Impact of Oil Price Volatility on Investment and Human Capital Development in Nigeria

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ABSTRACT
The study examined oil price (revenue) volatility effect on investment and human capital development (measured with gross school enrolment) in Nigeria, using quarterly time series data from World Bank's development indicator and Central Bank of Nigeria Statistical Bulletin 2013. EGARCH model was used to obtain the conditional variance of oil price (i.e., a measure of oil price volatility) which was employed in ordinary least square estimation. The model was also used to test for volatility persistence in oil price. ARCH test was conducted and discovery of ARCH effect justified the use of EGARCH model. From our results, the persistence effect was found large and significant; implying that volatility in oil price takes a long time to decay. Secondly, results from ordinary least square estimation revealed that oil price volatility has significant positive impact on investment in Nigeria. This implies that any sharp rise in oil price (revenue), stimulates investment through increase in government expenditure, say, on infrastructures, but the reverse happens for any sharp decline in oil price. The results also show that oil price volatility has significant negative impact on gross school enrolment in Nigeria. This indicates that high oil wealth caused by rise in oil price does not permeate the Nigeria education system. Summarily, these findings suggest that, diversification of the revenue base of the Nigerian economy is necessary in order to minimize the consequences of external shocks. Since variations in oil price, significantly influence the level of investment and school enrolment in Nigeria and considering the fact that volatility in oil price may not die out fast.
Keywords: Oil price volatility, Human capital development, Investment, EGARCH model

JEL Classification: O13, O15, E22, C22.

1. INTRODUCTION

Since the discovery of oil in commercial quantity; Nigeria has been a mono-product economy. The value of Nigeria's total export revenue in 2010 stood at US$70,579 million, while income from petroleum exports of the total export revenue was US$61,804 million, representing about 87.6%. The absolute dependence on oil export revenue has increased the level of Nigeria economy vulnerability to volatile oil price (Akpan, 2009). Volatility in oil price could either result to favourable or unfavourable terms of trade. Factors such as periods of high oil prices resulting from rise in demand and positive trading positions; enhance Nigeria's terms of trade. On the converse, low crude oil prices, occasioned by factors such as low demand or excess supply, cause the Nigerian economy to experience unfavourable terms of trade. Periods of high oil prices have generated huge amount of oil wealth to the Nigerian economy; irrespective of the huge oil wealth, the country has remained one of underdeveloped countries in the world (Englama *et al*., 2010).

For instance, Nigeria gained an average of US$390 billion in oil-related fiscal revenue between 1971 and 2005 (CBN, 2013). Unfortunately, the economy is still bedevilled with sustained underdevelopment, evidenced by poor physical and human capital development (Olusegun & Charlotte, 2009). Unstable investment environment, caused by improper management of oil wealth

and unstable oil revenue discourage investment activities (Hodo *et al*., 2013). Unstable oil revenue slow down investment, induces business firms to postpone investment decisions and distort the provision of infrastructural facilities. Poor infrastructural facilities (bad road network and unstable power supply) discourage investment through increase in cost of production. It affects small businesses and result to drastic fall in output (Guo & Kliesen, 2005). Decline in output and investment leads to unemployment and high rate of poverty in Nigeria. Large proportion of the population dwell in poverty. Oil wealth ought to have transformed into a considerable socio– economic development for the country, but Nigeria's basic social indicators place her as one of the 25 poorest countries in the world (Olusegun & Charlotte, 2009). The World Bank (2011) includes Nigeria in the list of top 15 places with the highest incidence of poverty, low literacy rate, school enrolment and life expectancy. The institution further stated that out of 162 million of her citizens, 90 million live below the poverty level of $2 per day, despite billions of dollars from oil revenue. This implies that successive governments have failed to use oil income effectively in solving the problems relating to poverty and development of human capital through the provision of education facilities (Baghebo, 2012).

Education facilities in Nigeria are in poor quality and do not reflect the huge amount of wealth which have been earned from the oil sector (Ishola *et al*., 2013). This view is in agreement with the position of Ude & Ikeagwu (2014) who recorded that government spending on human capital development in terms of education is generally low in Nigeria. Low expenditure on education results to continued decline in educational opportunities, education attainment and education standards in the country. They further noted that resource allocations to human capital development are not close to the United Nations Educational, Scientific and Cultural Organization's (UNESCO) recommended 26% of national budget to be spent on education in member countries, of which Nigeria is one. Ishola *et al.* (2013) recorded that the provision of adequate education services to the people through well managed resources is one of the major ways of improving the quality of human resources. Human and physical capital are not only fundamental to economic growth and development but are key determinants of economic performance both at micro and macro levels.

Disappointingly, reviewed empirical studies (Oriakhi & Iyoha, 2013; Mgbame *et al.*, 2015; Akinleye & Ekpo, 2013; Omisakin *et al*., 2009; Akpan, 2009; Edesiri, 2014; Gunu & Kilishi,
2010; Ani *et al.*, 2014; Alley *et al.*, 2014; Wilson *et al.*, 2014; ThankGod & Maxwell, 2013; Olomola, 2006; Ogundipe *et al.*, 2014; Aliyu, 2009; Ayadi, 2005; Nnanna & Masha, 2003) on oil price volatility effect in Nigeria and studies (Ibrahem, 2011; Atilla, 2013; Dogah, 2015; Rodríguez & Marcelo, 2004; Shahidan *et al.*, 2013; Ndungu, 2013; Katsuya, 2010; Rukmani & Bartleet, 2007; Guo, & Kliesen, 2005; Nagmi & Moftah, 2016; Shanaz & Sazan, 2016; Chang & Wong, 2003; Du *et al*., 2010; Elmi & Jahadi, 2011; Eltony & Al-Awadi, 2001; Jbir & Zouari-Ghorbel, 2009; Lorde *et al*., 2009; Bartolomeo *et al*., 2014; Tang *et al.*, 2010; Jin, 2008) abroad, have been centred mainly on economic growth and development. This implies that empirical investigations of such impact on investment and human capital development, especially as it relates to Nigeria are rare, to the best of our knowledge. The work of (Oluwatomisin & Adeyemi, 2010; Hodo *et al.*, 2013) examined oil price shock effect on only investment in Nigeria using Vector Autoregressive
Model and non-quarterly time series data, which have less frequency. This indicates that inquires on oil price volatility effect, using EGARCH Model and quarterly time series data are scarce. It is also not clear if there is persistence effect in oil price volatility in Nigeria. Hence, this paper contributes to knowledge by answering the following questions in the Nigeria setting: What is the impact of oil price (revenue) volatility on investment? What is the impact of oil price volatility on human capital development? What is the persistence effect in oil price volatility?

2. LITERATURE REVIEW

2.1. Theoretical Literature

The study is based on the following theories; **Dutch disease theory;** according to this theory, Dutch disease occurs when a country discovers a substantial natural resource deposit and begins a largescale exportation of it. As a result, the country's currency appreciates, thereby reducing the competitiveness of the country's traditional export sector (Mgbame *et al*., 2015). **Resource curse theory** refers to the paradox that countries with abundance of natural resources, tend to have less economic growth and worse development outcomes than countries with fewer natural resources (Adebiyi & Olomola, 2013). **Jorgenson's neoclassical theory of investment** explains that the rate of investment is determined by the speed with which firms adjust their capital stocks towards the desired level. It takes time to build and install new machines and construct new factories. Therefore, firms have to decide the rate per period it makes adjustment in their stock of capital to attain the desired level (Jhingan, 2003). **Profit theory of investment** regards profits as a source of internal funds for financing investment. The theory posits that investment depends on profits and profits, in turn, depends on income. Thus if total income and profits are high, the retained earnings are also high, this leads to large capital stock (Jhingan, 2003). **Human capital theory** views schooling and training as investment in skills and competences. It is argued that based on expectation of return on investment, individuals make decisions on education and training they receive as a way of augmenting their productivity. (Adelakun, 2011).

2.2. Empirical Literature

A number of studies (Oriakhi & Iyoha, 2013; Omisakin *et al.*, 2009; Akinleye & Ekpo, 2013; Madueme & Onyenkwere, 2010; Akpan, 2009; Gunu & Kilishi, 2010; Alley *et al.*, 2014; Ani *et al.*, 2014) in Nigeria have revealed positive outcomes using diverse methods (Vector Error Correction Model; Vector Autoregressive Model, Generalised Autoregressive Conditional Heteroscedasticity (GARCH) Model, Generalised Method of Momemt (GMM) and Ordinary Least Square Method (OLS) respectively) in the analysis of the relationship between oil price volatility and economic growth, while the study of Edesiri (2014) revealed negative outcome using the Vector Autoregressive Model (VAR). On the other hand, some foreign studies (Ahmad, 2015; shahidan *et al.*, 2013; Atilla, 2013; Dogah, 2015; Ndungu, 2013) have shown distinct results in the analysis of the relationship between oil price volatility and economic growth. For instance, Ahmad (2015) & Shahidan *et al.* (2013) employed Error Correction Model and found a positive result in Oman and Malaysia respectively while Atilla (2013); Ndungu (2013) & Dogah (2015) found negative results in Turkey, Kenya and Ghana respectively using VAR model.

In terms of the relationship between oil price volatility and investment, few studies (Hodo *et al.* 2013; Oluwatomisin & Adeyemi 2010) conducted in Nigeria have revealed different results. For example, Hodo *et al.* (2013) discovered that oil price volatility has negative significant impact on investment in Nigeria using VAR model while Oluwatomisin & Adeyemi (2010) found a positive result using the same method. In the foreign scene, Afshin *et al.* (2014) & Wiafe *et al.* (2014) used Generalized Method of Moment and Dynamic Ordinary Least Square Technique respectively. They found that oil price volatility has negative significant impact on investment in Ghana, while Adel (2016) employed Vector Autoregressive Model in his study of oil returns effect on government investment in Syria and found a positive result. Furthermore, there are few foreign studies (Ahmad, 2011; Anil, 2014) on the relationship between oil price volatility and human capital development, excluding (Adebiyi & Olomola, 2013) who studied oil wealth effect both home (Nigeria) and abroad (Norway), using the VAR model. They found that oil wealth has negative impact in Nigeria but positive impact in Norway. Ahmad (2011) discovered that oil revenue has positive significant impact on human capital (Education) in Saudi Arabia, using Ordinary Least Square Regression Technique. This result is similar to that of

Anil (2014) who found that oil boom periods is associated with increase in human capital development while the reverse is the case for periods of low oil prices in United States.

From the reviewed studies above, it is quite easy to infer that the relationship between oil price volatility, investment and human capital development has been less studied, especially as it relates to Nigerian economy. In other words, most of the literature in Nigeria concentrate on oil price volatility-economic growth nexus. It is also clear that studies on oil price volatility and investment differ both in method of analysis and agreement. For instance, some studies reported positive results while some others reported negative results. More so, it is not clear whether there is persistence effect in oil price volatility. Based on these outcomes, we contribute to knowledge by investigating the persistence effect in oil price and the impact of oil price volatility on investment and human capital development in Nigeria using quarterly time series data, Ordinary Least Square Method and
EGARCH Model.

3. METHODOLOGY

3.1. Theoretical Framework

The framework for this study is the education production function and accelerator theory of investment. Education production function was used to measure the impact of oil price (revenue) volatility on education status in Nigeria while the accelerator theory of investment was applied in measuring the impact of oil price volatility on investment in Nigeria. Education production function refers to the application of the concept of economic production function to the field of education. It relates various education inputs (i.e., schools, families, peers and income) to education output (e.g., enrolment rate) (Checchi, 2006). In utilizing this production function, the study adopted gross school enrolment as the index for education status and oil price as a proxy for income; following Asaolu & Ilo (2012) who recorded that the Nigeria income is mainly derived from oil revenue, which depends on oil price movements. On the other hand, the acceleration theory of investment states that when income rises, investment will rise by a multiple amount. The accelerator is the numerical value of the relation between the rise in investment resulting from an increase in income (Jhingan, 2003). In the use of the acceleration theory of investment, the study adopted the gross capital formation as the index for investment; and oil price as a proxy for income. Hence, in order to have a specification that is consistent with literature and allows for the identification of the channels through which oil price (revenue) volatility affect investment and education over time; multiple regression models are built and presented in the next sub-section. The choice of the variables selected is based on literature.

3.2. Model Specification

Model one, representing acceleration investment function is explicitly specified in a log form as follows:

$$\log GCF = \beta_0 + \beta_1 OPV + \beta_2 ITR + \beta_3 \log CEX + \mu \quad \text{.....3.2.1}$$

Where; logGCF = log of Gross Capital Formation (Investment)

OPV = Conditional Variance Measure of Oil Price Volatility ITR =

Interest Rate (i.e., Lending Rate) logCEX = log of Total Federal

Government Capital Expenditure

Model two, representing education production function is explicitly specified in a log form as follows:

$$\log GSE = \beta_0 + \beta_1 OPV + \beta_2 \log EEX + \beta_3 \log GDP + \mu \quad \text{.....3.2.2}$$

Where; logGSE = log of Gross School Enrolment logEEX = log of

Total Federal Government Education Expenditure logGDP = log of

Gross Domestic Product

3.3 Method of Estimation

The study employed a step by step estimation approach. First, the variables were tested for unit root. Second, Exponential Generalised Autoregressive Conditional Heteroskedasticity (EGARCH) Model was used to generate oil price volatility series. The generated series were used in Ordinary Least Square (OLS) estimation. The choice of OLS in this study is guided by the fact that its computational procedure is simple and estimates obtained from this procedure has optimal properties such as linearity, unbiasedness and minimum variance (Gujarati & Porter, 2009). EGARCH Model was also employed in determining the persistence effect in oil price volatility. According to Alexander (2009), EGARCH Model has been demonstrated by many studies to be superior compared to other competing asymmetric conditional variance models such as GARCH and ARCH Models. EGARCH (p, q) Model is specified as;

$$\log(\sigma_t^2) = \omega + \sum_{j=1}^{q} \beta_j \log\left(\sigma_{t-j}^2\right) + \sum_{i=1}^{p} \alpha_i \left|\frac{\mu_{t-1}}{\sigma_{t-1}}\right| + \sum_{k=1}^{r} \lambda_k \frac{\mu_{t-k}}{\sigma_{t-k}} \quad \text{... ... ... 3.3.1}$$

Where σ_t^2 is the conditional variance of the oil price, ω, β, α, and λ are parameter estimates. β measures the persistence in conditional volatility. When β is relatively large, volatility takes a long time to die out. μ_{t-1} and μ_{t-k} are the residuals which are measures of information about volatility in the previous period.σ_{t-j}^2 is the GARCH term representing the last period's forecast variance. Predicted values of log ($_t^2$) are applied as an estimate of oil price volatility (Alexander, 2009).

3.4. Data Sources

The data used in this study are quarterly time series data ranging from 1981Q1 to 2013Q4. They were sourced from the Central Bank of Nigeria Statistical Bulletin (2013) and the World Bank's development indicator (2013).

4. RESULTS AND DISCUSSIONS ON FINDINGS

The tables below show results of the study; followed by discussions on findings.

Table 1: Adf Test for Unit Root

Variable	**ADF Test Stat at level**	**5% Critical Value**	**ADF Test Stat at 1st difference**	**5% Critical Value**	**Order of Integration**
log(GCF)	-0.115475	-2.883579	-10.19678	-2.883753	Stationary at first difference I(1)
OPV	-2.952291	-2.883579	-12.89050	-2.883753	Stationary at first difference I(1)
ITR	-3.327284	-2.883753	-6.209878	-2.884109	Stationary at first difference I(1)
log(CEX)	-0.952237	-2.883753	-6.594905	-2.883753	Stationary at first difference I(1)
log(GSE)	-1.905230	-2.883753	-4.397681	-2.883753	Stationary at first difference I(1)
log(EEX)	-0.972226	-2.883753	-8.904768	-2.883753	Stationary at first difference I(1)
log(GDP)	-2.519088	-2.883753	-10.39213	-2.883753	Stationary at first difference I(1)

Table 2: The Regression Results for Model One

Dependent Variable = log(GCF)				
Variables	**Coefficients**	**Std. Error**	**T-statistics**	**Probability**
C	-0.106165	0.315425	-0.336577	0.7370
OPV	0.204226	0.082208	2.484248	0.0143
ITR	-0.000961	0.010380	-0.092611	0.9264
log(CEX)	1.073230	0.034937	30.71873	0.0000
Diagnostic Tests				
ARCH Test	Obs* R-squared	Prob value	Conclusion	
	14.40211	0.1554	Statistically Insignificant	
Serial Correlation Test	Obs* R-squared	Prob value	Conclusion	
	1.677010	0.4324	Statistically Insignificant	
Heteroscedasticity Test	Obs* R-squared	Prob value	Conclusion	
	4.912258	0.1783	Statistically Insignificant	
R-squared = 0.909306		Adjusted R-Squared = 0.907180		
Durbin Watson Stat = 0.113119				
F-Statistic = 427.7794		Prob(F-Statiistics) = 0.000000		

Table 3: Regression Results for Model Two

Dependent Variable = log(GSE)				
Variables	**Coefficients**	**Std. Error**	**T-statistics**	**Probability**
C	0.840161	3.034674	0.276854	0.7823
OPV	-0.176907	0.077713	-2.276414	0.0245
log(EEX)	0.864751	0.060212	14.36189	0.0000
log(GDP)	0.309979	0.277126	1.118546	0.2654
Diagnostic Tests				
ARCH Test	Obs* R-squared	Prob value	Conclusion	
	14.76641	0.1408	Statistically Insignificant	
Serial Correlation Test	Obs* R-squared	Prob value	Conclusion	
	0.000000	1.0000	Statistically Insignificant	
Heteroscedasticity Test	Obs* R-squared	Prob value	Conclusion	
	1.682561	0.6408	Statistically Insignificant	
R-squared = 0.952963		Adjusted R-Squared = 0.951861		
Durbin Watson Stat = 0.244619				
F-Statistic = 864.4297		Prob(F-Statiistics) = 0.000000		

Table 1 above display the unit root test for all the variables. Augmented Dickey-Fuller (ADF) was used to test for unit root in individual variable. The results show that at 5% critical value, all the variables are stationary at first difference. The unit root test was followed by a cointegration test. The cointegration test was conducted by estimating a normal equation, generating the residual and then testing for stationarity of the residual. We found that the ADF test statistics for the two models (-9.944306 and -13.16255) are greater than their corresponding 5% critical values (-2.884477 and -2.883930) in absolute terms. This implies that the residuals are stationary, leading us to conclude that the variables have a long run relationship. This will prevent the generation of spurious regression results. Table 2 and 3 show the regression results. Here, the t–test was applied to determine the statistical reliability of the estimated parameters. We employed 5% level of significance. The results of the t-test were evaluated based on the probability value of calculated tstatistic for each variable of interest. From the results in table 2, we found that oil price volatility has significant positive impact on level of investment in Nigeria; judging from the fact that the probability value is less than 5%, and that the coefficient of oil price volatility measure is positive (i.e., 0.204226). This implies that a 1% increase in oil price, increases investment level by 0.204226. This outcome is in agreement with the results of (Adel, 2016; Olawatomisin & Adeyemi, 2010), who also found positive outcomes in their study. Put differently, any sharp rise in oil price, increases government revenue. As a result, government is enabled to spend more money, say in construction of roads and bridges. These infrastructures help to stimulate investment. Conversely, a sharp decline in oil prices brings down the level of investment. From the results in Table 3, we found that oil price volatility has significant negative impact on school enrolment in Nigeria; judging from the fact that the probability value is less than 5%, and that the coefficient of oil price volatility measure is negative (i.e., -0.176907). This implies that a 1% increase in oil price reduces school enrolment level by 0.176907. This result is in contrast with the outcomes of (Adebiyi & Olomola, 2013; Ahmad, 2011), who found positive results in their study. Intuitively, the Nigerian government does not spend enough money in the education system, even in periods of high oil wealth. Since, increase in oil wealth brings down the education system. More so, we found that the persistence effect is large (2.302047 i.e., greater than one) and significant. The conclusion is that volatility in oil price takes a long time to die out. Table 2 and 3 also display the serial correlation test

for the two models; the probability values of obs*R^2 for the two models are greater than their corresponding 5% critical values. This suggests that there is no serial correlation in both models. For heteroscedasticity test. The probability values of $n \cdot R^2$ for the two models are greater than their corresponding 5% critical values; implying that, there is no heteroscedasticity in model one and two. For ARCH test, we also failed to reject the null hypothesis for the two models. Finally, table 2 and 3 show that the R-squared for the two models are sufficiently large (i.e., 0.90 and 0.95). This means that these models have good fit.

5. CONCLUSION AND RECOMMENDATION

The study evaluated the impact of oil price volatility on investment and human capital development in Nigeria using EGARCH model and ordinary least square method. The results show that changes in level of investment can be attributable to volatility in oil price. On the other hand, education status (gross school enrolment) in Nigeria is negatively affected by oil price volatility. In line with the above findings, we recommend that government should pursue policies of diversification; through investment in other sectors (e.g., industrial and agricultural sectors) of the economy. Investment in these sectors will help to increase the production of exportable goods. More foreign exchange can be earned from exporting these goods. This will reduce heavy dependence on oil revenue. There is the need for government to spend more money in the provision of infrastructures (e.g., transport facilities and stable power supply). This will help to encourage private businessmen to invest more resources in the economy through reduction in the cost of doing business. Again, government should increase expenditure in education sector, through the provision of school infrastructures such as buildings and laboratories. This will help to reduce the cost of schooling in the country.

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