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MONETARY TRANSMISSION CHANNEL, OIL PRICE SHOCK AND THE MANUFACTURING SECTOR IN NIGERIA

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Abstract

Research background: The need for diversification of the Nigerian economy has been emphasized and the manufacturing sector has a major role in this. Being an oil producing country, monetary policy is an important macroeconomic policy that has always been used to manage the influence of oil price shock on the manufacturing sector.
Purpose: The study examines the relationship between oil price shock, the monetary transmission mechanism and manufacturing output growth in Nigeria.
Research methodology: The study applied the structural vector auto regression (SVAR) modelling technique and a descriptive analysis.
Results: The results of the study show that the exchange rate is mostly affected by the oil price shock, while the monetary policy instruments and inflation rate are also very responsive to the exchange rate shock. The manufacturing sector output growth has also been shown to be strongly affected by the inflation rate and monetary policy shocks.
Novelty: The study has revealed the most effective channel via which oil price shocks affect manufacturing output. The exchange rate channel of the monetary policy transmission mechanism is the most significant channel through which oil price shock affects manufacturing output growth in Nigeria. This shows that effective management of the exchange rate policy via the appropriate monetary policy approach can be used to minimize the adverse effect of oil price shocks on Nigerian manufacturing output.

Keywords: Monetary Transmission Mechanism, Manufacturing Output, Oil Price Shocks
JEL classification: E23, E31, E52

Introduction

Movements in international crude oil price have created interesting episodes in oil exporting and oil dependent economies like Nigeria. Periods of oil price increase brings economic prosperity in terms of huge foreign exchange earnings and aggregate economic growth while periods of oil price collapse have resulted in serious economic downturns of oil dependent economies as was experienced in the mid-1980s when oil price declined to $ 11.59 per barrel. Relatedly, the recent decline in international crude oil price has been a major cause of concern for the Nigerian economy in general and policymakers in particular. The unprecedented progressive decline in oil price from about $ 105.79 per barrel mid-2014 to $ 30.32 per barrel in early 2016, created immense economic challenges for the Nigerian economy. This include among others, a 77.35% decline in oil earnings from ₦ 6,793.82 b in 2014 to ₦ 3,830.10 b in 2015; decline in the foreign reserve from $ 34,241.5 in December 2014 to $ 28,284.8 in December 2015. There was also an increase in exchange rate depreciation from ₦ 158.55/$ in 2014 to ₦ 193.28/$ and further to ₦ 304.5/$ in September 2016; and an increase in the inflation rate from a single of 8% in 2014 to a double digit inflation rate of 12.74% in August, 2016. A rising exchange rate depreciation and the inflation rate are expected to manifest in the growing cost of production with adverse consequences on production output. Consequently, the cumulative effect of the above is a nosedive in the growth rate of the economy from 6.22% in 2014 to 2.79 in 2015 and further to –0.36% and –2.06% in the first and second quarters of 2016 (National Bureau of Statistics, 2016).

Both the World Bank and International Monetary Fund have emphasized the need for the oil exporting countries in Africa to embrace diversification as a panacea to their economic problems (see World Bank, 2004; IMF, 2008). In Nigeria for example, the manufacturing sector has been tipped as a major sector that can help in the diversification process A. Kayode (2000). This sector has been described as a major catalyst that can boost local output of the real sector of the economy. For instance, among 65 countries that can be classified as natural resources–rich, only Botswana had long term investment exceeding 25% of its GDP between 1970 and 1998 and also recorded GNP per-capita growth exceeding 4% in a year (see Olomola, 2007; Gylfason, 2001). The major reason for the success of this economy was its ability to effectively diversify through accelerated growth in domestic output, which was made possible through a vibrant manufacturing sector (Olomola, 2007).

In the literature, the relevance and role of monetary policy in solving the myriads of problems confronting the oil producing countries' manufacturing sectors has been a subject

of debate (see for example Mohamed, 2011; Corden, Neary, 1982; Lama, Medina, 2010). All these debates are about coping with the pressure and fluctuations in oil price. For instance, the resulting pressure of the decline in international oil price on the domestic exchange rate through reductions in oil revenue (which is the main source of the supply of foreign currency in the forex market) and foreign reserve; could according to some schools of thought necessitate the monetary authority to employ tight monetary measures to curtail inflationary pressure. This monetary action will lead to high domestic interest rate, consequently discourage investment, and reduce manufacturing output with a rising unemployment rate (see Lee, 2005; Bernanke, 1986). However, another school of thought agreed that avoidance of a contractionary monetary policy would result in the increased cost of imported input owing to rising exchange rate depreciation. This will culminate into an increase in the marginal cost of production thereby cutting down a firm's capacity utilization and plummeting manufacturing output (Tang, Nasiopoulos, Ward, 2010).

However, while this claim may be substantiated in oil-importing or developed economies, the same cannot be said of oil-dependent economies like Nigeria where the price of oil drives the economy and oil revenue constitutes about 80% of foreign exchange earnings. The limitation of the straight forwardness of the monetary policy mechanism in an oil dependent economy like Nigeria is the fact that the bed rock of the economy which is oil price is exogenously determined hence it makes macroeconomic policies of the country highly susceptible to oil price shocks. Furthermore, identification of the monetary policy mechanism through which external shocks like oil price is transmitted to domestic manufacturing output remains very germane to the effectiveness of monetary policy in promoting the growth of the manufacturing sector in the country.

F.S. Mishkin (1995) identifies four channels of monetary policy transmission; interest rate channel, credit channel (balance-sheet and bank-lending channel), the exchange rate channel and other asset prices channel. However, the debate across the literature is more pronounced on both interest rate and exchange rate channels as it affects the real sector of the economy. This is as a result of the linkage between credit channels and interest rate channels as well as the linkage between exchange rate channels and asset price channels (See Clarida, Gertler, 1997; Bernanke, Mihov, 1997; Cushman, Zha, 1997; Smets, 1997; Kim, Roubini, 1995 and Barran, Coudert, Mojon, 2002).

Some groups of authors have concluded that interest rate channels tend to have the most pronounced effect on the output of the real sector. They support their points by explaining that a commodity price shock like oil price influence on the foreign exchange earning of a primary

good exporting country can be effectively transmitted to the real sector of the economy via an investment friendly interest rate which will improve credit availability for investment purposes. According to them, this is a way of channelling the economic prosperity brought about by the positive commodity price shocks to the productive activities that will promote the growth of the economy in the long run (see Kashyap, Stein, 2000; Kishan, Opiela, 2000; Huang, 2003; Sevestre, Loupias, Savignac, 2000).

On the other hand, some groups of authors have advocated the need for countries to manage their exchange rate properly in order to control the effect of external shocks on their domestic economic activities. Their arguments have been based on the fact that commodity price is strongly tied to exchange rate hence the influence on domestic output is enormous especially for developing countries that depend mainly on a primary export. They believed that the shock from commodity price like oil price is actually transmitted to the domestic economy via the exchange rate channel (See Smets, Wouters, 2003; Nombulelo, Alain, Eliphas, 2013).

It is evident from the discussions above that there is a lack of consensus in the literature regarding the monetary policy transmission mechanism channels that have the most pronounced effects on domestic activities when it comes to the effect of external shock. The case of the oil producing countries is peculiar as oil is among the most important international commodities that constitute external shocks to many economies in the world especially an oil exporting country like Nigeria.

Consequently, the major objective of this study is to investigate the monetary policy transmission channel that transmits the effects of oil price shock most to the Nigerian manufacturing sector being an important sub-sector under the real sector of the economy. The rest of the paper is divided into methodology, results and discussions and conclusions.

1. Methodology

This aspect of the study discusses the model specification, sources of the data and the method of analysis.

1.1. Model Specification

Following the endogenous growth model specifically, R. Barro and J. Lee (1993) as well as P. Romer (1989). The model that describes the relationship between the variables in the SVAR mode is stated as follows

The linear specification of the model to be estimated is expressed thus:

$$mgr_{t(i)} = \left[intr_t, msgr_t, inf_t, exr_t, oilgr_t, poil_t\right] \quad (1)$$

However, there is no independent or dependent variables in the model because an unrestricted VAR is utilized. Notwithstanding, oil price that is $poil_t$ is the exogenous variable identified in the model because it is determined outside the model. This is because oil is an international commodity whose price is determined by external forces beyond the control of the Nigerian monetary authority.

Again, this research effort is to examine the relationship between the monetary policy transmission mechanism, oil price shock and the growth of the manufacturing sector in Nigeria using a Structural VAR model. Generally, VAR models are seen as independent large scale macro econometric models that do not rely on unrealistic assumptions (Elbourne, 2007). The foremost theoretical framework of VAR analysis as proposed by C.A. Sims (1980) used Choleski decomposition to get impulse responses. However, the Choleski decomposition used in the VAR approach has been described as highly prone to incredible causal ordering if the researcher is interested in looking at more than just monetary shocks (see Bernanke, 1986; Elbourne, 2007). Whereas the structural VAR (SVAR) provides economic information for the rationale behind the restrictions that helps in identifying both monetary policy shocks and other shocks. Again, the study is interested in studying the short-term and the medium term behaviours of the variables since there is a near consensus that monetary policy can only influence output significantly in the short run (see Gul, Mughal, Rahim 2012; Sidrauski, 1967).

Since Nigeria is a net oil exporter in Africa we cannot ignore the influence of both oil resources and oil price shocks apart from the monetary policy shocks hence the suitability of the SVAR approach for this study. Another justification for choosing SVAR is the argument that not all variables respond instantaneously to shocks provided by VAR. Evidence from previous research has shown that many variables exhibit delay in their responses to shocks due to financial deepening and the level of integration with the global economy. The structure of the matrix in SVAR has made provision for this (see Ngalawa, Viegi, 2008). In addition, the Choleski decomposition in VAR used a partial identification which can only identify just one of the underlying structural shocks. All other shocks are treated as responding contemporaneously to the identified shocks (Elbourne, 2007).

According to S. Kim and N. Roubini (2000) SVAR has been designed to deal with all the puzzles that have affected the recent literature on the effects of monetary policy on economic

activities. The SVAR model adopted for this study is designed to allow for the assessment of both monetary policy shock and oil shocks on the manufacturing sector growth of Nigeria.

1.2. The SVAR Model

The construction of our VAR model follows the conventional method where the initial model is specified thus:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} +, ... + A_p y_{t-p} + \mu_t \tag{2}$$

where: y_t represents an ($n \times 1$) vector containing n endogenous variables, A_i ($i = 1, 2, \ldots, p$) are ($n \times n$) matrices coefficients, and μ_t is an ($n \times 1$) vector containing error terms.

Though the error is $\mu_t \sim iid\, N(0, \Omega)$ but errors do possess the tendency of correlating contemporaneously in all of the equations.

There exist pn^2 parameters in the A matrices. Equation 1 can be written in another form with the usage of the lag operator L which is selected through $L^k x_t = x_{t-k}$ the equation becomes:

$$A(L) y_t = \mu_t \tag{3}$$

where:

$$A(L) = A_0 L^0 - A_1 L^1 - A_2 L^2 - ... - A_p L^p.$$

A_0 = I (identity matrix) it is required that $A(L)$ lies outside the unit circle for stationarity to be ensured.

Variance decomposition and impulse response functions

Both variance decomposition and impulse response functions are computed by re-specifying our autoregressive (AR) function. The two of them evolve through the process described as follows:

$$A(L)\mu_t = y_t \tag{4}$$

y_t represents a stationary stochastic process in the system and lag operator is L, μ_t is the white noise error term. The theory also requires root $det(I - A(z)) = 0$ should have a module greater than 1, in such a way that $det(I - A(z))$ is invertible. The interpretation of our VAR is based on the vector moving average (MA) presented in the following form:

$$y_t = \varnothing_t + \sigma(L)\mu_t E(\mu_t) = 0 \tag{5}$$

$$E\left(\mu_t \mu_{t-k}\right) = Q, |k| = 0 \tag{6}$$

$$E\left(\mu_t \mu_{t-k}\right) = Q, |k| \neq 0 \tag{7}$$

where Q represents the covariance matrix sample, $\emptyset_t$ is predictable perfectly while the matrix of the coefficients of $\sigma(L)$ using lag 0 is the identity matrix.

Equation 4 can be normalized to generate the impulse response functions and at the same time forecast the error decomposition. Nonetheless the variance decomposition adopted is equal to the MA.

Model identification

The nature of SVAR requires the imposition of enough restrictions so as to identify the orthogonal structural components of the error terms that is present in the shocks. Note that this is at variance to the standard recursive Cholesky orthogonalizations. The non-recursive orthogonalizations of the error term produced through this process is used for the impulse response function and variance decomposition.

Let us assume that y_t is comprised of a vector of endogenous variables. For example say k the element of endogenous variables in our model where $\sum E[v_t v_t']$ is the residual of the covariance matrix, therefore our identification procedure is as follows:

$$Av_t = B\mu_t \tag{8}$$

where v_t and μ_t are vectors with lag length k, v_t is the observed residual and μ_t represents the unobservable structural innovations. A and B are $k \times k$ matrices which are to be estimated. However, innovation μ_t is assumed to be orthogonal in nature. Hence the covariance is an identity matrix $E[\mu_t \mu_t'] = I$. The imposition of restriction on A and B is made possible due to the orthogonal assumption of μ_t hence we have:

$$A \Sigma A' = BB' \tag{9}$$

The link between the reduced form and the structural form of the VAR model is presented as follows:

$$B\left(L\right) = B_0 + B^+\left(L\right) \tag{10}$$

$$A\left(L\right) = -B_0^{-1} B^+\left(L\right) \tag{11}$$

$$\Sigma = B_0^{-1} A (B_0^{-1})' \tag{12}$$

Equation 9 divided the structural form into contemporaneous correlations i.e. B_0 and $B^{+}(L)$.

The former represent a correlation at lag zero while the later represent a correlation in all of the strictly positive lags. Equation 10 separated each reduced form coefficients into its structural counterpart B_0 is identified through the reduced form, $\Sigma = E[\mu_t \mu_t']$, and the diagonal covariance matrix of the structural form, $A = E[v_t v_t']$ as shown in 11.

Furthermore, due to the vulnerability of long run restrictions to serious misspecification problems, we used a contemporaneous restriction on the B_0 matrix to identify the shocks as shown in equation 13 since this study is interested in short run and medium term responses (see Leeper, Sims, Zha, 1996; Elbourne, 2007).

$$\begin{bmatrix} \mu_t^{logpoil} \\ \mu_t^{logoilgr} \\ \mu_t^{logexr} \\ \mu_t^{loginf} \\ \mu_t^{logmsgr} \\ \mu_t^{logmgr} \\ \mu_t^{logintr} \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ b_{31} & b_{32} & 1 & b_{34} & b_{35} & b_{36} & b_{37} \\ b_{41} & b_{42} & 0 & 1 & 0 & 0 & 0 \\ b_{51} & b_{52} & 0 & 0 & 1 & b_{56} & 0 \\ 0 & 0 & 0 & b_{64} & 0 & 1 & 0 \\ 0 & 0 & b_{73} & b_{74} & b_{75} & b_{76} & 1 \end{bmatrix} = \begin{bmatrix} b_1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & b_2 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & b_3 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_4 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_5 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_6 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_7 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{logpoil} \\ \varepsilon_t^{logoilgr} \\ \varepsilon_t^{logexr} \\ \varepsilon_t^{loginf} \\ \varepsilon_t^{logmsgr} \\ \varepsilon_t^{logmgr} \\ \varepsilon_t^{logintr} \end{bmatrix} \quad (13)$$

There are seven variables in the SVAR model namely oil price (poil) which is the exogenous variable, it occupies row 1 and it constitutes an external pressure on the economy. Other endogenous variables include, oil resources growth rate (oilgr), interest rate (intr), money supply growth rate (msgr), inflation rate (inf), exchange rate (exr), and manufacturing output growth (mgr).

The above identification scheme shows how the variables influence each other depending on their position. Both matrices in equation 13 above are called K and K with non-zero coefficients k_{ij} and K_{ij}, indicate that any residual j affects variable i instantaneously. Equation 1 represents crude oil prices responding to their own lagged values while equation 2 shows that oil output growth responds contemporaneously to crude oil prices. Both variables indicate that their reactions are sluggish when responding to monetary variable shocks because of planning and information delays (Sims, Zha, 1998; Karame, Olmedo, 2002; Berklemans, 2005). The third equation shows that the exchange rate responds contemporaneously to all of the variables. This equation shows that the exchange rate has a contemporaneous effect on all variables because exchange rates are forward-looking asset prices (Kim, Roubini, 2000).

Inflation in the fourth equation responds contemporaneously to crude oil prices and oil output growth rate. Economic theory hypothesizes that, output has an instantaneous effect on inflation only. In this case we are referring to manufacturing output. The interest rate has a contemporaneous effect on exchange rates, money supply, manufacturing output and inflation.

1.3. The Data

The data collected were on a quarterly basis from 1980Q1 to 2017Q4. As shown from the model, seven variables are used in explaining the monetary policy transmission mechanism as it affects manufacturing output in Nigeria. Data on all the variables are sourced from the World Bank database except the data on oil price and growth rate of oil output that are sourced from the data base of the Organization of petroleum exporting countries (OPEC). It should be noted that the growth rate of the variables like money supply, GDP, manufacturing output and oil output are used as this presents a clearer and more realistic perspective of examining the variables in their real values (see Olomola, 2007).

2. Results and discussion

The results of the empirical analysis are presented here and they are interpreted and discussed in order to achieve the objective of the study. The first aspect of the results and discussion present and explain the results of the unit root test, which is an important pre estimation test for the SVAR as all the variables to be included in the SVAR, must be stationary.

Table 1. Unit root tests

Variable	ADF-unit root test		
	P* Statistics	P Value	order of integration
Mgr	223.5101	0.000***	I(1)
Infr	156.8511	0.000***	I(1)
Intr	80.5803	0.000***	I(1)
Msgr	115.4495	0.000***	I(1)
Poil	65.3935	0.000**	I(0)
Exr	102.6552	0.000***	I(1)
Oilgr	117.9667	0.000***	I(1)

***, ** and * represent a statistical significance at 1%, 5%, and 10%, respectively. Each model includes trend and constant terms.

Source: authors' computation.

The results of the unit root show that all the variables are stationary. For instance all of them are integrated in order one that is I(1) except oil price poil which is stationary at levels I(0). All of the results have satisfied the conditions to proceed to SVAR estimation.

The next aspect of the result discussion is the impulse response functions discussions. The graphs are presented as follows:

2.1. Impulse Response on Analysis

Figure 1 shows the responses from monetary policy instruments, the intermediate monetary variables as well as manufacturing output growth to a 1 per cent standard deviation oil price shock. The shock caused a steady fall in oil output in the first two periods before picking up gradually. This is realistic since the growth rate of oil output is used. H. Mahmud (2009) attributed this to a slow movement in oil production growth rate in catching up with an increase in global oil demand which probably caused the initial rise in the price of oil. The exchange rate falls in response to the shock that is local currency appreciates in value significantly. The resultant appreciation in the value of the local currency is similar to the results of studies by P. Olomola (2007), H.B. Riman, E.S. Akpan and A.I. Offiong (2013) and H. Mamhud (2009) where they found that in Nigeria, oil price shock usually causes appreciation in the value of Naira fall in the first two periods. Similarly, H. Burment (2009) found that currency appreciates in the study of countries like Oman and UAE which are net oil exporting countries. Though, R. Jimenez-Rodriguez and M. Sanchez (2005), and S.S. Chen and H.C. Chen (2007) have also found that oil price shock leads to a depreciation in the value of the currency of the G7 countries. However, inflation rate and the monetary policy variables fail to respond significantly to the shock. Currency appreciation leads to an initial steady and significant rise in the manufacturing output before falling gradually but insignificantly as well. The normal mechanism through which this work should be, that currency depreciation causes a setback in the import sector. In other words, it discourages imports and promotes exports. Export promotion has the tendency of influencing domestic output growth positively hence the steady growth of manufacturing output. But in Nigeria recent evidence has shown that the appreciation of Naira coincides with the rise in manufacturing output. According to the CBN (2016) the drastic fall in the price of oil between 2015 and 2016 from about $ 87 to as low as $ 30 caused the growth rate of the manufacturing sector to shrink by about 36%. However, since the Naira begins to appreciate, the growth rate of the manufacturing sector in Nigeria has started picking up.

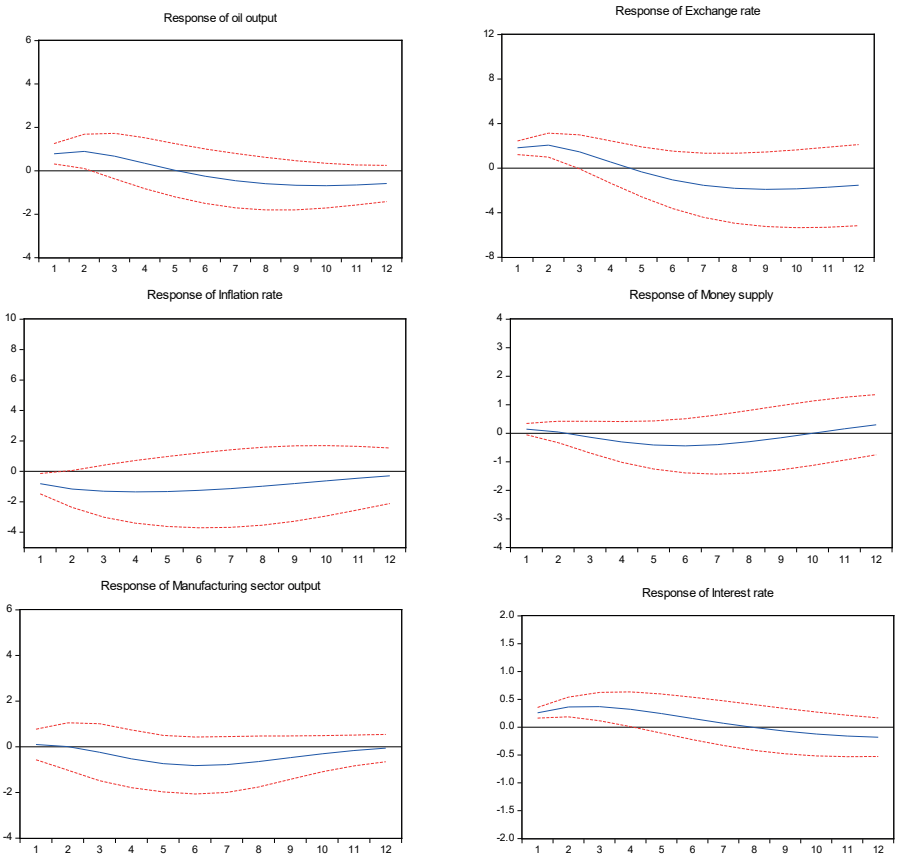


Figure 1. Responses to oil price shock

Source: authors' computation

The responses of other variables to shock from the oil output growth rate is illustrated in Figure 2. From the impulse response graph the inflation rate appears to be the only variable that shows initial significant response to oil output. The implication of this is that the kind of inflation rate generated by the oil output shock might not be a monetary phenomenon. The position of M. Friedman (1965) that inflation is always a monetary phenomenon has been criticized by many researchers. They argue that inflation might not be a monetary phenomenon all the time. For instance, increase in price that occurs because of decrease in output can aggravate the inflation rate. They further argue that inflation can be a monetary phenomenon everywhere only if output is stable which is not realistic (see Nathan, 2012; Aziz, 2013). In other words in the absence of price rigidities whenever there is decrease in output, it can lead to an increase in price which can trigger inflation apart from money supply. As earlier stated the reactions of other

variables in the model appear to be passive unlike the oil price. The implication again is that oil price might have a more macroeconomic influence than oil output growth in Nigeria.

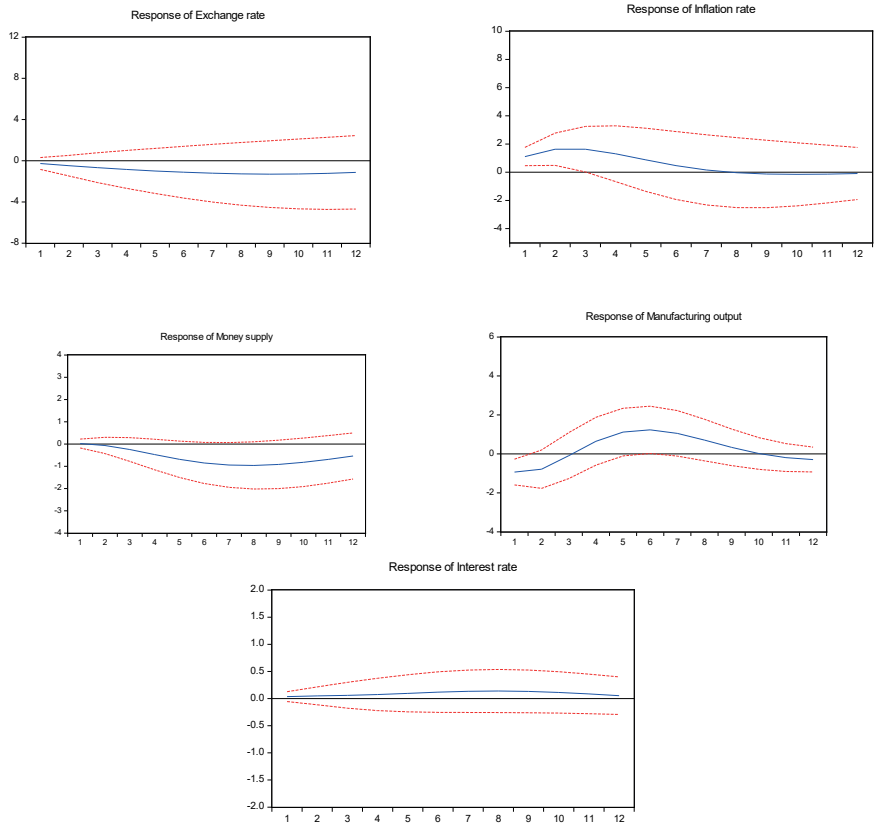


Figure 2. Responses to oil output growth rate shock

Source: authors' computation.

The responses to exchange rate shock are shown in Figure 3. The results show that virtually all the variables respond significantly to the exchange rate shock. Firstly, inflation rises significantly because of the positive shock to the exchange rate that is a fall in the value of the Naira. This supports the earlier fact that inflation in Nigeria might be more structural than monetary. In the same vein, the monetary policy instrument responds significantly also to the shock from the exchange rate. For instance, the interest rate rises because of currency depreciation. This might not be unconnected with the position of C.N.O. Mordi and M.A. Adebiyi (2010) that a fall in the value of the Naira will increase the demand for local currency to meet their international

financial obligation and thus pushing up the interest rate. The growth of the manufacturing sector is also significantly affected as it falls sharply. The implication of this result is that other macroeconomic variables included in the model are very responsive to exchange rate shock unlike oil price an oil output growth shock where some of the macroeconomic variables fail to respond significantly. The implication of what can be noticed in Figure 3 is that the exchange rate appears to be a very important factor in the monetary policy transmission mechanism.

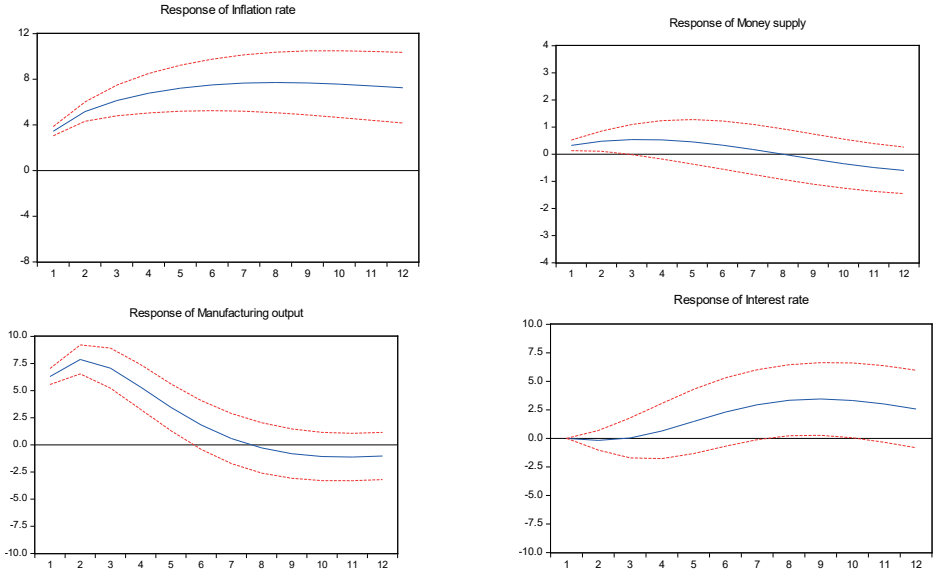
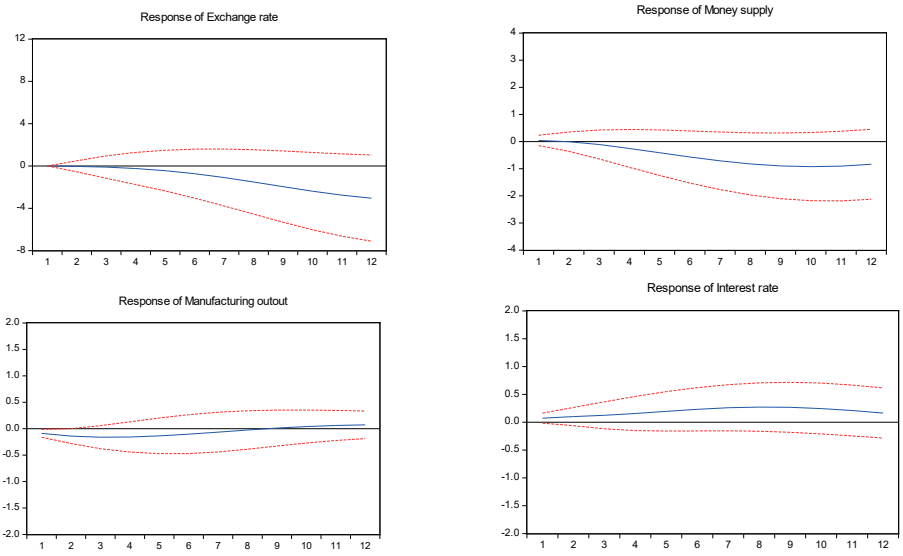


Figure 3. Responses to exchange rate shock

Source: authors' computation.

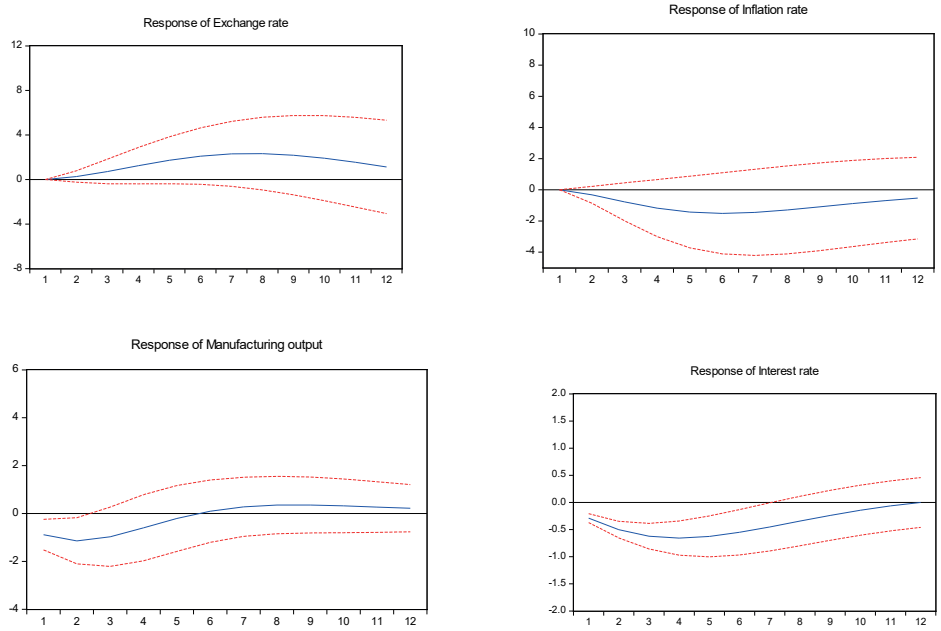
However, Figure 4 further confirms the significant influence of inflation rate on output in Nigeria. However, all other macroeconomic variables fail to respond significantly to inflation shock except for manufacturing output that shows an initial significant response. The result further underscores the importance of inflation rate in determining the growth rate of the Nigerian manufacturing sector. The figure shows that positive shock to inflation caused manufacturing output to fall significantly in the earliest part of the period. Other variables such as monetary policy instruments that is interest rate and money supply fail to respond significantly to inflation shock.

Figure 4. Responses to Inflation rate shock



Source: authors' computation.

Figure 5. Responses to Money supply shock



Source: authors' computation.

The responses to the shock from money supply is described in Figure 5. The results show that interest rate as the other monetary policy instrument used in the model is the most responsive to the money supply shock. All other variables fail to show any significant response to the shock. This shows a strong association between the two monetary policy variables. However, manufacturing output shows an initial and significant upward movement but the rise is not sustained as it dies off before approaching the second period.

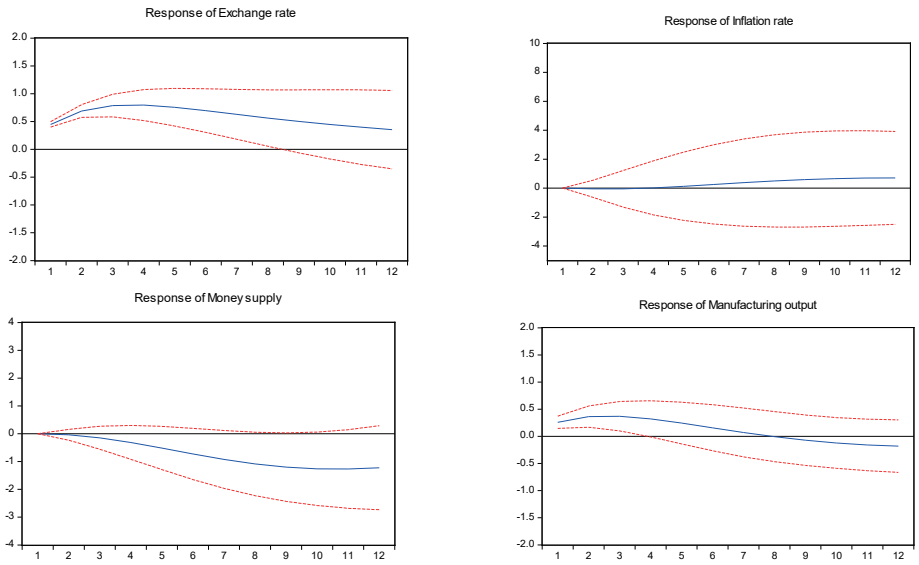


Figure 6. Responses to interest rate shock

Source: authors' computation.

The reactions of the variables to interest rate shock is described in Figure 6. The impulse response indicates that money supply is responsive to interest rate shock. Also, exchange rate and manufacturing output are the other variables that show significant responses to interest rate shock. The shock from the exchange rate caused a fall that is the Naira appreciates as the increase in interest rate reduces the volume of the Naira in circulation and hence the local currency appreciates in value. However, the rise interest rate causes a negative response from manufacturing output as the manufacturing sector appears to be adversely affected by the sudden rise in the interest rate. It is worth noting that the inflation rate fails to respond significantly to the interest rate shock. This further supports the earlier position that inflation in Nigeria might not be a monetary phenomenon.

Table 2. Variance Decomposition of the interest rate

Period	Poil	Oilgr	Exr	Inf	Msgr	Mgr	Intr
3	0.123209	0.002558	2.882352	0.061724	38.90868	1.217218	53.00414
6	0.229515	0.204024	4.058707	0.238932	23.99649	1.757792	57.18929
9	0.089283	0.779179	3.426626	1.878193	14.40817	1.646193	60.43908
12	0.096916	1.106545	1.834615	3.035066	34.42860	1.062448	43.98007

Source: authors' computation.

Table 2 shows the contribution of each shock to the interest rate. The table shows that apart from the shock that is the interest rate shock the money supply shock which is another monetary policy instrument is another variable that contributes to the highest shock to the behaviour of the interest rate. This is followed by the exchange rate. The implication of the results are that after monetary policy instruments, the exchange rate is very germane to the behaviour of the interest rate in Nigeria.

Table 3. Variance Decomposition of money supply growth rate

Period	Poil	Oilgr	Exr	Inf	Msgr	Mgr	Intr
3	0.707791	0.778798	10.077022	0.027127	80.62677	0.798941	0.976718
6	0.715545	0.784927	8.132836	0.020220	86.51526	0.817789	0.990439
9	0.713860	0.793649	2.154404	0.014230	96.44662	0.830373	1.005692
12	0.707037	0.801226	1.160558	0.009597	96.40000	0.836684	1.025730

Source: authors' computation.

Just like what we noticed in Table 1, the contribution of different shocks to money supply growth rate as shown in Table 3 indicates that exchange rate contributes the highest shock to the behaviour of money supply. Again, the implication is that the behaviour of money supply in Nigeria is highly controlled by the exchange rate. It further underscores the influence of exchange rate on monetary policy variables in Nigeria.

Table 4. Variance Decomposition of the inflation rate

Period	Poil	Oilgr	Exr	Inf	Msgr	Mgr	Intr
3	0.010088	0.008171	1.008794	97.09827	0.990878	0.073163	0.802611
6	2.348216	0.016867	18.77488	76.87957	0.947655	0.026666	0.308461
9	9.127256	1.121560	25.73016	59.90568	1.148199	1.396478	1.106616
12	2.129897	1.417971	75.55320	13.37427	4.874621	0.910843	0.285124

Source: authors' computation.

The dominance of the exchange rate shock in the behaviour of the variables in the SVAR model continues in Table 4. The exchange rate apart from the inflation rate shock contributes to the highest shock to the behaviour of the inflation rate. Also, oil price and money supply as a tool monetary policy are the next highest contributors to the behaviour of the inflation rate. The implication of this is that inflation in Nigeria is susceptible to oil price and exchange rate shock.

Table 5. Variance Decomposition of the exchange rate

Period	Poil	Oilgr	Exr	Inf	Msgr	Mgr	Intr
3	30.22134	0.219829	66.75793	0.295038	0.474743	0.012092	1.435790
6	9.958009	0.556608	84.64755	0.424758	0.599003	0.016142	3.027555
9	7.046002	0.594428	87.12238	0.463252	0.562961	0.015082	3.388307
12	6.150030	0.547584	88.17223	0.535412	0.532061	0.019177	3.197343

Source: authors' computation.

Oil price has come to play an important role in the shocks received by the exchange rate. Because oil is priced in foreign currency it contributes to a high percentage to the shock received by the exchange rate. The implication of the result is that oil price is an important factor determining the value of the Naira. Oil price constitutes the most significant variable in the determination of Naira exchange rate.

Table 6. Variance Decomposition of manufacturing output growth

Period	Poil	Oilgr	Exr	Inf	Msgr	Mgr	Intr
3	1.513972	0.696615	30.22018	3.025605	1.524216	58.18099	4.525016
6	0.910843	0.285124	13.37427	4.874621	1.417971	75.55320	2.129897
9	0.659569	0.209108	8.918578	5.541369	1.344279	79.17941	1.882385
12	0.473962	0.177336	6.045270	6.058079	1.286042	81.13250	1.876648

Source: authors' computation.

Table 6 shows the response of manufacturing output to the various structural shocks. The results are an indication that quite a number of shocks affect manufacturing sector growth in Nigeria. This ranges from interest rate, exchange rate, inflation rate to money supply in that order. But it is clear that oil price might not have a direct effect on manufacturing sector growth unless it goes through all these macroeconomic indicators. This shows that monetary policy has a great influence on manufacturing output because the interest rate and exchange rate are the next variables that have a high influence on the behaviour of manufacturing sector output.

However, inflation rate is another variable after these variables which have great influence on the manufacturing sector output growth.

2.2. Diagnostic test

The serial correlation test was conducted to verify that all the lag length structures used in the SVAR model are all free from the problem of autocorrelation. The results are presented in Table 7

Table 7. Serial Correlation Test

VAR Residual Serial Correlation LM Tests		
Null Hypothesis: no serial correlation at lag order h		
Lags	LM-Stat	Prob
1	54.670980	0.2680
2	12.170520	1.0000
3	72.022230	0.0678
4	567.948400	0.9453
5	81.160510	0.0726
6	4.329807	1.0000
7	32.418220	0.9674
8	392.059900	0.7843
9	42.715390	0.7244
10	6.767491	1.0000
11	31.618470	0.9745
12	353.649700	0.0783

Source: authors' computation.

Results in Table 7 is an indication that all the models estimated at various lag lengths are all free from the problem of autocorrelation. The probability values for all the lags are all greater than 5% hence the null hypothesis of no serial correlation in the lag order is accepted and we conclude that there is no problem of autocorrelation in the estimated SVAR model.

Conclusions

Findings from both the impulse response analysis and the variance decomposition analysis have shown diverse ways by which oil price influences the manufacturing sector output growth in Nigeria through the monetary policy mechanism. Firstly, it has been shown from the study that exchange rate is the most responsive to oil price shock. That is the oil price which is an

exogenous variable in the SVAR model has the most significant effect on the value of the Naira. The findings further show from the impulse response functions that arise in oil price can make the naira to appreciate and vice versa. This is evident from some recent events in the Nigerian economy when the oil price fell from about $ 100 per barrel in the second quarter of 2014 to as low as $ 45 per barrel in the third quarter of 2015 (CBN, 2015). At this same period, the value of the naira depreciated from about 197 NGN to a USD to about 385 NGN to a USD (CBN, 2015). This behaviour is also supported by the findings from this study under the variance decomposition when it was shown that the largest contributor to the behaviour of the exchange rate in Nigeria is oil price. The implication of the findings are that oil price accounts for significant changes in the exchange rate in Nigeria. Consequently, it can be concluded from the study that the exchange rate in Nigeria is the most responsive to the oil price shock among other macroeconomic variables.

It can be deduced from the findings as well that the monetary policy variable that is interest rate and money supply are very responsive to the exchange rate shock. Inflation rate is another variable that also showed from the impulse response function to be highly responsive to exchange rate shock. The implication of this is that the interest rate as a major instrument of monetary policy is highly influenced by the exchange rate. The chains of reactions from the impulse response function shows that a slump in the values of the naira can force the interest rate up. The reason for this might not be unconnected with the position of H. Berument (2009) that, the fall in the value of the Naira will lead to higher demand for the local currency to meet international commitments and this will force the interest rate up automatically.

Again, Inflation rate has been identified as the other variable that is responsive to exchange rate shock. Findings from the impulse response function indicate that exchange rate shock produces significant positive responses from the inflation rate. The implication is that depreciation of the Naira will lead to an increase in the inflation rate. The reason behind this might not be farfetched considering how highly import dependent the Nigeria economy is. As the local currency falls in value, imports become more expensive and more Naira will now be needed to be spent on international transactions as the price of import commodities will go up. Since the economy is highly dependent on foreign goods, the increase in the price of foreign commodities will push the inflation rate up. This finding is also in line with the recent events in the Nigerian economy when the inflation rate became a double digit for the first time in the fourth quarter of 2015 in almost a decade and this period coincides with the period when the Naira was experiencing a free fall on the foreign exchange markets (See Kutu, Ngalawa, 2016). The results from the variance composition also indicate that exchange rate is an important

contributor to the behaviour of the inflation rate in Nigeria. All these are pointers to the fact that the inflation rate in Nigeria might be more of a structural than monetary phenomenon.

It is also apparent from the analysis that the manufacturing sector output growth is very responsive to monetary policy shock especially concerning the interest rate and exchange rate. Another variable that also contributes high shock to the behaviour of manufacturing output growth is the inflation rate. The implication is that manufacturing output is significantly affected by the monetary policy variable, exchange rate and inflation rate. The result shows that an increase in the interest rate will lead to a significant fall in manufacturing output; the same reaction is also shown by manufacturing output to the inflation rate shock. This result is evident in the action of the CBN to raise the monetary policy rate from 12% in the last quarter of 2015 to about 14% in the first quarter of 2016 has further compounded the growth of the manufacturing sector in Nigeria. The contributions of the manufacturing sector to the GDP of Nigeria fell by about 34% between the last quarter of 2105 and the third quarter of 2016 (NBS, 2016). In the same period the inflation rate rose from about 12 to 16%. According to the manufacturing Association of Nigeria MAN, 2016, the most daunting challenges facing Nigerian manufacturing is the rise in the prices of imports. It has been observed that apart from capital goods like machineries, the manufacturing sector in Nigeria is also highly dependent on raw material imports. This further compounds the adverse effects of inflation rate on the output of the manufacturing sector.

Finally, the study has shown that the effect of oil price on the output of the manufacturing sector of Nigeria passed through some chain reactions and actions which give an important role to the monetary policy transmission mechanism. In conclusion, the study has shown that the exchange rate channel of the monetary policy transmission mechanism appears to be the major means through which the oil price shock affects the output of the Nigerian manufacturing sector. This is evident from the discussion above that oil price shock affects the exchange rate, while the exchange rate affects the monetary policy instruments and the inflation rate. The monetary policy instrument and inflation rate in turn influence significantly the manufacturing sector output growth in Nigeria. However, it is worth noting that the action of the CBN to increase the interest rate and devalue the Naira at the same time in 2016 during a period of oil price shock further compounds the problem of the Nigerian manufacturing sector. It is recommended that the CBN review downward the interest rate to increase the accessibility of Nigerian manufacturers to loanable funds. This will go a long way to cushion the adverse effects of the fall in the exchange rate.

Contributions to knowledge

The study has revealed the channels through which oil price shock affects the real sector of the Nigerian economy and particularly the manufacturing sector. This is necessary because it affects the monetary policy direction of the Central Bank especially in selecting monetary intervention that will have an immediate, sustainable and direct effect on the manufacturing sector and this depends on the ability to determine the most effective transmission channel which will help them achieve their intended target. The study has shown that contrary to what is obtained in some developed countries where asset price channel plays significant roles in the transmission of shocks; the exchange rate channel has been identified as the most effective channel through which external shocks such as oil price shocks affect the manufacturing sector of the Nigerian economy. Monetary policy instruments have been shown to be highly subservient to exchange rate hence oil price passes through the exchange rate to affect the monetary policy which in turn transmits its effect to manufacturing output via various monetary policy interventions.

Limitations of the study

The limitation of the study was mainly in the area of data collection. The data was expanded till 2017. Unfortunately, figures for 2018 were not available for many of the variables included in the model. However, it is believed that only one year might not make a significant difference to our conclusions. Hence, other studies coming after this study can include data from 2018 and see if or how it will affect the conclusions from this study based on 1980Q1 to 2017Q4 data.

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