PETROLEUM PRODUCTION AND CONSUMPTION PATTERN IN NIGERIA: DOES THE LAW OF DEMAND HOLD?

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ABSTRACT
With the Nigerian government pursuing programmes to improve the welfare of the citizenry, there are uncertainties endangering the actualization of this goal. Being an economy with a trajectory of high reliance on oil revenues through the years and high dependence on external financing, shocks in oil prices are expected to adversely affect the economy. This study seeks to address the impact of oil price change on the consumption pattern of Nigerians with a view to validating the theoretical law of demand. Employing the autoregressive distributed lag model, the study shows that increase in oil prices negatively affected both consumption and development level of the citizenry in Nigeria. Thus, the study recommends among other things, that government should endeavor to cushion the effect of such price fluctuations through fiscal policy-mix in the prevailing economic fundamentals.

Key words: fluctuation, ARDL, petroleum, liquefied, consumption, economy, maximization, utility

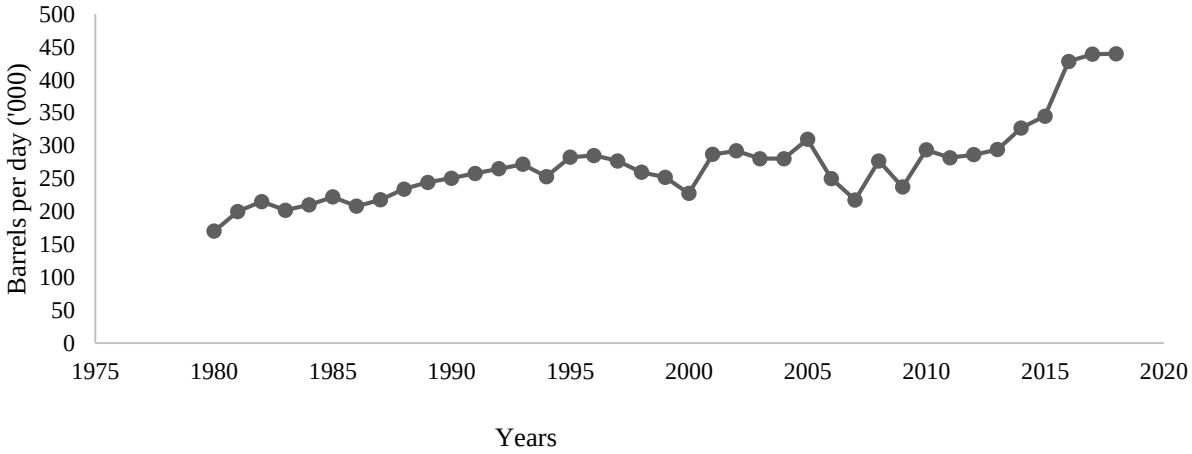
JEL Classification: D13, E30.

1. INTRODUCTION
The Nigerian economy was predominantly an agricultural economy in the early 1960s, with the country occupying polar positions in agricultural production and exportation of cocoa, groundnuts, oil palm as well as cotton. The economy was being sustained on revenues from the agricultural sector. However, with the discovery and exploration of crude oil in sustainable quantity, the narrative of the Nigerian economy was drastically altered. With the oil boom, Nigeria has high hopes of being among the world giants owing to her abundant crude oil.

Presently, the Nigerian economy largely depends on crude oil and its products for its existence and sustenance. The economy has become one operated and sustained by revenues from crude oil and allied products. The recent slump in the world oil price from $114.6/bbl in 2014 to $30.2/bbl in 2016 exposed the degree of reliance of the economy on the proceeds of crude oil for its existence and sustainance. For the first time in two decades, the economy plunged into a recession (a situation where an economy experience negative growth in GDP for two consecutive quarters) which affected the country adversely. This triggered several empirical studies on the effects of price changes on the Nigerian economy, leading to various conclusions and policy formulations.

A major recepient of the changes in the prices of crude oil is the composite households in the country. With a large proportion of their daily activities revolving around the utilization of crude oil and its products, the global slump took a toll on households in Nigeria. For instance, the figure below shows the trend in the consumption of petroleum in Nigeria.

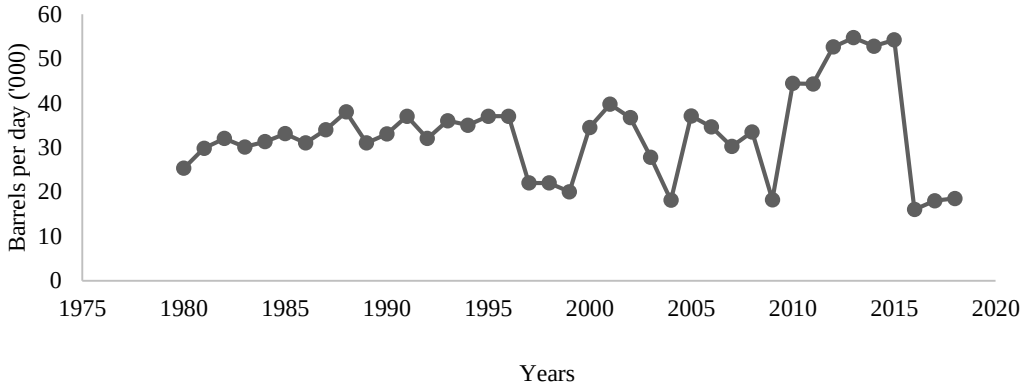
Figure 1: Nigeria Total petroleum consumption (Thousand Barrels Per Day)



Source: African Development Bank Indicator

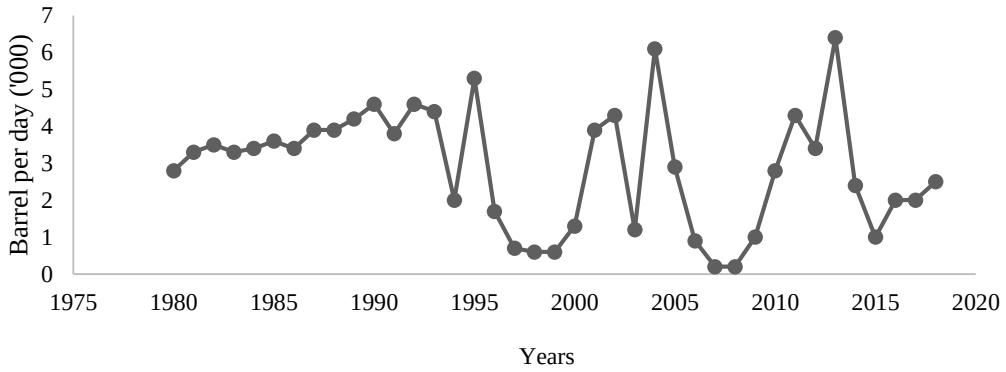
A critical evaluation of Figure 1 shows that there was a steady drop in the consumption of petroleum products through the years. Periods of down swings in the figure are mainly caused by increase in the price of oil in the world market. In order to capture the effects of such price dynamics on households in Nigeria, Figures 2 and 3 shows the trends in the consumption of kerosene and liquefied gas in Nigeria:

Figure 2: Nigeria consumption of kerosene (1980-2018)



Source: African Development Bank Indicators

Figure 3: Nigeria consumption of liquefied petroleum gases



Source: African Development Bank Indicators

The figures above depict wide gyrations in the consumption patterns in kerosene and liquefied petroleum products with down-swings dominating most of the years between 1980 and 2018.

The above scenerio neccessitate the need to empirically evaluate the impact of price dynamics on the consumption pattern in Nigeria, which forms the thrust of this study. Following the introductory section, section 2 reviews related literature on the impact of oil prices on household consumption; section 3 shows the methods adopted; section 4 discusses the results of our empirical model; while section 5 concludes the study through policy recommendations.

2. LITERATURE REVIEW

2.1 Theoretical Literature

The consumption of any product is influenced by both economic and non-economic factors. Economic factors include income, prices (products, substitutes, and complements), while non-economic factors include tastes, preferences, structural changes and other factors.

In conventional economic models, an individual's consumption decision is based on the assumptions of rational behaviour (utility maximization). The demand for petroleum products like

any other commodity is a multivariable relationship. In other words, the demand is determined by simultaneously by several factors. Thus, a household faced with increase in prices of petroleum products given a budget constraint will typically respond by either reducing consumption or choosing from an array of substitutions where available (Dahl and Sterner, 1991). This will usually occur in the long run. In the short-run however, most consumers will hardly alter their consumption level.

2.2 Empirical Literature

There exists numerous empirical studies on the impact of oil price changes on economic performance (Hajiyev & Rustamov, 2019; Ekong & Effiong, 2015; Ocheni, 2015; Wang, 2013; Odusami; 2010; Du, Yanan & Wei, 2010; Zhang, 2008; Hamilton, 2003; among others). However, this study concentrates on empirical studies in Nigeria owing to country-specific characteristics which may likely limit the applicability of studies in developed economies. Most of the empirical studies in Nigeria are based on the impact of oil price changes on economic variables. For instance, Ibrahim (2018) analyzes the impact of oil price fluctuation on output performance in Nigeria. Using the two stage least squares (2SLS) method, the study showed that oil prices has negatively affected the manufacturing, service and agricultural sectors in Nigeria, since fluctuations in oil prices tend to create uncertainties especially in the production sector. Such fluctuations have also undermined most government fiscal policies in the management of the economy. By recommendation, the study suggested diversification in the export base of the economy to improve manufacturing capacity and minimize uncertainty, as well as developing local capacity on the part of refineries in the country.

Gatawa and Abdullahi (2017) examined the effects of oil price fluctuations on the welfare of households in Zaria metropolis, Kaduna State. Using non-parametric techniques (questionnaires, chi-square test, etc.), the study found that increase in the prices of kerosene (DPK), gas (LPG) and petrol (PMS) has adversely households in terms of hike in the prices of goods and services which households consume. The multiplier effects of the increase in oil prices prompted the study to suggest that government deregulate the downstream business of the Nigerian petroleum sector to stimulate competition which will favourably affect prices and increase local capacity.

The empirical findings of Umar, Aliyu and Ahmed (2017) who investigated the impact of oil price fluctuations on economic growth in Nigeria were not different from those of Ibrahim (2018). Using the granger causality test, the study showed that oil price fluctuation causes adverse effects on the economic growth of the Nigerian economy, thus there is urgent need to curtail such fluctuations through properly strategized fiscal policies.

For their part, Gummi, Buhari, and Muhammad (2016) investigated the impact of oil price on economic growth in Nigeria between 1974 and 2014. Employing the Vector Autoregression (VAR) techniques along with the Johansen cointegration test, the study observed that there is no long run relationship between the variables, thus suggesting that sustained stability in oil prices will ensure economic growth in Nigeria.

The study of Nwanna and Eyedayi (2016) explored the influence that volatility in crude oil price exerts on economic growth between 1980 and 2014 in Nigeria. The empirical results from the specified multiple regression model showed that oil price volatility exerted a significant positive effect on economic growth in Nigeria under the period of review.

Adewuyi (2016) estimated determinants of import demand for refined petroleum products in Nigeria for the period 1984–2013. The study employed the autoregressive distributed lag (ARDL) bounds test cointegration method and analysed both long-run and short-run determinants of import demand for total and specific petroleum products. The study found that kerosene import is income elastic, gasoline import is income and relative price inelastic.

The study of Yusuf (2015) showed that the impact of oil shocks on the economy is a '2-edged knife'. The study using structural vector autoregression (SVAR) and data of 1970 to 2011 explained that shocks in oil prices exerts both positive and negative effects on the Nigeria economy. Thus, the study suggested that in order to achieve more positive impacts, the government should endeavor to diversify the economy and makes it more investor-friendly.

Alley, Asekomeh, Mobolaji, and Adeniran (2014) x-rayed the effects of oil price fluctuations on economic growth in Nigeria. Employing the generalized method of moment (GMM) econometric technique as well as macroeconomic data between 1981 and 2012, Alley, *et al* (2014) showed that rises in the oil price positively impact on economic growth. The study corroborated that of Nwanna and Eyedayi (2016) as against others, thus suggesting that a periodic increase in the oil prices will affect the economy positively in the long run.

Using a closely related technique adopted by Yusuf (2015), Oriakhi and Osaze (2013) investigated the impact of oil price volatility on the Nigeria economy between 1970 and 2010 employing the Vector Autoregressive model (VAR) technique. Their study showed that such changes in oil prices has made the economy more vulnerable to external shocks and thus retards the growth and partway to economy recovery.

Using quarterly data between 1973Q1 and 2010Q4, Akinyele and Ekpo (2013) investigated the impact of oil price shocks on economic performance in Nigeria. The Vector Autoregressive model revealed that positive oil price shocks result in both depreciation in the domestic currency and inflation due to expansionary fiscal policies. The study thus suggested that control of oil prices is necessary to achieving economic viability.

In the study of Udoh and Egwaikhide (2012), the relationship between changes in oil prices and the hike of local food prices in Nigeria was investigated. Using data between 1970 and 2008, the specified multivariate model in the study showed that wide gyrations in oil prices result in inflation especially in food commodities which negatively affect households in the economy. The study thus recommended that government should intervene in the control of oil prices.

In investigating the impact of oil prices fluctuation on macroeconomic variables in Nigeria through quarterly data between 1985Q1 to 2007Q4 in a VAR framework, Iwayemi and Fowowe (2010) found that negative oil price shocks adversely affect the performance of the selected macroeconomic variables (inflation, output, real exchange rate and government expenditure) in both the long-run and short-run.

2.3 Gap in Literature and Value Addition

An appraisal of reviewed literature showed a huge gap in knowledge when it comes to the impact of oil price changes on households in Nigeria. While few studies (such as Gatawa and Abdullahi, 2017; and Udoh and Egwaikhide, 2012) consider the welfare of households in the presence of oil price shocks, the majority of studies investigated the impact of such shocks on macroeconomic variables such as inflation, economic growth, expenditure, and others. Thus, this study seeks to fill in the gap in knowledge by incorporating the household consumption of petroleum products in the face of oil price changes.

3. METHODOLOGY

3.1. Theoretical framework

This study employs the typical neoclassical theory of consumer choice as expressed in Pollak (1971). The consumer utility function can be expressed as:

$$U(z_1, z_2, z_3, \dots, z_n) \quad (1)$$

When equation (1) is transformed monotonically, we will arrive at the following expression:

$$U = \sum_{i=1}^{n} \varphi_i In(z_i - \vartheta_i) \quad (2)$$

Where;

z_i = consumption level of good i; ϑ_i = subsistence parameter

In order to obtain maximization, it is assumed that $\varphi_i > 0$; and $z_i > \vartheta_i$. The neoclassical theory also assumes that $\Sigma\varphi_i = 1$.

The utility function of the consumer is subject to a budget constraint:

$$M = \sum_{i=1}^{n} p_i z_i \quad (3)$$

Where;

p_i = price of good i.

M = household expenditure on goods.

Solving equations (1)-(3) yield in the expression below:

$$p_i z_i = p_i \vartheta_i + \varphi_i \left[M - \sum_{j=1}^{n} p_j \vartheta_j \right] \quad (4)$$

Where;

j =jth good (substitute or complement).

Equation (4) implies that the consumer's consumption level depends on the price of the commodities, the prices of other goods (substitutes or complements) as well as the income level of the household.

3.2. Empirical Model

The study adopted the autoregressive distributed lag (ARDL) model owing to its supremacy over techniques. This method does not rely on the stationarity of all the variables. Variables integrated at I(0), I(1) or both can be analyzed using the autoregressive distributed lag (ARDL) model. The autoregressive distributed lag (ARDL) model is given below:

$$\boldsymbol{dY_t = \underbrace{\alpha + \beta Y_{t-1} + \delta X_{t-1}}_{a} + \underbrace{\sum_{i=1}^{p} \lambda_{1,i} [dY_{t-1}] + \sum_{i=1}^{q} \lambda_{2,i} [dX_{t-1}]}_{b} + \varepsilon_t} \quad (\mathbf{5})$$

Where;

a = long run relationship; b = short run relationship; and ε_t = error term

The Auto Regressive Distributed Lag (ARDL) model (where the dependent variable is assumed to be dependent on its past value and the current and past values of some other variables) holds advantages over other conventional methods. This is because this method does not require that the variables under study be integrated of the same other unlike the Johansen Cointegration approach. In addition, it is suitable for small or infinite sample data unlike the conventional approach which requires a large sample size as well as make it possible for the long and short run parameters of the model can be estimated simultaneously (Pesaran, *et al*., 2001).

In analyzing equation (5), the study employed data of 1980 to 2017 in evaluating the impact of oil price fluctuation on the demand of petroleum products in Nigeria. The following variables were adopted according; ΔOILP (dependent variable); ΔKC, ΔLPG, RPCGDPGR and ΔTPC (explanatory variables).

Thus, equation (5) can be written as an ARDL model given the explanatory variables specified:

$$\Delta OILP_t = \delta_0 + \delta_1 \Delta KC_t + \delta_2 \Delta LPG_t + \delta_3 RPCGDPGR_t + \delta_4 \Delta TPC_t + \sum_{i=0}^{p} \gamma_{1i} \Delta OILP_{t-1} + \sum_{i=0}^{q} \gamma_{2i} \Delta KC_{t-1} + \sum_{i=0}^{r} \gamma_{3i} \Delta LPG_{t-1} + \sum_{i=0}^{s} \gamma_{4i} \Delta RPCGDPGR_{t-1} + \sum_{i=0}^{u} \gamma_{5i} \Delta TPC_{t-1} + \varphi_1 ECT_1 + \varepsilon_{1t} \quad (6)$$

Where;

ΔOILP = change in oil prices

ΔKC = change in kerosene consumption

ΔLPG = change in liquefied petroleum gases consumption

RPCGDPGR = real per capita GDP growth rate

ΔTPC = change in total petroleum consumption

The variables ΔKC, ΔLPG, and ΔTPC were included in the model to capture the changes in the consumption level of kerosene, liquefied petroleum gases and petroleum due to changes in the oil price. This will help confirm the existence or otherwise of the law of demand in the consumption pattern of the products.

4. RESULTS AND DISCUSSION

4.1. Diagnostics:

Diagnostic tests were carried out to affirm the viability of the empirical results. Jarque Bera test [2.631010 (p = 0.268339; p>0.10)] in Figure 4; Heteroskedasticity Test [Breusch-Pagan-Godfrey (F statistics = 0.637847; p=0.6990>0.10)] in Table 1; and Ramsey RESET test estimated t = 0.364998, (p = 0.7179>0.10) in Table 2; imply that the specified model's residuals were normal distributed, devoid of heteroskedasticity, multicollinearity as well as serial correlation. Thus, our model is highly reliable for economic analysis and decision making.

Figure 4: Diagnostic Test

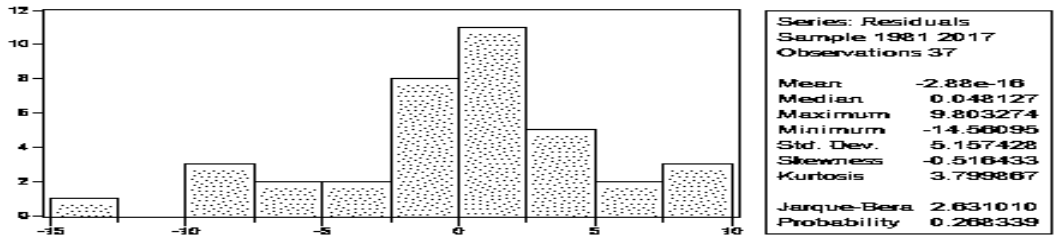


Table 1: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.637847	Prob. F(6,29)	0.6990
Obs*R-squared	4.196990	Prob. Chi-Square(6)	0.6500
Scaled explained SS	3.007863	Prob. Chi-Square(6)	0.8079

Source: EViews 9 Output

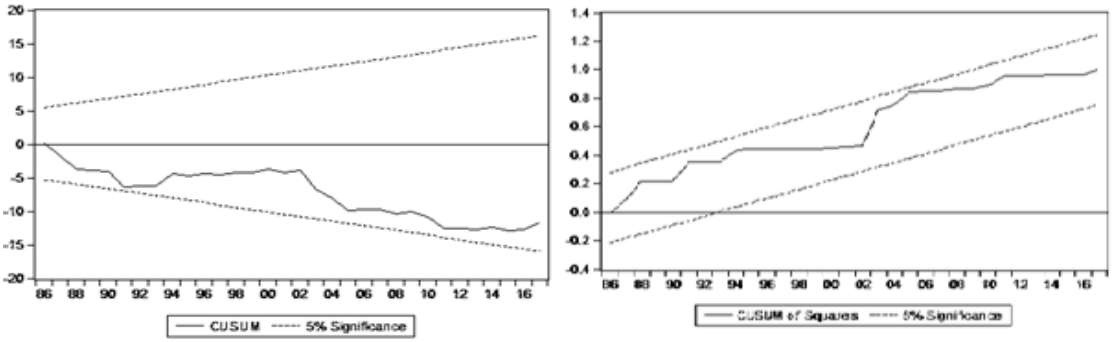
Table 2: Ramsey RESET Test

	Value	df	Probability
t-statistic	0.364998	28	0.7179
F-statistic	0.133224	(1, 28)	0.7179

Source: EViews 9 Output

In order to check the stability of the model, the CUSUM and the CUSUM square tests were adopted. The figures below show the output of the tests:

Figure 5: CUSUM and CUSUM square test



Source: EViews 9 Output

A close look at the figures above shows that the residual plot falls within the 5 percent significant boundaries. Thus, the estimates of the model are stable over the period of analysis (Bahmani-Oskooee and Nasir, 2004).

4.2 Unit Roots Tests

The Augmented Dickey Fuller (ADF) unit root test results are presented in Table 1 below:

Table 3: Stationarity Test

Variable	@ Level	@ 1st Difference	Level of Integration
KCCHANGE	-3.474604	-6.131384*	I(1)
LPGCCHANGE	-9.100745*	-5.995219*	I(0)
OILPCHANGE	-8.052472*	-11.02504*	I(0)

RPCGDPGR	-3.873462*	-7.937626*	I(0)
TPCCHANGE	-7.699740*	-8.513585*	I(0)

*significant at the 1 percent level of significance

Source: EViews 9 Output

The above table clearly shows that except the variable KCCHANGE, all the other variables in the model are stationary at level. However, due to this difference, the ARDL model is highly suitable.

4.3 ARDL Estimation Analysis

The ARDL tests results are presented in Table 4 below:

Dependent Variable: OILPCHANGE

Variable	Coefficient	t-Statistic	Prob.*
OILPCHANGE(-1)	-0.501984	-3.760674	0.0008
RPCGDPGR	-0.796008	-5.494765	0.0000
TPCCHANGE	-0.057343	-1.966054	0.0020
KCCHANGE	-0.171452	-2.226864	0.0009
LPGCCHANGE	-0.135385	-0.296103	0.7693
C	1.659458	1.019682	0.3163
@TREND	-0.182669	-2.330614	0.0269
R-squared	0.580082	F-statistic	6.676837
Adjusted R-squared	0.493202	Prob(F-statistic)	0.000162
Durbin-Watson stat	1.835400		

Source: EViews 9 Output

The table above shows that other than the LPGCCHANGE variable, the other variables in the model were influenced significantly by a change in oil price. The lagged value of change in oil price was equally influence the change in price variable negatively. This corroborated the studies of Ibrahim (2018), Gatawa and Abdullahi (2017) Aliyu, *et al*. (2017), Gummi, *et al*. (2016) and others. The table shows that a change in oil price will negatively affect total petroleum consumption, and kerosene consumption significant. Though such a change will also affect the consumption of liquefied gas negatively, but the effect is significant. This is possibly due to the fact that Nigerians in general consume liquefied gas product at a lower rate compared to petrol and kerosene.

In addition, the results shown in Table 4 suggest that regression results are not spurious regression since the value of R-squared (0.580082) is less than the Durbin-Watson statistic value of the (1.835400).

4.3 Bounds Test (Long term relationship between the variables)

The ARDL Bound Test shows the presence or otherwise of a long-term relationship between the variables in the model. The results in Table 5 below show that there is a long-term relationship

between OILPCHANGE and the explanatory variables, since the calculated F-statistics is greater than the Critical Value Bounds for the upper bound I(1). The study thus conclude that there is long-run relationship.

Table 5: ARDL Bounds Test

Significance	**Lower Bound Value**	**Upper Bound Value**
10%	3.03	4.06
5%	3.47	4.57
2.5%	3.89	5.07
1%	4.4	5.72
F-statistic	17.05624	

Source: EViews 9 Output

5. CONCLUSION AND RECOMMENDATIONS

This study investigated the validation of the law of demand in the consumption pattern of petroleum products in Nigeria using data spanning from 1980 to 2017. The empirical findings showed that the consumption of petroleum products were adversely affected by changes in oil prices, thus validating the law of demand that a price rise in a product will result in reduced demand for the product. The study also showed that the quality of life of the citizenry were also negatively affected by oil prices fluctuations since increases in oil price reduce the value of real income which in turn affect their consumption pattern negatively.

Drawing from the empirical findings of the study, there is thus urgent need to address the issue of oil price fluctuations in Nigeria. Government need to regulate prices of petroleum products in order to alleviate pressures on households which highly depend on consumption of these products in Nigeria. Although the Nigerian economy has no control over fluctuations in the international market, the governmental authorities can do much to cushion the effects of such fluctuations. Through fiscal policies, government can control local prices as well as regulate consumption patterns in the economy. There is need to diversify the Nigerian economy since over-reliance on the oil sector intensifies the adverse effect of the oil price fluctuations on the economy.

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