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Electricity Supply and the Manufacturing Productivity in Nigeria (1980-2012)

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Abstract: *The paper set out to examine the impact of electricity supply (EGI) on the productivity of manufacturing industries in Nigeria between 1980 and 2012. The variables in the model include, manufacturing productivity index (as dependent variable) while electricity generation, capacity utilization rate, government capital expenditure on infrastructures and exchange rate (represent the explanatory variables). The study employed the ordinary least square multiple regression to analyze the time series data between 1980 and 2012. The result of the study shows that electricity generation and supply in Nigeria under the viewed periods impacted positively on the manufacturing productivity growth, but the coefficient is very low due to inadequate and irregular supply of electricity especially to manufacturing subsector in the economy resulting from government's unnecessary spending on non-economic and unproductive sectors. In view of the findings, the study suggests among others, a reverse of the ugly trend of poor electricity supply by ensuring that funds allocated for the development of the electricity subsector are prudently utilized, and to ensure that the ongoing deregulation of the power subsector be sustained to allow for competitiveness of the industry as that would bring about adequate and regular electricity supply in the country*.

I. Introduction

Over the years, the manufacturing sector has been noted to be a key vehicle of economic development in any economy. Admittedly, Olayemi (2012) posits that manufacturing sector plays an instrumental role in economic development as it acts as a catalyst that accelerates the pace of structural transformation and diversification of the economy; it enables a country to fully utilize its factor endowment and to depend less on foreign supply of finished goods or raw materials for its economic growth, development and sustenance.

Accordingly, Nigerian government has been putting efforts to increase and sustain the productivity of manufacturing sector in the economy through budgetary allocations, policies and pronouncements (Anyanwu, 1996). Coupled with the fact that there has been consistent decline in the oil revenue, which over the time has been the major source of income for the country, attention has been drawn to diversify the economy; to stimulate the manufacturing sector productivity.

In this sense, Subair and Oke (2008) admitted that electricity supply which is mainly utilized for driving machines for the production of various items is a strong factor that will catalyze the productivity of manufacturing sector and thereby contribute significantly to the development of the economy. By way of responding to this discovery, successive Nigerian governments have been committing huge amount of resources into the electricity sub-sector, yet it appears that, this has not translate to a commensurate increased productivity of manufacturing sector in the country. Manufacturing sector in Nigeria is yet faced with the challenges of erratic power supply from the Nigerian Electricity Power Authority (NEPA), now called Power Holding Company of Nigeria (PHCN) and consequently, high cost of electricity generation from private electricity power generators (Onugu, 2005; Aremu and Adeyemi, 2011). Not all manufacturing firms would be able to run profitably on power generating sets in a highly competitive and open economy like Nigeria because of the high costs of fuel and maintenance. Ordinarily, the power generating sets which have now become the primary source of electricity supply to industries that could afford them ought to serve as backups or standby in the event of disruption from government sources (Okereke, 2010). But because of government inefficiency, the backups are serving as the primary source.

Against this backdrop, the research among others is targeted at ascertaining the impact of electricity supply on the productivity of manufacturing sector in Nigeria.

The study contributes to knowledge in an effort to finding enduring solutions to problems of low productivity of manufacturing firms in Nigeria and emerging economies and it would also be of significance to policymakers in the power sector who would be interested in improving the productivity of manufacturing sector in the economy. The paper is structured into five sections. After this introductory section, section two reviews related literature on electricity supply and manufacturing sector productivity. Methodology is discussed in the third section. Section four comprises of presentation and discussion of findings, and finally, section five draws conclusions on the basis of the findings as well as recommends the way forward.

II. Literature Review

2.1 Electricity Concept and Manufacturing Sector in Nigeria

For any meaningful improvement in the productivity of manufacturing sector to take place in any economy, electricity supply and demand must remain uncompromising elements of the process. This submission was corroborated by Iwayemi (1998) and Odell (1995) as cited in Olayemi (2012). While Iwayemi (1998) argued that, for Columbia as a nation to industrialize, electricity supply and demand are crucial factors in the process, Odell (1995) also averred the importance of energy sector in the socio-economic development of Nigeria; he further submitted that strong demand and increased supply of electricity would stimulate increased income and higher living standards in Nigeria.

Ndebbio (2006) agreed with this contention, noting that electricity supply drives the growth of manufacturing sector. He argued that one important indicator to show whether a country's manufacturing sector is growing or not is the megawatt of electricity (supplied and) consumed. According to him, a country's electricity consumption per capita in kilowatts per hour (Kw/H) is proportional to the state of the growth of the industrial sector of the country.

Adenikinju (2005) also supported the various arguments from Iwayemi (1998), Odell (1995), as well as Ndebbio (2006), by providing a strong argument to further support the overwhelming importance of energy supply to the Nigerian economy. The poor nature of electricity supply in Nigeria, according to him, has imposed significantly cost in the manufacturing sector of the economy. This argument is also in line with the survey of the Manufacturers Association of Nigeria (MAN) in 2005, where it was indicated that the cost of generating power constitute about 36 percent of the production.

Accordingly, Ekpo (2009), in his own opinion, elaborated on the cost of running a generator economy and its adverse effects on investment. He strongly opined that for Nigeria as a nation to accelerate the pace of the growth of manufacturing sector, the country should consider fixing power supply problem.

2.2 Theoretical Framework

This study has attracted some basic theoretical review, reflecting issues bordered on electricity and manufacturing productivity growth. Specifically, to consider in this study, the theories include, the liberalized electricity market theory, the traditional theory of cost and modern theory of cost and the Schumpeterian theory of capitalist development. The liberalized electricity market theory explains the right of firms to choose to invest in different types of power plants which allow production of electricity at different levels of marginal cost. The theory contends that, since electricity is not storable at reasonable cost, it is optimal for firms to invest in a differentiated portfolio of technologies in order to serve strongly fluctuating demand.

Olayemi (2012) agrees with the adoption of this theory in this work as he cited the experience of some economies that, prior to the liberalization of electricity markets, regulated monopolists decided on optimal investment and pricing strategies, but in the course of liberalizing those markets in Europe and US, which started in the 1990s, regulated monopolistic generators have been transformed into competing, but potentially strategically acting firms. On the other hand, the traditional theory of cost admits that the optimal level of output is attainable at a single level of output above which costs began to rise. Therefore, the output capacity is fully utilized at a point where the marginal cost curve cuts the average cost curve at the minimum while the former start rising. Under the traditional theory of cost, firms do not build plants with varying productive capacity, thus excess capacity is often a phenomenon experienced by firms. Excess capacity according to Bannock, et al (1998) cited in Olayemi (2012) is the difference between the amount produced by a firm or group of firms and the higher amount they could most efficiently produce. For instance, if a firm produces 1,000 cars at a cost of N5, 000 each, but the lowest cost output would be 1,300 cars at N4, 000 each. Therefore, there is excess capacity of 300 cars. Bannock et al (1998) asserts that sustained excess capacity is also a feature of firms in monopolistic competition, while it will only exist in the short run under perfect competition.

Excess capacity could also mean the difference between the actual output and maximum possible output of a firm, industry, or economy at large, when there are unemployed resources. However, the modern theory of cost, in its own description, assumed that firms build their plants with some flexibility in their productive capacity and making it possible for such firms to have reserve capacity. In furtherance to that, the theory also asserts that firms who utilize two-third and three quarters of their adequate supply of power are considered to be efficient. The reserve capacity under the modern theory of cost implies that some outputs can be produced at a single cost. Whichever positions or arguments put forward by each of the theories considered in this study, they are not permanently meant to bridge the gap between the electricity supply and manufacturing productivity growth especially in Nigeria. The permanent solutions should be sought in the total revolution and overhauling of the power sector, to allow the optimal use of the equipment in the manufacturing sector in the country. For instance, inadequate supply of power makes the manufacturing sectors in Nigeria go for power generator and the cost of running such leads to increase in cost of production such as money spent on petrol,

diesel etc. This increase in cost has sent many manufacturing firms out of business and eventually reduces the productivity of the manufacturing sector in the economy (Olayemi, 2012). The study also adopts the Schumpeterian theory of capitalist development in it contention that innovations and inventions are a major catalyst of economic development; to therefore inform the need of government, Non-Governmental Organizations (NGO), entrepreneurs/owners of manufacturing firms to device possible alternative ways of sourcing energy and of adopting manufacturing machines/equipments that will require little electric power to function in order to reduce the adverse effect of erratic power supply on the productivity of manufacturing firms in the country.

2.3 Empirical Review

Most of the empirical studies reviewed in this study have indicated the poor state of electricity supply in developing African economies. The poor state of this infrastructure also has a negative impact on the economic performance of developing economies. For instance Lee and Anas (1992) reported that manufacturing sub-sector in Nigeria spend on average 90% of their variable cost on infrastructure, with electric power accounting for half of time share. Having studied 179 manufacturing firms in Nigeria, they also reported that the impact of electricity deficiency of all types was consistently higher in small firms. Ukpong (1973) as cited in Olayemi (2012) also carried out a study on the cost of power outages to the industrial and commercial sector in Nigeria. He used the production function approach to evaluate the power outage cost between 1965 and 1966, with selected firms. From his estimates, he discovered the unsupplied electrical energy to be 130Kwh and 172Kwh between the periods. The corresponding costs of the power outage to the manufacturing sector in the two years were estimated at N1.68million and N2.75million respectively. The unsupplied electrical energy according to Ukpong, has negative implication on the manufacturing productivity growth in Nigeria.

A similar framework of analysis was also carried out by Uchendu (1993) on the industrial firms, in the commercial areas of Lagos State, Nigeria. The study estimated several types of outage costs such as material and equipment losses and value of unproduced output, which was estimated at N1.3million, N2.01million and2.32million in 1991, 1992 and mid 1993 respectively. The development reduced the value added of major manufacturing firms in Nigeria during these periods.

Similarly, World Bank (1993b) conducted a study and estimated the adaptive cost of electricity failure in Nigeria and found that it was amounted to USD380million. Also the estimate of Nigerian Electricity Power Authority (NEPA) (now Power Holding Company of Nigeria) revenue lost to unsupplied consumer energy was stated by World Bank as USD140million. These resultant short-term losses incurred by consumers such as raw material and equipment losses shows that the supply of electricity in Nigeria is unreliable from the public power supplier, and the reliability is known to be less than 50% by time nationwide (World Bank, 1993b).

On related findings, Olayemi (2012) conducted a study on the influence of electricity power outputs, supply and consumption in addressing the high rate of unemployment (low productivity) in Nigerian between the periods of 1970 to 2005 and discovered that power supplied to the industrial sector was lower than the supply for residential consumption. The study thus establishes that inadequate and unstable power supply to the industrial or manufacturing sector is the major cause of unemployment (low productivity) in Nigeria.

III. Methodology

The theoretical work of Ndebbio (2006) that adequate and regular supply of power stimulates the productivity of manufacturing sector in which he expresses manufacturing productivity index (MPI) as a function of megawatt of electricity generated or supplied (EGI) i.e MPI = f(EGI) informs the basis of the model to be adopted in this study.

3.1 Model Specification

From the existing model of Ndebbio (2006), the study specifies its model as follows:

$MPI = \beta_0 + \beta_1 EGI + \beta_2 CPU + \beta_3 GCE + \beta_4 EXR + Ui$

Where; MPI = Manufacturing Productivity index
EGI = Electricity Generation index
CPU = Capacity Utilization
GCE = Government Capital Expenditure and
EXR = Exchange Rates
Ui = Stochastic error term.

The expected results of the relationship from the specified model are that MPI, EGI, CPU, and GCE will be >0 while EXR<0. i.e all the variables except the exchange rate (EXR) are expected to have positive relationship with the manufacturing productivity index.

Ordinary least squares (OLS) multiple regression technique will be employed via the use of Eviews 3.1 in estimating the parameters of the model. The data for all the variables stated in the model will be extracted from 2012 edition of Central Bank of Nigeria Statistical Bulletin (over the period of 32 years).

IV. Presentation And Discussion Of Findings

4.1 Test for Stationarity

This test is directed to determine the time series characteristics of the variable. Accordingly, stationarity for the variables were tested and achieved at one differencing, integrated of order one. Hence, their ADF test statistics were compared to their critical values. The result is presented in table 4.1 below.

Table 4.1 Result of Unit Root Test

Variables	Lag length	Order of integration	ADF test Stat.	95% Critical Values of ADF	Remarks
Constant	1	I(1)	4.3259	-2.9705	Stationary
DEGEI	1	I(1)	4.7926	-2.9705	Stationary
DCPU	1	I(1)	4.1065	-2.9798	Stationary
DGCE	1	I(1)	5.3832	-2.9665	Stationary
DEXR	1	I(1)	3.5086	-2.9665	Stationary

Source: Author's Computation

We therefore proceed to test for the long run effect of the variables and the result is presented in table 4.2 below

Table 4.2 Cointegration Test (Unit Root Test on Residuals)

Variables	Lag Length	ADF Test Stat.	ADF Critical Value at 95%
MPI on EGI, CPU, GCE and EXR	1	3.0934	-2.9705

Source: Author's Computation

Cointegration test shown in table 4.2 indicates that MPI cointegrates with the associated variables. In order words, there is a long run relationship between MPI and the associated variables. We now move to the next step by presenting the error correction representation equation for the selected ARDL as follows:

$$MPI_t=0.11-0.18MPI_{t-1}+0.19EGI_{t-1}+0.37CPU_{t-1}-0.06GCE_{t-1}-0.02EXR_{t-1}-0.21ECT_{t-1}$$

(1.75) (0.93) (1.92) (1.51) (1.17) (0.28) (3.02)

R^2=0.72, R^2 Adjusted=0.51
Akaike Info Criterion -4.345781, Schwarz Info Crit. -4.012730
F-Stat.=3.43, D-W=1.77

4.2 Discussion of Result

By interpretation, a close examination of the parsimonious model presented above shows that, while one lagged value of MPI (the dependent variable), GCE EXR and ECT (error correction term) have negative influence on current MPI, EGI and CPU have positive relationship with the current value of the dependent variable, MPI. The value of EGI, CPU and EXR met our a priori expectations. The result of the relationship between the manufacturing productivity (MPI) and government capital expenditure was not in conformity with the a priori expectation. It is expected that government capital expenditure will respond positively with manufacturing productivity, however, it is negative as found in the result above. This may partly be due to high level of corruption which has resulted in improper channeling of Nigerian budgetary allocation to energy sector over the years to meet desired result. Olayemi (2012) agrees with this when he reported that during President Olusegun Obansanjo regime could not account for allocated fund meant for revitalizing energy sector. This further affects energy sector-causing inadequate and irregular supply of power especially, to manufacturing sector.

It was also revealed from the table, a high variation of 72% for the coefficient of multiple determination (R^2), meaning that 72% variation in manufacturing productivity is explained by the error correction model. The F-value of 3.42 is significant at 5% level, implying that there is a significant linear relationship between the explanatory variables in the ECM and the dependent variable (MPI). The D-W statistic of 1.77 shows the absence of autocorrelation in the ECM, and the error correction term .

V. Conclusion And Recommendations

From the forgone analysis, Nigerian manufacturing sector could not have been said to have found its rightful place as a sector which could ginger up the economic growth rate which stands at 6.3**%** in 2014 but instead has been bedeviled by structural problems and policy distortions. One of these problems is the irregular and inadequate power supply in the country. The Power Holding Company of Nigeria (PHCN) has not been efficient enough at sustaining electricity generation to industrial sector. The much proclaimed target of 6,000Megawatts (AEO, 2015) of electricity that could have been achieved in 2014 has remained a misery operating only at about 5000 Megawatts (Premium Times, 2015), thereby resulting in low productivity of the manufacturing sector. Government capital expenditure on energy sector that could have assisted the country to fix electricity problem in Nigeria could not because government officials have made it their usual habit to embezzle public funds that could have been used to finance power project. Moreover, it is evident that most of the manufacturing industries in Nigeria heavily rely on foreign capital inputs and expertise for efficient production which could have been made readily available through a strong domestic currency. Nevertheless, the prospects of improved performance in the manufacturing sector are not far from reality, only if government can show serious commitment and spend sufficiently but judiciously on electricity sub-sector for its regular and efficient distribution, especially to manufacturing sector in Nigeria and to ensure adequate investment on related capital projects, ensure maximal capacity utilization. In addition, the ongoing deregulation of the power sector should be sustained by the federal government as that would allow for competitive market system which guarantee effective and efficient generation and distribution of electricity, hence increase in the productivity of the manufacturing sector.

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