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The Effects of Oil Price Shock on Monetary Policy in Nigeria

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Abstract

Oil price fluctuations are a major source of disturbance for the economies of oil producing countries like Nigeria. While several authors have considered the direct channels of transmission of energy price increases, other authors have argued that the economic downturns arose from the monetary policy response to the inflation presumably caused by oil price increases. Moreover, policymakers are worried about possible slowdowns in the economic performance of the most developing countries like Nigeria.. In this paper a structural cointegrated VAR model has been considered for Nigeria in order to study the direct effects of oil price shocks on the economy and the reaction of monetary variables to external shocks using a times series data from 1970 - 2010.Empirical analysis indicates that there is a long run relationship involving oil prices, inflation rate, treasury bill rate, exchange rate, interest rate and money supply in Nigeria.We found that an unexpected oil price shock is followed by an increase in inflation rate and a decline in exchange rate and interest rate in Nigeria which is consistent with the foundings of Olomola (2006). On the response of treasury bill rate to a surge in the price of oil, we argue that treasury bill rate as a monetary policy has an inverse relationship with oil price shock.

Keywords: Oil price shocks, Monetary policy , Impulse response function.

1. Introduction

Following a slump in oil prices in 2009 which caused a large contraction in the value of Nigeria's exports to US$28.2bn, from US$76.3bn in 2008, the CBN embarked on "emergency" measures to bolster the liquidity of the system by easing the monetary policy rate from 9.75% to 8 percent. It has cut the cash reserve requirement for banks by half, from 2% to one percent and banks' minimum liquidity ratios by 5% to 25 percent. These emergency measures are aimed at improving liquidity conditions in the domestic economy as

well as responding to the complex mix of external and domestic financial developments affecting Nigeria.

However, Sebastian Spio-Gebrah faulted CBN's moves, saying that they are inflationary (Nigeria's core inflation rose from 2.5% in January 2008 to 8 percent in January 2009) adding that, this policy might lead to agitation by civil servants for an increase in wages, which the government may not be able to do. Moreover, according to him, these measures do not address the growing worry by many Nigerian savers who may lose substantial sums of money to some of the middle-tier banks who may be facing an "insolvent" crisis in addition to the more generalized financial sector "liquidity" problem. For example, over the past six months the non-performing loan ratios of many banks have risen. In response, some of the most stressed ones have dramatically increased the interest rates they pay to depositors, while also dramatically cutting back on lending. This deeply-worrying phenomenon may have necessitated the adoption of the unprecedented policy of interest-rate controls on both deposits (max.15%) and credit (max.22%). Regrettably the loosening of liquidity has not done anything structurally to address the underlying bank-toxic-loan problem which triggered the liquidity problem in the first place.

Import growth slowed down, owing to falling international prices for many commodities and lower domestic demand, but the traditional trade surplus is forecast to turn to deficit. Meanwhile, the services and income accounts remained firmly in deficit, although the income deficit shrank in line with the fall in oil prices and concomitant lower profit remittances from the international oil companies operating in Nigeria.

Sharp increases in the price of oil are generally seen as a major contributor to business cycle asymmetries. Early scepticism that oil comprised a large enough sector of the economy to be responsible for the recessions following the price shocks has led to a number of studies that try to distinguish between the effects of oil price shocks and monetary policy shocks around the episodes of 1973-74, 1979-80 and 1990-91. An oil price shock confronts monetary policy with a fundamental trade-off. A restrictive monetary policy is needed to counter rising inflationary pressure, while efforts to offset real economic effects call for a more accommodative policy. The monetary policy response can therefore have a major influence on the extent to which higher oil prices impact inflation and the real economy. The extent of this influence has long been the subject of controversial debates. This debate has been made more difficult by the fact that the oil price is increasingly driven by demand. It is becoming more and more difficult to disentangle the monetary policy response to an oil shock from the response to a general increase in inflation. Moreover, since the CBN's interest rates have not yet translated into increased spending on interest-sensitive investment and consumption, there is no alternative to fiscal policy if government wants to reverse the current downturn. Against this background, the paper seeks to assess the relationship between oil price volatility and monetary policy with reference to Nigeria between 1970 and 2010. The rest of the paper, beside the introduction, which occupies section one, is organized in the following way. Section two dwells on literature review and theoretical issues. Section three presents the research methodology of the paper, section four contains empirical results and discussion, and finally, summary and recommendations are drawn in section five.

2. Literature Review

According to Luft (2006) since 1970s, the world economy has suffered adversely due to fluctuation in oil prices. Although there were periods of recovery but that could not sustain long and the adverse impact mostly dominated the world economy (IMF, 2000). The developed economies faced decline in growth estimated to be around 2% per annum.

With regard to the response of monetary authority to oil price changes, Bohi (1989) asserted that, if a classic supply shock explains the principal effects of an oil price shock, energy-intensive industries should be the most affected after an increase in energy prices. However, since he found no relationship between these industries and their level of energy-intensity and no statistically significants effects of oil price shocks on the business cycle of four countries, he concluded that the restrictive monetary policy carried out by the central banks of these countries accounts for much of the decline in aggregate economic activity in the years that followed oil price increases.

According to Golub (1983), rise in oil prices is a form of wealth transfer from oil importing economies to oil exporting economies. Thus, the impact of oil price shocks on the exchange rate would depend on the distribution of oil imports across oil importing economies.

Similarly, results by Bernanke, Gentler and Watson (1997) clearly support this view demonstrating that if, following an oil price shock, the Federal Reserve had not increased interest rates, the economic downturns that hit the U.S. might be largely avoided. In particular they show that the U.S. economy responds differently to an oil price shock when the federal funds rate is constrained to be constant than in the case in which monetary policy is unconstrained. In the unconstrained case, a positive oil price shock leads to an increase in the federal funds rate and a decline in real GDP. With the federal funds rate held constant, BGW find that a positive oil price shock results in an increase of real GDP and of the inflation rate. According to the three authors these results show the importance of the part of the real effects of oil price shocks due to the monetary policy response.

Hamilton and Herrera (2001) challenged the conclusions of BGW on two grounds. First, they found that both the nature and magnitude of the actions suggested for the U.S. central bank are sufficiently inconsistent with the historical correlations as to call into question the feasibility of such a policy. Second, they demonstrated that if a longer lag length is considered even when the federal funds rate is kept constant an oil price shock still yields a sizable reduction in output, which implies that monetary policy has little effect in easing the real consequences of an oil price shock. The analysis of Hamilton and Herrera is consistent with those of other authors who show that counter-inflationary monetary policy was only partly responsible for the real effects of oil price shocks that hit the U.S. during the last thirty years.
Other authors who have stressed as causes of the economic downturns that hit the developed countries in the ’70s and ’80s possible indirect effects arising from the Federal Reserve’s response to the inflation presumably caused by an oil price increases have been Barsky and Kilian (2001). Their analysis suggests that the Great Stagflation observed in the 1970s is unlikely to have been caused by oil price shocks; however, it was at first a monetary phenomenon: in substantial part it could have been avoided, if the Federal Reserve had not permitted major monetary expansions in the early 1970s.

Finally, several economists have argued that monetary policy could be responsible for the asymmetric response of aggregate economic activity following an oil price shocks. While Tatom (1988) provided some early evidence that monetary policy responded asymmetrically to oil price shocks by showing that the economy responded symmetrically to oil price shocks if the stance of monetary policy is taken into account, Ferderer (1996) showed that monetary policy cannot account for the asymmetry in the response of real activity to oil price shocks in his model.

Balke, Brown and Yucel (2002) found that, even if negative and positive oil price shocks have asymmetric effects on output and interest rates, the Federal Reserve’s response to oil price shocks does not cause asymmetry in real economy activity. In fact while interest rates does appear to respond asymmetrically to oil prices movements, the asymmetric response of real GDP does not go away - and in fact is enhanced - when movements in either the Fed Funds rate or the Fed Funds rate and expectations of the Fed Funds are eliminated.

Cunado and Gracia(2004**),** in a study on "Oil prices economic activity and inflation: evidence for some Asian countries", they studied for six Asian countries over the period 1975Q1–2002Q2, suggested that oil prices had a significant effect on both economic activity and price indexes, although the impact was limited to the short run and more significant when oil price shocks are defined in local currencies and found evidence of asymmetries in the oil prices–macro economy relationship for some of the Asian countries.

Berument and Ceylan (2005) examined how oil price shocks affect the output growth of selected Middle East and North African countries that are either exporters or net importers of oil commodities. In this respect, they used a structural vectorautore-gressive (SVAR) model, focusing explicitly on world oil prices and the real GDP over the period of 1960-2003. Their impulse response analysis suggests that the effects of the world oil price on GDP of Algeria, Iran, Iraq, Jordan, Kuwait, Oman, Qatar, Syria, Tunisia and UAE are positive and statistically significant. However, for Bahrain, Egypt, Lebanon, Morocco and Yemen they did not find a significant impact on oil price shocks.

Adejumo (2006) examined the effects of oil price shocks on output, inflation, real exchange rate and money supply in Nigeria using quarterly data from 1970 to 2003. Using VAR methodology they find that oil price shocks do not have any substantial effect on output and inflation. Oil price shocks only significantly determine the real exchange rate and in the long run money supply. Olomola and Adejumo conclude that this may squeeze the tradable sector, giving rise to the "DutchDisease".

Markwardt (2007), by applying a VAR approach, analyzed the dynamic relationship between asymmetric oil price shocks and major macroeconomic variables in Iran. Contrary to previous empirical findings for oil net importing developed countries, oil price increases (decreases) have a significant positive (negative) impact on industrial output. Unexpectedly, we can not identify an significant impact of oil price fluctuation on real government expenditures. The response of real imports and the real effective exchange rate to asymmetric oil price shocks are significant. Furthermore, the response of inflation to any kind of oil price shocks is significant and positive.

More reently, Korhonen and Juurikkala (2009), using pooled data from 1975-2005, showed that high oil price leads to appreciation of the real exchange rate with the elasticity of exchange rate to oil price between 0.4 and 0.5.

3. Data and Methodology

The study adopts annual time series data for the period 1970 to 2010. This period is chosen to capture the first and second oil boom periods of the 70s and mid-2000s respectively. To represent the oil price (nominal oil price), we chose the price index in US dollars of Bonny Light crude oil (*rop)*. The monetary indicators used includes inflation rate *(inf)*; real effective exchange rate (*rexr*); treasury bill *(tbr);* interest rate *(intr)* and money supply *(mss).* The oil price data which is used in this study is taken from International Monetary Fund and International Energy Agency websites. Data of key monetary variables will be obtained from the Central Bank of Nigeria (CBN) publications, National Bureau of Statistics (NRS) and the World Bank publications.

To investigate the response of macroeconomic variables to asymmetric and innovations in oil prices, an unrestricted Vector Autoregressive model (VAR) is adopted. The VAR is commonly used for forecasting system of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. It provides a multivariate framework where changes in a particular variable (oil price) are related to changes in its own lags and to changes in other variables and the lags of those variables.

Our unrestricted autoregressive VAR model in reduced form of order p is presented in the following equation,

$$Y_t = c + \sum A_i y_{t-i} + \varepsilon_t \qquad (3.1)$$

where $c = (c_1, \ldots\ldots\ldots\ldots, c_6)$ is the (6*X*1) intercept vector of the VAR, *Ai* is the *ith* (6*X*6) matrix of autoregressive coefficients for $i = 1,2,\ldots\ldots\ldots,p$ and is the (6 *X* 1) generalization of a white noise process.

As described in the data section, we use six endogenous macroeconomic variables in our system: *rop*, *tbr*, *inf*, *mss*, *exr*, and *intr*. The form of unrestricted VAR system in this study is thus given by:

$$\begin{bmatrix} rop \\ tbr \\ \inf \\ mss \\ exr \\ \text{int } r \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \\ c_3 \\ c_4 \\ c_5 \\ c_6 \end{bmatrix} + A(l) \begin{bmatrix} rop_{t-1} \\ tbr_{t-1} \\ \inf_{t-1} \\ mss_{t-1} \\ exr_{t-1} \\ \text{int } r_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix} \qquad (3.2)$$

where *A*(*l*) is the lag polynomial operators, the error vectors are assumed to be mean zero, contemporaneously correlated, but not autocorrelated.

The unrestricted VAR system can be transformed into a moving average representation in order to analyze the system's response to a shock on real oil prices, which is:

$$y_t = \mu + \sum_{i=0}^{\infty} \psi_i \varepsilon_{t-i} \qquad (3.3)$$

with ψ_0 is the identity matrix and μ is the mean of process:

$$\mu = (I_p - \sum_{i=0}^{\infty} A_i)^{-1} c \qquad (3.4)$$

The application of moving average representation is to obtain the forecast error variance decomposition (VDC) and the impulse response functions (IRF). In this study, the innovations of current and past one-step ahead forecast errors would be orthogonalised using Cholesky decomposition so that the resulting covariance matrix is diagonal. This assumes that the first variable in a per-specified ordering has an immediate impact on all markets and variables in the system, excluding the first variable and so on. In fact, pre-specified ordering of markets and variables is important and can change the dynamics of a VAR system. In this analysis, we will use two different orderings. The first one is as follows: *rop*, *tb*, *inf*, *mss*, *exr* and *intr*. For robustness test we shall make use of an alternative ordering which is based on VAR Granger Causality test is as follow: *rop*, *intr*, *inf*, *mss*, *exr* and bop.

The alternative approach related to studies of the macroeconomics of oil price shocks is applying structural vector autoregressive models (SVAR). Essentially, the SVAR attempts to identify the variance decomposition and impulse response functions by imposing a priori

restrictions on the covariance matrix of the structural errors and the contemporaneous and/or long-run impulse responses themselves. But the SVAR approach has also some drawbacks, one of them is validity of this a priori restrictions. In the case of linkages between macroeconomic variables in the system, it would be very difficult to impose a priori assumptions. In order to overcome the problems of the dependence of the orthogonalised impulse responses on the ordering of the variables in the VAR and the SVAR approach, the generalised VAR was developed by Pesaran and Shin (1998). This approach is invariant to the ordering of the variables in the VAR and therefore results in one unique solution.

4. Empirical Result

4.1 Unit Root and Cointegration Tests

The first step in our empirical implementation is to determine the unit root and cointegration properties of the variables under consideration. Briefly stated, a variable is said to be integrated of order d, written I(d) if it requires differencing d times to achieve stationary. Then, a set of variables is considered cointegrated if they are non-stationary integrated of the same order and yet their linear combination is stationary. The evidence of cointegration suggests that they cannot drift farther away form each other arbitrarily. Any deviations of a variable from the long run relationship will result in some variables adjusting to return back to the long run path; that is, the deviations (or disequilibrium) will be corrected. Accordingly, results from cointegration test not only provide information on the long run relationship among the variables but also are crucial for proper specification of their short run dynamics.
We apply the commonly used augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests to determine the variables' stationarity properties or integration order. Before estimating the VAR model, we use the most recommended Akaike Information Criterion (AIC) test to determine the lag length of the VAR system to make sure the model is well specified.

Table 4.1: Unit Root Test Result

Variables	DF		ADF		Phillips -Perron	
	Level	1st Diff	Level	1st Diff	Level	1st Diff
ROP	-2.09**	-5.67***	-2.48**	-7.51***	2.47**	-7.15***
TBR	-3.68***	-8.43***	-3.71***	-8.33***	-3.71***	-32.02***
EXR	-0.87	-6.11***	-0.71	-6.20***	-0.71	-6.20***
INF	-3.09***	-6.07***	-3.10**	-6.08***	-3.00**	-9.67***
INTR	0.87	-9.52***	-1.27	-9.41***	-1.64	-9.52***
MSS	-0.85	-1.99**	1.91	2.89**	0.67	2.49**

Note : *, **, *** statistically significant at 10%, 5% and 1% significant level

The result of table 4.1 indicates that only ROP, TBR and INF are stationary at level. That is, EXR, INTR, and MSS show presence of unit root at levels using DF, ADF and PP statistics. The null hypothesis of presence of unit root for EXR, INTR and MSS is therefore acepted at level. At first difference, all the series are integrated at order 1. i.e. The result reflects the data is integrated at order one.

Next step is to check the long run association among the variables whether they exist or not for this purpose Johnson con integration test was used. The finding of Johnson co integration test shown in table 4.2

4.2 Johansen Cointegration Test Result

Having established the order of integration of our series in the preceding section, the next task is to determine the number of long run equilibrium relationships or cointegrating vectors among the variables. We conduct the cointegration test in line with the Johansen test specified in equation (3.2). Table 4.2 presents the test results for the number of cointegrating vectors. The results show that both the maximum eigenvalue and the trace statistic suggest the presence of one cointegrating equation among the six variables in the Nigerian economy at 1 percent level in line with the Osterwald-Lenum critical values. This unveils the existence of a long run equilibrium relationship between real oil price and the variables used in the model.

Table 4.2: Johanson Cointegration test result

Hypothesized No. of CE(s)	Trace Statistic	0.05 Critical Value	Max-Eigen Statistic	0.05 Critical Value
None *	287.0637	95.75366	90.60566	40.07757
At most 1 *	196.4580	69.81889	76.87625	33.87687
At most 2 *	119.5818	47.85613	47.54563	27.58434
At most 3 *	72.03614	29.79707	29.00534	21.13162
At most 4 *	43.03080	15.49471	26.73634	14.26460
At most 5 *	16.29446	3.841466	16.29446	3.841466

After having found six cointegration relationships between the variables ROP, INF, EXR, INTR, MSS and TBR ,we chose the cointegrating equation which best meets our a priori expectations. The selected cointegration equation is normalized on the oil price rate variable since the objective of this study is to determine whether a long run relationship exists between ROP and the other variables. Table 4.3 presents the normalized *(β)* of the variables in the model. All the coefficients were correctly signed and statistically significant at 1 percent level

$$INTR = 0.427732 - 0.23939\,ROP - 0.00001\,MSS + 0.03369\,EXR - 0.04058\,INF - 0.00018\,TBR \quad (1)$$

$$EXR = 0.0249 - 7.10639\,ROP - 0.00031\,MSS + 29.6858\,INTR - 1.20475\,INF - 0.00519\,TBR \quad (2)$$

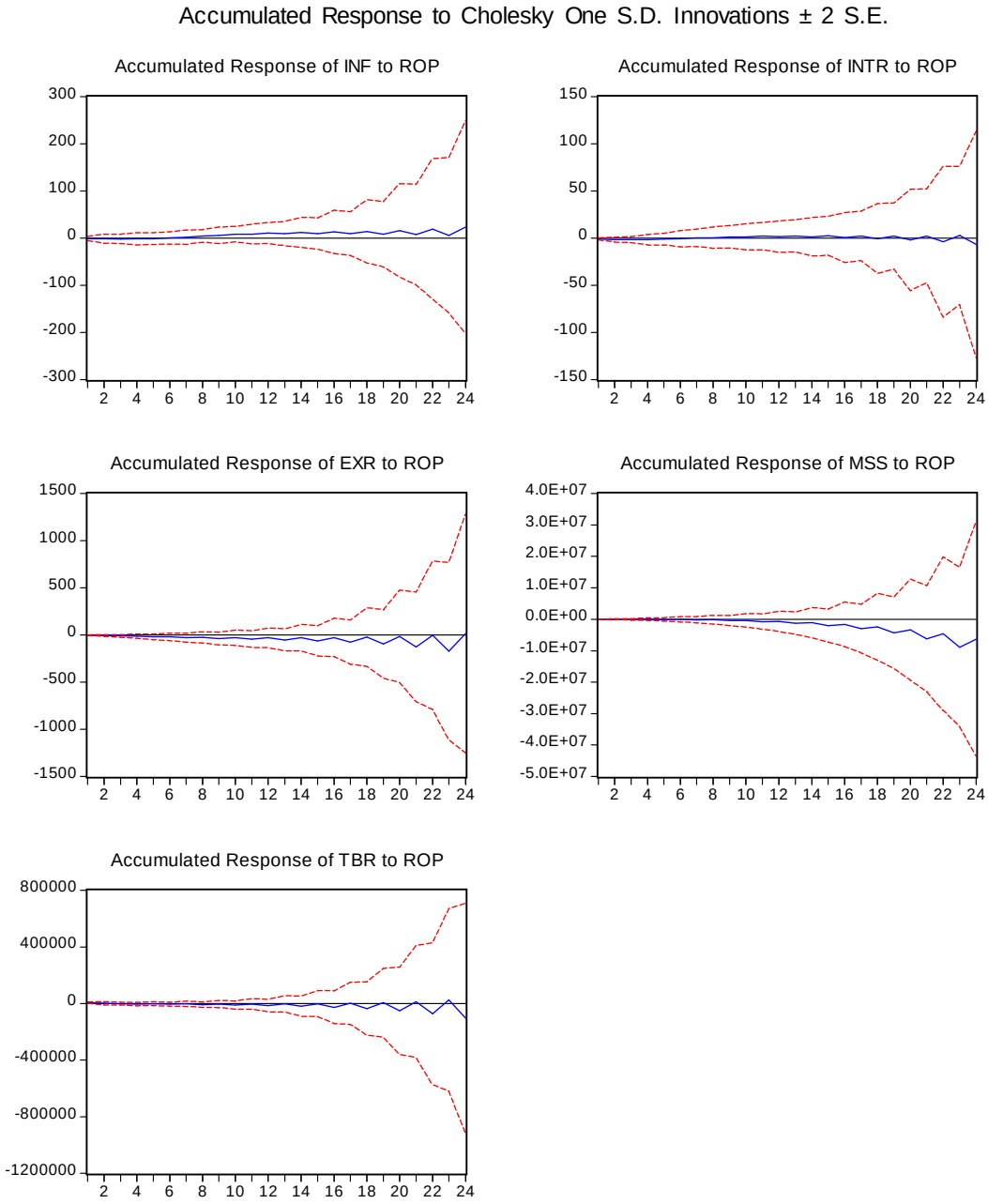
$$TBR = 0.56334 - 1368.78\,ROP + 0.05997\,MSS - 192.61\,EXR - 5717.84\,INTR - 1.20475\,INF \quad (3)$$

Based on cointegration results (equations 1 to 3) the long-term impact of crude oil price on monetary variables. With interest rate as a dependent variable, we can interpret that, in the long run a one percent increase in oil price cause the interest rate to decrease by 0.24 percent With exchange rate as the dependent variable, we found that crude oil price is negatively correlated with exchange rate. Finally, considering treasury bill as a monetary policy instrument, we also observed that increase in oil price shock discourages sell of treasury bill.

4.3 Impulse Response Function

In order to capture the short-run dynamics of the model, we use impulse response functions, which trace the effect of a one-standard-deviation shock in a variable on current and future values of the variables. In our model, we assume that oil prices do not react to disturbances in the monetary variables. The shock can be identified through a standard Cholesky decomposition with the variables ordered as follows: [*rop, mss,*intr*, tbr, inf* and *exr*].

Table 4.4 shows the accumulated response to a positive oil price shock. These results suggest that rising oil price has positive effects on inflation rate was initially negative in the first five quarters but began to appreciate from the sixth quarter and increased to 0.23 percent in the twenty-fourth quarter. Also, interest rate declined initially to sixth quarter, increased in the next ten quarters, then unexpectedly fell to 6.51 in the last quarter. At the same time, for exchange rate, the response to the shock is marginally negative all through the whole quarters. This may be mainly attributed to the decrease aggregate demand driven by oil export income. Money supply and Treasury bill rate also responded in similar fashion to increase in oil price shocks.



5. Conclusion

In this paper, using co-integration analysis and impulse response functions, we have attempted empirically to assess to what extent the World oil price increases affect real

effective exchange rate, inflation rate, money supply, interest rate and treasury bill rate in Nigeria for the period 1970 - 2010. The results indicate that there is a long run relationship involving oil prices, inflation rate, treasury bill rate, exchange rate and interest rate in Nigeria in which oil price positively impact the price level. In the short run, we find that an unexpected oil price shock is followed by an increase in inflation rate and a decline in exchange rate in Nigeria which is consistent with the foundings of Olomola (2006) . On the response of interest rate to a surge in the price of oil, we argue that monetary policy has in the past been with the intention of lessening any growth consequences of oil price shocks, but at the cost of higher inflation. Our findings also demonstrate that oil price shocks do not have substantial effects on Treasury bill rate. The fact that oil price shocks impact the Nigerian economy and the recent decision of the government to eliminate subsidies on petroleum products and bring domestic petroleum prices closer to world prices has important implications for monetary policy. For an effective inflation targeting in Nigeria, the credibility of monetary and fiscal policies should be improved and properly coordinated so as to anchor inflationary expectations and mitigate any external shocks on the economy.
Thus, we conclude that oil price shock is an important determinant of real exchange rates and in the long run money supply..

References

[1] J.O. Adekunle, The demand for money, in money and monetary policy in *Less Developed Countries- A Survey of Issues and Evidence*, edited by W.L. Coats and D.R. Khatkhate, (1980), London, Pergamon Press.

[2] B. Adrangi and M. Allender, Budget deficits and stock prices: International evidence, *Journal of Economics*, 22(2-3) (1998), 57-66.

[3] P.R. Agenor, Money, exchange rates and inflation in Africa: A vector autoregression analysis, *International Monetary Fund*, (Unpublished), November (1989).

[4] S. Johansen, Statistical analysis of cointegration vectors, *Journal of Economic Dynamics and Control*, 2(June-September) (1988), 231-54.

[5] S. Johansen and K. Juselius, Maximum likelihood estimation and inferences on cointegration – With application to the demand for money, *Oxford Bulletin of Economics and Statistics*, 52(2) (1990), 169-210.

[6] S. Johansen, *Likelihood-Based Interference in Cointegrated Vector Autoregressive Models*, (1997), Oxford, Oxford University Press.

[7] P.A. Olomola, Oil price shock and aggregate economic activity in Nigeria, *African Economic and Business Review*, 4(2) (2006), 48-61.

[8] E. Papapetrou, Oil price shocks, stock market, economic activity and employment in Greece, *Energy Economics*, 23(5) (2001), 511-532.

[9] C. Price, Nigeria's compass in the tide of economic meltdown, *Business Day*, 30 March (2009), 30 and 50.

[10] J.L. Pierce and J.J. Enzler, The effects of external inflationary shocks, *Brookings Papers on Economic Activity*, 5(1) (1974), 13-61.

[11] R. Rasche and J. Tatom, Energy price shocks, aggregate supply and monetary policy: The theory and the international evidence, in K. Brunner and A.H. Meltzer, (eds), Supply shocks, Incentives and National Wealth, *Canergie-Rochester Conference Series on Public Policy*, 14(1981), 125-142.