International Journal of Economics, Commerce and Management
United Kingdom Vol. II, Issue 11, Nov 2014
http://ijecm.co.uk/ ISSN 2348 0386

AN ECONOMETRIC INVESTIGATION OF THE DEMAND FOR PETROLEUM PRODUCTS IN NIGERIA

Musa, Adewunmi Sulaimon
Department of Economics, University of Ibadan, Ibadan, Nigeria
malonenas@yahoo.com

Abstract

The demand for petroleum products in Nigeria (especially the PMS and Diesel) has been on the rise for nearly over a quarter of a century ago. It is against this bourgeoning demand that this study investigates the demand for petroleum products in Nigeria. The study employed the Error Correction Model to examine both the short and long dynamics of petroleum in Nigeria. The paper therefore found that price and income elasticity of demand for petroleum product have long run impact on the energy demand in Nigeria. Although, there are short run fluctuations, the impact of the elasticities on energy demand does not exist in the short run. It is however the recommendation of this study that energy policy in Nigeria should be towards providing long term solution to energy problems. Also, policies geared toward diversifying the country's alternative sources of energy should be formulated and ultimately implemented. It is also the recommendation of this study that the government should restructure and reposition the power sector and other alternative sources of energy so as to reduce the demand pressure on petroleum products which will help foster future growth and energy security in the country.

Keywords: Demand, Elasticities, Error Correction Model, Income, Petroleum Products, Price

INTRODUCTION

Nigeria is the largest producer of crude oil in Africa and the sixth largest among the OPEC members (OPEC, 2008). The petroleum sector, over the last four decades, has been playing a dominant role and occupies a strategy position in the Nigerian economy (Azaiki and Shagari, 2007). This has culminated in the sector not only being the mainstay of the nation's economy, but also a major source of foreign exchange earnings. With proven reserves of roughly 23 billion barrels of crude oil, the country is the tenth oil-richest nation on planet earth (United State Energy Information Administration, 2007). Petroleum sector, in spite of various laudable attempt

by the government to diversify the economy still accounts for about 90 per cent of the country's foreign exchange, accounts for80 % of government revenue, and contributes well over 20% to the country's Gross Domestic Product (GDP) (US EIA, 2012; World Bank, 2012; IMF, 2012).

The demand for petroleum products in Nigeria (especially the PMS and Diesel) has been on the rise since the early 70's when the "golden water" was first discovered in commercial quantities (Iwayemi, Adenikinju, and Babatunde, 2010). This continuous rise has been due largely to (not until recently), the price of petroleum products which have been heavily subsidies in order to achieve some national objectives, as well as to protect the domestic consumers from the stochastic nature of the international crude oil market. The growth of GDP per capita as a result of the oil boom is another major factor that has contributed to the rise in the domestic demand of petroleum products. Industrial expansion through the influx of foreign direct investment has resulted in demand for energy, increase in demand for vehicles has also resulted in increase in demand for fuel, the epileptic nature of electric power has also increases the demand for private household generator, as well as for firm which has also heighten the demand for petroleum products. Lastly, the ever growing population and extension the adult population has also contributed to the increase in demand for petroleum products in Nigeria.

In spite of the huge market presence of the country in the world oil market, the country still sometimes struggle to meet domestic demand for petroleum. This has been largely attributed to dilapidated, decayed states of the country's refineries, lack of political will to have functioning refineries, the problem s of insecurity in the Niger Delta, and the most recently is the Boko Haram epidemic that is rocking the nation. This is putting serious pressure on the oil production and distribution in the country. The key questions that however arise of this are:

- What are the dynamics and structure of the demand for petroleum products in Nigeria?
- What are the of the price and income elasticities of demand of petroleum products in Nigeria?
- In what ways will this dynamics shape direction of energy policies in Nigeria?

The dynamics of the petroleum sector in the Nigerian economy has made the study of the demand for petroleum products in the country highly imperative (Sulaimon Said, 2009; Iwayemi et al, 2010). As such, estimating the dynamics of petroleum products demand is pivotal in enriching our understanding of consumers' responsiveness to change in relative energy prices and the level of income, since the impact the oil boom of the early 70's and the oil glut of the early 80's has on the economy is highly documented (Gate, 1993, Dahl, 1994; Liu, 2004; Akinboade et al, 2008; Iwayemi et al, 2010). The estimates of the dynamics of energy consumption is highly fundamental to one, our knowledge of the country's (projected) future energy demand, two, how these estimates shape the direction of future energy policies in

Nigeria, and lastly, the fact that our knowledge of the dynamics of petroleum products demand parameters is also highly fundamental to a more informed and successful energy policy making and implementations. This therefore makes the study significant because it examines the energy demand in Nigeria from another dimension in terms of scope and methodology.

The key objective of this paper to model and estimate the dynamics of petroleum products demand in Nigeria, with special focus on the Petroleum Motor Spirit (PMS) and Automotive Gas and Oil (AGO). This choice of these products is burn out of the fact that, together with Household Kerosene, they constitute 90 per cent of petroleum products consumed in Nigeria as shall see in the next section. The specific objectives of this paper include:

- To examine whether there exist a long run relationship between petroleum products demand and the price of petroleum products and the level of income.
- To examine its short run dynamics of this relationship.
- To examine the various policy implications of this dynamics.

This study is the first rigorous econometric examination of the energy demand in Nigeria at the aggregate level because it employed the multivariate co-integration technique in estimating the dynamics of energy demand in Nigeria. The study also widens the scope of the study from 1980 to 2012.

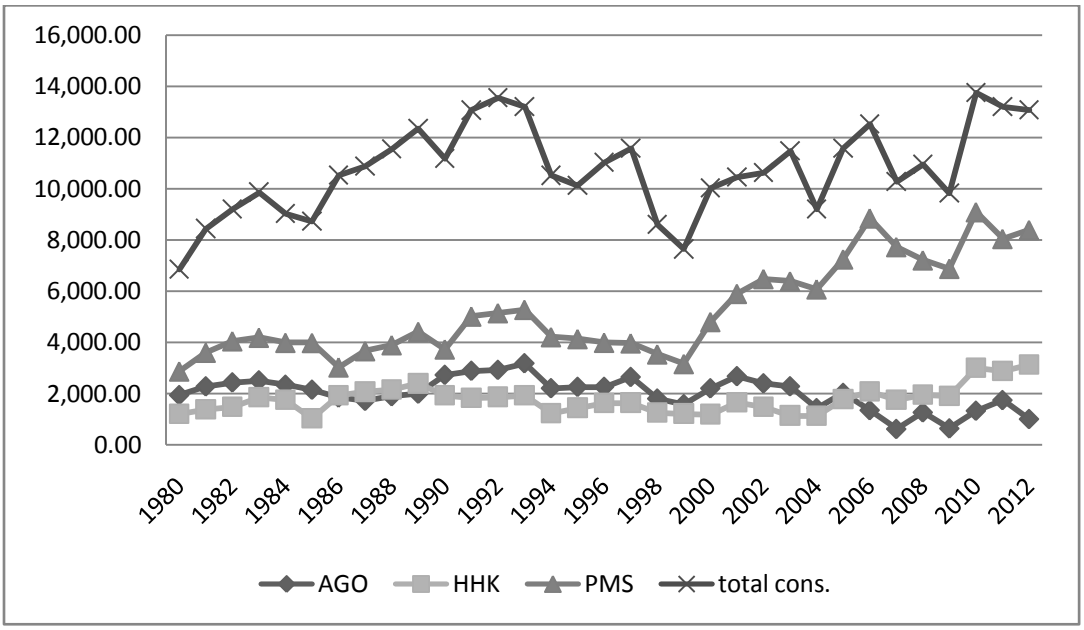
The rest of the paper is as follows; section two examines the various background and stylized facts on the dynamics of energy demand in Nigeria. Section 3 looks at the review of various theoretical, empirical and methodological literatures associated with the study. Section 4 discusses the analytical framework on which the study is predicated as well as the modeling of the energy demand equation. While section 5 deals with the various estimation issues that is, the results of estimations and its policy implications, section 6 then concludes the study.

BACKGROUND AND STYLIZED FACTS OF ENERGY DEMAND AND THE NIGERIAN ECONOMY

Structurally, transport fuels and diesel constitutes for the bulk of oil consumption in Nigeria, with motor gasoline (petrol/PMS), automotive gas oil (diesel/AGO) and household kerosene (ATK) accounting for approximately 90% of total petroleum products consumption in 2012 alone. Based on data from the NNPC and the International Energy Agency (IEA), this structure has not changed significantly over the last two decades. Any significant growth in demand is most likely to come from the transport sector; mainly from PMS use (motor gasoline alone accounts for about 70% of the petroleum products demand spectrum). It is therefore imperative at this junction to examine the various dynamics and trends of petroleum products consumption as well

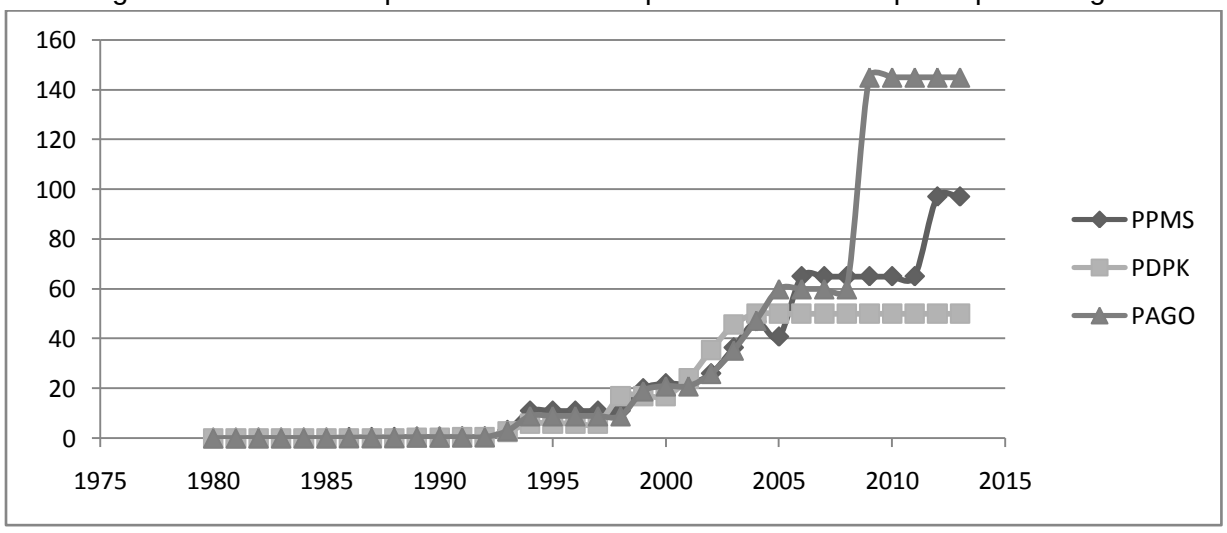
as its prices and the level of economic activities in the country. This is presented in Fig. 1 and 2 respectively.

Figure 1: Petroleum Products Consumption Trends in Nigeria



Sources: NNPC, 2013; PPPRA, 2013.

Fig.2: The trend of the prices of Petroleum products and GDP per capita in Nigeria.



Source: PPPRA, 2013.

From Fig. 1, we observe the trend of petroleum products consumption both at the aggregate and the disaggregate level. Between 1980 and 1985, petroleum products consumption has risen on the average by 7.19 per cent representing 11.53 per cent share of African consumption and 0.269 per cent of world consumption in 1980. In the SAP era, consumption deep marginally with

a -6.171 per cent representing 11.45 per cent of the share of Africa and 0.337 of world consumption, this was as a result of the deregulation of the downstream sector consumption deep marginally with a -6.171 per cent representing 11.45 per cent of the share of Africa and 0.337 of world consumption. By the early 90's, petroleum reaches an all time height representing 12.44 per cent of Africa consumption and 0.401 per cent of the world's consumption in 1993. This upward trend continues with minima deep in the late 90's and then picked up again at the turn of the new millennium. By 2011, petroleum consumption also reaches the all time height with 18.08 per cent growth rate, but also deep marginally in 2012. Several reasons have been attributed to this continuous upsurge in petroleum products consumption over the years. The price development over this period partly provides an answer to the consumption pattern observed above. Until recent times, in an attempt to achieve national objectives, the prices of oil products as well as energy products have been heavily subsidized, this according to the United State Energy International Administration's report on Nigeria is 100 per cent subsidy prior to deregulation.

Another explanation for the upward trend observed in petroleum products consumption relates to the developments in real per capita national income proxy by real GDP per capita. The real GDP per capita has been on the rise since the early 80,s although it deepen during the SAP era, and picked up again in the post SAP period and has continue to rise, it stood at $1,052.34 in 2013.

Interestingly, the continuous rise in petroleum demand has been partly attributed to the low relative prices of these petroleum products prior the SAP era (Iwayemi et al, 2010). Unfortunately, figure shows that the prices of these products have been rising over time although steady in some numbers of years.

Another important development concerns the pattern to domestic petroleum demand in Nigeria. Gasoline continues to dominate the composition of total demand. Its share increased from 42 per cent in 1980 to 50.5 per cent in 1997 and 71.03 per cent in 2006, and the year 2010, the figure stood at 66.1 per cent. The figure now stood at 64.13 per cent in 2012. The share of diesel however fell from 28.4 per cent in 1980 to 9.24 per cent in 1990 and rose to 22.05per cent in 2000. The figure stood at 7.74 per cent at the end of 2012. This development reflects the impact of rising prosperity of the oil boom period on the rapid acquisition of vehicles and the increasing use of private electric generators by the Nigerian household and Firms as back up in response to the epileptic nature of power supply from the state-owned monopoly (now debunked) Power Holding Company of Nigeria (PHCN) (Iwayemi et al,).

REVIEW OF LITERATURE

Since the oil price shock that engulfed the world in the early 70's and 80's, numerous literature has sprang up on the demand for petroleum products using either the aggregate analysis of petroleum demand in relation to prices and income, or at the disaggregate level that is the use of the simultaneous equation approach (Iwayemi et al). Although, research on the demand for petroleum product is flooded for the developed and OECD countries, little attention has been placed on research on this subject in Sub Saharan African countries. Irrespective of whether is conducted for developed, developing, regional or a carter (e.g OPEC), methodological and scope of study, the result of estimation is more or less the same .The only difference has always being in terms of the magnitude of elasticities of the parameters and this is due sometimes to the methodology employed in estimation (Macatangay, 2013). A common characteristic of petroleum products demand like other energy demand studies is that there is little consistency in terms of methodology, assumptions as well as the nature of data used in each study. Table 1 below shows the schematics of the literature reviewed.

Table 1: Review of literature on the demand for petroleum products for developing countries

Authors	Estimation Techniques	Country/Region/Carter	Price Elasticity	Income Elasticity
Dahl (1994)	Survey	Developing Countries	-0.36	2.20
Rao and Parikh (1996)	Two-step co integration	India	$-0.03\ to\ -0.25$	$0.02, -0.75$
Eltony and Mutairi (1995	Two-step co integration	GCC countries	-0.46	-0.92
Alfaris (1997)	Two-step co integration	GCC (OPEC members) countries	-0.11	-0.29
Hunt et al (1999)	Two-step co integration	Honduras	-0.24	1.58
Ramanathan (1999)	Two-step co integration	India	-0.32	2.58
Dahl and Kurtubi (2001)	Two-step cointegration	Indonesia	-0.59	1.35
Dahl and Kurtubi (2001)	Partial adjustment OLS	Indonesia	-0.68	1.34
Belhaj (2002)	OLS	Morocco	-0.30	0.50
Alhamadian et al (2007)	Structural Time series model	Iran	$-0.63, -0.74$	1.25
Akinboade et al (2008)	ARDL/Bound co integration	South Africa	-0.47	0.36
Suleiman and Sa'ad (2008)	Structural Time series model	Indonesia & S. Korea	-0.16	0.47
Iwayemi et al (2010)	Multivariate co integration	Nigeria	-0.106	0.660
Macatangay R., (2013)	OLS	Malawi	0.3988	-0.3688

In spite of the enormous importance of energy in today's world, especially in developing economies particularly Nigeria, few studies on energy demand have been done on developing countries especially Nigeria whose economy life wire depends on crude oil, and whose petroleum consumption in recent years is threatening her future energy security. Apart from Bayo and Adegbulugbe (1987), and Iwayemi et al (2010), no other work has been done on the petroleum products demand analysis in Nigeria. The work available on this subject however, either fell short of scope or methodology and as such it is this research gap that this study intends to fill.

Dahl (1994) using a survey to examine the demand for petroleum products in developing countries found the price elasticity of petroleum products demand to be -0.36 and the income elasticity of demand to be 2.20, this suggested that the demand for petroleum products is more responsive to changes in income than changes in real prices Suleiman (2009). Rao and Parikh (1996) employed the two-step co integration to study the energy demand in India. They found the price and income elasticity of energy demand for India to be $-0.03\ to\ -0.25$ and $0.02\ to\ -0.75$ respectively. Using similar methodology to examine the demand for petroleum products in GCC (OPEC members) countries, Alfaris (1997) found that the price and income elasticity to be $-0.11\ and\ -0.21$ respectively. Also, Ramanathan (1999) examine the demand for oil India using the two-step co integration. He found the price and income elasticity of oil demand in India to be $-0.32\ and\ 2.58$ respectively. Hunt et al. (1999) employed the Engel–Granger technique to data for Honduras and reported the long-term price elasticity of gasoline demand to be -0.24 and long-term income elasticity to be 1.59. In studies of Indonesia, Dahl and Kurtubi (2001) used the Engel–Granger (two-step) and partial adjustment models to estimated demand for petroleum products in Indonesia .Under the former, long-term price and income elasticities were -0.59 and 1.35. Using a partial adjustment model for the same country, they estimated a long-term price elasticity of 1.34 and a price impact of -0.68. Akinboade (2008) studied the demand for petroleum products in South Africa using the ARDL or the Bound co integration methodology. He found the long-term price elasticity of petroleum product demand to be -0.47, while the long-term income elasticity of demand to be 0.36. Sa'ad (2008) employed the structural time series model to estimate oil demand both in Indonesia and South Korea, then found the price and income elasticity of oil demand to be $-0.16\ and\ 0.47$ respectively. Iwayemi et al (2010) examined the petroleum products demand elasticities for Nigeria using the multivariate co integration approach. They found the long run price and income elasticity of demand to be $-0.106\ and\ 0.66$ respectively. Lastly, we review the work done recently on the demand for petroleum products in Malawi. Using an Ordinary Least Square approach

Macatangay (2013) found the price elasticity of demand to be 0.398, while the income elasticity stood at -0.368. This study will therefore proceed to examine the analytical framework of this study and then present the petroleum products demand models for estimation.

ANALYTICAL FRAMEWORK

The build block for demand analysis sees income, own price, prices of complements and substitutes (factoring in consumer expectations of price changes), and consumer preferences determine demand (Bhattachanya and Blake, 2009).

$D_{t=}\ \alpha_0 + \alpha_1 P_t + \alpha_2 Y_t + \alpha_3 P_{st}$ ..... (1)

Furthermore, petroleum demand is a derived demand, since consumers gain utility from petroleum products only in combination with other inputs, like cars, generators and cooking stove for instance. Energy demand function is therefore formulated to reflect the prices and income of petroleum products. We therefore apply the lagged value of the dependent variable (i.e the petroleum demand) in the equation and also take the logarithm of the equation to capture the "good fit" of the data and enables direct comparison to previous studies(Hughes et al, 2008). Given that the petroleum demand function is given as:

$PD_t = \ \alpha_0 + \alpha_1 P_t + \alpha_2 Y_t + \ \mu_t$ ..... (2)

Where PD_t represents Petroleum products demand, P_t is the aggregate price of petroleum product, while Y_t is the level of income (as measured by the GDP per capita). $\alpha_1 and\ \alpha_2$ are the parameter estimates. Taking the log of eqn (2) and introducing lagged value of the endogenous variable, we have:

$\log PD_t = \alpha_0 + \alpha_1 \log P_t + \alpha_2 \log Y_t + \alpha_3 \log PD_{t-1} + \mu_t$ ..... (3)

PD_{t-1} is the lagged value of the endogenous variable. We adopt the dynamic model because it captures the complex process of adaption of the changes in prices and income. Among the common lag structure applied in similar studies include Sterner (1991), Cooper (2003), Bhattachanya and Blake (2009), Iwayemi et al (2009). The rationale for such specification is usually derived from specific stock adjustment mechanism, habit persistence or adaptive expectations (Engsted and Bentzen, 2001). We therefore present the demand function for each of the petroleum products.

$\log DPMS_t = \alpha_0 + \alpha_1 \log PPMS_t + \alpha_2 \log Y_t + \alpha_3 \log DPMS_{t-1} + \mu_t$ ..... (4)

$\log DAGO_t = \alpha_0 + \alpha_1 \log PAGO_t + \alpha_2 \log Y_t + \alpha_3 \log DAGO_{t-1} + \mu_t$ ..... (5)

$\log DHHK_t = \alpha_0 + \alpha_1 \log PHHK_t + \alpha_2 \log Y_t + \alpha_3 \log DHHK_{t-1} + \mu_t$ ..... (6)

Where $DPMS_t$the aggregate demand for petroleum product is, $PPMS_t$ is the weighted average of petroleum products, $DPMS_{t-1}$ is the lagged value of the demand for petroleum product.

The same definition applies for each of the petroleum products that is, the PMS, AGO, HHK for fuel, diesel, and kerosene respectively. The parameters, $\alpha_1 \; and \; \alpha_2$ represents the prices and income elasticity of the petroleum products demand. Therefore, we expect $\alpha_1 < 0;\ \alpha_2 > 0; \alpha_3 > 0$. The study uses data from 1980 to 2012 to analysis the petroleum product demand in Nigeria. The aggregate and the disaggregate petroleum data is obtained from the Central Bank of Nigeria (CBN), and the Nigeria National Petroleum Corporation (NNPC) Annual Abstract of Statistics. The retail (pump) prices of petroleum products are obtained from both NNPC and the Petroleum Product Pricing Regulatory Agency (PPPRA).

ESTIMATION TECHNIQUES AND RESULT PRESENTATION

The building block for any time series estimation is to examine the statistical properties of the variables used in estimation in order to avoid spurious result which might ultimately hinder statistical inferences and/or provide misleading judgement for energy policy making and implementations. We therefore begin our analysis by testing the unit root of each of the variables under study. We then proceed to check whether the variables is each of the petroleum demand function are co integrated.

The Unit-root Test

We present the results of the Augmented Dickey-Fuller (ADF) in Table 2 below:

Table 2: Unit root Test Using Augmented Dickey-Fuller (ADF) and Phillip-Perron Test.

Variables	ADF test at level	ADF test at 1st diff.	Order of Integration	Phillip-Perron at level	Phillip-Perron at 1st diff.	Order of Integration.
$\boldsymbol{logPD_t}$	0.73	-1.99^{**}	$I(1)$	-3.43^{*}	-8.67^{*}	$I(0,1)$
$\boldsymbol{logDAGO_t}$	-0.37	-6.38^{*}	$I(1)$	-0.402	-22.08^{*}	$I(1)$
$\boldsymbol{logDPMS_t}$	1.14	-5.91^{*}	$I(1)$	-4.01	-6.11^{*}	$I(1)$
$\boldsymbol{logY_t}$	0.71	-3.86^{*}	$I(1)$	-0.71	-4.07^{*}	$I(1)$
$\boldsymbol{logP_t}$	-1.42	-9.36^{*}	$I(1)$	-1.37	-9.36^{*}	$I(1)$
$\boldsymbol{logPPMS_t}$	-0.40	-3.63^{*}	$I(1)$	-0.603	-3.64^{*}	$I(1)$
$\boldsymbol{logPAGO_t}$	-0.27	-3.71^{*}	$I(1)$	-0.60	-3.67^{*}	$I(1)$

Notes: Variables are as defined in Table 2.

**Significant at 1 per cent level*

***Significant at 5 per cent level*

****Significant at 10 percent level*

From the Table 2 above, it can easily be seen that all the variables are not stationarity at level except the PP test for the total demand of petroleum products that is stationarity at level. This result is a justification that most economic variable are only stationarity at first difference (Gujarati, 2004).

Having discovered all the variables are non stationary, we then proceed to examine whether there exist a long-run relationship between the variables in each of the model. We employ the Johansen cointegration methodology to discover the number of cointegrating ranks in each of the model.

Before proceeding to test for cointegration, we must satisfy the lag length and the study employed both the Alkaike Information Criteria and the Schwarz Information and found the lag length to be one. The test for cointegrating for each show that at least each has one cointegrating vector using both the trace test and the Maximum Eigen value test. This implies that there exist long run relationships in each of the model. We can therefore proceed to estimate the long run dynamics of the demand for petroleum products in Nigeria starting with the aggregate, and then followed by each of the disaggregate demand for petroleum products.

Table 3: Long run estimates of Petroleum demand in Nigeria.

Products	Price Elasticity	Income Elasticity
Ag.Petroleum DD	$-0.0054(-0.464)$	$0.364(1.80)^{***}$
PMS Demand	$0.34(1.67)^{***}$	$1.16(4.03)^{*}$
AGO Demand	$-0.095(-1.03)$	$-0.026(-0.02)$
HHK Demand	$-0.227(-2.65)^{**}$	$3.53(2.53)^{**}$

**Significant at 1 per cent level t-statistics in parenthesis*

***Significant at 5 per cent level*

****Significant at 10 percent level*

Table 3 shows the long run price and income elasticity of demand for petroleum products in Nigeria. The results show that only the demand for petrol is significant and has the best goodness of fit. Both the price and income elasticity of demand are significant at 10 percent and 1 per cent respectively. This implies that a percentage increase in the level of income will increase the demand for fuel by 1.16 per cent. However, the price elasticity of demand for fuel is significant but wrong signed. This is a pointer to the fact the government is not much to provide alternative energy especially the epileptic nature of power supply has made people to demand fuel to power their household appliance irrespective of the growing price. At the aggregate level, the income elasticity of demand is also significant at 10 per cent, this show that the growth in the level of income has also been responsive to demand for petroleum products. However, the

price elasticity of petroleum demand, although conforms to apriori expectation, it is not significant. For both Diesel and Kerosene demand, although not significant, they are still worth reporting. The price and income elasticity of demand for diesel is $-0.095\ and\ -0.026$ respectively, while that of kerosene is $-0.227\ and\ 3.53$ respectively. This results is such a conundrum ,and it may be attributed to the fact that diesel has been in short supply and has given rise to the establishment of black market which sells over and above the equilibrium price. For kerosene, both parameters are significant at 5 per cent level, the reason can be attributed to the product still being under government subsidy and it is the most widely used product for cooking among Nigerian households. The government is not doing much to explore the general use of gas which is cheaper and allowed it to be flared away on a daily basis, it also with its environmental consequences.

Table 4: The Short- run Dynamics of the Demand for Petroleum Products

Aggregate Petroleum (Short-run) Demand Model

$$DlogDP_t = -0.009 + 0.014DlogP_t + 1.232DlogY_t + 0.04DlogP_{t-1} + 0.175DlogDP_{t-1} + 0.07DlogDP_{t-2} - 0.83ECM(-1)$$
$$(-0.76)\quad (0.90)\quad (2.042)^{**}\quad (2.19)^{**}\quad (0.84)\quad (0.38)\quad (3.40)^{*}$$

R-square	0.48	Durbin-Watson	1.98
Adj. R-square	0.32	Akaike Information Criterion	-2.839
S.E of regression	0.52334	Schwarz Criterion	-2.466
Sum of squared res.	0.0602	F-stat	2.91
Log Likelihood	50.587		

Fuel(PMS) Short-run Demand Model

$$DlogPMS_t = 0.016 - 0.06DlogPPMS_t + 0.6DlogY_t - 0.05DlogPPMS_{t-1} + 0.114DlogPPMS_{t-1} + 0.006DlogPPMS_{t-2} - 0.45ECM(-1)$$
$$(0.98)\quad (-0.73)\quad (0.79)\quad (0.08)\quad (0.52)\quad (0.23)\quad (0.04)^{*}$$

R-square	0.244	Durbin-Watson	2.03
Adj. R-square	0.20	Akaike Information Criterion	-2.389
S.E of regression	0.066	Schwarz Criterion	-2.065
Sum of squared res.	0.105	F-stat	1.29
Log Likelihood	44.03		

Diesel(AGO) Short-run Demand Model

$$DlogAGO_t = -0.085 + 0.17DlogPAGO_t + 1.1DlogY_t + 0.5DlogPAGO_{t-1} + 0.14DlogAGO_{t-1} + 0.06DlogAGO_{t-2} - 1.28ECM(-1)$$
$$(-0.83)\quad (0.36)\quad (0.23)\quad (0.97)\quad (0.54)\quad (0.44)\quad (3.77)^{*}$$

R-square	0.583	Durbin-Watson	1.94
Adj. R-square	0.456	Akaike Information Criterion	1.325
S.E of regression	0.421	Schwarz Criterion	1.695
Sum of squared res.	4.076	F-stat	4.598
Log Likelihood	-12.54		

Kerosene(HHK) Short-run Demand Model

$$DlogHHK_t = 0.021 - 0.12DlogPHHK_t - 0.3DlogY_t - 0.07DlogPHHK_{t-1} - 0.30DlogHHK_{t-1} - 1.13ECM(-1)$$
$$(0.47)\quad (-0.55)\quad (-0.157)\quad (-0.304)\quad (-3.4)\quad (10.97)^{*}$$

R-square	0.829	Durbin-Watson	0.57
Adj. R-square	0.795	Akaike Information Criterion	-0.17
S.E of regression	0.203	Schwarz Criterion	0.10
Sum of squared res.	1.034	F-stat	24.27
Log Likelihood	8.72		

Note: t-statistics in parenthesis

The short run dynamics of the determinants of petroleum products is presented in Table 4 above. It is interesting to note that at the aggregate level, the price elasticity of previous period rather that the present period is significant at 10 per cent. However, the income elasticity of petroleum is also significant in the short run. A percentage increase in the level of income will result in 1.32 per cent increase in demand. The error correction model for the aggregate petroleum demand is highly significant and reported that about 83 per cent of the disequilibrium in the previous period is eliminated in this current period. The price elasticity of the aggregate petroleum demand is neither significant nor does conform to apriori expectation, reasons for this can be tagged to the myriad of problems that has engulfed the downstream of the petroleum sector over the years. Problems ranging from corruption, importation of the products to augment domestic production, logistics issue that has hampered the efficient distribution of these products, apparent degree of hoarding to raise prices in the black market to mention few. At the disaggregate level, none of the variables are significant except for the error correction model of all the disaggregate models and the previous demand of kerosene. For the PMS, although not significant, all the parameters do conform to apriori expectation. The ECM of the Fuel demand reported that about 4 per cent of the disequilibrium in the previous is eliminated in the current period, and for the diesel and kerosene, their ECM shows that about 128 per cent and 113 per cent of the disequilibrium in the previous period is adjusted in the current period. With this caveat in mind, several policy implications can be drawn this analysis, these are:

- Policy should be geared towards meeting ever-increasing domestic demand for petroleum products that will encourage the flow of petroleum products and that includes resolving the Niger-Delta crisis, and also discourage the hoarding of petroleum products that normally creates artificial scarcity. The fact that none of the determinants of the disaggregated (short run) petroleum demand is significant is a pointer to the fact that there are still some distortions that creates disequilibrium in the domestic oil market.
- The fact that income is an important factor in petroleum demand at the aggregate level ia also a pointer that the increasing demand for petroleum product goes hand in glove with the level of income. If government intends to improve the level of income in the country, energy policy should also be directed at improving energy need of the country.
- The fact that almost of all the parameters in the model have a long run impact is a pointer to the fact that energy policy might not be generally successful in the short run and as such, energy policy should be directed to achieve a long term target.
- Fuel consumption has been highly dominant as shown both in the background to this study and empirical analysis also attest to that fact. This increase in fuel consumption has been largely due to the use of power generating set as an alternative source of power by

household and firms, since the state power is not reliable. This demand will continue rise as long as income irrespective of price as this study have shown. Policy therefore should be geared towards restructuring and repositioning the power sector and other alternative sources of energy which will ease the demand pressure of petroleum products and a guaranteed future energy security.

CONCLUSION

This study examined the price and income elasticity of energy demand in Nigeria both at the aggregate level and by product type over the last 3 decades from 1980 to 2012. The study employed the multivariate cointegration approach to estimate the price and income elasticities. The paper there found that price and income elasticity of demand for petroleum product have long run impact on the energy demand in Nigeria. Although, there are short run fluctuations, the impact of the elasticities on energy demand does not exist in the short run. It is however the recommendation of this study that energy policy in Nigeria should be towards providing long term solution to energy problems. It is also recommended that since the level seems to have both short and long run impact on aggregate energy consumption, policy towards diversifying the source of energy should be formulated and ultimately implemented. However, there are significant areas of this that are yet to be exploited in Nigeria both in terms of methodological approach and aggregate petroleum demand in Nigeria. (see Akinboade et al., 2008 and Iwayemi et al., 2010). Finally, it is the recommendation of this study that the government should restructure and reposition the power sector and other alternative sources of energy so as to reduce the demand pressure on petroleum products which will help foster future energy security in the country.

REFERENCES

Akinboade, A.O., et al., (2008). The Demand for Gasoline in South Africa: An empirical analysis using co-integration techniques. Energy Economics 30 (6), 3222–3229 (November 2008).

Baker, P., Blundell, R.W., Micklewright, J.(1987). Modelling Energy Demand and Household Welfare using micro-data. CEPR Discussion Papers with number 173.

Central Bank of Nigeria, (2006). Central Bank of Nigeria Abstract of Statistics, (Statistical Bulletin), vol.14. Central Bank of Nigeria, Abuja.

Chakravorty, U., Fesharaki, F., Zhou, S. (2000). Domestic Demand for Petroleum in OPEC countries. OPEC Review 24, 23–52.

Dahl, C. (1994). A Survey of Oil Product Demand Elasticities for Developing Countries. OPEC Review 18, 47–86.

Dahl, C., Kurturbi, (2001). Estimating Oil Product Demand in Indonesia using a cointegrating error correction model. OPEC Review 25, 1–25.

Dayo, F.B., Adegbulugbe, A.O.(1987). Oil Demand Elasticities in Nigeria. Energy Journal 8 (2), 31–41.

Dickey, D.A., Fuller, W.A.(1979). Distribution of the Estimators for Autoregressive Time-series with a Unit root. Journal of the American Statistical Association 74, 427–431.

Eltony, N.(1994).The Demand for Gasoline in Kuwait. OPEC Review, 291–296.

Eltony, N.M., Al-Mutairi, N.H.(1995). Demand for Gasoline in Kuwait. An Empirical Analysis using Co-integration Equations. Energy Economics 17(3):249–253.

Energy Information Administration,(2013). Country Analysis Briefs- Nigeria. /www.eia.doe.gov.

Gately, D.(1992). The Imperfect Price-reversibility of world oil demand. Energy Journal 14 (4): 163–182.

Gately, D., Streifel, S.S. (1997). The Demand for Oil Products in Developing Countries. World Bank Discussion Paper No. 359.

Gujarati, D. N. (2003), Basis Econometrics. New York, McGraw-HillIwayemi, A., Adenikinju A. and Iwayemi, A; Adenikinju, A.; Babatunde, M. A.(2010) Estimating Petroleum Products Demand in Nigeria: A Multivariate Co-integration Approach. Energy *Economics 32 (2010), 73-85*

Johansen, S.(1991). Estimating and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. Econometrica 59 (6), 1551–1580.

Johansen, S., Juselius, K.(1990). “Maximum Likelihood Estimation and Inferences on Cointegration—with applications to the demand for money.” Oxford Bulletin of Economics and Statistics 52, 169–210.

Liu, G.(2004). Estimating Energy Demand Elasticities for OECD countries: A Dynamic Panel Data Approach. Discussion Papers No. 373, March. Statistics Norway, Research Department.

Ramanathan, R. (1999). Short-and long-run elasticities of gasoline demand in India: an empirical analysis using cointegration techniques. Energy Economics 21 (4), 321–330.

Suleiman, S. and Muhammad, S. (2012), Price and Income Elasticities of Demand for Oil Products in African Member Countries of OPEC: A Cointegration Analysis. Available at http://mpra.ub.uni-muenchen.de/37390/ (last visited on 4th April, 2012)