Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6, 1-11
2024
Publisher: Learning Gate
DOI: 10.55214/25768484.v8i6.1701

Impact of productivity drivers on the performance of manufacturing firms

Adedeji Elijah Adeyinka[1*]; ADELOWOTAN Michael[2]
[1,2]School of Accounting – College of Business and Economics, University of Johannesburg; eadedeji@uj.ac.za (A.E.A) madelowotan@uj.ac.za (A.M).

Abstract: A considerable number of research indicates that a nation's industrial sector plays a crucial role in its economic growth. Therefore, it is crucial to research the productivity drivers among businesses engaged in the manufacturing sector to create a sound, inclusive, long-lasting, and innovative industry. Thus, as a micro-perspective of industrialization, this study looks into the main productivity drivers of manufacturing firms in Nigeria. The study analyses an imbalanced panel firm-level dataset from 2007 to 2019 using the simultaneous approach of the stochastic frontier to achieve its goal. Our research shows that Nigerian manufacturing firms deal with growing returns to scale and a high labour intensity. For policy actions, it was recommended that a realistic industrialization strategy has to be micro-founded. This strategy should prioritise large-scale industrial companies, promote exports, and provide a steady supply of electricity. The findings also show that small and micro firms in Nigeria are more productive than large manufacturing firms, even though the frequency of power outages and average labour costs impede the productivity of these firms.
Keywords: *Industrialization, Manufacturing firms, Productivity, Stochastic frontier analysis.*

1. Introduction

In both developed and developing economies across the world, industrial development is seen as the cornerstone of economic growth at every stage of development (World Bank, 2019). Nations of the world, irrespective of their degree of development, are still implementing pertinent strategies that guarantee stable macroeconomic governmental actions that would facilitate a healthy business environment for the manufacturing firms (Earle & Gehlbach, 2014).

A substantial amount of research indicates that the manufacturing sector is important for economic growth (Ngo *et al.*, 2019); it is also important for innovation and technology diffusion (Mijiyawa, 2017); it provides a path for the creation of jobs and other opportunities (Kreuser & Newman, 2018); it advances technological advancement (Landi & Niederreiter, 2017); and it has other positive spillover effects. Designing strategies to encourage the expansion of the manufacturing sector requires a knowledge of the industry's productivity performance and its drivers, given the significance of the manufacturing sector in the context of emerging nations (Kreuser and Newman, 2018).
In a similar vein, Calza *et al.* (2019) point out that research on the productivity of manufacturing businesses and their factors is thus required to design policies focused towards broad-based, inclusive, and sustained growth. Nonetheless, the majority of earlier research on firm-level productivity analysis has been done for developing and developed countries (Xu *et al.*, 2020; Cieōlik *et al.*, 2019; Guzmán *et al.*, 2019; Rahmati & Pilehvari, 2019; Che & Zhang, 2018; Diebolt *et al.*, 2017; Landi & Niederreiter 2017).

Nonetheless, the necessity for nation-specific research was brought about by the persistent variations in the productivity development of the manufacturing sector among nations. To the best of our knowledge, not many studies have used firm-level data to investigate the factors influencing productivity development in Nigeria at the national level. Kreuser & Newman (2018) emphasise that

* Correspondence: eadedeji@uj.ac.za

creating the foundation for a nation's future growth requires a precise micro-data study of corporate productivity. Therefore, utilising panel firm-level data for Nigeria, this study attempts to investigate the factors influencing the productivity of manufacturing businesses.

The major contribution of this study is that it focuses on Nigeria, a nation facing developmental obstacles, and a region where a significant amount of empirical firm-level research has not yet been completed. The majority of earlier research on Nigeria employed proxies to get macro-level data (e.g., Rahmati & Pilehvari, 2019; Otalu & Anderu, 2015), which eventually compromised the validity of their conclusions. However, it is now feasible to precisely measure and analyse the factors that drive productivity in manufacturing firms thanks to the availability of firm-level data from the World Bank's Enterprise Survey. Therefore, this studycontributes to the body of knowledge in this perspective.

Likewise, it offers empirically grounded proposed policy actions that will empower Nigeria to swiftly deal with the challenges militating against the expansion of manufacturing firms. This study employs econometric approaches along with Stochastic Frontier Analysis (SFA) as a productivity measure, in contrast to many previous studies that employed labour productivity metrics such as output per worker or total factor productivity. This makes it possible for the study to delve more into the productivity level and cost-effectiveness of manufacturing firms.

The adoption of SFA is quite unique for the examination of manufacturing firms' productivity in Nigeria since it enhances comparison of productivity distributions and trends across nations and manufacturing subsectors. In productivity studies at the firm level, the measure is usually thought to be more robust and accurate (Adeniran *et al.*, 2023). The study also uses broad specifications because it uses new variables that weren't utilised for the Nigerian example before. If these elements were excluded, the estimate would be skewed. The connotation of the results may be appropriate for government policies intended to boost long-term productivity among manufacturing firms in Nigeria.

The manufacturing sector in Nigeria has been a primary emphasis of successive administrations since the country's political independence in 1960. The goal of attaining economic growth and development via industrial transformation has remained unwavering. The manufacturing sector reform is an objective of many development plans and strategies, which serve as examples of this. However, given that the nation's industrial foundation is considered to be weak and outdated, it is concerning that these development plans and programmes have not produced the necessary level of expectation (World Bank, 2019). The early 1970s oil discoveries made matters worse by making wealth from the crude oil sales, which led to the neglect of other economic sectors, particularly the industrial sector (Adeniran & Ben, 2018). But during the last ten years, calls for Nigeria's economy to diversify to overcome the country's significant reliance on the oil subsector have arisen due to changes in the oil market and the actions of terrorists in the country's oil area. The manufacturing sector is crucial to lowering poverty, decreasing hunger and malnutrition, and giving work possibilities to the hordes of jobless young people in the nation because of its connections to agriculture and other input providers.

Furthermore, manufacturing firms have a significant impact on the development of hard and soft infrastructure at the rural and urban levels, the transfer of production and processing technologies, the processing and distribution of manufactured goods to the public, and direct export (Anyawau, 2017). The industry offers additional prospects due to the sizeable market for completed goods and the variety of raw materials that may be used in manufacturing.

But for many years, Nigeria's industrial sector has not made a significant contribution to the country's GDP. According to data from the Central Bank of Nigeria (CBN, 2019), the manufacturing sector's share of the nation's GDP climbed from 4.8% in 1960 to 7.2% in 1970 and 7.4% in 1975. About 10% of Nigeria's GDP came from the manufacturing sector before the oil boom of the 1970s. The sector's relative GDP share decreased as a result of higher crude oil sales income.

Before the increasing record of 10.7% in 1985, it had fallen to 5.4% in 1980 (CBN, 2019). Steel production became the primary focus of policy attention when the industrial sector experienced a slump brought on by the decline in oil prices in the early 1980s (World Bank, 2019). Earlier, foreign capital inflows were restricted by the Nigerian Enterprises Promotion Decrees of 1972 and 1977, which changed the majority company ownership from foreign to Nigerian (Iwuagwu, 2009). To encourage import substitution, the Federal Government of Nigeria banned the importation of raw materials in 1987 as part of the World Bank's structural adjustment programmes (SAPs).

The programme allowed the nation's producers of intermediate inputs to resume producing at a competitive level, which resulted in fewer plant closures. This, together with the 1988 Privatisation and Commercialization Act, pushed Nigeria's industrial sector to attain a greater level of efficiency (World Bank, 2019). The manufacturing sector's percentage of the total economic output increased by 0.62% points from 1986 and 1988. Additionally, the manufacturing sector's contribution to Nigeria's GDP decreased during the 1990s, from 8.1% in the 1990s to 7.9% in 1992, 6.7% in 1995, and 6.3% in 1997 (CBN, 2019). But from 6.2% in 2000 to 3.4% in 2001 and then up to 4.16% in 2011, it declined even further (CBN, 2019).

Nigeria kept up its heavy reliance on oil exports in the 1990s and 2000s, which allowed the industrial sector to continue to deteriorate despite its importance to the country's economy. The majority of the nation's businesses lacked efficiency and were not focused on exports, which led competitive businesses to move their manufacturing overseas [Nigeria Economic Empowerment and Development Strategy (NEEDS, 2005)]. The industry was kept afloat by a few major sectors, including tobacco, cement, textiles, and drinks, although even these were only operating at half capacity. Page (2018) points out that Ajakuta Steel Company is the biggest and most ambitious of Nigeria's many elephant projects. The federal government has invested more than $5 billion in the facility since 1979, yet it has never produced anything until recently.

In addition, since 2010, the government has paid out over ₦30 billion ($83.3 million) in worker pay, with an additional $1.2 billion in investments anticipated to keep the business operating. Concerns exist regarding rent-seeking to the sector's funding distribution and government officials' appropriate execution in this respect [Nigerian Bureau of Statistics (NBS, 2019)]. The industrial sector in Nigeria has grown well in recent years, despite the obstacles it faces. The government's prohibition on imports as well as many other policies, such as tax breaks and soft loans, are to blame for this.The GDP contribution of the industry, for instance, was 9.43% in 2015; nevertheless, it climbed dramatically to 9.65% in 2018 before declining to 8.4% in 2019 (CBN, 2019).

Weak consumer spending, low foreign exchange liquidity, interruptions in both local and international supply chains, and high operational expenses were the main causes of the sector's activity reduction in 2019.Due to its continued reliance on imports, the industry is extremely susceptible to shocks from outside sources. Many Nigerian manufacturing firms have an extremely low potential for creating jobs, weak integration in the past, weak integration in the present, and low local value addition (Galadanci 2010; NBS, 2019). Nigeria's manufacturing industry contributed 9.65% of GDP in 2018, which is much less than that of China (30%), South Africa (13%), Brazil (14%), Egypt (15%), and India (17%).

To strengthen the industrial sector, the government recently unveiled the Industrial Revolution Package. However, considering the history, one cannot be persuaded that this is a long-term answer to Nigeria's industrial growth dilemma. The problem is that, unless urgent action is taken to address the underlying issues that led to the previous policies' failure such as inadequate long-term loanable funds, an unstable business environment, and a lack of power and infrastructure which is the new policy may still end up like its predecessors.

On the other hand, opinions differ slightly over how much the manufacturing sector's downturn affects economic expansion. Galadanci (2010) contends that insufficient power supply and excessive production costs are partially to blame for the drop in job prospects in Nigeria's industrial sector. Given that the manufacturing sector is a significant driver of economic growth, these trends are concerning. Similarly, Iwayemi (1994) emphasises that by carefully examining the factors that drive productivity in the industry, it is possible to reverse the manufacturing sector's poor contribution to the output growth of the Nigerian economy.

This is because the government has already implemented complex policies throughout the years to restructure the industry, place it in a job-producing environment, and aid in hastening the nation's growth and development. This means that to build future industrial policies that will support the sector's growth in the nation, it will be necessary to look at the factors that drive productivity in the industry.

2. Methods Estimation

The main objective of this study is still to investigate the factors that influence the productivity of Nigerian manufacturing firms as a means of determining the factors that drive industrialization at the firm level. Since total factor productivity measures the production efficiency (using inputs to produce output), panel Stochastic Frontier Analysis (SFA) was used. This is a parametric technique that allows production or cost function estimates to be made while explicitly acknowledging the existence of production unit inefficiencies (Battese & Coelli, 1995).

According to Charoenrat & Harvie (2014), the SFA approach has three benefits over other measures: it provides tested relevant SFA hypotheses, observable functional links between inputs and outputs, and a visible and statistically estimable production form. Using specifications from Battese & Coelli (1995), the Aigner *et al.* (1977) panel model was concurrently simulated to address the issue of inconsistency related to the two-stage technique, which is mostly utilised in the empirical literature currently available on efficiency drivers, including Tenaye (2020).

The two-stage method used in the first step is based on the assumption that the SFA production function's inefficiency scores are uniformly distributed. The second step's methodology, in contrast to the first step's premise, assumes that the inefficiency scores differ depending on firm-specific factors (Diaz & Sanchez, 2007). This method is not consistent enough. Equation (1) illustrates the model presented by Battese & Coelli (1995):

$Y_{it} = \exp(X_{it}\beta + V_{it} - U_{it})$, (Equation 1)

Where:

Y_{it}, X_{it} and β denote output, a vector of known function of inputs and a vector of parameters to be computed of firm i at time t respectively.

V_{it} is a stochastic error term;

U_{it} is a non-negative random variable denoting inefficiency.

The two form equation 1

$U_{it} = z_{it}\delta + W_{it}$, (Equation 2)

where z_{it} is a MX1 set of regressors of inefficiency score;

δ is a MX1 set of coefficients of the regressors to be computed; and

W_{it} denotes a random variable defined by the truncation at zero of the normal distribution with zero mean and variance, σ^2.

Maximum likelihood is applied in the estimation of the production function coefficients and variance coefficients, $\sigma_s^2 = \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u^2 / \sigma_s^2$.

The technical efficacy (TE) of the manufacturing productivity is determined by equation (3), which divides the technical efficacy of the observed production by the maximum technical output for a particular firm.

$TE_{it} = [\exp(X_{it}\beta + V_{it} - U_{it})] / [\exp(X_{it}\beta + V_{it})] = \exp(-U_{it}) = \exp(-z_{it}\delta - W_{it})$ (Equation 3)

TE_{it} ranges from 0 (perfectly inefficient firm) to 1 (perfectly efficient firm), which implies that $0 \leq TE_{it} \leq 1$.

The more flexible translog and quadratic production functions were estimated instead of the more rigid Cobb-Douglas structure. Production functions that are quadratic and translog can be obtained by including an inefficiency component whose mean is established by a collection of regressors.

Two-stage technique was used to estimate the stochastic models to assess the consistency and stability of the results (Charoenrat and Harvie 2014). As the inefficiencies are trimmed from the left (at

ISSN: 2576-8484
Vol. 8, No. 6: 1-11, 2024
DOI: 10.55214/25768484.v8i6.1701

zero) and right (at one or one hundred percent), the unconditional fixed effect of Tobit model was applied in the second stage.

2.1. Sources of Data

The study employed the Enterprise Panel Survey (NPS) dataset, which was gathered and produced by the World Bank (2019) for the years 2007, 2009, 2014, and 2019, to investigate the primary productivity drivers of manufacturing firms in Nigeria. Over 130,000 organisations in 135 countries are now covered by the Enterprise Surveys, of which 121 have been polled. Data was gathered on the experiences of the firms and their perceptions of the environment (including creative activities) in which they operate.

The NPS is a nationally representative survey that was collected at random from over 2640 commercial entities, the majority of which are engaged in publishing, food,apparel, furniture,printing, hotel,recorded media, restaurant, non-metallic mineral goods, and retail. The various elements that influence the corporate environment are the main focus of the enterprise surveys.These elements are either thought to be essential to a company's success or to be impeding its performance. As suggested by the reviewed theoretical and empirical research, many interrelated factors influence an economy's ability to industrialise at either the macro or micro level.

The following categories of criteria were commonly assigned to estimate the efficiency level of manufacturing enterprises based on the data availability and micro nature of this study: Features unique to a firm: Research has shown that business-specific factors such as age, ownership structure, scale, and exporting status are powerful drivers of manufacturing firm productivity or efficiency (Ding *et al.*, 2016; Charoenrat & Harvie, 2014).The study uses a website and foreign-licensed technology as a proxy for technical variables because, as noted by Sharma (2019) and Guadagno (2016), technological elements significantly increase the productivity of manufacturing firms.

As previously noted by Che & Zhang (2018), the efficiency of a corporation is mostly determined by its human capital, hence we use the average labour cost or income as a proxy for worker competence. Lastly, we incorporate commercial cities and market structure, as proxied by the Herfindahl-Hirschman Index, into our model of efficiency determinants, similar to Charoenrat & Harvie (2014). The variable description, which is based on the World Bank Enterprise Survey (WBES) questionnaire, is displayed below. It provides information on the definitions and measurements of the variables used in the models.

2.2. Variable Description

lnlabour-cost-per wkr: Natural log of the total labour costs divided by the firms' total full-time employees.

Lncapital: This is the natural log of replacement costs of physical capital (equipment and motor vehicle, and land and buildings).

lnVA: This is the natural log of manufacturing firms' value-added.

Lnlabour: This is the natural log of the total number of firms' full-time (permanent and temporary) employees.

lnlabour-squared: 0.5* lnlabour^2

lncapital-squared: 0.5* lncapital^2

Lnage: This is the natural logarithm of a company's years of operation.

Direct exports: If a manufacturing company exports, this dummy value equals 1.

Foreign tech: If a manufacturing company employs technology that has been licenced from elsewhere, this dummy value equals 1.

Website: If a manufacturing company has a website, this is a dummy variable that equals 1.

Credit line: If a business has a loan or line of credit from a financial institution, this dummy value is equal to 1.

No. power outages: The natural logarithm of the total number of power outages that a manufacturing company has during a normal fiscal year.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 1-11, 2024
DOI: 10.55214/25768484.v8i6.1701

Market share Used to capture market power based Herfindahlj = $\sum_i \left(\frac{Sales\ i}{Sales\ j}\right)^2$ j implies industry and I imply firm.
Dom. Priv. own: If domestic private persons own more than 10% of the company, this dummy value equals 1.
Foreign ownership: If foreign private people possess more than 10% of the company, this dummy value equals 1.
Govt. own: If the government owns more than 10% of the company, this dummy value equals 1.
Micro: If the total number of full-time employees at the company is less than or equal to 10, this is a dummy value equal to 1.
Small: If the total number of full-time employees at the company is more than 10 but less than or equal to 50, this is a dummy value equal to 1.
Medium: If the company employs more than 50 full-time workers but fewer than or equal to 200, this is a dummy value of 1.
Large: If the company employs more than 200 people full-time overall, this dummy equal 1.
Kano If the company is based in Kano, the second-biggest commercial hub in Nigeria, then this dummy equal 1.
Lagos: The major commercial hub in Nigeria, Lagos is the dummy value that equals 1 if the company is located there.

3. Results and Discussion of Findings

Descriptive statistics for all the continuous variables used in the study are shown in Table 1. It shows that the average value-added and physical capital are ₦7.4 billion and ₦3874.1 million, respectively (or US$19.37 and US$10.11 million at the current exchange rate of US$1 = ₦1562), indicating a strong capital basis for industrial enterprises. The majority of manufacturing firms are small and newly established, as demonstrated by the average number of employees and years of operation, which are approximately 31 and 14 years, respectively.

As shown in Table 2, the average annual labour earnings or costs per worker are ₦4.16 million, or US$10816.04 per year or US$901.32 monthly, which is surprisingly low given Nigeria's lack of adequate, functional public facilities.Lastly, the manufacturing sector is demonstrated to be competitive, with an average market power of 0.6%, and the enterprises face an average of 36 power outages each year. Lastly, the manufacturing sector is demonstrated to be competitive, with an average market power of 0.6%, and the enterprises face an average of 36 power outages each year.

Table 1.
Summary of statistics.

Variables	Mean	Standard dev.	Minimum	Maximum
Firm's age	13.62	10.70	0	168
Value added	1.82e + 09	2.96e + 10	0	6.73e + 11
Lab. costs per worker	1,015,828	2.09e + 07	0	7.26e + 08
Market share	0.006	0.03	0	1
Total labour	31.29	146.36	0	5000
Power outage duration	36.39	85.13	0	2000
Physical capital	9.50e + 08	7.83e + 09	120	1.00e + 11

Source: Authors' study using the WBES dataset.

Table 2.
Stochastic frontier analysis of quadratic and translog production functions.

Variables	Parameters	Simultaneous models		Two-step models	
		Cobb-Douglas	**Translog**	**Cobb-Douglas**	**Translog**
Lncapital	β_1	-0.15 (0.24)	-0.05 (0.26)	-0.37** (0.16)	-0.36** (0.16)
Lnlabour	β_2	17.98*** (0. 42)	14.61* (7.92)	-0.26 (0.34)	-0.73 (0.51)
lncapital-squared	β_3	.019 (0.02)	0.02 (0.02)	0.04*** (0.01)	0.03***(0.01)
lnlabour-squared	β_4	-0.07 (0.12)	-0.11 (0.12)	0.23** (0.12)	0.21* (0.12)
lncapital* lnlabour	β_5		-0.06 (0.05)		0.04 (0.03)
Constant		11.87** (1.81)	9.76*** (2.62)	15.67*** (1.31)	16.33***(1.41)
Industrial effect	β_6	Yes	Yes	Yes	Yes
Efficiency model					
Lnage	δ_1	-0.97 (0.66)	0.17 (0.84)	-0.04 (0.05)	-0.04 (0.04)
lnlabour-cost-per wkr	δ_2	0.48***(0.18)	0.35 (0.25)	-0.02**(0.01)	-0.02**(0.01)
Direct exports	δ_3	-3.14* (1.73)	-5.31 (4.37)	-0.11* (0.06)	-0.11**(0.06)
Website	δ_4	-1.39 (1.04)	-6.81 (4.43)	-0.04 (0.09)	-0.03 (0.09)
Micro firm	δ_5	-6.24*** (1.95)	-9.18* (4.92)	-0.96*** (0.37)	-0.89*** (0.34)
Small firm	δ_6	-.18*** (1.61)	-7.11* (4.13)	-0.88** (0.37)	-0.81** (0.35)
Medium firm	δ_7	11.16 (16.71)	-25.06 (37.20)	-0.58 (0.37)	-0.51 (0.35)
Foreign technology	δ_8	-1.76 (2.16)	-2.45 (3.28)	-0.04 (0.09)	-0.05 (0.09)
Foreign ownership	δ_9	0.06 (1.60)	0.68 (1.68)	-0.01(0.08)	-0.01 (0.08)
Dom. priv. own	δ_{10}	-0.52 (0.81)	0.29 (1.15)	0.11 (0.07)	0.11 (0.07)
No. power outages	δ_{11}	0.92*** (0.31)	0.93** (0.37)	0.02 (0.02)	0.02 (0.02)
Credit line	δ_{12}	-2.57 (1.62)	-3.77 (3.29)	0.01 (0.07)	0.01 (0.07)
Market share	δ_{13}	-1.74(26.52)	13.87 (36.24)	-0.25 (0.21)	-0.25 (0.21)
Kano	δ_{14}	-8.54 (33.87)	-14.71 (676.1)	-0.19** (0.08)	-0.19** (0.08)
Lagos	δ_{15}	-9.16 (54.37)	-14.19 (463.2)	0.11 (0.09)	0.11 (0.09)
Constant					
Sigma (u)	σ_u^2	0.63***	0.62***	13.13	14.76
Sigma (v)	σ_v^2	1.59***	1.63***	1.39***	1.39***
Lambda	$\lambda = \sigma_u^2 / \sigma_v^2$	0.39***	0.38***	9.42	10.61
Gamma	$\gamma = \sigma_u^2 / (\sigma_u^2 + \sigma_v^2)$	0.29	0.275	0.90	0.91
Wald Chi²		4.2e + 07	24.27	136.88	149.80
Prob. Chi²		0.00	0.00	0.00	0.00
Log-likelihood		-827.99	-828.12	-2167.90	-2167.15

Note: Standard errors in parentheses ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 3.
Hypotheses' tests of the simultaneous stochastic frontier models.

Restriction	Wald test statistic	
	Translog	**Quadratic**
Constant-return-to-scale technology	51.23***	41248.11***
	[0.00]	[0.00]
No unobserved heterogeneity	4.27**	4.36**
	[0.03]	[0.03]
No observed heterogeneity	41.93***	[0.00]
	54.05***	[0.00]

As shown in Table 2, only the first-order labour unit is significantly driving output in the production function, according to simultaneous quadratic and translog models. It follows that Nigerian manufacturing firms are very labour-intensive and show growing returns to scale, which may be related to the low cost of labour in the nation. On the other hand, second-order capital and labour have a favourably significant influence on determining the businesses' production, but first-order capital has a negative and significant effect, according to two-stage quadratic and translog models. This suggests that the companies show declining returns to scale and have a minimum efficient scale or non-convex production function.

While two-stage models reflect a high degree of technical inefficacy of nearly 90% across the enterprises, simultaneous models show minimal technical inefficacy among the firms. Due to the inconsistency associated with two-stage models, our interpretation and discussion of efficiency determinants primarily focus on the findings of simultaneous models, even if all of the models in Table 3 produce almost similar conclusions with little differences. Once more, the simultaneous quadratic model's conclusions seem more trustworthy and sturdier because the simultaneous translog model's efficiency determinant coefficients are biassed higher.

According to the simultaneous quadratic model, small and micro manufacturing businesses outperform large ones in terms of efficiency, although the cost of labour per worker seems to be promoting inefficiencies within the industry. Exporting manufacturing firms are found to be more efficient than those that do not export. Finally, the bigger the number of power outages the worse would be the degree of technical efficacy among industrial enterprises in Nigeria.

The testing of the null hypotheses about the characteristics of the production technology and the applicability of the inefficiency term are shown in Table 2. The first test in Table 3 examines whether the functional specifications for quadratic and translog are adequate. The test's results reject the null hypothesis, which states that the more limited Cobb-Douglas production function would better match the data than either a quadratic or translog function. Put differently, it is discovered that unconstrained production technologies such as the quadratic and translog functions match the data more accurately than the Cobb-Douglas function.

Technical inefficacy is random and significant in determining adequate representation of the data since the second test also rejects the null hypothesis that the inefficiency element is irrelevant in the model. This supports the result shown in Table 3, where the projected value of gamma is twenty-eight percent of the overall error term. This indicates that the typical ordinary least square (OLS) estimation of the production function is not as appropriate as the stochastic frontier with inefficiency effects.

The last test in Table 3 disproves the null hypothesis, which states that the technical inefficacy component is not diverse according to the model's contributing elements. This indicates that the factors that determine the inefficiency term have a significant impact on how the inefficiency term changes.

Based on the previous data, it can be inferred that the primary factors influencing the productivity of manufacturing businesses in Nigeria between 2007 and 2019 were average labour costs, exporting status, company size, and frequency of power outages. Large companies were intended to be more efficient than smaller ones as they are meant to take advantage of economies of scale to provide goods and services at lower average prices. Like Diaz and Sanchez (2008), this study results, however, point to a different conclusion because micro and small businesses are found to be more efficient than large ones.

This makes sense because big manufacturing firms in Nigeria could severely struggle with bureaucratic bottlenecks, be too complicated to keep an eye on employee behaviour, and have demoralizingly low wages and working conditions. As might be predicted, manufacturing firms that export are shown to be more productive than their counterparts who do not export, and this finding may have something to do with the impact of global competition. For exporting businesses to enter, stay in, and profit from foreign markets, they need to operate with extreme efficiency.

It is undeniable that increasing the productivity or efficiency of all businesses, not just industrial ones depend on a steady power supply. The results indicate that the frequency of power outages appears to be causing a yearly decline in productivity of about one percent. The length of a power outage does not determine its efficiency; rather, its unpredictable nature which typically results in the loss of raw and intermediate materials and delays due to unplanned disruptions of the production process affects it. Given the significant expenses of acquiring and maintaining such alternate sources of electricity, even businesses with power generators or other alternatives may suffer. There is little doubt that the ensuing effects of the power loss led to significant inefficiencies. Moreover, if labour compensation is not determined by performance or skill level, labour expenses per worker may promote inefficiency inside the companies. These talks lead us to the conclusion that factors such as average labour prices, exporting status, size, and power outages must be taken into consideration when Nigerian industrialization is being driven at the micro level.

4. Conclusion

Industrialization has been and continues to be one of the policy choruses sung by different administrations in Nigeria, from early independence to the present, followed by various policy strategies and programmes with little or nothing accomplished to that effect.The study analyses the data concurently using the technique of SFAto achieve the aim. The SFA technique has an advantage over other metrics since it can be statistically calculated and its production form is observable. Once more, the pertinent SFA hypotheses were tested, and the functional links between inputs and outputs were shown.

According to the quadratic stochastic frontier model's findings, industrial companies have growing returns to scale and a labour-intensive structure. It is also revealed that micro and small businesses seem to be more productive than large-scale manufacturing firms. This might be related to the complexity of large businesses and the bureaucratic conflicts that are often exclusive to them. Manufacturing firms that export is seen to be more productive than those that don't, maybe as a result of global rivalry. It is also discovered that power outages harm industrial companies' productivity.

Last but not least, average labour expenses, which reflect workers' skills, are surprisingly lowering industrial businesses' levels of efficiency. This suggests that there may be a mismatch in skills or a lack of sufficient incentives for skilled people to be more productive. Based on these results, the paper deduces that, during the years 2007–2019, Nigerian microindustrialization was mostly driven by average labour costs, exporting status, size, and power outages.

5. Policy Implications

To create a industrialization strategy, the approach must be bottom-up manufacturing firms must be focused on. Since exporting helps manufacturing firms become more productive, exporting should be encouraged. Ensuring a favourable business climate for manufacturing firms, particularly those operating on a big scale, should be a top priority for policymakers to allow them to fully capitalise on the benefits of economies of scale. The present corporate reforms ought to focus heavily on lowering operating expenses by guaranteeing manufacturing firms have access to a sufficient, reliable, and reasonably priced power supply. The small and micro firms should pull outputs together for exportion.

Along with eliminating any other needless bureaucratic roadblocks, the reform should concentrate on encouraging employees to put in more effort through appropriate talent matching and suitable compensation. This study has shown beyond a shadow of a doubt that investigating the productivity drivers of manufacturing firms is essential in formulating policies meant to support and grow the private sector's role as a major engine of export promotion and job creation in a nation. Our research lays the groundwork for future investigations into the variables influencing the development in productivity of many industries, including agriculture and services.

References

[1] Adeniran, A. O. & Sidiq, O. B. (2018). Economic Recession and the Way-Out: Nigeria as Case Study. *Global Journal of Humanities and Social Science: E Economics*, *18*(1), 1-6.

[2] Adeniran, A. O., Muraina, M. J., & Ngonadi, J. C. (2023). Energy Consumption for Transportation in Sub-Sahara Africa. Crowther, D. and Seifi, S. (Ed.) *Achieving Net Zero (Developments in Corporate Governance and Responsibility, Vol. 20)*, Emerald Publishing Limited, Leeds, Pp. 203-231. https://doi.org/10.1108/S2043-052320230000020009.

[3] Aigner, D. J., Lovell, C. K.&Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics*, 6:21-37

[4] Anyanwu, J. C. (2017). Manufacturing value added development in North Africa: analysis of key drivers. *Asian Develop. Policy Rev.*, 5(4):281-298.

[5] Battese, G. E.&Coelli, T. J. (1995). A model for technical inefficacy effects in a stochastic frontier production function for panel data. *Emp. Econ.*, 20:325-332

[6] Calza, E., Goedhuys, M.&Trifkovic, N. (2019). Drivers of productivity in Vietnamese SMEs: the role of management standards and innovation. *Econ. Innov. New Technol.*, 28(1):23-44

[7] Central Bank of Nigeria (CBN) (2019). Central bank of Nigeria statistical bulletin, Abuja

[8] Charoenrat, T.&Harvie, C. (2014). The efficiency of SMEs in Thai manufacturing: a stochastic frontier analysis. *Econ. Model.* 43:372-393

[9] Che, Y. &Zhang, L. (2018). Human capital, technology adoption and firm performance: impacts of China's higher education expansion in the Late 1990s. *Econ. J.* 12(6):2282-2320

[10] Chikabwi, D., Chidoko, C.&Mudzingiri, C. (2017). Manufacturing sector productivity growth drivers: evidence from SADC member states. *Afr. J. Sci. Technol. Innov. Develop.*, 9(2):163-171

[11] Cieslik, A., Michałek, J. J.&Gauger, I. (2019). The regional dimension of firm-level productivity determinants: the case of manufacturing and service firms in Ukraine. *Central Eur. Econ. J.*, 5(52):81-95

[12] Diaz, M. A.&Sánchez, R. (2007). Firm size and productivity in Spain: a stochastic frontier analysis. *Small Bus. Econ.*, 30(3):315-323

[13] Diaz, M. A.&Sanchez, R. (2008). Firm size and productivity in Spain: a stochastic frontier analysis. *Small Bus. Econ.* 30:315-323

[14] Diebolt, F. X., Schorfheide, F.&Shin, M. (2017). Real-time forecast evaluation of DSGE models with stochastic volatility. *J. Econometrics*, 201(2):322-332

[15] Ding, S., Guariglia, A.&Harris, R. (2016). The determinants of productivity in Chinese large and medium-sized industrial firms, 1998-2007. *J Prod Anal.*, 45(2):131-155

[16] Earle, J.&Gehlbach, S. (2014). Productivity consequences of political turnover: firm-level evidence from Ukraine's orange revolution. IZA Discussion Paper, No, p 8510

[17] Galadanci, D. M. (2010).*Developing structure of the Nigerian economy.* ABU University Press, Zaria.

[18] Guadagno, F. (2016). The determinants of industrialization in developing countries. *Stud Econ.*, 2:4

[19] Guzman, B. V. R., Brun, A. &Domínguez, O. F. C. (2019). Quality management is a determinant factor of productivity. *Int. J. Produc. Perform. Manag.*, 3(1):43-56

[20] Iwayemi A (1994). Perspectives and problems of economic development in Nigeria: 1960-1990. CEAR Monograph Series Paper, No. 1-1994. University of Ibadan, Nigeria

[21] Kreuser, C. F.&Newman, C. (2018). Total factor productivity in South African manufacturing firms. *South Afr. J. Econ.*, 86:40-78

[22] Landi, S.&Niederreiter, J. (2017). Sector technology advancement as a driver of Italian total factor productivity. *J Econ Finan.*, 7(1):34-50

[23] Mijiyawa, A. G. (2017). Drivers of structural transformation: the case of the manufacturing sector in Africa. *World Dev.* 99:141-159

[24] Nigerian Bureau of Statistics (NBS) (2019). Nigerian economy: past, present and the future. Macroeconomic forecasts, 5thedition.

[25] Nigeria Economic Empowerment and Development Strategy (NEEDS) (2005). National economic empowerment and development strategy. Special report, Abuja, Nigeria

[26] Ngo, T., Le, T., Tran, S. H., Nguyen, A.&Nguyen, C. (2019). Sources of the performance of manufacturing firms: evidence from Vietnam. *Post-Commun. Econ.*, 31(6):790-804

[27] Otalu, J. A.&Anderu, K. S. (2015). An assessment of the determinants of industrial sector growth in Nigeria. *Journal of Researchin Business Management*, 3(7):1-9

[28] Rahmati, M. H.&Pilehvari, A. (2019). The productivity trend in Iran is evidence from manufacturing firms. *Econ. Trans. Instit. Change.*, 27(2):395-408.

[29] World Bank (2015). World Bank Enterprise survey: a panel data for Nigeria. The World Bank Group, Washington, DC

[30] World Bank (2019). World development report. World Bank, Washington, DC

[31] Xu, B., Sendra-García, J., Gao, Y.&Chen, X. (2020). Driving total factor productivity: capital and labour with tax allocation. *Technol. Forecast. Soc. Chang.*, 150:11-32