Energy Price Fluctuation and Inflation in Nigeria: A Granger Causality Analysis

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ABSTRACT: The Nigerian economy depends to a reasonable extent on the sale of crude oil for its expenditure. The country also depends on importation for a high level of its consumption. Given these events, this paper set out to investigate the causality effect of energy price fluctuations on inflation in Nigeria. This was done using time series data from 1985 to 2018. Oil price, gas price and exchange rate were the independent variables and inflation was the dependent variable. The result of the pairwise granger causality test shows that inflation is not caused by oil price or gas price fluctuations. The paper proposes that fiscal and monetary policy should be engaged to understand the causes of inflation in Nigeria.

1.0 INTRODUCTION

The Nigerian economy is highly dependent on its sale of crude oil for its revenue (Agbaeze et al 2015). Nigeria also depends on the value of energy prices to make critical decisions. For instance, the Nigerian government engages in crude oil price forecast, which it uses as it's benchmark for budgeting purposes. This is important because of the size of revenue the Nigerian government receives from the sale of crude. It goes a long way to determine if the country will be able to cover its capital and recurrent expenditure.

Electricity is also important to the sustenance of the industrialization and growth of the Nigerian economy. Electricity price is determined by the gas price in Nigeria; however, gas prices are calculated in American dollars and are affected by exchange rate fluctuations. This means that individuals and firms that utilize electricity as a factor input in their production process would be observant of the gas price and the exchange rate of Nigerian naira to the American dollar movements.

The importance of energy prices to the Nigerian economy cannot be overemphasized. The movement in energy prices also has the potential to affect the price of oil and gas derivatives such as premium motor spirit (PMS), AGO and DPK. These fluctuations have the potential to affect the price level in the economy. For instance, the consumption of crude oil derivatives that facilitate the transportation sector could experience higher transportation cost because of oil price fluctuation. This increase in cost could affect the final price of the product or service being transported. In economics this instance is defined as cost-push inflation.

It is therefore important to find out if energy price fluctuations can cause inflation in Nigeria. To do this the next section will give a conceptual clarification and review literature on the relationship between energy prices and inflation in Nigeria. Then the method of analysis will be explained and the analysis on the causal relationship between inflation and energy prices will be done. The paper will conclude with an interpretation of the results and a policy prescription based on the results.

2.0 LITERATURE REVIEW

This section of the paper will review literature on inflation and energy prices. It will also give conceptual clarification of some of the terms that will be used in this research.

Conceptual Clarification
Energy Prices

In this paper energy price will be the energy prices for the two most important energy variables in Nigeria which are oil and gas. The oil price is the globally acceptable brent crude price which is measured in barrels and presented in American dollars. The gas price is the prescribed petroleum industry bill gas price which is also presented in American dollars.

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Inflation

Kpagih et al (2021) defines inflation as a key economic indicator that informs the government on the rate at which the general price level in the economy increases over time. Inflation is usually measured as the consumer price index (CPI) or the personal consumption expenditure (PCE). The method used in Nigeria is the CPI.

Empirical Literature Review

This part of the paper is going to review the literature on the relationship between energy price and inflation in the global economy. Thought all literature in this line of research would not be exhausted, it would however provide the foundational understanding necessary for this paper.

Agbo (2020) investigated the 'effect of oil price fluctuations on Nigeria's monthly inflation rate. The time series data on monthly inflation rate and Brent crude price used in this analysis covered the period of January 1997 to August 2020. The unit root analysis informed the use of the nonlinear autoregressive distributed lag framework to analyze the data. The results shows that oil price fluctuations are negatively insignificant in determining inflation rate in Nigeria. The study recommends the consideration of oil price fluctuation when making fiscal policy decision regarding inflation control.

Kpagih et al (2022) examined the impact of oil price volatility on Inflation in Nigeria. The analysis examined time series data covering the period of 1985-2018. The data was first subjected to a unit root test which showed that the data was made up of combination of series that were stationary at level and at first difference. The unit root result necessitated the use of the ARDL (Autoregressive Distributed Lagged Model) method of analysis. The data series were also seen to have long-run relationship after being subjected to a bounds test. The result of the ARDL analysis showed that in the long run energy prices do not determine inflation in Nigeria. Oil price has a negatively significant impact on inflation in the short run, while gas price has a positive impact on inflation in the short run.

Sek and Wong (2015) studied the effect of oil price changes on inflation. The study was carried out in two group of countries. These groups are called the high oil dependence group and the low oil dependence group. The analysis was done using the ARDL format using the pooled mean group method. The result shows that oil price fluctuations have a direct impact on inflation in low oil dependent countries. In high oil dependent countries, oil price fluctuations do not have a direct impact on inflation. The paper concludes by suggesting that policy makers use monetary policy to stabilize the effect of oil price fluctuation on inflation in Nigeria.

Asghar and Naveed (2015) analyzed the 'pass-through of world oil prices to inflation'. The analysis was done in Pakistan using monthly time series data from January 2000 to December 2014. The data was subjected to the Augmented Dickey-Fuller unit root test. The result informed the use of the Autoregressive Distributed Lag (ARDL) method of analysis. The result of the ARDL bounds test showed that the existence of long-run relationship among oil prices, exchange rate and inflation in Pakistan. The long-run relationship also shows that oil price has a positive relationship with inflation in Pakistan. Furthermore, the Granger Causality test reveals that there is a one-way causality that runs from oil price to inflation in Pakistan.

Abatcha (2021) empirically analyzed the impact of oil price changes on inflation in Nigeria. The analysis made use of monthly time series data from January 1991 to April 2019. The unit root test performed revealed the presence of a mixture of integrated order of stationarity which directed the researcher to make use of the Autoregressive Distributed Lag (ARDL) method of analysis. The result of the ARDL test shows that in the long run, oil price has a positive impact on inflation rate in Nigeria. In the short run, oil price also has a positive impact on the rate of inflation in Nigeria. The paper concludes by proposing that both oil price and exchange rate fluctuation be considered when making use of monetary and fiscal policy to control inflation.

Samarah and Bal (2021) used the structural vector autoregressive (VAR) framework to examine the impact of crude oil price on the inflation rate and economic growth in India. This examination was done using time series monthly data from April 1997 to July 2016. The method of analysis applied on the data is the VAR framework. The results showed that there is a positive relationship between crude oil price on inflation in India. The result also shows that crude oil price has a negative relationship with economic growth in India. The paper suggests that policy direction should be towards the reduction of crude oil production as it would protect India from the volatility of oil prices and consequently inflation. It would also help promote a greener economy in India.

Dejan and Jasmina (2018) carried out an investigation to determine how oil price changes affect inflation in Central and Eastern European countries? Monthly data for Brent Oil price and inflation rate from eleven countries in central and Eastern Europe. The data for this analysis were collected from the years 1996 to 2018. The paper used the wavelet-based Markov switching approach to analyze the data. The findings showed that the impact of oil price fluctuation on the inflation rate in relatively low in the

central and eastern European countries ranging from 1 to 6 %. Slovakia and Bulgaria experienced the highest impact of oil price fluctuation on inflation.

Kilian and Zhou (2020) analyzed the nature of the relationships that exists among inflation, oil prices and gas prices in America between 1990 to 2013. Time series data for the different variables were analyzed using the Vector Autoregressive model (VAR). The analysis showed that gasoline price volatility accounts for approximately 39% of the variation in household inflation. Kilian and Zhou (2020) propose that more examination is needed to determine the causes of inflation in America as gas prices alone cannot give reasonable information on inflation rate volatility.

The literature reviewed above is not able to achieve a consensus on the impact of energy prices on inflation in Nigeria. This provides further reason for this analysis to be done in Nigeria to see its own independent results and to determine if energy price fluctuations should be considered when the Nigerian government is making fiscal and monetary policy decisions about inflation. The next part of this paper is going to explain the method and analyze the nature of the causal relationship that exists between energy prices and inflation in Nigeria.

3.0 METHODOLOGY
3.1 Data
This analysis will be done using time series data spanning from 1985 to 2018. The data used for this analysis were sourced from the Nigerian National Petroleum Corporation (NNPC) and the World Bank data base.

3.2 Model Specification
The causal effect between energy prices and inflation in Nigeria is modeled below:

$$INF_t = f(OILP_t, GAS_t, EXC_t) \qquad (3.1)$$

The econometrics form of the equation is written as:

$$INF_t = \propto_0 + \beta_1 OILP_{t-1} + \beta_2 GAS_{t-2} + \beta_3 EXC_{t-3} + \mu_t \qquad (3.2)$$

For this analysis the log linear form of equation 3.2 will be used which is presented below:

$$\log INF_t = \log \propto_0 + \beta_1 \log OILP_{t-1} + \beta_2 \log GAS_{t-2} + \beta_3 \log EXC_{t-3} + \mu_t \qquad (3.3)$$

$$\beta_1 > 0; \beta_2 > 0; \beta_3 > 0$$

Where:
- INF is the Inflation rate
- OILP is the Oil price
- GAS is the gas price
- EXC is the exchange rate between the Nigerian naira and the American Dollar
- $\propto_0$ is the constant
- β_1-β_3 are the coefficients of independent variables
- μ_t is the error term

Table 3.1: Explanation of Variables

Variable	Measurement	Source of Data
Inflation (INF)	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly.	World bank data base
Oil Price (OILP)	This is the internationally recognized brent crude oil price usually presented in American dollars.	NNPC statistical bulletin
Gas Price (GAS)	This is the internationally recognized price of natural gas which is usually recognized in American dollars.	NNPC statistical bulletin
Exchange Rate (EXC)	This is the rate at which one American dollar exchanges for the Nigerian naira.	World bank data base

Source: author's compilation

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The data provided for this analysis are all secondary in nature and cover the years 1985 to 2018.

4.0 RESULT AND DISCUSSIONS
This section presents the empirical analysis and results of the time series data.

4.1 Descriptive Statistics
The nature and behavior of the data will be analyzed using descriptive statistics. It helps the researcher identify data that could possibly be problematic. It also helps to get a possible relationship between the different variables.

Table 4.1: Descriptive Statistics of Variables in the Model

DESCRIPTION	LOGINF	LOGOILP	LOGGASP	LOGEXH
Mean	17.34375	7.409026	6.790170	98.87916
Median	10.67683	4.789655	4.746215	114.8886
Maximum	75.40165	18.81897	16.74817	306.0837
Minimum	0.686099	2.158621	3.049654	0.893774
Std. Dev.	15.45061	5.410599	4.257874	86.41662
Skewness	1.937272	0.951191	1.187250	0.687772
Kurtosis	7.250605	2.544020	3.163881	2.902563
Jarque-Bera	46.86297	5.421554	8.025575	2.693951
Profitability	0.000000	0.066485	0.018083	0.260025
Sum	589.6875	251.9069	230.8658	3361.892
Sum Sq. Dev.	7877.810	966.0610	598.2732	246438.5
Observations	34	34	34	34

Source: E-views computer output.

Table 4.1 contains the results of the descriptive statistics of the variables in the model. There are 34 observations within the different variables within the time span of 1985 to 2018. Within this period, we see that the inflation rate (LOGINF) has a minimum of 0.68 percent and a maximum of 75.4 percent. However, it averages out at 10.68 percent.

Oil price (LOGOILP) within the period of 1985 to 2018 hovered within $0.69 dollars per barrel of oil and $75 dollars per barrel of oil. The oil price within this same period averaged out at $17.34 dollars per barrel.

Gas price (LOGGASP) did not have they type of range we see in LOGOILP. The descriptive statistics shows that LOGGASP hovered around $4.7 dollars per mmbtu and $18 dollars per mmbtu. The gas price within this period averaged out at approximately $6.8 dollars per mmbtu.

The American dollar exchange rate against the Nigerian naira averaged at 99.88 naira. The highest value at which the American dollar traded for the naira is 306 naira for one American dollar. While the lowest exchange rate is 0.89 naira for one American dollar. The American dollar was initially weaker than the Nigerian naira, but it has become stronger than the Nigerian Niara over time.

The result of the Pairwise granger causality test conducted is presented in the table below:

Table 4.1: Granger Causality result on Energy Prices and Inflation

Null Hypothesis:	Obs	F-Statistic	Prob.
OIL_PRICE does not Granger Cause INFLATION	32	2.57098	0.0950
INFLATION does not Granger Cause OIL_PRICE		0.11745	0.8896
GAS_PRICE does not Granger Cause INFLATION	32	2.18105	0.1324
INFLATION does not Granger Cause GAS_PRICE		0.05932	0.9425
EXCHANGE_RATE does not Granger Cause INFLATION	32	2.31439	0.1181

INFLATION does not Granger Cause EXCHANGE_RATE		1.77574	0.1886
GAS_PRICE does not Granger Cause OIL_PRICE	32	8.46532	0.0014
OIL_PRICE does not Granger Cause GAS_PRICE		10.2121	0.0005
EXCHANGE_RATE does not Granger Cause OIL_PRICE	32	2.34997	0.1146
OIL_PRICE does not Granger Cause EXCHANGE_RATE		2.10147	0.1418
EXCHANGE_RATE does not Granger Cause GAS_PRICE	32	2.29009	0.1206
GAS_PRICE does not Granger Cause EXCHANGE_RATE		2.52983	0.0984

Source: E views output

The granger causality test was conducted with a maximum of two lags. The null hypothesis is presented in the table and is accepted or rejected based on the probability value of the F-statistics. Where the probability value is less than 0.05, the null hypothesis is rejected and vice-versa. The result shows us that oil price fluctuations do not cause inflation in Nigeria. It also shows that inflation does not cause oil price fluctuation in Nigeria.

The result in the table above also shows that gas price fluctuation does not cause inflation in Nigeria and inflation does not cause gas price fluctuation in Nigeria. This is evident in the fact that the probability values are greater than 0.05, therefore we fail to reject the null. The implication of these results is that oil price and gas price do not influence inflation in Nigeria and cannot be used to control the inflation rate.

The result however shows that oil price fluctuation can cause, gas price fluctuation and vice-versa. This is evident in the fact that the probability values for these hypotheses are less than 0.05. The result also informs us that policy decisions regarding gas prices can be inferred from studying oil price movements.

Finally, the result in the table above shows that exchange rate fluctuations does not individually cause inflation rate, oil price or gas price fluctuations in Nigeria. Also, gas price, oil price and inflation rate fluctuations, individually, do not cause exchange rate fluctuations in Nigeria. With reference to the research topic this analysis shows that energy price fluctuations do not cause movements in inflation in Nigeria.

5.0 CONCLUSION

The paper set out to investigate the impact of energy price fluctuations on inflation in Nigeria. The energy variables used for this analysis are oil price and gas price. The results of the granger causality test carried out shows that fluctuations in energy prices do not cause inflation rate fluctuation in Nigeria and vice-versa. This information is important for policy makers in Nigeria as they would be able to understand the causes of inflation in Nigeria go beyond energy prices. They would need to explore means such as fiscal and monetary policy to control inflation.
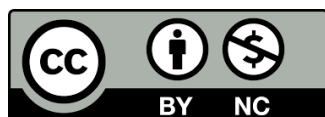
This result also somewhat justifies the assertion of the world bank that removing petroleum subsidy in the oil and gas sector would not cause inflation in Nigeria. However, deeper research into the impact of oil derivative price fluctuation on inflation in Nigeria would give room for better justification. This paper has provided a foundation for such research.

REFERENCE

1) Abatcha, M., (2021). Empirical Analysis of Oil Price Changes on Inflation in Nigeria. Journal of Management and Economic Studies. Vol 3(3):84-101. DOI: 10.26677/TR1010.2022.915.
2) Agbaeze, E. K., Udeh, S. N., & Onwuka, I. O., (2015). Resolving Nigeria's dependency on oil- The derivation model. Journal of African Studies and Development. Vol 7(1): 1-14. DOI: 10.5897/JASD2014.0303.
3) Agbo, E. I., (2020). Effect of Oil Price Fluctuations on Nigeria's Monthly Inflation Rate. Scholars Journal of Economics, Business and Management. Vol 7(12): 408-413. 10.36347/sjebm.2020.v07i11.05.
4) Asghar, N., & Naveed, T. A., (2015). Pass-through of World Oil Prices to Inflation: A time series analysis of Pakistan. Pakistan Economic and Social Review. Vol 53(2): 269-284. https://www.jstor.org/stable/26153260.

5) Dejan, Z., Jasmina, D., & Slavica, M., (2018). How do oil price changes affect inflation in Central and Eastern European Countries? A wavelet-based Markov switching approach. Baltic Journa of Economics. Vol 19(1): 84-104. https://doi.org/10.1080/1406099X.2018.1562011.

6) Kilian, L., & Zhou, X., (2020). Oil Prices, Gasoline Prices, and Inflation Expectations: A New Model and New Facts. Federal Reserve Bank of Dallas. https://doi.org/10.24149/wp2025.

7) Kpagih, L. L., Leelee, D. N., & Nyeche, E., (2021). The nexus between the external sector and inflation in Nigeria. International Journal of Advanced Research. Vol 9(11): 1151-1160. DOI: http://dx.doi.org/10.21474/IJAR01/13853.

8) Kpagih, L. L., Amini, M., & Odungweru, K., (2022). The Impact of Energy Price Volatility on Inflation in Nigeria. Journal of Economics, Finance and Management Studies. Vol 5(2): 289-294. http://dx.doi.org/10.47191/jefms/v5-i2-05.

9) Sarmah, A., & Bal, D, P., (2021). Does Crude Oil Price Affect the Inflation Rate and Economics Growth in India? A New Insight Based on Structural VAR Framework, The Indian Economic Journal. Vol 69 (1): 123-139. https://doi.org/10.1177%2F0019466221998838.

10) Sek, S. K., Teo, X. Q., & Wong, Y. N., (2015). A Comparative Study on the Effects of Oil Price Changes on Inflation. Procedia Economics and Finance Vol 26: 630-636. https://doi.org/10.1016/S2212-5671(15)00800-X.