Energy Economics Letters
ISSN(e): 2308-2925
DOI: 10.18488/journal.82.2019.62.66.83
Vol. 6, No. 2, 66-83.

URL: www.aessweb.com

ENERGY CONSUMPTION AND INFLATION DYNAMICS IN NIGERIA: AN ARDL COINTEGRATION APPROACH

Godwin Edet Bassey[1]
Uduak Michael Ekong[2+]

[1,2]Department of Economics, Faculty of Social Sciences, University of Uyo, Uyo, Akwa Ibom State, Nigeria.
[2]Email: wills4live@yahoo.com

(+ Corresponding author)

Article History
Received: 9 August 2019
Revised: 17 September 2019
Accepted: 21 October 2019
Published: 6 December 2019

Keywords
Energy consumption
Petroleum energy consumption
Inflation dynamics
Demand-pull
ADL
Energy prices
Petroleum sector
Nigeria.

JEL Classification:
C10; E31; O13; P18.

ABSTRACT

This paper investigated the dynamic relationship between energy consumption and inflation in Nigeria using time series data obtained for the period 1980 to 2017. Applying Autoregressive Distributed Lag (ADL) technique on the variables, the study found that Premium Motor Spirit (PMS), Dual Purpose Kerosene (DPK) and Natural gas were noninflationary in Nigeria both in consumption and prices over the period. Also, Automotive Gas Oil (AGO) consumption produces strong evidence of positive inflationary pressure but not in prices throughout the study period. Further, we found a strong causality link between natural gas consumption and inflation in Nigeria. We concluded that inflation in Nigeria is not majorly a demand-pull phenomenon, pulled by energy consumption. We provide both subjective and evidence-based reasons for the economic trend and recommend a bridge in the degrading systemic informality in the energy sector that will deliver real time effect of energy consumption-inflation proposition in Nigeria.

Contribution/ Originality: This study documents that changes in Inflation in Nigeria is not necessarily a demand-pull phenomenon, pulled by energy consumption. Changes in inflation could be explained away from energy consumption, notably inflation expectation by the citizenry.

1. INTRODUCTION

One of the growing concerns in development literatures is the influence of energy consumption on the macroeconomic performance. A large chunk of the debate is that energy consumption is sine qua non for general economic development (Kraft and Kraft, 1978; Onakoya *et al.*, 2013; Mustapha and Fagge, 2015; Sama and Tah, 2016). However, increasing debate shows that energy consumption may affect the general price level as well (Haider *et al.*, 2013; Iyke, 2014; Eregha and Mesagan, 2017). More particularly, for developing economies, energy consumption has continued to be a driving force for macroeconomic activities. For instance, it appears that no sector of the economy functions effectively without the use of energy. For Nigeria in particular, energy consumption chart continues to show an upward swing. According to global energy statistical year book (2017), the energy consumption figures for Nigeria grows from 66 million tonnes of oil equivalent (Mtoe) in 1990 to 86 Mtoe in year 2000. By the year 2010, total energy consumption for Nigeria was 120 Mtoe, with the accelerated increase continuing to the peak of 137 Mtoe in 2016.[1]

The Nigerian economic policies and growth have been influenced by the activities of energy sector for many decades now particularly the oil sector. Aside from its production decisions which generally dictate the pace of revenue accumulation for the country, of recent, the energy consumption plans of the country have also been of serious concern to policy makers and players in the sector. In order to combat the incessant energy scarcity experienced in the country, the Nigerian National Petroleum Corporation (NNPC) continues to purchase and distribute oi-energy products to meet the energy demands of Nigerians.

Within the same period of increased energy consumption in the country, the rate of inflation also grew rapidly. Inflation rose, year on year, sharply to 38.8 percent in 1983, up from 17.4 percent in 1981 and 16.1 percent in 1980. Inflation also rose from 23.0 percent in 1991 to 76.8 percent in 1994 and even when it declined; it fell to 51.6 percent in 1995. In the year 1999, the rate of inflation was 6.6 percent. However, it rose from there consistently to 23.8 percent in 2003. Further, from 2012, the rate of inflation had moved from a single digit of 8.5 percent to a double digit of 18.6 percent in 2016. With the level of income accruing to the households remaining unchanged, coupled with the falling economic activities leading to recession in late 2016, the welfare of the citizenry declined. Modern analysis of inflation reveals that rising inflation like this is mainly caused either by demand side factors or supply side factors or both. Demand side factors include the activities of consumption, investment and government expenditure. Jongwanich and Park (2008) found strong evidence of demand-pull inflation for Asian countries. The rising trend in energy consumption and inflation in Nigeria give rise to the following research questions. Is inflation in Nigeria demand-driven, led by energy consumption? What is the causal relationship between energy consumption and inflation in Nigeria?

The energy sector of the economy consists of electricity sub-sector, petroleum subsector, Biofuel sub-sector, coal sub-sector among other sub-sectors. Recently, much concern has also been shown on renewable energy as a sub-sector. While recognizing the importance of all these sources of energy in our energy consumption discuss, this study however concentrates on petroleum energy consumption in Nigeria. The choice of this sub-sector is due to its dominance in the livelihood of the Nigerian nation. As noted by Musa (2014) petroleum's product consumption accounts for over 90 percent of the total energy consumption for Nigeria in 2012 alone and this structure have not changed significantly over the last two decades.

Following the above introduction, the rest of the paper is planned as follows: section two examines the theoretical background and review of related empirical literature; section three presents the methods adopted for the study and analysis of data; section four presents the major findings of the study and section five provides valuable recommendations to adopt even as section six concludes the paper.

2. THEORETICAL ISSUES ON ENERGY CONSUMPTION AND INFLATION

Theoretically, the relationship between energy consumption and inflation dynamics can be explained through the demand-pull theory, the structuralist theory, the inflation expectation theory, the demand shift theory and the new political macroeconomics theory of inflation.

Demand-pull theory: Often popularized in the Keynesian economics, the demand-pull theory to inflation determination emphasized non-monetary influences such as government spending and consumption to inflation determination. According to the demand-pull theory, inflation in the economy is the result of excess aggregate demand over supply at full employment level of output. Aggregate demand comprises of consumption, investment, government expenditure and net export in open economy like Nigeria. Given a constant average propensity to save, rising money incomes at the fully employment level would lead to an excess of aggregate demand over aggregate

[1]The Nigerian energy consumption profile is shown in Figure 1 at appendix.

supply and to a consequent inflationary gap. Aggregate demand may exceed supply either because resources are not fully utilized or production cannot be increased rapidly to meet the increasing demand. As a result, prices begin to rise in response to a situation often described as "too much money chasing too few goods." When aggregate demand exceeds aggregate supply at full employment level, due to say, increase in consumption expenditure, the result is an inflationary gap. The bigger the gap, the higher the inflation. As Bayo (2005) pointed out, once an economy has reached the point of full employment, any slight increase in aggregate demand over the available output will obviously lead to a rise in price. If such demand persists, the result is inflation. Thus, continuous growth in energy consumption can fit into the economy's consumption component of the aggregate demand function and trigger inflation. According to demand-pull inflation theory, policy that causes decrease in each component of total aggregate demand is effective in reducing pressure on demand and hence inflation (Totonchi, 2011).

Structuralist theory: The structuralist school suggests that inflation is a natural outcome of rapid economic development and growth process that results primarily from non-monetary factors. The structuralists argued that increase in investment expenditure and the expansion of money supply to finance it are partly proximate factors responsible for inflation especially in developing countries. Notable contributors to the idea of structuralism included Noyola (1956) and Sunkel (1960). Kirkpatrick and Nixon (1976) have generalized this structural theory of inflation as an explanation of inflation prevailing in all developing countries. These proponents argued that in times of rapid economic growth and development, the aggregate demand in the economy rises, however the supply in the economy does not rise at the same rate as the rise in aggregate demand due to the existence of structural bottlenecks. The identified bottlenecks include, but not limited to, Agricultural bottlenecks, Resources constraint or Government budget constraint, Foreign exchange bottleneck, and physical infrastructures bottleneck. The gap between aggregate demand and supply created by the presence of these bottlenecks lead to inflationary pressures in the economy.

Demand-shift theory: The energy consumption-inflation nexus for the Nigerian economy may also follow the demand shift structure. Sectoral or demand-shift inflation is credited to Schultz (1959) who showed that price increase in the United States from 1955-57 were not caused by demand-pull or cost-push but by sectoral shifts in demand. The demand shift theory of inflation argued that prices and wages may be flexible upward in response to excess demand in one sector and may be rigid downward in other sectors of the economy. Thus, even if aggregate demand is not excessive, excess demand in some sectors of the economy and deficient demand in other sectors, will still lead to a rise in the general price level. This is because prices do not fall in the deficient-demand sectors, there being downward rigidity of prices. But prices rise in the excess demand sectors and remain constant in the other, sectors. The net effect is overall rise in the general price level. Moreover, increase in prices in excess-demand sectors spread to deficient-demand sectors through the prices of materials and wages of labour of the sector. Excess demand in one sector will lead to a general rise in the price of intermediate goods and supplies of other sectors and components. The rise in prices of materials will spread to demand-deficient sectors which use them as inputs. The demand-deficient sectors must raise the prices of their products in order to protect their profit margin. This way, increase in energy consumption spills over to other sectors of the economy and influence the general price level (Totonchi, 2011).

Political Macroeconomic theory: The New Political Macroeconomics theory of Inflation takes into account the non-economic factors for explaining inflation process in an economy. Non-economic factors refer to institutions, election and culture etc. They argued that there are some linkage between inflation cause and timing of event which mainly relates to important political and institutional decisions (Totonchi, 2011). The Central Bank independence relates to the monetary policy as well as inflation. Equally, the Nigerian National Petroleum Corporation (NNPC) relates to energy supply and demand in the Nigerian economy. They also argued that protracted budget deficit can be the cause of inflation. All these interplays of institutional activities and decisions play a vital role in price changes especially in developing countries like Nigeria.

Rational Expectation theory: The Rational Expectation Theory of Lucas, Sargent and Hansen also show that there may be energy consumption-inflation dynamics in Nigeria. According to Rational Expectation Theory, people do not make the same mistakes consistently and their expectation is based on past and current information available for them. According to the Rational Expectation approach, once every economic agent has rational expectation on future inflation, they will make huge purchases now to beat future inflation. That growth in demand is expected to outgrow current supply and trigger demand-pull price rise. Once expectation of inflation sets in, it's hard to eradicate and the result may be galloping inflation. The Nigerian energy consumption-price change situation may be typical of rational expectation in that during energy scarcity period, panic purchases creates an unexpected rise in price of energy product.

2.1. Empirical Review

The debate on energy consumption-inflation nexus is an ongoing global issue. For instance, Iyke and Odhaimbo (2014) in investigating the energy consumption-growth led linkages for Ghana, used a trivariate ARDL frameworkfortheperiod1971–2012. They found that at 10 percent level of significance, energy consumption (proxied by electricity consumption), induces inflation in the Ghanaian economy. Faced with such evidence, the authors agitated for appropriate monetary policies in order to accommodate potential inflation hikes stemming from excessive demands for electricity over time.

In another instance, Iyke (2014) explored a similar linkage for Nigeria in a dynamic causal relationship for the period 1971 to 2012. His results showed that inflation can Granger-cause electricity energy consumption at least in the short run. The study argued for rigorous monetary policies to moderate the rise in inflation which has dampening effect on economic growth.

Behname (2013) explored the relationship between energy prices and inflation with particular attention to the size of the market in 5 Northern European countries of Denmark, Norway, Sweden, United Kingdom and Finland in a panel from 1980 to 2009. Applying random effect model on the data, he found that, depending on the size of market, oil consumption (proxied by oil prices) inflate regional prices of Northern Europe by up to 1.15 percentage point in the medium term. The effect of such influences on the long term may not be certain, but the immediate influences may trigger other unhealthy economic consequences in the region, notably unemployment.

Stuber (2001) investigated the continuous changing effect of major energy consumption on the overall economic activity and inflation in Canada in late 20th century. His exposition shows that for the most part of 1999, the large increases in the prices of gasoline, fuel oil, and natural gas at the consumer level largely explain why CPI inflation in Canada has been well above core inflation within the period. The study also showed that other facets of price hike could be noticed for wages and other intermediate industrial products.

Rehman (2014) examined the relationship between energy consumption monetary policy and inflation for 5 Asian countries in the years following the global financial crisis using Granger causality relationships. His results showed evidence of strong interaction between oil consumption and inflation for at least two Asian countries. He thus argued that if there are high oil prices in the international market, the domestic inflation in these two countries is likely to be the oil price push inflation.

Looking at the global scale, Parker (2017) investigated how global inflation is triggered by, among many other factors, energy prices. Using both bivariate and multivariate least squares regressions on datasets from 223 countries inclusive of both high and low income regions, found supporting evidence of global inflation- domestic energy consumption nexus. More generally, the sub-component level datasets produce more global inflation influences on energy prices than on food prices.

In his contributions, Abdullahi (2014) examined the elasticity behaviour of petroleum products prices for Nigeria between 1978 and 2010. Applying Structural Time Series Models (STSMs) on data collected from both local and international sources for the country, he found that petroleum product demand and consequently consumption, is largely inelastic. The implication is that, energy consumption in Nigeria continues to rise, not-minding both energy and other prices increase.

Ibrahiem (2018) investigated the effect of energy consumption on population, urbanization and growth for the Egyptian economy between 1980 and 2011. Applying VAR decomposition techniques on already vectored corrected variables, he showed that energy consumption in transportation will have serious implications on urbanization in the long run and therefore, proffered energy conservation policies as growth options for the economy.

Josheski *et al.* (2014) examined the impact of energy consumption on economic development and prices of 4 Central, Eastern and Southern countries of Europe including Albania, Bosnia and Herzegovina, Serbia, and Macedonia using cointegration and error-correction modeling techniques. Their result indicated an inverse trend in energy consumption- inflation relationships for the region in the medium term. Stated specifically, an increase in energy use by one percentage point will mitigate inflation significantly by 0.3 percent for Albania, between 0.08 and 0.5 percent for Bosnia and Herzegovina, between 12 and 16 percent for Macedonia and between 3 and 21 percent for Serbia. From their result, they argued on energy conservation measures without severe impact on economic growth.

The literature is also giving intrinsic attention to price relatives in energy consumption. There are growing number of scholars confirming the fact that rising absolute energy prices stifle energy consumption (Amano, 1990; Li and Lin, 2015) and relatively fewer scholars are arguing in favour of relative energy prices instead (He *et al.*, 2016). As He *et al.* (2016) pointed out, no area of price consideration should be taken lightly because this may ignore general inflation effects, whereby the prices of baskets of goods may rise or fall at different rates from those of energy prices. Thus, it may be the relative energy price, not the absolute energy price, that has most important effects on energy consumption. In many of these studies, growing energy prices pushes down energy consumption. He *et al.* (2016) showed that the direct impacts of relative energy prices on total energy consumption and intensity are −0.34 and −0.25, respectively; and the depressing and upward effects of rising and falling energy prices on energy consumption are 0.35 and 0.36, respectively. Zhang (2015) opined that one of the key reasons for increasing energy cost around the globe is energy security. Based on this assumption, developing countries like Nigeria, trek on subsidy removal to equilibrate energy prices with current market rates, and in the developed world, this is showed-up in internalizing environmental costs in energy prices. However, Zhang (2015) lamented that, this is often done with policy neglects to the poor, causing economic distress, particularly for poor households. Bobai (2012) showed that petroleum product prices influence inflation in Nigeria. Applying ordinary least square regression on prices of petroleum products and inflation from 1990 to 2011, he found that premium motor spirit and diesel prices affect inflation positively, but not so with dual purpose kerosene.

Haider *et al.* (2013) found that energy consumption causes energy inflation in an economy. In a study of the Pakistani economy from 1973 to 2012 using Ordinary Least Square (OLS), Generalized Least Square (GLS) and Generalized Method of Movement (GMM) methods, they showed that Oil prices have an indirect effect on energy inflation in Pakistan. However, such effect will only show up after some interval of shocks and marginally significant.

While consideration has always been given to the effect of energy consumption on changes at the macro level of the economy, it however, seems plausible to believe that the effect of energy consumption and price changes may be more pronounce at the micro level, and not actually captured. To cater for this micro level effect, Moradkhani *et al.* (2010) examined the change in prices of different kinds of energy such as crude oil, natural gas and coal, petroleum production and electricity and gas on the prices of other goods, especially in the industrial and transportation sectors which are major users of energy and household expenditure in Malaysia using close input-output model in a leontief's price system. The study took more of a comparative analysis of the performance in the two sectors considered between 1999 and 2005. Their findings show that doubling the price of primary energy for instance crude oil, natural gas and coal, and petroleum production greatly affected the prices of non-energy goods in

Malaysia more than doubling the prices of secondary energy like electricity and gas. This means that doubling the prices of all kinds of energy in Malaysia brought about increase in transport sector by as much as 13 percent, even as the industrial sector was also positively affected by as much as 22 percent of price doubling of the secondary energy products. More than that, employee compensation and wages were affected two times more by raising the prices of primary energy than those of secondary energy.

Saidi and Hammami (2014) applied Johansen cointegration technique on time series data collected in Tunisia from 1974 to 201 to examine the interrelationship existing between energy consumption and economic growth. Their studies included the energy price variable that interacted with energy consumption and own-price effect. Their result shows that there could be a spiral effect of own-price of energy. In real terms, energy prices can significantly affect future energy price growth by up to 80 percent over time. If this result holds, the continuous rise in energy price in Tunisia will reduce energy consumption as time passes.

Eregha and Mesagan (2017) examined the performance of selected African countries which depend mostly on energy production to measure the development of their economy. In their analysis, Tunisia, Egypt, Morocco, Algeria and Nigeria where analyse in a panel using both dynamic OLS and Fully Modified OLS techniques for the period 1970 to 2015. Their result shows an inverse relationship between energy consumption and inflation from both the fully modified ordinary least squares panel and the dynamic ordinary least squares model. According to them, improvement in the productive sectors of the specific countries' economy is the bed—rock through which pressure on output rise to meet the expectation of the aggregate demand sector thereby forcing down inflation perpetually to the tune of over 61 percent.

Even when many studies have shown an inverse relationship in energy consumption-inflation relations, in other regions, prices of individual energy continue to rise. Several factors are associated with this such as lifestyle, consumption habit and pattern. Abd'razack *et al.* (2012) found that due to increasing price of kerosene, electricity and liquefied natural gas products in Minna, Niger State, Nigeria, the indigenes shifted their energy use behaviour to biomass with the attendant environmental concerns.

3. METHOD OF STUDY

We specify our model base on the Autoregressive Distributed Lag (ARDL) method. Studies on Autoregressive Distributed Lag (ARDL) models date back to the preliminary works of Pesaran and Shin (1999) and Pesaran *et al.* (2001). This approach provides an easy investigation of dynamic relationship among variables of interest both in the long run and shot run periods. The literature is of diverse opinion on the benefit of the ARDL bound testing model (for instance see, Akpan (2011); Adamu and Darma (2016); Nkoro and Uko (2016)). The long run relationship of the underlying variables is detected through the F-statistic (Wald test). In this approach, long run relationship of the series is said to be established when the F-statistic exceeds the critical value band. That is, if the computed F_test value lies above the upper bound critical value, long run cointegration relationship exist among the variables. A computed F_test value lower than the lower critical bound value is an indication of no cointegration. Similarly, a computed F test value in-between the two critical band values are indication of inconclusive analysis.

The basic form of an ARDL (p, q_1, q_2....q_m) model is specified thus:

$$\pi_t = \sum_{i=1}^{\rho} \delta_\kappa \pi_{it-\rho} + \sum_{i=0}^{q} \beta_\kappa x_{it} + \mu_t \qquad (1)$$

Where, π_t, is the explained variable; x_t, are the vector of explanatory variables in the model which could be endogenous or exogenous; μ_t, is a white noise variable assumed to be serially independent of other variables in the model; *(p,q)*are the various lags of the variables in the model, $(\delta_{\kappa}, \beta_{\kappa})$ are estimated parameters to their lags $\kappa, and\ q = 1,2 \ldots m$. An expansion of the above model to a standard bound testing procedure becomes:

$$\Delta\pi_t = \delta_o + \sum_{i=1}^{\rho} \delta_{\kappa}\Delta\pi_{it-\rho} + \sum_{i=0}^{q} \beta_{\kappa}\Delta x_{it-q} + \psi_1\pi_{it-1} + \psi_{2i}x_{it-1} + \mu_t \quad (2)$$

Where, ψs, are the parameters of all the included variables in the model lagged one period, Δ, is the difference operator, other indices are as already defined. For our analysis, the long run relationship between inflation and energy consumption activities is specified as:

$$\Delta\pi_t = \delta_o + \sum_{i=1}^{\rho} \delta_1\Delta\pi_{it-\rho} + \sum_{i=0}^{q} \beta_0\Delta pms_{it-q} + \sum_{i=0}^{q} \beta_1\Delta dpk_{it-q} + \sum_{i=0}^{q} \beta_2\Delta ago_{it-q}$$
$$+ \sum_{i=0}^{q} \beta_3\Delta ngas_{it-q} + \sum_{i=0}^{q} \beta_4\Delta ms_{it-q} + \sum_{i=0}^{q} \beta_5\Delta ge_{it-q} + \psi_1\pi_{it-1} + \psi_2 pms_{it-1}$$
$$+ \psi_3 dpk_{it-1} + \psi_4 ago_{it-1} + \psi_5 ngas_{it-1} + \psi_6 ge_{it-1} + \psi_7 ms_{it-1}$$
$$+ \mu_t \quad (3)$$

Where, π is inflation rate in the economy, *pms* is petrol consumption in Nigeria; *dpk* is kerosene consumption in Nigeria; *ago* is diesel consumption in Nigeria and *ngas* is natural gas consumption in Nigeria. We had earlier noted that our preference for this sub-sector is its dominance in the livelihood of the Nigerian nation. Our variables also include money supply (*ms*)and growth of government expenditure (*ge*) to control for policy shift in the economy. Elsewhere, such as in Equation 4 below, g_t is a measure of individual consumption channel in Nigeria. Apriori, we expect petroleum product consumption to affect inflation positively due to its dominance in the livelihood of the Nigerian nation. Data for the study was sourced from data publications within the country such as CBN Statistical bulletin, NNPC Statistical bulletin and other external publications like the World Bank Development country report for Nigeria, Statistical Review of World Energy.

$$\Delta\pi_t = \delta_o + \sum_{i=1}^{\rho} \delta_1\Delta\pi_t + \sum_{i=0}^{q} \beta_i\Delta g_{it-1} + \psi_1\pi_{it-1} + \psi_2 g_{it-1} + \mu_{it} (4)$$

for i= 1,2,3,4[2]

3.1. The Specification for Causality Test

In order to examine the causal link existing between energy consumption and inflation in Nigeria, we used the Granger Causality test. As Narayan and Smyth (2005) asserted, once the existence of co-integration is established for the relations, then there is a case for causality in one or more directions. Thus, following previous works (see (Narayan and Smyth, 2005; Akpan, 2011; Iyke and Odhaimbo, 2014)) we specify our causality test as follows:

[2]The control variables are not included

$$\Delta\pi_t = \delta_o + \sum_{i=1}^{n} \delta_1 \Delta\pi_{t-i} + \sum_{i=0}^{n} \beta_i \Delta EC_{t-1} + \psi_3 ECM_{t-1} + \mu_{1t} \quad (5)$$

$$\Delta EC_t = \delta_o + \sum_{i=1}^{n} \delta_1 \Delta EC_{t-i} + \sum_{i=0}^{n} \beta_j \Delta\pi_{t-1} + \psi_4 ECM_{t-1} + \mu_{2t} \quad (6)$$

According to Bildirici and Kayikci (2012) Granger causality are tested in three ways. First, short run or weak Granger causalities are tested by H0 :β_i = 0 and H0 : β_j = 0 for all i in Equations 5 and 6. Second, long run Granger causalities are tested from the ECMs in those equations. Long-run causalities are tested by H0 :ψ_3 = 0 and H0 : ψ_4 = 0 . Third, Strong Granger causalities are tested by H0 :β_i = ψ_3 = 0 and H0 : β_j = ψ_4 = 0 for all i in Equations 5 and 6. We tested for strong causality among the variables.

3.2. Stationarity Test

As is often the case when using times series data, a test of stationarity will be conducted to avoid making inferences with spurious estimates. This study adopts the PP test for stationarity developed by Perron (1997). There is wider acceptability in the literature that the PP test evaluates the time series properties of the variables in the presence of structural changes at unknown points in time and thus endogenises these structural breaks, an advancement from the traditional augmented dickey fuller test of stationarity. The PP test is specified as:

$$\theta_\alpha^* = \theta_\alpha \left[\frac{\gamma_\circ}{\omega_\circ}\right]^{\frac{1}{2}} - \frac{T(\omega^\circ - \gamma^\circ)[se(\varphi)]}{2\omega_\circ^{\frac{1}{2}} s} \quad (7)$$

Where, φ is the estimate, and θ_α is the t-ratio of φ, $se(\varphi)$ is the coefficient standard error, and s is the standard error of the regression equation. ω^o and γ^o are the residual spectrum at zero frequency and consistent estimate of the error variance respectively.

3.3. Analysis of the Data

Our analysis begins with the description of our variables on Table 1. Table 1 shows that all the variables are positively skewed normally distributed with reasonable peak.

Next we investigate the stationarity properties of the variables. As reported on Table 2, all our variables were well-behaved at levels not exceeding first difference at 5 % level of significance.

With such statistical satisfaction, we proceed to examining the lag structure of the variables to include in the analysis. This is necessary, for failure to attain a proper lag length for the variables may leave some of the desired information on the white noise, leaving our estimates ill-best. Thus, after systematically evaluating 2500 models of different lag specifications, the lag structure of 4,4,4,3,2,3,0 was selected using Akaike Information Criterion (AIC) for inflation, petrol consumption, kerosene consumption, diesel consumption, natural gas consumption, money supply and government expenditure respectively. The 20 top models captured by our selection criterion is shown in Figure 1.

Table-1. Descriptive properties of the variables.

Variables	π	Pms	dpk	Ago	Ngas	Ms	Ge
Mean	20.3191	3322.741	3732618	3280.428	12.6472	6005.728	1481.685
Median	12.5000	0.0552	-0.7933	-0.05692	7.2786	488.1500	487.1100
Maximum	76.8000	122776.5	137877.8	121229.7	164.3979	8008.20	5185.320
Minimum	3.6000	-26.7844	-74.1975	-55.1656	-48.8506	13.0400	9.6400
Std Dev.	18.2388	20183.58	22665.98	19929.42	36.6464	13990.78	1843.845
Skewness	1.6715	5.8333	5.8333	5.8333	2.4099	4.2153	0.9921
Kurtosis	4.7157	35.0277	35.0274	35.0274	10.6781	22.4544	2.8933
Jarque-Bera	21.7674	1791.241	1791.207	1791.210	116.4260	693.0536	6.6280
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0363
Observations	37	37	37	37	37	37	37

Table-2. Unit root test.

Variable	PP test	Integration order
π	-2.9552**	1(0)
Pms	-5.9974*	1(0)
Dpk	-6.0011*	1(0)
Ago	-5.9988*	1(0)
Ngas	-6.6289*	1(0)
Ms	-4.6011*	1(0)
Ge ΔGe	-1.4165 -6.3494*	 1(1)

Test critical values: 1% 5% 10% -3.6268 -2.9458 -2.6115
**, * significance at 5% and 1% respectively.

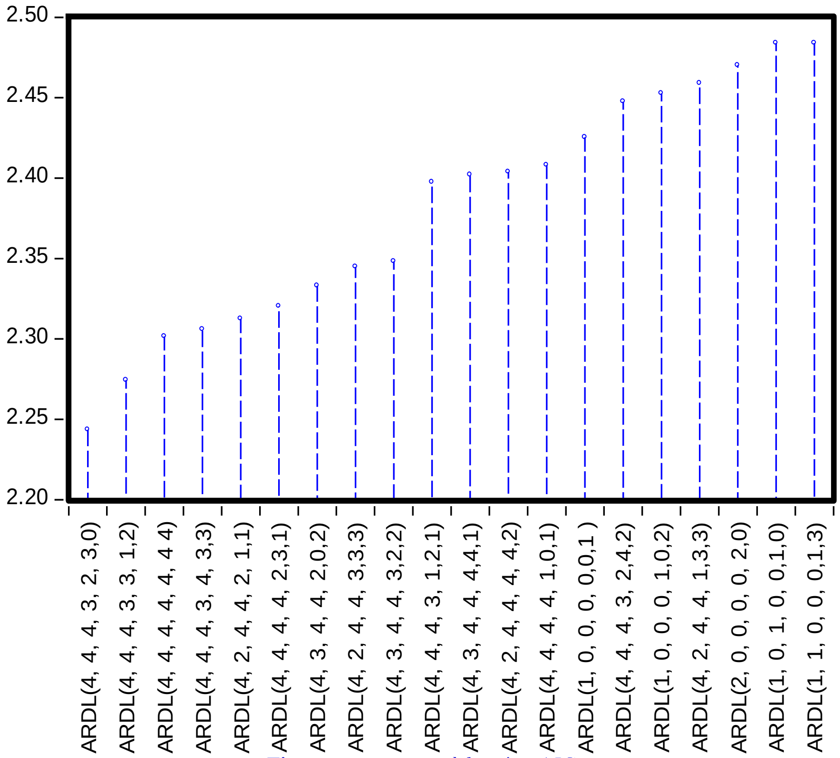

Figure-1. 20 top models using AIC.

Selected model: ARDL(4,4,3,2,3,0).

Table-3. ARDL bound test result.

Estimated variables	lags	$F_{Calculated}$	Conclusion
π *Pms*	1 0	8.498*	Cointegrated
π *Dpk*	1 0	8.499*	Cointegrated
π *ago*	1 0	8.498*	Cointegrated
π *Ngas*	1 0	10.841*	Cointegrated
π, *pms*, *dpk*, *ago*, *ngas*, *ms*, *ge*	4, 4, 4, 3, 2 3 0	5.702	Cointegrated

Test critical value bounds

Significance	1(0)	1(1)
10%	2.45	3.52
5%	2.86	4.01
1%	3.74	5.06

Note: all lags were system selected.
* Test critical bounds for each energy source was different.

Having dealt with the issue of lag selection, we proceed to our autoregressive distributed lag (ARDL) analysis. First, we examined the long run relationship for the individual energy consumption, and next the joint relationship of all the energy consumption components considered in our analysis and report the results on Table 3. Our result shows that there exists a long run relationship for both the individual energy consumption routes and the joint consumption of all the energy analysed with changes in inflation in Nigeria. We report the long run relationship of petroleum products consumption and inflation dynamics on Table 4.

Table-4. Long run estimates.

Dependent variable: Log (π)

Variable	Coefficient	Std. error	t-Statistic	Prob.
Pms	-0.018981	0.006978	-2.720013	0.0262
*dpk_*	-0.023536	0.002886	-8.154055	0.0000
*ago_*	0.045979	0.007014	6.555568	0.0002
*ngas_*	-0.007113	0.005159	-1.378667	0.2053
Ms	0.000163	0.000103	1.589640	0.1379
Ge	-0.002299	0.001140	-2.015687	0.0669
C	3.042136	0.065814	46.223314	0.0000

Our result shows that consumption of premium motor spirit, dual purpose kerosene and natural gas impacted negatively on inflation in Nigeria over the period. However, while such negative effect was strong and statistically significant from DPK to PMS, it was milder from natural gas consumption. Adamu and Darma (2016) show that such negative relationship is possible. They argued that more energy consumption could correlate positively with general economic performance of a region and ultimately lowers the general price level. They specifically showed that improved access to natural gas consumption in Nigeria leads to lower production cost for output. This makes the general price level to go down, and trigger more demand, which will make businesses and markets to flourish in the country. Contrary to the trend exhibited by the trio energy sources, Automotive Gas Oil (AGO) consumption was found to produce positive and statistically significant impact on changes in inflation in Nigeria over the period.

A unit increase in the consumption of Diesel increases inflation in the country by at least 5 percent over time. The positive effect of AGO could be attributed to a more sustained level of deregulation achieved on the energy source and transmitted to its consumption. The choice of policy direction in Nigeria in the study period also affected changes in inflation. An expansionary monetary policy affected inflation positively. A unit rise in money supply was found to raise inflation in Nigeria by 0.002 percent in the long run. The implication of this is that pursuing expansionary monetary policy options in seasons of demand-pull inflation may worsen the economy further. Furthermore, increase in government expenditure will reduce inflation in the long run and statistically significant.

The negative petroleum product's Consumption-Inflation dynamics experienced over time in Nigeria is not gotten by chance. Our analysis shows that the trend continues from the short run, with no possibility of structural break, into the long run see Table 5. PMS consumption continues to deliver negative impact on inflation over the four-period lag with some lags statistically significant. The consumption of DPK also continues to dampen inflation in Nigeria from the current period to the fourth period. However, such effect will only be significant statistically from two-period lag. The natural gas consumption also affects inflation negatively over the short run period. However, its effect was undulating over the period. Only AGO consumption showed a positive inflation nexus even in the short run. Our result shows that a unit increase in the consumption of AGO increases inflation by at least 3 percent from the current period to at most 5 percent as time progressed before falling down but all statistically significant over the short run. We attribute this positive relationship between AGO and Inflation to the relative stability in price of the product achieved mainly through the product's deregulation. From 2007/2008 to date, AGO obtained full deregulation and stable price of 145 naira and consumption of the product followed that price.

Table-5. Short run output.

Dependent variable: Log(π)				
Variable	**Coefficient**	**Std. error**	**t-Statistic**	**Prob.***
Log(π(-1))	-0.072788	0.229925	-0.316572	0.7597
Log(π(-2))	-0.775488	0.298738	-2.595879	0.0318
Log(π(-3))	-0.551891	0.320710	-1.720845	0.1236
Log(π(-4))	-0.645781	0.218182	-2.959825	0.0182
*pms_*	-0.024275	0.010910	-2.225087	0.0567
pms_(-1)	-0.040505	0.013251	-3.056832	0.0157
pms_(-2)	-0.031029	0.012618	-2.459018	0.0394
pms_(-3)	0.009868	0.009275	1.063992	0.3184
pms_(-4)	0.028126	0.010729	2.621507	0.0306
*dpk_*	-0.001540	0.002660	-0.579009	0.5785
dpk_(-1)	-0.003073	0.003425	-0.897310	0.3958
dpk_(-2)	-0.014588	0.004723	-3.088440	0.0149
dpk_(-3)	-0.027449	0.006217	-4.415081	0.0022
dpk_(-4)	-0.025041	0.009553	-2.621210	0.0306
*ago_*	0.026329	0.011777	2.235553	0.0558
ago_(-1)	0.044503	0.013883	3.205556	0.0125
ago_(-2)	0.048000	0.013839	3.468553	0.0085
ago_(-3)	0.021218	0.008988	2.360627	0.0459
*ngas_*	0.012743	0.011699	1.089306	0.3077
ngas_(-1)	-0.019442	0.006995	-2.779416	0.0239
ngas_(-2)	-0.014968	0.011764	-1.272394	0.2390
Ms	-0.000163	0.000103	-1.589640	0.1379
ms(-1)	5.50E-05	5.20E-05	1.056376	0.3116
ms(-2)	6.04E-05	7.24E-05	0.834629	0.4202
ms(-3)	0.000205	0.000113	1.820580	0.0937
Ge	-0.002299	0.001140	-2.015687	0.0668
Ecm (-1)	-0.156882	0.047856	-3.278209	0.0021
C	9.266190	1.770116	5.234791	0.0008

R^2 0.88 Adjusted R^2 0.71 F-statistics 6.5757 Prob.F-stat 0.2599
D. W. 2.16 AIC 2.1391 SC 3.1666

Table-5.1. Long run coefficients for product prices.

Dependent variable: log(π)

Variable	Coefficient	Std. error	t-Statistic	Prob.
log(pmsp)	0.083240	0.523232	0.159088	0.8759
log(dpkp)	-0.086462	0.281111	-0.307574	0.7629
log(agop)	-0.013351	0.312306	-0.042750	0.9665
logms	0.277129	0.296522	0.934599	0.3639
log(ge)	-0.088587	0.178593	-0.496028	0.6276
C	2.529497	0.807121	3.133976	0.0073

Table-5.2. Short run output of product prices.

Dependent variable: Log(π)				
Selected model: ARDL(4, 2, 3, 4, 2,1)				
Variable	**Coefficient**	**Std. error**	**t-Statistic**	**Prob.***
log(π (-1))	-0.016379	0.181310	-0.090337	0.9293
log(π (-2))	-0.420227	0.177634	-2.365695	0.0330
log(π (-3))	-0.037721	0.183777	-0.205253	0.8403
log(π (-4))	-0.240661	0.192367	-1.251055	0.2314
log(pmsp)	0.663589	0.398027	1.667193	0.1177
log(pmsp(-1))	0.459579	0.483505	0.950515	0.3580
log(pmsp(-2))	-0.980412	0.513609	-1.908869	0.0770
log(dpkp)	0.168998	0.570077	0.296448	0.7712
log(dpkp(-1))	0.468016	0.723764	0.646642	0.5283
log(dpkp(-2))	-1.358229	0.590850	-2.298773	0.0374
log(dpkp(-3))	0.572933	0.491502	1.165679	0.2632
log(agop)	-0.044654	0.553222	-0.080717	0.9368
log(agop(-1))	0.333614	0.620848	0.537353	0.5995
log(agop(-2))	0.652101	0.526929	1.237549	0.2362
log(agop(-3))	-0.245236	0.505334	-0.485295	0.6350
log(agop(-4))	-0.718722	0.318518	-2.256454	0.0406
logms-	-0.032622	0.011338	-2.877206	0.0139
logms(-1))	0.023349	0.011853	1.969936	0.0724
logms(-2))	0.017292	0.008144	2.123258	0.0552
log(ge)	-0.795567	0.486609	-1.634922	0.1243
log(ge(-1))	0.643642	0.516397	1.246408	0.2331
ecm(-1)	-0.868244	0.426117	-2.037571	0.0251
C	4.338058	1.556037	2.787889	0.0145
R-squared	0.828094	Mean dependent var		2.702747
Adjusted R-squared	0.607073	S.D. dependent var		0.757913
S.E. of regression	0.475089	Akaike info criterion		1.643437
Sum squared resid	3.159938	Schwarz criterion		2.505063
Log likelihood	-8.116713	Hannan-Quinn criter.		1.933348
F-statistic	3.746666	Durbin-Watson stat		2.456723
Prob(F-statistic)	0.007864			

We also found that the economy's control variables influenced inflation at various dimensions over the period. For instance, monetary policy proxied by money supply affects inflation positively in the short run though not statistically significant. However, in the current year, the effect maybe negative and statistically significant. Government fiscal operation was found to dampen inflation in the short run and statistically significant. A unit rise in government expenditure will reduce inflation by 0.2 percent in the short run. Some scholars however, are of the opinion that the Petroleum product's effect on inflation may be more felt through the product's prices (see for instance Eregha and Mesagan (2017)). When the analysis was conducted with the products' prices and reported on Tables 5.1 and 5.2, our outcome was not much different. In-fact, in the immediate period, the only significant outcome between inflation and energy product prices were negative. In the long run, only PMS price produce an insignificant positive outcome. Other energy sources showed the negative inflation relation. Eregha and Mesagan (2017) also met such outcome for most of the energy sources.

Our result is different from popular results (see for instance (Bobai, 2012; Eregha and Mesagan, 2017)). In-fact popular stance is that energy consumption and prices cause trend in inflation; more so for a more energy dependent country like ours. However, empirics show that this could be different for some reasons. The disparity between petroleum product prices in Nigeria may obscure the true relationship of the economic variables. Official petroleum product prices and the prices the citizens buy the products are much different. For instance, as at the time of this analysis, the official DPK price was 50 naira, when the populace were getting the product at not less than 190 naira. Such price distortion may also distort real economic relations. Again, much of the consumed energy products in the country may be attributed to what we may call "consumption parallelism". For instance, the Nigerian National Petroleum Corporation (NNPC) continues to report increasing volumes of energy product for bunker activities. Only confused perceptions can make us believe that this does not spill into the country's energy consumption portfolio unaccounted for. Moreover, people's perceptions on energy-inflation relationships may work out to play down on the general price level (the inflation expectation hypothesis). As our result shows, past inflation hysteria, play down on the general price level over the short run. Because people always believe that once consumption and /or prices of energy rises, inflation will rise, such knowledge will also force them to reduce the product's intake (at least at the time of the price hike) thereby tinkering on the general price level ultimately.

Our search for a clear coincidence of empirics' outcomes with the popular perception is a search towards bridging energy activities informality in Nigeria on the one hand and petroleum product's managers band wagon effect on the other. Onwioduokit and Adenuga (2000) noted such band wagon effect when they said "the occasional petrol shortages experienced by Nigerian towns and villages due to inefficient distribution is as a result of incompetence and corruption on the part of bureaucrats and the business class". Corruption reduction policies in the sector are recommended for tackling band wagon effect in the sector. We recommend rural economic development policies like provision of basic social amenities to energy producing host communities. Also added to this will be local–foreign technology synergy between the government and the bunker communities thereby bringing their activities into the main stream production and consumption. These, will make macroeconomic outcomes like inflation fully reflect the energy consumption activities of the country.

When we analyse the causal links between the variables, our result shows a uni-directional causality that runs through natural gas consumption to inflation in Nigeria and was statistically significant.

Table-6. Causality results.

Ngas-Inflation →	3.22267	0.0818

Our post diagnostic test was conducted with the Ramsey Reset test. The result, reported on Table 7 shows that our system was well specified. Our F value of 0.58 less than the Table F value of 5.14 shows that we cannot reject the null hypothesis of correct system specification at 5 percent level of significance. Overall, our outcomes are stable and reliable.

Table-7. Ramsey RESE test.

F-statistic	Value	Df	Probability
	0.583913	(2, 6)	0.5865

4. MAJOR FINDINGS

The interest of the study was on investigating energy consumption-inflation relationship in Nigeria. Our major finding is that the consumption of premium motor spirit, dual purpose kerosene and natural gas produces statistically significant noninflationary evidence in Nigeria both in the short and long run periods. Specifically, the combined effect of the consumption of premium motor spirit, dual purpose kerosene and natural gas on reducing inflation is 5 percent in the long run. In the short run, the combined effects of the consumption of premium motor spirit, dual purpose kerosene and natural gas on reducing inflation are 7, 7 and 3 percent respectively. These failed to meet our apriori expectation. The main reasons identified for the inverse relationship was informality in production and prices in the petroleum sector, corruption in the system and inflation expectation. However, inflation is demand-pull in AGO consumption in Nigeria. The consumption of Automotive Gas Oil positively affects inflation significantly in Nigeria by at least 4 percent in the long run and 14 percent cumulatively in the short run.

The economic implication of our finding is that inflation in Nigeria is not majorly a demand-pull phenomenon, pulled by energy consumption. Inflation in Nigeria may be propelled by other factors outside energy consumption.

5. CONCLUSION

The study investigated the dynamic relationship between energy consumption and inflation in Nigeria for the period 1980 to 2016. Having considered the theoretical nexus of the variables, we applied the Autoregressive Distributed Lag (ARDL) model of Pesaran and Shin (1999) and Pesaran *et al.* (2001) on the chosen variables. Our findings show that within the immediate time and into the future, petroleum product's consumption premium motor spirit, dual purpose kerosene and natural gas do not affect the rate of inflation in Nigeria positively, rather the relationship was inversed. Only Automotive Gas Oil (AGO) consumption showed a positive consumption-inflationary trend that was linked to deregulation stability achieved with AGO over other energy sources for some time now. A weak causality link between the choice variables also supports the noninflationary-energy consumption stance for Nigeria. Only natural gas consumption was shown to have strong statistical causation on inflation in the moment. Our study identified possible subjective and evidence-based explanations for the observations as well as thoughtful policy path, including local–foreign technology synergy that will bring bunker activities into official consumption activities.

6. RECOMMENDATION

Based on our findings, we make the following recommendations:

1. The consumption of other petroleum product sources such as dual purpose kerosene should be given full deregulation. This is based on the fact that AGO that have been given full deregulation seems to show an acceptable trend.
2. Because of the band wagon effect in the petroleum sector, we recommend corruption reduction polices for the sector. Thus, we encouraged reforms focusing on improving financial management and strengthening the role of auditing agencies to generate greater financial transparency and accountability. In-fact, financial management should exclude classified information rule in its system.
3. To curb bunker activities, we recommend that bunker activities should be brought into the main stream production of the economy. This can be achieved by training them through foreign-local technology transfer that can help to grow the economy.
4. Based on the strong causality links flowing from natural gas to inflation, we recommend citizenship education on energy switch to natural gas as a more cleaner energy source for domestic use.

Funding: This study received no specific financial support.
Competing Interests: The authors declare that they have no competing interests.
Acknowledgement: Both authors contributed equally to the conception and design of the study.

REFERENCES

Abd'razack, N.T.A., S.O. Medayese, V.I. Matins, O.O. Idowu, A. B.M. and L.O. Bello, 2012. An appraisal of household domestic energy consumption in Minna, Nigeria. IOSR Journal of Environmental Science, Toxicology and Food Technology, 2(3): 16---24.Available at: https://doi.org/10.9790/2402-0231624.

Abdullahi, A.B., 2014. Modeling petroleum product demand in Nigeria using structural time series mdel (STSM) approach. International Journal of Energy Economics and Policy, 4(3): 427-441.

Adamu, A. and M.R. Darma, 2016. Inland natural gas consumption and real economic growth in Nigeria: ARDL cointegration test. Journal of Economics and Sustainable Development, 7(8): 183-206.Available at: https://doi.org/10.1504/ajesd.2019.10025216.

Akpan, U.F., 2011. Cointegration, causality and Wagner's hypothesis: Time series evidence for Nigeria, 1970-2008. Journal of Economic Research, 16(1): 59-84.

Amano, A., 1990. Energy prices and CO2 emissions in the 1990s. Journal of Policy Modeling, 12(3): 495-510.

Bayo, F., 2005. Determinants of inflation in Nigeria: An empirical analysis. International Journal of Humanities and Social Science, 1(18): 262-271.

Behname, M., 2013. The relationship between market size, inflation and energy. Atlantic Review of Economics: Revista Atlántica de Economía, 2(1): 11-13.

Bildirici, M.E. and F. Kayikci, 2012. Economic growth and electricity consumption in emerging countries of Europa: An ARDL analysis. Economic Research, 25(3): 538-559.Available at: https://doi.org/10.1080/1331677x.2012.11517522.

Bobai, F.D., 2012. An analysis of the relationship between petroleum prices and inflation in Nigeria. International Journal of Business and Commerce, 1(12): 1-7.

Central Bank of Nigeria, 2016. Statistical Bulletin, Abuja, Nigeria.

Central Bank of Nigeria, 2006. Statistical Bulletin, Abuja, Nigeria.

Central Bank of Nigeria, 2014. Statistical Bulletin, Abuja, Nigeria.

Eregha, P.B. and E.P. Mesagan, 2017. Energy consumption, oil price and macroeconomic performance in energy-dependent African countries. Applied Econometrics, 46(2): 74–89.

Haider, A., Q.M. Ahmed and Z. Jawed, 2013. Determinants of energy inflation in Pakistan: An empirical analysis. Pakistan Development Erview, 53(4): 491-504.

He, L., H. Ding, F. Yin and M. Wu, 2016. The impact of relative energy prices on induatrial energy consumption in China: A consideration of inflation cost. Springerplus, 5(1001): 1-21.Available at: https://doi.org/10.1186/s40064-016-2661-z.

Ibrahiem, D.M., 2018. Road energy consumption, economic growth, population and urbanization in Egypt: Cointegration and causality analysis. Environment, Development and Sustainability, 20(3): 1053-1066.Available at: https://doi.org/10.1007/s10668-017-9922-z.

Iyke, B.N., 2014. Electricity consumption, inflation, and economic growth in Nigeria: A dynamic causality test. MPRA Paper No 57818.

Iyke, B.N. and N.M. Odhaimbo, 2014. The dynamic causal relationship between electricity consumptionand economic growth in Ghana: A trivariate causality model. Managing Global Transitions, 12(2): 141-160.

Jongwanich, J. and D. Park, 2008. Inflation in developing Asia: Demand-pull or cost-push? Asian Development Bank Economics and Research Department Working Paper Series No:121.

Josheski, D., M. Magdinceva-Sopova and Z. Sovreski, 2014. Energy consumption, economic development and prices: Time series evidence in CESEE countries. Available from http://eprints.ugd.edu.mk/9704/1/SSRN-id2420112.pdf [Accessed 15.07.2018].

Kirkpatrick, C.H. and F.I. Nixon, 1976. The origins of inflation in less developed countries: A selective survey. Manchester: The Manchester University Press.

Kraft, J. and A. Kraft, 1978. Onthe relationship between energyand GNP. Journal of Energy and Development, 3(2): 401–403.

Li, K. and B. Lin, 2015. How does administrative pricing affect energy consumption and CO2 emissions in China? Renewable and Sustainable Energy Reviews, 42: 952-962.Available at: https://doi.org/10.1016/j.rser.2014.10.083.

Moradkhani, N., Z.A. Rashid, T. Hassan and A.M. Nassir, 2010. The impact of increasing energy prices on the prices of other goods and household expenditure: Evidence from Malaysia. Available from https:// www.iioa.org.991-20100424051.

Musa, A.S., 2014. An econometric investigation of the demand for petroleum products in Nigeria. International Journal of Economics, Commerce and Management, 2(11): 1-14.

Mustapha, A.M. and A.M. Fagge, 2015. Energy consumption and economic growth in Nigeria: A causality analysis. Journal of Economics and Sustainable Development, 6(13): 42-53.

Narayan, P.K. and R. Smyth, 2005. The residential demand for electricity in Australia: An application of the bounds testing approach to cointegration. Energy Policy, 33(4): 467-474.Available at: https://doi.org/10.1016/j.enpol.2003.08.011.

Nkoro, E. and A.K. Uko, 2016. Autoregressive distributed lag (ARDL) cointegration technique: Application and interpretation. Journal of Statistical and Econometric Methods, 5(4): 63-91.

Noyola, V.J., 1956. Economic development and inflation in Mexico and other Latin American countries. Investagacion Economica, 16(4): 603-649.

Onakoya, A.B., A.O. Onakoya, O.A. Jimi-Salami and B.O. Odedairo, 2013. Energy consumption and Nigerian economic growth: An empirical analysis. European Scientific Journal, 9(4): 25-40.

Onwioduokit, E.A. and O. Adenuga, 2000. Determinants of the demand for petroleum products in Nigeria. CBN Economic and Financial Review, 38(2): 33-57.

Parker, M., 2017. Global inflation: The role of food, housing and energy prices. European Central Bank Working Paper Series No 2024, 1-40.

Perron, P., 1997. Further evidence on breaking trend functions in macroeconomic variables. Journal of Econometrics, 80(2): 355-385.

Pesaran, M.H. and Y. Shin, 1999. An autoregressive distributed lag modeling approach to cointegration analysis. In: Storm, S. (Ed.), Econometrics and Economic Theory in the 20th Century, The Ragnar Frisch Centennial Symposium, Cambridge, Cambridge University Press.

Pesaran, M.H., Y. Shin and R.J. Smith, 2001. Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3): 289-326.

Rehman, A., 2014. Relationship between energy prices, monetary policy and inflation; A case study of South Asian Economies. Journal of Central Banking Theory and Practice, 3(1): 43-58.Available at: https://doi.org/10.2478/jcbtp-2014-0004.

Saidi, K. and S. Hammami, 2014. Energy consumption and economic growth nexus: Empirical evidence from Tunisia. American Journal of Energy Research, 2(4): 81-89.Available at: https://doi.org/10.12691/ajer-2-4-2.

Sama, M.C. and N.R. Tah, 2016. The effect of energy consumption on economic growth in Cameroon. Asian Economic and Financial Review, 69(9): 510-521.

Schultz, C.L., 1959. Recent inflation in the United States, In: Employment, growth and prices. Joint Economic Committee, U.S. Congress.

Stuber, G., 2001. The changing effects of energy-price shocks on economic activity and inflation. Bank of Canada Review, 2001(Summer): 3-14.

Sunkel, O., 1960. Inflation in Chile: An unorthodox approach. International Economic Papers, 10(3): 6242-6271.

Totonchi, J., 2011. Macroeconomic theories of inflation. A Paper Presented at International Conference on Economics and Finance Research IACSIT Press, Singapore.

Zhang, F., 2015. Energy price reform and household welfare: The case of Turkey. The Energy Journal, 36(3): 71-95.Available at: https://doi.org/10.5547/01956574.36.2.4.

APPENDIX

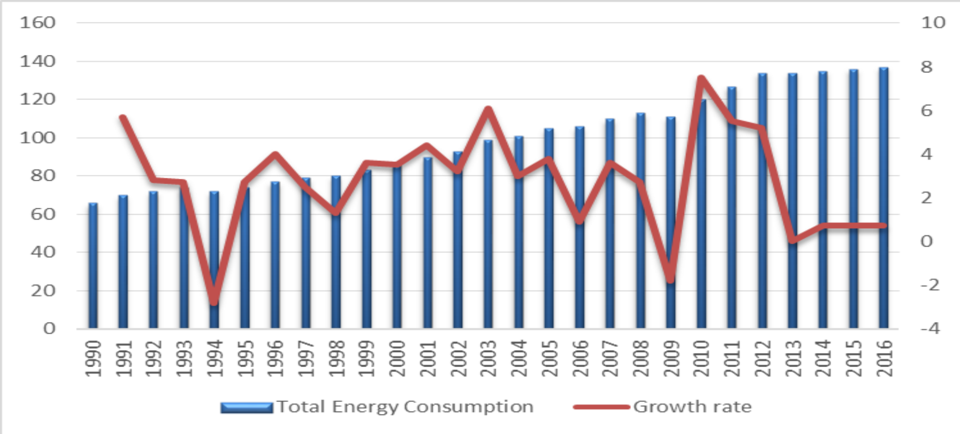

Figure-1. Total energy consumption in Nigeria and its growth rate (1990-2016).

Table–A3. Data used for the study.

Years	Inflation	PMS	DPK	AGO	NGAS	MS	GE
1980	16.1	2863.35	1201.83	1944.11	38	13.04	10.02
1981	17.4	3596.17	1385.29	2285.88	76	14.47	11.41
1982	6.9	4043.91	1485.89	2439.99	50	15.79	11.92
1983	38.8	4181.44	1845.76	2518.31	81	17.69	9.64
1984	22.6	3981.98	1749.59	2347.67	97	20.11	9.93
1985	5.5	3976.76	1735.71	2155.05	108	22.3	13.04
1986	13.7	3621.52	1923.02	1851.07	116	23.81	16.22
1987	9.7	3656.85	2068.48	1721.14	131	27.57	22.02
1988	61.2	3889.86	2157.9	1900.6	133	38.36	27.75
1989	44.7	4410.72	2392.8	2000.42	166	45.9	41.03
1990	3.6	4366.3	2273.37	2382.79	131	52.86	60.27
1991	23	4368.71	2273.99	2383.8	168	75.4	66.58
1992	48.8	4400.05	1741.05	1868.2	173	111.11	92.8
1993	61.3	5336.35	2256.95	3367.73	178	165.34	91.23
1994	76.8	5640.01	1627.34	2310.35	161	230.29	160.89
1995	51.6	4129.37	1445.54	2266.4	183	289.09	248.77
1996	14.3	3985.14	1633.72	2265.11	193	345.85	337.22
1997	10.2	3961.78	1640.54	2650.86	207	413.28	428.22
1998	11.9	3530.19	1266.37	1809.92	208	488.15	487.11
1999	6.6	3153.59	1217.38	1591.34	219	628.95	947.69
2000	14.5	4798.6	1194.92	2210.74	238	878.46	701.05
2001	16.5	5896350	1648724	2682284	219	1269.32	1018
2002	12.1	6475736	1488444	2404216	225	1505.96	1018.18
2003	23.8	6384127	1145093	2288025	301	1952.92	1225.99
2004	10	6073330	1132880	1437457	329	2131.82	1426.2
2005	11.6	9572014	2164001	2361481	366	2637.91	1822.1
2006	8.2	8846929	2073820	1358199	386	3797.91	1938
2007	5.4	8859802	535098.1	1384956	374	5127.4	2450.9
2008	11.6	7206729	1949837	1273203	433	80008.2	3240.82
2009	12.5	6876577	1898722	648416.9	348	9411.11	3452.99
2010	13.7	9090470	2996467	1336361	178	11034.94	4194.58
2011	10.9	8042354	2869296	1750465	191	12172.49	4712.06
2012	12.2	8391032	3123279	1013223	505	13895.39	4605.39
2013	8.48	7822127	3691371	1113305	554	15160.29	5185.32
2014	8.06	6913444	3127256	551338	569	17679.29	4587.39
2015	9.02	8059131	1947747	247189	571	18901.3	4988.86
2016	18.55	10998373	770146	664903	577	21607.88	5160.74

Source: CBN Statistical Bulletin, 2066, 2014, 2006; NNPC Statistical Bulletin various Issues; BP Statistical Review of World Energy, 2017

Note: Ms, Ge in Naira Billion;Oil consumption measured in million tones of oil equivalent.

Table–A4. Data used for the study.

Years	Inflation	Pmsprice	Dpkprice	Agoprice
1980	16.1	0.15	0.104	0.1
1981	17.4	0.15	0.104	0.1
1982	6.9	0.2	0.104	0.1
1983	38.8	0.3	0.104	0.1
1984	22.6	0.3	0.104	0.1
1985	5.5	0.39	0.105	0.11
1986	13.7	0.39	0.105	0.29
1987	9.7	0.42	0.11	0.29
1988	61.2	0.6	0.15	0.29
1989	44.7	0.6	0.1575	0.35
1990	3.6	0.7	0.4	0.5
1991	23	0.7	0.5	0.5
1992	48.8	5	0.5	0.55
1993	61.3	3.25	2.75	3
1994	76.8	11	6	9
1995	51.6	11	6	9
1996	14.3	11	6	9
1997	10.2	15	6	9
1998	11.9	15	6	9
1999	6.6	20	17	19
2000	14.5	22	17	21
2001	16.5	26	17	21
2002	12.1	30	24	26
2003	23.8	40	38	38
2004	10	49	48	48
2005	11.6	52	50	60
2006	8.2	64.5	50	60
2007	5.4	75	50	60
2008	11.6	75	50	60
2009	12.5	65	50	145
2010	13.7	65	50	145
2011	10.9	65	50	145
2012	12.2	97	50	145
2013	8.48	97	50	145
2014	8.06	87	50	145
2015	9.02	145	50	145
2016	18.55	145	50	145

Source: Central Bank of Nigeria (2016; 2014; 2006) NNPC Statistical Bulletin various Issues.
Note: Energy Price expressed in naira units.