

Impact of Crude Oil Price Volatility on the Cost of Living in Nigeria

Attamah Nicholas and Okolo Chimaobi Valentine

Department of Economics Enugu State University of Science and Technology

numanick@esut.edu.ng; chimaobi.okolo@gmail.com; valentine.okolo@esut.edu.ng

Abstract

The study investigated the impact of crude oil price volatility on the cost of living in Nigeria. Generalized autoregressive conditional heteroscedasticity was employed to measure the influence of crude oil price volatility on the fluctuating price level of consumables in Nigeria. Crude oil price positively and significantly impacted on consumer price index in Nigeria as its volatility impacted on the price level fluctuation. Previous period's volatility of the consumer price index and information of the volatility of its previous volatility influenced current volatility significantly. Therefore Nigerian government should grow the external reserve by increasing export, and saving more of their excess net income. Government should also consider reducing cost of production and in turn the price of crude oil in order to attract increased demand for it and therewith increased earnings.

Keywords: Consumer price index, cost of living, crude oil price, volatility.

Introduction

From the period of the oil boom of the 1970s till now, Nigeria has neglected her strong agriculture and light manufacturing bases in favor of unhealthy dependence on crude oil [1,2]. He added that new oil wealth has led to a concurrent decline of other sectors in the economy and has fueled massive migration to cities and led to increasingly wide spread poverty especially in rural areas. [3,4] argued that Nigeria's job market has witnessed very high degree of unemployment, small wage and pitiable working environments. Between 1970 to 2000, Nigeria's poverty rate increased from 36 percent to just fewer than 70 percent and it is believed that oil revenue did not seem to add to the standard of living at this time but actually caused it to decline [5,6].

Prices of goods and services in Nigeria has risen in recent times, particularly due to the depreciation of the Naira vis-à-vis the USD. A number of factors can be attributed to this occurrence, such as the sharp drop in oil price and the nation's dependence on the import of consumables. The volatility of crude oil price, particularly, the decline in price reduced the income earning of Nigeria and further depreciated the Naira vis-à-vis the USD. The consequence of this depreciation is the rise in the cost of importation, which increased the price level and the cost of living in Nigeria. Where consumers turned to local production, particularly food, clothing and other locally produced goods, the price of these products rose fast due to the astounding increase in demand over supply [7,8].

The run up in oil prices was motivated initially by demand driven tightening of market balances; but later has been further fuelled by a combination of supply concerns and financial factors. Market tightening is expected to persist because of a sluggish supply response [9,10]. According to them, many Nigerians believed that the nation should be free from any negative oil price shocks. However, the reality is a far cry from this expectation. Only few households seem to benefit from the oil windfall while others are subjected to further deprivation, higher food prices, higher transport costs

and higher energy costs. The study is therefore motivated by the need to evaluate the extent to which crude oil price volatility translate to the price level in Nigeria and its contribution to the cost of living in Nigeria.

Literature Review

[11], examined the effects of oil price shocks on exchange rate volatility in Nigeria using generalized autoregressive conditional heteroscedasticity models and found out that real exchange rate fluctuation in Nigeria is significantly influenced by oil price fluctuations and a strong positive correlation between exchange rate return and future oil price volatility. [12], study of macroeconomic implications of symmetric and asymmetric oil price and oil revenue shocks in Nigeria, evidenced that both positive and negative oil price shocks influence real government expenditure only in the long run. Positive shocks to oil revenue stimulate expansionary fiscal posture in the Nigerian economy in the short run, thereby causing a rise in inflation the depreciation of the Nigerian Naira [9]. [4], therefore recommended that any policy to address the issue of exchange rate fluctuations in Nigeria should concentrate on oil price fluctuation of the variables as this will help to enhance the real exchange rate in Nigeria.

[2], queried the oil price-exchange rate linkage in Nigeria and found that an increase in the price of oil culminates in an appreciation of the Nigerian currency against the US dollar. [7], examined the consequences of oil price volatility on the growth of the Nigerian economy within the period 1970 to 2010. Using quarterly data and employing the VAR methodology, [11] revealed that oil price volatility impacted directly on real government expenditure, real exchange rate and real import, implying that oil price changes determine government expenditure level, which in turn determines the growth of the Nigerian economy. In a bid to empirically justify the determinants of inflation in the case of Nigeria, [9] employed time series econometric technique, particularly, Error Correction Model and found that there is significant autoregressive effect on inflation, while imported inflation, income level, exchange rate and interest rate were found not to be significant in the short run and long run, explaining the immediate response of prices to policy changes.

[1], on the other hand, re-examined the co-movement and the causality relationship between international oil price fluctuations and domestic food price inflation in Nigeria, providing clear evidence in support of a causal relationship between oil price distortions and food price instability in Nigeria. The Granger causality test showed that causality runs from international oil price to domestic food price, showing that volatility of international oil price significantly causes the unpredictability or otherwise of domestic food price [3]. Following the reviewed literature, this study therefore sought to re-evaluate the influence of crude oil price volatility on the cost of living in Nigeria.

Methodology

The framework for determinants of inflation (dependent variable) is based on the Structuralism and internationalism theory of inflation. According to [5], the inelasticity in the structures of the economy - mostly developing economies - is the main drive of inflation based on this theory. Generalized Autoregressive conditional heteroscedasticity (GARCH) was used to test the hypothesis of the study.

In line with [4], adopting structuralism and internationalism theory of inflation, consumer price index (CPI) will be modeled as a function of oil price volatility, official and parallel exchange rates in Nigeria.

The models therefore are:

$$1. \text{ CPI} = f(\text{OP}, \text{OER}, \text{PER}) \quad (1)$$

Mean equation: Adopting partial logarithm (log of dependent variable);

$$\text{LNCPI} = b_0 + b_1\text{OP} + b_2\text{OER} + b_3\text{PER} + \mu \quad (2)$$

Variance equation:

$$\mu = b_0 + b_1\mu_{t-1} + b_2\mu_{t-1}^2 + OPV \tag{3}$$

Where,

- OP = Oil Price
- OPV = Oil Price Volatility
- OER = Official Exchange rate
- PER = Parallel Exchange rate
- LNCPI = log of Consumer Price Index
- μ = error term/residual/volatility of price level
- μ_{t-1}^2 = Previous periods volatility of price level
- μ_{t-1} = Previous period's information about the volatility of price level.

On the other hand, in order to determine the oil price index, as stated in the theoretical frame work, a GARCH model will be developed thus;

$$OP = f(OPROD) \tag{4}$$

Mean equation:

$$OP = b_0 + b_1OPROD + \mu \tag{5}$$

Variance equation:

$$\mu = b_0 + b_1\mu_{t-1} + b_2\mu_{t-1}^2 \tag{6}$$

Where,

- OP = Oil Price
- OPROD = Per Capita Income
- μ = error term/residual/volatility of oil price (OPV)
- μ_{t-1}^2 = Previous periods volatility of oil price
- μ_{t-1} = Previous period's information about the volatility of price level in Nigeria.

However, here we are only interested in the getting the time series data of the volatility of the dependent variable (oil price), we'll focus on the dependent variable of the variance equation or the residual of the mean equation (μ) in order to use it as a time series independent variable in the first model (OPV).

Discussion

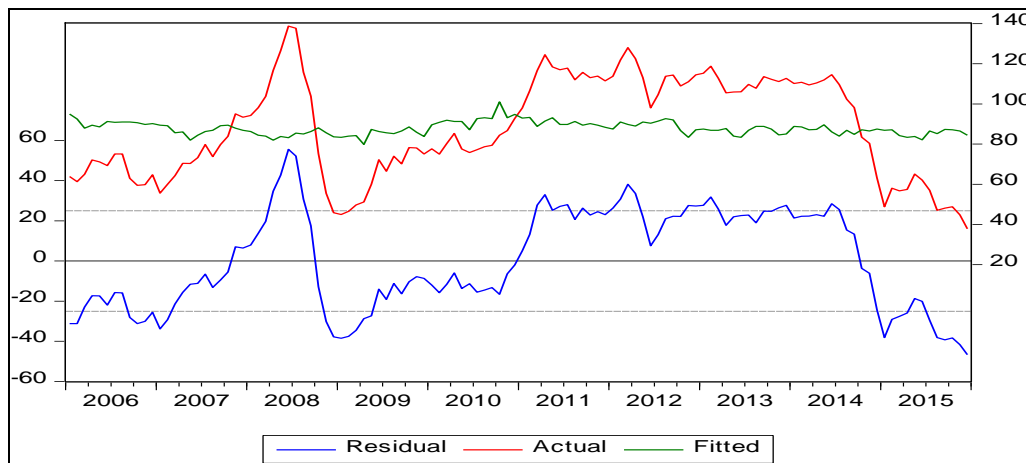
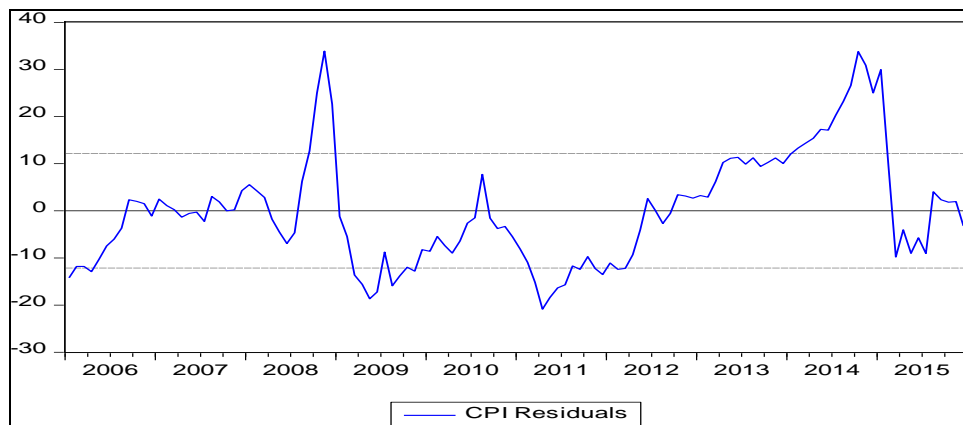
Unit Root Test

Augmented Dickey Fuller (ADF) Test

Variable	ADF Test Statistics	5% Critical Value	Order of Integration
CPI	-13.85354	-3.448348	I(1)
OP	-7.154239	-3.448348	I(1)
OPROD	-14.38547	-3.448348	I(1)
OER	-7.396035	-3.448348	I(1)
PER	-8.373446	-3.448348	I(1)
OPV	-8.190635	-3.448021	I(0)

Source: author's computation using e-views 9 software

The Augmented Dickey test for stationarity at 5% level of significance showed that there is unit root problem in the variables as they were not stationary at level form. Other than the oil price volatility variable, the other variables became stationary at the first order of integration. This implies that the variables cannot be relied upon for time series regression; given that one of the conditions of time series regression is that the variables must be stationary. In view of the result, a cointegration test was done and the result showed that in model 1, there is a cointegrating equation. However, in the second model, determining the volatility of crude oil price, there is no long run relationship. Therefore, an error correction mechanism of the GARCH was adopted for the model determining the fluctuation of price level in Nigeria as a function of oil price volatility and exchange rates. For the second model, determining oil price volatility, the usual generalized autoregressive conditional heteroscedasticity (GARCH) will be conducted with the variables at first order of integration.



Source: authors' computation using e-views 9

Proving that the residual of the models were conditionally heteroscedastic and supporting the use of GARCH, the residual graphs shows that there were periods of constant variance along the zero margin and periods of trend movement from the zero margin. Periods of low volatility were followed by periods of low volatility and periods of high volatility were followed by periods of high volatility.

Determining the Volatility of Crude Oil Price

Dependent Variable: D(OP)				
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)				
Date: 11/23/16 Time: 17:40				
Sample (adjusted): 2006M02 2015M12				
Included observations: 119 after adjustments				
Convergence achieved after 22 iterations				
Coefficient covariance computed using outer product of gradients				
Presample variance: backcast (parameter = 0.7)				
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.296542	0.559425	0.530083	0.5961
D(OPROD)	4.74E-06	3.86E-06	1.226425	0.2200
Variance Equation				
C	7.688945	4.373926	1.757905	0.0788
RESID(-1)^2	0.566955	0.262603	2.158979	0.0309
GARCH(-1)	0.380255	0.160161	2.374206	0.0176
R-squared	-0.003214	Mean dependent var		-0.218908
Adjusted R-squared	-0.011788	S.D. dependent var		7.165804
S.E. of regression	7.207917	Akaike info criterion		6.605644
Sum squared resid	6078.626	Schwarz criterion		6.722414
Log likelihood	-388.0358	Hannan-Quinn criter.		6.653061
Durbin-Watson stat	1.184478			

Source: authors' computation using e-views 9.5 software

The result of the GARCH conducted at 5% level of significance showed that oil production, which proxied the cost of all factor input, did not significantly determine oil price ($0.2200 > 0.05$), although its contribution to oil price was positive. This followed the *s priori* expectation that increase in the cost of producing crude oil will increase its price. However, previous month's volatility [GARCH (-1)] and information of previous month's volatility [RESID (-1)²] significantly impacted on the current volatility of crude oil price ($0.0176 < 0.05$ and $0.0309 < 0.05$ respectively). Having confirmed using the supply theory of price determination, that oil production (cost of factor input in production) positively but insignificantly impacted on crude oil price, the result revealed that the volatility of oil price is influenced by previous period's volatility and information of the volatility of previous period. We therefore extract the oil price volatility (OPV) data and introduce it in the model 1. Heteroscedasticity was not found in the model as the probability of F-statistics and prob. chi-square of Observed R-square were greater than 5%.

Oil Price Volatility and Cost of Living in Nigeria

Dependent Variable: D(CPI)				
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)				
Date: 11/24/16 Time: 11:05				
Sample (adjusted): 2006M02 2015M12				
Included observations: 119 after adjustments				
Failure to improve likelihood (non-zero gradients) after 157 iterations				
Coefficient covariance computed using outer product of gradients				
Presample variance: backcast (parameter = 0.7)				
GARCH = C(7) + C(8)*RESID(-1)^2 + C(9)*GARCH(-1) + C(10)*OPV				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
LOG(GARCH)	-0.367221	0.013674	-26.85516	0.0000
C	0.706253	0.005612	125.8429	0.0000
D(OP)	0.024456	0.006946	3.521080	0.0004
D(OER)	0.009674	0.034607	0.279547	0.7798
D(PER)	0.004109	0.009129	0.450046	0.6527
ECM(-1)	-0.008297	0.002566	-3.233012	0.0012
Variance Equation				
C	0.111176	0.044755	2.484083	0.0130
RESID(-1)^2	1.506621	0.177171	8.503747	0.0000
GARCH(-1)	0.225571	0.049207	4.584095	0.0000
OPV	0.008221	0.004023	2.043552	0.0410
R-squared	0.056714	Mean dependent var		0.947059
Adjusted R-squared	0.014976	S.D. dependent var		1.400231
S.E. of regression	1.389707	Akaike info criterion		2.821322
Sum squared resid	218.2352	Schwarz criterion		3.054861
Log likelihood	-157.8686	Hannan-Quinn criter.		2.916155
Durbin-Watson stat	2.327082			

Source: author's computation using e-views 9.5nsoftware

The error correction mechanism of the GARCH test conducted at 5% level of significance indicated that crude oil price significantly and positively impacted on the price level of consumables in Nigeria (0.0004 < 0.05). Exchange rates (official and parallel market exchange rates), although positively contributed to growing price level in Nigeria, its effect was insignificant. Furthermore, oil price volatility significantly impacted on consumer price index fluctuation in Nigeria (0.0410 < 0.05). The error correction mechanism significantly adjusted the residual to long run equilibrium at the speed 0.83% (0.0012 < 0.05).

Significantly, previous volatility of the consumer price index, as well as information on the previous volatility of the price level of consumables impacted on its current volatility (0.0000 < 0.05 and 0.0000 < 0.05 respectively). The independent variables contributed to only 5.67% of the variation in the consumer price index. This implies that the model is not a good fit; nonetheless, the model was fitted according to relevant theories and within the scope of the study. The correlogram of standardized residual, using the Q-statistics indicates that the residual is not serially correlated and the further moves in a constant variance.

Test of Hypotheses

1. Crude oil price does not have significant impact on price level in Nigeria.

The result showed that oil price significantly impacted on the consumer price index in Nigeria ($0.0004 < 0.05$). We therefore reject the null hypothesis and conclude that Nigeria's crude oil price significantly impacts on the cost of living (price level of consumables) in Nigeria.

2. Crude oil price volatility has not significantly affected price level fluctuation in Nigeria.

Oil price volatility variable (OPV) had significant impact on the fluctuation of the consumer price level in Nigeria ($0.0410 < 0.05$). Additionally, previous period volatility of consumer price index and information of the volatility of CPI in the previous period caused by oil price, official and exchange rates significantly impacted on the current period's fluctuation of the consumer price index in Nigeria. In view of this, we reject the null hypothesis and conclude that the volatility of crude oil price significantly causes the cost of living (CPI) in Nigeria to fluctuate.

Conclusion and Recommendations

The price of Nigeria's crude oil is basically determined by world demand and OPEC and non-OPEC supply at the international oil market (having little of domestic supply side effect evidenced from the result), as the raw crude oil has little or no domestic consumption value. Shocks to crude oil price greatly affect national income, exchange rate and the cost of living in Nigeria. The nation's earnings which is supposed to cushion the cost of living as an oil exporting nation is countered by heavy dependence on import for almost all consumables, including foods. This has both direct and inverse effect on the cost of living in Nigeria. Evidenced from the result of the GARCH analysis, crude oil volatility significantly influenced the cost of living (consumer price index fluctuation) in Nigeria.

It is therefore recommended that:

1. Evidence from the study showed that exchange rates (official and parallel) contributed positively to consumer price index (i.e. demand pull inflation), implying that an increase in exchange rates in Nigeria causes cost of living to rise and vice versa. Therefore, in order to forestall exchange rate volatility and further reduce the living cost in Nigeria, government should grow the external reserve by increasing export, and saving more of their excess net income. This is in line with [3], discovery that high level of external reserves reduces exchange rate volatility.
2. Since oil price and oil price volatility contributes positively and significantly to the consumer price index in Nigeria, according to the findings of the study, it implies that declining oil price will better suit consumers, who prefer cheaper cost of living. However, declining oil price does not necessarily imply reduced earnings for the economy. From the study, it is clear that the supply side (Nigeria) does not determine oil price but rather the demand for it. Therefore, in order to take stronger control of price determination and sale of oil, the government should reduce cost of production and in turn the price of crude oil in order to attract increased demand for it and therewith increased earnings.
3. Just as the Banks and the private sector, Nigerian government should seize the opportunity of the financial networking (ponzi schemes), which has gradually increased aggregate demand and business activities in the country, to encourage local production and export, by discouraging the importation of good, such as clothes, shoes, some foods and other locally manufactured goods that in sufficient supply to local market; while given tax, export and loan incentives to domestic real investors/ producers. This would drastically reduce leakage from the economy, diversify production base of the economy, improve the local currency value and exchange rate, trade balance and reduce the cost of living in Nigeria.
4. Furthermore, through the tax, credit and other investment incentives, the government of Nigeria should encourage production and export of other locally produced goods with comparative advantage, such as snail, groundnut, cocoa among others, while gradually increase export of crude oil as price increase.

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