International Journal of Economics, Commerce and Management
United Kingdom Vol. VII, Issue 1, January 2019
http://ijecm.co.uk/ ISSN 2348 0386

OIL PRICE SHOCKS AND MACROECONOMIC VARIABLES IN NIGERIA: A LOCAL PROJECTION IMPULSE RESPONSE FUNCTION APPROACH

Joseph C. Odionye
Department of Economics, Abia State University, Uturu Nigeria
josephodionye@yahoo.com

Benson Mbonu Ogbonna
Department of Economics, Abia State University, Uturu, Nigeria

Chikeziem Fortunatus Okorontah
Department of Economics, Rhema University Aba, Nigeria

Abstract

The impact of oil price shocks on exchange rate and economic output has been a matter of great concern to policy makers in many oil dependence economies such as Nigeria. Hence, this study investigated the effects of oil price shocks on macroeconomic variables in Nigeria from 1981-2016. The study employed local projection impulse response function (LPIRF) to determine the response of exchange rate and economic output to oil price shocks in Nigeria. The LPIRF results suggest that exchange rate and GDP respond significantly to oil price shocks and that there is a higher persistence level of oil price shocks in exchange rate than GDP. Furthermore, the empirical results shows that shock in oil prices caused by its own shock is highly significant at 1% but cumulatively insignificant which implies that shocks in oil price accounted for by its own shock do not persist for a long time and its dies up rapidly.

Keywords: Oil price, GDP, Exchange rate, Shocks, Impulse response

INTRODUCTION

The effect of oil price movement on macroeconomic variables has occupied the attention of researchers and policymakers over the last four decades. The attention was drawn by an important role which oil plays in the world economy and the observed linkage between oil price movement and business cycle. Oil plays a dominant role in Nigerian economy given its huge contribution to the revenue of the country. For instance, data from CBN statistical bulletin (2011) shows that oil receipts accounted for 82.1%, 83% and about 90 per cent of the nation's foreign exchange earnings in 1974, 2008 and 2010 respectively. Similarly, the value of Nigeria's total export revenue in 2010 was US$70,579 million and the revenue of petroleum exports from the total export revenue was US$61,804 million which is 87.6% of total export revenue.

However, empirically, oil price is one of the most volatile prices which has a significant impact on macroeconomic behavior of many developed and developing economies (Ferderer, 1996; Guo & Kliesen, 2005). Furthermore the works of Mork, Olsen and Mysen (1994), Hooker (1999), Guo and Kliesen, (2005), Narayan and Narayan (2007), Mehrara (2008), Salisu and Fasanya (2013) all show the presence of volatility clustering and existence of asymmetries in oil price volatility.

The dependence of the Nigerian economy on oil proceeds as the major source of revenue is capable of raising suspicion about the effect of oil price shocks on macroeconomic volatility in the country. Macroeconomic volatility implies the vulnerability of macroeconomic variables to shocks. It is the tendency of macroeconomic variables such GDP, inflation, exchange rate etc to be unstable and weak in terms of withstanding shock. It is a situation whereby little shock in the economy subjects the macroeconomic variables to fluctuations and uncertainty. In the light of this, many studies investigated the impact of oil price movements on macroeconomic variables in Nigeria. However, there is no general consensus on the impact of oil price changes on economic output (see Adeniyi, 2011; Omojolaibi, 2013; Olowe, 2009; Wilson, David, Inyiama & Beatrice, 2014; Taiwo, Abayomi & Damilare, 2012; Apere & Ijiomah, 2013).

The recent dwindling in global crude oil prices which started in July 2014 has adversely affected Nigeria, especially in the areas of foreign reserves, currencies crisis, declining government revenue, and ultimately threat in terms of ability to meet financial obligations as at when due. Oil price fell from its all time high of USD105.87 in 2013 to USD 96.29 in 2014 and further fell to USD40.76 (OPEC, 2016). This means between 2013 and 2016 oil price declined sharply by more than half (64.5%). The resultant effect has been a large out pour of policies among policy makers and debate among economists on the best policy intervention to reverse the situation.

In response to this, the Nigerian government devalued its currency by 8% from N155 to N168 in October 2015, following the global oil price dwindling and depletion of foreign exchange reserve and economic downturn, in order to revive the economic situation. The Nigerian official exchange rate depreciated consistently since October 2015 from N168 in October, 2015 to N347.25 in August 2016 representing about 106.7 per cent in less than one year (CBN, 2016). The removal of subsidy in the downstream oil sub-sector which led to hike in gasoline pump price of 67 per cent further aggravated the situation as the Nigerian GDP grew by -0.36 per cent (year-on-year) in real terms in the first Quarter of 2016 and 0.82 per cent in the second quarter of the same year. This was lowered by 2.47 percent point from growth recorded in the preceding quarter and also lowered by 4.32 percent point from growth recorded in the last corresponding quarter of 2015. It averaged 0.18 percent from 2013 to 2016, reaching all time high of 9.19 percent in the third quarter of 2015 and a recorded low of -13.7 in the first quarter of 2016 (NBS, 2016).

These ugly economic trends have accentuated the need for a further study on the effects of oil price movements on macroeconomic variables in Nigeria. The remaining part of this work is divided into four sections. Section two discusses the theoretical literature, section three discusses the methodological issues and section four presents and discusses the empirical results while section five highlights policy implications and conclusions

LITERATURE REVIEW

Ujunwa (2013) in his research work conducted an investigation on the impact of the oil industry on the economic growth performance of Nigeria. In the process of the research, the ordinary least square (OLS) regression technique was employed. Considering the impact of time on changes in economic variables, the analysis was carried out using the simple regression method in which Gross Domestic Product (GDP), proxy for economic growth was used as the dependent variable, while the oil Revenue (OREV) and time appeared as repressors. A two-tailed test of 5% significant levels were conducted indicating that the two explanatory variables did not have any significant impact on growth performance of the Nigerian economy within the same period. The researcher therefore recommends that government should formulate appropriate policy mix that would motivate the firm in the oil sector to enhance improved performance and contribution of the sector.

Examining macroeconomic dynamics in oil exporting countries with the use of Panel VAR, Mohaghegh and Mehrara (2011) established that oil shocks are not necessarily inflationary. Further, domestic policies, instead of oil boom causes inflation and money is the main cause of macroeconomic fluctuations.

Ebrahim, Inderwidi and King (2014) embarked on theoretical investigation of macroeconomic impact of oil price volatility. The result showed that oil price volatility constitutes a fundamental barrier to economic growth due to its damaging and destabilizing effect on macro economy. Precisely, they show that oil price volatility adversely affect aggregate consumption, investment, industrial production, unemployment and inflation particularly in non-OECD countries. particularly in non-OECD countries.

Wilson, David, inyiama and Beatrice (2012) examined the relationship between oil price volatility and economic development in Nigeria. Applying Ordinary Least Square and Granger Causality Test, the study shows that there is no significant relationship between oil price volatility and key macroeconomic variables (Real GDP, inflation, interest rate and exchange rate).

Contrarily, the study of oil price shocks and volatility of selected macroeconomic indicators in Nigeria carried out by Taiwo, Abayomi and Damilare (2012) using Johasen Cointegration Test and Error Correction Model indicated that crude oil price, stock price and exchange rate have significant influence on the growth of the Nigerian economy. Oriakhi and Osaze (2013) examined the consequences of oil price volatility on the growth of the Nigeria economy within the period 1970 to 2010. With the use of VAR model, the study find that oil price volatility has direct impact on government expenditure, real exchange rate, and real import while real GDP and inflation are indirectly influenced by the oil price volatility. By implication the study shows that changes in oil price determine government expenditure which in turn determines the growth of the Nigerian economy.

Mordi and Adebiyi (2010) examined the asymmetric effects of oil price shocks on output and prices in Nigeria using a structural VAR model between 1990 and 2008. The result of their finding shows that the oil price shocks on output and prices is asymmetric in nature with the impact of oil price decrease significantly greater than oil price increase.

Similarly, using monthly data, Apere and Ijomah (2013) indicated unidirectional relationship between interest rate, exchange rate and oil price with direction from oil prices. Also, oil price has no significant impact on real GDP. They arrived at this conclusion with the use of EGARCH model, Impulse Response Function and Lag-Augmented VAR for the investigation of the macroeconomic impact of oil price levels and volatility in Nigeria during the period 1970-2009.

Bondzie, Bartolomeo and Fosu (2014) examined the impact of oil price fluctuation on the Ghanaian economy. Based on the features of its economy, they employed dynamic stochastic general equilibrium (DSGE) model and their results show a persistent effect of world oil price

and monetary policy shocks on economic growth. It further shows that a shock on interest rate leads to a sharp fall in prices.

Most recently, Abdulkareem and Abdulhakeem (2016) provides an analytical insight on modeling macroeconomics and oil price volatility in Nigeria. They employed quarterly data within the multivariate GARCH model. Their result shows that all the macroeconomic variables considered (RGDP, interest rate, exchange rate, oil prices) are volatile and they concluded that oil price is a major source of shocks to macroeconomic variables in Nigeria.

In another development, Imobighe (2015) studied the impact of oil price instability on the growth process of the Nigerian economy between 1970 and 1997. He employed simple regression technique and found a positive and significant relation between GDP and oil prices.
Nwanna and Eyedayi (2016) examined the impact of crude oil price volatility on economic growth in Nigeria between 1980 and 2014. They employed ordinary least square (OLS) technique and their results show a positive and significant relationship between oil price and economic growth in Nigeria.

Aimer (2016) examines the effects of fluctuations of oil price on economic growth in Libya using annual data from 2000 to 2015. Observing the sharp movements in the prices of oil as an important source of economic fluctuation in the world economy, he employed VAR model and johansen coinegration technique to examine the effects of fluctuation on output. He found out that there is no long run relationship between oil prices and economic growth. He further reports that oil price has a positive and statistical significant impact on economic growth in Libya.

METHODOLOGY

The data for this work were sourced from CBN Bulletin (2016). The study employed Local Projection Impulse Response Function due to Jorda (2005) and modified by Teulings and Zubanov (2014) to examine the response of macroeconomic variables to oil price shocks in. The LPIRF was introduced by Jorda (2005) as an alternative to impulse function generated by VAR and has been widely used because of its advantages over VAR. LPIRF uses a new set of estimates for each horizon and thus avoids escalation of the misspecification error through the non-linearity of the standard VIRFs technique as h increase and h > 1. The advantages of LPIRF over VAR are: (i) it is more robust to misspecification, (ii) it does not involve the same non-linearity as VAR and hence are more likely to be well approximated by Gaussian distribution, in contrast to VAR and SVAR, assumptions on the structure are not needed (iv) it can be estimated by simple regression and (v) it does not require identification (Jorda, 2005; 2007; Ronayne, 2011; Caselli and Roiman, 2015; IMF-WEO. 2016)

The general form of an impulse response function is given below:

$$IRF(\mathrm{t},\mathrm{h},\mathrm{d}_i) = E\left[y_{t+h} \middle| \ \mu_{t+h} \begin{Bmatrix} d_i \, if \ j=0 \\ 0 \ if \ j\in[1,\mathrm{h}] \end{Bmatrix}; \mathrm{I}_t \right] - E\left[y_{t+h} \middle| \ \mu_{t+h} = 0 \forall \ \mathrm{j} \in [0,\mathrm{h}]; \mathrm{I}_t \right] ...(1)$$

Thus IRFs measure the reaction of the system's variables at t+h, for h = 0,1,…,H to a shock of the disturbance vector of d_i .I_t is the information available at t which is the set of lagged dependent variable vectors up to lag order p.

In view of the above the LPIRF is specified as

$$IRF_{t+h} - [EXR_{t-1} + GDP_{t-1}] = \alpha_i^h +$$

$$\delta^h \Delta S_{t-1} + \sum_{i=1}^{p} \delta_{1,j}^h \Delta S_{j-j} + \sum_{j=0}^{p} \phi_{1,j}^h \Delta OPR_{t-j} + \sum_{j=1}^{p} \phi_{2,j}^h \Delta EXR_{t-j} + \sum_{j=0}^{h-1} \delta_{2,j}^h \Delta \mathrm{S}_{t-h-j} + \sum_{j=0}^{h-1} \phi_{3,j} \Delta OPR_{t+h-j} + \varepsilon_t^h ...(2)$$

Where, EXR = exchange rate, GDP = gross domestic product, OPR = oil price, h represents time horizon (h = 0, 1, ….H), ΔSt represents shocks variables caused by variables other than oil price (monetary policy shock), δ^h represents the cumulative effects on macroeconomic variables (EXR and GDP), where h denotes the time horizon, the third and fourth terms account for shocks in macroeconomic variables and other factors occurring before time t but may have influence on the macroeconomic outcomes in the country, the coefficient of EXR_{t-j} explains the effects on exchange rate caused by its own lagged. The fifth and sixth terms introduced by Teulings and Zubanov (2014) account or the effects of shocks in macroeconomic variables (EXR and GDP) and other variables occurring between t and t+h that can influence macroeconomic environment at time t+h.

In estimating the LPIRF model, we first run a VAR model with the maximum lag length and then select the optimal lag length based on information criteria. Then the next step is to estimate the LPIRFs. One of the problems of IRFs is that IRF can suffer from serial correlation, which may lead to wider marginal error bands. In order to avoid this problem, Jorda (2009) introduced two sets of conditional bands to represent uncertainty about the shape of the LPIRFs and to examine the individual significance of the coefficients in a given trajectory. The next step after estimating the LPIRF was to impose restrictions on impulse response and test for their significance level. Two significant tests are "joint" and "cumulative." "Joint" refers to the null hypothesis that all the response coefficients are jointly zero while "cumulative" refers to the null that the accumulated impulse response after included periods is zero. Lastly we carried out counterfactual analysis to enable us know the response of a macroeconomic variables to oil price shock due to conditioning path.

RESULTS AND DISCUSSION

Response of macroeconomic variables to oil price shocks using LPIRFs

As earlier stated, the starting point to estimate local projection impulse response function according to Jorda (2005, 2009) is to calculate and estimate VAR (q) model, and thereafter, estimate the local projection impulse response function. The lag length selection based on the information criteria, allowing for a maximum lag of four, was selected based on Akaike Information criteria. The result of the LPIRF is presented in the appendix B. The solid green lines with circles are the regular VAR impulse response function (VIRF) while the remaining solid lines are the LPIRF with associated marginal error bands at 95% confidence bands. The LPIRF result shows that GDP responds negatively to oil price shock after a short period (second period) but the first two periods, GDP respond insignificantly to oil price shock as the line oscillates around zero before it responds negatively after the second period. In the case of exchange rate, it responds negatively and exponentially to oil price shocks from the first period and the shock seems to persist for a longer time than that of GDP implying a high persistence level of shocks in exchange rate. This result suggests that there is a higher persistence level of shocks in exchange rate transmitted from oil price shock than in GDP. This result supports the findings of Abdulkareem and Abdulhakeem (2016) but contradicts the result of Imobighe (2015) all for Nigeria.

Test of Significance level of the Impulse Response coefficients

To test for the significance level of individual responses and to ensure that the IRF coefficients do not suffer from serial correlation, we run the LPIRF with the conditional error bands. Conditional error bands help remove the variability caused by serial correlation in IRFs (Jorda, 2009). The conditional error bands are consistent with two null hypotheses namely Joint and Cumulative null hypotheses. Joint null hypothesis refers to the null hypothesis that all the response coefficients are jointly zero and cumulative null hypothesis refers to the null hypothesis that the accumulated impulse response after 10 periods is zero. The summary of the result of the individual significance level extracted from the LPIRF conditional band (see Appendix B) is presented below:

Table 1: Summary of Result of the Significance Level of Macroeconomic Variables Responses to Oil Price Shocks using LPIRF (E-views 9.0 output)

Responses From	Joint Null Hypothesis	Cumulative Null Hypothesis
GDP	0.069	0.015*
EXCR	0.071	0.000**
OPR	0.000**	0.135

** (*) denote statistical significant at 1% and 5% levels of significance respectively.

Table 1 shows the p-values for the significance level of the response function. The decision rule is to reject the null hypothesis if the p-value is less or equal to 0.05. Obviously shock in oil price caused by its own shock is highly significant at 1% but cumulatively it is not significant as the p-values for the cumulative null hypothesis is greater than 0.05. This implies that shocks in oil price accounted for by its own shock do not persist for a long time and its effect dies up rapidly. The results further show that shocks transmitted from oil price to GDP and exchange rate is significant cumulatively given that only the cumulative null hypotheses are rejected. This implies that responses of macroeconomic variables (GDP and exchange rate) to shock in oil price are significant only after ten years.

Counterfactual Responses conditioning on shocks in Oil Price

Following Jorda (2009), we create a conditioning response path in order to examine the change in system's behavior. We impose a restriction on the response of inflation to a shock in exchange rate by substracting 0.25 points from every coefficient. Solid (blue) lines with squares and associated dashed (blue) lines are the original impulse responses with conditional error bands. Solid (red) line with the circles is the counterfactual response in the bottom graph, whereas it denotes the conditional response given this counterfactual in the top panel.

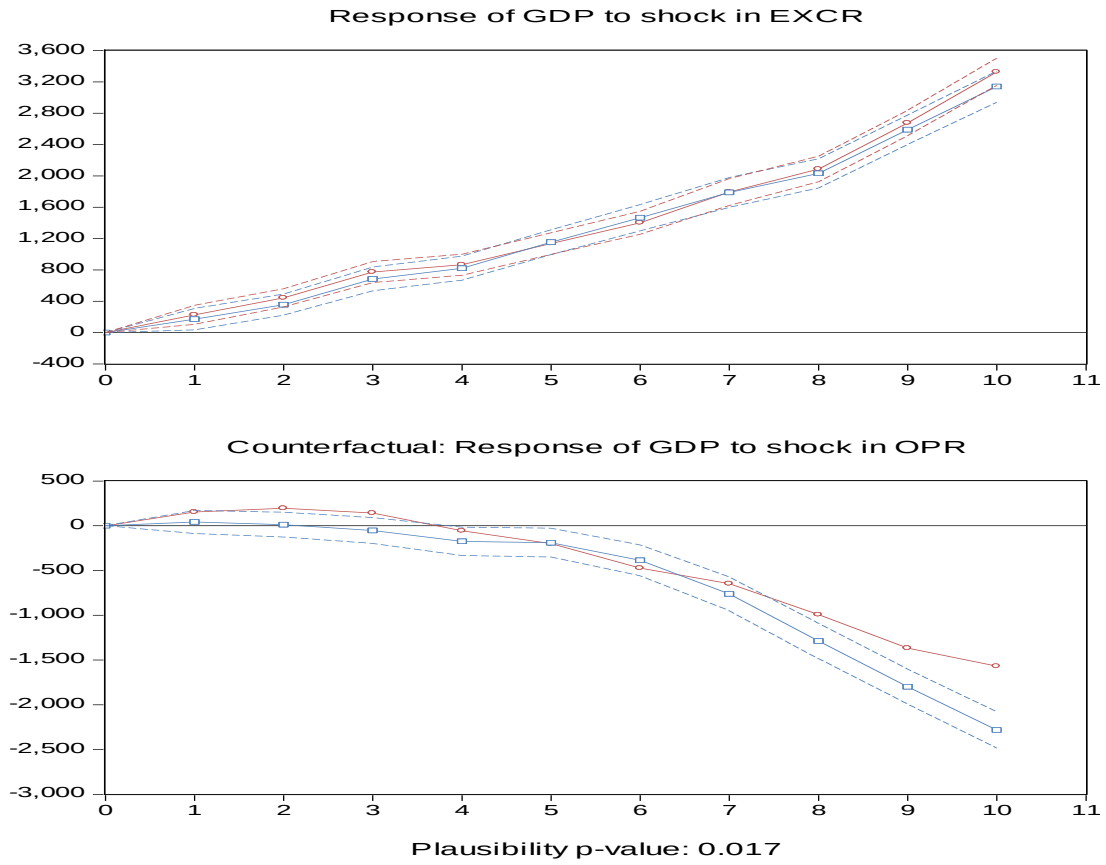


Figure 1: The response of GDP to oil price shocks

The above figure is the response of GDP to oil price shocks. The p-value measures the distance between the conditioning event and the sample estimates (Jorda, 2009; Stock and Watson, 2001). From the result we conclude that the response of GDP to oil price shock in Nigeria is significant since the p-value is less than 0.05.

İn order to see how the response of exchange rate to oil price shock due to the system behaviour in Nigeria, we estimate the counterfactual of response of exchange rate to oil price due to condioning path.

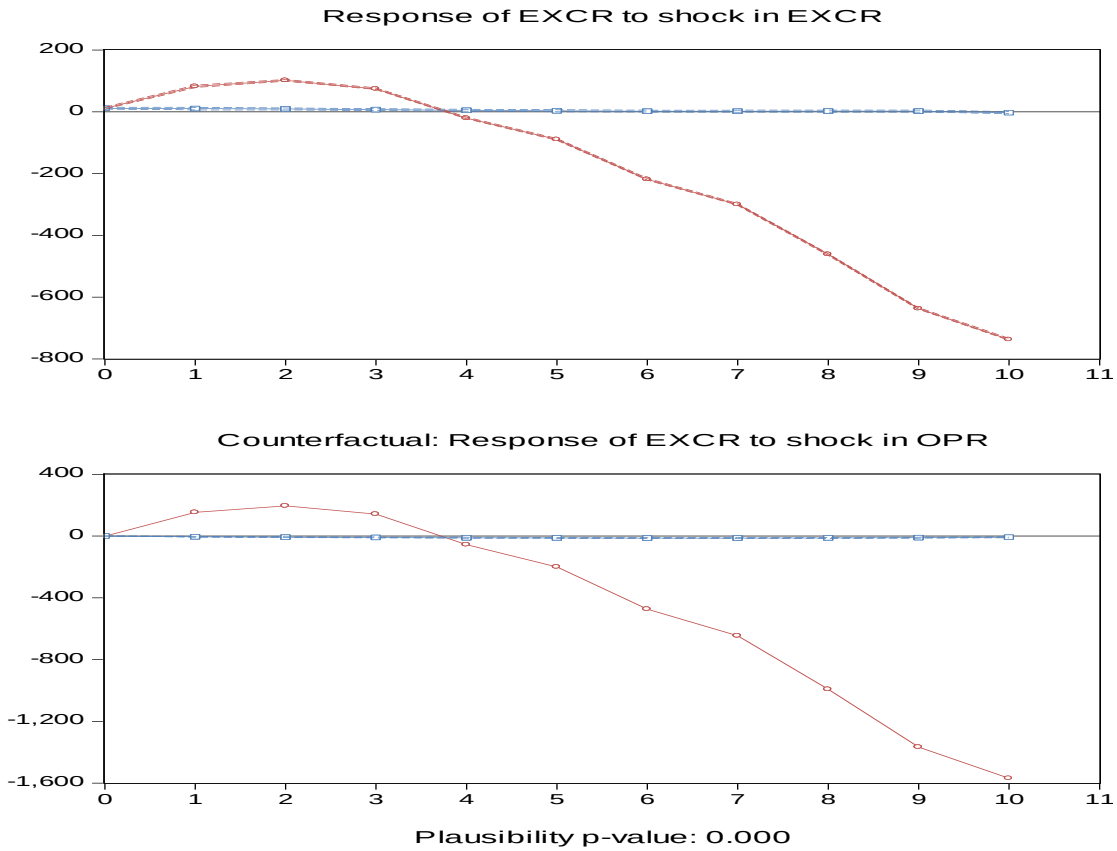


Figure 2: The response of exchange rate to oil price shocks

Obviously oil price shock due to conditioning path significantly transmit to exchange rate in Nigeria as the p-value is 0.000 (less than 0.05)

CONCLUSIONS AND POLICY IMPLICATIONS

The empirical result shows that GDP responds negatively to oil price shock after a short period while exchange rate responds negatively and exponentially to oil price shocks from the first period and the shock seems to persist for a longer time than that of GDP implying a higher persistence level of shocks in exchange rate than in GDP. The empirical result further shows

that shock in oil prices caused by its own shock is highly significant at 1% but cumulatively insignificant which implies that shocks in oil price accounted for by its own shock do not persist for a long time and its dies up rapidly. The results further show that shocks transmitted from oil price to GDP and exchange rate is significant cumulatively given that only the cumulative null hypotheses are rejected. This implies that responses of macroeconomic variables (GDP and exchange rate) to shock in oil price are significant only after a period of ten years. The policy implication of this study is that shocks in macroeconomic variables transmitted from oil price shocks have a long memory. This therefore requires a high degree of credibility in terms of policy response and appropriate and timely policy response is essential.

SCOPE FOR FURTHER STUDY

The study "Oil Price Shocks and Macroeconomic Variables: Local Projection Impulse Response Function" was carried out in Nigeria and covered the period 1981 to 2016. The macroeconomic variables included in the model were exchange rate and gross domestic product. Further study can be carried out to include key macroeconomic variable like inflation and may also consider how oil price shock affect stock prices in Nigeria.

REFERENCES

Abdulkareem, A. and Abdulhakeem, K. A. (2016). "Analysing Oil Price-Macroeconomy Volatility in Nigeria." CBN Journal of Applied Statistics in Nigeria, 7 (1), 1-22.

Adeniyi, O. A.(2011). Oil Price Shocks and Economic Growth in Nigeria: Are Thresholds Important? Department of Economics and Business Studies, Redeemers University.

Adeyemi, O. and Samuel, E. (2013). Exchange rate pass-through to consumer prices in Nigeria. European Scientific Journal, 9 (25), 110-123.

Aimer, N. M. M. (2016). "The Effect of Fluctuations of Oil Price on Economic Growth of Libya." Energy Economics Letters, 3 (2), 17-29.

Apere O. & Ijomah A. M. (2013). Macroeconomic Impact of Oil Price Levels and Volatility in Nigeria. International Journal of Academic Research in Economics and Management Sciences 2(4), 15-25

Bondzie, E. A., Bertolomeo, G. D. and Fosu, G. O. (2014). "Oil Price Fluctuations and it Impact on Economic Growth: A Dsge Approach." International Journal of Academic Research in Business and Social Siences, 2 (2), 217-242.

Caselli, F.G and Roitman, A. (2016). Non-linear exchange rate pass-through in Emerging markets. International Monetary Fund (IMF) Working Paper No. 16/1 pp 1-36.

CBN (2016). Revised Guidelines for the operation of the Nigerian Inter-bank Foreign Exchange Market (IFEM). 15th June, 2016.

Ebrahim, Z., Inderwildi, O.R. & King. D. A.(2014). Macroeconomic impacts of oil price volatility: mitigation and resilience, Front Energy review, 288-295

Ferderer, J.P. (1996). Oil Price Volatility and the Macroeconomy. Journal of Macroeconomics, 18 (1), 1-26.

Guo, H., & Kliesen, K.L. (2005). Oil price volatility and US macroeconomic activity. Review, Federal Reserve Bank of St. Louis 57 (6): 669–683.

Hooker, M.A. (1996). "What Happened to the Oil Price Macroeconomy Relationship?" Journal of Monetary Economics 38, 195-213.

Imobighe, M. D. (2015). “The Impact of Oil Price Instability on the Growth Process of the Nigerian Economy.” Journal of Resources Development and Management, 14 (2015), 56-70.

Jorda, O. (2005). Estimation and inference of impulse responses by local projections. American Economic Review, 161-182

Jorda, O. (2007). Joint Inference and counterfactual experimentation for impulse response function by local projection. University of California (Davis) Working Paper series, 06-24

Jorda, O. (2009). Simultaneous confidence regions for impulse response function. Review of Economics and Statistics, 91 (3), 629-647.

Mehrara, M. (2008). The sources of macroeconomic fluctuations in oil exporting countries: A comparative study. Economic Modelling, 24, 365–379.

Mohaghegh, M. & Mehrara, M. (2011). Macroeconomic Dynamics in the Oil Exporting Countries: A Panel VAR study. International Journal of Business and Social Science, 2(21), 288-295

Mork, K. A. O., Olsen, O.& Mysen, H. (1994). Macroeconomic Responses to Oil Price Increases and Decreases in Seven OECD Countries, Energy Journal, 15,19-35.

Narayan, P., & Narayan, S. (2007). Modelling oil price volatility. Energy Policy 35, 6549–6553.

National Bureau of Statistics (2016). Quarterly Review, first quarter, 2016.

Nwanna, O. I and Eyedayi, A. M. (2016). “Impact of Crude Oil Price Volatility on Economic

Growth in Nigeria.” IOSR Journal of Business and Management, 18 (6), 10-19.

Omojolaibi. A.J. (2013).Does Volatility in Crude Oil Price Precipitate Macroeconomic Performance in Nigeria? International Journal of Energy Economics and Policy, 3(2), 143-152.

Olowe, R. A. (2009). Oil Price Volatility and the Global Financial Crisis. Paper presented at 9th Global Conference on Business & Economics, Cambridge University, UK.

Ronayne, J.B. (2011). Which Impulse Response Function? Warwick Economic Research Paper No 971.

Salisu, A.A. & Fasayan, I.O. (2013). Modelling oil price volatility with structural breaks. Energy Policy, 52, 554-562.

Taiwo, M., Abayomi, T. & Damilare O. (2012). Crude Oil Price, Stock Price and Some Selected Macroeconomic Indicators: Implications on the Growth of Nigeria Economy, Research Journal of Finance and Accounting, 3(2), 42-48.

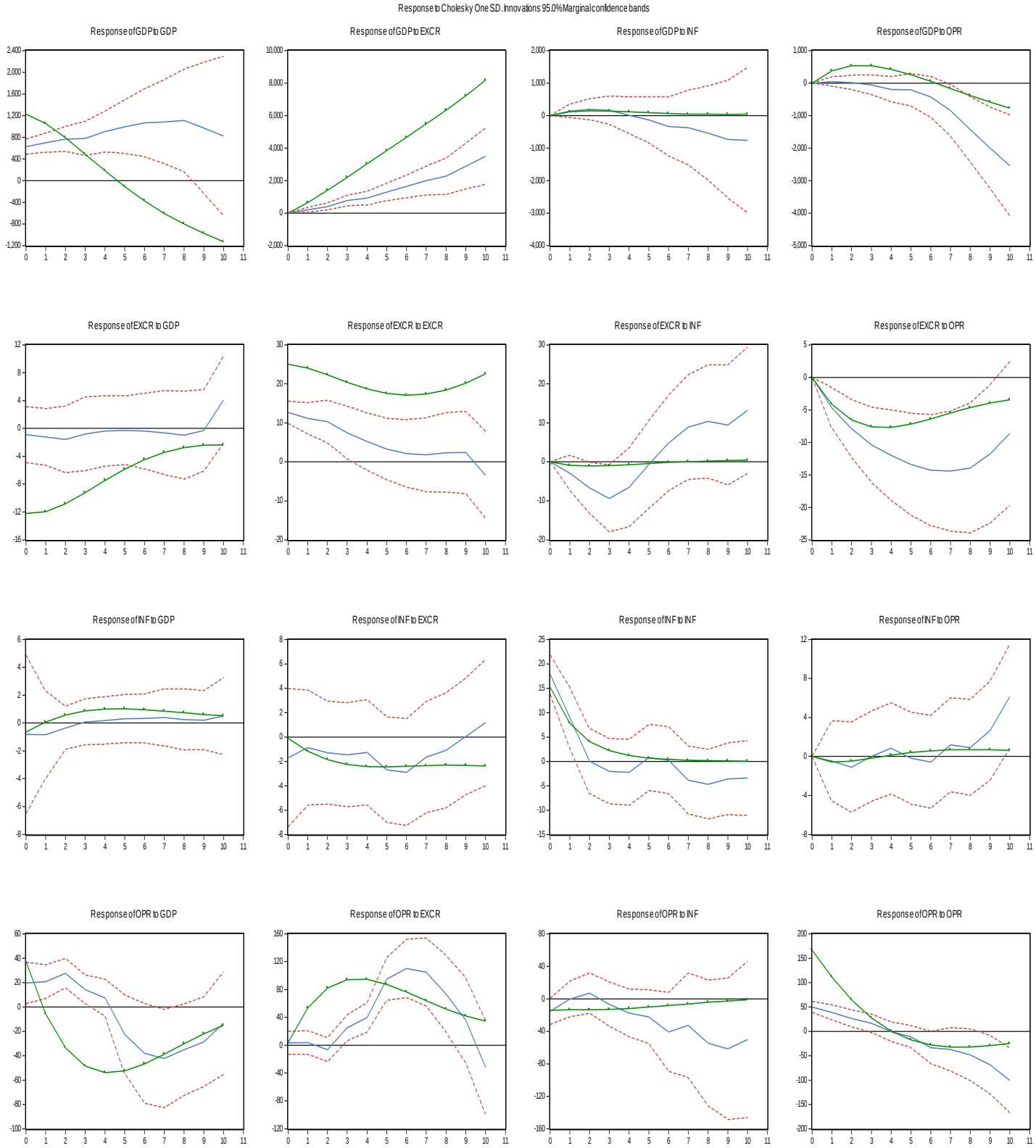
Teulings, C.N. and Zubanov, N. (2014). Is economic recovery a myth? Robust estimation of impulse response. Journal of Applied Econometrics, 29 (3), 497-514.

Wilson, A. David, U. Inyiama, O. & Beatrice, E. (2014). Oil price volatility and economic development: Stylized evidence in Nigeria. Journal of Economics and International Finance, 6(6), 125-133

Zubair, A., Okorie, G. and Sanusi, A.R. (2013). Exchange rate pass-through to domestic prices in Nigeria: An empirical investigation. Economic and Financial Review, 5 (1), 1-27

APPENDICES

Appendix A



Appendix B