ENERGY CONSUMPTION AND MANUFACTURINGOUTPUT IN NIGERIA

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ABSTRACT
The paper examined the relationship among electricity (ELECT), gas (GAS), coal (COAL), premium motor spirit (PMS) and manufacturing output (MOT) in Nigeria using the annual time series data spanning from 1981 to 2019 by employing the Autoregressive Distributed Lags (ARDL) Model application to cointegration and Error Correction Model techniques. Unit root test was conducted on all the variables of interest in the study. The study finds evidence that electricity and premium motor spirit have a positive, significant and dynamic impact on manufacturing output in Nigeria. Furthermore, gas consumption has positive but not significant effect on manufacturing output in Nigeria. In addition, the study reveals that there is long run relationship among electricity, gas, coal, premium motor spirit and manufacturing output in Nigeria. The finding of this study has implications for energy policy as policy makers and economic planners need to formulate and implement policies aimed at conserving energy use, improving energy efficiency and designing energy demand management. In the same vein, another policy implication with respect to the findings of the study is that, stimulating power generation through gas, which constitutes one of the components of power generation mix in Nigeria will help in addressing a lot of our macroeconomic problems because it will unequivocally enhance and improve the manufacturing sector with much needed electricity supply. The study recommends among others the adoption of energy consumption policies in favour of the variables that significantly impact manufacturing output as this will invariably enable the manufacturing sector access the needed power to improve their capacity and productivity in Nigeria.
Keywords: Electricity, Gas, Coal, Premium Motor Spirit, Manufacturing Output Growth.

JEL Classification: E5, E52, E58, E62, E63.

1. INTRODUCTION

Energy is an imperative enabler that affects many aspects of economic and human development. Thus, economic growth and development may be constrained without adequate energy capacity and access to affordable modern energy services (Ekone and Amaghionyeodiwe, 2020). In the same vein, Aseghar (2008) opines "energy is a key source of economic growth because many production and consumption activities involve energy as a basic input. Energy is one of the most important inputs for economic development'' Alam (2006) posits "energy is the indispensable force driving and impetus for everyeconomic activity". The importance of energy lies in other aspect of development as it increases foreign earnings when energy products are exported, transfer of technology in the process of exploration, production and marketing; increase in employment in energy industries; improvement of workers' welfare through increase in workers' salary and wages, improvement in infrastructure and socio-economic activities in the process of energy resource exploitation. Energy is the heart of economic growth and development in every economy and through the provision of energy, we can power our factories, and also function our various offices, hospitals, schools (Ebhotemhen, 2021). Thus in the quest for optimal development and efficient management of available energy resources, equitably allocationand efficient utilizationcan put the economy on the part of sustainable growth and development (Adegbemi, Adegbemi, Olalekan and Babatunde, 2013). Most of the energy consumed in Nigeria is from nonrenewable energy sources: Petroleum products, Hydrocarbon gas liquids, Natural gas, Coal, Nuclear energy. Crude oil, and coal are called fossil fuels because they were formed over millions of years by the action of heat from the earth's core and pressure from rock and soil on the remains (or fossils) of dead plants and creatures such as microscopic diatoms (Chinedu, Daniel and Ezekwe, 2019). More importantly, Adegbemi et al (2013) opine that energy is widely regarded as an enabler that stimulates every economic activity and without mincing words industrial production. In the same vein, electricity has been the major driving force for business sustainability in today's competitive business environment. However, distorted or uncertainty in the supply of electricity has become an impediment to the survival and profitability of smalland medium scale enterprises as this will lead to high productivity and hence overall economic growth as electricity remains a significant component of virtually any production process (Alo and Adeyemo, 2021). Nevertheless, Okungbowa and Abhulimen (2021) empirically examined the influence of energy on industrial Productivity in Nigeria as they disaggregated energy supply into: petroleum, electricity, natural gas, coal consumption, electricity price. Their results revealed the existence of a positive relationship between petroleum consumption, coal consumption, energy price, and physical capital tend to significantly impact industrial output. However, an inverse relationship exists between industrial output, natural gas, electricity, and human capital.

Most of the empirical studies in the literature focused on either testing the role of energy in stimulating economic growth or examining the direction of causality between these two variables while few empirical studies have been carried out in examining the nexus between energy consumption and manufacturing output in Nigeria. However, a general observation from these empirical studies is that the literature produced conflicting results and there is no distinct and consensus on the relationship existing between energy consumption and manufacturing output in Nigeria as past studies have been inconclusive as to what type of relationship exists between energy consumption and manufacturing output in Nigeria. As such this research question arises: what is thenature of relationship between energyconsumption and manufacturing outputin Nigeria? In order to bridge the identified knowledge gap, this study empirically investigated into the relationship between energy consumption and manufacturing output in Nigeria.The remaining part of the paper is structured as follows: Section 2 reviews relevant literature, Section 3 covers the methodology, Section 4 deals with the data analysis and results and discussion of empirical results, while Section 6 concludes the paper.

2. LITERATURE REVIEW

This section presents the theories underpinning the relationship between energy consumption, other inputs and economic productivity and itsummarizes the empirical studies on the energy-growth/productivity linkages.

2.1 Theoretical Literature

Theoretically, energy consumption contributes positively to economic growth (Stern and Cleveland, 2004). Disaggregating energy consumption into renewable and non-renewable components may cause this contribution to vary based on the energy source in consideration (Turner and Hanley, 2011; Chien and Hu, 2007; Hisnanick and Kymn, 1992).

Barnes and Floor (1996) assert that the linkages between energy use, other inputs and economic productivity varies significantly as an economy evolve, and this is described as the energy ladder as this is described as stated as follows:

$Y= f (K, H, E)$……………………………………………………………………...(2.1)

$E= E(K_E, H_E)$……………………………………………………………………….(2.2)

$H = G (H_H, L)$ ……………………………………………………………………(2.3)

Where, Y represents the production of final goods and services, K_Y stands for physical capital and H_Y stands for human capital, along with another intermediate good, E is energy services. Energy services in turn depend on physical and human capital services, K_EH_E as shown in (2.2). Accordingly, if there is more than one input (capital and natural resources), there are many alternative paths an economy can take and these paths are determined by the institutional arrangements that are assumed to exist (Ozturk,2010).

Therefore, the energy-economic growth nexus can be analyzed under four hypotheses.

The first theory states that energy usage plays a crucial role in economic growth which is known as Growth hypothesis which implies that energy consumption plays important direct and indirect roles economic growth and acts as a complement to factors of production (labour andcapital) in the production process.

The second hypothesis is the feedback hypothesis which confirms the existence of bidirectional causality between energy used and growth (Yildrim and Aslan, 2012).

The third hypothesis is the Neutrality hypothesis which states that energy use does not influence economic growth which implies that no causality exists between energy use and economic growth (Tsani, 2010).

The fourth hypothesis is known as the Conservative hypothesis which states that a unidirectional connection runs from economic growth to energy consumption (Sharma, 2010).

> *Another Theory called the second law of thermodynamics states that a minimum quantity of energy is required to carry out the transformation of matter. Since all production involves the transformation of inputs into output in some way, it, therefore, means that all such transformations require energy. According to the law of thermodynamics, no mechanized production can occur without the conversion of energy. For this reason, we expect the respective energy source to have a positive relationship with industrial output (Stern, 2012).*

2.2 Empirical Review

The literature focuses on various studies that examined the relationship between energy consumption and economic growth. Among the empirical studies carried out with respect to energy consumption and economic growth nexus.In view of this, Gbadebo, and Okonkwo (2009) investigated the relationship between energy consumption and the Nigerian economy from the period of 1970 to 2005. The energy sources used to test for this relationship were crude oil, electricity and coal. By applying the co-integration technique, the results derived infer that there exists a positive relationship between current period energy consumption and economic growth with the exception of coal which was positive.

From another perspective, Oyaromade, Adagunodo and Bamidele (2014) investigated the relationship between total energy consumption and economic growth in Nigeria and the study found no clear relationship between energy consumption and economic growth.Nwosu, Ihugba, and Osmond (2019) employed the EGARCH model to extricate only the increases in oil price and used the conditional volatility measure in the Bayesian Vector Autoregression(BVAR)model based on monthly data (1986M1 to 2015M12) for industrial production index and selected macroeconomic variables in Nigeria. Their results show that shock to oil price causes a rise in industrial production which may indicate that positive oil price increase is favourable to output growth in Nigeria. Tochukwu., Onyechi and Chukwuemeka (2021) examined the effect of carbon emission from non-renewable energy sources on renewable energy consumption in Nigeria and their results showed a positive and significant relationship with trade openness,CO_2emission from non-renewable sources and renewable energy consumption and the variables of interest in their study at 5% level of significance. Their result also showed the existence of a negative and significant relationship between urban population, GDP per capita and renewable energy consumption except oil rent which is not statistically significant at 5% level of significance. Ikhide (2021) analysed the disaggregated and combined effects of renewable and fossils energy consumption on economic growthin Nigeria and their results revealed a negative coefficient both in the short run and long run implying that a 1% increase in renewable energy consumption policy should be focused on a comprehensive examination of an optimal energy portfolio that can sustainably drive economic growth.In fact, Ogbebor and Ashakah (2021) examined the type of relationship which exists between access to electricity and economic growth in sub-Saharan Africa. The results confirm that a negative and significant relationship between access to electricity and economic growth while the other control variables used in the study except the GFCF/GDP variable were significant and correctly signed in accordance with a priori expectation.

Without mincing words, Kasim and Isik (2020) examined the impact of energy consumption on industrial growth in a transition economy: evidence from Nigeria and employed variables such as: manufacturing value added as dependent variable, electricity consumption, per capita income, exchange rate, import and export. The study revealed a negative and insignificant relationship between electricity consumption and industrial growth in Nigeria and the cointegration test established the presence of long run relationship among the variables used in their study. In addition, Abiola, Adedoyin, Henry, Adenike, Akinyomade, Olayemi and Chisaa (2021) investigated into electricity consumption and manufacturing sector performance in Nigeria and used output, employment and capital to proxy manufacturing sector performance and the evidence from their results revealed that electricity consumption and credit to manufacturing sector have a negative relationship with output. Ugwoke and Dike (2016) examined the impact of electricity supply on industrial output in Nigeria and the results showed that electricity supply and trade openness impact industrial production negatively in Nigeria and were not statistically significant. In the same vein, Chinedum and Nnadi (2016) analyzed the relationship between electricity supply and the output of the Nigerian manufacturing sector using Johansen cointegration and vector autoregression tests identified that electricity supply has an insignificant relationship with the manufacturing sector in Nigeria. Their results revealed an existence of long run relationship between electricity supply and manufacturing output in Nigeria. Adelegan and Otu (2020) estimated the impact of energy on industrial productivity in Nigeria and their study revealed that there was a direct and significant relationship between gross capital formation, gas consumption, electricity consumption and petroleum products consumption on industrial productivity in the long run in Nigeria. Bernard and Adenuga (2016a) investigated the contribution of energy consumption on output of industrial sector in Nigeria and they found an evidence of long run relationship among oil consumption, gas consumption, electricity consumption, coal consumption and industrial output in Nigeria. In addition, their study revealed that all the variables contributed positively to industrial output in Nigeria. From another perspective, Bernard and Adenuga (2016b) examined the structural effect of the energy policy on industrial output in Nigeria. They used dummy variable regression technique to analyze data on energy consumption that is, oil, gas, electricity and coal and industrial output in Nigeria and their result revealed that energy policy has significant influence on industrial output in Nigeria.

In the same vein, Agbede and Onuoha (2020) investigated the effect of electricity consumption on industrial output in Nigeria and their ARDL results revealed that there is no long run relationship among all the variables. Nkwatoh (2021) investigated the long run relationship between natural gas utilization and economic activities in Nigeria The result showed there exists a long run relationship between Natural Gas and its determinants. The finding suggests that investing in gas supply infrastructure will enhance gas utilization via power generation, LNG production and Gas-based industrial utilization and also reduce gas flaring while encouraging national growth. A policy implication with respect to this finding is that, stimulating power generation through gas, which constitutes about 60% of power generation mix in Nigeria will help in addressing a lot of our macroeconomic problems like poverty and unemployment because it will stimulate the manufacturing sector and also improve the service sector with much needed electricity supply.

Most of the studies reviewed reported conflicting results of no distinct and clear nexus between energy consumption and industrial output. However, a general observation from the few empirical studies carried out were characterized with conflicting results and there is no distinct and consensus on the relationship existing between energy consumption and manufacturing output in Nigeria. In order to fill the identified knowledge gap, the study examinedthe nexus between energyconsumption and manufacturing output in Nigeria.

3. METHOLOGY

This section explores the theoretical underpinnings of the study as well as estimation techniques adopted for data analysis.

3.1 Model Specification

Following Barnes and Floor (1996) that assert that the linkages between energy use, other inputs and economic productivity varies significantly as an economy evolve, and this is described as the energy ladder. In addition, theoretically, energy consumption contributes positively to economic growth (Stern and Cleveland, 2004). Disaggregating energy consumption into renewable and non-renewable components may cause this contribution to vary based on the energy source in consideration (Turner and Hanley, 2011; Chien and Hu, 2007; Hisnanick and Kymn, 1992).

For this reason, we expect the respective energy source to have a positive and direct relationship with manufacturing output, the model of this study is modified and set as follows:

MOT = f (PMS, GAS, ELECT, COAL) ……………………………………………… (3.1)

Where,

MOT = Manufacturing Output captured by Manufacturing output growth

PMS = Premium Motor SpiritConsumed

GAS = Gas Consumption

ELECT = Electricity Consumption

COAL = Coal Consumption

In an explicit form, it is presented as follows:

$MOT_t = \phi_0 + \phi_1 PMS_t + \phi_2 GAS_t + \phi_3 ELECT_t + \phi_4 COAL_t + U_t$ …………………….......(3.2)

Where: ϕ_0 = Constant term, ϕ_1 to ϕ_4 = coefficients and U_t = Error Term.

3.2 A Priori Expectations

$\delta MOT_t / \delta PMS > 0$, $\delta MOT_t / \delta GAS_t > 0$, $\delta MOT / \delta ELECT > 0$, $\delta MOT / \delta COAL > 0$

3.3 Estimation Techniques

Unit Root Test

The stochastic characteristics of each time series will be tested at levels for stationary in this study using Phillip-Perron unit root test.

Autoregressive Distributed Lag (ARDL) Approach to co-integration Test

This study employs the autoregressive distributed lag approach to co-integration (ARDL) proposed by Peasaran, Shine and Smith (2001) to investigate the linear empirical model specified in equation 3.2. Other co-integration techniques require all the variables to be integrated of the same order. The implementation of the ARDL test for Equation (3.2) involves the estimation of the following model:

$MOTt = \phi t + \phi 1 MOTt - 1 + \phi 2\ PMSt - 1 + \phi 3 GASt - 1 + \phi 4 ELECTt - 1 + \phi_5 COAL\ t - 1 + U_t$ ---------------------------3.3

Where, MOT_t, PMS_t, GAS_t, $ELECT_t$ and $COAL_t$ are stationary variables and U_t is a white noise.

The final step is to obtain the error of the short-run dynamic elasticities by estimating an error correction model associated with the long run estimates. This is specified as follows:

$$\Delta MOTt = C + \sum \Pi \Delta MOTt - 1 + \sum \text{'}\Omega \Delta PMSt - 1 + \sum \mu \Delta GASt - 1 + \sum \beta 3 \Delta ELECTt - 1 + \sum \delta \Delta COALt - 1 + \lambda ECM \sum t - 1 - - - - - 3.4$$

The symbols Π, 'Ω, μ,β, δ and ▯ are the short run dynamic elasticities of the model's convergence to long run equilibrium and λ is the speed of adjustment. Δ represents the first difference operator and ECM_{t-1} is the one period lagged error correction term.

$\Delta MOTt$ is the change in current manufacturing output, $\Delta MOT\text{t} - 1$ is the change in previous manufacturing output, PMS_{t-1} is the lagged premium motor spirit, $\Delta GAS\ t - 1$is the lagged Gas, $\Delta ELECTt - 1$ is the lagged electricity, $\Delta COALt - 1$ is the lagged coal.

3.4 Sources of Data

This study employed annual time series data covering 1981 to 2019. The data was collected from Central Bank of Nigeria (CBN) and National Bureau of Statistics (NBS).

4. RESULTS AND DISCUSSION OF FINDINGS

4.1 Results

Testing the Correlation Among the Series using Correlation Matrix

Table 1: Correlation Matrix of Selected Series

Series	COAL	ELECT	GAS	MOT	PMS
COAL	1.000000	0.226381	0.247557	0.083274	0.278718
ELECT	0.226381	1.000000	0.173113	-0.051090	-0.315586
GAS	0.247557	0.173113	1.000000	-0.018972	0.296518
MOT	0.083274	-0.051090	-0.018972	1.000000	0.077087
PMS	0.278718	-0.315586	0.296518	0.077087	1.000000

Source: Author's computation (2021)

The result in Table 1 gives us a preliminary idea of the relationship existing among the series indicates that electricity (ELECT) and gas (GAS) have negative correlation with manufacturing output (MOT) while premium motor spirit (PMS) and coal (COAL) have positive correlation with manufacturing output (MOT). The result gives us a preliminary idea of the relationship between MOT and each of the variables. It is inconclusive in itself because it does not measure the cause – effect relationship among the variables.

Testing the Stationarity of the Series using Unit Root Test

Table 2: Phillip-Perron Unit Root Test

Series	At Levels		1st Difference		Level of Integration
	Statistics	Probability	Statistics	Probability	
COAL	0.0103	29.4089	0.0000	134.648	1(0)
ELECT	0.7707	29.4089	0.0003	134.648	1(1)
GAS	0.9809	29.4089	0.0000	134.648	1(1)
MOT	0.0010	29.4089	0.0000	134.648	1(0)
PMS	0.0514	29.4089	0.0000	134.648	1(0)

Source: Author's computation (2021)

The result in Table 2 confirms that COAL, MOT and PMS are stationary at levels while ELECT and GAS are integrated of order one which indicates that the condition for Johansen cointegration is not met. Therefore, the Bounds Testing (or Autoregressive distributed lag (ARDL) cointegration procedure is adopted.

Testing the Long-run relationship Among the Series

Table 3: Co-integration Test based on Bound Test for GDP

F- Statistic	3.784506	
K	4	
Level of Significance	I(0) Bound	I(1) Bound
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

Source: Author's Computation (2021)

This result in Table 3 indicates the rejection of the null hypothesis of no cointegration between the dependent variable MOT and all the explanatory variables in the model implying that the estimated model for Manufacturing output establishes that the fact that a valid long-run relationship is found in the bound test. This is because the F-statistic value of 3.784506 is greater than the critical values at both the lower bound (2.56) and upper bound (3.49) using 5% significant level. Based on this, the study confirms that there is evidence of a long-run relationshipexisting among ELECT, GAS, COAL, PMS and MOT in Nigeria.

Table 4: Estimated Long-run coefficients using ARDL Technique

Variable	Coefficient	Std. Error	T-Statistic	Prob.
MOT	-0.855480	0.185948	-4.600639	0.0001
ELECT	0.884990	0.550794	1.606751	0.1189
GAS	-21.03681	25.74580	-0.817097	0.4205
COAL	-0.013559	0.083042	-0.163284	0.8714
PMS	1.762781	1.435040	1.228385	0.2292
C	-8.292615	6.268391	-1.322926	0.1962
R-squared	0.438383	Mean dependent var	0.498286	
Adjusted R-squared	0.438383	S.D. dependent var	13.68846	
S.E. of regression	10.25829	Akaike info criterion	7.522204	
Sum squared resid	3577.903	Schwarz criterion	7.566642	
Log likelihood	-130.6386	Hannan-Quinn criter.	7.537544	
Durbin-Watson stat	2.047359			

Source: Author's Computation (2021)

The estimated long-run coefficients for ARDL model in Table 4 confirms that in the long-run, electricity (ELECT)at 1.61t-statistic value has a positive impact on manufacturing output in Nigeria. Furthermore, gas (GAS) at 0.82 t-statistic was found to have a negative and significant impact on manufacturing output (MOT) in Nigeria at 5% level of significance. In addition, coal (COAL) at 0.16 t-statistic has a negative and insignificant impact on manufacturing output (MOT) in Nigeria at 5% level of significance while premium motor spirit (PMS) at 1.23 t-statistic has a positive and significant impact on manufacturing output (MOT) in Nigeria at 5% level of significance.

The Short-run Dynamic Relationship among the Series

Table 5: Short-run Dynamic Relationship among the Series using ARDL Error Correction Regression

ARDL Error Correction Regression				
Dependent Variable: D(MOT)				
Selected Model: ARDL(1,0,0,0,0)				
Sample: 1981-2019				
Included observations: 35				
ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(MOT(-1)	-0.855480	0.185948	-4.600639	0.0001
D(COAL)	-0.013559	0.083042	-0.163284	0.8714
D(ELECT)	0.884990	0.550794	1.606751	0.1189
D(GAS)	-21.03681	25.74580	-0.817097	0.4205
D(PMS)	1.762781	1.435040	1.228385	0.2292
C	-8.292615	6.268391	-1.322926	0.1962
CointEq(-1)*	-0.855480	0.165802	-5.159655	0.0000
R-squared	0.438383	Mean dependent var	0.498286	
Adjusted R-squared	0.438383	S.D. dependent var	13.68846	
S.E. of regression	10.25829	Akaike info criterion	7.522204	
Sum squared resid	3577.903	Schwarz criterion	7.566642	
Log likelihood	-130.6386	Hannan-Quinn criter.	7.537544	
Durbin-Watson stat	2.047359			

Source: Author's Computation (2021)

Table 5 confirms the error correction term is well defined since it is negative and statistically significant at 5% significant level which further affirms the presence of long-run relationship between manufacturing output (MOT) and all the independent variables in Nigeria. The coefficient is -0.855480 which implies that about 86% of any disequilibrium in manufacturing output (MOT) is corrected by the explanatory variables within one period (one year). This also shows the speed at which the model converges to equilibrium.

Testing for Structural Stability

In order to test for the stability of the model used in this paper, we applied the recursive test, cumulative sum of the recursive residuals (CUSUM) and cumulative squares of the recursive residuals. The test finds parameters instability if the plots of the Recursive test and cumulative sum of the recursive residuals (CUSUM) go outside the area between the two critical lines. The plots are shown in figures 1, 2 and 3 below:

Fig. 1: Recursive Test for Structural Stability of the Parameters

Fig. 2: CUSUM Test for Structural Stability of the Parameters

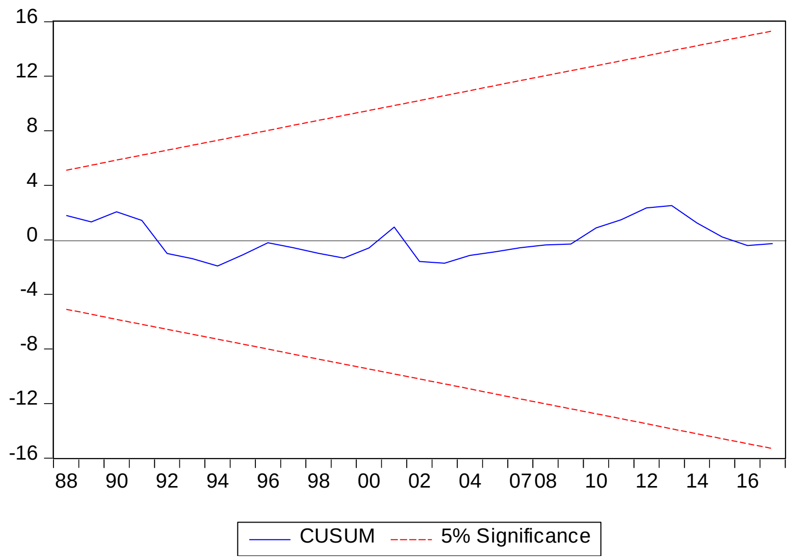
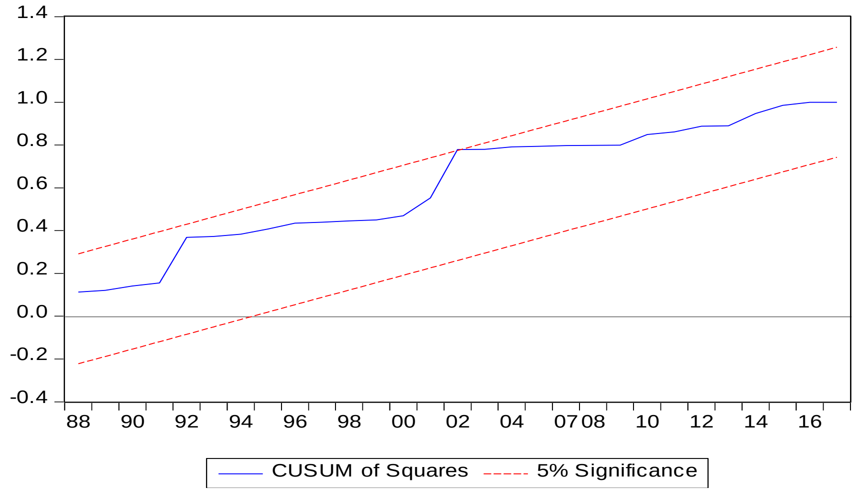


Fig. 3: CUSUM of Squares Test for Structural Stability of the Parameters



As shown in fig 1, fig 2 and fig. 3, the results are suggestive of coefficient stability since the plots did not move outside the 5% critical bound. This confirms the existence of coefficient stability for the estimated parameters for the short run dynamics and long run of manufacturing output function over the sample periods as the results indicate tendency of further coefficients stability. One can conclude that the model is well estimated and the observed data fit the model specification adequately, hence the coefficients are valid for policy discussions in Nigeria.

4.2 Discussion of Findings

Electricity has a positive, significant and dynamic impact on manufacturing output in Nigeria. In the same vein, premium motor spirit has a positive, significant and dynamic impact on manufacturing output in Nigeria. This is in line with Nwosu, Ihugba, and Osmond (2019). In contrast, coal has a negative and insignificant impact on manufacturing output in Nigeria. This result is in congruence withBernard and Adenuga (2016) whose results indicate that a long-run relationship exists between industrial output and energy consumption variables as they established that both petroleum consumption and electricity consumption were statistically significant on industrial output but coal consumption is statistically insignificant.This is in contrast with Ikhide (2021) whose results revealed that renewable and fossils energy consumption on economic growth in Nigeria have a negative coefficient both in the short run and long run.In the same vein, gas has a negative but significant and dynamic impact on manufacturing output in Nigeria. This is in contrast withBernard and Adenuga (2016) that indicate that in the long run, gas consumption has positive but not significant effect on industrial output.

The study also confirms that there is evidence of a long-run relationship existing among all the variables of interest in the study. This result is in line with Bernard and Adenuga (2016), Kasim and Isik (2020) and Okungbowa and Abhulimen (2021) whofound the evidence of significant, positive and long run relationship amongpetroleum, electricity, aggregate energy consumption andindustrial output in Nigeria. In contrast, Ugwoke and Dike (2016) and Agbede and Onuoha (2020) found no evidence of long run relationship among all thevariables.

5. CONCLUSION AND POLICY RECOMMENDATIONS

The findings of this study has implications for energy policy as policy makers and economic plannersneed to formulate and implement policies aimed at conserving energy use, improving energy efficiency and designing energy demand management. In the same vein, another policy implication with respect to the findings of the study is that, stimulating power generation through gas, which constitutes one of the component of power generation mix in Nigeria will help in addressing a lot of our macroeconomic problems such as poverty and unemployment because it will unequivocally enhance and improve the manufacturing sector with much needed electricity supply.The study recommends among others the adoption of energy consumption policies in favour of the variables that significantly impact manufacturing output in order to maximize industrial output in Nigeria. In addition, stakeholders in the real sector of the economy should pay rapt attention to energy policy especially as it relates to ensuring an adequate mix of conventional and renewable energyas this will invariably enable the manufacturing firms to access the needed power to improve their capacity and productivity. Finally, the Nigerian government should consider other salient measures to enhance regular power supply as this will invariably improve the efficiency and productivity of manufacturing sector in Nigeria.

REFERENCES

Abiola, J.A., Adedoyin, I. L., Henry, E, I., Adenike, O. O., Akinyomade, O.O., Olayemi, M.S. and Chisaa, O. I. (2021). Electricity Consumption and Manufacturing Sector Performance: Evidence from Nigeria, *International Journal of Energy Economics and Policy,* 11(4), 195 – 201.

Agbede and Onuoha (2020). Electricity Consumption and Industrial Output in Nigeria, *Akpauche: International Journal of Arts and Social Sciences,* 1(2), 74 – 83.

Adegbemi, B. O., Adegbemi, O. O., Olalekan, A. J. & Babatunde, O. O. (2013). Energy Consumption and Nigerian Economic Growth: An Empirical Analysis, *European Scientific Journal*, 9(4).

Adeyemi, A. O. & Ayomide, A. (2013). Electricity Consumption and Economic Growth in Nigeria. *Journal of Business Management and Applied Economics*, 2(4).

Asogwa, I. Ugwuanyi, C. & Anumudu, C. (2018). Determinants of Renewable Energy Use and Carbon Emission Intensity in Sub Saharan, *Journal of Economics and Allied Research,* 2(2); 66-77.

Alam, M. S. (2006). Economic growth with energy, *MPRA Paper*, No. 1260.

Barnes, D.R. & Floor, W.M. (1996). Rural Energy in Developing Countries: A Challenge for Economic Development. *Annual Review of Energy and the Environment*, 21, 497530.

Bernard, O.A. & Adenuga, O. (2016a). Is Energy Consumption Relevant to Industrial Output in Nigeria? *European Journal of Research in Social Sciences,* 4(4), 1 – 14.

Bernard, O.A. & Adenuga, O. (2016b). The Structural Effect of Energy Policy and Industrial Output in Nigeria, *International Journal of Development Research*, 6(4), 7617 – 7624.

Central Bank of Nigeria (2011). Statistical Bulletin Retrieved from www. cenbank.org

Chinedu, U. A., Daniel, O. C., & Ezekwe, U. C. (2019). Impact of Energy Consumption on Economic Growth in Nigeria: An Approach of Time Series Econometric Model. *International Journal of Academic Research in Economics and Management and Sciences,* 8(2),65–77.

Chien, T. & Hu, J.L. (2007). Renewable energy and macroeconomic efficiency of OECD and non-OECD economies. *Energy Policy*, 35(7), 3606-3615.

Ebhotemhen, W. (2021). Economic Growth and Electricity Generation in Nigeria, *Journal of Economics and Allied Research,6(1)*, 264-278.

Ekone, F. A. & Amaghionyeodiwe, L. (2020). Renewable Energy Consumption and Economic Growth in Nigeria: any Causal Relationship? *The Business and Management Review*, 11(1)

Gbadebo, O. O & Okonkwo, C. (2009). Does energy consumption contribute to Economic Performance? Empirical evidence from Nigeria, *Journal of Economics and International Finance*, 1(2), 044-058.

Hisnanick, J.J. & Kymn, K.O. (1992). The impact of disaggregated energy on productivity: a study of the U.S manufacturing sector, 1958–1985. *Energy Economics*, 14(4), 274-278.

Ikhide, E.E. (2021). Alternative Energy Consumption and Economic Growth in Nigeria, *Journal of Economics and Allied Research, 6(1***), 1-** 20.

Kassim, F. & Isik, A. (2020). Impact of Energy Consumption on Industrial Growth in a Transition Economy: Evidence from Nigeria, *Munich Personal RePEc Archive Paper*, 101757.

Nkwatoh, L.S. (2021). Testing the Long Relationship Between Natural Gas Utilization and Economic Activities in Nigeria, *Journal of Economics and Allied Research,*6(2),265-278.

Nwosu, C. A., Ihugba, O. A. &Okonkwo, O.N. (2019).Relating Oil Price Differentialsto Industrial Production in Nigeria: BVAR Approach,*Journal of Economics and Allied Research**., 3 (1),1***61-74

Okungbowa, E.F.O. & Abhulimen, M.O.(2021).Energy and Industrial Productivity in Nigeria: A Disaggregated Case, *Journal of Economics and Allied Research****, 6(1),201-*** 217.

Ogbebor, T.O. & Ashakiah, F.O. (2021). Access to Electricity and Economic Growth in Sub-Saharan Africa: Is There an Energy –Growth Nexus? *Journal of Economics and Allied Research*, 6(1), 103 – 119).

Oyaromade, R., Adagunodo, M., & Bamidele P. A. (2014). Energy Consumption and Economic Growth in Nigeria: A Causality Analysis, *International. Journal of Sustainable Energy and Environmental Research 3(1), 53-61.*

Ozturk, I. (2010). A literature survey on energy–growth nexus. *Energy Policy*, 38(1), 340349.

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

Sharma, S.S., (2010). The relationship between energy and economic growth: Empirical evidence from 66 countries. *Applied energy*, *87*(11), 3565-3574.

Stern, D.I. & Cleveland, C.J. (2004). Energy and economic growth. *Working Papers in Economics,* No. 0410. New York: Department of Economics, Rensselaer Polytechnic Institute.

Turner, K. & Hanley, N. (2011). Energy efficiency, rebound effects and the environmental Kuznets Curve. *Energy Economics*, 33(5), 709-720.

Tochukwu, G., Onyechi & Chukwuemeka C.E. (2021*).* Decarbonizing Nigeria's Energy Mix: The Role of Renewable Energy Consumption, *Journal of Economics and Allied Research, 6(2),1*2- 22.

Tsani, S.Z. (2010). Energy consumption and economic growth: a causality analysis for Greece. *Energy Economics*, 32(3), 582-590.

Ugwoke, T.I. & Dike, C.K. & Elekwa, P. 0. (2016). Electricity Consumption and Industrial Production in Nigeria, *Journal of Policy and Development Studies,*10(2), 8 -19.

Yildirim, E. & Aslan, A. (2012). Energy Consumption and Economic Growth Nexus for 17 Highly Developed OECD Countries: Further Evidence Based on Bootstrap-Corrected Causality Tests. *Energy Policy*, 51, 985-993.