Print ISSN: 2053-4019(Print)

Online ISSN: 2053-4027(Online)

Website: https://www.eajournals.org/

Publication of the European Centre for Research Training and Development -UK

Effect of Crude Oil Price Shock on Inflation and Exchange Rate in Nigeria

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doi: https://doi.org/10.37745/ejbir.2013/vol12n25666 Published March 23, 2024

Citation: Okeke, S.O., Nwoha C.E., and Duru A.N. (2024) Effect of Crude Oil Price Shock on Inflation and Exchange Rate in Nigeria, *European Journal of Business and Innovation Research*, Vol.12, No.2, pp.,56-65

ABSTRACT: The study examined the effect of crude oil price shock on inflation and exchange rate in Nigeria. The study adopted an ex-post facto research design, covering the period between 1990 and 2022. Secondary data were extracted from the CBN Statistical Bulletin and World Development Indicators. Multiple regression technique was used for test of hypotheses. The findings revealed a noteworthy adverse effect of oil price shocks on Nigeria's inflation rate, indicated by a probability value of 0.0180. Additionally, the impact of oil price shocks on exchange rates in Nigeria was also adverse and statistically significant, as reflected by a probability value of 0.047. Moreover, these findings align with established economic theory. The negative effect of oil price shocks on the exchange rate can be explained by the consistent devaluation of the Naira relative to the US Dollar in response to abrupt, particularly negative, changes in oil prices. The study, therefore, recommended that the government should enhance the proportion of funds allocated to the excess crude accounts relative to its revenue expenditures. By doing so, the government can build a financial cushion that can be tapped into when price shocks disrupt the crude oil market. Furthermore, it is advisable to employ contractionary monetary and fiscal policies when price shocks occur. These policies can effectively counteract excessive cost-push inflation that may result from the shocks. By reducing the overall demand in the economy through measures like higher interest rates and reduced government spending, inflationary pressures can be curbed.

KEYWORDS: crude oil price shock, inflation, exchange rate, devaluation, excess crude accounts, financial cushion

INTRODUCTION

Energy is recognized as the most important input for growth and development; oil and gas supply two-thirds of the world's energy requirements (African Development Bank and the African Union, 2009). Nigeria is Africa's largest oil producer, with around 37 billion barrels of proved oil reserves as of 2015, ranking it second in Africa behind Libya (U.S. Energy Information Administration EIA, 2017) and 11th in the world. Crude oil was discovered in commercial quantities in Nigeria in 1956, and Nigeria became an oil-producing country with

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Online ISSN: 2053-4027(Online)

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exploration beginning with the very first oil field at Oloibiri in the Niger-Delta area in 1958, producing 5,100 barrels of crude oil per day. Soon after, oil exploration proceeded with the discovery of numerous more onshore and offshore oil fields; by the early 1970s, oil output had reached around 2 million barrels per day, and the nation joined the Organization of Petroleum Exporting Countries (OPEC) in 1971. (Nigerian National Petroleum Corporation, 2020).

The Nigerian economy is significantly reliant on crude oil sales receipts as a primary source of revenue and foreign exchange gains. Annual budgets are developed for each fiscal year and are connected to a baseline of predicted global oil prices and daily crude oil production output. From the 1980s until the present, oil has been the leading export commodity, accounting for over 90% of total exports. Despite this, the oil sector still accounts for 60.1% of total government revenue receipts as of 2019 Q4 (Central Bank of Nigeria, 2019), and is the country's dominant export commodity, accounting for 76.1% of total export value. According to the International Monetary Fund (IMF), Nigeria received around \$87 billion in revenue from oil and natural gas exports in 2014, accounting for nearly 58% of total government revenue. The proceeds from the sale of oil and gas are the country's principal source of foreign money; in 2014, oil accounted for more than 95% of the total value of Nigeria's exports.

The Nigerian economy's continuous reliance on oil is reason for concern since volatility in the global oil price would influence other macroeconomic factors, rendering the macroeconomy vulnerable to oil price shocks. An economy that relies largely on the export of crude oil, a commodity whose price is highly unpredictable, as its primary source of revenue and foreign money is vulnerable to the global oil market shocks. A classic illustration of this was the 2014 episode of oil price shocks, which happened as a result of oversupply on the one hand and a reduction in demand on the other. On the supply side, the culprits were a rise in non-OPEC oil output and a jump in US shale oil production. Sluggish development in developing countries, notably China, India, and Brazil, was cited as a main reason of the drop in oil demand, causing the oil price to decrease by more than half between June 2014 and March 2015. (Huo, 2015). The price of oil fell from US\$110.9 per barrel in May 2014 to \$56.69 per barrel in March 2015, with the price falling as low as \$30.66 per barrel in January 2016. A reduction in the oil price of this size has both trade and growth implications for the oil-producing countries.

The most recent oil price shock, which occurred in March/April 2020, was caused by both supply and demand shocks. The supply shock was created by Saudi Arabia and Russia's oil price war, while the demand shock was caused by the COVID-19 pandemic, which resulted in industrial closures, worldwide supply chain disruption, and air, sea, and road transport shutdowns. Brent crude fell to \$32.01 per barrel in March and as low as \$18.38 per barrel in April, down from \$63.65 and \$55.66 per barrel in January and February 2020, respectively. This outcome compelled the Nigerian government to reassess its fiscal year 2020 budget and alter the official exchange rate from N307/\$1 to N360/\$1 in March 2020, followed by another downward adjustment in the value of the naira to N381/\$1 in May 2020.

With oil contributing for the majority of foreign exchange earnings to the Nigerian economy, its importance in setting the value of the Nigerian Naira's foreign exchange rate cannot be

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Online ISSN: 2053-4027(Online)

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overstated. The transmission of changes in oil prices to currency rates, especially for oil exporting and importing economies, is well established in both theory and experience. This is especially true given that oil is a key source of energy for many countries as well as a major export product for several. With recent events in the international oil market caused by the increase and decrease in oil prices, economists and policymakers have continued to argue the influence and nature of pass through of oil prices (priced in US Dollar) to national currency rates (Abubakar, 2019). Furthermore, the consequences of oil price variations are felt not only in the Nigerian currency rate, but also in the cost of consumer items. However, Nigeria's economy has been largely shielded from the direct impact of oil price fluctuations due to fuel subsidies, however it is susceptible to inflationary pressures caused by rises in the cost of producing imported commodities when oil prices rise in the international market (Bawa, Abdullahi, Tukur, Barda and Adams, 2020).

Furthermore, positive oil price shocks tend to boost the money supply in oil-producing nations (Oyeyemi, 2013; Omolade, Ngalawa, & Kutu, 2019), which has a significant impact on consumer pricing. Furthermore, declining oil prices reduce oil producing nations' foreign profits, resulting in currency devaluation and rising inflation (Bala & Chin, 2018). Thus, whether positive or negative, oil price shocks have a significant impact on consumer prices and exchange rates in oil-producing nations such as Nigeria. This necessitates research to determine if these shocks exist and how much they will affect exchange rates and inflation. Oil-dependent countries are inevitably on the receiving end of these shocks, and the implications will be felt acutely if suitable cushion measures are not in place.

This study presents additional value to various empirical studies which investigated the effect of oil price shocks on macroeconomic variables. However, the study is a novelle attempt at understanding this dynamic in the face of the most recent shock orchestrated by the coronavirus. Also, the study captures the period up till August, 2022, indicating that it stands the most current study on the effect of oil price shocks and volatility on macroeconomic variables such as inflation rate and exchange rate. The study objectives were to determine the effect of oil price shocks on the exchange rate and inflation rate of the Nigerian economy. In addition to these, the study also examined the effect of crude oil prices on these macroeconomic variables, with a view on proffering solutions and recommendations to them.

LITERATURE REVIEW

Inflation Rate

Price inflation is defined as an increase in the price of a standardized commodity or service or a basket of goods or services over a certain time period (usually one year). When the price of goods and services rises, this is referred to as inflation. When price increases are persistent and exceed the stated benchmark, this is referred to be inflation. For example, an increase in the money supply can quickly lead to a rise in the price level. There are several varieties of inflation described in the literature, including: Demand-pull inflation occurs when aggregate demand grows without a matching increase in supply; supply push or cost-push inflation occurs when supply falls due to an increase in the cost/price of the product supplied (Anochiwa & Maduka,

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2015). It can also be structural inflation, which occurs as a result of monetary policy changes. This sort of inflation is commonly known as built-in inflation. Inflation can be hyper, extremely high, chronic, high, moderate, or low within these categories (Umaru & Zubairu, 2012).

Exchange Rate

McDonald (1990) defines exchange rate as "the price of foreign currency that clears the foreign exchange market." As a result, a currency's exchange rate is the relationship between local and international prices of products and services. Furthermore, Mordi (2006) defines exchange rate as the price of one currency in terms of another. The price at which one currency may be purchased with another currency or gold, according to Economics Dictionary (2019). According to the Investment Dictionary (2014), an exchange rate is the price of one nation's currency represented in the currency of another country. In other words, the exchange rate at which one currency may be converted into another. According to Fahrettin (2001), an exchange rate, defined as the price of one country's currency in terms of another's, is one of the most essential prices in an open economy. It has an impact on the movement of goods, services, and capital inside a nation, as well as the balance of payments, inflation, and other macroeconomic indicators.

Oil Price Shocks

The oil industry dominates the economy of Africa's oil-producing countries, with Nigeria at the forefront; the economies of these countries rely heavily on the extremely unpredictable oil rent, rendering them vulnerable to oil market volatility (Omolade, 2019). Oil price shocks are a key cause of macroeconomic variations, with a spike having a contractionary effect on global demand and GDP in the short term. This is because growing energy prices boost the cost of production, depending on labor market flexibility and manufacturers' capacity to pass on rising costs to customers in the form of higher pricing- higher oil prices generate inflation (Akpan, 2009) & (Omolade, 2019). Other else being equal, a continuous rise in the price of oil has a large beneficial influence on the economies of oil-exporting countries while having a negative impact on the economies of oil-importing countries. In the event of a drop in oil prices, the reverse occurs.

Theoretical Framework

The Dutch-Disease idea first appeared in the Netherlands in the 1950s. It clearly explains the impact of low oil prices; it is based on the negative consequences of the natural resource boom on the nation's other important sectors owing to their abandonment (Salawu, Oyebayo, Obafemi, Oyeleye and Olaniwun, 2021). Natural resource income have resulted in a fall in economic growth owing to corruption, mismanagement, and inflation, reducing competitiveness and profitability. Natural resources may become a burden for oil-producing countries, making other industries unreliable and stifling economic progress. The idea is pertinent to the research because, following the commercial discovery of oil, there has been no substantial influence on the lives of citizens or the economy, and no historic development has resulted from oil earnings.

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Empirical Review

Obi, Awujola, and Ogwuche (2016) used annual data from 1979 to 2014 to analyze the effects of oil price shocks on Nigerian macroeconomic performance. This study's theoretical foundation is based on Sims' unconstrained Vector Auto Regression model (1980). The models are used to estimate the link between changes in oil prices, the inflation rate, the GDP, and the real exchange rate. Unit root tests, Johansen co-integration technique, variance decomposition test, granger casualty test, and Vector Auto Regression Mechanism were used to investigate the speed with which variables shift from short run dynamics to long run dynamics. It was discovered that a proportionate change in oil price causes a more than proportionate change in Nigeria's real exchange rate, interest rate, and GDP.

Mathew and Ngalawa (2017) used the Panel Structural Vector Autoregressive (PSVAR) estimate approach to analyze empirically the transmission mechanisms of oil price shocks and their influence on economic performance within the monetary framework of net oil-exporting African states from 1980 to 2015. The study's variables include GDP, inflation rate, money supply, bank rate, exchange rate, unemployment, and oil price. The data analysis results demonstrated a strong reaction to oil price shocks by the included variables, as well as a significant positive relationship between oil price and the GDP of the oil-exporting African nations. As a result, the oil price has a significant impact on the macroeconomic performance of these economies; moreover, the effects of oil price shocks are transferred through the medium of money supply, exchange rate, and inflation.

Ononugbo (2018) used ARCH-GARCH and ARDL-ECM methodologies to analyze the influence of oil price volatility on GDP, inflation, currency rate, and interest rate in Nigeria, using monthly time series data from 2000 to 2015. According to the findings of their analysis, oil price volatility has a beneficial influence on real GDP but has a considerable negative impact on exchange rates, as a spike in oil price volatility causes the value of the Naira to depreciate by more than a comparable amount. According to the study, the impact of oil price variations on the economy is mediated via the exchange rate channel.

Maku, Adegboyega, and Oyelade (2018) investigated the dynamic influence of oil price shocks, inflation, and the exchange rate on Nigerian economic development from 1980 to 2016. To investigate the data features, many tests were done, including descriptive statistics, the autoregressive conditional heteroskedasticity (ARCH) test, the unit-root test, and cointegration. The GARCH model's variance equation was used to reflect the oil price shock and the volatility of the exchange rate. The data demonstrate that a one percentage point spike in Brent reduces gross domestic product by -0.005617% points, indicating that a Brent oil shock has a very small yet negative impact on GDP. Furthermore, a one percentage point rise in exchange rate volatility reduces GDP by -0.000149%, demonstrating that currency volatility has a very small yet negative influence on GDP. An rise in currency volatility will result in a relatively tiny boost in GDP. Thus, stability in the oil price and exchange rate in Nigeria might lead to a rise in the country's GDP.

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Online ISSN: 2053-4027(Online)

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Abubakar (2019) analyzed the characteristics of the link between the oil price and the Nigerian currency rate using monthly data from January 1986 to June 2018. It identifies inequalities in the link between oil price and exchange rate, as well as the impact of oil price shocks on the exchange rate. For the investigation, the threshold autoregressive (TAR), momentum threshold autoregressive (MTAR), and structural vector autoregressive (SVAR) models were used. The results of the TAR and MTAR models indicate the absence of asymmetric cointegration, leading to the conclusion that there are no asymmetries in the connection between oil price and exchange rate in Nigeria. The SVAR model results reveal that the naira gradually appreciates (although with a temporal lag) in response to positive shocks to the oil price. The research advises, among other things, diversifying the economy's foreign exchange earnings base in order to reduce the impact of negative shocks to the oil price.

Abrokwah (2019) used a vector autoregressive (VAR) model to investigate the impacts of oil price shocks on Nigeria's interest rate, real GDP, and real effective exchange rate. The impulse response function results indicate that positive oil price shocks have no influence on interest rates (monetary policy), real exchange rate, or real GDP. This finding implies that Nigerian monetary policy does not respond to oil price shocks. Both the impulse response functions and the variance decomposition analysis indicated, to a considerable extent, that oil price shocks can only explain a tiny part of the prediction error variation of the variables under study.

Agbo (2020) used a nonlinear autoregressive distributed lag framework to investigate the influence of oil price variations on Nigeria's monthly inflation rate. The ex-post facto research design was used. The data set included a Brent spot series and monthly inflation rates from January 1997 through August 2020. The findings indicate that both positive and negative changes in oil prices have a negative and non-significant influence on Nigeria's inflation rate, as well as the absence of asymmetric effects between variables. The research advocates counter-cyclical fiscal measures and effectively binding budgetary regulations to help the monetary authority reach its lower inflation objective.

Bawa, Abdullahi, Tukur, Barda, and Adams (2020) investigated the influence of oil price shocks on Nigerian inflation. On quarterly data covering 1999Q1 to 2018Q4, a Non-Linear Autoregressive Distributed Lag (NARDL) technique was used. The findings revealed that rising oil prices caused a rise in Nigeria's headline, core, and food inflation indices. However, a drop in the price of oil led in a drop in the marginal cost of production, which resulted in a moderation of domestic inflation. Furthermore, when the exchange rate was removed from the models, negative oil price shocks resulted in higher inflation in Nigeria, indicating that the exchange rate absorbed the impact of oil price declines earlier, as lower oil prices resulted in lower external reserves, naira depreciation, and ultimately higher inflationary pressures. Furthermore, core inflation is more sensitive to changes in oil prices than food inflation. These findings were unaffected by changes in econometric parameters or sample duration.

Magaji and Singla (2020) used yearly time series data from 1981 to 2019 to explore the influence of oil price shocks on the Nigerian exchange rate and economic development. To evaluate the existence of the long run and short run link between variables in each equation,

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Online ISSN: 2053-4027(Online)

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the study used Bounds test co-integration analysis using the ARDL model. The Bounds test analysis results showed a strong rejection of the null hypothesis of no co-integration among the variables of the GDP equation at the 5% level of significance, implying the existence of a long-run relationship between GDP, Oil Price, Exchange Rate, and other variables included in the GDP equation. The ARDL model for the GDP equation results show a substantial positive association between oil price and GDP in both the short and long run. As a result, a 1% increase in oil prices over time leads to a 0.85% increase in GDP. Similarly, the oil price, interest rate, and currency rate are important long-term determinants of Nigerian economic development. In the near run, the price of oil has a major impact on the exchange rate. These findings show that variations in the price of oil have a significant impact on Nigeria's economic development and exchange rates.

Agu and Nyatanga (2022) investigated the impact of predicted oil prices on inflation rates in order to better understand the behavior of inflation in Nigeria as a result of shocks to expected crude oil prices. The study used an Autoregressive Distributed lag (ARDL) and Bound testing cointegration technique to assess the variables' short-run and long-run impacts. The estimation result reveals that the predicted oil price has a considerable and favorable influence on inflation in Nigeria, both in the long and short run. Surprisingly, interest rates have a positive and large long-run influence on inflation rates as compared to apriori estimates.

METHODOLOGY

The study objectives include to determine the presence of price shocks in the price of crude oil in Nigeria, and to investigate the impact of these shocks on the exchange rate and inflation rate in the Nigerian economy. Firstly, in order to achieve the first objective, the study utilizes the generalized autoregressive conditional heteroskedasticity (GARCH) process, while ordinary least squares (OLS) is used for the second objective.

For the first objective, the model specification is given below;

```
H_t = \beta_0 + \beta_1 U^2_{t-1} + \beta_2 U^2_{t-2}
Where H_t = variance of the error term
\beta_1 U^2_{t-1} = \text{Mean Equation}
\beta_2 U^2_{t-2} = \text{Variance Equation measuring the existence of volatility in the model}
The underlying assumptions here are;
\beta_1 > 0, \ 1 < \beta_2 > 0
For the second objective, the model specification is given as;
INF_t = \beta_0 + \beta_1 OP_t + \beta_2 OPS_t + U_t \dots I
EXR_t = \beta_0 + \beta_1 OP_t + \beta_2 OPS_t + U_t \dots I
Where, INF = Inflation Rate
EXR = Exchange Rate
OP = Oil Prices
OPS = Oil Price Shocks
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DATA ANALYSIS AND DISCUSSIONS

Shock Analysis (GACHE method)

The GARCH model is employed to test for the presence of shocks in the price of oil in Nigeria. However, in order to carry this out, the presence of ARCH effects need to be determined. The ARCH heteroskedasticity test is used for this purpose. This was used to determine if we can go on to estimate the ARCH model. It tells us if the time series data exhibits some levels of volatility.

Heteroskedasticity Test: ARCH

F-statistics	45.09850	Prob. F (1,196)	0.0000
Obs*R-Squared	37.03674	Prob. Chi-Square (1)	0.0000

Source: E-views 10.0 Software, 2023 **Ho:** There is no arch effect

Decision Rule: Reject Ho if p-value of Chi-square is less than 0.05. Do not reject if otherwise. Since the p-value of chi-square is 0.0015 which is less than 0.05, we therefore conclude that there is ARCH effect in the variable. As a result, we now go on to estimate the GARCH model.

Results of GARCH Model

The GARCH (1, 1) model was used here to check for the existence oil price shock in Nigeria.

Mean Equation					
Variable	Co-efficient	Std. Error	z-Statistic	Prob.	
С	2.983532	1.463827	2.038173	0.0415	
Oil Price (-1)	0.970511	0.017725	54.75267	0.0000	
Variance Equation					
C	11.72060	4.352117	2.693080	0.0071	
RESID $(-1)^2$	0.489765	0.130419	3.755326	0.0002	
GARCH (-1)	0.337697	0.124980	2.702013	0.0069	

Source: E-views 10.0 Software, 2023

Ho: There is no presence of shocks in the oil price of Nigeria.

Decision Rule: Reject Ho if the p-value of z statistics is less than 0.05 level of significance.

Decision: Since the p-value of the z-statistics is 0.0000 which is less than the 0.05 level of significance, it indicates that there is volatility or shocks in the oil price of Nigeria. Therefore, the next step of the study would be to determine how the presence of these shocks have impacted on the inflation and exchange rates of the Nigerian economy.

Regression Analysis

The result of the Ordinary Least Squares Regression analysis to capture the effect of oil prices and oil price shocks on the inflation and exchange rates of Nigeria are displayed below;

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Table 1: Dependent Variable: Inflation Rate

Variables	Coefficients	Std. Errors	T-Statistic	Prob	
Constant	13.93103	0.719734	19.35579	0.0000	
Oil Price	-0.026138	0.008699	-2.004579	0.0030	
Price Shocks	0.075276	0.031554	2.385608	0.0180	
$R^2 = 0.056$, Adjusted $R^2 = 0.046$, Prob. F-Stat = 0.00 Durbin-Watson Stat = 0.047,					

Source: E-views 10.0 Software, 2023

Table 2: Dependent Variable: Exchange Rate

Variables	Coefficients	Std. Errors	T-Statistic	Prob	
Constant	436.7406	48.47997	9.008682	0.0000	
Oil Price	-2.321402	0.539568	-4.302331	0.0000	
Price Shocks	3.300562	1.153456	2.861456	0.0047	
$R^2 = 0.23$, Adjusted $R^2 = 0.23$, Prob. F-Stat = 0.00 Durbin-Watson Stat = 0.059,					

Source: Eviews

Interpretation of Results

The table above shows the results of the Ordinary Least Squares Regression analysis, to find the effect of oil price shocks on inflation rate. From the table, the coefficient of oil price is -0.026, which shows that a unit increase in the oil prices will decrease inflation rate by 0.026 units. The sign also shows that this is a negative or inverse relationship. Furthermore, the coefficients for price shock is positive and 0.075, showing that an increase in the volatility of oil prices increased inflation rate by 0.075 units. This relationship is a direct but negative one. In addition, table 2 shows the effects of oil price and oil price shocks on the exchange rate. The coefficient of oil price is -2.32, indicating that a unit increase in oil prices will reduce exchange rate by 2.32 units. Also, a unit increase in oil price shocks with a coefficient of 3.30, will increase exchange rate by 3.3 units. The relationship between oil price shocks and exchange rate is negative, while the relationship between oil prices and exchange rate is positive. This is in line with a priori expectations.

DISCUSSION OF FINDINGS

This study delved into the impact of oil price shocks on Nigeria's inflation and exchange rates. To identify these shocks, the study employed ARCH and GARCH models. The results from the GARCH (1,1) model unveiled the presence of significant volatility or shocks in Nigeria's oil prices. These shocks were substantial, evident from the coefficients associated with the relevant variables.

Subsequently, the study employed Ordinary Least Squares to scrutinize how oil price shocks affected exchange rates and inflation rates in Nigeria. The findings revealed a noteworthy adverse effect of oil price shocks on Nigeria's inflation rate, indicated by a probability value of 0.0180. Additionally, the impact of oil price shocks on exchange rates in Nigeria was also adverse and statistically significant, as reflected by a probability value of 0.047.

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Moreover, these findings align with established economic theory. The negative effect of oil price shocks on the exchange rate can be explained by the consistent devaluation of the Naira relative to the US Dollar in response to abrupt, particularly negative, changes in oil prices. Such fluctuations negatively impact Nigeria's oil revenue, necessitating interventions like foreign borrowing, which in turn weakens the Naira. Thus, these results harmonize with economic theory.

Likewise, the relationship between oil price shocks and inflation rate in Nigeria displayed a significant negative impact. This can be attributed to the intricate interplay between oil prices, government revenue, and overall domestic productive capacity. Shortfalls in oil prices and revenue can adversely affect domestic producers, especially those reliant on government support. Furthermore, government activities within the country can be hampered, contributing to the inflationary pressure within the economy.

CONCLUSION AND RECOMMENDATIONS

Utilizing the GARCH model, this study successfully pinpointed significant price shocks within Nigeria's oil market. Furthermore, it revealed that these oil price shocks wield considerable influence on both inflation and exchange rates within the country. These findings offer valuable insights that can inform recommendations for managing these price shocks effectively.

Regarding exchange rates, a key recommendation is for the government to enhance the proportion of funds allocated to the excess crude accounts relative to its revenue expenditures. By doing so, the government can build a financial cushion that can be tapped into when price shocks disrupt the crude oil market. This strategic use of the excess crude account can help stabilize prices, irrespective of fluctuations in global oil prices. Additionally, in times of revenue turbulence caused by price shocks, domestic borrowing can be explored as a means to finance essential government operations. This approach can mitigate the potential inflationary impact of foreign borrowing by controlling the increase in the money supply.

Furthermore, it is advisable to employ contractionary monetary and fiscal policies when price shocks occur. These policies can effectively counteract excessive cost-push inflation that may result from the shocks. By reducing the overall demand in the economy through measures like higher interest rates and reduced government spending, inflationary pressures can be curbed. These recommendations aim to provide practical strategies for managing the impact of oil price shocks on Nigeria's economy. By bolstering financial reserves, exploring domestic borrowing, and implementing appropriate economic policies, the government can better navigate and mitigate the adverse effects of price shocks in the oil market.

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