Journal of Sustainable Development in Africa (Volume 15, No.4, 2013)
ISSN: 1520-5509
Clarion University of Pennsylvania, Clarion, Pennsylvania

LONG RUN AND SHORT RUN EFFECTS BETWEEN DOMESTIC FUEL CONSUMPTION AND ECONOMIC GROWTH IN NIGERIA

Philip Ifeakachukwu, Nwosa
Department of Accounting, Economics and Finance, Bells University of Technology, Nigeria

ABSTRACT

Environmentalists have emphasized the need to reduce environmental damages resulting from fuel consumption through appropriate energy policy in order achieve both growth and sustained development. In view of this, this paper empirically examines the long run and short run relationship between domestic fuel consumption (petrol, Kerosene and diesel) and economic growth in Nigeria and its implication for the achievement of sustainable development. The study covers the period 1980 to 2010 and adopts an Error Correction Model (ECM) approach. The Johansen's multivariate co-integration test showed that the variables are co-integrated and the long run estimate showed that the consumption of the three domestic fuels had insignificant impact on economic growth. However, the short run estimate revealed that the overall impact of petrol consumption was positive and significant while the overall impact of diesel consumption was negative and significant. The overall impact of kerosene consumption was negative and insignificant. This paper concludes that petrol consumption is crucial for growth in Nigeria and energy policy on petrol consumption would hamper economic growth. Therefore to achieve growth and sustainable development, this paper recommends the need for the development of greener energy sources that would compensate for the reduction in petrol consumption in Nigeria.

Keywords: Petrol; Diesel; Kerosene; Error Correction Model; Economic Growth; Nigeria.

INTRODUCTION

Issues on energy consumption-economic growth nexus has been hotly debated in the energy literature over the past decades due to the controversy on the impact of energy on the macroeconomy. On the one hand, some energy economists posited that energy is key to economic growth as capital and labour are, and as such increased energy consumption is perceive to lead to economic growth. In contrast, some energy economists contended that energy consumption cannot stimulate economic growth, given the small fraction of energy usage in the production process. Apart from the foregoing, scholars particularly environmentalist also contended that increased persistent global warming, climate change and other environmental damages such as pollution are a consequent of increased energy consumption and are detrimental to the attainment of sustainable macroeconomic development. In the light of the above conflicts on energy consumption, plethora of studies has been carried out on the causal nexus between energy consumption and economic growth in the developed and developing countries, particularly to ensure appropriate implementation of energy policies that can enhance growth and at the same time promote sustained macroeconomic development. For instance, if energy consumption influences economic growth, then appropriate influencing energy consumption policies could be implemented taken into cognizance the environmental cost; but if energy consumption does not cause economic growth then energy conservation policy may be implemented without any adverse consequence on the macroeconomy.

Our perusal of literature on energy consumption-economic growth nexus suggest that majority of the previous studies exist on two main strands. One, studies have focused on the nexus between aggregate energy consumption and economic growth (Binh, 2011; Kaplan et al, 2011; Noor & Siddiqui, 2010; Stern, 2000; Adeniran, 2009; Omisakin, 2008; Chen et al, 2007; Erol & Yu, 1987; Kraft & Kraft, 1978), and two studies have equally focused on the nexus between disaggregate energy consumption (such as electricity, coal, gas, etc) and economic growth (see Akinlo, 2009; Khan & Ahmed, 2009; Narayan & Singh, 2007; Altinay & Karagoal, 2005; Worlde-Rufael, 2004; Shiu & Lam, 2004; Yoo, 2005; 2006). In general, the findings of these studies have been mixed. While some observed a unidirectional causation from energy consumption to economic growth (see Akinlo, 2009; Narayan & Singh, 2007; Altinay & Karagoal, 2005; Worlde-Rufael, 2004; Shiu & Lam, 2004), others observed that the causation runs from economic growth to energy consumption (see Binh, 2011; Yoo & Kim, 2006; Kraft & Kraft, 1978). In addition, some studies revealed a bidirectional causation between energy consumption and economic growth (see, Kaplan et al, 2011; Chen et al, 2007; Yoo, 2005; 2006; Jumbe, 2004; Erol & Yu, 1987) while other studies (see Ghaderi et al, 2006; Zou & Chau, 2006; Stern, 2000; Akarca & Long, 1980) observed no causality between energy consumption and economic growth.

Taking cognizance of the above unresolved findings on the exact nexus between energy consumption and economic growth and to the best knowledge of the author, only a few studies (Aqueel & Butt, 2001; Siddiqui, 2004; Zou & Chau, 2006) have examined the relationship between petroleum consumption and economic growth while none have considered this issue in Nigerian. Endogenous studies (see Ogunleye & Ayeni, 2012; Akinlo, 2009; Odularu & Okonkwo, 2009; Omisakin, 2008) failed to take into cognizance the impact of domestic fuel consumption (such as Kerosene, Petrol and Diesel) on economic growth in Nigeria in their analysis. It is no doubt that the consumption of these energy products play an important role in household usage as well as in the production process especially in the face of epileptic power supply that have rocked the Nigeria economy and therefore may have important implication for long run as well as short run changes in macroeconomic activities. Also, given the increased global issues on global warming, climate change, environmental damage such as air pollution and particularly the need to reduce CO_2 emission, it is important to examine the nexus between domestic fuel consumption and economic growth because emission from the consumption of these

energy products are causal agents to CO_2 emission that are detrimental to achieving sustainable development. Thus examining whether these energy consumption influence economic growth or not is necessary for appropriate policy recommendation. Theoretically, an appropriate energy policy choice should depend on the actual relationship between energy consumption and economic growth (Binh, 2011).

Apart from the above and in the light of abrupt increases in the prices of these domestic energy products by the government especially in an attempt at liberalizing the prices of these petroleum products, an examination of the nexus between domestic fuel consumption and economic growth is pertinent to ensure the prevention of pricing policy that may adversely affect the consumption of these product, particularly if the consumption of these energy sub-components is found to influence economic growth. More so, given the desire of the Nigerian government in moving the economy from its deplorable state to becoming one of the 20th most developed economies of the world by the year 2020; care must be taken on unexpected increase in the prices of these domestic fuels. Because such increase could deter the consumption of these domestic fuels with negative consequence on the macroeconomic activities and a bottleneck to the achievement of the Nigerian objective of becoming one of the 20th most developed economies by 2020, especially if found to influence economic growth. Finally, this study depart from previous studies that have mainly focused the causality issue by examining both the short run and long run effects of domestic fuel consumption on economic growth in Nigeria using the Error Correction Method (ECM) of analysis.

Base on the foregoing, this study breaks the silence in the energy literature pertaining to the relationship between domestic fuel consumption and economic growth in Nigeria with a view to building a strong empirical basis for inform energy policy that can promote sustained macroeconomic growth. This is the gap this study fill in literature. In addition to the introductory section, this study contains the following sections: literature review; research methodology; empirical analysis and the conclusion and policy recommendation section.

LITERATURE REVIEW

Literature abound on the energy consumption-economic growth nexus. However, a few of such literature are reviewed herein. Ogunleye & Ayeni (2012) examined the demand for energy at disaggregate level (gas, electricity and petroleum) for Nigeria over the period 1970-2007. Using a multivariate co-integration approach, the study revealed no evidence of long-run relationship between the energy sources and the per capita real income and domestic price. The short-run dynamics using the VAR analysis suggested that the average income elasticity of gas consumption is positive and higher than petroleum and electricity consumptions, making gas consumption more of a luxury than necessity. The study also observed that domestic price elasticity remained insignificant for the three energy sources. Furthermore, the result of the variance decomposition revealed that shocks to electricity and petroleum consumptions result mainly from disturbances in the production or supply of the products and not from domestic price and real income shocks.

Bekhet & Othman (2011) examined the causal nexus between electricity consumption, consumer price index, gross domestic product and foreign direct investment in Malaysia during the period 1971 to 2009. Using the Vector Error Correction Model (VECM) approach, the study observed significant long run causality from electricity consumption to foreign direct investment, gross domestic product and inflation. According to the study, this suggests that electricity consumption is an important element determining economic growth in Malaysia and a powerful tool in executing government policy for energy saving.

Adebola (2011) examined the relationship between electricity consumption and real gross domestic product in Botswana for the period 1980 to 2008. Using an Autoregressive Distributed Lag (ARDL) and Granger causality approaches, the study observed a unidirectional causality is from electricity consumption to real gross domestic product while autoregressive distributed lag estimate revealed that that electricity consumption is positively associated with real gross domestic product in the long run. In addition, it was observed that a unidirectional causality exist from capital formation to real gross domestic product.

Kaplan et al (2011) examined the causal relationship between energy consumption and economic growth for Turkey during 1971–2006. Utilizing two multivariate models, namely demand model and production model, based on vector error correction model, the study observed that energy consumption and economic growth are co-integrated and there exist bidirectional causality between energy consumption and economic growth. Consequently, the study concluded that energy is a limiting factor to economic growth in Turkey and, hence, shocks to energy supply will have a negative impact on economic growth and vice versa.

Noor & Siddiqui (2010) examined causal link between energy use and economic growth for five South Asian countries over period 1971-2006. The study utilized panel co-integration, error correction model and FMOLS approaches for short and long run estimates. In short run, a unidirectional causality was observed from per capita gross domestic product to per capita energy consumption but without any feedback from per capita energy consumption to per capita gross domestic product. In long run, the study revealed that a-one percent increase in per capita energy consumption results in a decline in per capita GDP by 0.13 percent.

Belke et al (2010) examined the causal relationship between energy consumption and economic growth for 25 OECD countries from 1981 to 2007 taking into account the role of energy prices. Applying factor decomposition to distinguish between common factors and idiosyncratic components as potential drivers of the relationship between energy consumption and economic growth, the study observed that only the common components of energy consumption, economic growth and energy prices are co-integrated. This finding highlights the relevance of international developments to explain energy demand in these countries. The study therefore recommended that policy makers should take into account the international impact on energy demand when designing efficient energy policies.

Akinlo (2009) examined the causal nexus between energy consumption and economic growth for Nigeria during the period 1980-2006. The findings of the study showed that real gross domestic product and electricity consumption are co-integrated and there is only unidirectional causality from electricity consumption to real gross domestic product. Afterwards, the study applied the Hodrick-Prescott (HP) filter to decompose the trend and fluctuation components of real gross domestic product and electricity consumption series. The result showed that there is co-integration between the trend and cyclical components of real gross domestic product and electricity consumption, which suggested that causality is possibly related with the business cycle. Based on the findings, the study recommended the investing more and reducing inefficiency in the supply and use of electricity can further stimulate economic growth in Nigeria.

Khan & Ahmed (2009) examined the demand for energy at disaggregate level (gas, electricity and coal) for the Pakistan economy over the period 1972-2007. Using a multivariate co-integration approach, the study observed that electricity and coal consumption responded positively to changes in real income per capita and negatively to changes in domestic price

level. The gas consumption responded negatively to real income and price changes in the short-run, however, in the long-run real income exerted a positive effect on gas consumption, while domestic price remained insignificant. Furthermore, the study revealed that in the short-run the average elasticities of price and real income for gas consumption (in absolute terms) were greater than those of electricity and coal consumption.

Odularu & Okonkwo (2009) examined the relationship between energy consumption at disaggregated level (crude oil, electricity and coal) and economic growth in Nigeria for the period of 1970 to 2005. Using an error correction method of analysis, the study observed a positive relationship between current period energy consumption and economic growth. Also, it was observed that with exception to coal consumption which was positive, a negative relationship was noted for lagged values of energy consumption and economic growth. The implication of these findings according to the study is that increased energy consumption is a strong determinant of economic growth in Nigeria, having an implicit effect in lagged periods and both an implicit and explicit effect on the present period.

Adeniran (2009) examined causal relationship between energy consumption and gross domestic growth in Nigeria at the aggregate and disaggregate level using systematic econometric techniques for the period 1980 to 2006. At disaggregate level, the study observed a unidirectional causality from gross domestic product to electricity and gas consumption. However, the analyses also revealed no causality between oil consumption and gross domestic growth. In aggregate analysis, the study revealed that energy consumption granger causes economic growth in Nigeria. The study therefore recommended that a policy to reduce energy consumption aimed at reducing greenhouse gas emissions is likely to have a detrimental impact on the nations GDP.

Omisakin (2008) examined the relationship between energy consumption and economic growth in Nigeria, using aggregate and disaggregate energy data for the period 1970 to 2005. Utilizing the non-causality approach and the bound testing approach to co-integration which was based on the autoregressive Distributed Lag (ARDL), the study revealed a unidirectional causation from total energy consumption to economic growth. Based on disaggregate data, the study observed a unidirectional causation from oil consumption and gas consumption to economic growth while with respect to electricity consumption, no causality was observed between electricity consumption and economic growth. In addition, the co-integration test identified long run relationship between total energy consumption and economic growth and also between oil consumption and economic growth. Meanwhile, the co-integration analysis revealed no long run relationship between gas consumption and economic growth and also between electricity consumption and economic growth.

Erbaykal (2008) examined the relationship between energy consumption and economic growth in Turkey for the period 1970 to 2003, using disaggregated data (oil and electricity). Applying the auto-regressive distributed lag approach, the study observed that in short run both oil consumption and electricity consumption has positive and statistically significant effect on economic growth. In long run, oil consumption was observed to have an insignificant positive effect on economic growth while electricity consumption had an insignificant negative effect on economic growth.

Examining the diversifying nature of the Nigerian petroleum industry, Aigbedion & Iyayi (2007) observed that the petroleum industry in Nigeria has brought unprecedented changes to the Nigerian economy, particularly in the past five decades when it replaced agriculture as the cornerstone of the Nigeria economy. The study further noted that, the Nigerian oil industry contributes the lion share to gross domestic product and accounting for the bulk of federal government revenue and foreign exchange earnings since early 1970. Despite the foregoing, the study noted that the

benefits from the oil industry have not translated into enviable economic performance; rather, the nations mono-cultural has assumed a precarious dimension in the past decades susceptible to the vagaries of the international oil markets. According to the study, the dismal performance of the economy has continued despite various economic reforms embraced by successive Nigerian governments since 1980. The study concluded that unless the country deepens its economic reform initiatives to include effective diversification of the petroleum sector, the performance of the economy will continue its unimpressive trend. The study recommended the need for the diversification of the economy beyond the petroleum sector so that the country can become a major force in the emergent global economic order of the 21st century. The study also recommended that policymakers should develop the nation's vast resources in the agricultural and solid mineral sectors for the global markets and reap the benefits that accompany economic diversification.

Chen et al (2007) examined the relationships between gross domestic product and electricity consumption in ten newly industrializing and developing Asian countries using both single data sets and panel data procedures. The empirical results from single data set indicate that the directions of causality in the ten Asian countries are mixed. Using the panel estimate, the study revealed a uni-directional short-run causality running from economic growth to electricity consumption and a bi-directional long-run causality between electricity consumption and economic growth. The long-run estimate revealed that a sufficiently large supply of electricity can ensure a higher level of economic growth.

Aqeel & Butt (2001) examined the causal nexus between energy consumption and economic growth and energy consumption and employment in Pakistan. Utilizing the co-integrating and Hsiao's version of Granger causality, the findings of the study showed that a unidirectional causation exist from economic growth to total energy consumption and petroleum consumption, while no causation was observed between economic growth and gas consumption. In addition, the study revealed a unidirectional causation from electricity consumption to economic growth without any feedback observed from economic growth to electricity consumption. The study concluded that energy conservation policy regarding petroleum consumption would not lead to any side-effects on economic growth in Pakistan while an energy growth policy in the case of gas and electricity consumption should be adopted in such a way that it stimulates growth in the economy and thus expands employment opportunities.

As emphasized in the introductory section, it was evident from the reviewed literature that the empirical findings on the relationship between energy consumption and economic growth are mixed and only a few examined the relationship between petroleum consumption and economic growth. This therefore provided credence to examine this issue in Nigeria.

RESEARCH METHODOLOGY

Data Measurement and Sources

Economic growth is measured by the real gross domestic output (GDP) obtained by dividing the nominal gross domestic product by the consumer price index. Capital stock is measured by the gross fixed capital formation. Labour force is measured by the total labour force as provided by the World Development Indicators (WDI). Domestic fuel consumption (that is, petrol, kerosene and diesel) are measured by the quantities of each of this commodity consumed yearly as provided by the Central Bank of Nigeria (CBN) statistical bulletin.

Method of Analysis

To examine the short run and the long run relationship between domestic fuel consumption and economic growth, this study utilized the co-integration and Error-Correction Methodology (ECM). The co-integration approach provides information about the long run relationship between the variables while the Error-Correction Method (ECM) provides information about the both short-run relationship between the variables. The error correction term provides information on the speed of adjustment from the short run equilibrium to the long run equilibrium in the event of any deviations from the long run equilibrium.

Model Specification

To examine the relationship between domestic fuel consumption and economic growth, this study adopted the multifactor neoclassical production function framework proposed by Ghali & El-Sakka (2004). The model is expressed as:

$$InY_t = f\{In(K, L, EC)\} \quad (1)$$

where: Y = Economic Growth *(RGDP)*; L = labour *(LAB)*; K = capital *(CAP)*; and EC = Energy Consumption. In this study energy consumption is represented by domestic fuel consumption which includes petrol *(PMS)*, kerosene *(DPK)* and diesel *(AGO)*. Thus, re-writing equation (1), we obtain:

$$InRGDP_t = f\{In(CAP, LAB, PMS, DPK, AGO)\} \quad (2)$$

linearizing equation (2), we obtain:

$$InRGDP_t = \alpha_0 + \alpha_1 InCAP_t + \alpha_2 InLAB_t + \alpha_3 InPMS_t + \alpha_4 InDPK_t + \alpha_5 InAGO_t + \varepsilon_t \quad (3)$$

α_0, is intercept, α_1 to α_5 are the slope of the coefficients of the independent variables to be determined where ε_t is the error term at time t. equation (3) is the long run regression equation to obtain to the long run relationship between the variables. In order to estimate the short-run relationship among variables in equation (3), the corresponding error correction equation is estimated as follows:

$$\Delta RGDP_t = \alpha_0 + \sum_{i=1}^{n} \alpha_1 \Delta InRGDP_{t-i} + \sum_{i=1}^{n} \alpha_2 \Delta InCAP_{t-i} + \sum_{i=1}^{n} \alpha_3 \Delta InLAB_{t-i} + \sum_{i=1}^{n} \alpha_4 \Delta InPMS_{t-i}$$

$$+ \sum_{i=1}^{n} \alpha_5 \Delta InDPK_{t-i} + \sum_{i=1}^{n} \alpha_6 \Delta InAGO_{t-i} + \psi ECM_{t-1} + \varepsilon_t \quad (4)$$

EMPIRICAL RESULT

Unit Root Test

This study commenced it empirical analysis by testing the properties of the time series, used for analysis. The stationarity test on the variables was carried out using both the Augmented Dickey-Fuller (ADF) and the Philip-Perron tests and the results are presented in table 1. It was observed from the ADF test estimate on the left hand of the table that all the variables except aggregate and labour force (llab) and real gross domestic product were integrated of order one. Labour force was integrated of order two while real gross domestic product was observed to be stationary at level, that is integrated of order one. The results of the ADF estimate was confirmed by the Philip-Perron test result, on the other column (right hand) of table 1.

Table 1: Unit Root Test Result

Augmented Dickey-Fuller (ADF) Test				Phillip-Perron (PP) Test		
Variables	Level	1^{st} / 2^{nd} Diff	Status	Level	1^{st} /2^{nd} Diff	Status
Lago	-2.1586	-5.4715*	I(1)	-2.1859	-5.4715*	I(1)
Ldpk	-0.9495	-6.0955*	I(1)	-0.5697	-6.1084*	I(1)
Lgfcf	-2.0872	-4.3094*	I(1)	-2.1064	-5.4831*	I(1)
Llab	-0.2927	-6.7909*	I(2)	1.0817	-7.0058*	I(2)
Lpms	-1.4752	-7.3575*	I(1)	-1.3513	-7.3146*	I(1)
Lrgdp	-4.6848*	-	I(0)	-4.1742*	-	I(0)

Note: *=1% and **=5% significance level.

Co-integration Estimate

The co-integration estimate was carried out using the Johansen (1991) co-integration technique. This is a powerful co-integration test, particularly when a multivariate model is used and moreover, it is robust to various departures from normality in that it allows any of the six variables in the model to be used as the dependent variable while maintaining the same co-integration result (Nwachukwu & Odigie, 2009). The result of the co-integration estimate is presented in table 2 below.

Table 2: Summary of the Co-integration Estimate

Trace Test				Maximum Eigen value Test			
Null	alternative	Statistics	95% critical values	Null	alternative	Statistics	95% critical values
r=0	r≥1	132.413	95.754	r=0	r=1	64.804	40.076
r≤1	r≥2	67.610	69.818	r≤1	r=2	28.121	33.877
r≤2	r≥3	39.488	47.856	r≤2	r=3	18.012	27.584
r≤3	r≥4	21.476	29.797	r≤3	r=4	15.642	21.132
r≤4	r≥5	5.835	15.495	r≤4	r=5	5.764	14.265
r≤5	r≥6	0.071	3.841	r≤5	r=6	0.071	3.841

Source: Author's Computation, 2011

From the above table, it was observed that the null hypothesis of no co-integration, for r=0 were rejected by both the trace statistics and the maximum eigen-value statistics. The statistical values of these tests were greater than their critical values. However, the null hypothesis of no co-integration that is r≤1 could not be rejected by the trace and maximum eigen-value statistics because their statistical values were less than their critical values. The implication of the co-integration estimate is that there is one co-integrating equation in the model at 5%. Having confirmed the existence of co-integration among the variables, the long-run relationships estimate from the ordinary least technique (OLS) is presented below:

Long Run Regression Estimate

$LRGDP_t = -26.43 + 0.125LCAP_t + 2.244LLAB_t - 0.144LPMS_t + 0.053LDPK_t + 0.021LAGO_t + \varepsilon_t$

t:	[0.957]	[2.305]**	[-0.419]	[0.174]	[0.401]
SE:	(0.131)	(0.973)	(0.344)	(0.303)	(0.052)

Note: ** implies 5% significance level.

It was observed from regression estimate that the consumption of various domestic fuels (that is petrol (PMS), Kerosene (DPK) and Diesel (AGO)) had insignificant effect on economic growth in Nigeria in the long run. This implies that changes in the consumption of these domestic fuels would have no impact on the Nigerian macroeconomy. With respect to other macroeconomic variables in the model, it was observed that only labour force had significant impact on economic growth while capital stock was observed to have an insignificant impact on economic growth in the long run. Therefore, a one percent change in labour force (LAB) would stimulate the growth of the economy by 2.24 percent in the long run.

Short Run Estimate

Before estimating the short run equation, the residual from the long run equation was tested for unit root and was discovered to be stationary at five percent and ten percent significant levels. The absolute value of the observed variable was greater than the absolute critical value, implying that the null hypothesis which states that the residual of the co-integrating regression equation was not stationary was rejected at five percent and ten percent significant levels. Thus, it is evident that there exists a long run relationship between the variables in the growth equation. The residual stationarity test is presented in table 3.

Table 3: Residual Stationarity Test

Variable	Phillip-Perron Test	Order of Integration
Residual	-7.3826**	I(0)

Note: ** implies 5% significance level.

Following the residual stationarity test, we over parameterized the first differenced form of the variables in equation (4) and used Schwarz Information Criteria to guide parsimonious reduction of the model. This helps to identify the main dynamic pattern in the model and to ensure that the dynamics of the model have not been constrained by inappropriate lag length specification. From the short run parsimonious estimate reported on table 4, it was observed that the coefficient of the error-term for the ECM model is both statistically significant at one per cent and negative. The coefficient estimate of the error correction term of -0.25 implied that the model corrects its short run disequilibrium by about 25 percent speed of adjustment in order to return to the long run equilibrium. In addition, and with respect to the variables of interest, it was observed that changes in the current and past two period's petrol (LPMS) consumption exerts a positive effect on current economic growth. However, only the effect of the immediate past period was significant at one percent while the effect of its second lag was significant at ten percent. The overall effect (0.3642) of LPMS consumption on economic growth is positive in the short. The Wald test conducted on the current and lagged values of LPMS showed that the overall effect of LPMS is significant (see appendix). This is because the probability value (0.021) of the F-statistics is significant at five percent. Changes in the current and second lagged values of kerosene (LDPK)

consumption were observed to have negative and positive effects on economic growth respectively. These effects were observed to be insignificant at five percent. The overall effect of domestic consumption of kerosene on economic growth is negative in the short run. Also the Wald test revealed that the overall effect of kerosene consumption on economic growth was insignificant (see appendix). The probability value (0.471) of the F-statistics was insignificant. Furthermore, changes in the current and first lagged values of diesel (LAGO) consumption were observed to have insignificant-negative effects on economic growth. The overall effect of domestic consumption of diesel (LAGO) on economic growth is negative in the short run. Also the Wald test revealed that the overall effect of diesel (LAGO) consumption on economic growth was significant (see appendix). The probability value (0.043) of the F-statistics was significant. The implication of the above findings is that environmental energy conservation policy on the consumption of domestic energy such as petrol (PMS) would hamper the growth of the Nigerian economy while environmental energy conservation policy on the consumption of kerosene (DPK) and diesel (AGO) will have no negative effect on the growth of the Nigerian economy.

Table 4: Parsimonious Short Run Regression Estimate

Variables	**Coefficient**	**Std. Error**	**t-Statistics**	**Probability**
C	0.8837	0.6030	1.4654	0.1666
ECM(-1)	-0.2474	0.0887	-2.7887	0.0154
ΔLRGDP(-1)	0.3071	0.1924	1.5960	0.1345
ΔLPMS	0.0898	0.0516	1.7410	0.1053
ΔLPMS(-1)	0.1892	0.0625	3.0296	0.0097
ΔLPMS(-2)	0.0850	0.0474	1.7939	0.0961
ΔLLAB	-2.8687	3.1428	-0.9128	0.3780
ΔLLAB(-1)	-8.1969	4.2592	-1.9245	0.0765
ΔLLAB(-2)	-4.4819	2.6333	-1.7020	0.1125
ΔLCAP	0.0169	0.0150	1.1201	0.2829
ΔLCAP(-1)	-0.0619	0.0137	-4.5272	0.0006
ΔLDPK	-0.0801	0.3988	-2.0088	0.0658
ΔLDPK(-2)	0.6351	0.3648	1.7412	0.1053
ΔLAGO	-0.0119	0.0068	-1.7590	0.1021
ΔLAGO(-1)	-0.0115	0.0074	-1.9756	0.0698
Adjusted R^2	0.8441	***S.D dependent Var:***		0.0510
S.E of Regression	0.0290	***F-Statistic***		5.0271
D.W Stat	2.27	***Prob. (F-Statistic)***		(0.0030)

Diagnostic and Stability Tests

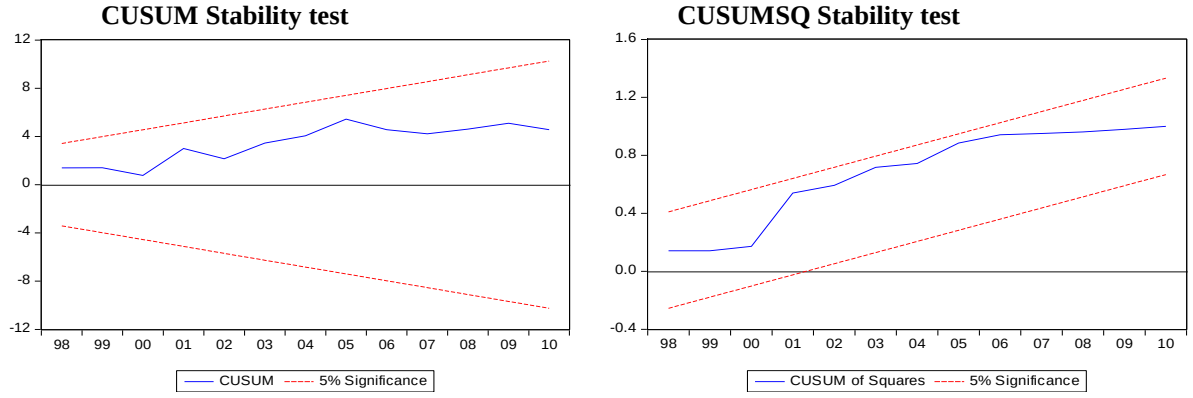
The appropriateness of the model was further verified by carrying out various diagnostic (the serial correlation LM test, Breusch-Pagan-Godfrey test and the ARCH test) and stability (cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ)) tests on the residual of the ECM model; namely. The serial correlation, Breusch-Pagan-Godfrey and ARCH tests presented on table 5, confirmed that there is no serial correlation in the residuals of the ECM regression. This is because the F-statistics of these tests were insignificant. This shows that there are no lagged forecast variances in

the conditional variance equation. In other words, the errors are conditionally normally distributed, and can be used for inference (Nwachuwu & Odigie, 2009). The cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests presented on Figure 1 revealed that the residuals of the error-correction model fell within the critical bounds of five percent significant level. This implies that the estimated parameters are stable over the period 1980-2010. Overall, the model could be considered to be reasonably specified based on the above tests.

Table 5: Diagnostic Tests

Tests	F-statistic	P-value
Breusch-Godfrey Serial Correlation LM Test	0.4767	0.6331
Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.7502	0.7001
Heteroskedasticity Test: ARCH	1.7472	0.1982

Figure 1: Stability Tests



CONCLUSION AND POLICY RECOMMENDATION

This study examined the relationship between domestic fuel consumption and economic growth in Nigeria for the period spanning 1980 to 2010. Given the result of the unit root test and the Johansen's multivariate co-integration test, it was revealed that the variables are co-integrated. Consequent to the co-integration result, the model was analysed using the error correction method of analysis. Based on the analysis, the long run regression estimate revealed that the consumption of domestic fuels (petrol (Premium Motor Spirit (PMS), kerosene (Dual Purpose Kerosene (DPK)) and diesel (Automative Gas Oil (AGO)) had insignificant effect on the growth of the economy in the long run. In addition, the short run revealed that the overall effect of consumption of petrol had a positive and significant effect on economic growth while the overall effect of diesel consumption on economic growth was observed to be negative and significant. With respect to the consumption of kerosene, its overall effect on economic growth in the short run was negative and insignificant. Based on the aforementioned findings, this study recommended that:

Given the positive and significant impact of the consumption of petrol on economic growth, great caution should be observed on the implementations of policies (such as subsidy removal policy and deregulation of the downstream sector of the oil sector) that can hamper the consumption of the product through price hike. A decline in consumption of petrol may impair economic growth and constitute a blockage to the achievement of sustained growth in Nigeria.

Furthermore, energy policy against petrol consumption would inhibit growth. Thus, to achieve growth and sustainable development, this study recommends the need for the development of greener energy sources that would compensate for the reduction in petrol consumption in Nigeria.

Finally, the provision of stable electric supply and the encouragement of households in the use of electronic cooking appliances will reduce the negative impact of the consumption of kerosene on economic growth in Nigeria.

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ABOUT THE AUTHOR:

Nwosa, Philip Ifeakachukwu is an Assistant Lecturer at the Department of Economics, Accounting and Finance, College of Management Sciences, Bells university of Technology Ota, Ogun, State and also a PhD student at Obafemi Awolowo University Ile-Ife, Osun State.