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CAUSAL IMPLICATION OF OIL PRICE SHOCK, ENERGY CONSUMPTION ON SUSTAINABLE ECONOMIC GROWTH IN AFRICA: THE CASE OF NIGERIA

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ABSTRACT

The paper established the causal nexus among oil price, energy consumption and economic growth in Nigeria. The paper also examined the implication of such caul relationship of sustainable economic development in Nigeria. Both Unit root and integration test were conducted to determine the time series properties of the variables before Vector Error Correction technique was used to determine the causal relationship and draw policy inferences. The results revealed that the result indicated that energy consumption is income elastic and there is significant negative bidirectional causality between domestic investment and energy consumption. A significant positive unidirectional causality was detected from economic growth to energy consumption but not vice versa. Changes in world oil prices did not affect the total energy consumption, domestic investment and economic growth in Nigeria. This suggests that increase in the level of economic activities induced greater energy demand and consumption. The policy implication was that economic development has significant impacts on energy, therefore, energy demand and consumption can only be curtailed at greater cost on sustainable economic growth. Therefore to keep the tempo of current improvement in economic growth parameter and to further enhances sustainable economic development in Nigeria, energy conservation policy especially energy saving policy and energy efficiency strategy are more effective for sustainable economic development in Nigeria.

Keywords: Energy Consumption, Domestic investment, Sustainable Development and Growth; VECM Granger Causality

INTRODUCTION

Economic theorists and policy analysts are beginning to realized that the attainment of sustainable economic development rest squarely on how effective we manage our natural resources. Nigeria is one of the top oil producers and the bulk of it energy demand are met through oil resources. The implication of this is that movement and fluctuations in the international oil price is an important consideration in designing and implementing sustainable development policies and programmes. The focus of this paper is to investigate the dynamic causal relationship between oil price, energy consumption and sustainable economic growth in the context of an African especially Nigeria with a view to determining the implication of such relationship of sustainable development polyc in Nigeria.. The global energy crisis and the renewed interest in international policies needed to find a suitable energy supply and consumption pattern has raised the tempo of research interest in the linkages between the energy sector and sustainable growth across countries. The controversies over the impact of and the direction of causality between energy consumption and economic growth have added to the impetus to unravel this linkage. The conflicts are usually on the direction of causality and its long term verses short term impact on energy policy. The main motivation for the paper came from a study carried out on another country. Bekhet and Yusop (2009) investigated similar issues with data from Malaysia and found that there is an evidence for a stable long-run relationship between the oil price, employment, and economic growth. Bekhet and Yusop (2009) also showed that changes in world oil prices also affect the total energy consumption in Malaysia but reverse does not hold in Malaysia context. In view of the fact that Nigeria is also a net export of oil and a developing country facing challenges with energy policy and economic growth, it is imperative to examine whether the result obtained in Malaysia could be replicated with data from Nigeria. This analysis is useful in assessing the dependence of energy consumption for Nigerian economy. This is important because when a country's economy is heavily dependent on energy consumption, environmental policies for energy conservation could adversely affect sustainable economic growth. Therefore, the understanding of the direction of causality between energy consumption and economic growth could have important policy implications sustainable development agenda and macroeconomic management. Indeed, the relationship between use of energy and economic growth has been a subject of greater inquiry as energy is considered to be one of the important driving forces of economic growth in all economies (Pokharel, 2006). Besides that, this paper is also trying to look at the effects of world oil price to energy consumption as well as to the sustainable economic development.

In the light of above background the remaining part of the part is organized as follows: Section 2 review existing literature, section 3 presents the methodology and data sets. Section 4 presents the empirical results and its discussion thereof. Section 5 concludes with policy implications.

REVIEW OF LITERATURE

In recent times, a vast number of studies is being carried out on the relationship between energy consumption and economic growth for different countries and different periods and a broad literature has been constituted in this field, (Erbaykal 2008). Kraft and Kraft (1978) pioneered the attempt to link energy consumption with the economic performance for the US

economy. The study found a unidirectional causality relation from GNP to energy consumption. This findings arouse interest in the energy- growth relationship for obvious reason. Energy consumption was expected to drive aggregate demand and hence economic growth, the lack of causal linkage from energy to economic growth then raised some suspicion about the previously held view.

In attempt to confirm this pioneered results Akarca and Long (1980) re examined this relationship with the same data for the USA for 1947–1972 period but surprisingly could not established any significant relationship between variables. To further unravel the controversy with respect to the mixed result from the US data, Erol and Yu (1987) extended the analysis to incorporate five developed countries namely England, France, Italy, Germany, Canada and Japan with the data of 1952–1982. The result from the study were mixed and varied across the countries. While the study found bidirectional for Japan, unidirectional from energy consumption to GDP for Canada and unidirectional from GDP to energy consumption for Germany and Italy, they could not find any causality for France and England. Issues were raised about these results especially on methodological approaches adopted by the studies. For instance, it was observed that the studies adopted bivariate models. Stern (1993) claimed that causality relationship in bivariate models is not healthy since the substitution effect of energy with other variables is ignored. In view of this Stern (1993) then examined the relationship between the USA's energy consumption and GDP with a multivariate cointegration model but still could not find a significant causal relationship. Not satisfied with the earlier result, Stern (2000) reexamined the causality between energy consumption and GDP for the USA for the period between 1948 and 1994 with a multivariate model and the results supported his previous study.

With respect to developing countries, Soytas, Sari and Ozdemir (2001) examined the relationship between energy consumption and GDP for Turkey for the period between 1960 and 1995 and found a unidirectional causality relationship from energy consumption to GDP for that period. When we look at the literature on energy, besides studies which study energy as a whole, also there are studies which examine energy by separating it into its sub-components such as electricity and petroleum. Ghosh (2002) examined economic growth and electricity consumption of India between 1950 and 1997. As a result of the study, he found a unidirectional causality relationship from economic growth to electricity consumption. Jumbe (2004) examined the relationship between electricity consumption and GDP for Malawi for the period between 1970 and 1999 and found a bidirectional causality relationship. However, when he examined the relationship between non-agriculture GDP and electricity consumption, he found a unidirectional causality relationship from GDP to energy consumption. Rufael (2006) examined the relationship between electricity consumption and GDP for 17 African countries for the period between 1971 and 2001 with limit test approach and found cointegration relationship in 9 countries and Granger causality relationship for 12 countries. While the direction of causality is from GDP to electricity consumption in 6 of these countries and from electricity consumption to GDP in 3 of them; bidirectional causality was found in 3 countries. In the literature, there is not enough study which investigates oil consumption and GNP interaction except Zou and Chau (2005). Zou and Chau (2005) found no cointegration between oil consumption and GDP, in China for the period of 1953-2002. Due to liberalization of China's economy in 1984; they separate these periods into 1953-1984 and 1985-2002. They found cointegration relationship between oil consumption and GDP. In 1953-1984 periods, they found no causality between oil consumption and GDP in the

short run; conversely, they found bidirectional causality in the long run. In 1985-2002 period; in short run they found unidirectional causality from oil consumption to GDP, however, in long run there is bidirectional causality as observed in 1953-1984 period.

Erbaykal(2008) used oil and electricity consumption as measures of energy consumption. He then investigated the causal relationship between these two measures of energy consumption and economic growth for 1970-2003 periods in Turkey. As against earlier attempt the paper employed Bounds test approach by Pesaran at al (2001) for co integration relationship and found that in short run both oil consumption and electricity consumption has positive and statistically significant effect on economic growth, however, in long run oil consumption has positively effect on economic growth while electricity consumption has negative effect. But in long run the electricity and oil consumption coefficients are statistically insignificant. We can infer both electricity and oil has short run effect on economic growth. Bekhet and Yusop (2009) examine the relationship oil price, energy consumption employment and economic growth in Malaysia. The study found that the long run relationship between energy consumption and economic growth is stable and found bidirectional causality between economic employment and energy consumption. Pradhan (2010) explores the nexus between energy consumption (oil and electricity) and economic growth in the five SAARC countries over the period 1970-2006. Using cointegration and Error Correction Model (ECM), the paper finds a unidirectional short run and long run causality from oil consumption to economic growth in Bangladesh and Nepal, a unidirectional short run and long run causality from electricity consumption to economic growth in Pakistan and Sri Lanka, a unidirectional short run and long run causality from economic growth to oil consumption in India and Sri Lanka, and a unidirectional causality from economic growth to electricity consumption in India and Nepal. It also finds the bidirectional causality between electricity consumption and economic growth in Bangladesh and between oil consumption and economic growth in Pakistan. The paper at the end suggests that energy and environmental policies should recognize the differences in the energy consumption-growth nexus in order to maintain sustainable economic growth in the region.

Existing studies on Nigeria either examined causality between energy consumption (Odularu and Okonkwo, 2009), Omotor, 2008 and Subair and Oke, 2008) and growth or oil price and growth (Olomola and Adejumo et al (2006). Ebohon (1996) examined the causality nexus between energy consumption and economic growth for Nigeria and Tanzania. The study found a simultaneous causal relationship between energy consumption and economic growth for Tanzania and Nigeria. None of them attempted to incorporate both the oil price and energy consumption simultaneously in analyzing the energy –growth relationship in Nigeria. This paper aims to break the silence in the empirical literature pertaining to the relationship between energy consumption, oil price and macroeconomic performance in the Nigerian context.

EMPIRICAL METHODOLOGY

Empirical Model

Two different but not mutual exclusive approaches have been adopted in the literature in tracing the nexus between energy consumption and economic growth. First, regression approach (Pachauri, 1977), where there is little attention to direction of causality and second, causality approach (Odhiambo, 2009; Bowden and Payne, 2009; Yuan et al. 2008), where there is high stress on the direction of causality. This paper attempt to combine the two approaches they can be netted within the vector error correction mechanism adopted in this paper. The central issue in the causal relationship between economic growth and energy consumption has been whether economic growth stimulates energy consumption or is energy consumption itself a stimulus for economic growth via indirect channels of effective aggregate demand, improved overall efficiency and technological progress (Ghosh and Basu, 2006). There are two related hypotheses on the nexus between energy consumption and economic growth: energy - led- growth hypothesis and growth- led- energy hypothesis. The investigation of these two hypotheses is well established in the development literature, yet the outcomes remain inconsistent and controversial. Pradhan had attributed the controversy over the results from the existing studies to various structural frameworks and policies followed by different countries under different conditions and time periods. Apergis and Payne (2009), Balat (2008), Chiou-Wei et al., (2008), Lee and Chang (2007,2008), Mahadevan and Asafu- Adjaye, (2007); Hatemi-J and Irandoust, (2005) attributed the controversy to differences in methodology, various proxies for energy consumption and growth, presence of omitted variables, varying energy consumption patterns, etc. Of all these shortcoming, the omitted variable is the most critical error among all others as it impedes the ability to determine the indirect channels through which the either energy consumption or economic growth impacted on each other when causality was not established between them.

The paper employs a 4-variable VAR model. The model incorporates oil price and private investment in addition to energy consumption and economic growth that have been the standard variables in the existing studies is to correct for this omitted variable error.. The oil price is included to capture the external shock, which may be an important factor in determining energy demand and overall economic growth and stability while private investment is included as conditioning variables. Also it might provide an indirect channel through which energy consumption could affect economic growth. In order to capture the causality relationship between oil price, energy consumption, investment and real economic growth and to account for possible feedback effects from the short run fluctuations to the long run steady state of the relationship between the key variables, the model is expressed in the form that allows for the testing of both unit root and cointegration. Therefore, the granger causality test is done in the error correction method (ECM).

$$\Delta EC_t = \sum_{j=1}^{p} \delta_{1j} \Delta EC_{t-1} + \sum_{j=1}^{p} \beta_{1j} \Delta OILP_{t-1} + \sum_{j=1}^{p} \alpha_{1j} \Delta MEV_{t-1} + \varphi_1 ECM_{1_{t-1}} + u_t \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\Delta OILP_t = \sum_{j=1}^{p} \delta_{2j} \Delta EC_{t-1} + \sum_{j=1}^{p} \beta_{2j} \Delta OILP_{t-1} + \sum_{j=1}^{p} \alpha_{2j} \Delta MEV_{t-1} \varphi_2 ECM_{2_{t-1}} + u_t \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\Delta MEV_t = \sum_{j=1}^{p} \delta_{3j} \Delta EC_{t-1} + \sum_{j=1}^{p} \beta_{3j} \Delta OILP_{t-1} + \sum_{j=1}^{p} \alpha_{3j} \Delta MEV_{t-1} \varphi_3 ECM_{3_{t-1}} + u_t \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Where MEV = macroeconomic variables in this case real economic growth (GDP and Private investment (PINV), OilP= international oil Price Indices, EC= Energy Consumption and ECM_1 ...ECM_3 are the lagged values of the error correction term from the cointegration equations for each variable.

Models 1 to 3 imply four possible relationships between energy consumption and economic growth: unidirectional causality from energy consumption to economic growth (i.e. growth hypothesis), unidirectional causality from economic growth to energy consumption (i.e. conservation hypothesis), bi-directional causality from energy consumption to economic growth (i.e. feedback hypothesis) and no causality between energy consumption and economic growth (i.e. neutrality hypothesis) (Pradhan 2010). The four hypotheses form the nucleus of the issues subjected to investigating in this paper.

Data Description and Analytical Technique

The paper uses annual data to examine the relationship between oil price, private investment, economic growth and energy consumption for Nigeria for the period 1970 to 2009. The annual data on total energy consumption measured in British thermal unit (Btu) were collected from Energy Information Administration (EIA) online database (www.eia.com) energy statistics. The real GDP was measured in constant price (2000 as base year) denominated in US Dollars and was taken from International Financial Statistics (IFS). Gross capital Formation and Average World Oil Prices dominated in US Dollars in constant price (2000as the base year) were taken from World Economic Indicators. All the variables were expressed in log forms before the analysis.

The cointegration analysis of Johansen (1990, 1991) and Vector Error Correction Model (VECM) are employed to investigate the linkages between energy consumption and economic growth and private investment. Using the above VECM technique four steps were involved. The first step involving testing the stationarity of the series or their order of integration as the series need to be integrated of same order as implied by Equation 1to 3. The second step is to examine the presence of a long run relationship among the variables in equations. However, the long run coefficients are estimated using the associated cointegration model proposed by Johanse and Julieus (1990). Once the cointegration is confirmed in the model, the residuals from the equilibrium regression can be used to estimate the error correction model in the third step. Finally, the fort step involves conducting Granger causality/Wald Lag Restriction test to determine the direction and the significance of the causal relationship among the variables. The validity and efficiency of VECM model depend crucially on the lag structure. The model lag length selection was determined by both Schwarz (SIC) and Akaike (AIC) Information Criterion.

EMPIRICAL RESULTS AND DISCUSSION

Unit Root Tests

The first and prime step of the nexus between energy consumption and economic growth requires that all the variables should be integrated of same order, specifically, I(I). The ADF and PP tests are deployed for investigating the same. The estimated results of these variables are reported in Table 1. Table 1 shows that all variables were not stationary at their levels for ADF and P-P test, since the *p*-value for all series are not significant. The null hypothesis of unit roots at all level is then rejected. However, when the variables were expressed in first difference forms, the null hypothesis that the growth rate forms of all the variables are non stationary could not be rejected. The P-value becomes significant at 1% and 5% for all the variables with ADF tests and in the case of P-P test ,except oil price which was significant only at 10% critical values, all other variables were significant at 5% . This therefore precludes the existence of unit root in the variables when their I(I) series.

Cointegration Tests

The Johansen multivariate cointegration test is deployed. The estimated results are reported in Tables 2. The cointegration test uses an intercept but no trend. The estimation procedure of Johansen test is very sensitive to the choice of lag length. The Schwarz Bayesian Information criterion (SBC) is used to fix the optimal lag length. The estimated results indicate that the two series have one cointegrating relationship (see Table 2). This is because the null hypothesis of H0: $r = 0$ against $r \leq 1$ is rejected at 1% level. Hence, the superiority of Johansen's approach compared to Engle Granger's residual based approach lies in the fact that Johansen's technique is capable of detecting multiple cointegrating relationships among the variables (Asafu-Adjaye, 2000 and Pradhan 2010). The above results confirm that there is long run equilibrium relationship between energy consumption and measures of macroeconomic performance in Nigeria. The presence of co-integration among these variables is consistent with results found by other studies such as Ghosh (2002), Fatai et al (2004), Hatemi and Irandoust (2005), Maamor et al. (2005) and Bekhet and Yutop (2009) which had established the presence of co-integration relationship between energy consumption and macroeconomic variables like economic growth and employment in the long run for Malaysia. Pedroni (2004) also, indicated at least one co-integrating relation for the panel of 19 European countries, which confirmed the presence of long run relationship between the energy consumption, economic growth and energy price and Pradhan (2010) established similar long run relationship for SAAR countries. In addition, the Johansen procedure is used to obtain the long-run coefficients of the model as shown the table 2

Table 1: ADF and P-P Unit root Tests for Stationarity

	ADF				P-P			
	Level		First Differences		Level		First Differences	
	t-stat	p-value	t-stat	p-value	t-stat	p-value	t-stat	p-value
LEC	-2.126	0.236	-3.767	0.008[a]	-2.404	0.150	-3.504	0.016[b]
LRGDP	0.972	0.995	-5.002	0.000[a]	1.343	0.998	-5.388	0.000[a]
LPRINV	0.440	0.981	-3.804	0.008[a]	0.581	0.987	-2.897	0.058[c]
LOILP	-0.681	0.836	-5.977	0.000[a]	-0.526	0.872	-6.018	0.000[a]
McKonnon Critical values								
1%	-3.689		-3.700		-3.689		-3.700	
5%	-2.972		-2.976		-2.972		-2.976	
10%	-2.625		-2.627		-2.625		-2.627	

Note: * indicates the one sided p-value for testing the null hypothesis that the variables have a unit root or non-stationary, a, b & c indicate the significance level of 1%, 5% & 10% respectively
LEC= log of energy consumption, LRGDP= log of Real gross domestic product, LPRINV= log of Gross capital formation, LOILP= log of oil price indices

Table 2: Long Run Cointegration Equations

	MODEL 1			MODEL 2		
	LEC	LRGDP	LPRINY	LEC	LRGDP	LPRINY
C	-30.58	-28.96	26.32	-25.87	-30.75	33.95
LEC	-	0.94(11.4)	-8.56(-9.3)	-	1.18 (10.9)	-12.9 (-8.1)
LRGDP	1.06(9.7)	-	-9.02(-28.8)	0.84(8.4)	-	-10.88 (-18.0)
LPRINY	-0.11(-6.9)	-0.11(-25.3)	-	-0.77(-4.9)	-0.09(-14.3)	-
LOILP	-0.03(-2.0)	-0.03(-2.4)	0.224(2.6)	-	-	-

Note: the variables were as defined in table 1. Model 2 excluded the oil price variable

Table 2 has two sections. Section I contains estimates of model that include oil price while section two contains estimates without oil price variable. The results from the two models show that the real GDP and level of investment are significant determinants of energy consumption function. The coefficient of GDP was (1.06) and 0.841 respectively on energy consumption which implies that the value of income (GDP) elasticity of demand for energy is greater than unity for model 1 but less than unity for the second model. The exclusion of oil price therefore reduces the income elasticity of energy consumption, thus implying that real GDP growth has significant impact on energy consumption through an oil price channel. This confirms the earlier proposition that that there could be indirect causality between energy consumption and

economic growth. This result is in line with the Bekhet and Yusop (1.77, 1.48) and Goldstein-Khan values [1.0, 2.0] for typical income elasticity (Bekhet and Yusop, 2009, Goldstein and Khan, 1985). The positive relationship between energy use and economic growth is also consistent with finding from other studies (such as Stern 2000; Ghosh 2002; Fatai et al 2004; and Hatemi and Irandoust 2005) which also reported strong positive relationship between economic growth and energy consumption in other developing countries like Malaysia and Turkey. The real output and investment equation also show that energy consumption was a significant determinants of macroeconomic performance in Nigeria. The effect of energy consumption on real output and investment is positive and negative respectively which implies that increased energy consumption could promote economic growth but may depress real capital formation in Nigeria.

Vector Error-Correction Models (VECM)

The third and fourth steps involve the estimation of the VECM model. The VECM reports causality from two dimensions. the t-tests of the 'differenced' explanatory variables give an indication of the 'short-term' causal effects, whereas the 'long-run' causal relationship is implied through the significance of the 't' test(s) for the lagged error-correction term(s) (ECM) which contains the long-term information since it is derived from the long-run co-integrating relationship(s). In order to determine the lag length of the VAR model, information theoretic model selection criteria attributed to Schwarz (1978) (Schwarz information criteria) were considered. Based on this procedure, a VAR [1,2] specification was selected for this analysis. The estimated error correction model and the VECM granger causality conducted through Wald Test are reported in table 3 and 4 below.

The estimates in the short run model (Table 3) show that economic growth and oil price are not significant in explaining energy consumption. Private investment has negative significant effect on energy consumption in short run. However, when oil price is excluded real income/output become significant though at 10% critical level. In both cases, the coefficient on real income is greater than one thus suggesting that the energy consumption is income elastic. In the case of the effect of energy consumption on real income/ GDP, the results show that energy consumption is not significant in two models.

The income and price elasticity estimates are similar to the long run estimates and consistent with other estimates from other similar studies in other countries. The significant value of real income in the energy consumption function would indicate that in the short run there is positive unidirectional causality running from real income to energy consumption. This result was consistent for both models, captured by Wald test where P-value is significant at 10% level. These results inferred that the growth rate of national income would lead to more demand for energy consumption. The positive unidirectional causality running from economic growth to energy consumption seems to be more consistent with studies for other developing countries (see, e.g., Ghosh 2002;Fatai et al. 2004; Hatemi and Irandoust 2005; and Jay Squalli 2006).

Moreover, the coefficients of private investment for model 1 and II were -0.121.09 and -0.125 respectively, and were the most effective coefficient among all the variables. This means that, if holding other independent variables constant and investment increases by 100%, the energy demand will decrease nearly by 12%. Then, it can be concluded that the energy demand is very sensitive to the level of investment. Also, this means that there is significant negative unidirectional causality

running from private investment to energy consumption at 1% and 5% level. In other words, the increase of the private investment level leads to the decrease of energy consumption, and vice versa. The negative relationship between investment and energy consumption can be explained by the energy saving policy. Also energy consumption also has significant negative effect on private investment. Therefore private investment causes energy consumption and energy consumption also causes private investment. Thus, suggesting bidirectional causality from energy consumption to private investment. The estimated models also indicate that the null hypothesis which is world oil price does not influence energy consumption, cannot be rejected at any significance level. This means that in short run the changes in world oil price does not affect the energy consumption in Nigeria. Also, there is significant causality between oil price and energy consumption. However, if the world oil price increases, the energy consumption will decrease. Private investment also has unidirectional causal effect on economic growth especially when oil price is excluded from the model albeit at 10% level of significance.

The estimated coefficient of the error correction term (ECMt-1) for Model I and Model II are highly significant at 1% and 5% level except for private investment in model 2. This suggests the validity of a long run equilibrium relationship among the variables. In other words, the energy consumption system has corrected its previous period's disequilibrium for the long term. However, if the changes of energy consumption are driven directly by this long-run equilibrium error, then it is responding to this feedback by 176 % of speed adjustment. In other words, when the variables are found to be co-integrated in this equation, in the short-term, deviations from this long-run equilibrium will feed back on the changes in the dependent variable in order to force the movement towards the long-run equilibrium. If the two models above are compared, Model 1, which included oil price as the channel of causalities, the speed of adjustment, is 176% which is lower than the speed adjustment of Model II (209%). These results indicate that the system that included oil price variable corrects its previous disequilibrium more sluggishly and sticky than the second model. This is consistent with Nigerian government restraint to respond to oil price shock. Nigeria domestic fuel price is not market driven. The fuel price is subsidized and current fuel price (N65) per litre was fixed since 2008 in order to insulate the economy from the price shock. Such policy helps to control the adverse effects on the economy, which in turn could help stabilize the domestic oil price around it mean value.

The oil price model also indicates that in the short run world oil price become an exogenous variable, since all independent variables are not significant, even at 10% significance level. The error correction term (ECM) is also not significant, as showed by P-value (0.345). The non-significance of t –stat and Wald Chi-square tests indicated the presence of econometric exogeneity of the dependent variables (Granger, 1986). These results were quite similar to Glasure's (2002) findings. The error correction term (ECMt-1) is only significant in the energy consumption model. So, it can be concluded that in the short-term, for any deviations from long-run equilibrium, the energy consumption will feed back on the changes in the independent variables in order to force the movement towards the long-run equilibrium. If energy consumption is driven directly by this long-run equilibrium error, then it is responding to this feedback. The coefficient estimate of error correction term of -1.76 for the Model 1 means that when there is an exogenous shock on the model, the system corrects it disequilibrium by 176% speed of adjustment per year in order to return to the equilibrium. Also, both models show that the energy consumption has shown negative sign of ECM which is indicating a move back towards equilibrium. However, the positive sign of error

correction term in the case of economic growth equation indicates that the systems in the model are moving away from equilibrium (Granger, 1978).

The overall VECM causality results can be summarized as represented in Figure 1 shows that there is short run causality running from energy consumption to private investment, private investment to energy consumption and real income/ GDP to energy consumption. In other words, the VECM causality test indicated that in the short run there are positive unidirectional causality effects running from real income to energy consumption however the opposite does not hold in Nigerian context. Besides that, there is negative bidirectional causality effect between energy consumption and private investment, and vice versa, which means that changes in energy consumption and investment affect each other. Also there is a unidirectional causality from investment to economic growth. The long run causality shows that there are bidirectional causality among all the four variables. In the case of Nigeria, the world oil price becomes an exogenous variable since all independent variables in oil price model are not significant

Table 3: Short Run Estimates for Model with and Without Oil Price

	Model I				Model II		
Error Correction:	D(LEC)	D(LOILP)	D(LRGDP)	D(LPRINV)	D(LEC)	D(LRGDP)	D(LPRINV)
CointEq1	**-1.7588**	**-5.51635**	**1.049963**	**3.856273**	**-2.094362**	**1.280386**	2.142137
	[-3.062]	[-1.478]	**[2.58963]**	**[2.18415]**	**[-4.45816]**	**[4.16715]**	[1.23934]
D(LEC(-1))	0.645668	3.633906	-0.484201	-0.62923	0.63542	-0.436481	0.23625
	[0.93598]	[0.81078]	[-0.99437]	[-0.29674]	[1.09969]	[-1.15497]	[0.11113]
D(LEC(-2))	-0.96657	-5.64311	-0.513588	**-4.475355**	-1.02694	-0.424547	**-4.373192**
	[-1.582]	[-1.422]	[-1.19159]	**[-2.38446]**	[-1.92871]	[-1.21911]	**[-2.23233]**
D(LOILP(-1))	-0.05184	**-0.6094**	0.039286	0.079991			
	[-1.030]	**[-1.865]**	[1.10664]	[0.51744]			
D(LOILP(-2))	-0.01095	-0.38018	0.02243	0.106841			
	[-0.236]	[-1.261]	[0.68532]	[0.74963]			
D(LRGDP(-1))	1.364046	7.383864	-0.663299	-0.256149	**1.105038**	-0.455644	1.553581
	[1.57158]	[1.30938]	[-1.08264]	[-0.09601]	**[1.72420]**	[-1.08700]	[0.65884]
D(LRGDP(-2))	-0.28272	-2.94435	-0.835614	**-4.159027**	-0.31496	-0.753983	-3.052809
	[-0.369]	[-0.592]	[-1.54861]	**[-1.77002]**	[-0.51147]	[-1.87206]	[-1.34741]
D(LPRINV(-1))	**-0.12134**	0.03947	0.022563	**0.365989**	**-0.124984**	0.021768	0.290125
	[-2.042]	[0.10225]	[0.53799]	**[2.00402]**	**[-2.49374]**	[0.66407]	[1.57333]
D(LPRINV(-2))	0.010135	-0.23722	0.059346	-0.147927	0.032259	**0.05368**	-0.258842
	[0.18668]	[-0.672]	[1.54866]	[-0.88647]	[0.71129]	**[1.80968]**	[-1.55120]
Adj R-squared	0.587554	0.329818	0.470435	0.757162	0.629946	0.592094	0.687843

Note: The variables and Symbols are defined earlier

Table 4: ***VECM Granger Causality Wald Test Result Interpretation***

Model I				**Model II**			
Dependent variable: D(LEC)							
Exclude	Chi-sq	df	Prob.	Exclude	Chi-sq	df	Prob.
D(LOILP)	1.217841	2	0.5439				
D(LRGDP)	3.512585	2	0.1727	D(LRGDP)	3.674177	2	**0.100**
D(LPRINV)	4.197275	2	0.1226	D(LPRINV)	6.260535	2	**0.0437**
All	8.227450	6	0.2219	All	8.395649	4	**0.0781**
Dependent variable: D(LOILP)							
Exclude	Chi-sq	df	Prob.				
D(LEC)	2.926751	2	0.2315				
D(LRGDP)	3.053227	2	0.2173				
D(LPRINV)	0.452469	2	0.7975				
All	6.628872	6	0.3565				
Dependent variable: D(LRGDP)							
Exclude	Chi-sq	df	Prob.	Exclude	Chi-sq	df	Prob.
D(LEC)	2.203093	2	0.3324	D(LEC)	2.754694	2	0.2522
D(LOILP)	1.233343	2	0.5397				
D(LPRINV)	3.058542	2	0.2167	D(LPRINV)	4.393259	2	**0.1012**
All	4.430639	6	0.6186	All	5.999678	4	0.1992
Dependent variable: D(LPRINV)							
Exclude	Chi-sq	df	Prob.	Exclude	Chi-sq	df	Prob.
D(LEC)	5.690555	2	**0.0581**	D(LEC)	5.010292	2	**0.0817**
D(LOILP)	0.578015	2	0.7490				
D(LRGDP)	3.491404	2	0.1745	D(LRGDP)	2.658139	2	0.2647
All	7.658270	6	0.2642	All	8.718974	4	**0.0685**

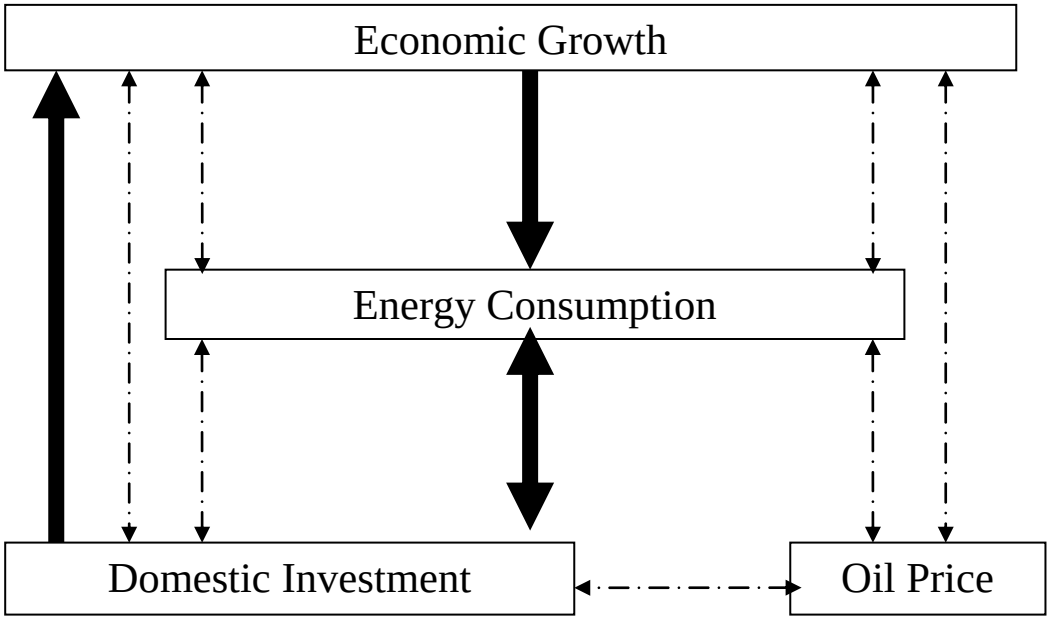

Figure 1.Scemtic illustration of Direction of Causality among the variables

Note: The bold arrow indicate short run causality while the dotted light arrows represent the long run causality. The double edged arrow implies bidirectional causality while single arrow indicates unidirectional causality.

CONCLUSION AND POLICY RECOMMENDATION:

The linkages and causal effects among the oil price, energy consumption and macroeconomic performance have been examined and the results show that domestic investment and economic growth are key determinants of energy consumption while energy consumption causal effects on domestic investment. Private investment was also a key determinant of economic growth but oil price was not found to be any significant in the causal relationship in the short run. These findings provide some insights with respect to the role of energy consumption in economic growth and also serve as basis for discussing energy and environmental policies.

One, the observed unidirectional causality from economic growth to energy consumption, implies that the country is not entirely dependent on energy consumption for its economic growth. Hence, energy conservation policies can be implemented with little or no adverse effects on economic growth. In other words, energy conservation policies might be initiated without any negative effect on economic growth (Boehm, 2007). That means result from this paper supports the conservation hypothesis with respect to Nigeria economy. An increase in economic growth causes an increase in energy consumption. The findings of this study which is a unidirectional running from economic growth to energy consumption have also been supported by the previous research. They found the unidirectional causality from GNP growth to energy consumption for the

USA for the period of 1947-1974. Moreover, in the long run there is also positive effect from economic growth to total energy consumption which may imply that energy policy especially would have significant impacts on economic growth in the long run. Importantly, the estimated results would infer that the presence energy policy has significant impact on economic growth in Nigeria in the long run but not in the short run. This finding then suggest the need for implementation of energy conservation policy that relates to energy saving and efficiency policies which is gaining attention in global energy discussion in recent times. For instance Malaysia has introduced energy conservation policy since 1999 under a "four fuel" strategy aimed at reducing the country's dependence on oil revenue (Malaysia Report, 2008).

Two, the bidirectional causality between energy consumption and private investment implies that a high level of domestic investment leads to high level of energy demand and vice versa. That means they are interrelated and may very well serve as complements to each other in overall macroeconomic development (Lee, 2005, Apergis and Payne, 2009). However, establishing negative relationship between investment and energy used has important policy implications. The energy dependence interpretation becomes less intuitive and is open to other alternative interpretations (Lee, 2005). In fact, when causality flows negatively from energy to domestic investment, the increase of energy consumption would lead to lower domestic investment. Conversely, when causality flows negatively from domestic investment to energy, the increase of investment would result in reduced energy consumption. The interpretation of such causality is not as clear as several factors may be the culprits in the adverse impact on energy.

One of such factor is oil price which may put upward pressure on energy consumptionit. Nigerian economy is also being constrained by political, infrastructural, or mismanagement of resources which might generate inefficiencies and the reduction in the demand for goods and services, including energy consumption. In this case, an increase in economic growth would have an adverse impact on energy consumption and increase in energy consumption could adversely affect macroeconomic fundamentals such domestic investment and economic growth (Squalli, 2007). In such a case, an energy policy oriented towards improvements in energy consumption efficiency would not adversely affect domestic investment and by extension economic growth. For instance, energy consumption policies aimed at declining energy use must look for some channels to reduce consumer demand in order to impede unfavourable effects on domestic investment and economic growth. Such an attempt could be achieved through an appropriate combination of energy taxes and subsidies. Policy makers should adopt investment friendly macroeconomic policy that will drive investment to key sector including energy sector, which in turn will translate into a hike on employment and income growth.

Similarly, industries should be encouraged to adopt technology that reduces pollution (Hatemi-J and Irandoust, 2005). The so called neutrality hypothesis that implies that energy conservation policies do not affect economic growth (Asafu-Adjaye, 2000; Paul and Bhattacharya, 2004) is not a Nigerian phenomenon. .

The observed significant effects of changes in world oil price on Nigeria's real GDP and energy consumption in the long run but not in the short run is consistent with theoretical expectation that there should be negative relationship between oil price and economic growth as well as energy consumption. The implication on the sustainable economic development in Nigeria is that continuous upward movement in oil prices will lead increase in government subsidies on fuel and other

essential items. Thus, the government's expenditure will rise and tax revenues would fall resulting in an increase in the country's fiscal deficit. Therefore the downstream sector of the oil sector needs to be restructured and made more transparent. Even if the fuel subsidy removal is politically difficult to implement effort must be made to increased local fuel refining which will lead to reduction in fuel subsidy and strengthen the macroeconomic management and subsequently help in promoting and sustainable the current tempo of real economic development of Nigerian economy.

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