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Effect Of Oil Price Fluctuations On Nigeria's Monthly Inflation Rate

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Abstract **Original Research Article**

This paper examined the effect of oil price changes on Nigeria's monthly inflation rate using a nonlinear autoregressive distributed lag nonlinear autoregressive distributed lag framework.Ex-post facto research design was employed. The data comprised a Brent spot series and monthly inflation rates for the period from January 1997 to August 2020.. The results suggest that both positive and negative movements in oil prices have negative and non- significant effects on Nigeria's inflation rate.and the absence of asymmetric effects between the variables. To enable the monetary authority achieve lower inflation target, the study recommends the formulation and implementation of counter-cyclical fiscal policies and effectively binding fiscal rules.

Keywords: Inflation, Oil Price, Nonlinear autoregressive distributed lag model, Nigeria.

INTRODUCTION

Fluctuations in crude oil price are global phenomena that are experienced by every country in the world(Siok, Xue & Yen,2015),. The effect of oil price is in particular influential in determining the economies of emerging countries as a result of the fact that those economies are weak and financially unstable to cope with the influences of external shocks. One of the major areas where oil price changes usually create much impact is on inflation rate.The resultant fluctuations in inflation or price levels may further cause changes in the economy that will affect the overall economic performance . This explains why inflation rate is considered as the main economic indicator that affects economic performance. Consequently, price stability and low inflation are often the main policy objectives usually targeted by policymakers. The importance of establishing the true nature of the effect of oil price changes on inflation notwithstanding,the studies carried out in the past on this subject-matter have so far ended with conflictng results.

The aim of this study, therefore, is to contribute to closing the gap in literature by investigating the effect of oil price fluctuations on inflation in the case of Nigeria, an oil-rich country. The main contribution of the paper arises from the fact that the channel from oil price to consumer price fluctuations is evaluated in the case of Nigeria, where to the best of our knowledge such study has been rarely carried out.

The paper is divided into five sections. Section 2 reviews the literature.Section 3 presents the methodology. Section dwells on the results and discussion, while 5 concludes the paper.

2. REVIEW OF THE RELATED LITERATURE

2.1 Theoretical and coneptual review

Increasingly, crude oil has become an essential commodity as it is not only a fundamental cost for majority of industries, but also its price continues to fluctuate.(Zhu & Singh,2016). Recent studies such as Driesprong, Jacobsen and Maat(2008) as well as Ribas, Leiras and Hamacher(2010) agree that crude oil price is a significant determinant of stock market returns.Equally, Pompermayer, Florian, Leal, and Soares(2007) as well as Narayan and Sharma(2011) consider crude oil price as an important determinant of firm returns.For this reason, oil price volatility creates uncertainties with regard to firm profitability, valuations and investment decisions. On the one side, oil is an essential input for industries that consume petroleum products made from crude oil. For those firms not involved in the oil industry, escalating oil prices present increased cost to business enterprises.In the absence of an offsetting increase in revenues, thisis likely to result in a reduction in profits. On the other side, oil is an important output for oil exploration and production companies. For firms in this category, an increase in oil price brings about a potential increase in profits. According to Namovsky (2018), when oil prices increase, international trade becomes more localized because countries begin to trade relatively more with their neighbors. In the contrary, when they decrease, trade becomes more dispersed as the distance between countries becomes less relevant. Namovsky (2018) asserts that an oil price halving will make trade more dispersed by relatively increasing trade by 40% for a distance of 10,000 miles and by 25% for a distance of 1,000.

Inflation is one of the several macroeconomic variables that affect the economic growth of a nation. The macroeconomic variables are all directly controlled by the volume of money in circulation. Inflation has been defined as a quantitative measure of the rate at which the average price level of a basket of selected goods and services in an economy increases over a period of time. Inflation is a decrease in the purchasing power of money, reflected in a general increase in the prices of goods and services in an economy. It is equally considered as the constant rise in the general level of prices where a unit of currency buys less than it did in prior periods. Often expressed as a percentage, inflation indicates a decrease in the purchasing power of a nation's currency. For Mankiw (2007). For Hall and Taylor (1993),inflation rate is the annualized percentage change in a general price index, over time .Inflation affects economies in various positive and negative ways. When prices rise for energy, food, commodities and other goods and services, the entire economy is affected. Rising prices impact the cost of living, the cost of doing business, borrowing money and every other facet of the economy. The negative effects of inflation include an increase in the opportunity cost of holding money, uncertainty over future inflation which may discourage investment and savings, and, if inflation were rapid enough, shortages of goods as consumers begin hoarding out of concern that prices will increase in the future. However, inflation equally has some positive effects in an economy. For instance, it reduces unemployment due to nominal wage rigidity, allows the central bank more leeway in carrying out monetary policy, encourages lending, makes more money available to consumers to buy goods and services and invest instead of hoarding, minimizes the inefficiencies associated with deflation and encourages economic growth benefits (Mankiw,2007).

Zhu and Singh(2016) assert that oil price change has its direct effect on domestic inflation in low oil dependency group. However, its impact is indirect on determining the inflation in the high oil dependency group through increasing the exporters' production cost. The major determinants of inflation differ across groups of countries. Theoretically, oil price increases are generally expected to increase inflation and reduce economic growth. With regard to inflation, oil prices directly affect the prices of goods made with petroleum products. The increases in oil prices are capable of depressing the supply of other goods because they increase the costs of producing them (Federal Reserve Bank of San Francisco, 2007). The effects of oil price fluctuations on inflation equally depends on whether countries are consumers (importers) or producers (exporters) of oil. According to Živkov, Đurašković and Manić (2019), when oil price is high, companies prefer to reduce production rate due to high production costs. In the same vein, oil price reduction decreases production cost and price level. However, it does not bring down the price level of goods in price stickiness condition because suppliers keep the price at a high level.

The changes and volatility in the relationship between oil price and consumer inflation have attracted many researches on the relationship between oil price and inflation. According to Blanchard and Gali (2007), the strong relationship between oil price and consumer inflation in the 1970s can be explained by two episodes, i.e. low growth, high unemployment and high inflation rate. From a global perspective,Siok, Xue and Yen(2015) report that the impact of oil price on inflation was in particular very strong during the oil price shocks in the 1970s and the 1990s. According to those authors, historical data indicate that oil price rose from $3 per barrel before 1973 to close $40 per barrel in 1979. Oil price also witnessed a high increase from $15 a barrel in 1998 to almost $140 a barrel in 2008. The consumer price index (1982 base year) compiled by Bureau of Labor Statistics, United States also exhibited the same high jump from 41.10 (January 1972) to 86.30 (end of 1980) and then increased from 164.30 (January 1999) to 214.82 (April 2008). Over the years, Nigeria's inflation rate has been unsteady. It exceeded 16 percent in 2017. According to Lioudis(2020), there was a strong correlation between inflation and oil prices during the 1970s.However,since the 1980s, the relationship between the two has been less eignificant.

2.2 EMPIRICAL REVIEW

Nigeria is essentially an exporter of crude oil. However, it is also an importer of refined oil. Consequently, this review of literature centers on both oil exporting and importing countries.

In 2002,Hooker (2002) studied the relationship between oil prices and inflation on the sample year 1962 – 1980 and 1981 – 2000. The results of the study showed that oil price had significance impact on inflation in the first sample period but not in the later sample period. The results again imply the strong relationship between oil price and inflation in the early 1970s has disappeared after mid 1980s

Cologni and Manera (2008) examined the effect of oil price changes in the G-7 countries.They found that oil prices affect inflation significantly and that inflation in turn affects the real economy by increasing the interest rates.Just like Evans and Fisher (2011) and using the data from 1985 to 2011, Chen and Wen (2011) arrived at results that made them to conclude that oil price shocks has no impact on the trend inflation but the effect is transitory through headline or core inflation.

Focusing on the possible reactions of monetary policies to external shocks, Wu and Ni (2011) investigated the relationship between oil prices, inflation, interest rates and money for the US for the period of 1995-2005. Their results showed that oil price changes affect inflation in both symmetric and asymmetric models, and oil price changes Granger cause inflation. Cavalcanti and Jalles (2013) did a similar work in the case of the USA and Brazil, which had different path on oil import dependence rate such that oil import dependency is higher in the USA than Brazil. The authors concluded that although inflation volatility was declining in the USA, oil price shocks still accounted for a larger fraction of the volatility.

Abounoori,Nazarian and Amiri(2014) also carried out a study on the effect of oil price on inflation in Iran.The results of the study showed a positive impact of oil price on inflation in short and long terms.

Using quarterly data from 1990 to 2011,the study of Ozturk (2015) on this subject-matter revealed positive impacts of oil price shocks on inflation in Turkey. Similarly, the studies conducted by Sibanda, Hove and Murwirapachena (2015) for South Africa exhibited a positive relationship between oil price and inflation.

Katircioglu, Sertoglu, Candemir and Mercan (2015), analyzed the impact of oil price movements on macroeconomic performance in the case of OECD countries. They found that the price of oil exerts statistically negative impact on macroeconomic variables; GDP, unemployment rate and the Consumer Price Index. Katircioglu et al. (2015) concluded that the impact depends on the extent to which the country's industry depends on oil.

Siok, Xue and Yen(2015) empirically analyzed the effects of oil price changes on inflation in two groups of countries, namely the high versus low oil dependency groups. In addition,they compared the relative effect of oil price with other types of shocks such as real exchange rate, domestic output and exporters' production cost. The authors modeled the pass-through equation in an autoregressive distributed lag (ARDL) format. The model was estimated using pooled mean group method. The results of the study revealed that oil price change has its direct effect on domestic inflation in low oil dependency group but has indirect impact on domestic inflation in the high oil dependency group through changes on the exporter's production cost. In addition,they found that the main determinants of domestic inflation are real exchange rate and exporter's production cost (high oil dependency group) and domestic output and exporter's production cost (low oil dependency group).

While caaying out a smilar study, Rasasi and Yilmaz (2016) employed quarterly data from 1987 to 2015 .They found that oil price increases affect inflation positively with a delay. The result was the same in the case of Trang (2017) after investigating Vietnam.

After conducting a study on the link between oil price and inflation for Pakistan, Malik (2017) found a positive relationship between oil price and inflation.

In another dimension,Apere (2017) sought to find out empirically the relationship between inflation and oil price fluctuations in Nigeria with quarterly data over the period 1980:1 to 2015:4.The author used secondary data obtained from the Central Bank of Nigeria (CBN) Statistical Bulletin 2015 and Energy Information Administration (EIA) short-term outlook, December, 2016. Vector autoregressive model econometric technique was employed in analysing the data while the following analysis were carried out; the Lag length selection, VAR stability tests, VAR LM test for serial correlation, the Impulse Response Function and the Forecast Error Variance Decomposition. The study found that the response of inflation to oil price fluctuation is that as oil prices falls inflation falls also and a stable and positive oil price results in a stable negative inflation rate. Thus the relationship between them(inflation and oil price fluctuation) is negative

Contrary to some of the results of earlier studies, however, and after employing seasonal data and non-linear ARDL, Davari and Kamalian (2018) found that there is no significant relationship between an increase in oil-price and inflation rate while a significant relationship exists between the reduction in oil price and inflation.

Bala and Chin(2018) investigated the asymmetric impacts of oil price changes on inflation in Algeria,Angola, Libya, and Nigeria using three different kinds of oil price data ,namely the actual spot oil price of individual countries, the OPEC reference basket oil price, and an average of the Brent, WTI, and Dubai oil price. Autoregressive distributed lag (ARDL) dynamic panels were employed to estimate the short- and long-term impacts. Also, the oil price was partitioned into positive and negative changes to capture asymmetric impacts and found that both the positive and negative oil price changes positively influenced inflation and that that a rise in oil prices would lead to higher inflation The authors found that the impact was more significant when the oil prices dropped. They also found that the money supply, the exchange rate, and the gross domestic product (GDP) are positively related to inflation, while food production is negatively related to inflation.

Some other studies that report significance impacts of oil price on inflation include Kiptui (2009), Misati, Nyamongo and Mwangi (2013). and Kargi (2014) On the other hand, Chou and Tseng (2011) conducted analyses on the pass-through effect of oil prices on CPI inflation in a group of emerging Asian countries. They found the evidence of long-run pass-through effect of oil on CPI inflation in majority countries but the results were not significant in the short run. In addition, Ibrahim (2015) investigated the relationship between food and oil prices for Malaysia using a nonlinear ARDL model. The study found long run relationship on the oil price increases and food price. However, there is no long run relationship between oil price reduction and food price. A number of studies find small or limited effect of oil price on inflation. Among them includes Hooker (2002). Jiranyakul (2015) also failed to detect the long-run impact of oil price shocks on consumer prices in the case of Thailand.

3. METHODOLOGY

3.1 Data

This study examined the asymmetrical effects of oil price fluctuations on the Nigerian inflation rate. It relied on monthly historical data spanning the period from January 1997 to August 2020. Oil prices per barrel are available from the US Energy Information Administration (EIA) short-term outlook. Amidst the various types of crude available in the world oil market, we selected Europe Brent for the oil exporting country that we intended to investigate. The monthly data on Nigeria's official inflation rate were retrieved from the Central Bank of Nigeria (CBN)'s publications of the relevant years. For the purpose of analysis, the oil price (OP) was measured in U.S. dollars per barrel whereas inflation rate(INR) was measured in the consumer price index (2010=100). In empirical estimations, all the variables were used in logarithmic form. While OP was used as the independent variable, INR was employed as the dependent variable.

3.2.2 Model Specification

The results of the stationarity tests in tables 2.1 and 2.2 show that the variables of this study have mixed orders of integration(I,1 and I,0) and none of them is of the I(2) order of integration.Consequently,this paper was able to investigate the link between the movements of oil prices and Nigerian monthly inflation rate using the nonlinear autoregressive distributed lag (NARDL) framework. The attraction of NARDL likes in the fact that it is represents the simplest method available of modeling combined short- and long-run asymmetries(Allen &McAleer,2020).NARDL model which uses the bounds testing framework can be applied to both stationary and non-stationary time series vectors, or combinations of both provided that none of the sries is of the I(2) integration order.

It has advantages over the ARDLmodel since its very construction permits one to incorporate the possibility of asymmetric effects of positive and negative changes in explanatory variables on the dependent variable In addition, NARDL method provides graphs of cumulative dynamic multipliers used to trace out the adjustment patterns following the positive and negative shocks to explanatory variables. Furthermore, the NARDL model is regarded as simple and comprehensive enough to allow for any asymmetry switching from short-run to long-run or vice versa.Finally,unlike the conventional ARDL which assumes that the impact or regressor(s) on the dependent variable are uniform, the NARDL technique holds on the asymmetric assumption for the impact. Hence, for NARDL,there will be two possible coefficients for one regressor.

To capture non-linear and asymmetric relationship among the variables, we applied nonlinear autoregressive distribution lag (NARDL) model developed byHatami (2012). NARDL model captures the nonlinear and asymmetric co-integration between variables.In addition, it distinguishes between the short-term and long-term effects of the independent variables on the dependent variable. Additionally, NARDL is most suitable instrument for time series data to test co-integration among the variables in single equation.

The NARDL model is specified as follows:-

$$\Delta INR_t = \alpha_0 + \rho INR_{t-1} + \beta_1^{+} OP^{+}_{t-1} + \beta^{-}_2 OP^{-}_{t-1} + \sum_{t=1}^{-p} \alpha_1 \Delta INR_{t-1} + \sum_{t=0}^{-p} \alpha_2 OP^{+}_{t-1} \sum_{t=0}^{-p} \alpha_3 OP^{-}_{t-1} + \mu_{t.} \ldots\ldots\ldots..(1)$$

In the NARDL equation as modelled above, αi represent short run coefficients while βi stand for the long term coefficients with i = 1....4th. While the short term analysis relates to the immediate effect of the independent variable towards the dependent variable, the long term analysis reveals the speed of adjustment towards equilibrium. The variables INR_t and OPt in this model represent monthly inflation rates and Brent crude oil prices respectively; t stands for time. We run Wald test to know the long run asymmetry β=β+=β− and for short run asymmetry α=α+=α− for the selected variables

4.ESTIMATION AND RESULTS

The estimation was carried out at 5 percent level of significance.

4.1 Dynamic Estimation of NARDL

Table 4:Asymmetric Relationship between Variables (Effect of Positive and negative shocks)

Dependent Variable: LINR
Method: ARDL
Date: 11/06/20 Time: 12:03
Sample (adjusted): 1997M04 2020M08
Included observations: 281 after adjustments
Maximum dependent lags: 3 (Automatic selection)

Model selection method: Akaike info criterion (AIC)
Dynamic regressors (3 lags, automatic): LOP_POS LOP_NEG
Fixed regressors: C
Number of models evalulated: 48
Selected Model: ARDL (3, 0, 0)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LINR(-1)	1.606829	0.059939	26.80759	0.0000
LINR(-2)	-0.554645	0.108699	-5.102571	0.0000
LINR(-3)	-0.098721	0.059432	-1.661071	0.0978
LOP_POS	-0.004484	0.007194	-0.623371	0.5336
LOP_NEG	-0.006648	0.008171	-0.813684	0.4165
C	0.102683	0.022315	4.601488	0.0000

R-squared	0.978791	Mean dependent var	2.379316
Adjusted R-squared	0.978405	S.D. dependent var	0.437011
S.E. of regression	0.064219	Akaike info criterion	-2.631905
Sum squared resid	1.134132	Schwarz criterion	-2.554218
Log likelihood	375.7827	Hannan-Quinn criter.	-2.600748
F-statistic	2538.231	Durbin-Watson stat	1.985050
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

4.2 Results and discussion

The objective of this paper was to examine the effect of oil price changes on Nigeria's monthly inflation rate during the period from January 1997 to August 2020.In order to find out the characteristics of the variables of the study some tests were carried out,viz:-

4.2.1.1 Descriptives

Table 1: Descriptive statistics

	INR	OP
Mean	11.74930	57.72750
Median	11.60500	55.72500
Maximum	24.10000	133.9000
Minimum	0.900000	9.800000
Std. Dev.	4.012595	32.16818
Skewness	0.134781	0.451290
Kurtosis	3.256095	2.149733
Jarque-Bera	1.635929	18.19500
Probability	0.441329	0.000112
Sum	3336.800	16394.61
Sum Sq. Dev.	4556.561	292846.1
Observations	284	284

Source: Researcher's computation

The descriptives in table1 show that the monthly average oil price was 57.72 USD and inflation rate had an average of 11.74%. On a monthly basis, the INR and OP reached their maximum value of 24.1US dollars and 133.9 per cent respectively during the study period. Each of the two series was positively skewed. The Jarque-Bera test indicated that INR was normally distributed while the OP oil price was non- normal.

4.2.1.2 Unit root test

To determine the appropriatness of the NARDL model,unit root tests were carried out both for OP and INR(table 2.1 &2.2).

Table 2.1a Unit Root Test for Stationarity for Oil Price (OP) (At level Form)
Null Hypothesis: OP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.066324	0.2587
Test critical values:	1% level	-3.453400	
	5% level	-2.871582	
	10% level	-2.572193	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(OP)
Method: Least Squares
Date: 12/04/20 Time: 07:09
Sample (adjusted): 1997M03 2020M08
Included observations: 282 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OP(-1)	-0.023666	0.011453	-2.066324	0.0397
D(OP(-1))	0.159905	0.058968	2.711706	0.0071
C	1.443707	0.757448	1.906014	0.0577

R-squared	0.036984	Mean dependent var	0.084787
Adjusted R-squared	0.030080	S.D. dependent var	6.254042
S.E. of regression	6.159262	Akaike info criterion	6.484372
Sum squared resid	10584.29	Schwarz criterion	6.523116
Log likelihood	-911.2965	Hannan-Quinn criter.	6.499909
F-statistic	5.357337	Durbin-Watson stat	2.036816
Prob(F-statistic)	0.005211		

The result of unit root test for OP (at level form) in table 2.1a indicates that the t-statistic was -2.066324 and the p-value was 0.2587.Since p-value is greater than 0.05, the null hypothesis that OP has a unit root was rejected .This implies that OP is not stationary at level.Consequently, the test was repeated with OP at first difference(table 2.1.b).

Table 2.1.b. Unit Root Test for Stationarity for Oil Price (OP) (inFirst Difference Form)
Null Hypothesis: D(OP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-14.40261	0.0000
Test critical values:	1% level	-3.453400	
	5% level	-2.871582	
	10% level	-2.572193	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(OP,2)
Method: Least Squares
Date: 12/04/20 Time: 07:10
Sample (adjusted): 1997M03 2020M08
Included observations: 282 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(OP(-1))	-0.850886	0.059079	-14.40261	0.0000
C	0.074333	0.368937	0.201480	0.8405

R-squared	0.425565	Mean dependent var	0.014681
Adjusted R-squared	0.423513	S.D. dependent var	8.159340
S.E. of regression	6.195120	Akaike info criterion	6.492468
Sum squared resid	10746.26	Schwarz criterion	6.518297
Log likelihood	-913.4380	Hannan-Quinn criter.	6.502826
F-statistic	207.4352	Durbin-Watson stat	2.029434
Prob(F-statistic)	0.000000		

The result of unit root test for OP at first difference f shows that the t-statistic was -14.40261 while the P-value was 0.0000.Since the p-value is less than 0.05, the null hypothesis that OP had a unit root was rejected in favor of the alternative hypothesis.This implies that OP was stationary at first difference.

.As for INR, its unit root test at level (Table 2.2) has a result showing that the t-statistic is -5.401424 and the P-value is 0.0000. Since the P-value is less than 0.05, the null hypothesis: that INR had a unit root was rejected.Hence, inflation rate was stationary at level.

Table 2.2 Unit Root Test for Stationarity for Inflation Rate (At level Form)

Null Hypothesis: INR has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.401424	0.0000
Test critical values:	1% level	-3.453567	
	5% level	-2.871656	
	10% level	-2.572233	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INR)
Method: Least Squares
Date: 10/30/20 Time: 10:23
Sample (adjusted): 1997M05 2020M08
Included observations: 280 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INR(-1)	-0.049156	0.009101	-5.401424	0.0000
D(INR(-1))	0.201754	0.056771	3.553814	0.0004
D(INR(-2))	0.347159	0.054236	6.400889	0.0000
D(INR(-3))	0.237927	0.057043	4.170983	0.0000
C	0.573679	0.111419	5.148841	0.0000

R-squared	0.448308	Mean dependent var	-0.028500
Adjusted R-squared	0.440284	S.D. dependent var	0.758642
S.E. of regression	0.567572	Akaike info criterion	1.722798
Sum squared resid	88.58801	Schwarz criterion	1.787705
Log likelihood	-236.1918	Hannan-Quinn criter.	1.748832
F-statistic	55.86668	Durbin-Watson stat	2.023151
Prob(F-statistic)	0.000000		

Figure 1

4.2.1.3 Lag selection

Having established the appropriateness of using the NARDLmodel for estimation,as the variables were of mixed order of integration and none of them became stationary at second difference(I,2), the Eviews 10 statistical software was employed to selcct the optimal lag length. The Akaike Information Criterion(AIC) in table 3 points at 3 as the optimal lag for the estimation.

Table 3: Optimal lag selection

VAR Lag Order Selection Criteria
Endogenous variables: LINR
Exogenous variables: C LOP
Date: 11/03/20 Time: 13:51
Sample: 1997M01 2020M08
Included observations: 276

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-160.8748	NA	0.190591	1.180252	1.206487	1.190780
1	260.8082	834.1989	0.009040	-1.868175	-1.828823	-1.852384
2	365.1733	205.7051*	0.004275	-2.617198	-2.564728*	-2.596142*
3	366.4210	2.450169	0.004267*	-2.618992*	-2.553406	-2.592674
4	366.8113	0.763688	0.004286	-2.614575	-2.535870	-2.582992
5	366.8192	0.015356	0.004317	-2.607385	-2.515564	-2.570539
6	367.5964	1.509315	0.004324	-2.605771	-2.500832	-2.563660
7	367.6116	0.029474	0.004355	-2.598635	-2.480578	-2.551261
8	367.6850	0.141539	0.004384	-2.591920	-2.460746	-2.539283

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion

4.2.1.4 Serialautocorrelation LM test Table 7 shows the res eult of the serial autocorrelation LM test. Given that the F-statistic is 0.168424, the null hypothesis that states that the residual exhibit no serial auto correlation was accepted.

Table 7:Serial autocorrelation test
Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.589485	Prob. F(2,273)	0.5553
Obs*R-squared	1.208300	Prob. Chi-Square(2)	0.5465

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 11/07/20 Time: 20:33
Sample: 1997M04 2020M08
Included observations: 281
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINR(-1)	-0.941391	1.457724	-0.645795	0.5190
LINR(-2)	1.605466	2.538128	0.632540	0.5276
LINR(-3)	-0.703964	1.141231	-0.616846	0.5379
LOP_POS	-0.003641	0.008794	-0.414033	0.6792
LOP_NEG	-0.005575	0.011307	-0.493115	0.6223
C	0.087234	0.133824	0.651851	0.5150
RESID(-1)	0.948970	1.460959	0.649553	0.5165
RESID(-2)	-0.054435	0.211832	-0.256971	0.7974

R-squared	0.004300	Mean dependent var	7.70E-16
Adjusted R-squared	-0.021231	S.D. dependent var	0.063643
S.E. of regression	0.064315	Akaike info criterion	-2.621980
Sum squared resid	1.129255	Schwarz criterion	-2.518397
Log likelihood	376.3882	Hannan-Quinn criter.	-2.580437
F-statistic	0.168424	Durbin-Watson stat	2.002326
Prob(F-statistic)	0.991219		

Null hypothesis: State that residual exhibit no serial auto correlation

4.2.1.5 Heteroskedasticity test

The result of heteroskedasticity test shown in table 8 idicates that the p-value is 0.000. We therefore rejected the null hypothesis that states that residual is homoskedastic and concluded that the residual is heteroskedastic

Table 8:Heteroskedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	20.69179	Prob. F(4,277)	0.0000
Obs*R-squared	64.87622	Prob. Chi-Square(4)	0.0000
Scaled explained SS	318.5205	Prob. Chi-Square(4)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/07/20 Time: 20:27
Sample: 1997M03 2020M08
Included observations: 282

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.035472	0.003861	9.188177	0.0000
LINR(-1)	-0.012059	0.001582	-7.620493	0.0000
LOP_POS	-0.002860	0.001286	-2.223657	0.0270
LOP_NEG	-0.002737	0.001461	-1.872962	0.0621
D(LINR(-1))	-0.019918	0.007283	-2.734891	0.0066

R-squared	0.230058	Mean dependent var	0.004067
Adjusted R-squared	0.218939	S.D. dependent var	0.012996
S.E. of regression	0.011486	Akaike info criterion	-6.077807
Sum squared resid	0.036544	Schwarz criterion	-6.013234
Log likelihood	861.9708	Hannan-Quinn criter.	-6.051913
F-statistic	20.69179	Durbin-Watson stat	1.365872
Prob(F-statistic)	0.000000		

Null hypothesis:
HQ: Hannan-Quinn information criterion

4.2.1.6 NADRL estimation result

Table 4 shows that one unit increase in oil price (LOP_POS) in the short run was associated with 0.00448 or (0.4%) decrease in inflation rate on average, ceteris paribus. This increase in oil price did not have a statistically significant effect on the inflation rate since the p-value is 0.5336. The p-value is greater than 0.05, so the null hypothesis that there is no significant effect of oil price increase on inflation rate in the short run was accepted.In addition, one unit decrease in oil price (LOP_NEG) in the short run was associated with 0.00664 or (0.6%) increase in inflation rate. This decrease in oil price did not have a significant effect on the inflation rate since the p-value is 0.4165. The p-value is greater than 0.05, so the null hypothesis that there is no significant effect of oil price decrease on inflation rate was not rejected.

4.2.1.7 Bound test result

Table 5:Long term relationship: bounds test

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LINR)
Selected Model: ARDL(3, 0, 0)
Case 2: Restricted Constant and No Trend
Date: 11/07/20 Time: 09:12
Sample: 1997M01 2020M08
Included observations: 281

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.102683	0.022315	4.601488	0.0000
LINR(-1)*	-0.046537	0.009206	-5.055142	0.0000
LOP_POS**	-0.004484	0.007194	-0.623371	0.5336
LOP_NEG**	-0.006648	0.008171	-0.813684	0.4165
D(LINR(-1))	0.653366	0.058035	11.25819	0.0000
D(LINR(-2))	0.098721	0.059432	1.661071	0.0978

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOP_POS	-0.096357	0.154298	-0.624488	0.5328
LOP_NEG	-0.142860	0.175009	-0.816298	0.4150
C	2.206461	0.167091	13.20513	0.0000

EC = LINR - (-0.0964*LOP_POS -0.1429*LOP_NEG + 2.2065)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	6.455383	10%	2.63	3.35
K	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5
			Finite Sample:	
Actual Sample Size	281		n=80	
		10%	2.713	3.453
		5%	3.235	4.053
		1%	4.358	5.393

The bound test shown in table 5 indicates that the F-Statistic is 6.455383 while the critical value of the lower bound I(0) is 3.1 at 5%.Consequently, the null hypothesis of no cintegration was rejected since 6.455383 is greater than critical values of I(0).Hence, there was cointegration between the variables,implying that there is long run relationship between the variables.

4.2.1.8 Long run asymmetric effect:The response of inflation rate to positive and negative changes of oil price

Table 5 shows that the asymmetric co-integrating equation is as follows:-

LINR = -0.0964 LOP_POS - 0.1429 LOP_NEG.......(2)

This means that one unit increase in oil price (LOP_POS) was associated with 0.096357 or (9.6%) decrease in inflation rate on the average, ceteris paribus. With a p-value of 0.5328,this effect of an increase of oil price on inflation is statistically non – significant. We therefore concluded that oil price increase has no significant effect on Nigeria's inflation rate.Also, the regession results in table 5 indicate that one unit decrease in oil price (LOP_NEG) is associated with 0.142860 or (14.3%) increase in inflation rate. Since the p-value is 0.4150 which is greater than 0.05 ,the implcation is that this decrease in oil price does not have a statistically significant effect on the inflation rate . Consequently, the null hypothesis that oil price decrease does not have a significant effect on Nigeria's inflation rate was accepted.

4.2.1.9 Testing for long-Run and short-run asymmetries

A test was conducted to determine if the difference between the coefficients of the positive (POS) and negative (NEG) changes was statistically significant in order to arrive at the conclusion on whether the relationship between LINR inflation rate and oil price LOP is asymmetric.

Using Wald test to check for long-run asymmetry between the variables,it was observed that neither positive nor negative changes in LOP have significant impact on LINR.The results of the test as found in table 6 indicate that there is no long run evidence of asymmetric (non - linear) relationship between inflation rate and oil price and that the two impacts are the same.In other words, both positive and negative changes in oil price LOP have the same effect on inflation rate LINR:there is no asymmetric effect.

Table 6:

Wald Test:

Equation: Untitled

Test Statistic	Value	Df	Probability
t-statistic	1.423476	277	0.1557
F-statistic	2.026283	(1, 277)	0.1557
Chi-square	2.026283	1	0.1546

Null Hypothesis: -C(3)/C(2) = -C(4)/C(2)

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
-C(3)/C(2) + C(4)/C(2)	0.051142	0.035928

Delta method computed using analytic derivatives.

4.2.2 DISCUSSION

One of the results of this study shows that neither positive nor negative changes in oil price had significant impact on Nigeria's inflation rate during the period covered.This finding buttresses the observation made in Lioudis(2020) that since the 1980s, the relationship between oil and consumer prices had diminished(see Gregorio, Landerrectche, & Neilson (2007); Jiranyakul,2015). Another result indicates that the effects of both the increases and decreases in the oil price during the study period led to decreases in Nigeria's inflation rates. The results of the study are in tandem with those of Apere (2017).They also agree with the findings of Katircioglu, Sertoglu, Candemir and Mercan (2015) who analyzed the impact of oil price movements on macroeconomic performance in the case of OECD countries. Also,the outcome of this study slightly agrees with those of Živkov, Đurašković & Manić,(2019) which indicate that that the transmission of oil price changes to inflation is relatively low and an increase in the oil price of 100% in the Central and Eastern European countries is followed by a rise in inflation of 1–6 percentage points. However,for Bala and Chin(2018), the result was different.The authors investigated the asymmetric impacts of oil price changes on inflation in Algeria,Angola, Libya, and Nigeria. Employing Autoregressive distributed lag (ARDL) dynamic panels to estimate the short- and long-term impacts, they found that both the positive and negative oil price changes influenced inflation significantly. Bala and Chin(2018) also found that the impact was more significant when the oil prices dropped and that inflation increased when the oil price dropped. The results of this study also fail to agree with the theoretical a priori expectation that that an increase in oil price will lead to an increase in the general price level(see Balke, Brown & Yucel,2002; Tang, Wu & Zhang,2010; Razmi, Azali, Chin & Shah,2016).It is also in conflict with the result of Adeniyi et al.(2012) cited in Apere (2017) which shows that Nigeria exhibits higher sensitivity to oil price volatility. Using the ARDL methodology in the Phillips curve framework, the authors estimated that 1 percent increase in oil prices leads to 0.04 percent increase in domestic inflation in the short run and 0.06 percent increase in the long run. Opinions suggest that the extent to which oil price increases lead to consumption price increases depends on how important oil is for the production of a given type of good or service. In the more recent times, there appears to have arisen an increase in the interest to use alternative sources of energy .This might be the explanation for the current trend where consumer price index is becoming less sensitive to oil price changes than was the case in the 1970s(Hooker (2002).According to Mukhtarov, Smammadov and Ahmadov. (2019), oil price shocks that affect production sectors and consumer prices in oil importing countries also affect the economies of oil exporting countries. As one of the oil-rich countries having less diversified economies and weak financial sectors and as a country experiencing the resource curse syndrom, Nigeria's inflation rate might hardly react to the fluctuations to oil prices in line with the a priori theoretical expectations.

5. CONCLUSION

The paper features an examination of the effect of oil price changes on Nigeria's monthly inflation rate using a nonlinear autoregressive distributed lag nonlinear autoregressive distributed lag framework. The data comprise a Brent spot series and monthly inflation rates for the period from January 1997 to August 2020.. The results suggest that both positive and negative movements in oil prices have negative and non-significant effects on Nigeria's inflation rate.as well as the absence of asymmetric effect between them.

This study recommends that the cost channels transmission ought to be weakened through further diversification of the Nigeria economy as well as the enhancement of import substitution strategies. To enable the monetary authority to achieve achieve lower inflation and stable economic growth targets, counter-cyclical fiscal policies and effectively binding fiscal rules should be formulated and carried out.

REFERENCES

Abounoori, A.A., Nazarian, R. & Amiri, A. (2014). Oil price pass-through into domestic inflation: the case of Iran. International Journal of Energy Economcis and Policy , 4(4), 662-669.

Allen, D.E. & McAleer, M.(2020).A Nonlinear Autoregressive Distributed Lag (NARDL) Analysis of West Texas Intermediate Oil Prices and the DOW JONES Index, *Energies,13,4011,1-11, doi:10.3390/en13154011* www.mdpi.com/journal/energies *MDPI*

Apere, T. G. O. (2017). Crude Oil Price Fluctuation And Inflation In Nigeria. Advances in Social Sciences Research Journal, 4(3) 190-200. DoI:10.14738/assrj.43.2757

Bala, U. & Chin,L.(2018). Asymmetric Impacts of Oil Price on Inflation:An Empirical Study of African OPECMember Countries,Energies, doi:10.3390/en11113017 www.mdpi.com/journal/energies

Balami, Y. K. (2006).Structural Disequilibrium and Inflation in Nigeria: A Theoretical and Empirical Analysis, *Center for Economic Research on Africa.* New Jersey 07043: Montclair State University, Upper Montclair.

Balke, N.S.; Brown, S.P.A.& Yucel, M.K.(2002) Oil price shocks and the U.S. economy: Where does the asymmetry originate? Energy Journal, 23, 27–52.

Blanchard, O. J. & Gali, J. (2007). The macroeconomic effects of oil price shocks: why are the 2000s so different from the 1970s? Working Paper no. 13368, National Bureau of Economic Research.

Cavalcanti, T., Jalles, J.T. (2013), Macroeconomic effects of oil price shocks in Brazil and in the United States. Applied Energy, 104, 475-486.

Chen, M. & Wen, Y. (2011). Oil price shocks and inflation risk. Economic Synopses. Short essays and reports on the economic issues of the day, no. 19. Federal Resreve Bank of St. Louis.

Chou, K. W. & Tseng, Y. H. (2011). Oil price pass-through into CPI inflation in Asian emerging countries: the discussion of dramatic oil price shocks and high oil price periods. Journal of Economics, Finance and Management Sciences, 2(1), 1-13.

Cologni, A., Manera, M. (2008), Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G-7 countries. Energy Economics, 30(3), 856-888.

Davari, H.& Kamalian, A. (2018), Oil price and inflation in Iran: Non-linear ARDL approach. International Journal of Energy Economics and Policy, 8(3), 295-300.

Driesprong, G., Jacobsen, B. & Maat, B. (2008). Striking oil: Another puzzle? Journal of Financial Economics, 89: 307-327.

Evans, C. L. & Fisher, J. D. M. (2011, May). What are the implications of rising commodity for inflation and monetary policy? Chicago Fed Letter no. 286.). Another pass-through bites the dust? Oil prices and inflation. Central Bank of Chile.

Federal Reserve Bank of San Francisco (2007). What are the possible causes and consequences of higher oil prices on the overall economy? San Francisco

Hall, R.E. & Taylor, J.B. (1993). Inflation. *Hall and Taylor's Macroeconomics*: Study guide New York; London: W.W. Norton, ©1993.

Hamilton, J. D. (2003). What is an oil shocks? Journal of Econometrics, 113(2), 363-398. doi:10.1016/S0304-4076(02)00207-5.

Hooker, M. (2002). Are oil price shocks inflationary? Asymmetric and nonlinear specifications versus changes in regime. Journal of Money, Credit and Banking, 34(2), 540-561.

Ibrahim, M.H. (2015). Oil and food prices in Malaysia: A nonlinear ARDL. Analysis.Agricultural and Food Economics, 3(2), 1-14, doi:10.1186/s40100-014-0020-3 .

Jiranyakul, K. (2015). Oil price shocks and domestic inflation in Thailand. MPRA paper no. 62797.

Kargi, B. (2014). The effects of oil prices on inflation and growth: time series analysis in Turkish economy for 1988:01 – 2013:04 period. MPRA paper no. 55704.

Katircioglu, S.T., Sertoglu, K., Candemir, M., Mercan, M. (2015), Oil price movements and macroeconomic performance: Evidence from twenty-six OECD countries. Renewable and Sustainable Energy Reviews, 44, 257-270.

Kiptui, M. (2009). Oil price pass-through into inflation in Kenya. Kenya School of Monetary Studies Research Centre.

Lioudis, N. (2020),What Is the Relationship Between Oil Prices and Inflation? Retrieved from https://www.investopedia.com/ask/answers/06/oilpricesinflation.asp

Malik, K.Z, Ajmal, H., Zahid, M.U. (2017), Oil price shock and its impact on the macroeconomic variables of Pakistan: A structural vector autoregressive approach. International Journal of Energy Economics and Policy, 7(5), 83-92.

Mankiw, G. N. (2007). Macroeconomics, 7e. Worth Publishers, New York.

Misati, R. N., Nyamongo, E. M., Mwangi, I. (2013). Commodity price shocks and inflation in a net oil-importing economy. OPEC Energy Review, 37(2), 125-148, doi: 10.1111/opec.12010.

Mukhtarov, S., Mammadov, J.& Ahmadov, F. (2019). The Impact of Oil Prices on Inflation: The Case of Azerbaijan, International Journal of Energy Economics and Policy, 9(4), 97-102.

Namovsky, S. (2018).The impact of oil prices on trade. Review of International Economics, 27(1).https://doi.org/10.1111/roie.12383

Narayan, P.K. & Sharma, S.S. (2011). New evidence on oil price and firm returns. Journal of Banking & Finance, 35(12): 3253-3262.

Ozturk, F. (2015), Oil price shocks-macro economy relationship in Turkey. Asian Economic and Financial Review, 5(5), 846-857.

Pesaran,M.& Pesaran,P.H.(1997).Working with Microfit 4.0: Interactive Econometric Analysis Oxford University Press, Oxford

Pompermayer, F.M., Florian, M., Leal, J.E. & Soares, A.C. (2007). A spatial price equilibrium model in the oligopolistic market for oil derivatives: an application to the Brazilian scenario. Pesquisa Operacional, 27(3): 517-534.

Rasasi, M.A., Yilmaz, M. (2016), The effects of oil shocks on Turkish macroeconomic aggregates. International Journal of Energy Economics and Policy, 6(3), 471-476.

Razmi, F.; Azali, M.; Chin, L. & Shah, H.M.(2016). The role of monetary transmission channels in transmitting oil price shocks to prices in ASEAN-4 countries during pre- and post-global financial crisis. Energy , 101, 581–591.

Ribas G, Leiras A & Hamacher S. (2010). Optimization under Uncertainty for Operational Planning of Petroleum Refineries. Simpósio da Sociedade Brasileira de Pesquisa Operacional.

Sibanda, K., Hove, P., Murwirapachena, G. (2015), Oil prices, exchange rates, and inflation expectations in South Africa. International Business and Economics Research Journal, 14(4), 587-602.

Siok,K.S., Xue, Q. T. & Yen N. W.(2015). Comparative Study on the Effects of Oil Price Changes on Inflation,Procedia Economics and Finance 26 (2015) 630 – 636 2212-5671

Tang, W.; Wu, L.& Zhang, Z.(2010). Oil price shocks and their short- and long-term effects on the Chinese economy.Energy Economics, 32, 3–14.

Trang, N.T.N., Tho, T.N., Hong, D.T., (2017), The Impact of oil price on the growth, inflation, unemployment and budget deficit of vietnam. International Journal of Energy Economics and Policy, 7(3), 42-49.

Wu, M.H., Ni, Y.S. (2011), The effects of oil prices on inflation, interest rates and money. Energy, 36, 4158-4164.

Zhu,Q. & Singh,G.(2016). The impacts of oil price volatility on strategic investment of oil companies in North America, Asia and Europe. Pesqui.Oper. 36 (1),http://dx.doi.org/10.1590/0101-7438.2016.036.01.0001

Živkov,D., Đurašković,J. & Manić,S.(2019).How do oil price changes affect inflation in Central and Eastern European countries? A wavelet-based Markov switching approach,Baltic Journal of Economics,10(1); 84-104