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Causality Nexus Between Electricity Consumption and Growth in Nigeria Manufacturing Sector

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Abstract
The study examined the causal relationship between electricity consumption and manufacturing sector's growth in Nigeria using time series data covering the period 1986 – 2017. Multiple least square regression method was used to capture the effect of electricity consumption and other variables on manufacturing sector's growth, with the aid of Eview software. Granger causality test was conducted to examine the direction of causality between electricity consumption and manufacturing sector's growth. The study found that electricity consumption has positive and significant effect on the growth of the manufacturing sector. Also, the study revealed an evidence of unidirectional causality from manufacturing sector's growth to electricity consumption. It was also infered from the trend analysis that Electricity Consumption in Nigeria has a positive and direct impact on the growth of Nigeria Manufacturing Sector. Since the study shows how electricity is vital to manufacturing sector, any impediment to electricity will grossly affect manufacturing sector's growth. To enhance sustainable growth in manufacturing sector, appropriate reforms must come up to ensure stable electricity in Nigeria.
Keywords: Electricity consumption, Causality, Trend analysis, Manufacturing sector.
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1. Introduction

The Electricity Consumption has attracted much interest in recent times because it is seen as not only related to economic wealth but also an indicator of socioeconomic development. The demand for electricity is increasing rapidly, particularly in the developing countries.

Electricity Consumption is vital to Nigeria's wellbeing because it is used for domestic, commercial and industrial purposes in the country. Poor access to electricity in Nigeria has been a major impediment to Nigeria's economic growth.

Manufacturing sector, according to Okonjo and Osafor (2007) have been adjudged as the engine of economic growth but its performance is grossly dismal due to inadequate electricity. Manufacturing sector is the aspect of an economy that engages in the production of real goods by transforming raw materials through production process. Manufacturing is therefore the life force for sustainable economic growth: is a catalyst to the transformation of an economy from a raw material base into a more active and productive economy. For an economy to achieve sustainable growth, it is imperative to have a sound manufacturing sector. A vibrant and well-efficient manufacturing sector is a necessary impetus for rapid and favourable economic growth.

Regular and sufficient electricity is one of the most crucial determinants stimulating economic growth for any economy. Electricity is the most flexible form of energy and constitutes one of the critical resources for modern life and economic growth of any nation (Enebeli, 2010). Hence, due to few studies on electricity consumption and growth, facts on energy are also adapted for this study. Economic growth results from growth in three factors: capital input, labour input and productivity. 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).

These incidents showed that economic growth is closely related with the use of energy and caused economy to be defined within the context of energy (Jobert and Karanfil, 2007). Costantini and Martini (2009) argue that most of the literature on energy and economic development discusses how growth affects energy use rather than vice versa. This aspect of literature considers economic growth as the main driver for energy demand (electricity consumption) and only advanced economies with a high degree of innovation capacity can decrease the consumption without reducing economic growth.

1.1 Problem Statement / Justification

Previous theoretical and empirical studies were either centred on "energy consumption and economic growth in Nigeria" or "electricity consumption and economic growth in Nigeria". This study moved further by examining the causality nexus between electricity consumption and growth of the manufacturing sector in Nigeria.

Poor electricity distibution is perhaps the greatest infrastructural problem confronting the manufacturing

sector. The Manufacturing and other sectors of the economy experiences power failure or voltage fluctuations about seven times per week, each lasting for about two hours, without the benefit of notice to electricity consumer (Adenikinju, 2003). This is a major factor that affects the smooth operation of the manufacturing sector. Hence, the need to examine the causal link between electricity consumption and growth of manufacturing sector in Nigeria. This is different from the studies on electricity consumption and economic growth.

1.2 Objectives of the study.
The study examined the effect of electricity consumption and some other variables on economic growth. It also examined the causality nexus between electricity consumption and growth of manufacturing sector in Nigeria. The linkage of electricity consumption and manufacturing growth were also examined by thier trends flow.

2. Literature Review

The link connecting electricity consumption with GDP has been an issue of intense debate in the literature. Scholars are still unable to arrive at an agreement on the kind as well as nature of the causal relationship that connect electricity consumption with GDP. This was owing to the fact that the causal direction among economic variables and electricity consumption, in addition to the techniques utilized to build up this connection remain debatable. Due to few studies on electricity consumption and growth, facts on energy are also adapted for this study.

2.1 Theoretical review
According to Fisher –Vanden (2013), the environmental impact of energy used is influenced not only by energy intensity of output (the structural component) but also by the carbon intensity of energy (the technology component) the implication of this is that the environmental benefits of reduction in energy intensity may not be achieved if the carbon intensity of energy use is on the increase. Furthermore, if the energy rebound theory is correct, then reduction in energy intensity is not desirable for environmental sustainability. According to this theory, the more efficiently energy is used, the greater the use of energy. The implication of this is that electricity efficiency gains may cause electricity consumption to rise above the pre-efficiency levels.

2.2 Empirical Review
Soytas and Sari (2003) discovered there is no considerable causal connection between GDP and electricity consumption. Lee (2006) discovered bidirectional causality among GDP and energy consumption by utilizing a multivariate framework. Ozturk and Acaravci (2011) believe that electricity consumption and GDP have non directional causality.

Harris and Prakash (2012) investigated the economic growth and electricity nexus using co-integration with the result showing a short-term unidirectional causality from electricity consumption to economic growth. Olusanya (2012), found that electricity showed a positive relationship to economic growth in Nigeria.

In the study of Masuduzzaman, (2012), three variables (electricity consumption, GDP and investment) were modeled for Bangladesh and the results confirmed the existence of a unidirectional causality running from electricity consumption to economic growth.

Yilmaz and Hasan (2014) investigated this relationship for 21 emerging economies and found a positive relationship with bi-directional causality. The empirical work of Akinlo (2009) also discovered a bi-directional relationship between electricity consumption and economic growth.

It is very important for prospective manufacturer and policy maker to know the direction of causality between electricity consumption and growth in the manufacturing sector to stimulate smooth operation, profitability and growth.

Previous studies on the causality nexus brought contradictory results and they were not centred on manufacturing growth. There is need to further research on causality nexus between electricity and growth as related to manufacturing sector in Nigeria.

3. Data and methods of Research

The secondary data of labour, capital and electricity consumption used in this study were extracted from the World Development Indicator (WDI, 2017). The GDP from manufacturing sector (MFGDP) was used as a proxy for growth in the sector which is a common choice in literature and its data were derived from Central Bank Of Nigeria Statistical Bulletin (2017). Corruption parameter index was sourced from Transparency International record.

3.1 Modelling
The study used a Cobb-Douglas production function as adapted in the study of Hamad, Hayat and Luqman (2012) . Also, in the study of Ogundipe and Apata (2013). Their works centered on the effect of electricity consumption on economic growth. The function can be further adapted to growth in manufacturing sector:

The general form of the production function is

$Y = AK^{\alpha} L^{\beta}$ ……..(1)

$MFGDP = \beta_0 ELECT^{\beta 1} KAP^{\beta 2} LAB^{\beta 3} CPI^{\beta 4}$ ……..(2)

The expression above can be written explicitly as:

$MFGDP_t = \beta_0 + \beta_1 ELECT_t + \beta_2 KAP_t + \beta_3 LAB_t + \beta_4 CPI_t + U_t$ ……(3)

The explicit form of the model in (3) stated in log-linearized form is presented as:

$LMFGDP_t = \beta_0 + \beta_1 LELECT_t + \beta_2 LKAP_t + \beta 3 LLAB_t + \beta 4 LCPI_t + U_t$

Where:

$MFGDP_t$	=	Gross Domestic product of Manufacturing sector
$ELECT_t$	=	Electricity Consumption (kilowatt per hour)
LAB_t	=	Total labour Force
KAP_t	=	Gross Capital Formation
CPI	=	Corruption parameter Index (Proxied Corruption level)
β_0	=	Constant
$\beta_1 - \beta_4$	=	Coefficient of variable
U_t	=	Error term

It is pertinent to note that " the higher the CPI the lower the Corruption level of any country". Hence, the approximate expectation is $\beta_1 - \beta_4 > 0$

The model for granger causality test can be expressed as:

$$LMFGDP_t = \sum_{i=1}^{n} \alpha_i LELECT_{t-i} + \sum_{j=1}^{n} \beta_j LMFGDP_{t-j} + U_{1t} \text{ ……..(4)}$$

$$LELECT_t = \sum_{i=1}^{n} \lambda_i LELECT_{t-i} + \sum_{j=1}^{n} \theta LMFGDP_{t-j} + U_{2t} \text{ ……..(5)}$$

The above equation 4 and 5 is adapted for the main objective of this study which centered on the causality relationship between electricity consumption and growth in Nigerian manufacturing sector. According to Gujarrati (2003) while explaining concept of Granger Causality "If event A happens before event B, then it is possible that A is causing B. However, it is not possible that B is Causing A. Then, one can say event A granger causes event B"

4. Analysis of result

4.1 Stationarity Test.

The stationarity or otherwise of variables can strongly influence their behaviour and properties. Hence, there is need to conduct stationarity test on the variable used. If variables used in a regression model are non-stationary then the result could be spurious. The result of the Augmented Dickey Fuller (ADF) test and Philip Perron (PP) test were shown in table 1 below.

Table 1:

Variables	Level		First Difference	
	ADF	PP	ADF	PP
LMFG	-1.1497	-1.1131	-8.8075	-17.0778*
LELECT	-0.1403	-0.0322	-6.4209	-6.3859*
LKAP	-1.9405	-2.3038	-11.9005	-11.5446**
LLAB	-1.6348	-1.4706	-4.2588	-4.2626*
LCPI	-0.31433	-0.2254	-6.8215	-6.7011*

*Significance at 1% ,** Significance at 5%

Source: Author's computation 2019.

The ADF and PP result of stationary test in table 1 reveals that all the variables are stationary at 5% level of significance at first difference.

4.2 Ordinary Least Square Regression Result

The R^2 result in table 2 shows that about 87% of systematic variations in the dependent variable are explained by the independent variables. The table shows that electricity consumption (LELECT) brings about 25.3% positive and significant change to any growth in manufacturing sector (LMFGDP).

Other variables like Capital, Labour and Corruption level also bring about positive and significant effect to any change in growth of the manufacturing sector with Labour (LLAB) contributing the largest proportion 27.86734 (about 279%) while corruption free environment contribute 0.364646 about (36.4%) to any slight growth

in the manufacturing sector. It means corruption in the manufacturing sector is so minimal and controlled not to have brought negative effect to growth.

In terms of overall significance, the independent variables electricity consumption, capital, labour, and corruption level had a combined significant effect on growth of the manufacturing sector. The Durbin-Watson value of 1.89 which is very close to 2 is an indication of the absence of auto-correlation.

TABLE 2: Regression Result
Dependent Variable: LMFGDP
Method: Least Squares
Date: 04/10/19 Time: 12:39
Sample: 1986 2017
Included observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-111.6563	33.31032	-3.352003	0.0024
LELECT	2.533766	1.183170	2.141507	0.0408
LKAP	1.753362	0.481732	3.639707	0.0011
LLAB	27.86734	8.305391	3.355332	0.0024
LCPI	0.364646	0.098192	3.71336	0.0004

R-squared	0.870779	Mean dependent var	6.722773
Adjusted R-squared	0.851635	S.D. dependent var	1.726713
S.E. of regression	0.665098	Akaike info criterion	2.164835
Sum squared resid	11.94358	Schwarz criterion	2.393856
Log likelihood	-29.63736	Hannan-Quinn criter.	2.240749
F-statistic	45.48619	Durbin-Watson stat	1.898480
Prob(F-statistic)	0.000000		

Source: Author's computation 2019.

4.3 Granger Causality Test:

The Causality test using the pairwise approach shows the Causal nexus between electricity consumption and GDP of manufacturing Sector. Table 3 shows the result of Pairwise Granger Causality test that was conducted. The Prob-value of 0.046 <0.05 level of significance implies we cannot reject the Null hypothesis, that says electricity consumption (LELECT) does not Granger cause growth in manufacturing sector (LMFGD) during the observed period.

This could be a result of the irregular electricity supply to the manufacturing sector. This can be also ascribed to major reason why some big manufacturing companies in Nigeria relocated their factories to those countries where they would have better access to electricity.

The other Prob-value of 0.5925 implies growth in manufacturing sector (LMFGDP) Granger causes electricity consumptions. This means the bigger the manufacturing sector causes increase in electricity consumption.

TABLE 3:
Pairwise Granger Causality Tests
Date: 04/10/19 Time: 12:59
Sample: 1986 2017
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LELECT does not Granger Cause LMFGDP	30	3.48988	0.0461
LMFGDP does not Granger Cause LELECT		0.53459	0.5925

Source: Author's computation 2019

This causality nexus shows that growth in manufacturing sector causes increase in electricity consumption. However, this result shows that electricity consumption in Nigeria has not translated to growth in the manufacturing sector within this observed period of study.

Trend Analysis

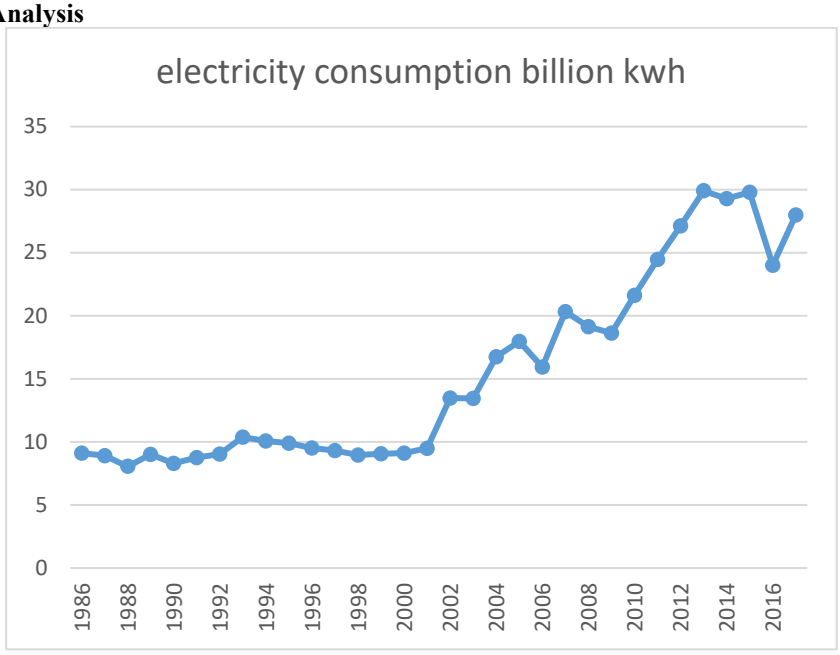

Fig 1: Trend of growth in Electricity Consumption in Nigeria
Source: Author's computation (2019)

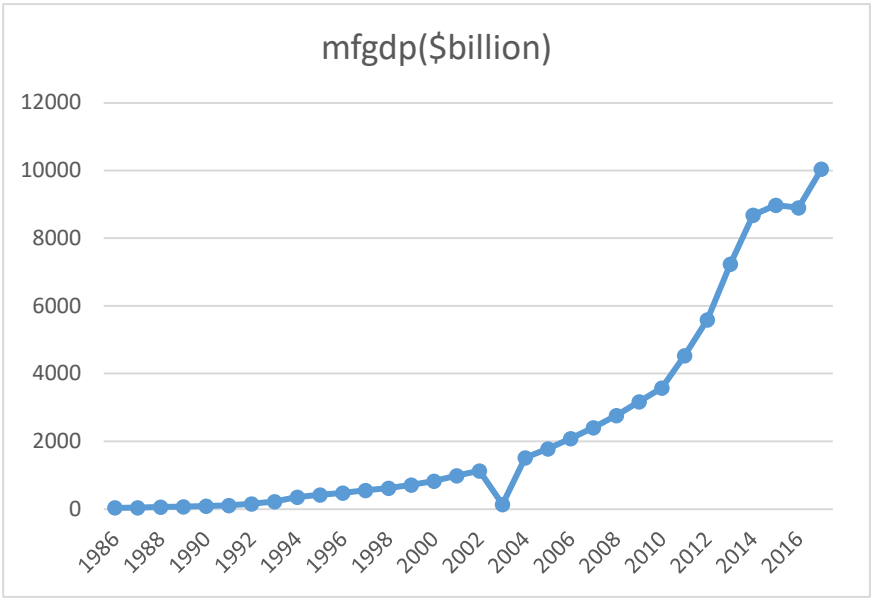

Fig 2: Trend of growth in Nigeria Manufacturing Sector

Fig 1 shows the trend in the growth in electricity consumption and fig 2 shows the trend the growth of Nigeria Manufacturing sector. It is observed in fig 1 that there is a steathy rise in the growth in electricity consumption between 1986 and 2016 with slight fluctuation between 2006 and 2010. This steathy rise in electricity consumption in Fig 1 directly tanslates to steathy rise in the growth of Nigeria Manufacturing sector in Fig 2 between 1986 and 2016 with a slight fall in 2003. Hence, it can be infered from this trend analysis that Electricity Consumption in Nigeria has a positive and direct impact on the growth of Nigeria Manufacturing Sector.

5. Conclusion and Recommendations:

This study examined the effect of Electricity consumptions, Labor, Capital and Corruption free society on the growth of the manufacturing sector. The regression result confirms that all the independent variables have positive and significant effect on growth of the manufacturing sector. The study also examined the causality nexus between electricity consumption and growth in the manufacturing sector. The result of the granger causality test revealed that manufacturing sector growth Granger causes electricity consumption. However, electricity consumption does not granger cause manufacturing growth in Nigeria for the observed period which could be ascribed to incessant

power failure in the country. There exist a unidirectional causality from manufacturing sector growth to electricity consumption. It was also infered from the trend analysis conducted that the Electricity Consumption in Nigeria has a positive and direct impact on the growth of Nigeria Manufacturing Sector for the observed period of study (1986-2017).

To enhance sustainable growth in the Nigeria manufacturing sector, appropriate reforms must be put in place to meet the growing electricity consumption in Nigeria. Electricity consumption is a catalyst to growth in the manufacturing sector. Growth in the manufacturing sector will also propel economic growth and development in Nigeria.

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