Oil Price Volatility and Inflation Rate: Lessons for Overcoming Recession?

by

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Abstract

An important question is "what are the best options for diversifying a mono-product economy in recession?" Nigeria becomes a good case-study - as rising oil prices portend recovery for her economy, this paper explores the effects of variations in international crude oil prices and shocks on Nigeria's inflation rate. To better highlight her situation, we analyze inflation rate changes in the twenty-year period (1996 – 2016) with respect to oil price volatility. A detailed analysis of the instability of inflation in Nigeria was performed by correlating it with international crude oil prices, domestic consumer price index and oil export proceeds by creating a VAR model and testing it for trends and correlation. The research reveals that the inflation rate is directly and indirectly affected by changes in oil prices in international markets. However, it was also discovered that shocks in oil prices do not immediately affect inflation rates significantly, but do have a delayed ripple effect that becomes detectible over time. The study also identifies reasons for unexplained variations in statistics and subsequently provides recommendations to minimize Nigeria's vulnerability to international oil price shocks. One of which is to deepen the financial sector towards channeling resources to the real sector as money supply increases. Second, is to consider the effects of demographic changes on monetary policy measures. Finally, to incorporate the excess supply and its asymmetric effects on international and domestic prices.

1 Introduction

1.1 Background[1]

Crude oil price is an economic index with varying implications for economic actors due to its volatility. For a crude-oil-exporting country like Nigeria, whose national budget is based on estimated oil export revenues, oil price volatility portends major consequences for budget appropriation and implementation. Oil price shocks result in budget deficits where prices are lower than budget benchmark, which may in turn increase government borrowings and related costs, as well as, reprioritization of important developmental projects and socio-economic programs.

The following changes in oil price highlight the issue: over the four-month period from August 2001 ($35.60) to November 2001 ($26.02); seven-month period from June 2008 ($138.74) to January 2009 ($44.95); and another seven-month period from June 2014 ($114.6) to January 2016 ($28.50) (Central Bank of Nigeria (CBN), 2016). Such fluctuations have been due to speculation and actual imbalances in demand-supply (Ji, Liu & Fan 2015). Small demand-supply distortions will require significant change in the oil price to restore equilibrium (Moshiri 2015). For economies that are largely dependent on oil and gas revenues, the impact of oil price shocks is usually significant – affecting labour markets, aggregate consumption and investment, as well as, economic indices like exchange rate, interest rate, government spending, inflation rate, and balance of payment.

Consequently, Central Banks have become more committed to controlling inflationary levels and ensuring price stability in their countries, through tightly controlled monetary policies, with effective monitoring of the trends. Many of these Central Banks have been successful in this regard. Following over fifty percent loss in her oil export revenue between October 2014 and March 2017, the Central Bank of Nigeria kept monetary policy measures unchanged from July 2016 to April 2017. Oil prices are not expected to attain year-2014 levels soon. Could there be lessons for petroleum exporting countries?

[1] **Acknowledgement:** We like to appreciate Covenant University for her financial support.

Nigeria is the focus of the study because she is the sixth largest producer of oil in the world, with average daily production of about 2.5 million barrels, and heavily dependent on oil export revenues - 95% of foreign exchange earnings and about 65% of government budgetary revenue (Nigerian National Petroleum Company, NNPC 2016). Against this background, the study focuses on Nigeria to analyze inflation rate changes over the twenty-year period (1996 – 2016) relative to oil price volatility.

1.2 Literature Review

A sudden, significant and sustained increase or decrease in oil price which generates corresponding global geopolitical or political-economic consequences could be termed oil price shocks (OPSs). Some oil price shocks (OPSs) witnessed in the past four decades have enormously influenced and changed global perceptions of oil price-macroeconomic relationships (Chuku 2012). OPSs, though caused by exogenous factors, are likely to impact on endogenously determined economic variables. The World Bank Group (2015) noted that past episodes of significant oil price declines have often been associated with a weak global economy and followed by a sharp reduction in inflation. On the brighter side, the plunge in oil prices presents an opportunity for energy subsidy and tax reforms and for structural measures to diversify oil-producing economies.

Several scholars, Adeniyi, Oyinlola & Omisakin 2011; Chuku 2012; and Moshiri 2015, have attempted to determine the impacts of oil price shocks on economies of oil exporting countries. Chuku (2012) investigated the impact of crude oil price shocks (OPSs) on Nigeria's macroeconomic indicators and concluded that there is no correlation between Nigeria's macroeconomic indicators and oil price movements, including foreign reserves, consumer price index (CPI) and real GDP. Also, research by Adeniyi *et'al (*2011), using an augmented vector autoregressive (VAR) model, produced similar results, leading to the conclusion that the impact of OPSs on most of the macroeconomic variables in Nigeria is at best minimal. In the study, OPSs accounted for less than 1% of the variations in input, inflation and government revenue. Applying two-regime VAR analysis, Adeniyi *et'al* (2011) observed that the effect of oil price shocks on macroeconomic performance of a country is dependent on the economy's degree of dependence on oil, noting that the extent of response by oil-importing and oil-exporting countries differ significantly, with fuel substitution by the importing countries and diversification strategy by the exporting countries. Similar outcome was obtained by Moshiri (2015), who concluded that for oil-exporting developing countries, negative OPSs have adverse effects on economic growth while positive OPSs do not have any significant impact; on the other hand, OPSs (whether positive or negative) do not have any impact on the economies of oil-producing developed countries.

Oil price volatility has been prevalent in the 2000's, following the first shock recorded in 1973 (Moshiri 2015). The impact of oil price volatility on world inflation has in recent years been minimal compared to what was observed in the 1970s and 1980s. Inflation is now lower in recent years than in earlier years despite the relatively higher oil prices (Hooker 2002; De Gregorio *et'al* 2007). De Gregorio *et'al*. (2007) attributed the lower pass-through of oil prices to a combination of improved macroeconomic policies, increased exchange rate flexibility, credible inflation targets and strong currency appreciation in many countries, while maintaining that the effects of oil price increase on inflation is a function of whether the increase is a result of decrease in supply or a strong demand for oil. This was corroborated by Blanchard and Galí (cited by De Gregorio *et 'al* 2007), who noted that some oil importers respond to increase in oil prices by reducing dependence on oil, improving monetary policies and introducing shock-offsetting measures.

The expectation of persistence associated with oil price shocks may be a contributory factor to its actual impact on inflation. An expectation that the oil price will be short-lived/temporary usually results in lower pass-through effects, compared to an expectation of a longer hike. The impact of OPSs on inflation may have been diminished by the growing trend towards globalization and increased global competition, which has reduced the extent to which producers can pass on the increased cost of production to consumers. Producers may be forced to absorb the additional costs rather than risk losing their market shares to competitors (De Gregorio *et'al* 2007). Additionally, structural changes in the world economy, which is increasingly becoming more service-oriented and the adoption of energy-efficient technologies, have diminished dependencies on oil (Blanchard and Gali 2007, cited by Moshiri 2015). Consequently, as oil-dependency decreases and its contribution to total product costs reduce, the impact of oil price volatility on inflation and other macroeconomic variables is minimized.

Revenues from oil sales form a significant share of the GDPs of oil exporting countries. The impact of oil price volatility on the economies of these countries is largely dependent on how the governments of these countries apply the oil revenues (Berument, Ceylan & Dogan, 2010). OPSs for oil-exporting developing countries show asymmetric effects. While lower oil prices result in major revenue shortfalls, disruption of socioeconomic activities and stagnation of the economy, oil price increases with its higher revenues do not result in appreciable growth in the economy (Moshiri 2015). Moshiri (2015) also observed that negative OPSs (lower oil prices) for oil-exporting developing countries often result in abandonment of capital projects and continuation of government's recurrent obligations while, on the other hand, for oil-exporting developed countries, the impact of negative OPSs is less pronounced, as their economies have been well diversified thereby diminishing the contribution of oil revenues to the country's GDP. They are, therefore, less vulnerable to OPSs. Similar asymmetric effect is observed for oil-importing developed countries, such as the United States and some OECD countries. While oil price increases have adverse impacts, oil price decreases do not have appreciable effects on these countries' economic indicators (Herrera *et'al* ., 2011, cited by Moshiri 2015).

The natural response of oil-exporting developing countries to OPSs is: for oil price increases, governments embark on large social development and investment projects, some of which have little relevance to economic development of the country, thereby fueling inflation; for sharp oil price drop, governments abandon investment projects and practically shuts down major economic activities, borrow money from central banks and external sources to fund recurrent obligations and budget deficits (Moshiri 2015). With the high level of dependency on oil and gas, it is expected that oil price shocks will have significant impact on Nigeria's economy, affecting most macro and micro economic indicators.

1.3 Research Questions

This study questions the conclusions of Chuku (2012) and Adeniyi *et'al (*2011) that OPSs are not major determinants of macroeconomic indices in Nigeria. The paper also considers the lessons that could be deduced for Nigeria - a major OPEC-member country - that is in recession. Specifically, it seeks to address the following questions:

1. Are there identifiable relationships between oil prices and Nigeria's inflation rates?
2. How significant is the impact of oil price shocks to the inflation variable in Nigeria?
3. What countermeasures can be adopted by the government of Nigeria to minimize the economic impacts of oil price shocks e.g. on inflation?

An economy that is highly dependent on income from a natural resource runs the risk of instability or possible collapse if the price of such resource decreases in the global market, hence the importance of economic diversification in building sustainable economic growth (Albassam 2015). The research recommends that the practice of national development planning, premised on forecasts of anticipated oil prices should be de-emphasized in Nigeria. This is a relevant proposition as government starts implementing Nigerian Economic Recovery and Growth Plan (NERGP).

2. Research Method

2.1 Method

The methodology for this study is the use of VAR (Vector Autoregressive) Modeling over a 20-year period (1996-2016). VARs are flexible time series models that can capture complex dynamic interrelationships among macroeconomic variables (Giannone *et'al* 2015). VAR analysis is used since the research is quantitative in nature, hence time series results need to be obtained, using relevant algorithms and variable analyses. Several researchers, (e.g. including Olomola & Adejumo 2006; Ayadi 2005; Akpan 2009; Adeniyi *et'al* 2011, all cited in Chuku 2012; Moshiri 2015; De Gregorio *et'al* . 2007), undertaking similar projects requiring time series analyses of data have found VAR to be useful, as it facilitates interactions among endogenous variables and provides estimation of the impact and effects of shocks on various variables, like inflation, exchange rates, etc (De Gregorio *et'al* 2007; Moshiri 2015).

The software used to create the VAR model was Gretl, which is an econometric software widely used to create various economic models and analyze data of different categorization. It is a software that is utilized widely in industry and academia primarily due to its free nature. Further it has a vast functionality with multiple features for analyzing data from all angles and exploring all possible aspects related to the data. Gretl was used to create the VAR model and carry out primarily four tests, namely Test for Normality, Autocorrelation, Wald Test, and ARCH. Further, a two-step Engle-Granger Cointegration test was also performed on the data to check for relationships and trends. Graphs and plots of the results were created on the software to produce the results in a lucid manner and are demonstrated in this study.

2.2 Nature and Source of Data

Secondary data sources are used for this study. The versatility and richness of the internet in data and information, coupled with the ease of use has made it a veritable source of secondary data (Saunders *et'al* . 2012, p. 304). Data on the monthly average prices, production and sales volumes for the Nigerian crude oil are obtained from publications of the CBN (2016); data on the inflation and consumer price indices (CPIs) are obtained from Trading Economics (2016) and their accuracy corroborated with data obtained from the Nigerian National Bureau of Statistics (2016) and CBN.

3. Data Analysis and Interpretation of Results

3.1 Data Analysis

Toda *et'al* (1994) explicitly indicate that the VAR model can be practically implemented for understanding the casual effect of one variable on another variable by testing the variation of one variable in real time with respect to the variation in the other. The data collected for this study was time-varying and thus had to be analyzed with a proper technique to explore the major aspects of consideration to answer the research question. Ito & Sato (2008) implemented the Vector Autoregression (VAR) model to study the effects of exchange rate on the consumer prices in the Asian economies in the post-crisis scenario, obtaining exceptionally reliable and accurate statistics to produce consistent results.

Furthermore, Cogley & Sargent (2002) observe the viability of VAR model for correlating the theoretical concepts with the empirical findings through strategic analyses of available data. This study, being of a similar nature, primarily employed the VAR model to test the plausible correlation between the price of crude oil in International market and inflation rate in Nigeria. This study uses five different time variant variables to empirically analyze of the effects of international oil price on the inflation rate of Nigeria. The five variables are Inflation Rate, Consumer Price Index (CPI), Crude Oil Price, Crude Oil Revenue and Surplus Million Barrels per Day.

The data available from May 1996 to May 2016 in a monthly format was analyzed using the VAR model for primary investigation and the Engle-Granger Cointegration test to verify the significant statistical correlation between inflation and oil prices. VAR Model was created using an average lag of 12 for the quarterly data consolidated by averaging. The VAR lags selected are depicted in Table 3.1. The asterisks indicate the best (that is, minimized) values of the respective information criteria: AIC = Akaike Criterion, BIC = Schwarz Bayesian Criterion and HQC = Hannan-Quinn Criterion. The test and analysis carried out on the data are individually discussed below.

Table 3.1 Vector Auto-Regressive Lagged Data

lags	Loglik	p(LR)	AIC	BIC	HQC
1	-1568.29668		47.859602	49.011307	48.315335
2	-1528.28429	0.00000	47.411471	49.385823	48.192727
3	-1507.90463	0.02433	47.549392	50.346390	48.656171
4	-1471.97084	0.00000	47.223010	50.842655	48.655313
5	-1418.83549	0.00000	46.383149	50.825440	48.140975
6	-1400.13457	0.05286	46.571181	51.836119	48.654530
7	-1374.36684	0.00137	46.548264	52.635848	48.957136
8	-1353.44920	0.01872	46.670125	53.580356	49.404521
9	-1292.11764	0.00000	45.585601	53.318478	48.645520
10	-1209.40057	0.00000	43.862704	52.418227	47.248146
11	-1120.41875	0.00000	41.952798	51.330969	45.663764
12	-873.81854	0.00000	35.337867*	45.538683*	39.374355*

Auto-Correlation of Residuals (Test for Autocorrelation)

Autocorrelation test is used to study and deduce a correlation between the data and the theoretical values of the function at varied points. Portmanteau test, specifically Ljung Box test used in this study, is primarily used to test the possibility of an autocorrelation of a group not being zero. This test checks the overall randomness with respect to number of lags. The value of P is rejected at 1%, specifically being less than that of (.01). Since we used five variables in this study, we have five equations autocorrelating one variable with the others.

Null Hypothesis: There are no Autocorrelations.

The above hypothesis is tested below for a *P* value greater than 1%.

Equation 1:

Ljung-Box Q' = 14.636 with p-value = P(Chi-square(4) > 14.636) = 0.00552

Since the value of P is less than (0.1), the hypothesis is rejected in this case

Equation 2:

Ljung-Box Q' = 22.5393 with p-value = P(Chi-square(4) > 22.5393) = 0.000156

Since the value of P is less than (0.1), the hypothesis is rejected in this case.

Equation 3:

Ljung-Box Q' = 14.5611 with p-value = P(Chi-square(4) > 14.5611) = 0.0057

Since the value of P is less than (0.1), the hypothesis is rejected in this case.

Equation 4:

Ljung-Box Q' = 17.8472 with p-value = P(Chi-square(4) > 17.8472) = 0.00132

Since the value of P is less than (0.1), the hypothesis is rejected in this case.

Equation 5:

Ljung-Box Q' = 18.5966 with p-value = P(Chi-square(4) > 18.5966) = 0.000943

Since the value of P is less than (0.1), the hypothesis is rejected in this case.

Thus, our system is completely autocorrelated and indicates inconsistent estimators. This verifies that our data is not independent with respect to time, and is correlated. Since we reject the null hypothesis in every case, it is conclusive that there is strong correlation between the considered variables with respect to time.

ARCH Test (Autoregressive Conditional Heteroskedasticity)

ARCH models individually test the variation and instability with respect to time. They can be used to define the time dependent increase in variance of any variable. However, ARCH test of a VAR model is based on similar principles to that of LM test of autocorrelation Luetkepohl (2009) and tests the residual autocorrelation of a defined order taking in account the possible covariance as a factor. For the analysis of data, a test for ARCH of order 4 was carried out on the residual data set of the VAR model. Below are the results obtained. The null hypothesis is tested and is rejected for 1%, i.e. a value less than (.01).

Null hypothesis: no ARCH effect is present

Equation 1:

	Coefficient	std. error	t-ratio	p-value
alpha(0)	5.39030	2.45013	2.200	0.0318 **
alpha(1)	0.0382166	0.128836	0.2966	0.7678
alpha(2)	0.0651218	0.128791	0.5056	0.6150
alpha(3)	0.00908126	0.129008	0.07039	0.9441
alpha(4)	0.184739	0.129432	1.427	0.1589

Test statistic: LM = 2.68009 with p-value = P(Chi-square(4) > 2.68009) = 0.612702

Result: Since the value of P is more than (0.01), no ARCH effect is present.

Equation 2:

	Coefficient	std. error	t-ratio	p-value
alpha(0)	470.030	128.595	3.655	0.0006 ***
alpha(1)	−0.151120	0.131848	−1.146	0.2564
alpha(2)	−0.0583113	0.133023	−0.4384	0.6628
alpha(3)	−0.0120624	0.133034	−0.09067	0.9281
alpha(4)	−0.0205676	0.138345	−0.1487	0.8823

Test statistic: LM = 1.49726 With p-value = P (Chi-square(4) > 1.49726) = 0.827127

Result: Since the value of P is more than (0.01), no ARCH effect is present.

Equation 3:

	Coefficient	std. error	t-ratio	p-value
alpha(0)	3.45034e+07	1.38640e+07	2.489	0.0157**
alpha(1)	−0.0647182	0.128626	−0.5031	0.6168
alpha(2)	−0.0790029	0.127530	−0.6195	0.5380
alpha(3)	0.101254	0.128060	0.7907	0.4324
alpha(4)	0.204808	0.131614	1.556	0.1251

Test statistic: LM = 3.8482 With p-value = P(Chi-square(4) > 3.8482) = 0.426939

Result: Since the value of P is more than (0.01), no ARCH effect is present.

Equation 4:

	Coefficient	std. error	t-ratio	p-value
alpha(0)	0.0803148	0.0418433	1.919	0.0599 *
alpha(1)	0.220022	0.129796	1.695	0.0954 *
alpha(2)	0.0790888	0.131001	0.6037	0.5484
alpha(3)	0.0316896	0.131143	0.2416	0.8099
alpha(4)	0.118391	0.128802	0.9192	0.3618

Test statistic: LM = 5.83114 With p-value = P(Chi-square(4) > 5.83114) = 0.212119

Result: Since the value of P is more than (0.01), no ARCH effect is present.

Equation 5:

	Coefficient	std. error	t-ratio	p-value
alpha(0)	0.373992	0.237500	1.575	0.1208
alpha(1)	0.166374	0.130553	1.274	0.2076
alpha(2)	0.229561	0.127730	1.797	0.0775 *
alpha(3)	0.158024	0.127255	1.242	0.2193
alpha(4)	0.00372179	0.127053	0.02929	0.9767

Test statistic: LM = 10.4755 With p-value = P(Chi-square(4) > 10.4755) = 0.0331364

Result: Since the value of P is more than (0.01), no ARCH effect is present.

We obtained a result signifying that there is no ARCH effect present in our data. No ARCH effect signifies conditional homoscedasticity which allows valid inference. This implies that the noise in the signal, variance of data from the line of regression in statistical terms, is uniform and does not vary with time. Gouriéroux (2012) explains that homoscedasticity can be considered an indication of strong intercorrelation of variables with respect to time.

Trend Analysis (Wald Test)

Wald test is implemented to study the interrelation between the data set, specifically between variables. Ismail (1998) observed its viability in his research conclusively indicating it to be a viable method to detect trends between visually unrelated variables. The test compares the chi-squared distribution with the square of the difference.

Null hypothesis: no trend (Rejected below 1%)

Wald test: Chi-square(5) = 63.9553, p-value 1.84551e-012

Result: Since the value of p is less than .01, the null hypothesis is rejected indicating a specific statistical trend of values.

Normality Test

Test for normality is conducted to analyse the stability, specifically, reliability of the system. The approach utilizes the outline of the concept laid by Lomnicki (1961) and tests the viability of taking inferences from VAR model.

Null Hypothesis: Positive Normality

Residual correlation matrix, C (5 x 5) (Doornik-Hansen test)

1.0000	*0.41016*	*0.94572*	*-0.045769*	*0.11986*
0.41016	*1.0000*	*0.68031*	*-0.51847*	*-0.33928*
0.94572	*0.68031*	*1.0000*	*-0.20750*	*-0.010615*
-0.045769	*-0.51847*	*-0.20750*	*1.0000*	*0.97421*
0.11986	*-0.33928*	*-0.010615*	*0.97421*	*1.0000*

Eigenvalues of C

0.00148121

0.00268758

0.442635

1.90619

2.647

Chi-Square(10) = 6.76437 [0.7475]

Result: Since the value of P is more than (.01), the null hypothesis cannot be rejected. Thus we obtain a positive normality of 74.75% for valid inference.

Engle-Granger Cointegration (Relationship between Inflation and Crude Oil Prices)

This is a two-step process where we firstly create a least square model and then carry out a unit root test on the residuals of the least square model. MacKinnon (1990) clarifies that though quite simple, this test is very useful for testing the relationship between two variables. The unit root test used was Augmented Dickey-Fuller Test.

Null Hypothesis: No Cointegration (Rejected at 1%, i.e. p= .01)

Test with Constant

*Model: (1-L)y = b0 + (a-1)*y(-1) + ... + e*

Estimated value of (a - 1): -0.546942

Test statistic: tau_c(1) = -3.61032

Asymptotic p-value 0.005595

1st-order autocorrelation coefficient for e: -0.096

Lagged differences: F(11, 54) = 3.778 [0.0005]

Result: Since the value of P is less than .01, there is at least one positive cointegration relationship between the inflation and price of crude oil.

With Constant and Trend

*Model: (1-L)y = b0 + b1*t + (a-1)*y(-1) + ... + e*

Estimated value of (a - 1): -0.550985

Test statistic: tau_ct(1) = -3.48751

Asymptotic p-value 0.04066

1st-order autocorrelation coefficient for e: -0.095

Lagged differences: F(11, 53) = 3.710 [0.0006]

Result: Since the value of P is less than .01, there is at least one positive cointegration relationship between the inflation and price of crude oil.

Test without Constant

*Model: (1-L)y = (a-1)*y(-1) + ... + e*

Estimated value of (a - 1): -0.547256

Test statistic: tau_nc(1) = -3.64286

Asymptotic p-value 0.0002672

1st-order autocorrelation coeff. for e: -0.093

Lagged differences: F(11, 55) = 3.835 [0.0004]

Result: Since the value of P is less than .01, there is at least one positive cointegration relationship between the inflation and price of crude oil.

Correlation Coefficients

5% critical value (two-tailed) = 0.2213 for n = 79

Barrel_day	Inflation_Rate	Revenue	Price_Barrel	CPI	
1.0000	0.1973	-0.1732	-0.3349	-0.6375	Barrel_day
	1.0000	-0.1324	-0.1639	-0.1631	Inflation_Rate
		1.0000	0.9833	0.6621	Revenue
			1.0000	0.7345	Price_Barrel
				1.0000	CPI

4.2 Answering the research questions

The Vector Autoregressive model provided valid inferences for the empirical study of inflation rates in Nigeria with respect to change in prices of crude oil. Data analysis provides viable information about the prices of crude oil in international market and their effects on Nigerian economy. Using these inferences and specific results, we will answer the questions that form the base of this study.

Question 1: Are there identifiable relationships between oil price and Nigeria's inflation rates? Analysis of available data for a considerable time frame reveals that there is a strong correlation between the inflation rate of Nigeria and international Crude Oil Prices. Data analysis indicates that there is an indirect relationship between the two. The negative value of correlation coefficient between inflation rate and price of crude oil per barrel is a clear indicator of the same.

Figure 3.1

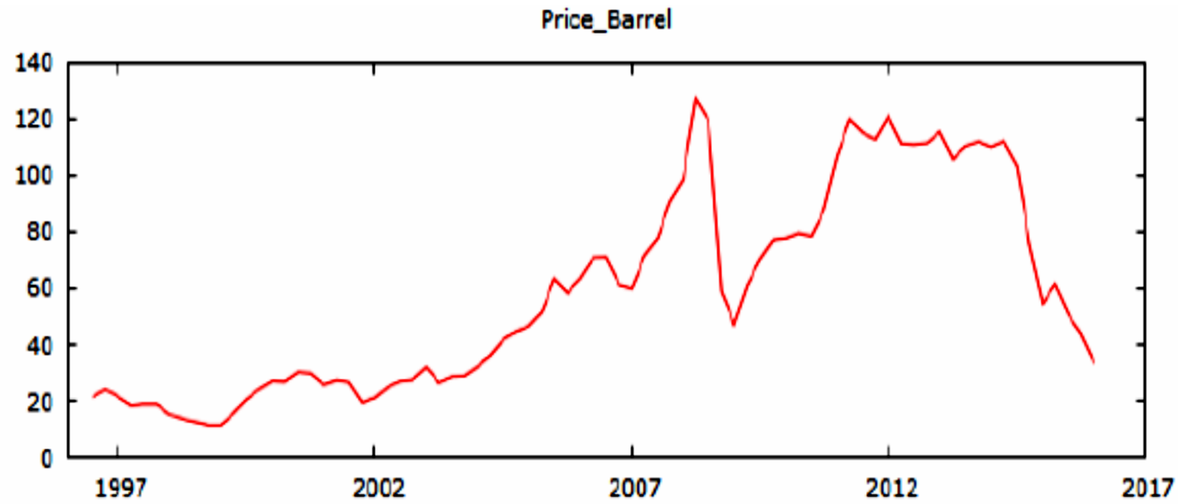

Price_Barrel
140
120
100
80
60
40
20
0
1997
2002
2007
2012
2017

Figure 3.2

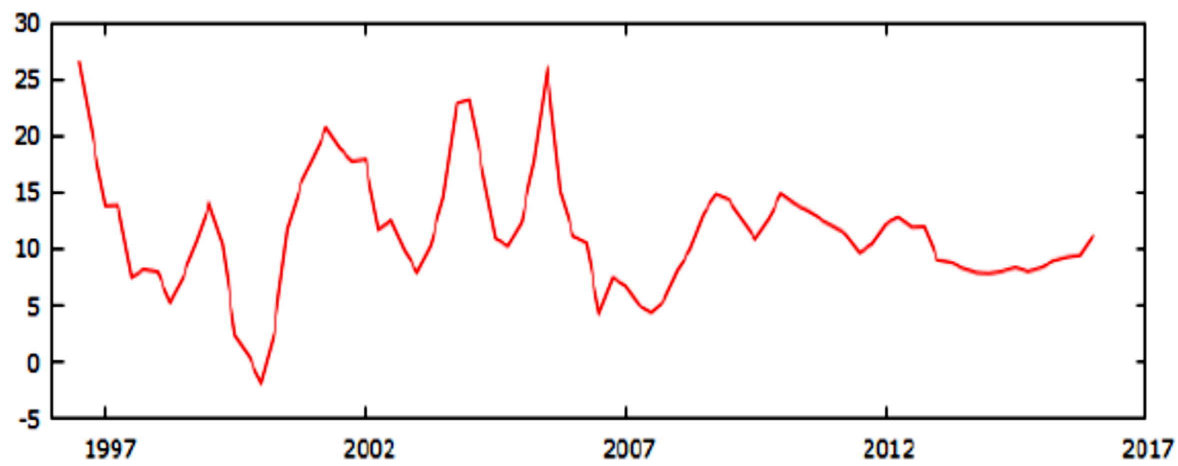
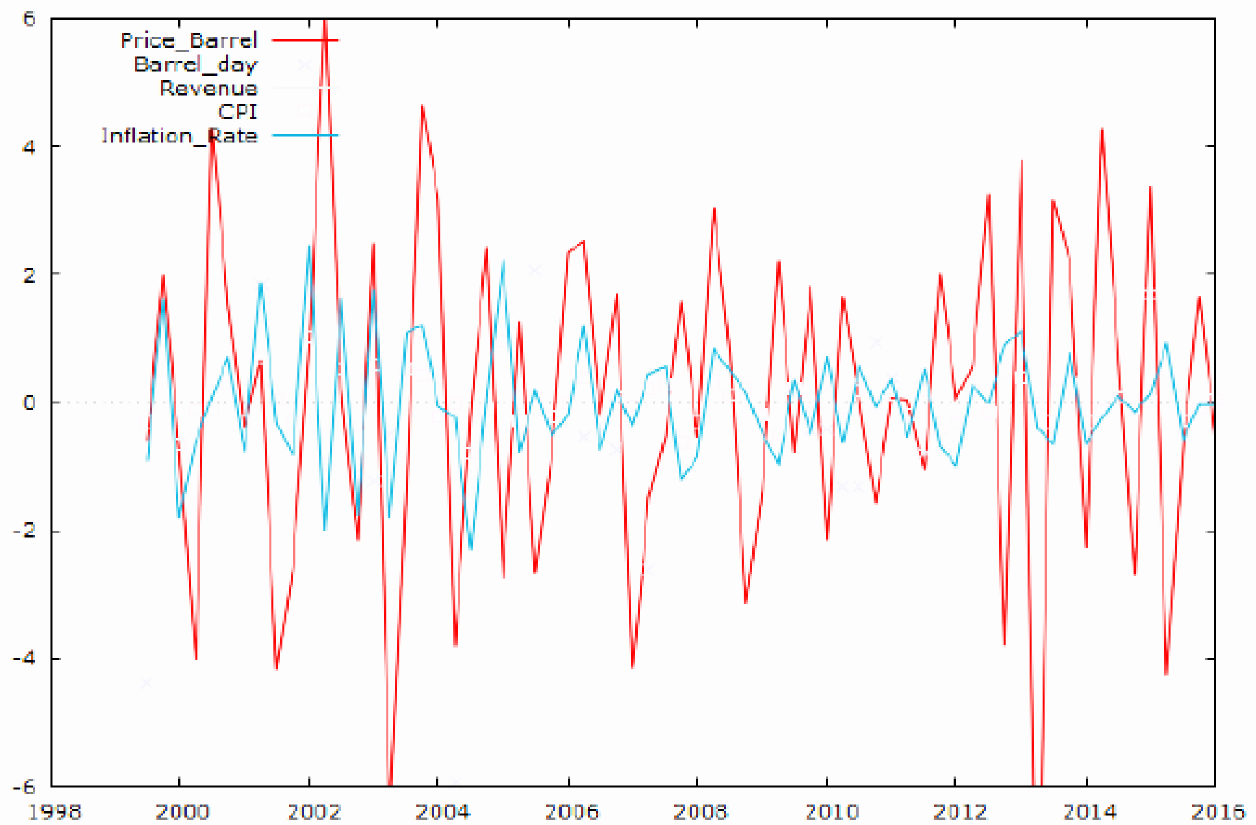

Inflation_Rate
30
25
20
15
10
5
0
-5
1997
2002
2007
2012
2017

Figure 3.3: VAR residuals



It is prominent that inflation rates fall with oil price increases and vice versa. It is to be noted that though oil export form a major part of Nigerian economy, it does not specifically control the macro economy. Thus the variable spikes and other variations from clear correlation can be explained as the arbitrary variables that also affect the economy such as natural calamities, epidemic outbreak or institutional breakdown in industrial or administrative sector. Although the correlation is eminent statistically as well as graphically, no definite function to explain the relation can be established that can be considered accurate. Further, inflation in economics is a natural and indirect indicator of a countries growth, thus many strategic decisions of economic administration of any country directly affect the rate of inflation. Nigeria being a developing nation, in a bid to attain a better national growth rate, may take specific decisions that may affect the rate of inflation and consumer price index.

Figure 3.4: Residual_Inflation

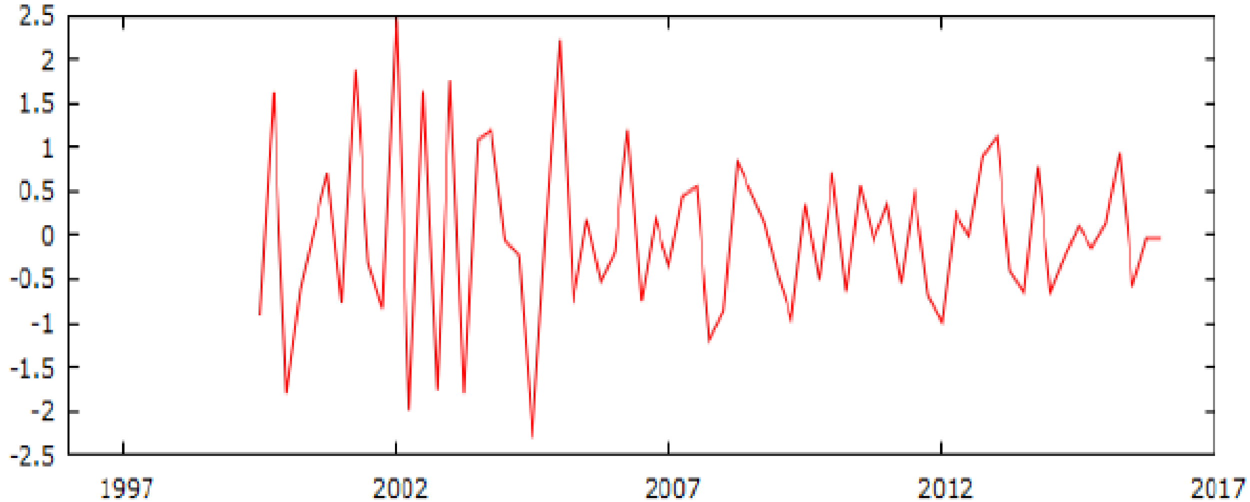
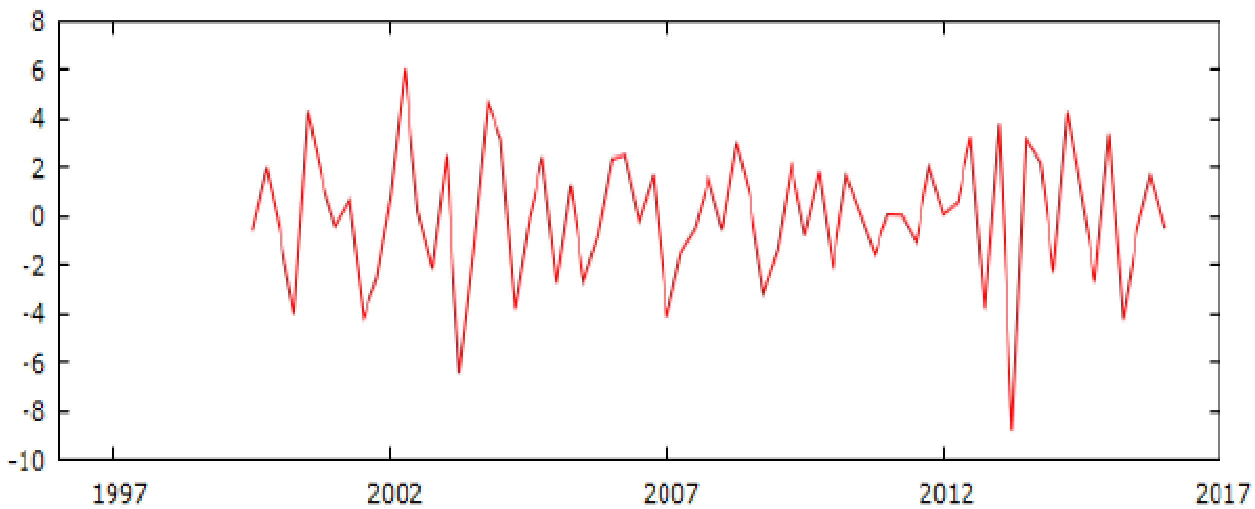


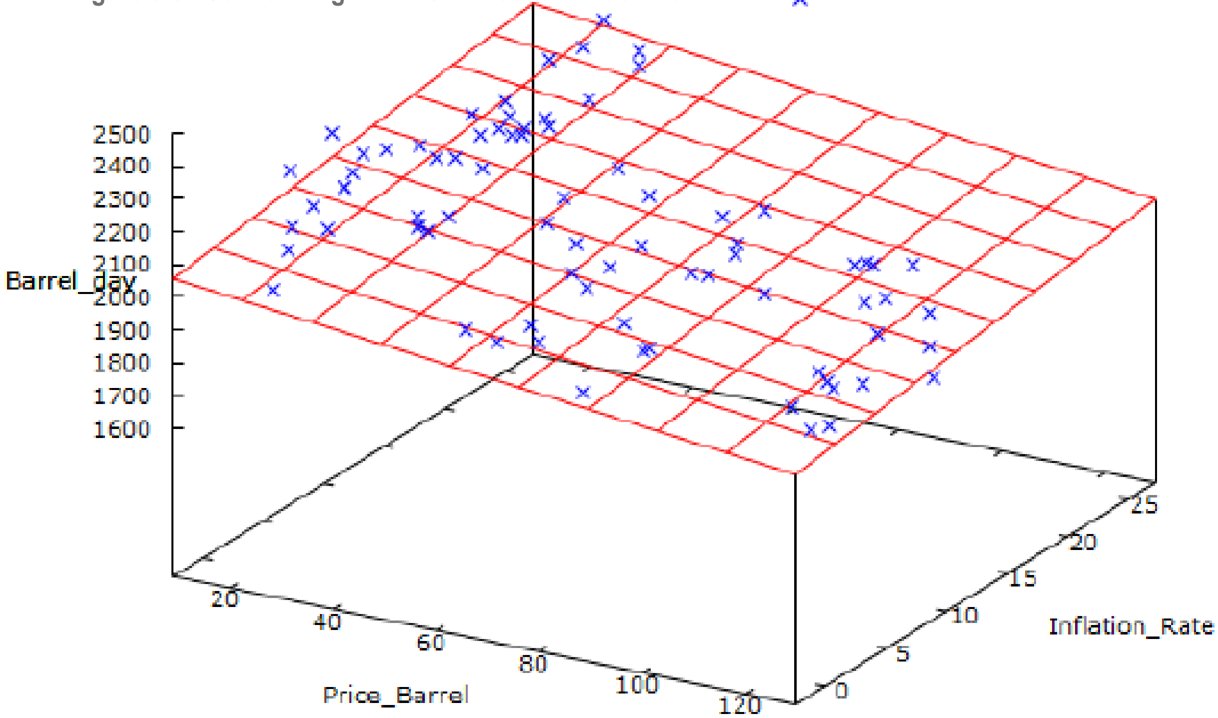
Figure 3.5: Residual_Price_Barrel



It is indicated through the statistical profile of the graphs that the inverse correlation between the price and inflation is followed. This ideology is in harmony with that of Barsky & Kilian (2004), who discuss how the variations of oil prices affect a macro economy, having negative impacts on consumer abilities. One specific feature of their research was their acceptance of the fact that any factor, oil or other, cannot be defined as the sole driver of any economic feature of a country.

The Figure 3.6 provides a clear explanation of the research conclusion. The graph projects the scattered formation of inflation rate with respect to million barrels per day surplus and the price of crude oil per barrel. The range and nature of frequency distribution explain that price of oil cannot be the sole factor for the variation of inflation rate; however, its influence cannot be denied. Significant influence is also indicated through the graph in Figure 3.6, implying that though direct correlation can be doubted, indirect influence is immense.

Figure 3.6: Scatter Diagram of Oil Price & Inflation Rate



Nigerian industrial economy is largely import dependent for most of the consumables, oil being her primary export. However, Nigeria attained a trade surplus in most of the fiscal years - indicating that the local economy could be largely self-sufficient. Rotemberg and Woodford (1996) discussed a model that depicted the imperfections in market and economic calculations in a very similar manner. They too accepted the presence of hidden factors of influence in an economy and cited "modifying the standard neoclassical growth model by assuming that competition is imperfect makes it easier to explain the size of the declines in output and real wages that follow increases in the price of oil." (Rotemberg and Woodford, 1996)

Finally, the key understanding can be summed up as:

1) There is an obvious negative correlation between international crude oil prices and Nigeria's inflation rate.

2) There are other factors, natural and manmade, that affect the inflation rate of Nigeria, thus defining the sudden surges and shocks.

3) Nigeria is self-sufficient for internal production requirements, and has attained a trade surplus almost every year since 1996. Despite this, there is an apparent instability in its economic front. The economy is greatly dependent on oil for internal as well as other requirements. When oil prices fall, there is a shortfall of trade and export, thereby reducing the flow of money in the market. This causes a damping of buying power and simultaneous increase in rate of inflation. The change in inflation rate, if not fully, is mostly influenced by the variation in oil prices. Ayadi (2005) also in his research discusses about this indirect impact of variation of oil prices on exchange rates.

Consequently, it can be understood that both directly and indirectly, there is a strong correlation between the oil prices and inflation rate of Nigeria. The variation of statistical data and graphical variations in certain cases can thus be explained by the chain effect of economy. This, in case of Nigeria, is the issue of indirect dependence of people on oil. The fall in price slows the trade, which in turn reduces the cash flow in market, reducing the buying power of people, thus in a counteractive manner, increasing inflation. The problem lies in the fact that this effect takes place in a span of 2-3 months, i.e. its effects become evident in about one quarter, thus causing unaccountable effects.

Question 2: How significant is the impact of oil price shocks to the inflation variable in Nigeria?
The method employed in this study is the VAR model for analysis of variables. It is to be noted that there is a positive impact on inflation due to shock in price of oil, but it is statistically insignificant in terms of range. The normality of data was recovered to be more than 74%, which indicates the intrinsic stability of the system to withstand shocks. The cointegration test further established that the system was interdependent. Strong interdependence indicates that there will be a proportional movement of other factors with respect to one specific factor.
In context of inflation, the strong correlation between CPI, Inflation Rate and Price per Barrel indicated that the shocks will not have any significant impact on the inflation rate. The strong CPI and Inflation correlation indicates that the state run policy to cope up with short term crisis will avert the possibility inflation rate variation. The univariate Dickey-Fuller test results also indicate the presence of at least one cointegration relationship which further stabilizes the system. This idea is also shared by Aliyu (2009) where she also indicated the stability of the system to resolve and handle shocks. See **Appendix 2** for graphical depictions of responses of inflation rates to shocks in price/barrel, revenues and CPI.

As indicated by the graphical interpretation of data and VAR model, it is imminent that the Nigerian economy is robust enough to withstand external shocks or short term issues through financial backing. But in case of internal factors such as CPI, inflation is significantly volatile and destabilized and cannot withstand any shocks. The above representation depicts how the response of increase in price rise of oil is taken up smoothly, thus aiding in dampening in case of price fall. Where a shock in oil price will make inflation rate volatile for 1-2 quarters, a small shock in CPI will cause inflation to become variable and volatile for 5-6 quarters.

Question 3:
What countermeasures can be adopted by the government of Nigeria to minimize the economic impacts of oil price shocks and recover from recession?

Our study is premised on the fact that Nigeria is primarily dependent on oil - a volatile internationally traded commodity. After oil price shocks as analyzed here, Nigeria needs a sovereign wealth or stabilization fund. Such a fund could be managed to deduct increasing proportion of oil revenue from the Nigerian economy especially now that the oil price is low. This strategy will fundamentally complement any recovery or diversification endeavours in the economy. Chuku *et'al* (2011) provide another plausible method to achieve this feat by reserve-augmenting strategies where the government primarily strategizes to manage a reserve to act as a buffer for any crisis evasion and control. Umar & Kilishi (2010) had posited that an improvement in the production sector will aid in reducing dependency on oil revenue. In this regard, inflationary effects of oil price shocks could be reduced by deepening the financial sector towards channeling resources to the real sector as money supply increases. This can be enhanced through reinforcing monetary policy measures as also argued in Anwu (1992). However, government should consider the effects of demographic changes on monetary policy measures.

5. Implications and recommendations

The empirical findings of this study indicate that there is no direct impact of shocks in oil prices on inflation of a particular sector. It was imminent from the results that shocks in external factors did not affect inflation rate in Nigeria, corroborating the findings of Chuku (2012) and Adeniyi *et'al* (2011), while a small shock in an internal factor had a huge impact on inflation rate, increasing the recovery period by over 5 times. The latter view also strengthens the study by Iwayemi *et'al* (2011) where they elucidated the fact that oil exporting economies have a positive trade advantage thus reducing the impact of price variation of oil on country's economy. Olomola (2006) also stated similar views about the effect of shocks on inflation, noting its significant effect on exchange rates. This defines the insignificant variation in inflation rate due to price variation. In addition, this study provides an inverted negative correlation between inflation and oil prices – with both short-run and long-run relationships as well. The inverse dependence of inflation on price variation is defined by the dependence of the country on oil in a direct, as well as, indirect manner.

The research presented and some of the results could be made more econometrically robust by adding more variables to capture unexplainable behavior of the economy at certain times. Factors like global crude oil demand, imported petroleum products, vandalism, disruptions to oil production operations, corruption index, and import could be included to enhance the reliability and usefulness of the results.

4.0 Conclusion

In the Nigerian economy, as shown here, inflation is directly and indirectly affected by price shocks in the international oil market. There are ripple effects in different sectors of the economy, explained by lags in inflation at multiple times and response to oil price variations in the previous quarter. An inverse dependence of inflation on oil prices is seen and the impact of decline in price is more prominent than price rise suggesting government interventions in the market. The idea is further shared by Agri *et'al* (2016) suggesting diversification and we agree.

Our work emphasizes the need to shift dependence from oil to more stable or less volatile sectors like manufacturing and agriculture for sustainable development. However, negative surges significantly impact on exchange rate and GDP – resulting in short term inflation effects. Though shocks are sustained by the market, indirect effects of the shocks cannot be denied. Oil price shocks will have less impact on Nigeria (and perhaps OPEC) if the excess oil supply from US shale and its asymmetric effects on international and domestic prices are taken into consideration.

Meanwhile, measures to curb activities such as money laundering and tax evasion are important to ensure stability. As such, fiscal policy measures to incentivize new taxpayers and ensure income redistribution could be effective. These steps will close the income gap between rich and poor, stabilize the price level and ensure economic resilience in case of external shocks.

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