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The impact of Petroleum Product Prices on the Nigerian Economy

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Abstract
This work investigated the effect of petroleum product prices on Nigeria's manufacturing sector's output between 1981 and 2019. The work employed annual time series data with Autoregressive Distributed Lag Model used for the estimation. The result showed that Petrol and Diesel prices negatively and significantly affect manufacturing output in Nigeria. However, the Gas price showed a positive relationship with production. Therefore, the study recommends that the refineries that have been comatose be renewed to reduce to the barest minimum the level of importation of petroleum products in Nigeria. Similarly, the power sector should be upgraded to supply the required electricity to these companies to reduce their cost of production and improve their productivity.

Key Words: Petroleum Products, Petroleum Product Prices, Manufacturing Output,
JEL Classifications: Q42, Q43, L11

I. Introduction

There has been a long-standing link established theoretically and empirically between energy product consumption, economic growth and development of any nation. Some confirmed the unidirectional causality from electricity consumption to growth (Iyke, 2014; Kasperowicz, 2014), which supports the growth hypothesis that an increase in energy consumption leads to economic growth. Some others support the conservative hypothesis, which states that economic growth leads to an increase in energy consumption (Faisal et al., 2017). At the same time, some other works showed evidence of the feedback hypothesis, indicating bi-directional causality between energy consumption and economic growth (Ogundipe&Akpata, 2013). It is also well known that the growth and development of any nation are primarily hinged on the nation's industrial capacity. The more industrialized a nation is, the faster the growth of such a nation. The growth of industrial, commercial and business productivity is strongly connected with the volatility of crude oil prices, which is the primary foreign exchange earner for the country. Therefore, the direction of changes in crude oil price determines to a large extent, the changes in the prices of petroleum products, which directly or indirectly impacts the nation's economic growth (Alenoghena&Aghughu, 2022). This implies that the pattern and direction of crude oil price movement have a strong multiplier effect on the nation's economic performance.

Petroleum products have become essential ingredients for general productivity in any economy. The direction of crude oil prices determines the energy bills and cost of production of producing firms both in the short and long run (Loungani, 1986). Oil price changes affect the economy both through the demand and supply sides. On the supply side, oil price instability reduces capacity utilization, affects the production cost, alters productivity, alters prices, and consequently affects the demand for goods and services, which slows the demand for labour and consequently creates unemployment (Kumar, 2009; Chuku et al., 2010). On the demand side, changes in prices of oil transmit through the pump prices into the domestic prices that affect demand for goods and services, and this further goes on to affect the aggregate demand for goods and services and consequently affect investment, which further affects export and national income and cause balance of payment disequilibrium (Jiranyakul, 2006).

It has been established that government expenditure in Nigeria and crude oil prices are pro-cyclical (Obioma, 2006). The relationship is since government revenue from oil forms the dominant revenue used to finance all other sectors, including agriculture, education, health and infrastructure. These sectors are the drivers of the nation's economic growth, and if there is a crash in oil prices, revenue will crash, and government expenditure will slide downwards in the same direction. Several studies have been carried out on the impact of crude oil fluctuations on macroeconomic variables, and it has been found that oil price affects both GDP and investment in the country (Guo&Kliesen, 2005; Alenoghena, 2020).

Any economy characterized by a weak domestic technological base will have oil price shocks enforced on import-dependent technology transfer at a considerable cost that is prohibitive and foreign exchange dependent, with the clear implication of upward trend movements in domestic prices. In addition, global markets are integrated such that instability in the global crude oil market has severe implications for international finance, as indicated by the experience of the global financial crisis beginning in 2008. The crude oil price plunge sent shock waves throughout all the leading crude oil sales-dependent economies, such as Nigeria, with poor and negative macroeconomic indicators. The question to be addressed in this work is how prices of petroleum products (diesel, petrol and gas) affect economic growth in Nigeria. Theoretically, an increase in petroleum product prices is expected to generate a reduction in the general productivity of the nation, considering the supply and demand side effects of the fluctuations.

Interestingly, the fall in the crude oil price of 2020 resulted in the prices of petroleum products rising in Nigeria, contrary to expectations. For instance, the pump price of petrol went up between June and September 2020 from N121.50 to N162 naira per litre (Jeremiah, 2020). This signifies about a 33 per cent increase, which must have affected the economic activities that depend heavily on the products. Therefore, this work aims to investigate the effect of petroleum product prices on productivity growth in Nigeria.

The following section presents the relevant literature review for the work. Section three highlights the work's theoretical framework and model specification, while section four shows the work's nature and sources of data. Section five presents the estimated model results and the interpretation, and the last section presents the conclusion and policy recommendations.

II. Literature Review

Narayan et al. (2019) analysed the effect of petroleum consumption and economic growth in India between 1985 and 2013. The work investigated the link in the different states in India using Vector Error Correction Model. It was found that some states supported the conservative hypothesis, and some others supported the feedback hypothesis between petroleum consumption and growth. It was revealed from the work that none of the states supported causality running from petroleum consumption to growth. Instead, the high-income states showed that there was the presence of a neutral hypothesis.

Al-Risheq (2016) investigated the influence of crude oil prices on the productivity of the industrial sector in 52 developing nations between 1970 and 2012. The work used variables that included exchange rate and oil price as independent variables and employed the fixed effect with instrumental variables to analyse the work. The findings include that increase in oil price has a negative and significant effect on industrial production. The exchange rate was found to exert a more significant influence on industrial production between the two independent variables. The overall results indicated that developing nations are prone to adverse oil shocks.

Shaari et al. (2013) investigated the variability of oil prices in Malaysia's economy with quarterly data between 2000 and 2011. The data were subjected to a unit root test and found stationary at first difference. It was also discovered that the variables were cointegrated, and the Granger causality test was adopted to show the causality among the variables and establish the causality direction. The findings revealed that oil prices significantly affected the agriculture, manufacturing and transport sectors.

Eksi et al. (2011) studied the effect of oil prices on industrial production for some OECD countries using monthly data between 1997 and 2008. Unit root was tested for, and cointegration was confirmed. The findings showed that there is causality running from crude oil price to industrial production in all the countries except France. Similar results were found for oil exporting countries like Saudi Arabia and Iran, that oil prices cause industrial production.

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Farzanegan&Markwardt (2008) analysed the dynamic association between oil price shocks and some macroeconomic variables in Iran. The work employed Vector Autoregressive (VAR) methodology to analyse the estimation. The findings revealed a strong positive relationship between oil price shocks and industrial output.

Zied et al. (2006) examined the degree of interrelationship between oil prices and economic growth in four middle east countries (Saudi Arabia, United Arab Emirates, Kuwait and Venezuela) between 2000 and 2010 using monthly data. The analysis tested for cointegration and unit root using Engle and Granger (1978). The results showed that oil price shocks during fluctuations in global business cycles affect the relationship between oil and the economic activities of the countries.

Guo&Kliesen (2005) analysed the impact of crude oil volatility on US macroeconomic activity between 1984 and 2004. Considering the symmetry and asymmetry effect of oil price volatility, the findings revealed that future oil prices negatively and significantly affect future GDP over the period under consideration. Moreover, the effect became more pronounced with the inclusion of the spot price of oil.

III. Theoretical Framework and Model Specification

This work is hinged on a synthesis of two theories: neo-classical growth theory by Solow (1956) and the theory propounded by Samuelson and Nordhaus called Mainstream theory in the 20th century. Solow's model posited that growth is a function of capital and labour using the Cobb-Douglas production function to relate the relationship between capital input and labour on output. The Mainstream theory similarly introduced energy into the production function. If labour and capital are the primary factors of production, then energy can be an intermediate factor.

The amount of each factor that will be consumed in the production process is a function of the prices (wages, interest and the prices of petroleum products).

$$D_{input} = f(wages, interest\ and\ price\ of\ oil) \quad \ldots \quad (1)$$

The classical and neo-classical philosophy believes the equilibrium price to pay to any factor of production is the marginal productivity of that factor. No matter the price of the primary factors, there cannot be effective production if the price of energy is not favourable. In determining the marginal product of oil as an energyresource useful in determining economic growth, this theory considers in one part its capacityto do work, cleanliness, amenability to storage, flexibility of use, safety, cost of conversionand so on. The theory therefore estimates the ideal price to be paid for crude oil asone that should be proportional to its marginal product. The production function of the manufacturing sector can then be related to the factors such as:

$$Manufoutput = f(Capita, Labour, Oil\ price) \quad \ldots \quad (2)$$

From some of the previous studies by Farzanegan&Markwardt(2008) that modelled industrial output as a function of oil price, exchange rate, FDI, government expenditure, Gross Fixed Capital formation and interest rate for Iran; Gummi et al. (2018) that modelled manufacturing performance as a function of oil price, exchange rate and interest rate for Nigeria and Riaz et al. (2016) that modelled Manufacturing production index as a function of real exchange rate, rate of inflation and oil uncertainty for Pakistan, we can then adopt and present the functional model for this work as:

$$Manout = f(Exr, AGOP, PMSP, GASP) \quad \ldots \quad (3)$$

Where $Manout$ = Manufacturing output, $AGOP$ = Automotive Gas Oil price, PMSP = Premium Motor Spirit price, $GASP$ = Gas price.

The rational for the inclusion of AGOP, PMSP and GASP is to consider the effect of oil price both from the supply and demand side of the manufacturing sector.

Model (2) can be re-expressed econometrically as:

$$Manout_t = \beta_0 + \beta_1 Exr_t + \beta_2 AGOP_t + \beta_3 PMSP_t + \beta_4 GASP_t \mu_t \quad . \quad (4)$$

Where the variables are as defined above.

After testing for the presence of unit root, the result showed a mixture in the order of integration of order one [I(1)] and order zero [I(0)]. Therefore, this work employs Auto Regressive Distributed Lag model (ARDL) for estimating the parameters.

3.1 ARDL Model Specification

The generalized ARDL (p, q) model is specified below:

$$Q_t = \alpha_{0j} + \sum_{i=1}^{p} \rho_j X_{t-1} + \sum_{i=0}^{q} \tau_j^{\cdot} Y_{t-1} + \varepsilon_{jt} \quad \ldots \quad (5)$$

In a situation where there is cointegration among the variables, the following steps will be taken to estimate the ECM:

i. Establish the cointegration using Bounds testing

ii. If there is cointegration, choose appropriate optimal lag length.

iii. Estimation of the long-run ARDL model

iv. Reparameterization of the ARDL model into Error Correction Model

The long-run relationship can be expressed as follows:

$$Mfgout_t = a_{01} + b_{11}Mfgout_{t-1} + b_{31}Agop_{t-1} + b_{41}Gasp_{t-1} + b_{41}Pmsp_{t-1} + b_{51}Exr_{t-1} + e_{1t} \quad (6)$$

For an ARDL of four variables (p. q1, q2, q3), we can reparameterise to obtain the error correction model as:

$$\Delta Mfgout = a_0 + \sum_{i=1}^{p} a_{1j}\,\Delta Mfgout_{t-1} + \sum_{i=1}^{q2} a_{3j}\,\Delta Agop_{t-1} + \sum_{i=1}^{q3} a_{4j}\,\Delta Gasp_{t-1} + \sum_{i=1}^{q4} a_{5j}\,\Delta Pmsp_{t-1} + \sum_{i=1}^{q5} a_{6j}\,\Delta Exr_{t-1} + \gamma ECM_{t-1} + e_t \quad (7)$$

IV. Nature, Sources and analysis of Data

This work will employ time series data to cover the period under review between 1981 and 2019. The variables include manufacturing output from the National Bureau of Statistics, Exchange rate, AGOP, PMSP and GASP to be obtained from the Central Bank of Nigeria Statistical Bulletin. These data shall be processed using the Eviews econometric software for all the analysis.

V. Presentation and analysis of Results

5.1 Unit Root Tests

The test for unit root is to satisfy the assumption of stationarity under time series analysis. The test was conducted using the Augmented Dickey-Fuller test, and the results are presented in Table 1.

Table 1: Unit Root test result

At Level				At First Difference			
Variable	ADF stat	5 % Level	P-Value	ADF stat	5 % Level	P-Value	Order of Int.
Mfgout	-1.58247	-2.94343	0.4813	-4.26763	-2.94584	0.0018	I(1)
Agop	-0.05002	-2.94115	0.9477	-6.19905	-2.94343	0.0000	I(1)
Gasp	-2.46554	-2.94115	0.1317	-6.4306	-2.94584	0.0000	I(1)
Pmsp	4.675219	-2.9484	1.0000				I(0)
Exr	1.393597	-2.94115	0.9986	-4.26349	-2.94343	0.0018	I(1)

Source: Computed by authors

Table 1 shows that manufacturing output, AGO price and Gas Price were not stationary at level, but when they were differenced once, they became stationary. That implies that the three variables are integrated of order one, I(1). The condition for the decision is that if the ADF statistic is higher than the 5% significance level, then the variable is stationary. Alternatively, if the Probability value is less than 5%, it is stationary. The three variables satisfy the two conditions only after the first difference.

On the other hand, PMS price was stationary at level, with the ADF stat higher than the 5% significance level. The exchange rate became stationary only at the first difference with a probability value of 0.018 %. Hence, we have a mixture of I(0) and I(1). This result shows that we need to use the Auto Regressive Distributed Lag model for the estimation.

5.2Cointegration Test

The tests for cointegration enable us to establish if there is any long-run relationship among the variables to help us with prediction and policy analysis. The bounds test for cointegration was used for this purpose, as shown in Table 2.

Table 2 presents the Bounds testing for cointegration. The decision rules are:

i. If the F-stat is lower than the lower bound values at the 5% level, there is no cointegration.
ii. There is cointegration if the F-stat is higher than any of the upper bound values at a 5% significance level.
iii. If the F-stat is in between the lower and upper bound values, it is not decided.

Table 2: Cointegration Test using Bounds Testing

F-Bounds Test		
Null: No level relationship		
F-statistic	11.4409	
Signif.	I(0)	I(1)
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

Source: Computed by authors

The result shows that the F-statistic is higher than all the upper bound values at all significance levels, indicating cointegration. That also implies a long-run relationship among the variables.

5.3: Optimal Lag Selection

The lag selection criteria adopted for evaluation include AIC, FPE, LR and HQ, except one (SC) and they selected lag one.

5.4: Error Correction Model

Model 6 was estimated, and Table 3 is the result. The ECT variable was obtained by estimating the long-run model and then generating the residual, called the error correction term.The ECT is the component of the long-run model represented in the ECM. The ECT is the speed of adjustment of short-run disequilibrium into long-run equilibrium annually. For the model to be acceptable, the ECT coefficient must be negative and statistically significant at the 5 per cent level.

Table 3: Error Correction Model (ECM)

Dependent Variable: MFGOUT				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	38.18791	16.98771	2.247973	0.0321
MFGOUT(-1)	0.33019	0.115885	2.849283	0.0078
AGOP(-1)	-0.21243	0.08298	-2.55996	0.0157
PMSP(-1)	-0.273378	0.081198	-3.366793	0.0021
GASP(-1)	0.062426	0.052117	1.197817	0.2404
EXR(-1)	-0.04554	0.02534	-1.79728	0.0824
ECT(-1)	-0.730242	0.193587	-3.772165	0.0007
R-squared	0.947748			
Adjusted R-squared	0.937298			
F-statistic	90.69033			
Prob(F-statistic)	0.0000			
Durbin-Watson stat		1.983406		

Source: Computed by authors

5.5 Residual Diagnostic Test

The residuals of the ECM are subjected to some diagnostic tests for serial correlation, heteroscedasticity and normality. Table 5 contains the test results.

Table 4: Residual Diagnostic test

	Residual Test	P-Value
1	Breusch-Godfrey Serial Correlation LM Test	0.9691
2	Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.0269
3	Normality Test: Jarque-Berra	0.2682

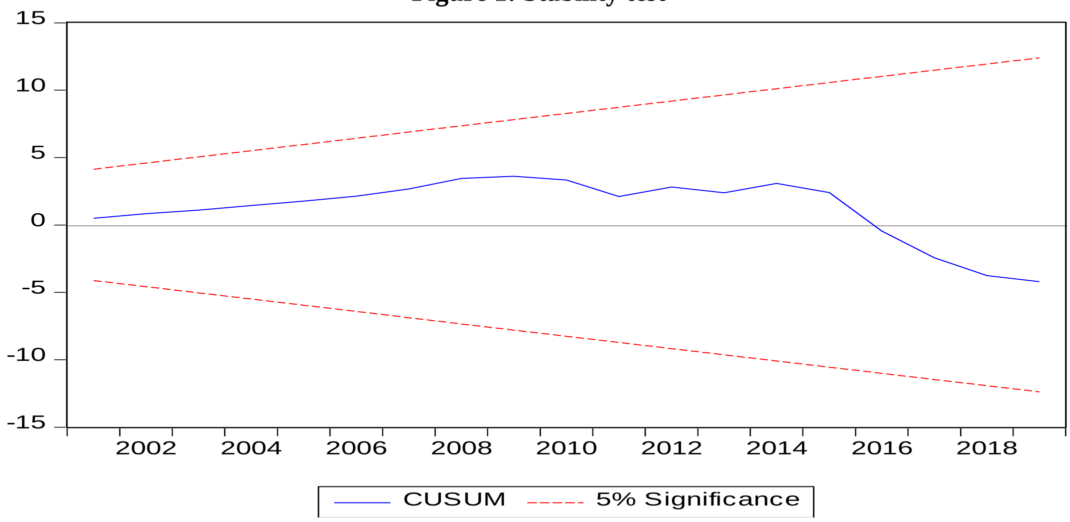
Source: Computed by authors

The residual diagnostic test for serial correlation showed that the Probability value was 96 per cent, which is higher than 5 per cent. The Breusch-Godfrey LM Test reinforces the Durbin-Watson statistic of no serial correlation. We then reject the hypothesis of serial correlation and accept that there is no serial correlation. The probability value for heteroscedasticity is 0.027 per cent is less than 5 per cent indicating the presence of heteroscedasticity. Hence, the variance of the error term is not constant with an increase in the sample size. The normality test shows that the residuals are normally distributed at a probability of 26.8 per cent.

5.6 Stability test

The stability test reveals whether the model will be stable over time. Figure 1 shows the result of the CUSUM test. The model trend lies between the 5 per cent significance levels and reveals the model's stability.

Figure 1: Stability test



Source: Estimated by authors

5.7 Discussion of Findings

The findings from the analysis of data in this study are discussed as follows:

i. MFGOUT lagged one, which represents the previous year's output, shows a positive sign which agrees with apriori expectation and is statistically significant with a probability value of 0.078. That implies that the previous output affects the current output positively and significantly. That also implies that a 1% increase in the previous year's output will cause about a 33% increase in the current output.

ii. AGOP lagged one period is negatively related to manufacturing output in the current year and statistically significant at a probability value of 1.6 per cent, which is less than 5 per cent. The coefficient reveals that a 1% increase in AGO price in the previous year will decrease manufacturing output by 21.2 per cent in the current year. The result appears realistic because most manufacturing firms use diesel majorly to power the plants, which negatively influences the output.

iii. PMSP lagged one period has a negative relationship with manufacturing output and is statistically significant at 0.021 per cent, less than 5 per cent. The result reveals that a 1% increase in petrol price will decrease output by about 27%. We, therefore, conclude that petrol price affects manufacturing output negatively in Nigeria.

iv. GASP lagged one period is positively related to manufacturing output in the current year and not statistically significant at a probability value of 24.4 per cent, which is more than 5 per cent. We, therefore, conclude that Gas price does not have a statistically significant effect on manufacturing output in Nigeria. However, the result also reveals that a 1% increase in Gas price will increase the manufacturing sector's output by 6.1 per cent. Hence, most firms do not use gas to power their plants.

v. The exchange rate has a negative effect on manufacturing output as well, with a coefficient of -0.04554 but not significant at a probability value of 8.2 per cent. This result shows that a 1% increase in the exchange rate will lower manufacturing output by 4.5 per cent.

vi. ECT lagged one period has a coefficient of 73%, statistically significant at 0.007 per cent. The coefficient shows the speed of adjustment of short-run disequilibrium to long-run equilibrium, which shows a speed of 73 per cent. A long-run relationship confirms that the coefficient must be negative and statistically significant.

VI. Conclusion and Policy Recommendation

This work examined the effect of petroleum product prices on the manufacturing output in Nigeria between 1981 and 2019. It has been found from the result that petroleum product prices, Diesel (AGOP) and Petrol (PMSP) have a significant negative effect on manufacturing output in Nigeria, but Gas (GASP) has a positive effect on manufacturing output. Similarly, Exchange rate instability has a negative effect on manufacturing output in Nigeria. Therefore, it is pertinent to observe these effects and know the policies that would be adequate and expedient in reducing the negative effects on manufacturing output.

i. One reason Nigeria imports petroleum products is that the country's refineries have been in a state of coma for several years now. Hence, this study recommends the overhaul of the country's refineries to process crude oil and save the wasteful expenditures on importing petroleum products and foreign exchange.

ii. It is true that, as a nation, there is no control over the price of crude oil. However, several measures can be put in place to mitigate the effect of oil price volatility on the country's domestic economic productivity. One is to develop the power sector strong enough to supply enough electricity for industrial consumption, thereby leading to less dependence on petroleum products to power the plants.

iii. The window through which petroleum products affect the manufacturing output is through the power plants of the firms. Hence, this study recommends that a new energy policy be implemented to incentivize private enterprises to invest in alternative energy sources and resources that will be a good source of powering the firms' equipment. These policies could include fiscal policies such as tax policies on the productivity of such energy sources. The policy could also include further deregulation of the energy sector. The current distribution companies are still operating more or less like regional monopolies. Power supply generation and transmission are still highly regulated in the country. The degree of regulation affects the power supply and forces manufacturing firms to resort to petroleum products, which are far more expensive.

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