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The Impact of Energy Price Volatility on Inflation in Nigeria

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ABSTRACT: The event of the covid-19 pandemic led to fluctuation in energy prices and different economies are still recovering from the impact of the pandemic. The pandemic also saw a rise in prices which made the cost of living difficult for the common man. This paper investigated the relationship between energy prices and inflation in Nigeria between the years 1985 to 2018. The unit root test performed on the data indicated that the ARDL method be used to analyze the data. The result of the bounds test shows the presence of long run relationship. The long run result shows that energy prices have no impact on inflation in the long run. In the short run the one-year lag of oil price has a negatively significant impact on inflation while, the one-year lag of gas price has a positively significant impact on inflation in Nigeria.

INTRODUCTION

Inflation is one of the foremost economic indicators that is of importance to any government. It can be exaggerated by the energy price shocks, since energy price vicissitudes could further lead to fluctuations in the price level through both direct and indirect means. Moreover, being a fundamental input for the production process, energy price changes may also cause rise in the producer prices, which could spark cost-push inflation affecting an upsurge in the price of other goods and services.

The rise in the inflation rate could have negative impact on an economy and affect significant economic variables such as GDP (Gross Domestic Product), unemployment rate and the exchange rate. If the prices of goods and services in an economy are high, the citizens would opt for importation rather than consuming home-made goods thereby negatively affecting GDP and the exchange rate of the economy. High prices could also cause workers to be laid off by firms to reduce their costs and prices. This would increase the level of unemployment in the economy and put pressure on the government.

Nigeria is a highly oil dependent country. Revenue from the sale of crude oil makes up majority of the country's national income. It also makes a reasonable level of income from the sale of gas, although it has not tapped into its gas market as much as its oil market. Given these realities, energy price fluctuations are critical to the growth and development of the Nigerian economy. Inflation has also been a big issue in the Nigerian economy recently as there has been a persistent rise in price level. This has made the livelihood of the Nigerian masses harder.

The Nigerian government has also complained about the impact of the covid-19 virus on the energy industry. As oil prices were seen to fall, the revenue of the Nigerian government also fell; and this placed the government in a position where it could not meet up its expenses without borrowing. This rise in borrowing was also accompanied my high prices in the economy at that time. These movements of energy prices, inflation rate and external debt to finance the Nigerian economy is a serious cause for concern for policy makers. Hence, this has necessitated that this paper investigates the nature of the relationship that exists between energy prices and inflation in Nigeria.

Cost-push inflation refers to instances where the rise in factors of production lead to an increase in the inflation rate. Energy prices are key factors of production for different production processes. This paper therefore takes the position that energy prices will have a positive impact on the inflation rate in Nigeria as its null hypothesis. The empirical investigation will provide us with a result to either accept or refute this claim. The next part of this paper will review literature on energy prices and inflation in Nigeria. The paper will then go on to explain the method of analysis after which the analysis will be carried out. The paper will end with an interpretation of the result of the analysis and a conclusion.

LITERATURE SURVEY

There are a variety of empirical papers examining the link between energy prices and inflation. The different studies have their different outcomes. These outcomes are assessed by numerous approaches and different classification. The outcome of each paper differs depending on the period chosen, data processed, other variables integrated in the technique or econometric approach employed. This section of the paper will review the different literature.

REVIEW OF EMPIRICAL STUDIES

Bawa et al (2020) studied the asymmetric impact of oil price on inflation in Nigeria. The study covered the period of the first quarter of 1999 till the last quarter of 2018. The time series data covering this period was subjected to a Non-linear Autoregressive Distributed Lag (NARDL) method of analysis. The result of the analysis showed that increase in the oil price was responsible for core and food inflation in Nigeria and vice-versa. This is because oil price has a high impact on cost of production in Nigeria. Bawa et al (2020) go on to advice for the use of monetary policy to control inflation in the time of oil price increase. The paper also advocates for policies that would promote local agricultural activities. This would enable local food consumption and reduce the impact of oil price volatility on food inflation in Nigeria.

Kilian and Zhou (2020) examined the relationship that exists among inflation, gasoline prices and oil prices in the Unites States of America between the years 1990 to 2013. To do this, the paper made use of the Vector Autoregressive (VAR) model. The result of the model shows that gasoline price fluctuations drive the level of inflation in America. Specifically speaking, the results shows that gasoline price fluctuations accounts for 39% of the variation in household inflation. The paper proposes that more research should be done to accurately determine the other factors responsible for inflation in Nigeria as gasoline prices alone cannot be used to moderate the rate of inflation in America.

Conflitti and Luciani (2019) investigated the relationship between oil price and core inflation in the United States of America and Europe between the years 1984 to 2018. The innovation in this research is that it accessed the impact of oil price fluctuations on disaggregated price level indicators. A dynamic factor model on a panel of disaggregated prices was used to carry out this analysis. Vector Autoregressive (VAR) model was used to determine the pass-through effect of oil price into inflation. The result of the analysis shows that oil price inflation passes through into inflation. Therefore, it is important for policy makers to consider oil price volatility while making policy decisions to control inflation.

Zhao *et al* (2016) analyzed the effects of oil price volatility on output and inflation in China. They identified that oil price volatility could be derived from a variety of sources. However, for the purpose of the analysis the sources of oil price volatility were broken down into political events in OPEC countries, volatility in the demand for industrial commodities, demand shocks specific to the crude oil market and other oil supply shocks. To engage in this analysis, they engaged an open-economy dynamic stochastic general equilibrium model with China and the rest of the world. The result shows that oil price volatility as a result of political events affects inflation in the short-run. However, the oil price volatility, originating from the other sources of oil price volatility affect inflation in the long-run. Basically, oil price volatility has a significant impact on inflation.

Hadzwan *et al* (2019), accessed the nature of energy subsidy, oil price fluctuation and price behavior in Malaysia. The aim of the paper is to investigate the impact of energy subsidy and oil price fluctuation on inflation to enable policy makers in decision making. The study made use of time series data from the year 1981 to 2015. The data was subjected to the Autoregressive Distributed Lagged (ARDL) model of analysis. The result shows that oil price volatility has significant impact on inflation in Malaysia within the years 1981 to 2015. The findings also showed that the Producer Price Index (PPI) is more sensitive to oil price volatility than the Consumer Price Index (CPI). The paper proposes that social safety nets be employed to reduce the impact of oil price volatility on the common man.

Gylych *et al* (2020) investigated the impact of oil price fluctuation on the economy of Nigeria, the core analysis for energy producing countries. The data for this analysis covered the period of 1995 to 2018 for the following variables being exchange rate, inflation rate and interest rate. Gylych *et al* (2020) used the Toda-Yamamoto (TY) model to carry out the analysis. The analysis also adopted the TY Modified Wald test approach to causality. The findings of the test shows that oil price is a strong determinant of exchange rate and inflation rate in Nigeria. The paper therefore advices that forecasting oil price volatility would be useful to fiscal and monetary policy decision makers in Nigeria.

Ozaydin (2019) investigated the nexus between energy prices and inflation. This analysis was done from a historical perspective being the case of the Ottoman Empire which existed within the period of 1885 to 1914. The timeseries data for this research were subjected to unit root rest and none of the variables were stationary at second or higher orders. The ARDL bounds test to

cointegration was employed and it was discovered that there is long-run relationship between energy prices and inflation in Ottoman. The result showed that energy prices have a positive impact on inflation as energy price fluctuation accounted for 85% of the movement in inflation rate in Ottoman.

Atiq (2014) studied South Asian economies to understand the relationship between energy prices, monetary policy, and inflation. The objective of Atiq's (2014) paper was to address the dilemma that exists in a situation where contractionary monetary policy is being used to reduce cost push inflation which exists because of energy price increase. Time series data from 1980 to 2012 was used for this analysis. The data was subjected to unit root and granger causality tests. The result shows that oil price fluctuation has cost implications on inflation. The paper suggests that the use of monetary policy to reduce cost push inflation is not effective.

Behname (2013) analyzed the relationship between market size, inflation, and energy in Northern Europe. The data for this analysis covered the period of 1980 to 2009. This data was then subjected to unit root test which showed that all the variables were integrated at first order. Given this result the Hausman test suggests a fixed-effects model. The result of the Pedroni test shows the absence of long-run relationship. The result of the short-term Granger test shows that there is a bilateral relationship among market size, oil price and unemployment which jointly lead to inflation and economic growth. It is therefore important to monitor oil price shocks as it affects economic growth and inflation.

The literature reviewed the relationship between energy prices and inflation. It revealed in Nigeria, the oil market is more active than the gas market and therefore, oil price should have more impact on inflation in Nigeria than gas price. This is true as majority of Nigeria's revenue is gotten from the sale of oil. The literature reviewed also shows a consensus that oil price fluctuation has positive and significant impact on inflation. However, this impact varies depending on the economic situation of the country. This position is therefore taken to be the null hypothesis of this paper and will be subjected to empirical examination in the next part of the paper.

METHODOLOGY

This part of the paper will explain the data collection and analytical methods that will be used in this study. The plan is to adopt descriptive statistics and Ex Post Facto Research Design. The variables used for the analysis are inflation (INFR) which is the dependent variable. The independent variables are oil price (OILP), gas price gas price (GASP) and trade openness (TOP). These variables were subjected to a unit root test to determine their stationarity level. A co-integration tests was then conducted to determine if there is the existence of long-run relationship between inflation and energy prices in Nigeria between the period of 1985 and 2018. Secondary data gotten from Bloomberg and the World Bank data base was used for this analysis.

3.1 Model Specification:

$$INFR_t = \beta_0 + \beta_1 OILP_t + \beta_2 GASP_t + \beta_3 TOP_t + \mu_t$$

For the analysis the model will be transformed to a log linear form. This is seen in the equation below:

$$\log INFR_t = log\beta_0 + \beta_1 logOILP_t + \beta_2 logGASP_t + \beta_3 logTOP_t + \mu_t$$

β_1>0;β_2>0;β_3>0;β_4>0; β_5>0;

Where:

β_0 is the constant term for the model, β_1 is the parameter estimator for OILP, β_2 is the parameter estimator for GASP, β_3 is the parameter estimator for TOP and μ_t is the error term for the model.

RESULTS AND DISCUSSION

4.1 Energy prices and inflation

The impact of energy prices on the inflation rate in Nigeria is analyzed in this section. The hypothesis below us used to test this impact:

Hypothesis

H01: There is no significant impact of oil prices on inflation in Nigeria.

H02: There is no significant impact of gas prices on inflation in Nigeria.

4.2 Unit Root Test

The Augmented Dickey-Fuller (ADF) was utilized to test for the existence of unit roots in the data at trend and intercept. The results of the test at level are shown below:

Table 4.1- Augmented Dickey-Fuller Unit Root Test @ Trend and Intercept I (0)

SERIES	ADF TEST STATISTIC	5% CRITICAL VALUES	10% CRITICAL VALUES	ORDER	REMARKS
INFR	-3.551669	-3.552973	-3.209642	I(0)	Non-stationary
OILP	-4.710025	-3.603202	-3.238054	I(0)	Stationary
GASP	-2.198294	-3.552973	-3.209642	I(0)	Non-stationary
TOP	0.036027	-3.595026	-3.233456	I(0)	Non-stationary

Source: E-views computer output

The results above shows us that OILP is stationary at level I(0) as the ADF calculated statistics is less than its critical values at both 5% and 10% level of significance. However, the calculated statistics value for INFR, GASP and TOP are greater than their respective critical values at both 5% and 10% levels of significance which implies that they are not stationary. Given that these variables are not stationary at level, the first difference of these variables will be taken to make them stationary (Shrestha and Bhatta 2018). The first difference is taken and presented below:

Table 4.1- Augmented Dickey-Fuller Unit Root Test @ Trend and Intercept I 1)

SERIES	ADF TEST STATISTIC	5% CRITICAL VALUES	10% CRITICAL VALUES	ORDER	REMARKS
INFR	-6.804008	-3.557759	-3.212361	I(1)	Stationary
GASP	-4.777929	-3.557759	-3.212361	I(1)	Stationary
TOP	-4.124981	-3.612199	-3.243079	I(1)	Stationary

Source: E-views computer output

From the table above the calculated statistics value for INFR, GASP and TOP are all less than their critical values at 5% and 10% indicating that they are all stationary. Sherstha and Bhatta (2018) advise that the ARDL method of analysis be used when a timeseries model contains variables that are stationary at different levels.

ARDL Bound Test Approach

In engaging the ARDL bound test, we start by using the bound test to check for the existence of long-run relationship among the variables within the model. The results of the bounds test are seen below:

K	F-Statistic	Significant	Lower Bound, I(0)	Upper Bound, I(1)
3	4.119304	10%	2.618	3.532
		5%	3.164	4.194
		1%	4.428	5.816

Source: E-views computer output

The result of the bounds test above shows that the calculated F-statistics of 4.119304 is higher than the upper bound (3.532) at 10% which is a sign that there is long run relationship among the variables. The calculated F-statistics is in-between the higher and lower bound at 5%. From the results above the short-run and the long-run results will be presented to gain a proper understanding of the impact of energy prices on inflation in Nigeria. The long-run results are presented in the table below:

Variable	Coefficient	Std. Error	T-statistic	P-Value
OILP	2.627206	4.433850	0.592534	0.5605
GASP	-9.142621	6.387258	-1.431384	0.1686
TOP	-0.686358	0.394336	-1.740541	0.0979

Source: E-views computer output

The table above shows the long-run results for the analysis of the relationship between energy prices and inflation in Nigeria. On the table we see that in the long-run, oil prices have a positive but insignificant impact on inflation in Nigeria. Therefore, a 1% increase in oil prices will lead to approximately 2.6% increase in the inflation rate in Nigeria.

Unlike the case of oil prices, in the long-run gas prices have a negative but insignificant relationship with inflation in Nigeria. This implies that a 1% increase in gas prices will lead to approximately 9.14% decrease in the inflation rate in Nigeria.

Finally, we can see a negative and insignificant relationship between trade openness and inflation in Nigeria. This implies that a 1% increase in trade openness in the long-run would lead to an approximately 0.69% decrease in the inflation rate in Nigeria.

The results in the table above tell us that in the long-run energy prices do not have any significant impact on inflation in Nigeria. This paper will now proceed to examine the impact of energy prices on inflation in the short-run.

Variable	Coefficient	Std. Error	t-statistic	P-value
D(OILP)	-5.060398	2.803771	-1.804855	0.0870
D(OILP)(-1)	-9.006892	2.965212	-3.037520	0.0068
D(GASP)	6.804198	3.720196	1.828989	0.0831
D(GASP)(-1)	10.87906	3.857527	2.820217	0.0109
D(TOP)	-0.386693	0.203134	-1.903635	0.0722
D(TOP)(-1)	-0.646158	0.193100	-3.346242	0.0034
D(TOP)(-2)	-0.537661	0.195872	-2.744960	0.0129
CointEq(-1)*	-0.691192	0.138425	-4.993259	0.0001

Source: E-views computer output

The table above presents the short-run effects of energy prices on inflation in Nigeria. The result shows us that the different energy prices have instances when they significantly affect inflation in Nigeria after a certain lag period.

From the table above we see that oil price has a negative but insignificant impact on inflation in the short-run. However, oil price has a negative and significant impact on inflation in the short-run after a one year lag. Therefore, if oil price should increase by 1%, gas prices will reduce by approximately 9% after a one-year lag in the short-run ceteris-paribus.

From the table we also see that gas price has a positive and insignificant impact on inflation in the short-run. However, gas prices have a positive and significant impact on inflation in Nigeria after one year lag in the short-run. This implies that a 1% increase in gas prices will lead to an approximately 11% increase in the inflation rate in the short-run, ceteris-paribus.

Trade openness generally has a negative relationship with inflation in Nigeria from the results presented. We see that trade openness has a negative and insignificant impact on inflation in Nigeria in the short-run. However, trade openness has a negative and significant impact on inflation in Nigeria after a year lag. This implies that a 1% increase in trade openness in the short-run will lead to approximately 0.6% reduction in the inflation rate, ceteris-paribus after a year lag. Trade openness also has a significant impact on inflation in the short-run after two years lag in Nigeria. This implies that a 1% increase in trade openness will lead to approximately 0.5% decrease in inflation in Nigeria after two years lag in the short-run ceteris paribus.

The coefficient of the error correction mechanism (CointEq(-1)) is appropriately signed as negative and statistically significant at 5%. The absolute value of -0.691192 implies that the speed of adjustment of the model to the long-run equilibrium is approximately 7% within the year.

Post Estimation Test

Test	**Techniques**	**Statistic**	**P-Value**	**Remarks**
Residual Normality	Jacque-Bera	Jacque-Bera	0.070412	Accepted
Serial Correlation	Breusch-Godfrey	X^2	0.6811	Accepted
Heteroskedasticity	Breusch-Pagan-Godfrey	X^2	0.9158	Accepted

Above are the results of the post estimation tests conducted in this research. The result of the normality test shows that the estimated residuals are normally distributed. The result also shows the absence of serial correlation within the error term. The result of the heteroskedasticity test also shows the absence of heteroskedasticity among the estimated error terms.

IMPLICATION OF RESULTS

Looking at the results presented above, we can see that energy prices do not have any significant impact on inflation in Nigeria in the long run. In the short run we see that energy prices (oil price and gas price) are significant in determining inflation after a year lag. The implication of this is that changes in energy prices will lead to a fluctuation in the inflation rate in Nigeria after at least a year lag. When oil price rises, inflation in Nigeria will fall after a year lag and when gas prices rise inflation will also rise after a year lag. However, we also see that in the long-run energy price fluctuation have no significant impact on inflation in Nigeria.

CONCLUSION AND RECOMMENDATIONS

CONCLUSION

This paper set out examine the impact of energy price fluctuation on inflation in Nigeria. The specific objective was to examine the impact of oil price and gas price on inflation in Nigeria in the short-run and long-run between the years 1985 to 2018.

Ex-post facto research design using Nigeria's data obtained from the World Bank covering the years 1985-2018 was utilized. The pre-test analysis used on the data was the Augmented Dickey Fuller test (ADF) which showed that the data set is made up of a combination of I (0) and I(1) data. The data was further subjected to the Autoregressive Distributed Lag (ARDL) bounds test to check the existence of co-integration. Given that the result showed the presence of co-integration, the short-run and long-run results were presented. We found out that in the long-run energy prices have no significant impact on inflation in Nigeria. In the short-run oil price has a negative impact on inflation after a year lag in Nigeria, while gas price has a positive impact on inflation in Nigeria in the short-run after a year lag.

It is therefore important for policy makers to monitor energy price fluctuations so that they anticipate its impact on the inflation in the country and engage the necessary fiscal or monetary policy to keep the inflation rate at Nigeria's benchmark inflation rate that would promote economic growth.

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