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Electricity Power Consumption and Manufacturing Sector Performance

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Abstract: *This study examined the effect of Electricity consumption on manufacturing sector performance in Nigeria. The problem of the study is hinged on poor state of power supply in Nigeria which was widely viewed as one of the major constraints to manufacturing sector performance hence economic growth Data were sourced from the CBN Statistical Bulletin and World Bank Development Indicator for the period of 1980-2019. However, to achieve the objective, Auto Regressive Distributed Lag (ARDL) techniques was used in analyzing the data. The variables used are manufacturing output which serves as the dependent variable while electricity supply, credit to manufacturing, human capital development, and Exchange rate form the independent variable. However,the result revealed that Variables such as electricity supply (ELECT), Exchange rate (EXR), Credit to Manufacturing Sector (CRMS) and Human capital development (HCD) have long and short run relationship with manufacturing output (MANOUT). Subsequently the ARDL test was carried out, with the bound test revealing that there is a long run relationship between manufacturing output and electricity supply in Nigeria, base on the findings, it was recommended that, Therefore there is a need to implement policies that will enhance electricity supply. Consequently, policy on energy and the restructuring of the electricity sector should meet up with the designed goals of enhancing electricity supply. Policy makers should therefore implement policies such that electricity should not be a barrier to the performance of the manufacturing sector.*

Keywords: *Electricity Consumption, investment, Manufacturing Output, Exchange Rate, Bank Credit to Private Sector, Human Capital Development.*

INTRODUCTION

Electrical power is an important component for the development of any economy and hence for prosperity. Besides capital and labor, it is regarded as a third important production factor in economic models (Awosope, 2014). More than eight years after the new investors took over the assets of the Power Holding Company of Nigeria (PHCN), most electricity consumers begin to testify that power supply in Nigeria has improved slightly. This is an indication that stable power supply is achievable in Nigeria. In Lagos, customers in some areas under the Ikeja and Eko Electricity Distribution Companies (IKEDC) have testified that supplies to the area have improved since August this year (Asubiojo, 2017).

Nigeria's electricity supply has shown significant improvements with the current expansion and rehabilitation of the transmissions and distribution systems. Its current generation capacity, however, still continues to hover between 3,000 and 7,000 megawatts (Ikeonu, 2017). The peak generating capacity was attained in September, 2017 reaching a whopping 7000 megawatts. In order to keep up with the population growth, this generation capacity of 7000 megawatts is plausible.

According to World Bank report cited in (Charles, 2017), in 2015, about 75 million Nigerians lacked access to adequate electricity and Nigeria was ranked highest amongst the countries with electricity access deficit when energy access, efficiency and renewable are on the rise in many developing nations. Much of the electricity distribution network at 2010 - 2016 was poorly maintained and the supply in a lot of areas was often described as epileptic in nature, characterized by extreme voltage variations, load discharges, frequent and long outages and reliance by small scale businesses, industries and affluent individuals on off-grid generation (Kuale & Jacob, 2017).

The poor state of power supply in Nigeria was widely viewed as one of the major constraints to the nation's economic growth (Joy, 2017). While Nigeria has an abundant supply of natural resources, including large reserves of oil and gas, it had one of the lowest net electricity generations (Uzor, 2017).

However, with funding from World Bank, Japan International Corporation Agency, the African Development Bank, proceeds from the sale of the National Integrated Power Project (NIPP), EXIM China and contractor-financed turnkey projects all making up funding for the power sector reform, this has helped with massive expansion of the electricity distribution networks in Nigeria (Report on good governance initiative, 2017). Nigeria loses $25 billion (N75 trillion at the current exchange rate of N305 per dollar) yearly

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due to irregular electricity supply (Charles, 2017). Besides, accumulated power sector cash deficits from January 2015 to September 2017 amounted to N931 million ($2.9 billion) (Kuale & Jacob, 2017). This is the total amount underpaid by all the distribution companies (DISCO's). A report from the Manufacturers Association of Nigeria (MAN) in 2016 show that member companies in the past years (2013 –2015) spent N20.8 billion, monthly on power generation to run production process (Ikeonu, 2017). The ripple effects of power shortages and constant outages are numerous to the industries. This ranges from cut down in production, job loss to outright closure or relocation to other countries.

Companies bear so much loss as outages often occur when goods are in the middle of production. When power is taken unannounced in the process of production, all goods are destroyed. Many MAN members generate power privately and cut of dependence on the national grid (Bacon, 1995). The consequence of incurring high cost of power generation from the industries makes the nations industries less competitive (Ikeonu, 2017).

A 2015 report on the Good Governance Initiative (GGI), say Nigerians spent N3.5 trillion on fuelling there generators annually and N2 trillion spent on running generators by over 17 million small and medium scale enterprises, banks, other corporate entities and traders across the country (Charles, 2017). It can be inferred that an improved and stable power supply is vital to boost the manufacturing sector of a country thereby improving the economy. Many functions necessary to present day living comes to a halt when the supply of energy stops or fluctuates; the greater the per capital consumption of electric power in a country, the higher the standard of living of its people (Sambo, 1987). The survival of manufacturing undertakings and our social structures depends primarily upon low cost and uninterrupted power supply. Against this background, this research work seeks to assess the impact of electricity consumption on manufacturing sector performance in Nigeria from 1980 to 2019. And the specific objectives are to: 1. Determine, the relationship between electricity supply and manufacturing output in Nigeria; 2. Examine, the relationship between credit to manufacturing sector and manufacturing output in Nigeria; 3. Determine, the relationship between human capital development and manufacturing output in Nigeria; 4. Examine, the relationship between exchange rate and manufacturing output in Nigeria

LITERATURE

Empirical Literature

Yakubu *et al.* (2015) the study examined the relationship between electricity consumption and manufacturing output in Nigeria and employed autoregressive distributed lag (ARDL) as a research technique. Annual time series data covering the period 1971 to 2010 was used. A long run relationship between the variables was observed. Manufacturing output was found to be possibly depending on electricity supply both in the short run and long run but only significant in the long run.

Allcott *et al.* (2015) conducted a study estimating the effect of electricity shortages on Indian manufacturing using Cobb-Douglas production function model. A time series data from1992 to 2010 on weather, power sector and manufacturing production was used. The results obtained revealed that power shortages slowed down production in the manufacturing sector. This resulted in revenue reduction of 5.6 to 8.6 percent for the average plant in a short run. The results have also shown that producer's surplus dropped 9.5 percent for the average plant, of which 3.9 percent was due to capital costs incurred for backup generators. It was also discovered that in the short run plants reduced their inputs in response to electricity shortages and that led to a decrease in total production.

Qazi *et al.* (2015), used the same methodology as the one that is used in this study (VAR), the focus was on how electricity consumption affect industrial output and this study focus on the supply of electricity and how it affects output.

Husain & Lean (2015) used a demand function to investigate the relationship between electricity consumption, output and price in the Malaysian manufacturing sector. The study employed annual time series data and covered the period 1978 to 2011. In the long run, electricity consumption, output and price were found to be cointegrated. Evidence of a positive relationship was found between electricity consumption and manufactured output. A long run, a unidirectional relationship from manufacturing output to electricity consumption was also obtained. Results obtained for the short run showed a unidirectional relationship running from electricity consumption to output. This indicates that in the short run, a decrease of energy usage in production might lead to a reduction in output growth.

Fisher-Vanden *et al.* (2015) conducted a study on electricity shortages and firm productivity with evidence from China's industrial firms. The study applied econometric techniques to an unbalanced panel of firm level data consisting of approximately 23000 of the most energy consuming firms in China covering the period from 1999 to 2004.For this study, it was discovered that firms in regions with greater shortages decreased factor share of electricity and increased shares of materials. No evidence was found on an increase of self-generation of electricity. From 1999 to 2004, firm costs rose by eight percent and was primarily due to input factor substitution.

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Sun & Anwar (2015) used a tri-variate vector autoregressive framework that includes entrepreneurship to examine the relationship between electricity consumption and industrial production in Singapore's manufacturing sector. Using monthly data, the study was done starting from January 1983 to February 2014. Evidence of cointegration among the variables was observed meaning that a long run relationship exists between electricity consumption, manufactured output and entrepreneurship in Singapore. It was also observed that entrepreneurship granger causes electricity consumption which causes industrial production.

Bernstein & Madlener (2015) used a cointegrated VAR approach to estimate electricity demand elasticities for eight subsectors of the German manufacturing sector. The study used annual data covering the period 1970 to 2007. In this study, a long run relationship was found in five of the eight subsectors namely food and tobacco, pulp and paper, chemicals, non-metallic minerals and transport equipment sectors. Tests on granger causality revealed evidence for the feedback hypothesis in food and tobacco and pulp and paper industries. As for chemicals, non-metallic minerals and transport equipment sectors the conservation hypothesis was observed. In the short run, the elasticity estimates were found to be economically reasonable in terms of the sign and magnitude. The impulse response function was applied in this study to trace out the dynamic behaviour of electricity demand in response to shocks in other variables. A plausible behaviour was observed as electricity demand responded positively to shocks in value added and negatively to electricity prices. On the other hand, there was no causality between residential use of energy and gross domestic product.

Adewuyi & Emmanuel (2018), examined the effect of Electricity Outages and Firm Performance across the Six Geo-Political Zones in Nigeria: The Role of Corruption Using the World Bank Enterprise Survey (WBES), the study employed a cross sectional Ordinary Least Squares (OLS) and Two-Stage Least Squares (2SLS) techniques the results of the findings indicate that, bribery does not mitigate the effect of electricity outages on firms across all the geo-political zones in Nigeria with exception of the North-East and the South-East geo-political zones.

Sabo & Lekan (2019), examine Electricity Supply and Performance of Small and Medium Enterprises in Nigeria using multiple linear regressions. The study found that, relationship exists between SMEs growth, electricity supply and firm characteristics (firm age, size and leverage). Specifically, the relationship is positively strong between SMEs growth, electricity supply and firm age whereas both firm size and leverage had a similar less relationships.

Summary of Literature

The empirical literature on studies which focused on Nigeria poses a research gap in terms of methodology used, and their main focus was on electricity supply and industry output and or GDP. This study therefore seeks to close this gap by using ARDL approach and focus on the consumption side of electricity and how it affects the manufactured output.

RESEARCH METHODOLOGY

Research Design

The research designed adopted in this study is expo factor research design. This is ideal for conducting social research when is not possible or acceptable to manipulate the characteristics of human participant. It is a substitute for true experimental research and can be used to test hypotheses about cause and effect or correlational relationships, where it is not practical or ethical to apply a true experimental design. Expo factor design uses data already collected, but not necessarily amassed research purpose

Model Specification

Our model is a linear one of the form:

MANOT=F(Xi)…………………………… (1)

Where,

MANOT = Manufacturing Output proxy by Manufacturing Value Added in Local currency and the dependent variable.

Xi = set of chosen explanatory variables.

The chosen variables are reflected in the model as

MANOT=F (ELEC, CRMS, HCD, EXR)………… (2)

Where,

MANOT = Manufacturing Output proxy by Manufacturing Value Added in Local currency and the dependent variable.

ELEC = Electricity supply proxy by electricity consumption.

CRMS= Credit to Manufacturing Sector as proxy by Credit to Private Sector.

HCD = Human Capital Development as proxy by Government Expenditure on Education and Healthcare.

EXR = Exchange Rate.

The functional form of the model

$MANOT = b_0 + b_1 ELEC + b_2\ CRMS + b_3\ HCD + b_4\ EXR + U$……………………………………………..…(3)

Where,

b_0 = intercept

$b_1 = b_4$ = coefficients of the parameters

Source Data

The data used in this study were annual data, obtained from CBN Statistical bulletin (2019) and World Bank development indicators (2019) https://data.worldbank.org/indicator.

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Economic Apriori Expectation

The economic apriori expectations of the model are as follows:

- **Electricity supply:** is expected to have a positive relationship with the independent variable (Manufacturing Output).
- **Gross Fixed Capital Formation:** is expected to have a positive relationship with the independent variable (Manufacturing Output).
- **Human Capital Development:** is expected to have a positive relationship with the independent variable (Manufacturing Output).
- **Exchange Rate:** is expected to have a negative relationship with the dependent variable (Manufacturing Output), such that an increase in exchange rate, will lead to a reduction in manufacturing output:

Table 1. *Apriori* Expectation

Variable	Direction of Effect
Electricity supply	*Positive*
CRMS	*Positive*
Human Capital Development	*Positive*
Exchange Rate	*Negative*

Dependent Variable: Manufacturing Output
Source: Researcher Compilation 2021

METHOD OF DATA ANALYSIS

ARDL Bounds Test Approach

The use of ARDL test approach is predicated on its several advantages over Johansen's cointegration method. Firstly, the ARDL efficiently determines the cointegrating relation in small sample cases (Ghatak & Siddiki, 2001; Tang, 2003), whereas Johansen's method requires large sample for validity. Secondly, Johansen's method requires that the variables must be integrated of the same order before the cointegration test is carried out, while the ARDL approach can be applied irrespective of whether the regressors are *I(1) and I(0) or mutually* cointegrated, in which the dependent variable must be *I(1)*.If the nature of the stationarity of the data is not clear, then the use of the ARDL Bounds test is appropriate. A unit root test is not necessary if a conclusion can be made from the Bounds test for cointegration (Pesaran *et al.*, 2001). Thirdly, the choice in Johansen's method are limited, when using the ARDL a large number of choices can be made including decisions regarding the number of endogenous and exogenous variables, if any, for inclusion, the treatment of deterministic elements. The other major advantage of the ARDL approach is that it can be applied to studies that have small sample size.

Diagnostic Test of the Model

The following diagnostic test of the model were carried out using, unit root test, co integration, error correction, Autoregressive Distributed Lag (ARDL) model, coefficient of multiple determination, R^2 analysis of variance

Stationarity Test

To fully explore the data generating process, we first examined the time series properties of model variables using the Augmented Dickey- Fuller test.

The ADF test regression equations with constant are:

$$\Delta Y_T = \alpha_0 + \alpha_1 Y_{T-1} + \sum_{j=1}^{k} a_j \, \Delta Y_{T-1} + \varepsilon_T \dots \quad (4)$$

Where, Δ is the first difference operator ε_T is random error term that is iid k = no of lagged differences Y = the variable. The unit root test is then carried out under the null hypothesis α = 0 against the alternative hypothesis of α < 0. Once a value for the test statistics

$$ADF_\tau = \frac{\hat{\alpha}}{SE(\alpha)} \dots\dots\dots\dots\dots\dots (5)$$

_is computed we shall compare it with the relevant critical value for the Dickey-Fuller Test. If the test statistic is greater (in absolute value) than the critical value at 5% or 1% level of significance, then the null hypothesis of α = 0 is rejected and no unit root is present. If the variables are non-stationary at level form and integrated of the same order, this implies evidence of co-integration in the model.

Autoregressive Distributed Lag (ARDL) model

The long-run relationship between two variables Y and X will explained using the ARDL approach. This approach involves first estimating the conditional error correction model (ecm) of the following after specification as:

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \sum_{t=1}^{p} \alpha_1 \Delta Y_{t-i} + \sum_{k=0}^{p} \alpha_m \Delta X_{t-i} + \delta_m X_{t-1} + \varepsilon_t ; t = 1 \dots\dots\dots\dots (6)$$

Where $\boldsymbol{Yt}$ is the dependent variable, $\boldsymbol{Xt}$ is the vector of observations of included explanatory variables in equation (4), Δ is the first difference operator, $\boldsymbol{m}$ is the number of regressors and $\boldsymbol{\varepsilon t}$ is the error term.

The test of the null hypothesis of no cointegration shall be the second step. This shall be done by restricting the coefficients of the lagged level variables equal to zero$\boldsymbol{H_0 = \partial_1 = 0 = \partial_m = 0}$ against the alternative hypothesis that $\boldsymbol{H_1 = \partial_1 = 0 = \partial_m \neq 0}$ using an F-test by estimating equation (1) by OLS. The asymptotic distribution of the F-statistic follows a non-standard distribution under the null of no cointegration as reported by Pesaran, Shin & Smith (2001), provides two stochastic simulations; the lower and the upper critical values. The lower and upper critical value assume that all variables are *I(0) and I* (1) respectively. If the estimated F-statistic appears larger than the upper bound of critical value, then the null hypothesis of no cointegration is rejected, which suggests that the variables included in the model are cointegrated. If the estimated F-statistic is smaller than the lower bound of critical value, then the decision of the null hypothesis is accepted. Again, if the F-statistic falls between the lower and upper critical value, the decision is inconclusive regarding the null hypothesis of no cointegration (Hoque & Yusop, 2010). The second step is to estimate the elasticities of the long run relationship and determine their values.

Finally, in the third step, calculation of the short run elasticities from the coefficient the first differenced variables of the ARDL model, the coefficients of the first differenced variables in the unrestricted error correction model represents short-run elasticities (Tang, 2003). To ascertain the goodness of fit of the ARDL model, relevant diagnostic tests and stability tests will be conducted. The diagnostic test examines the normality, serial correlation and heteroscedasticity associated with the models. To determine the long-run relationship among the variables of interest, we will follow Bannerjee *et al.* (1998) which used the t-test. If the calculated t-test exceeds the critical value tabulated by Bannerjee *et al.* (1998), it confirms the presence of the long-run relationship.

If there is an existence of cointegration, the final step will estimate the long-run and short-run coefficients of the selected ARDL models. In selecting the optimal lag structure (*p)* for the ARDL model in equation (1), we use Schwartz Bayesian Criterion (SBC) as this provides more parsimonious model specification, particularly for small samples (Pesaran & Pesaran, 2009). Granger causality test will be carried out to test whether there is uni-directional relationship or bi- directional relationship between foreign portfolio investment and stock market returns.

Further, the work adopted an Autoregressive Distributed Lag (ARDL) model because the variables are not integrated of the same order, they are integrated of order one and order zero. Furthermore, ARDL model can capture the long-run and short run at the same time. The ARDL model is stated as:

$$MANOT_t = \alpha_0 + \sum_{i=1}^{p} \gamma_i ELEC_{t-i} + \sum_{i=0}^{p} \beta_i CRMS_{t-i} + \sum_{i=0}^{p} \beta_i HCD_{t-i} + \sum_{i=0}^{p} \beta_i EXR_{t-i} \mu_{it} \text{.......}(7)$$

In order to obtain the cointegrating equation, equation 7 is transformed into 8 as follows:

$$\Delta MANOT_t = \alpha_0 + \sum_{i=1}^{p} \gamma_i \Delta ELEC_{t-i} + \sum_{i=0}^{p} \beta_i \Delta CRMS_{t-i} + \sum_{i=0}^{p} \beta_i \Delta HCD_{t-i} + \sum_{i=0}^{p} \beta_i \Delta EXR_{t-i} + \phi ECT + \mu_{it} \text{..}(8)$$

Where,

$$ECT_t = Y_t - \alpha_0 - \sum_{i=1}^{p} \gamma_1 \Delta Y_{t-i} - \sum_{i=0}^{p} \beta_i \Delta X_{t-i} \text{ and}$$

$$\phi = 1 - \sum_{i=1}^{p} \gamma_1 \Delta Y_{t-i} \text{.......................}(9)$$

The Bound test procedure used equations 4 and 5 into 7 as:

$$\Delta Y_t = -\sum_{i=1}^{p-1} \gamma_1 Y * \Delta Y_{t-i} + \sum_{i=0}^{p} \beta_i \Delta X_{t-i} - \rho Y_{t-1} - \alpha - \sum_{i=0}^{p} \delta X_{t-i} + \mu_{it} \text{................}(10)$$

Then we test the existence of level relationship as $\rho = 0$ and $\delta_1 = \delta_2 = ... = \delta_k = 0$ where Δ = difference operator, μ = white noise error term.

Test of Hypothesis

The Hypotheses were tested using the probability of t-statistics, **Decision:** Reject the Null hypothesis if the t-cal is greater than t-tab, otherwise accept the Null hypothesis when t-cal is less than t-tab

PRESENTATION AND ANALYSIS OF DATA

Introduction

This section attempts to present the data and result interpretation. In the proceeding chapter, the models for the study and variables employed were stated categorically and defined so as to enable us accomplish the effect of electricity supply on manufacturing output in Nigeria, over the period 1980-2019. The platform of this study which centers on review made us to employ only secondary data in carrying out the actual estimation of the models. This data set was sourced via the Central Bank of Nigeria (CBN) publications (statistically bulletin) for the various years and World Bank Development Indicator. The hypotheses formulated in chapter one, are tested using ARDL model.

Unit Root Test

A unit root test (ADF) was conducted to ascertain whether the variables in the model are stationary. This is necessary as it helps to avoid spurious regression results.

The summary of Unit Root Tests (ADF) results using E-views software is detailed in the table below:

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Table 2. Summary of ADF test results at 5% critical value

VARIABLE	ADF TEST STATISTICS	CRITICAL VALUE 5%	ORDER OF INTEGRATION	DECISION RULE
MANOT	-3.8437	-2.9571	I~ (0)	Reject Ho
ELECT	-8.5947	-2.9411	I~ (1)	Reject Ho
CRMS	-5.0318	-2.9640	I~ (0)	Reject Ho
HCD	-4.3362	-2.9640	I~ (0)	Reject Ho
EXR	-5.1185	-2.9411	I~ (1)	Reject Ho

Source: Authors computation 2021

From table 2 above, observe that the variables Manufacturing output (MANOT), credit to manufacturing sector (CRMS), and human capital development (HCD) were integrated of order zero (I ~ (0)) as it was stationary at level form; while Electricity supply (ELECT) and Exchange rate (EXR), weren't not stationary at level form but became stationary after first difference which implies that it was integrated of order one (I ~ (1)). The decision is based on the fact the ADF statistics that is greater than the ADF critical values at 5%, we reject H_0 and conclude that the variable is stationary.

ARDL Bound Co-Integration Test

Co-Integration analysis helps to clarify the long-run relationship between integrated variables. A necessary condition for testing for ARDL bound co-Integrating test is that each of the variables be Integrated of either of order one or zero or both (Pesaran *et al.,* 2001). Since all the variables are integrated of order one and zero, we proceeded to estimate the ARDL bound test. The null hypothesis of ARDL bound co-Integration is that the variables are not co-integrated as against the alternative that they are co-Integrated. The decision rule is to reject the null hypothesis if the F-statistics is greater than the upper bound critical values at chosen level of significance. The result of the ARDL co-Integration test for the first and second objectives is shown in table 3 below.

Table 3. ARDL Bound Co-Integration (5% critical value) Test Result for the Model

F-Statistics	K	Significance level	Critical Bound Value	
			I0 (Lower Bound)	I1 (Upper Bound)
32.52203	4	5%	2.56	3.49

Source: Author's Computation 2021

From table 3 the F-statistics for the model is 32.52203 and is greater than the upper (I1) bound of 3.49 at 5% level of significance. Thus, we reject the null hypothesis and conclude that there is presence of co-Integration in the model. This implies that there is a long run relationship between electricity supply and Manufacturing sector performance in Nigeria. Since there is a long run relationship we therefore estimate the short run and long run ARDL regression models and the results are presented in tables 4.4 and 4.5 below respectively:

Test for Short Run Relationship

The error correction term enables us to gauge the speed of adjustment of electricity supply to its long-run effect on manufacturing sector performance in Nigeria. It gives the proportion of the disequilibrium errors accumulated in the previous period which are corrected in the current period.

Table 4. Summary of Parsimonious Short Run Relationship Result between Electricity Supply and Manufacturing Sector Performance in Nigeria

ECM Regression Case 2: Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
CointEQ(-1)*	0.231307	0.015431	14.98992	0.0000

Source: Author's Computation 2021

From table 4 above; the coefficient of the error correction term (CointEQ) is statistically insignificant as it doesn't carry the expected negative sign at 5% level of significant. This result indicates that there is no short run relationship between electricity supply and manufacturing sector performance in Nigeria.

Test for Long Run Relationship

It's imperative to examine the implications of the long run coefficient of the exogenous variable on the endogenous variable. The ARDL long run coefficient test is as shown in the table below:

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Table 5. Summary of Long Run Coefficient of Electricity Supply and Manufacturing Sector in Nigeria

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ELECT	4.09E+10	3.29E+10	1.242285	0.2229
CRMS	6.98E+08	2.56E+08	2.722646	0.0103
HCD	-2.92E+10	1.68E+10	-1.736516	0.0918
EXR	1.63E+10	7.91E+09	2.062813	0.0471
C	-3.34E+12	2.77E+12	-1.205807	0.2365

Source: Author's Computation 2021

MANOT= -3.34E+12 + 4.09E+10ELECT + 6.98E+8CRMS –2.92E+9HCD + 1.63E+10EXR

The long run coefficient from table 5 above shows that the joint impact of all exogenous variables (ELECT, CRMS, HCD, and EXR) on the endogenous variable will amount to -3.34E+12units; this is on the basis that they are all held at constant. In other word if electricity supply variables are held at constant, Nigeria's manufacturing output will amount to -3.34E+12 unit.

Electricity supply (ELECT) and Manufacturing sector performance

Electricity supply (ELECT) as proxied by electricity consumption per capita had a positive coefficient value, suggesting that it shares a positive relationship with manufacturing output on the long run. This entails that as Nigeria's electricity supply per capita increases by a kilowatt, it causes the value added by the manufacturing sector to GDP to increases by 4.09E+10 units. The significant test however, revealed that is electricity supply shares a statistically insignificant relationship with manufacturing sector performance in Nigeria.

Credit to manufacturing sector (CRMS) and Manufacturing sector performance

Credit to manufacturing sector had a positive long run coefficient, suggesting that there exist a positive long run relationship between credits to manufacturing sector as proxied by credit to private sector and manufacturing output in Nigeria. Therefore if the credit availability to the manufacturing sector increases by a unit it will cause an increase in Nigeria's manufacturing output by 6.98E+8 units. The significance test shows that credit to manufacturing sector had significantly impacted on manufacturing sector performance in Nigeria and will continue to do so on the long run.

Human capital development (HCD) and Manufacturing sector performance

Human capital development has a negative long run coefficient value of -2.92E+9, implying that human capital development as proxied by government expenditure on healthcare and education shares a negative long run relationship with manufacturing sector output in Nigeria. This suggests that a unit increase in government spending on education and healthcare, it will cause a decrease in in manufacturing sector performance in Nigeria. The significant test showed that human capital development (HCD) insignificantly impacted on manufacturing sector performance in Nigeria.

Exchange rate (EXR) and Manufacturing sector performance

Exchange rate, which looks at the rate of exchange of the naira to the dollar, enjoys a positive long run relationship with manufacturing output. Hence, as the exchange rate increases, it results to 1.63E+10 increase in manufacturing value added to GDP. The significance test showed that exchange rate shares a significant relationship with manufacturing sector performance in Nigeria.

Diagnostic Test

Table 6. Diagnostic Test Table

Diagnostic Test	Result	Decision
Adj. Coefficient of determination (R^2)	0.9915= 99.15%	Very strong fitness
F-statistics	=828.13 (0.0000)	Model is significant
Prob. (F-stat)	=0.0000	

Source: Author's computation 2021

Coefficient of Determination

The coefficient of determination from table 6 showed that adjusted R-squared was 0.9915. This shows that the Explanatory variable could explain up to 99.15% of the total variation in the model. In other words, electricity supply variables (electricity supply, exchange rate, credit to manufacturing sector, and human capital development) explains up to 99.15% of the total variations in Manufacturing output in Nigeria.

Overall Test of Significance

The F-stat as shown in table 6; Given the F-values of 828.13 with probabilities of 0.0000, reveals that the overall regression is statistically significant, entailing that electricity supply possesses a joint

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significance with manufacturing sector performance in Nigeria.

Test of Hypotheses

Hypothesis 1

Ho_1: electricity supply has no significant impact on manufacturing sector performance in Nigeria

Conclusion

From table 4 above (ARDL long run coefficient result), the probability of t-stat of parameter (ELECT) was 0.2229, and greater than 0.05 critical values. Thus we accept the null hypothesis and conclude that electricity supply have no significant impact on manufacturing sector performance in Nigeria

Hypothesis 2

Ho_2: credit to manufacturing sector has no significant impact on manufacturing sector performance in Nigeria

Conclusion

From Table 4 above (ARDL long run coefficient result), the probability of t-stat of parameter (CRMS) was 0.0103, and less than 0.05 critical values. Thus we reject the null hypothesis and conclude that credit to manufacturing sector has a significant impact on manufacturing sector performance in Nigeria.

Hypothesis 3

Ho_3: human capital development has no significant impact on manufacturing sector performance in Nigeria.

Conclusion

From Table 4 above (ARDL result), the probability HCD is 0.0918 and greater than 0.05. Thus we accept the null hypothesis and conclude that human capital development have no significant impact on manufacturing sector performance in Nigeria.

Hypothesis 4

Ho_4: exchange rate has no significant impact on manufacturing sector performance in Nigeria.

Conclusion

From Table 4 above (ARDL result), the probability exchange rate (EXR) is 0.0471 and less than 0.05. Thus we reject the null hypothesis and conclude that exchange rate have a significant impact on manufacturing sector performance in Nigeria.

DISCUSSION OF FINDINGS

This study seeks to examine the impact of electricity consumption on manufacturing sector performance in Nigeria for a 40 year period from 1980-2019, the findings from this research are as follows:

The Stationarity of the time series data was ascertained by using the Augmented Dickey fuller Unit root test at 5% critical value, the result showed that Manufacturing output (MANOT), Human capital development (HCD), and credit to manufacturing sector(CRMS) were integrated of order zero (I ~ (0)) as it was stationary at level form; while Electricity supply(ELECT), and Exchange rate(EXR), wasn't not stationary at level form but became stationary after first difference which implies that it was integrated of order one (I ~ (1)). Indicating an Integration order of one [I~(1)].

Subsequently the ARDL test was conducted to test the dynamics of the model. The ARDL co-Integration bound test result showed that F-stat was 32.52203 and exceeded the lower and upper bound test which were 2.56 and 3.49 respectively, entailing at 5% critical value, that there was presence of co-integration implying that there is a long run relationship between electricity supplies and manufacturing sector performance in Nigeria.

The short run result revealed that there is no short run relationship between electricity supply and manufacturing sector performance in Nigeria.

The long run findings showed that; Electricity supply had an insignificant positive coefficient value, suggesting that it is positively related to manufacturing output on the long run. This entails that as Nigeria's electricity supply increases by a unit to causes the output of her manufacturing sector to change by 4.09E+10 units.

Credit to manufacturing sector had a significant positive long run coefficient, suggesting that there exist a positive long run relationship between credits to manufacturing sector as proxied by credit to private sector and manufacturing output in Nigeria. Therefore if the amount credit given to the manufacturing sector increases by a unit it will cause a 6.98E+8 units increase in Nigeria's manufacturing output.

Human capital development as measured by government expenditure on healthcare and education has an insignificant negative long run coefficient value of -2.92E+9, implying that it shares a negative long run relationship with Manufacturing output in Nigeria. This suggest that a unit increase in government expenditure towards the healthcare and the education sector will yield a decrease in manufacturing output in Nigeria.

Exchange rate had a significant positive long run coefficient, suggesting a positive long run relationship with manufacturing output. Hence, as the exchange rate between the naira and dollar increases, it causes Nigeria's manufacturing output to increase by 1.63E+10 units.

Diagnostic test were employed, and it showed that variations in electricity supply variables could confidently explain up to 99.1% of variations in

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Nigeria's Manufacturing output (manufacturing sector performance). The F-stat was 886.401 and its probability was 0.0000 showing that electricity supply has had significant impact on manufacturing sector performance in Nigeria.

SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

Summary of Findings

The study examines the impact of electricity consumption on manufacturing sector performance in Nigeria from 1980 2019. However, the result revealed that:

- Electricity supply has a positive and no significant relationship with manufacturing output in Nigeria.
- Credit to manufacturing sector has positive and significant relationship with manufacturing output in Nigeria
- Human Capital Development has negative and no significant relationship with manufacturing output in Nigeria.
- Exchange rate has positive and significant relationship with manufacturing output in Nigeria.

Conclusion

The study examines the impact of electricity consumption on manufacturing sector performance in Nigeria, for a period of 38 year, viz (1980-2019). Time series data from CBN statistical bulletin (2019) and World Bank Development Indicator was employed to help achieve the objective. The variables used are manufacturing output which serves as the dependent variable while electricity supply, human capital development, credit to manufacturing sector and Exchange rate form the independent variable. However, the result revealed that Variables such as electricity supply (ELECT), Exchange rate (EXR), Credit to Manufacturing Sector (CRMS) and Human capital development (HCD) have long and short run relationship with manufacturing output (MANOUT). The ADF unit root test was employed to ascertain the stationarity of the variables, with findings showing that, EXR, and ELECT were stationary at first difference, while MANOUT, HCD, GFCF was stationary at level. Subsequently the ARDL test was carried out, with the bound test revealing that there is a long run relationship between manufacturing output and electricity supply in Nigeria.

Recommendations

Following the findings from the research, the following recommendation is made:

- The findings revealed that electricity consumption and manufacturing output complements each other, considering that electricity stimulates manufacturing output, and high productivity in the manufacturing sector requires more electricity. Therefore there is a need to implement policies that will enhance electricity supply. Consequently, policy on energy and the restructuring of the electricity sector should meet up with the designed goals of enhancing electricity consumption. Policy makers should therefore implement policies such that electricity should not be a barrier to the performance of the manufacturing sector.
- Government should increase her expenditure on capital accumulation, as findings showed that credit to manufacturing sector, will on the long run significantly impact on manufacturing sectors output. There should be massive increment in the available stock capital (both human and material) existing in the economy.
- Since HCD contribute negatively to manufacturing performance, there is also need to improve on human capital development especially in the work training and fixing the right staff in the right place for increased productivity.

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