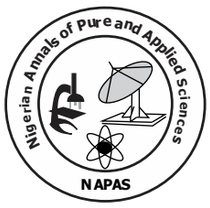

Statistical Analysis of the effect of Changes in Pump Price on Consumption of Petrol in Owerri Municipal, Imo State Nigeria 1973-2016

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Abstract
Transportation fare increases when motorists pay more for petrol and this occurs even when the case is marginal. In cases where the cost of petrol doubled, reports have shown that the increase in transportation was astronomical.

This in turn affected everything else, including school fees and house rent. The present study considered statistical analysis of the effect of changes in pump price on consumption of petrol in Owerri municipal, Imo State Nigeria 1973-2016. The study statistically checked whether the number of individuals who buy petrol will decrease irrespective of need, if the price of petrol increases. The population of the study was made up of residents of Owerri municipal who buy and use fuel. A sample of 100 individuals were taken in which 67 were males and 33 were females. A pretest was conducted and the outcome yielded r = 0.78 indicating degree of consistency and reliability. Primary and secondary data were collected and used for the study. Regression model was used to confirm formulated hypothesis. Findings revealed that pump price determines consumption rate of petrol. The study recommends that government should deregulate the price of petrol to favour economy of consumers and facilitate the construction of domestic refineries.

Keywords: Transportation fare, Astronomical, Reliability, Regression model, Deregulate.

Introduction

For a long period, the oil industry has remained the most important industry to the economy of Nigeria (Bobai, 2012). Unquestionably, it currently provides the highest foreign exchange earnings and revenue required for socio-economic and political development in the country. The major part of Nigerian crude oil is marketed unrefined. When refined, the products range from petrol to heavy liquids used for tarring roads. Most economic and social activities are usually associated with high dependency on petrol and everything appears to be linked to it in Nigeria. Unfortunately, prices of petrol have been rising indiscriminately since the 1970's in Nigeria (Orlu, 2017). Rising petrol prices has been one of the hottest topics in Nigeria and it causes economic disorderliness any time it occurs (Sanni, 2014; Gatawa and Abdullahi, 2017; Orlu, 2017). Evidences have shown that rises in petrol price remains a major problem that should be sustainably addressed in Nigeria (Ocheni, 2015).

Nigeria apparently operates a monoculture economy- heavy dependence on crude oil. A small change on the price of petrol has a large irreversible effect on prices of commodities. This obnoxious characteristic adversely affects all other sectors of the Nigerian economy. According to Bobai (2012), instability of price of oil products is worse in Nigeria compared to other countries of the world. Runl (2010) has stressed that Nigeria exports practically nothing but oil. This case in point is unfortunate because the author concludes that oil has made Nigerians poor. Arinze (2011) recorded that increases in fuel price increases inflation rate and recommended that more resources should be explored to diversify the Nigerian economy. Apart from inflation, hike in petrol prices in Nigeria summarily culminates in high cost of living, disequilibrium in income distribution and alarming increase in the prices of goods and services. These problems appear to stress the well-being of most Nigerians, but what is not clear is whether increases in the pump price of petrol would ultimately reduce consumption rate of the product irrespective of need. Rise in price of petrol can be related to changes in consumption patterns of the product. Therefore, effect of changes in the pump price of petrol on consumption rate deserves routine analysis. This is because, understanding how the market and people will likely respond to changes in petrol prices is crucial to many areas such as forecasting, policy development and funding. The objectives of this study were to conduct an econometric analysis of the effect of changes in pump price of petrol on consumption rate using Owerri Municipal as a case study and identify other factors of importance that will clarify the issue.

Materials and Methods

The study was conducted in Owerri municipal in Imo State of Nigeria. The population projection of Imo as at 2016 was 5,408, 800 (National Population Commission of Nigeria and National Bureau of Statistics). Owerri is located in the cities place category with the global positioning system coordinates of 5° 28' 34.7160" N and 7° 1' 33.0708" E. The latitude of Owerri, Imo is 5.476310 and the longitude is 7.025853 (https:/www.latlong.net/place/owerri-imo-nigeria-13046.html).

Primary and secondary data were used to gather adequate data for the study. To generate primary data, a total of one hundred consumers of petrol who came to ten petrol stations (chosen at random) in Owerri city were sampled at the point of purchase in August, 2019. Well-structured questionnaire, validated to ensure high data reliability was employed as an instrument to collect primary data. The questionnaire provided answers to the research questions and hypothesis. Sampled consumers of petrol were asked to fill the questionnaire and it was returned at the spot upon completion. The secondary data (Adagunodo, 2013 updated) used were changes in the pump price of petrol in Nigeria from 1973-2016. In the study, it was hypothesized that changes in pump price of petrol will significantly reduce petrol consumption in Owerri city. To test this hypothesis and check whether the propensity to consume remains unaffected irrespective of hike, the following econometric model was specified.

Given the classical linear regression model (CLRM), as shown below;

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \beta_k X_{ki} + u_i, \quad i = 1, 2, 3, \ldots, n \qquad (1)$$

The CLRM above is written to illustrate the k-variable population regression function (PFR) model with k-1 independent variables, where

Y_i = is the i^{th} response variable

$X_2, X_3, \ldots, X_k$ are the independent variables (explanatory variables)

β_1 = is the intercept term

β_2 to β_k = are the partial slope coefficients

u_i = the disturbance term

And

i = i^{th} observation , while n is the population size

In regression analysis, the population is usually generalized using the sample, since it is impossible in practice to get all the Xs, Y and u in order to fit the model in equation 1. However sample observations of the Xs and Y become the alternative with the distribution of u's specified and effort is made to obtain satisfactory estimate of the true parameter that defines the relationship. This is achieved by fitting a regression line to the observed sample data which approximates the true regression line. The true regression line is given below;

$$E(Y_i) = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \beta_k X_{ki} \qquad (2)$$

And the estimated relationship is

$$Y_i = b_1 + b_2 X_{2i} + b_3 X_{3i} + \ldots + b_k X_{ki} + e_i \qquad (3)$$

Equation 1 is a compact form of the following set of n simultaneous equations

$$\begin{aligned} Y_1 &= \beta_1 + \beta_2 X_{21} + \beta_3 X_{31} + \ldots + \beta_k X_{k1} + u_1 \\ Y_2 &= \beta_1 + \beta_2 X_{22} + \beta_3 X_{32} + \ldots + \beta_k X_{k2} + u_2 \\ Y_n &= \beta_1 + \beta_2 X_{2n} + \beta_3 X_{3n} + \ldots + \beta_k X_{kn} + u_n \end{aligned} \qquad (4)$$

The system of equations in equation 4 can be written in matrix form as shown below

$$\begin{pmatrix} Y_1 \\ Y_2 \\ . \\ . \\ . \\ Y_n \end{pmatrix} = \begin{pmatrix} 1 & X_{21} & X_{31} & \cdots & X_{k1} \\ 1 & X_{22} & X_{32} & \cdots & X_{k2} \\ . & & & & \\ . & . & . & . & . \\ . & & & & \\ 1 & X_{2n} & X_{3n} & \cdots & X_{kn} \end{pmatrix} \begin{pmatrix} \beta_1 \\ \beta_2 \\ . \\ . \\ . \\ \beta_n \end{pmatrix} + \begin{pmatrix} u_1 \\ u_2 \\ . \\ . \\ . \\ u_n \end{pmatrix} \quad (5)$$

Equation 5 above can be shortened as shown below;

$$Y = X\beta + U \quad (6)$$

Where,

Y= n x 1 column vector of observations on the explained variable Y

X= n x k matrix of k-1 explanatory variables given n observations, column 1of equation 5 represents the intercept term

β = k x 1 column vector of unknown (slope coefficients) parameters

u = n x 1 column vector of n disturbances (error terms)

Minimizing the sum of squared residual to obtain the consistent estimators of β, the following procedure is followed;

From equation 6,

$$u = Y - X\beta$$

Therefore,

$$u'u = (Y - X\beta)'(Y - X\beta) \quad (7)$$

$$= Y'Y - \beta'X'Y - Y'X\beta + \beta'X'X\beta \quad (8)$$

$= Y'Y - 2\beta'X'Y + \beta'X'X\beta$, here use is made of the fact that the transpose of a scalar is a scalar, thus;

$$Y'X\beta = (Y'X\beta)' = \beta'X'Y$$

$$\frac{\partial(u'u)}{\partial\hat{\beta}} = -2X'Y - 2X'X\hat{\beta} = 0$$

$\Rightarrow$

$$2X'X\hat{\beta} = 2X'Y$$

And

$$\hat{\beta} = (X'X)^{-1}X'Y \tag{9}$$

$$V(\beta) = E\left[(\beta - \beta)'(\beta - \beta)\right] \tag{10}$$

$$= E\left[\left((X'X)^{-1}X'Y - \beta\right)\left((X'X)^{-1}X'Y - \beta\right)'\right] \tag{11}$$

Where

$$Y = X\beta + \mu$$

Hence,

$$V(\beta) = E\left[\left((X'X)^{-1}X'(X\beta + \mu) - \beta\right)\left((X'X)^{-1}X'(X\beta + \mu) - \beta\right)'\right] \tag{12}$$

$$= E\left[\left((X'X)^{-1}X'X\beta + (X'X)^{-1}X'\mu - \beta\right)\left((X'X)^{-1}X'X\beta + (X'X)^{-1}X'\mu - \beta\right)'\right] \tag{13}$$

$$= E\left[(X'X)^{-1}X'\mu\mu'X(X'X)^{-1}\right] \tag{14}$$

$$= \left[(X'X)^{-1}X'E(\mu\mu')X(X'X)^{-1}\right], \text{ where } E(\mu\mu') = \sigma^2$$

$$= \left[(X'X)^{-1}X'\sigma^2X(X'X)^{-1}\right]$$

$$= \sigma^2\left[(X'X)^{-1}X'X(X'X)^{-1}\right]$$

$$= \sigma^2(X'X)^{-1} \tag{15}$$

The expression in equation 15 is a k by k matrix with the sampling variances of b_i displayed on the main diagonal and the co-variances in the off diagonal positions.

Precisely, the regression model used in this research is given in equation 16 below;

$$CON = \beta_1 + \beta_2 PRI + E_i \tag{16}$$

Where;
CON= consumption of petrol (the explained variable)
PRI= changes in the price of petrol (the explanatory variable)
β_1 = the intercept term
β_2 = the unknown slope parameter of the model
And
E_i = the error (disturbances) term

The data collected were analysed using regression model statistical technique. The software used for the analysis was statistical package for the social sciences version 23.0.

Results

The result of questionnaire validity and reliability test was r = 0.78. Table 1 presents a summary of the gender of the respondents in Owerri municipal, Imo State, Nigeria who came to different petrol stations to buy the product in August, 2019. Sixty seven respondents which represent 67% of the population sampled were males while the remaining thirty-three respondents which represent 33% of the population were females. Table 2 shows the marital status of the respondents. Fifty eight respondents which represent 58% of the population were single while 42 respondents which represent 42% of the population were married. Table 3 presents information on highest educational qualification of respondents. The results showed that there were variations in the highest educational qualification of individuals who consumed petrol in Owerri municipal during the period. Two respondents which represent 2% of the sampled population have doctorate (Ph.D.) degree. Ten respondents which represent 10% of the population have master's degree. Thirty-four respondents which represent 34% of the population have bachelor's degree. Fourteen respondents representing 14% have Higher National Diploma whereas 16 respondents representing 16% have Ordinary National Diploma. Eleven respondents which represent 11% possess the Nigerian Certificate of Education. Ten respondents representing 10% possess the West African Senior School Certificate. Three respondents representing 3% of the population have acquired the First School Leaving Certificate as highest qualification. Figure 1 shows how long consumers of petrol in Owerri municipal have used the product. Twenty percent of sampled population has used fuel for a period of 1-5 years. A total of 38% have used fuel for 6-10 years. Nineteen percent have used fuel for 11-16 years while 7 respondents representing 7% of the sampled population have used fuel for 16-20 years. Five percent have used fuel for 21-25 years. Eleven percent has used fuel for over 25 years. Figure 2 shows the time-rate of purchase of petrol by consumers in Owerri municipal, Imo State, Nigeria during August, 2019. Fifty-five respondents which represent 55% of the sampled population buy fuel daily. A total of 22 percent buys fuel weekly. Nineteen percent buys fuel more than once a week. It was observed that no petrol consumer buys fuel monthly whereas 4% buys fuel occasionally. Figure 3 shows the quantity of petrol purchased by consumers per visit to petrol station. A total of 45% of the consumers (the modal observation) buy 6 to 10 litres of petrol per visit to stations. Figure 4 presents the acceptability level of the assertion petrol price is considered very unstable in Nigeria. The results showed that 80% strongly agreed/ agreed that the price of petrol is very unstable in the country. Figure 5 shows that in relation to petrol consumer's economy the current price of petrol is drastic. The results showed that 79% strongly agreed/ agreed that 143 to 145 Naira per litre of petrol was too high. Figure 6 shows that there are economic factors for increase in the price of petrol in Nigeria. The result precisely showed that 78% of the consumers strongly agreed/ agreed that economic factors are also responsible for increase in price of petrol in Nigeria. Figure 7 shows that changes in pump price affects consumption of petrol in Nigeria. A total of 75% of petrol consumers strongly agreed/ agreed to it while the remaining 25% were undecided, disagreed or strongly disagreed. The correlation coefficient R of consumption of petrol and the prices of petrol in the study was 0.858. The study indicated that the relationship between consumption and changes in price is Consumption Pattern = $16.78 - 107\ PRI + E_i$ (17).

Table 1: Gender of respondents in the study

Sex	Frequency	Percentage (%)
Male	67.00	67.00
Female	33.00	33.00
Total	100.00	100.00

Source: *Authors computation from questionnaire*

Table 2: Marital status of respondents in the study

Marital status	Frequency	Percentage (%)
Single	58.00	58.00
Married	42.00	42.00
Total	100.00	100.00

Source: *Authors computation from questionnaire*

Table 3: Highest educational qualification of respondents in Owerri Municipal, Imo State, Nigeria during August, 2019

Highest qualification obtained	Frequency	Percentage (%)
Doctorate degree (Ph.D.)	2.00	2.00
Master's degree	10.00	10.00
Bachelor's degree	34.00	34.00
Higher National Diploma (HND)	14.00	14.00
Ordinary National Diploma (HND)	16.00	16.00
Nigerian Certificate of Education (NCE)	11.00	11.00
West African Senior School Certificate (WASSC)	10.00	10.00
First School Leaving Certificate (FSLC)	3.00	3.00
Total	100.00	100.00

Source: *Authors computation from questionnaire*

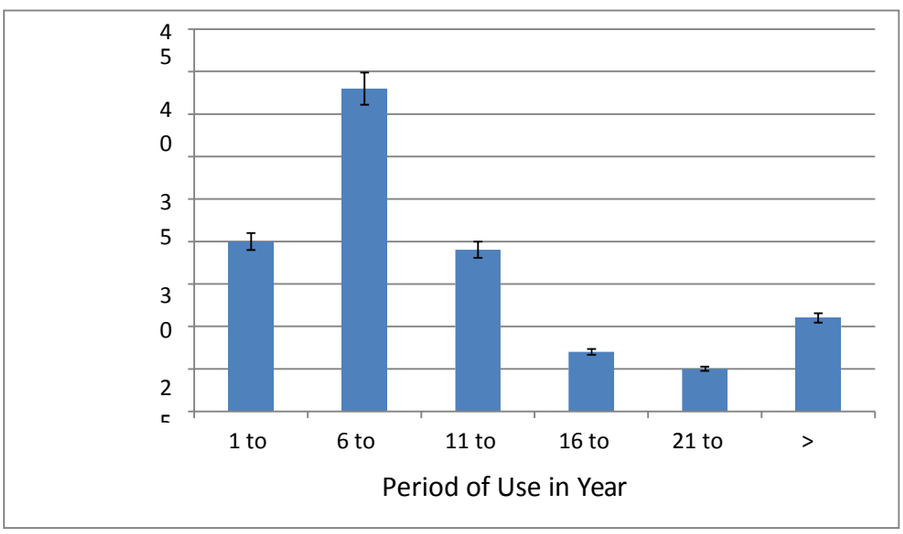

Figure 1: *How long consumers of petrol in Owerri Municipal have used the product*

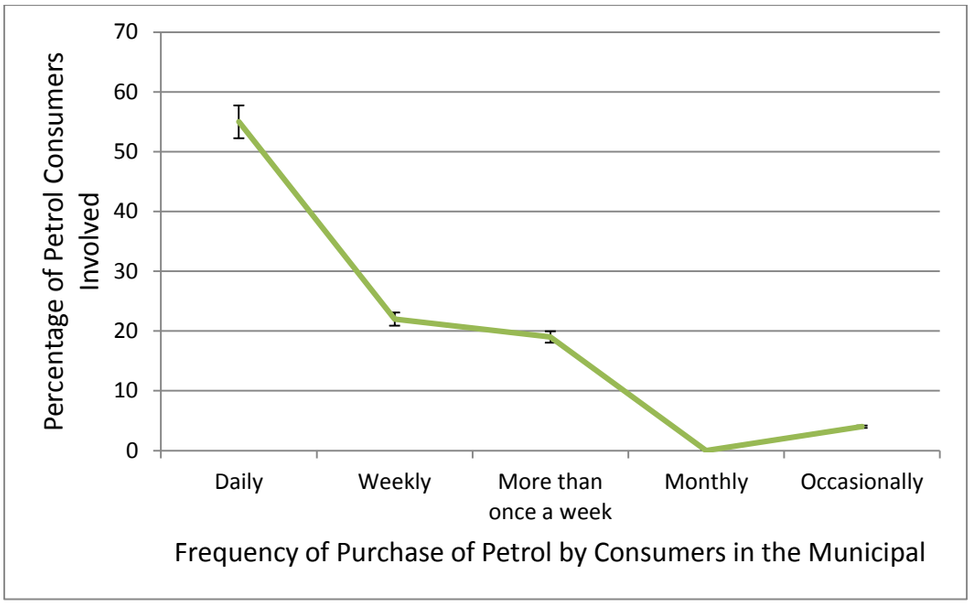

Figure 2: *Time-rate of purchase of petrol by consumers in Owerri Municipal, Imo State, Nigeria during August, 2019*

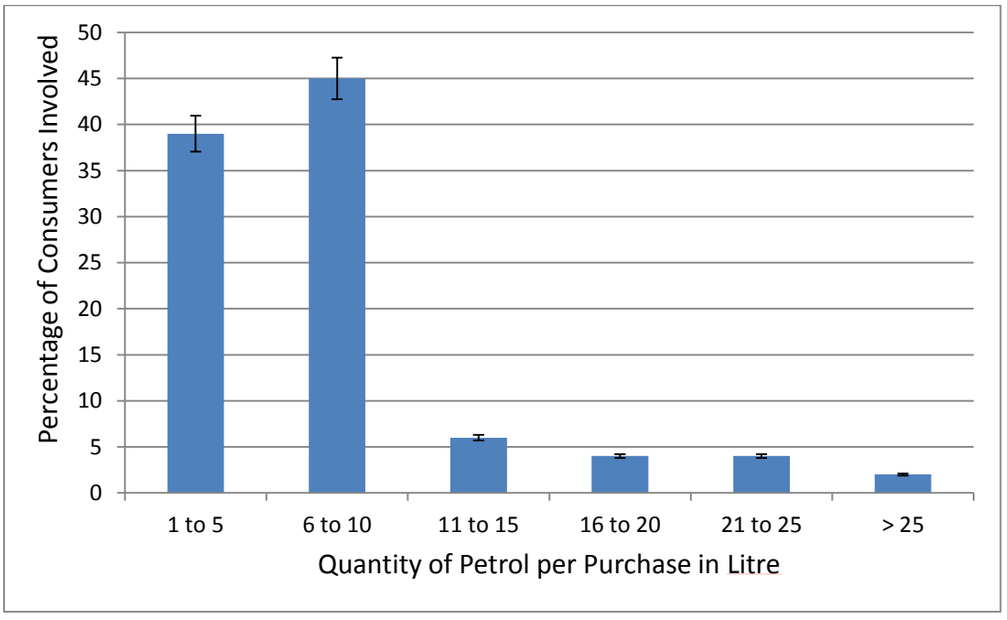

Figure 3: *Quantity of petrol purchased by consumers per visit to petrol station during August, 2019*

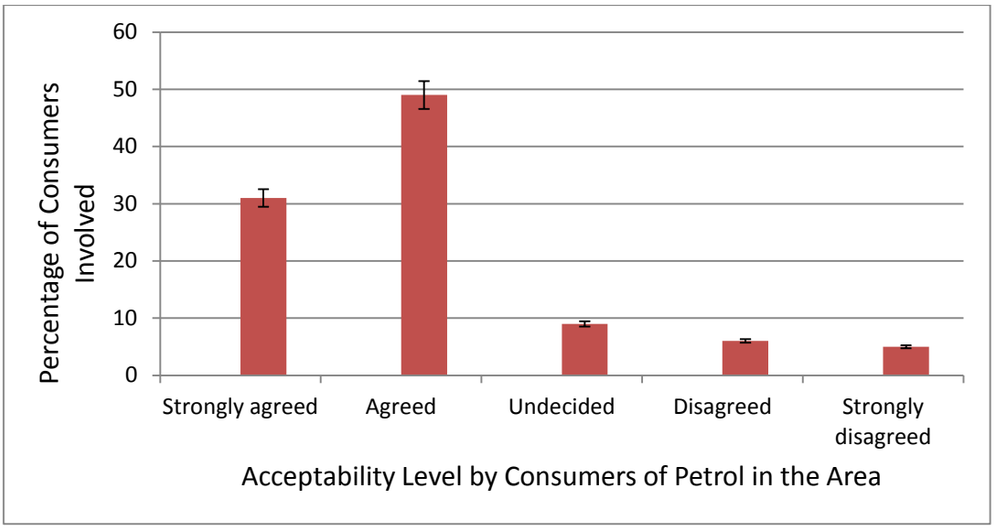

Figure 4: Acceptability level of the assertion petrol price is considered very unstable in Nigeria

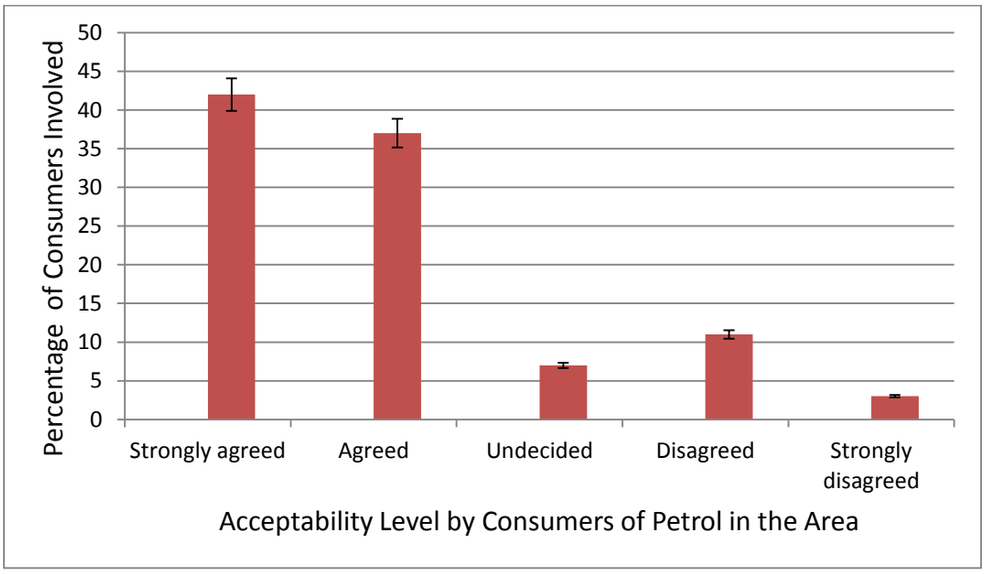

Figure 5: In relation to the individual's economy the current price of petrol is drastic

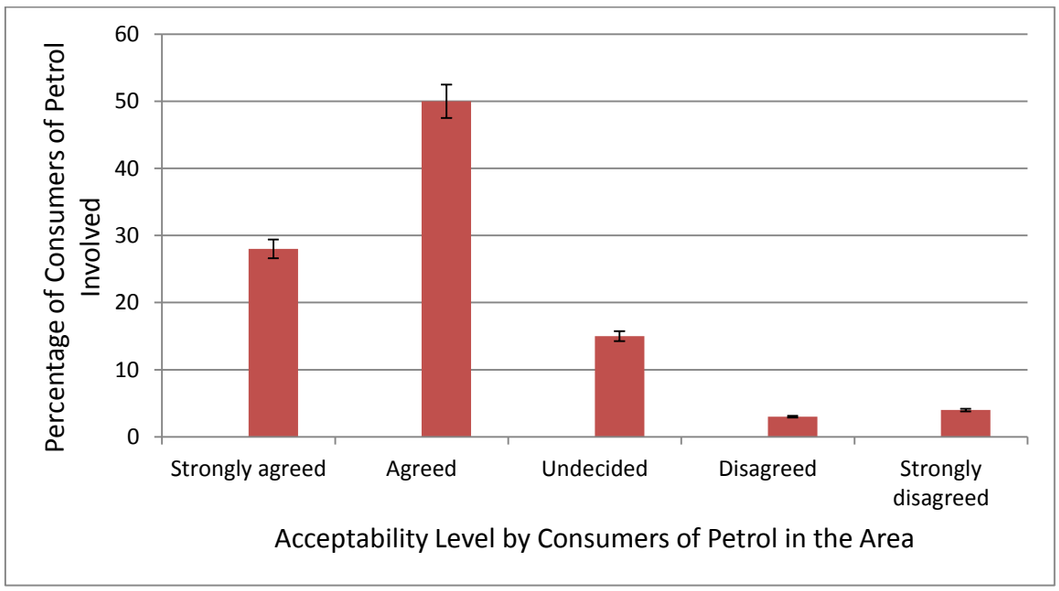

Figure 6: There are economic factors for increase in the price of petrol in Nigeria

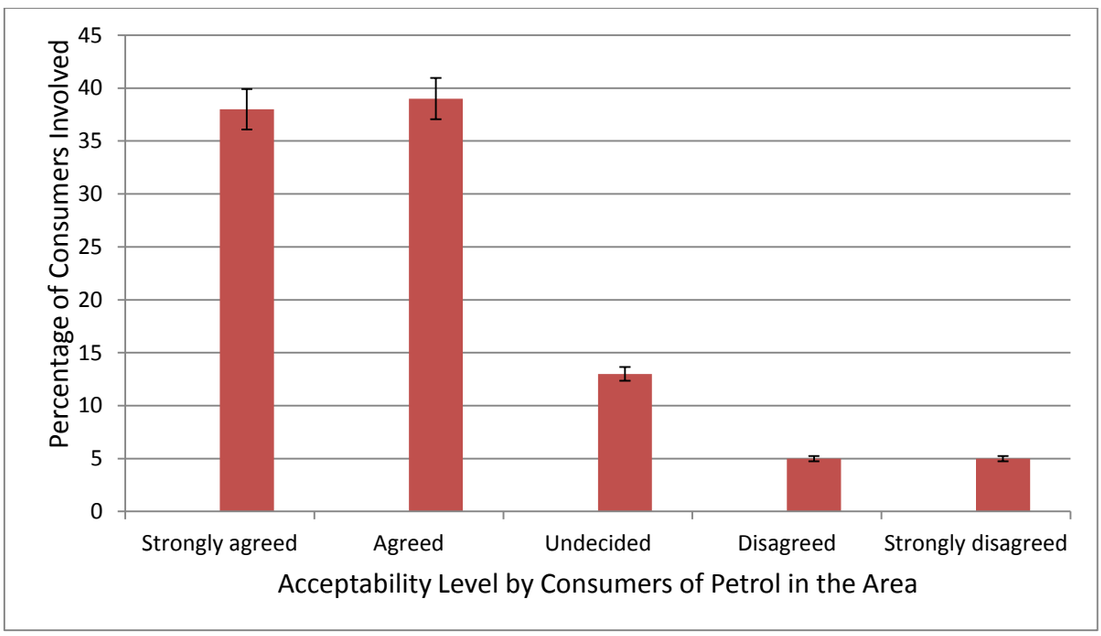

Figure 7: Changes in pump price affects consumption of petrol in Nigeria

Table 4: Changes in pump price of petrol in Nigeria from 1973-2016

Date	Price per liter	Percent change
January, 1973	8.45kobo	-
September, 1978	8.5kobo	0.59
October, 1978	15.5kobo	73.9
April 20,1982	20kobo	31.0
March 31,1986	39.5kobo	97.5
April 10,1988	42kobo	6.0
January 1,1989	40kobo for commercial	43.0
December 19,1989	60kobo for vehicles	43.0
March 6, 1991	70kobo	16.6
November 8, 1993	N5.00	614.0
November 22, 1993	N3.25	-35.0
October 2,1994	N15.00	361.5
October 4,1994	N11.00	-26.67
December 20,1998	N25.00	127.0
January 6,1999	N20.00	-20.0
June 1, 2000	N30.00	50
June 8, 2000	N25.00	-16.67
June 13, 2000	N22.00	-12.0
January 1, 2002	N26.00	18.2
June 20, 2003	N40.00	53.0
July 9, 2003	N34.00	-2.40
October 1, 2003	N38.50 and N42.00	23.53
May 29, 2004	N49.90	116.67
September, 2004	N53.00	8.16
September, 2005	N65.00	22.64
May 27, 2007	N70.00	7.6
June, 2007	N65.00	-7.6
January 1, 2012	N141.00	116.9
January 8, 2012	N97.00	-31.2
May 11, 2016	N145.00	49.48

Source: Adagunodo (2013) updated by the author

Discussion

The analysis of result of questionnaire validity and reliability indicates high reliability and this is supported by literature (Hinton *et al*., 2004). Changes in pump price of petrol in Nigeria have continued to attract routine analysis (Dike, 2007; Sanni, 2014; Ocheni, 2015; Orlu, 2017). The results of biometrics of the sampled population indicate that petrol consumers in the area are different categories of individuals at different levels of education and this variation helped to reduce bias. The results further revealed that petrol consumers sampled in the study are individuals who have used the product for reliable periods of time and 55% bought the product from petrol stations daily. So, data on changes in pump price and effect on consumption rate obtained from them are considered reliable. This is because experience is very important in reliability of information (Katarzyna and Shaofeng, 2018). It was also revealed that 45% of the consumers (modal observation) buy 6 to 10 litres of petrol per visit to stations. From this statistics, it is easily discernible that rise in petrol price will constitute a serious challenge to individual consumers and firms who depend largely on the product for their operations. Unquestionably, this will have an adverse effect on productivity and firms may find it very difficult to cope with rising energy costs. This is supported by literature (Orlu, 2017). The present investigation indicated that 80% strongly agreed/ agreed that the price of petrol is very unstable in Nigeria. This was a significant observation. Sanni (2014) and Bobai (2017) attributed price instability to scarcity emanating from problems of refinery maintenance/ rehabilitation, low capacity utilization, supply and demand inequalities, cost of distribution, unhealthy politics and general inefficiencies in the process. Onwioduokit and Adenuga (2000) added that poor energy planning had compounded the problem of scarcity- an influential factor of price instability. Bobai (2017) reported that price instability of oil products occurs more in Nigeria than other countries. The author pointed that smuggling is profitable and attractive and the proclivity to smuggle oil products from Nigeria to neighbouring countries is one of the factors which make price instability of oil products very common in Nigeria. The analysis of results revealed that 79% strongly agreed/ agreed that 143 to 145 Naira per litre of petrol was too high and unfavourable to their household economy and therefore considered the pump price too drastic. Therefore, the policy of subsidizing the price of fuel should be sustained to help to minimize the adverse effects of oil-price shock on the economy. Findings showed that a total of 78% of the consumers strongly agreed/ agreed that economic factors are also responsible for increase in the price of petrol in Nigeria. Meanwhile it was revealed that 75% of petrol consumers strongly agreed/ agreed that changes in pump price affect consumption of the product in Nigeria whereas the remaining 25% were undecided, disagreed or strongly disagreed. This implies that changes in the pump price of petrol do not affect certain class of Nigerians; this however, constitutes a smaller percentage of the population who must consume (unaffected by price) probably because of the need for the product. The correlation coefficient R = 0.858 recorded, implies that there is a strong positive correlation between consumption of petrol and the prices of petrol. The outcome of the statistical analysis suggests that we reject the null hypothesis and conclude that changes in pump price of petrol have significant effect on consumption. Based on the regression equation, it can be seen that consumption of petrol would reduce by -0.107 for every change in price of petrol. There is a trend in recent time that has affected petroleum products due to factors such as fluctuations in dollar value and this invariably contributes to change in consumption patterns. This has impacting influence on consumers' demand, choices and welfare. The perception of consumers for price increase in the future is also registered which reflects the lower consumer confidence in the petroleum markets. The understanding of how consumers will respond to changes in petrol prices is crucial to forecasting, policy development, funding and public transport-planning. Therefore, we recommend petrol

subsidy while facilitating construction of domestic refineries by the Federal Government of Nigeria. Households' incomes have been affected by the rise in petrol price and this would in turn affect the average individual to limit the consumption of petrol. Based on the present findings, we support the following recommendations: i. Government should embark on a full deregulation of petrol prices. ii. Subsidy should be sustained and if it must be removed, quick construction of domestic refineries by the Federal Government of Nigeria should follow. iii. Government should legislate against unauthorized dealership in the sale of petrol to reduce extortion hazards, unnecessary fire incidence which culminates in huge economic loss and loss of life during periods of petrol scarcity.

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