

# Comparative Effects of Power Outages as Infrastructure on Productivity of Food Industries in Nigeria

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**Abstract** - The primary objective of this study is to examine the impact of power disruptions on firm productivity in the subsectors of Food industries (bakery and soft-drinks) in Nigeria. Using Cobb Douglas models, results show that power outage variables have a positive effect on productivity. The significance of power outage variables suggests that there is a need for the Nigerian government to come up with ways of improving energy generation and supply, as well as proper maintenance of electricity infrastructure in the country. Deliberate efforts by the government to improve power infrastructure will result in the country's being able to increase electricity production threefold.

**Keywords** - Power outages; Productivity; Nigerian food industries

## I. INTRODUCTION

The use of energy is a close indicator of industrial activity and a significant index of a standard of living. In the developing countries of the world, no activity is more basic to the fuller utilization of their resources than the development of the energy industries. In most of tropical Africa, industrialization post-dates the age of steam as a source of energy. Electricity, rather than the steam engine drives the developing industries of modern Africa. The Federal Republic of Nigeria, with the largest population in Africa and an energy resource base by African standards, both rich and varied, demonstrates many of the problems and potentialities of electricity production in the developing countries of the tropical world (Simpson, 1969).

The problem with Africa's electricity sector is not that of scarcity, but lack of infrastructure, proper financing mechanisms, and regulations that are important so as to make markets work in support of energy for sustainable development (UNDP, 2004). According to UNDP (2004), most power utilities in many countries are state-owned monopolies and thus, low tariffs and fiscal constraints have resulted in little investment and poor maintenance of infrastructure. Power outages, power surges, brown-outs, and load shedding remain common features in most countries. Nigeria has an abundant supply of energy sources. It is endowed with thermal, hydro, solar, and oil resources, and yet it is described as an energy-poor country because the sector is relatively under-developed. The statistics available showed that only about one-third of Nigeria or approximately 40

percent of the population has access to electricity. The distribution of electricity shows great disparities between rural and urban, and between residential and industrial areas in the urban centres (Ali-Akpajiak & Pyke, 2003). The very poor quality of electricity supply in recent years has been a major constraint on the performance of the economy. Available statistics from the World Bank investment climate surveys show that South Asia, Sub Saharan Africa, the Middle East, and North Africa are parts of the world that are most affected by power outages. Thus, the average power outage days per month between 2000 and 2008 were 2.87 in North Africa and the Middle East, 10.30 in Sub-Saharan Africa (SSA), 42 and 3 in South Asia and Latin America, respectively, compared to the world average of 9 days per month.

According to Babatunde and Shuaibu (2009), despite Nigeria's vast oil reserves, much of the country's citizens do not have access to an uninterrupted supply of electricity. Thus, Nigeria has approximately 5900MW of installed generating capacity but is only able to generate 1600MW because most power infrastructure facilities are poorly maintained. This explains why the power sector also experiences high energy losses of about 30%-35% from generation to billing, low access to electricity by population (36%), as well as intermittent power outages (Babatunde and Shuaibu, 2009). Furthermore, Malik et al., (2004) said that erratic power supply has become a fact of life for most manufacturers in Nigeria who now increasingly rely on personal generators, voltage stabilizers,

**Table 1: Electricity Infrastructure Problems(2000-2008)**

| Country/<br>Region            | Number Of<br>Power<br>Outages<br>Per Month | Duration Of<br>Outages<br>Hours | % Output<br>Lost Due<br>To Power<br>Outages | Electricity From<br>Generator (If<br>Generator<br>Used) In % | Delay in<br>Obtaining<br>Electrical<br>Connection |
|-------------------------------|--|---------------------------------|---|--|---|
| Sub Saharan<br>Africa         | 10.30                                      | 6.70                            | 5.84  | 26.74  | 31.94   |
| East Asia &<br>Pacific        | 5.19                                       | 3.14                            | 2.76  | 12.31  | 21.65   |
| Latin America                 | 2.68                                       | 7.59                            | 4.19  | 18.40  | 34.45   |
| South Asia                    | 42.21                                      | 4.56                            | 10.81                                       | 25.94  | 48.42   |
| Middle East &<br>North Africa | 2.87                                       | 3.45                            | 4.21  | 16.16  | 49.08   |
| World                         | 8.48                                       | 5.56                            | 4.86  | 19.77  | 36.68   |

Source: World Bank’s Investment Climate Surveys Data

and motors to keep their machines running. In which, this self-supply of electricity raises the cost of production for domestic firms putting them at a significant cost disadvantage relative to their foreign competitors. This problem of power disruption is particularly costly for small firms and medium firms which often lack resources to buy generators and are not well connected to NEPA officials compared to large firms who, in some cases, have dedicated lines of power supply courtesy of NEPA.

Statistics in Table 2 also support these arguments that Nigeria experiences power outages for about 26 days per month and they last for about eight hours per day - for more than the regional and world averages. The severity of power problems in Nigeria are also explained by the fact that about 9% of sales are lost due to these disruptions, 86% of manufacturing firms in the country own or share a generator, and also, 76% of them expressed their dissatisfaction with the services of the National Electric Power Authority (NEPA), identifying power outages as a major business constraint (Table 2).

**Table 2: Power Infrastructure Indicators for Nigeria**

| Indicator                                       | Nigeria | Sub-Saharan | World |
|---|---------|-------------|-------|
| Number of electrical outages in a typical month | 26.3    | 10.7        | 8.6   |
| Duration of a typical electrical outage (hours) | 8.2     | 6.6         | 4.0   |

|  |      |      |      |
|--|------|------|------|
| If there were outages, the average duration of a typical electrical outage (hours) | 8.2  | 6.7  | 4.4  |
| Losses due to electrical outages (% of annual sales)                               | 8.9  | 6.7  | 4.8  |
| Percent of firms owning or sharing a generator                                     | 85.7 | 43.6 | 31.6 |
| The proportion of electricity from a generator (%)                                 | 47.5 | 13.8 | 7.1  |
| If a generator is used, the average proportion of electricity from a generator (%) | 60.9 | 27.1 | 20.9 |
| Days to obtain an electrical   | 7.5  | 31.6 | 33.6 |

|  |      |      |      |
|--|------|------|------|
| connection   |      |      |      |
| Percent of firms identifying electricity as a major constraint | 75.9 | 50.3 | 39.2 |

**Source:** World Bank’s Investment Climate Surveys data

The main aim of this study, is therefore to investigate the impact of power infrastructure quality; i.e., power disruptions on productivity of food industries and its subsectors in Nigeria, because power plays a very important role, not only in facilitating the use of electric machinery but in enhancing the productivity of other factor inputs such as labor. Nigeria is one country that has been experiencing severe power outage problems; therefore, this study attempts to analyze the impact of these disruptions on firm productivity and to identify how power outages affect food industries in Nigeria.

The other motivation for this research is that studies explore the relationship between power infrastructure and productivity of food industries in Nigeria at firm level are very scarce and also scarce for its subsectors, according to Estache (2005), this could be due to the low quality of available data and much econometric focus on human capital.

However, the current World Bank survey data provides a better alternative in that power infrastructure quality indicators measured at the firm level are now available in the form of an average number of days per month or hours per day without electricity, as well as percentage of output lost due to power outages.

## II. EMPIRICAL LITERATURE REVIEW

The role of infrastructure is widely analysed as very important to firms: availability and quality of infrastructure result in different decisions to invest and may influence migration, business establishment location. Infrastructure services are used as intermediate consumption item for firms. Availability of infrastructure services significantly influences the development of regions and countries. It is the reason why level and quality of infrastructure have direct effect on business productivity and growth.

The growing interest in the empirical investigation of infrastructure variables, like power, continued with the works of Aschauer (1989). He studied the relationship between aggregate productivity and stock and flow of government spending variables in the US economy for the period 1949-85. In his estimations, using a general Cobb-Douglas production function, he treated government spending on public capital as one of the inputs in the

production function and proxy for infrastructure variables, like electricity. His results suggest that there is a strong positive relationship between output per unit of capital input, the private labor-capital ratio, and the ratio of the public capital stock to the private capital stock.

Babatunde and Shuaibu (2009) said despite Nigeria’s vast oil reserves, most citizens of the country do not have access to an uninterrupted supply of electricity. Thus, Nigeria has 5900MW approximately of installed generating capacity which is able to generate 1600MW only because most of the power infrastructure facilities are poorly maintained. This shows why the power sector experience high energy loss about 30% - 35% from generation to billing, low access to electricity by population (36%) and also intermittent power outages.

Furthermore, Malik et al., (2004) said that most manufacturers in Nigeria increasingly rely on personal generators, voltage stabilizers and motors to keep their machines running due to an erratic power supply. This self-supply of electricity raises the costs of production for domestic firms putting them at a significant cost which disadvantages relative to their foreign competitors. This problem of power disruption is particularly costly for small firms and medium firms which often lack resources to buy generators and are not well connected.

One of the first attempts to conduct a more systematic, quantitative assessment of the importance of sub-Saharan Africa’s infrastructure is Estache et al (2005) and they found out that electricity, water, roads, and telecommunication are the main crucial factors that promote growth.

Ndebbio (2006) said that the major factor that drives the industrialization process is electricity supply he later pointed out that a country’s electricity consumption per-capita in kilowatt-hours (Kwtt) is proportional to the state of industrialization of that country.

Ekpo (2009) shed more light on the folly of running a generator economy and its adverse effects on investment which he argued for Nigeria that for Nigeria to jump-start and accelerate the pace of economic growth and development, the problem of power supply should be fixed.

Aigbokan (1999) said that the energy sector is paramount in shifting the production possibility curve of any economy country.

The result survey of Manufacturers Association of Nigeria (MAN, 2005) indicated that the costs of generating power constitute about 36percent of production and the result of this survey corroborates Adenikinju (2005), that the poor nature of electricity

supply in Nigeria has imposed a significant cost on the industrial sector of the economy. All these studies used time series analysis and electricity production and consumption as power infrastructure indicator variables while in this study, we go down to firm-level data and use an infrastructure reliability indicator (number of days and hours without power) which is a big gap from the standard approach in the literature.

### III. EMPIRICAL METHODOLOGY

Different number of methodologies can be used to estimate productivity in which each has its own strength and weaknesses and these includes index numbers, parametric and non-parametric methods, data envelop analysis and stochastic frontiers. Biesebroek (2003), said that index numbers and data envelopment analysis is flexible in the specification of technology in which it does not allow for measurement errors in the data. He later argued that when calculating productivity from an estimated production function using parametric methods are less vulnerable to measurement errors, certainly in the dependent variable, in which misspecification of the production function might be an issue.

For the study, we used an empirical model that borrows from the works of Njikam et al (2005). Cobb Douglas is used because the elasticities of the production to the inputs are easy to read and to interpret with the Cobb Douglass technology.

Cobb Douglas production functions as follows:

$$\text{Log}(Y_i) = \text{cons} + a \log(L_i) + b \log(K_i) + C(\text{Pwint})$$

Where (Y<sub>i</sub>): Value added (Total sales less Total Purchased material)

K<sub>i</sub>: Capital

L<sub>i</sub>: Labour

i: Industries

**Pwint:** power interruption: Total duration of power outages suffered by the plant in hours/ equals average duration times the total number of a power outage

### IV. DATA AND VARIABLES MEASUREMENT

The World Bank's investment climate surveys (ICS) on manufacturing sectors in Nigeria is the primary source of the data used in the study. The survey in this country was done in 2009 and the total number of establishments covered is 3,157 in which 242 is used for food industries.

More detailed information about the Enterprise Surveys can be found on the Enterprise Surveys website. We measure our productivity variables like capital using the replacement cost of plant and machinery while output and material inputs are

measures using total sales value, total cost of raw materials and intermediate goods used in production respectively. Power disruptions are measured using the number of days firms go without power.

We did our estimations using panel regression in which city is set as the time Random effects and fixed effects.

### V. RESULTS, PRESENTATION AND ANALYSIS

This section presents and discusses the result

**Table 3: Estimates of Cobb Douglas for Food Industries**

| Variable           | OLS                      | FE                       |
|--------------------|--------------------------|--------------------------|
| Log capital inputs | 0.18288764***<br>(0.028) | 0.16834615***<br>(0.03)  |
| Log labour inputs  | 0.93154921***<br>(0.039) | 0.94862614***<br>(0.044) |
| Power outage       | 0.00167355<br>(0.002)    | 0.0045045*<br>(0.02)     |
| Constant           | -0.81091177<br>(-0.811)  | -0.86983724<br>(-0.521)  |

Absolute values of standard errors in parenthesis\*\*Significant at 5% level; \*\*\* significant at 1% level; \* significant at 10% level

**Table 4: Estimates of Cobb Douglas for Bakery Firms**

| Variable           | OLS                     | FE                       |
|--------------------|-------------------------|--------------------------|
| Log capital inputs | 0.08472479*<br>(0.035)  | 0.06296493<br>(0.036)    |
| Log labour inputs  | 0.9114242***<br>(0.064) | 0.92507008***<br>(0.077) |
| Power outage       | 0.1843464<br>(0.003)    | 0.15653632<br>(0.004)    |
| Constant           | -1.2680332<br>(-0.875)  | -1.3031029<br>(-0.887)   |

Absolute values of standard errors in parenthesis\*\*Significant at 5% level; \*\*\* significant at 1% level; \* significant at 10% level

**Table 5: Estimates of Cobb Douglas for Soft Drinks Firms**

| Variable           | OLS                      | FE                       |
|--------------------|--------------------------|--------------------------|
| Log capital inputs | 0.263791***<br>(0.064)   | 0.2220918*<br>(0.085)    |
| Log labour inputs  | 0.86875215***<br>(0.103) | 0.94862614***<br>(0.148) |
| Power              | 0.42278366               | 0.30010728               |

|          |                        |                       |
|----------|------------------------|-----------------------|
| outage   | (0.004)                | (0.005)               |
| Constant | -1.4776568<br>(-1.025) | -2.0010764<br>(-1.44) |

Absolute values of standard errors in parenthesis\*\*Significant at 5% level; \*\*\* significant at 1% level; \* significant at 10% level

The results were estimated using both RE (Random Effects) and FE(Fixed effects). We estimated out the variable of interest power interruptions. This helps us to determine whether our results are robust to model and variable specification.

A result from the above regressions, the results clearly shows that there are differences in food industries and its subsectors (bakery and soft drinks) in Nigeria. It can be attributed to discrepancies in the investment climate. The results confirm that power interruption is critical to the development of food industries in Nigeria. Surprisingly the variable is insignificant in the subsectors model but is significant for food industries. This might be due to the small scale nature of most food firms in Nigeria.

According to Moyo B.(2012), said that power is an intermediate input and any reduction in its costs raises the profitability of production and enhances the marginal productivity of labor and capital. There will be a negative effect on productivity if there is a high number of hours without power, as well as high percentage of output lost due to electricity disruptions. The above results largely support this expectation. Thus, when using the number of hours without electricity, power disruptions have a negative effect on productivity.

Nigeria food businesses identify electricity as the biggest problem in doing business which is partly supported by descriptive statistics in which about 77% of larger firms were been affected by electricity and 74% and 62% for medium and smaller firms respectively. This may be that larger firms appear to be more concerned about using electricity than smaller firms. This reflected the power crisis that was ongoing in the country at this time of the survey. Not surprisingly, the top concerns vary across countries. For example 70% of Zambian firms were affected by electricity problem and about 80% Senegal small and medium firms were been affected too in which the findings were done by Cissokho et al.,(2013)

## VI. CONCLUSION

The primary objective of this study is to examine the impact of power outages on the productivity of food industries in Nigeria. The significance of power outage variable suggests that there is a need for the Nigerian government to come up with ways of improving energy generation and supply. The study recommends that regulatory bodies responsible for the energy sector must set some standards for the generation distribution and costing of electric power where preference would be given to key sectors of the economy such as small firms since they are

known to provide jobs for a large number of people and contribute significantly to the economic growth of the country standards in the distribution of power are also critical to ensure continuous supply of power to industries.

According to Wasiu (2008), energy is the engines that drive industrialization which improves communication and helps innovation in science and technology, provides sound health care delivery competitiveness and growth and reduce poverty and unemployment. The Nigerian government needs to consider the issue of power supply reliability very seriously by facilitating both private and public investment in electricity infrastructure. This will help in enhancing the performance of manufacturing firms and thus increase the development of industries in Nigeria.

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