EFFECT OF OIL PRICE SHOCKS ON EXCHANGE RATE VOLATILITY IN NIGERIA (1970-2022)

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ABSTRACT

The study objective is to examine the relationship between oil price shocks and exchange rate volatility in Nigeria. The study employed the Structural Vector Autoregression (SVAR) model and four macroeconomic variables namely, oil prices, real gross domestic product, exchange rates and consumer price index was used for this study. The study made use of quarterly data series dating from $1970Q_1$-$2022Q_4$ sourced from the central bank of Nigeria statistical bulletin and various issues. The findings showed that that there are long-run interdependences of oil price shocks and has significant impact on Real Exchange Rate in Nigeria. Based on the findings of this study, the study recommends that the government to diversify the economy to reduce the adverse effect of shocks emanating from the fluctuation of global oil prices.

Keywords: Oil price shocks, exchange rate, SVAR
JEL Codes: E32, F31, C3

1. INTRODUCTION

Over the past five decades, oil markets suffered from spectacular oil price swings. Prices fluctuations of such vital energy source depend much more than any other commodity on the supply changes over time (shortage or oversupply). Since 1970s, macroeconomists have viewed changes in the oil prices as an important source of fluctuations as well as paradigm of global shocks, likely to affect economies simultaneously. From the early 1970s to the early 1980s, the oil price rise is

dramatically associated with disruptions in the supply of oil from the Middle East countries. With the Iranian crisis in 1979, a major disruption in oil supplies started.

The year 1981 was the start date of the oil price drop which continued for a long period. This continuous decrease can be attributed to several factors such as the decline of oil demand due to the economic slowdown that occurred in most industrialized nations coupled with the adoption of more energy-efficient operation by large number of firms. These factors have contributed to a considerable demand declined, forcing the market to lower the price. Furthermore, during the same period the supply of oil rose as new and important oil fields, such as North Sea in Europe, were discovered. The combination of the demand decline and supply rise reduced significantly the world oil price to reach $17.10 per barrel (inflation adjusted) in 1998. The Nigerian economy has consistently relied on the export of crude oil for foreign exchange earnings and revenues, particularly as it accounts for over 95 per cent of export earnings and about 85 per cent of government revenues. Its contribution to GDP, however, stood at 17.85 per cent in 2008 (Aliyu, 2009).

Nigeria's oil statistics show that the country has an estimated 36.2 billion barrels of oil reserves which makes the country as the second largest in terms of oil reserve in the African continent. The Energy Information Administration (2009) estimates Nigeria's effective oil production capacity to be around 2.7 million barrels per day. But there's serious drop in oil production levels, this problem is compounded by decades of corruption in the oil sector, poverty, unemployment, processing and distribution costs, social conflicts in oil-producing areas resulting to pipeline vandalism, oil theft, kidnapping of expatriate oil workers, disruption in petroleum product supply and demand. Equally, the country is exposed to oil price shocks through massive importation of refined petroleum products since the collapse of local refineries in the late 1980s.

The country imports almost 85 per cent of refined products for local consumption and oil export revenue constitutes 95% of government revenue receipt, and income from oil export accounts for substantial part of government expenditure. The near collapse of the power generation and distribution industry in the country further accentuates the acute shortage of energy. The burden on the government to provide energy resources at subsidized rate became very unwieldy, and between 1999 and 2022, the Federal Government of Nigeria reduced its subsidy approximately 14 times which later on the country announced its total removal of subsidy in 2023. This adversely affected production, consumption and investment decisions and hence the exchange rate in the country. It is generally argued that for net oil-exporting countries, a price increase directly increases real national

income through higher export earnings and appreciation of local currency, though part of this gain would be later offset by losses from lower demand for exports generally due to the economic recession suffered by trading partners. Whereas in net oil-importing countries, higher oil prices lead to inflation, increased input costs, reduced non-oil demand and lower investment.

2. LITERATURE REVIEW

2.1 Conceptual Classification

2.1.1 Oil price shocks

Oil price shocks are predominantly defined with respect to price fluctuations resulting from changes in either the demand or supply side of the international oil market. These changes have been traditionally traced to supply side disruptions such as Organization of petroleum exporting countries (OPEC) supply quotas, political upheavals in the oil-rich Middle East and activities of militant groups in the Niger Delta region of Nigeria. The shocks could be positive (a rise) or negative (a fall). If there is a rise in the price of a country's export product (oil), the products become relatively more expensive in the international market hence importing countries will reduce their import of oil. Indeed, if oil import demand is highly in elastic, a rise in oil price causes domestic currency depreciation in the importing country.

2.1.2 The Concept Exchange Rate

Exchange rate is the rate at which one currency is exchanged for another. It is the price of one currency in terms of another currency. It is customarily defined as the price of one unit of the foreign currency to a unit of the domestic currency. The exchange rate translates all prices (including wages and interest rates) in one currency into their value in another currency.

Nominal exchange rate: Nominal exchange rate means a rate by which one can exchange domestic currency with the foreign currency at any financial institutions. It is the value of money which is received in an exchange with another currency.

Real Exchange Rate: The real exchange rate is a rate which measures how many times an item of goods purchased locally can be purchased abroad. It indicates the ratio of items purchased in the domestic market to the items purchased in the foreign market. Real exchange rate actually

determines the ratio of price in the local market to the price in the foreign market. Also, it actually indicates the goods and services consumed as compared to another country and it is complex and also a difficult method to calculate the real exchange rate. Therefore, it measures the purchasing power of domestic currency to the foreign currency at a prevailing time. Real exchange rate is highly affected by the change in the exchange rate in the global market.

2.2 Theoretical Review

There has been extensive theoretical work on the macroeconomic consequences of oil price shocks. Most of these studies argued that since the mid-1970s, oil price movements have been a major source of business cycle fluctuations.

2.2.1 The Elasticity approach

This theory is premised on the principle of import elasticity of demand. The exchange rate changes in response to the change in oil price depend on the elasticity of import of importing country. If there is a rise in the price of a country's export product (oil), the products become relatively more expensive in the international market hence importing countries will reduce their import of oil. Indeed, if oil import demand is highly in elastic, a rise in oil price causes domestic currency depreciation in the importing country.

2.2.2 Terms of Trade Channel

This theory is traced to Amano and van Norden (1998); they propounded a two sector model: tradable and non-tradable. The model assumed both sectors use a tradable input called oil, and non-tradable input called labor. Suppose there is a rise in the price of oil; this would affect the output prices of both tradable and non-tradable sectors, an increase in the price of oil could lead to either an appreciation or a depreciation of domestic exchange rate.

2.3 Empirical Review

The empirical literature on the macroeconomic impacts of oil supply shocks evolved as the new state of the oil market revealed itself gradually after 1973. One of the initial beliefs following the 1973-74 price shock was that the new, higher price of oil might be a permanent feature of a changed natural resource regime. Raguindin and Reyes (2005) examined the effects of oil price shocks on the

Philippine economy over the period 1981 to 2003. Their impulse response functions for the symmetric transformation of oil prices showed that an oil price shock leads to a prolonged reduction in the real GDP of the Philippines. Conversely, in their asymmetric VAR model, oil price decreases play a greater role in each variable's fluctuations than oil price increases.

Jung, et al. (2019) examined the relationship between the US-Canada exchange rate and real oil price by employing a nonlinear autoregressive distributed lag method and a granger causality test from January 1982 to March 2019. They found US-Canada exchange rate and the real price of oil are cointegrated. Also, long-run asymmetry causality runs from the US–Canada exchange rate to the real oil price. Similarly, Castro and Jime'nez-Rodrı'guez (2020) examined the interactive relationship between effective exchange rate and oil price for U.S. as an oil-importing country. They employed a time-varying VAR model, using monthly data from January 1974 to July 2019. They found the exchange rate appreciates after oil price shock in the long run and short-run, and the exchange rate response differently to oil price shock in the long run.

Herrera et al. (2011) illustrate that larger asymmetric effect acts at the disaggregate level than at the aggregate scale. Moreover, the nonlinearity impact is stronger for samples beginning before 1973, than samples after 1973. Using data for 1973Q2-2007Q4, Kilian and Vigfusson (2011), as well, illustrate no evidence against the null of symmetric responses to oil price shocks for the real GDP. More specifically, some studies have examined the macroeconomic instability origins in purely oil-exporting countries context. Bankole and Shuaibu (2013) examined the effect of the oil price change on international reserve accumulation from 1960 to 2011. The study employed a Vector Auto-regressive (VAR) method. They found that oil price change has substantially and negatively impacted the reserve in the long run and moderate in the short run.

Olanipekun (2016) examined the relationship between oil price shocks, exchange rate, external reserve and real GDP from the first quarter of 1971 to the first quarter of 2014. The study employed a structural Vector Autoregressive (SVAR) model and impulse response function. They found oil price shocks impacted negatively on foreign reserve, exchange rate and economic growth. Basher et al. (2015) examined the impact of oil shocks on the real exchange rate by employing Markov-switching models for a sample of Oil exporting and oil importing countries. They found oil supply shocks impact the exchange rate, and global demand shocks impact the real exchange rate of both importing and exporting nations. They could not find uniform appreciating and depreciating patterns in real exchange rates.

Bebonchu et al. (2015) examined the asymmetric response of U.S. real and nominal trade-weighted U.S. dollar exchange rate indexes to the oil price shock by disaggregating oil shock into demand and supply shock. They found oil supply shock has an insignificant impact on exchange rates while global aggregate and oil-specific demand shocks lead to depreciation. Also, exchange rates respond asymmetrically to shocks in the crude oil market, and it depends on the scales and magnitude of the shock. Akpan (2009) using VAR model analysis found a positively significant asymmetric effect of oil price shocks on real government expenditure in Nigeria, while such effect on industrial output growth was found to be marginal with observed significant appreciation of the real exchange rate.

Aliyu (2009) used a non-linear approach and found evidence of both linear and nonlinear effects of oil price shocks on real GDP in Nigeria; precisely, the study found that asymmetric oil price increases in the non-linear models have larger positive impacts on real GDP growth than in other specifications. The study, which focused on the effects of oil price shock and real exchange rate volatility on real economic growth in Nigeria, found a unidirectional causality running from oil prices to real GDP and bidirectional causality from real exchange rate to real GDP and vice versa, while further results indicate that oil price shock and appreciation in the level of exchange rate exert positive impact on real economic growth in Nigeria.

Omisakin et al. (2009) examined the short run implications of oil price shocks on the Nigerian economy using Vector Error Correction (VECM) model on data for the period 1970-2006 and found that a 10 per cent increase in oil price brought about 79 per cent increase in oil revenue, 45 per cent increase in government expenditure, 17 per cent increase in money supply, 11 per cent decrease in CPI and 31 per cent increase in GDP in the short run, which thus implies that the Nigerian economy is vulnerable to international oil price volatility.

Chuku *et al.* (2011) studied the linear and asymmetric impacts of oil price shocks on the Nigerian economy for the period 1970Q1-2008Q4 using VAR model and Granger causality test approach; and found that oil price shocks are not a major determinant of macroeconomic activity in Nigeria in the linear model; while Granger causality results indicate that world oil prices do not influence macroeconomic activity and that nonlinear specification results show that the impact of world oil price shocks on the Nigerian economy are asymmetric.

Furthermore, Agri, Inusa and Kennedy (2015) study the impact of oil price volatility on Macroeconomic variables and sustainable development in Nigeria using monthly data for the period

of 1990-2015 their results confirm the statistical significance of the impact of oil price volatility on macroeconomic variable. Olayungbo (2019) examined the impact of oil price change, external reserve, and the exchange rate on the exchange rate using annual data from 1970 to 2011. The study employed the GARCH model as well as the Johansen co-integration and error correction method. They found a proportional change in oil price led to more than a proportional change in Nigeria's exchange rate.

On the contrary, Olayungbo (2019) examined the causal link between oil price and exchange rate, international reserve and trade balance in Nigeria. They revealed that oil price does not cause exchange rate, trade balance, and the only international reserve has a long-run relationship with Nigeria's oil price. Umoru et al. (2018) examined the effects of oil price volatility on exchange rate variability, foreign exchange reserve, real gross domestic product and government expenditure. They used vector auto-regressive as well as impulse response analysis. They found oil price accentuate exchange rate volatility, foreign reserves, government expenditure and real gross domestic product.

3. METHODOLOGY

3.1 Data Source and Description

This presents methodology and properties of the Structural Vector Auto-Regression (SVAR) as an important tool for analyzing the dynamics of economic and financial variables and in assessment of impact of macroeconomic policies. The research will employ quarterly data for the period of $1970Q_1$-$2022Q_4$ to empirically examine the effect of oil price shock and exchange rate volatility in Nigeria over time. The data was sourced from the National Bureau of Statistics (NBS) publications, Central Bank of Nigeria (CBN) Annual Report and Statistical Bulletin, World Bank and International Financial Statistics (IFS) of the IMF.

3.2 Model specification

The model specification follows theoretical issues regarding the applicability of the SVAR model which includes the VAR lag order determination (lengths of the lags), deterministic components and data transformation. These issues are theoretically related to the variables that are captured in the SVAR model as the vector of endogenous variables.

$$A=\begin{bmatrix}1 & a_{12} & a_{13} & a_{14}\\ 0 & 1 & 0 & 0\\ 0 & a_{32} & 1 & 0\\ 0 & 0 & a_{43} & 1\end{bmatrix} Vt \begin{bmatrix}vtLOGRGDP\\ vtLOGOP\\ vtLOGEXR\\ vtLOGCPI\end{bmatrix} B=\begin{bmatrix}b_{11} & 0 & 0 & 0\\ 0 & b_{22} & 0 & 0\\ 0 & 0 & b_{33} & 0\\ 0 & 0 & 0 & b_{44}\end{bmatrix} \begin{bmatrix}etLOGRGDP\\ etLOGOP\\ etLOGEXR\\ etLOGCPI\end{bmatrix}$$

4. EMPIRICAL ANALYSIS AND DISCUSSION OF FINDINGS

This presents the analysis of estimated results of the model postulated and the parameters estimates were subjected to various economic, statistical and econometric tests. All estimations were done using E-view 10 versions.

Table 1: Descriptive Statistics

	RGDP	OP	EXR	CPI
Mean	4.84E+13	27.72082	113.684	39.09275
Maximum	2.99E+14	145.45	546.3054	145.796
Minimum	6.26E+10	8.03	0.546781	0.066485
Std. Dev.	2.08E+13	25.36	11.4754	9.90039
Skewness	1.746725	2.663379	1.467924	1.030203
Kurtosis	4.977946	9.030385	5.267262	2.547451
Sum	9.49E+15	5433.28	22282.06	7662.179
Observations	208	208	208	208

Source: Author's Computation, 2023

Table 1 above shows the descriptive statistics of the variables. The series have a total of 52 observations with four (4) time series variables namely Real Gross Domestic Product (RGDP), Oil Prices (OP), Real Exchange Rates (EXR), and Consumer Price Index (CPI) proxy of Inflation. The summary statistics showed that OP has a maximum and minimum value of $145.45 and $8.03 with the mean and standard deviation of $27.72 and $25.36 respectively. Likewise, EXR has a maximum and minimum value of ₦546.31 and ₦0.55 with the mean and standard deviation of ₦113.6 and ₦11.5 respectively. Also, all other variables are positively skewed. Meanwhile the kurtosis of the variables showed that the variables are positively skewed. This implies that the variables are flatter to the left as compared to the normal distribution and they are of a leptokurtic distribution (i.e. flat or short-tailed)

Table 2: Unit Root Tests

VARIABLES	LEVEL				1ST DIFFERENCE			
	ADF (Prob. Value)	PP (Prob. Value)	KPSS	Status	ADF (Prob. Value)	PP (Prob. Value)	KPSS	Status
RGDP	-2.332863 (0.1627)	-2.400603 (0.1429)	0.121421	Not Stationary	-13.21001 (0.0000)	-13.21001 (0.0000)	0.064321	Stationary
OP	-2.082912 (0.2519)	-2.293673 (0.1751)	0.718431	Not Stationary	-12.80400 (0.0000)	-12.77825 (0.0000)	0.067314	Stationary
EXR	-2.562623 (0.1026)	-2.700302 (0.0758)	0.656173	Not Stationary	-10.69225 (0.0000)	-10.73358 (0.0000)	0.029086	Stationary
CPI	-2.136817 (0.2306)	-2.557172 (0.1038)	0.417598	Not Stationary	-12.97539 (0.0000)	-13.03198 (0.0000)	0.042294	Stationary

Source: computed by the author using E-views. Version 10 (2023)

As observed from the results obtained in table 2, it seemed necessary to test the stationarity of the variables at their first difference since the variables were not stationary at levels. Thus, the series are now integrated of order 1, that is they are I(1).

Table 3: Johansen Cointegration Table

Trace Test			
No. Cointegration Equation	Statistic	5 % critical value	Prob
None *	75.07432	47.85613	0.0000*
At most 1	35.70540	29.79707	0.0093*
At most 2	14.51995	15.49471	0.0697
At most 3	2.947190	3.841466	0.0860
Maximum Eigenvalue			
No. Cointegration Equation	Statistic	5 % critical value	Prob
None *	39.36892	27.58434	0.0010*
At most 1	21.18545	21.13162	0.0491*
At most 2	11.57276	14.26460	0.1277
At most 3	2.947190	3.841466	0.0860

Source computed by the researcher using E-views version 10 (2023)

The table 3 above shows the unrestricted Johansen Cointegration Rank Test, the test hypothesized No Co integration equations. The result from the two tests therefore means there is at least one cointergrating relationship among variables and we cannot accept the null hypothesis that there is no co-integrating equation at 0.05 levels.

Table 4: Identification Scheme with Short-Run Restrictions

A =			
1	C(1)	C(3)	C(5)
0	1	0	0
0	C(2)	1	0
0	0	C(4)	1
B =			
C(6)	0	0	0
0	C(7)	0	0
0	0	C(8)	0
0	0	0	C(9)

Source: computed by the researcher using Eviews. Version 10.0 (2023)

The table 4 above presents the identification scheme and the restriction impose in this study. From the estimation, the result shows that the short-run identification scheme is over-identified which is sufficient for policy analysis for this study.

Impulse response function

Impulse response functions trace the effect of a shock emanating from an endogenous variable to other variables in a SVAR framework. The table below presents the IRF of the variables used in the model.

Table 5: Impulse Response Function

Variables			
Quarters	Q1-Q16	Q17-Q32	Q33-Q52
LOGOP	0.050090*	0.031669*	0.017184*
LOGRGDP	-0.079115*	-0.003438*	0.047659*
EXR	13.71126*	14.11018*	6.514633*
CPI	7.017627*	4.232717*	1.569916*

*Not * signifies significant at 5% Source: computed by the researcher using Eviews. Version 10.0 (2023)*

The result in table 5 above shows the impact of oil prices and exchange rate volatility in Nigeria; the shocks from Oil prices LOG (OP) have a significant effect on its own self. The results show in the short-term and the impact of shocks from oil prices to exchange rates statistically insignificant in Q_{15}.This is not surprising, as the current events shows how oil price shocks have cause macroeconomic fluctuation in Nigeria. From Q_{16} to Q_{30} in a medium term perspective, shocks from oil prices have a significant impact on exchange rate. Also, by Q_{50} oil price shocks have significant impact on exchange rate in the long-term. This study is similar to the findings of Olanipekun (2016) and Olayungbo (2019) who found that oil price shock has significant impact on exchange rate in the long run.

Table 6: Variance Decomposition

Variables			
Quarters	Q_1-Q_{16}	Q_{17}-Q_{32}	Q_{33}-Q_{52}
LOGOP	90.91512	83.27754	75.97536
LOGRGDP	8.595739	5.846042	4.166034
EXR	11.03950	31.50639	39.36518
CPI	23.24048	34.70718	37.77221

Source: computed by the researcher using Eviews. Version 10.0 (2023)

The table 6 above shows the contemporaneous relationship between oil prices and other macroeconomic variables in the SVAR system. From the results, oil prices (LOGOP) account for 90.9% of its variance. The effect of innovation of shocks from oil prices decreases from 90.9% by Q_{16} in the short-term to about 83.3% in Q_{32} in the medium term as the innovation further decrease to 75.10% in Q_{52}. In addition, shocks from oil prices to exchange rate increases from 11.04%, to 31.5% and 39.4% in Q_{16}, Q_{32} and Q_{52} in the short-term, medium-term and long-term periods

5. CONCLUSION AND RECOMMENDATIONS

The study examines the effect of oil price shocks on exchange rate volatility in Nigeria. Structural Vector Autoregressive model was employed for data analysis. The result obtained from SVAR model shows that there is long-run interdependences of oil price shocks and has significant impact on Real Exchange Rate in Nigeria. The major source of revenue and foreign earnings to the economy are mainly from the sales of crude oil, the economy entirely depends on the level of global oil prices, as such most of the macroeconomic indicators of the economy directly or indirectly was being affected by the oil price fluctuations. Also, the results obtained from the SVAR impulse response model shows significant response of negative relationship. When oil prices fall, foreign earnings will drop and subsequently leads to depreciation of the local currency to other foreign currencies. Since Nigeria is import dependent, the depreciation of the local currency to foreign currencies make imports to became very expensive as a result it leads to persistent hyperinflation evident from recent events in the country.

Based on the findings of this research work, the results obtained from estimation of and SVAR model shows that there is long-run interdependences of oil price shocks and has significant impact on Real Exchange Rate in Nigeria. Monetary policies markers and federal government should come up with polices that will minimize the transmission of oil price shocks on exchange rate in Nigeria. This can be done by formulating policies that will make key macroeconomic variables less dependent on oil prices.

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