 3.331157. The result shows that negative shock triggered off about 60% change in price. This agrees with the a priori expectation. The result of the positive shock in table one shows that the coefficient of EGARCH was 0.134982 while the e_t of EGARCH was positively statistically insignificant with a z-statistic of 0.761741. This shows that positive shock caused about 13% change in price. The positive shock has less effect on the conditional variance than negative shock of the same size. This equally agrees with the a priori expectation.

Figure One: Graph of oil Price



We equally presented the graph of oil price movement in Nigeria, from 1986 to 2008. The oil price exhibited an oscillation movement that showed generally a positive trend over the years. This is illustrated in figure one above.

5. Conclusion and policy implications

This paper has empirically attempted to investigate the shock of the Nigerian crude oil price and its conditional volatility in periods ahead by employing the Exponential Generalized Autoregressive Conditional Heteroscedasticity model, using quarterly data for the period 1986 to 2008. The result shows that negative shock significantly influences the price of crude oil while positive shock has insignificant influence on the crude oil price. The negative shock on the crude oil price triggers off expectation of future rise in the crude oil price thereby creating a positive response while the positive shock on the crude oil price creates a negative response. This shows that when the crude oil price falls, demand for crude oil increases at an increasing rate while when the crude oil price increases, demand for crude

oil decreases but at a decreasing rate. This calls for a stable positive increase in the international crude oil price. The study equally revealed a general upward movement of oil price over the years, though with many erratic up and down movements.

The result suggests that there is urgent need to stabilize the price of oil for better management of the economy. The economy needs to be diversified to avoid over reliance on the oil revenue as its shock produces serious ripple effect on the economy. Finally, we advocate for more research in this area.

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