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OIL PRICE VOLATILITY AND INDUSTRIAL OUTPUT IN NIGERIA

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Abstract: *This study examines the impact of Oil Price Volatility on Industrial Output in Nigeria between 1980 and 2019. The study makes use of both descriptive and quantitative analyses. The data for the variables were sourced from World Development Indicator (WDI, 2022). From the descriptive analysis, the graph shows that both oil price Volatility and Industrial Output are fluctuating throughout the period under review. While under the qualitative analysis, GARCH is employed in one hand to establish the presence or otherwise of Volatility in Oil Price in Nigeria and ARDL is also used in other hand to investigate the impact of Oil Price Volatility on Industrial Output in Nigeria. The results shows from GARCH confirm the presence of Volatility in Oil Price in Nigeria, while the ARDL results indicate that, Oil Price Volatility has positive impact on Industrial Output in Nigeria both in short-run and long-run. Based on these findings, the study therefore recommends that government should put-in-place policies that promote macroeconomic stability and also refocus her attention on how to make our local refineries functional and produced up to their installed capacity in Nigeria.*

KEYWORDS: *Oil Price, Volatility, Industrial Output, GARCH and ARDL.*

I. Introduction

It is the desire of every developing nation to attain certain level of development through industrialization. Therefore, the role of energy especially oil price in the path of industrialization of any Economy cannot be overemphasized. It has been noted that, the industrial infrastructure is affected by fluctuations in oil price which in turn hindered the industrial output of developing Economies (Shahbaz, M; Sarwar, S; Chen, W. & Malik, M. N., 2017; Sarwar, S. Khalfaoui, R. Waheed, R. & Dashgerdi, H. G., 2019 and Alao, R; Payaslioglu, C. & Alhassan, A. 2021). The recent invasion of Ukraine by Russia has forced the global oil price to move above $100 per barrel. Fluctuations in oil price has generated a lot of concern among the policy makers across the globe because of its negative impact on the net-importing countries like Nigeria, as it affects the output growth of a nation by negatively impacted on its major determinants and industrial output (Muhammad, F. R; Magbool, H. S. & Samia, N. 2016). Despite various policies put-in-place by successive governments in Nigeria in order to stimulate Industrial output growth, the industrial output level in Nigeria still leave much to be desired. This might be as a result of volatility in global oil price. Therefore, this study is out to examine the trend of oil price volatility and industrial output as well as investigating the impact of oil price volatility on industrial output in Nigeria between 1980 and 2019.

II. Methodology

To achieve the objective of this study, the study employs a linear equation model which is specified thus;

$$INDOgr = f(OPV, REER, INF, LEDgr, TRD)$$

Where, INDOPgr = Industrial Output Growth Rate
OPV = Oil Price Volatility
REER = Real Effective Exchange Rate
INF = Inflation
LEDgr = Lending Growth Rate
TRD = Trade

III. Estimation Techniques

This study make use of GARCH to establish of the presence of volatility or otherwise in oil price as well as ARDL cointegration to investigate the impact of oil price volatility on industrial output in Nigeria. Data on industrial output, oil price, exchange rate, inflation and interest rate all sourced from World Development Indicator (WDI) (2022) while data on Oil Price Volatility is generated from GARCH output.

IV. Results and Discussion of Findings

1.4.1 Descriptive Statistics

Table 1.1: Descriptive Statistics of Variables

Variables	Observations	Mean	Std. Dev.	Minimum	Maximum	Prob.
INDOPgr	42	2.1071	6.9999	-13.0910	22.1189	0.0473
OPV	42	0.4196	0.4135	-0.5189	0.8256	0.0199
INF	42	19.0024	16.8726	5.3822	72.8355	0.0000
LEDgr	42	17.4516	4.9414	8.4317	31.6500	0.6578
REER	42	149.0897	119.2801	49.7773	546.4059	0.0000
TRD	42	51.9945	15.8812	21.1244	81.8129	0.4100

Source: Author's Computation, 2022

In Table 1.1 above, the results of the estimated mean value which shows the data distribution indicates that of Real Effective Exchange Rate (REER) recorded the highest mean value of about 149.09 followed by value of Inflation (INF) of about 19.00, value of Lending growth rate (LEDgr) of about 17.045, value of Industrial Output growth rate (INDOPgr) of about 2.11 while the value of Oil Price Volatility (OPV) has the lowest mean value of about 0.42. One major observation is standard deviation which measures the variability of the data and all values of standard deviation are positive. Variable like REER (119.28) has higher standard deviation which means it demonstrates higher variability while other variables like INF (16.87), INDOPgr (7.00), LEDgr (4.94) and OPV (0.41) have low standard deviation with low variability respectively.

1.4..2 Volatility Test

Since one of the issues in this study is to check for volatility clustering in the exchange rate, the study starts by checking for Heteroscedasticity in the real effective exchange rate data series. The lag length was selected at 5. The result of the ARCH LM test is presented in Table 1.2

Table 1.2: Heteroskedasticity Test: ARCH ON OIL PRICE?

F-statistic	12.08027	Prob. F(5,277)	0.0000
Obs*R-squared	50.66247	Prob. Chi-Square(5)	0.0000
Test Equation:			
Dependent Variable: RESID^2			
Method: Least Squares			
Date: 09/13/17 Time: 12:12			
Sample (adjusted): 6 288			
Included observations: 283 after adjustments			

Source: Author's Computation, 2021

Table 1.2 shows the results of ARCH(5) test. The probability of F-statistics and $T*R^2$ are both zero, the null hypothesis of no heteroskedsticity is rejected. This indicates the presence of ARCH (volatility) in OPV (Oil Price Volatility) in Nigeria. With this result, the study then proceeds to test for degree of volatility in the data using the ARCH/GARCH method. The results of the ARCH/GARCH are presented in Table 1.3.

Table 1.3: ARCH/GARCH Volatility Test

Dependent Variable: REER					
Method: ML ARCH - Normal distribution (OPG - BHHH / Marquardt steps)					
Presample variance: backcast (parameter = 0.7)					
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)					
Variable	Coefficient	Std. Error	z-Statistic	Prob.	
C	12.9963	11.8694	1.0949	0.2735	
Resid(-1)^2	1.22028	0.49542	2.46312	0.0138	
GARCH(-1)	0.5237	0.31738	0.03992	0.0282	
R-squared	-0.5874	Mean dependent var		43.469	
Adjusted R-squared	-0.5874	S.D. dependent var		30.9698	
S.E. of regression	39.0194	Akaike info criterion		8.5039	
Sum squared resid	59377.9	Schwarz criterion		8.6728	
Log likelihood	-166.078	Hannan-Quinn criter.		8.56496	
Durbin-Watson stat	0.14206				

Source: Author's Computation, 2021

The GARCH ε_{t-1}^2 term is the volatility from previous period measures as the lag of the square residual from the mean equation is 1.2202 and the GARCH term σ_{t-1}^2 is the last period forecast variance is 0.5237 in Table 1.3. They are both significant at 5% level.

The rule of thumb for determining the presence of volatility after summing the root of autoregressive model is that: If $\alpha + \beta$ is less than 0.5, there is no volatility; If $\alpha + \beta$ fall between 0.5 and 1, there is volatility and If $\alpha + \beta$ is greater than 1, this is a case of overshooting.

The sum of the two coefficients is 1.2202, which is greater than 1.0. This shows that Oil Price Volatility in Nigeria is overshooting, that is, high level of volatility is present in Oil Price. To test the effect of this volatile nature on economic growth in Nigeria our technique model a new series is generated designated as Oil Price Volatility coefficient (OPV).

1.2 Trend Analysis of Oil Price Volatility and Industrial Output Growth in Nigeria

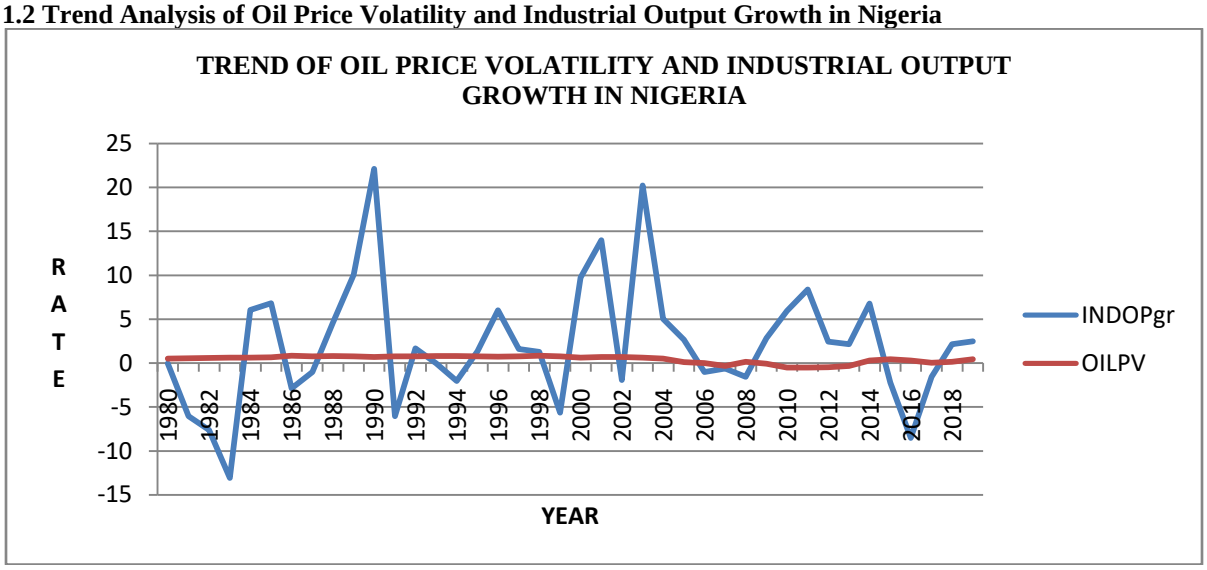

Figure 1.1: Trend of Oil Price Volatility and Industrial Output Growth Rate in Nigeria

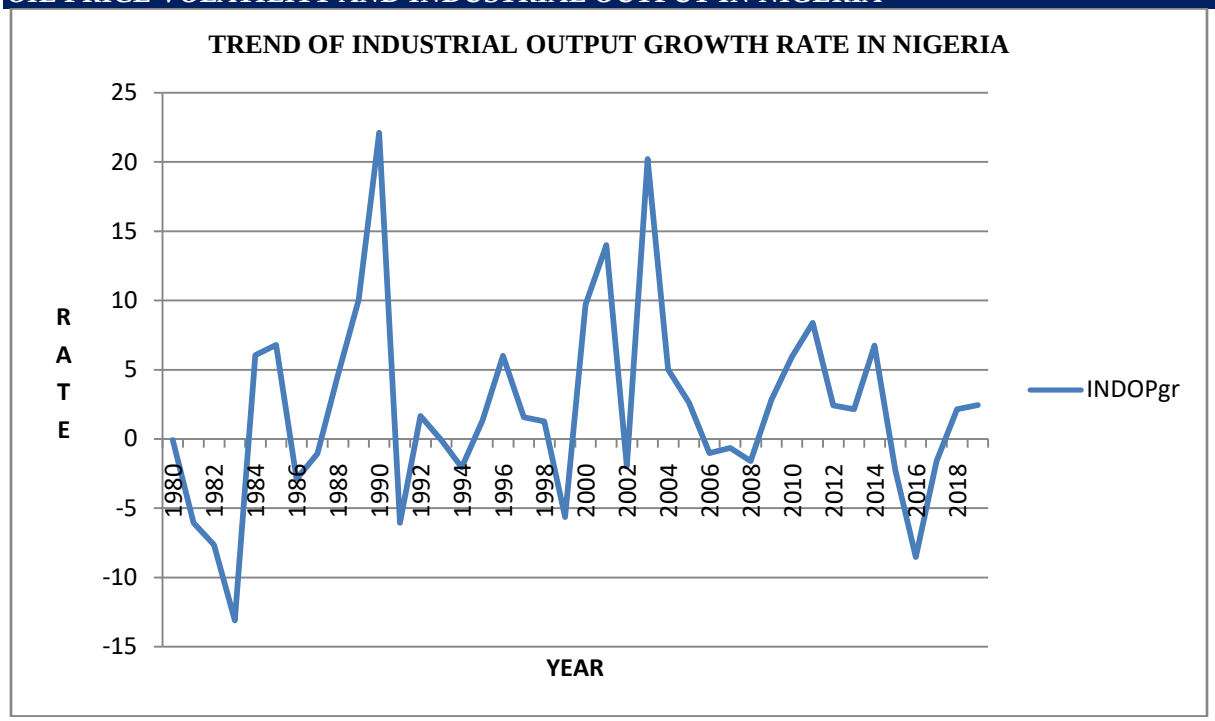

Figure 1.2: Trend of Industrial Output Growth Rate in Nigeria

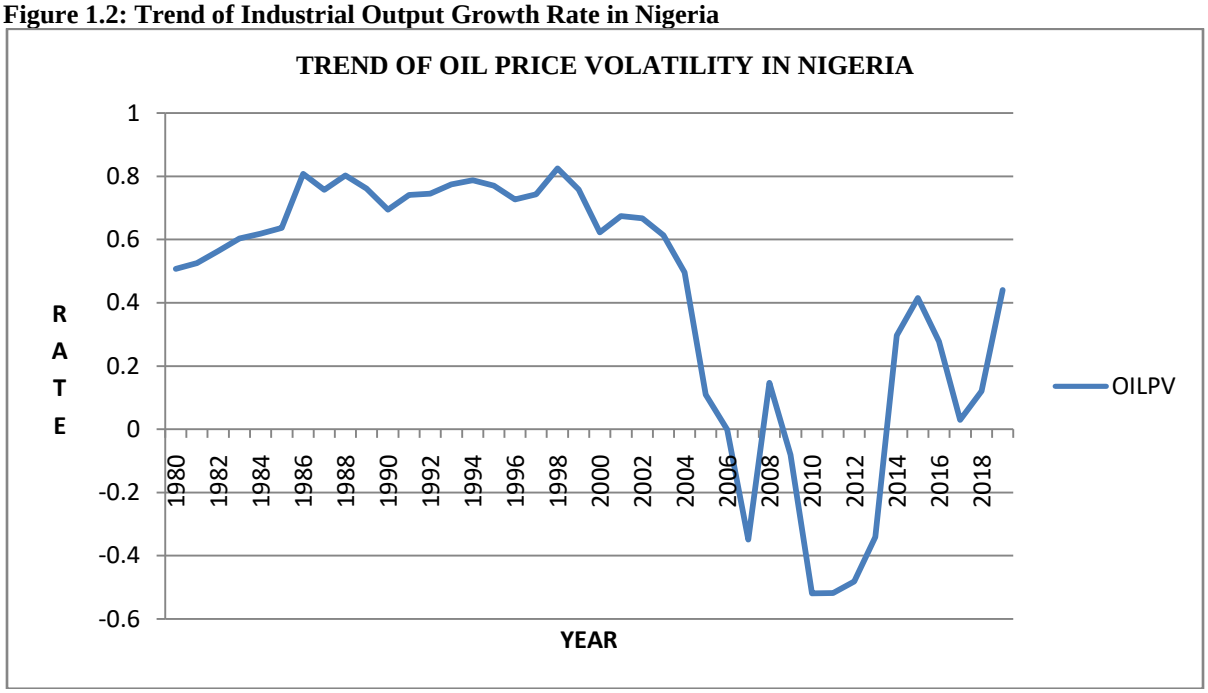

Figure 1.3: Trend of Oil Price Volatility in Nigeria

The graphs in Fig. 1.1, 1.2 and 1.3 above show the trend of Oil Price Volatility and Industrial Output growth rate in Nigeria. The Figures indicate, that industrial output growth rate is fluctuating throughout the period while Oil Price Volatility is relatively stable between 1980 and 2002 and thereafter, started declining sharply until 2005 when marginal increase was recorded and further decline again in 2008. In 2011, some levels of appreciable increase are recorded and this continues till 2015 when the trend started falling again. Comparatively, the industrial output growth rate is relatively stable while that of oil price volatility keeps fluctuating during this period.

1.3 Unit Root Test

Phillips-Perron Unit root test was carried out and the results are presented in Table 1.4 below.

Table 1.4: Unit Root Test

	AT LEVEL			**FIRST DIFFERENCE**			
Variables	**PP Statistics**	**1% Critical Value**	**5% Critical Value**	**PP Statistics**	**1% Critical Value**	**5% Critical Value**	**Order Integration**
INDOPgr	-5.20869	-3.6105	-2.9389	--------	---------	--------	I (0)
OPV	-1.5320	-3.6105	-2.9390	-5.1695	-3.6156	-2.9412	I (1)
INF	-2.8890	-3.6105	-2.9390	-11.9333	-3.6156	-2.9412	I (1)
REER	-1.9753	-3.6105	-2.9390	-4.1352	-3.6156	-2.9412	I (1)
LEDgr	-2.4000	-3.6105	-2.9390	-6.9079	-3.6156	-2.9412	I (1)
TRD	-2.8308	-3.6105	-2.9390	-8.7876	-3.6156	-2.9412	I (1)

Source: Author's Computation, 2022

The results of unit root test as shown on Table 1.4 examine the statistical prosperities of all the variables. The Phillips-Perron t-Statistics for unit root was conducted for all the variables in the model. The null hypothesis tested for the ADF is $H_0 : \alpha_1 = 0$ for all the variables while the alternative hypothesis is $H_1 : \alpha_1 < 0$, for at least one of the variables. The lag lengths are selected using the Akaike Information Criterion. The results of the test at level and first difference are presented accordingly, the null hypothesis is that there is a unit in each series, that is, each variable is non-stationary. The rule of thumb is that, the null hypothesis should be accepted if the Phillips-Perront-statistics are less negative, meaning that, greater than the critical value at any chosen level of significance. The results of Phillips-Perron on Table 1.4 therefore indicate that, all the variables are integrated of order one, that is, *I(1)* except INDOPgr which is found to be integrated of order zero, that is, *I(0)*. The results of unit root test thus suggest the use of ARDL Co-integration test based on the fact that all variables in the model are not stationary of the same order.

Table 1.5: Bound Test Result

ARDL Bounds Test		
Included observations: 38		
Null Hypothesis: No long-run relationships exist		
Test Statistic	**Value**	**K**
F-statistic	5.9238	4
Critical Value Bounds		
Significance	**I0 Bound**	**I1 Bound**
10%	2.45	3.52
5%	2.86	4.01
2.50%	3.25	4.49
1%	3.74	5.06

Source: Author's Computation, 2022

The rule of thumb is that, if the computed F-statistics falls below the lower bound value I(0), the null hypothesis, that is (no-cointegration) is accepted. But if the computed F-statistics exceeds the upper bound value I(1), the null hypothesis is rejected thus, there is existence of long-run relationship. If the computed result falls between the lower and upper bounds, then the test is inconclusive. Based on this, the result of Bound test from Table 1.5 shows that, the null hypothesis of no cointegration is rejected since the F- statistic value is5.9238whichis higher than the upper bound critical value of 3.99 (restricted) at 1% level from Table 1.6. the study therefore concludes that, there is cointegration among the estimated variables.

Table 1.6: Bound Test for Cointegration

	5% Critical Value		1% Critical Values	
	Lower	Upper	Lower	Upper
Restricted Intercept No trend	2.27	3.28	2.88	3.99
Unrestricted Intercept No trend	2.45	3.16	3.15	4.43

Source: Pesaran, *et al,* 2001

1.4.1 ARDL Long-Run and Short-Run Analyses

Table 1.5: ARDL Long Run and Short Run Results

Dependent Variable: INDOPgr				
Dynamic regressors (2 lags, automatic): OPV, REER, LEDgr, INF, TRD				
Selected Model: ARDL(1, 0, 2, 0, 1, 0)				
Variable	**Coefficient**	**Std. Error**	**t-Statistics**	**Prob.**
Long Run Equation				
OPV	1.0822	3.2880	0.3291	0.7445
REER	-0.0245	0.0182	-1.3430	0.1901
LEDgr	0.2692	0.4129	0.6519	0.5198
INF	-0.0031	0.0865	-0.0359	0.9717
TRD	-0.0345	0.0803	-0.4292	0.6711
C	2.4282	9.3675	0.2592	0.7974
Short Run Equation				
D(OPV)	1.2226	3.7454	0.3264	0.7465
D(REER)	-0.0510	0.0211	-2.4172	0.0224
D(REER(-1))	0.0409	0.0244	1.6735	0.1054
D(LEDgr)	0.3041	0.4686	0.6489	0.5217
D(INF)	-0.1630	0.1002	-1.6259	0.1152
D(TRD)	-0.0389	0.0920	-0.4235	0.6752
CointEq(-1)	-1.1298	0.1821	6.2024	0.0000
Akaike Info Criterion	5.537692			
Schwarz Criterion	6.199060			
Hannan-Quinn Criterion	5.802728			

Source: Author's Computation, 2022

Note: * is 10 % level significance, ** 5% level of Significance and * is 1% level of significance.**

From Table 1.7 above, the long run equation result indicates that variables such as; REER, INF and TRD show a negative insignificant relationship with the industrial growth rate in Nigeria. However, OPV and LEDgr exhibit positive but also insignificant relationship with industrial output growth in Nigeria. This implies that a unit increase in the level REER, INF and TRD lead to about 25, 3 and 3.5 per cent decrease respectively in the level of industrial output growth in Nigeria, and a unit increase in OPV and LEDgr bring about an increase of about 108.22 and 27 per cent increase respectively in the level of industrial output growth rate in Nigeria in the long run. The finding of this study is also supported by Akinlo and Apanisile (2015) who confirmed that, oil price volatility has insignificant positive impact on economic growth in 20 selected non-oil producing countries in sub-Saharan Africa. Again, the short run results indicate that, there is co-integration among the variables adopted in the equation. The results further show that, changes in Oil Price Volatility D(OPV), change in Real Effective Exchange Rate in the previous year D(REER(-1) and change in Lending growth rate D(LEDgr) are all found to have shown a positive but insignificant impact on Industrial Output in Nigeria. However, Real Effective Exchange Rate D(REER), change in Inflation D(INF) and change in Trade D(TRD) are said to have a negative but insignificant relationship with Industrial Output except change in Real Effective Exchange Rate D(REER) that is said to be significant at 5 per cent level. This implies that, a unit increase in changes in D(OPV), D(REER(-1)) and D(LEDgr) bring about 1.22, 0.04 and 0.30 increase in the level of industrial output in Nigeria in the short run. Again, the finding of this study is also supported by Akinlo and Apanisile (2015) who confirmed that, oil price volatility has insignificant positive impact on economic growth in 20 selected non-oil producing countries in sub-Saharan Africa. The coefficient of ECM which measures the speed of adjustment back to equilibrium is -1.1298 and it is significant at 1% level with the negative sign. This indicates that about 112.98% of previous disequilibrium in Nigeria is adjusted in the model in the short run.

V. Discussion of Findings

Various econometric tests were conducted in this study. First of all, the study confirms the presence of volatility in Oil Price. In line with the first objective of this research work, examine the trend of Oil Price Volatility and Industrial Output growth rate in Nigeria. The result shows that Industrial Output growth rate show high degree of oscillation throughout the period while the trend of Oil Price Volatility stable for the better part of the half of this period under review before started declining. This implies that, Volatility in Oil Price has little or no impact on industrial output in Nigeria. This might be as a result of the fact that bye products of oil that were consumed by the industrial sector were produced locally during this period therefore fluctuations in Oil Price at international marker has little or no effect on industrial output in Nigeria. And the fluctuations experienced in the later period of this study were as a result of breaking down in our local refineries we started import the refined product. This result is in conformity with the findings of Akinlo and Apanisile (2015) who confirmed that, oil price volatility has insignificant positive impact on economic growth in 20 selected non-oil producing countries in sub-Saharan Africa. To achieve the second objective of the study, stationary test was conducted first to avoid spurious regression, using Phillips-Perron Statistical test. The results revealed that the series are not integrated of the same order. While OILPV, INF, REER, LEDgr and TRD said to stationary at first difference, INDOPgr was found to be stationary at level. Based on this, the condition for co-integration has not been met, therefore, the study proceeds to make use of Autoregressive Distributed Lag (ARDL). The short run and long run ARDL results show that Oil Price Volatility has an insignificant positive relationship with Industrial Output growth rate (INDOPgr) both in the short run and in the long run. However, inflation (INF) and Real Effective Exchange Rate (REER) both show a negative impact on Industrial Output growth rate both in the short run and in long run but only REER said to be significant in the short run in Nigeria. This might be as a result of failure of some monetary policies to achieve certain macro objective policies such as price and exchange rate stability. The finding of this study is also supported by Akinlo and Apanisile (2015) who confirmed that, oil price volatility has insignificant positive impact on economic growth in 20 selected non-oil producing countries in sub-Saharan Africa. The long-run analysis from the ARDL results was carried out. The results show that REER, INF, and TRD have an insignificant negative impact on industrial output growth. This implies that a unit increase in REER, INF and TRD leads to a reduction in the level of industrial output growth rate in Nigeria in the long run.

VI. Conclusion

Based on the results and findings of this study, the following conclusions were made: Judging from the analysis of the impact of oil price volatility on industrial output growth rate in Nigeria, the study revealed that oil price volatility has an insignificant positive impact on industrial output growth rate in Nigeria. Sequel to the findings of insensitivity of industrial output growth rate to oil price volatility in Nigeria both in the short run and in the long run, the following recommendations are made.

In view of all the aforementioned findings in this research work, the following recommendations are therefore put forward: as the relationship between oil price volatility and industrial output growth rate in Nigeria found to be positive but insignificant, it is therefore recommended that, government should put-in-place policies that promote macroeconomic stability in Nigeria; for the fact that, oil price volatility demonstrates a positive impact on the industrial output growth rate in Nigeria, government should refocus her attention on how to make our local refineries functional and produced up to their installed capacity; inflation, though insignificant demonstrated that, it has capacity to reduce poverty level in Nigeria. Therefore, government needs to formulate policies that will promote moderate inflation so as to reduce poverty in Nigeria.

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