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Electricity supply efficiency in Nigeria: A case of electricity distribution companies

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Abstract

This paper examines the technical efficiency of electricity supply across eleven electricity distribution companies using the Data Envelopment Analysis (DEA). The analysis was performed with a recent and extended data from 2015 to 2019. The output indicator for calculating electricity supply efficiency is electricity supply proxy by energy received by each electricity distribution company. The input indicators are network losses (proxy by transmission losses) and aggregate technical commercial and collection losses (ATC&C). Empirical findings were reinforcing and in line with other findings in the literature. The results show that all electricity distribution utilities are technically inefficient in electricity supply to a varying degree. Four electricity distribution companies performed above 65 percent level of technical efficiency, while two operate at less than 70 percent. Thus, privatization has not eradicated technical inefficiencies in the electricity supply. The inefficiencies in the electricity sector are partly due to technical and commercial limitations

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1. Introduction

The electricity sector has traditionally been operating under a natural monopoly due to economies of scale and scope. The monopolization of the electricity sector gives rise to its vertical integration, mostly under government control. Since the 1990s, a paradigm shift towards a liberalized electricity market was advocated to limit government involvement in electricity sector. A strong impetus came from Colclough (1991) and Espinal (1992), who assert that the market is the optimal space for efficient production and distribution of goods and services. This belief in market extends to the privatisation of essential public properties like electricity sector. The ideology is underpinned by technological change, government budget constraint, and the other environmental factors limiting the efficiency of the sector. Besides, neoliberal ideology dominates the discourse of international organisations, like the International Monetary Fund (IMF) and the World Bank as a requirement to replace interventionist developmental state by a more non-interventionist state, and encourages the expansion of market forces by undertaking various market-friendly policies (Walton and Seddon, 1994). Hence, privatisation is meant to correct structural imbalances associated with public-owned goods (Oji et al. 2014). Privatisation is also presumed an effective means of improving efficiency and increasing investment (Vlahinic, 2011).

According to (Ahmed, 2007), the proponents of neoliberalism contend that in the electricity sector; electricity generation and distribution are entrenched in the ideologies of efficiency and profit maximization than on welfare objectives, for improved performance. Efficiency gains following cost reductions, depending on the severity of competition and the quality of the regulatory framework in place, are assumed to benefit consumers through price reductions and improvements in the quality of service. State intervention is being seen as the beginning of inefficiency. Thus, private control as against bureaucratic management is preferred for maximum efficiency gains. Firstly, social objectives, such as employment opportunities, associated with state control is criticized for enhancing inefficiency. Likewise, state's objective of providing electricity access to underserved and unserved, as well as those that cannot afford the cost of electrification is criticized as being politically motivated.

Some African countries, including Nigeria, have privatized their electricity sector to correct some inefficiencies that undermined the performance of the sector.[1] Nigeria's electricity sector privatisation process began with the enactment of the Electric Power Sector Reform (EPSR) in 2005. The EPSR was introduced as a legal and regulatory framework for private sector participation at the instance of unbundling the sector's monopoly. Consequent to the 2005 EPSR Act, the Power Holding Company of Nigeria (PHCN) took over the assets and liabilities of the erstwhile Nigerian Electricity Power Authority (NEPA). The PHCN was unbundled into eighteen entities; comprising six generation companies (GENCOs), a single transmission company (TRANSCO), and eleven distribution companies (DISCOs). In 2013, privatisation reform was fully introduced to both the electricity generation and distribution value chains to match the growing demand for a stable and reliable electricity supply, while enhancing efficient generation and distribution.

Nigeria's DISCOs play a critical role in the electricity sector; it interfaces directly with end users and indirectly with the generators through the transmission company and the Nigeria Bulk Electricity Trader (NBET). The privatisation is expected to enhance its competition and efficiency, thereby attracting the needed financial resources and management expertise (Parker, 2003). However, electricity supply remains epileptic and mostly unavailable to consumers. For instance, an average of 3130.3 MW electricity was generated in 2018 (World Bank WDI, 2020), about 40 percent ends up as transmission and distribution losses (NERC Quarterly Report, 2018); implying that the final electricity consumed was 1,963.3MW. An aspect of the reform is to crowd-in more funds for infrastructural development in the distribution subsector, but high network losses above 10 percent international threshold suggests a significant degree of stranded generation. The inherent underperformance of the distribution sub-sector is further mirrored in Aggregate Technical Commercial and Collection (ATC&C) losses, which is an index of technical, billing and revenue collection losses. The 2017 ATC&C in the distribution value-chain is 54 percent, although it declines in 2018 and 2019; the rates were twice higher than the Multi-Year Tariff Order (MYTO) allowable thresholds (NERC Quarterly Reports, 2019). This situation implies that the distribution value-chain suffers from a huge technical, billing and revenue shortfall, which invariably may affect its obligation to other segments of the electricity value chain.

An assessment of government policy is crucial in determining the effectiveness of changing a prevailing norm. Thus, evaluating the performance of the DISCOs is an avenue for policy review. Several debates across private and public stakeholders have ensued on the effectiveness of privatisation on Nigeria's electricity supply. Beyond the speculations, this paper contributes to the literature by seeking to compare the technical efficiency of electricity supply across DISCOs using the Data Envelopment Analysis (DEA). The DEA is widely adopted as a standard method for measuring firm-level efficiency, and as such, its application in this study adds to the empirical literature on the electricity sector's outlook after the privatisation reform. Existing studies in the context of Nigeria considered the issue from the political economy perspective (Aminu and Peterside, 2014; Audu et al., 2017), cross-national analysis (Samuel et al., 2019). Other studies also investigated the effect of privatisation on selected electricity distribution company performance (Samuel et al., 2019; Umar, 2020). Such partial analysis tends to be bias; as the outcome are limited, and as such, cannot be used to make a general inference about the performance of the electricity distribution value chain. An empirical investigation using a recent data increases the reliability of inferences, which could be beneficial for policymaking.

[1] Some of the African countries that have privatized their electricity sector are: Cote d'Ivoire, Uganda and Cameroon

The paper is structured into five sections including the introduction. Section 2 provides a review of relevant empirical literature. The description of data and methodology are provided in section 3. Empirical findings on technical efficiency of the electricity distribution companies are presented in section 4. Section 5 concludes.

2. Literature Review

It is presumed that the privatization of the electricity sector as situated within the neoliberal ideology provides market-oriented services at the value-chains. Change in ownership structure develops property rights due to new investment, technological change, and improved management control. Thus, efficiency gains ensued as a result of improved service delivery. The review shows that a plethora of investigations have been carried out on privatisation across different sectors. However, evidence on the efficiency gains of privatisation remained mixed both in developing and developed economies. The study by Adenikinju et al (2016) analysed the impacts privatisation on the technical efficiency of eleven distribution companies in Nigeria. Technical efficiency of the distribution companies was calculated with DEA using data from 2013 to 2016. They find that privatisation has not significantly improve electricity supply. The conclusion is that privatisation of the electricity sector is a step taken in a right direction, although performance has not significantly improved due to lingering challenges. The state of Nigeria's power supply in the post privatisation period was investigated by Audu et al. (2017). The study was exploratory within the framework of the elite theory. Due to the lop-sidedness of the privatisation process, the level of electricity supply has not improved differently from the pre privatisation era.

Samuel at al. (2019) examined the impact of Ibadan and Ikeja electricity distribution companies after electricity sector privatisation. The analysis was conducted based on descriptive and regression analysis. The distribution companies made no significant contribution to electricity supply due to poor service quality and billing, low metering level, among other factors. Likewise, Umar (2020) investigates the effect of privatisation on organisational performance of the Abuja electricity Distribution Company using primary data collected under the jurisdiction of the company. Information such as duration of electricity supply, infrastructure, compliant response time, quality of electricity supply, estimated billing, metering, power supply rationing, etc., were used in the Ordinary Least Squares (OLS) analysis. The empirical result shows that electricity supply in the assessed jurisdiction has not increased in the post privatisation period.

Empirical studies carried out in developed countries yielded mixed outcomes. For instance, Domah and Pollitt (2001) conducted a social cost-benefit analysis of restructuring and privatisation of electricity distribution and supply in England and Wales. They found that electricity prices fell by 15 percent due to increase electricity sales and improved efficiency as a result of electricity sector privatisation and restructuring. In Turkey, one of the targets of electricity sector liberalisation is to reduced consumer's electricity prices. However, the study by Karahan and Toptas (2013) find that privatisation of electricity distribution companies did not yield the expected decline in retail price of electricity, four years after privatisation. Estache et al. (2004) used DEA and a stochastic cost frontier approach to estimate the effect of competition, regulation and privatisation on 84 South American electricity utilities in the period 1994 to 2001. The study did not specify the individual effects of competition, regulation and privatisation on the electricity utilities. Moreover, Pombo and Taborda (2006) used DEA in estimating technical efficiency of Columbia's twelve power distribution companies with or without privatisation. The results confirm improved output, and positive effect of privatisation on the distribution companies.

Asides from the electricity sector, there is a broad belief that privatisation is also key to the efficient performance of other sectors. These categories of studies include the work done by Chris (2018) on the technical efficiency performance of privatised manufacturing firms in Nigeria. Firm technical efficiency was calculated using DEA. The study established that firms were more efficient after privatisation, as the mean efficiency value of output after privatisation was higher than the pre-privatisation value. A study by Jerome (2008) examined the impact of privatisation on technical efficiency of some selected firms in Nigeria. The study was conducted across three privatised enterprises that include the United Bank of Africa (UBA), Ashaka Cement, and Unipetrol. The study compares technical efficiencies of the selected enterprises pre and post privatisation periods using DEA. Firstly, for UBA earning assets and the total interest income of the firm are the output indicators. The inputs indicators are size of full-time employees, salary expenditure, fixed assets value and non-interest expenditure. Furthermore, the output indicators for Ashaka cement and Unipetrol are; cement per tonne and turnover. Inputs indicators include employee hours, and capital and material. The study finds that post-privatisation technical efficiency increases than the pre-privatisation efficiency across the three enterprises.

In Anderson et al. (2000), the effect of competition and ownership on the performance of 211 newly privatized firms in Mongolia was examined. The effect of competition on efficiency was significant. Enterprises under public ownership fared better to those under private control. The findings were due to the fragile nature of the Mongolian institutions that inhibit the performance of non-state actors. In the literature, studies that examined the case of the Nigeria's electricity distribution sub-sector in a detail empirical approach are scant. The available studies failed to utilise extended data in calculating supply efficiency when competition was introduced. The only known study (Adenikinju et al, 2016) was biased in drawing inferences as the analyses covered three years after privatisation. The authors acknowledged this limitation in their work and recommended further studies to use an extended period for a robust analysis.

3. Data and Methodology

3.1 Data

The efficiency of electricity supply across the eleven distribution companies is calculated based on their ability to maximize outputs commensurate with minimum inputs consumption. The firms are Abuja, Benin, Eko, Enugu, Ibadan, Ikeja, Jos, Kaduna, Kano, Port-Harcourt, and Yola electricity distribution companies. Thus, energy received (Megawatt/hour) by each distribution companies is the output indicators for energy supply. The input indicators are network losses (proxy by transmission losses) and aggregate technical commercial and collection losses (ATC&C). The privatisation of the electricity sector was in 2013, the effective date for take-over by all successor companies was 1st November 2014; hence, 2013 and 2014 are the years of public and private ownership of some distribution companies.[2] Thus, the year 2013 and 2014 were excluded from the analysis. The data for the empirical analysis spans from 2015 to 2019 collected across the eleven distribution companies.

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[2] https://nerc.gov.ng/index.php/home/nesi/401-history
https://www.internationallawoffice.com/Newsletters/Energy-Natural-Resources/Nigeria/Udo-Udoma-Belo-Osagie/Privatisation-of-the-Power-Holding-Company-of-Nigeria-recent-developments.
https://prog.lmu.edu.ng/colleges_CMS/document/books/Iseolorunkanmi%203%20-%20Issues%20and%20challenges%20in%20the%20Privatized%20Power%20Sector%20in%20Nigeria.pdf

The study used the annual data available in the reports of the Nigerian Electricity Regulatory Commission Quarterly Reports. The summary of the dataset is in Table 1.

Table 1: Dataset Description

S/N	**Variable**	**Unit of Measurement**	**Source**
1	Electricity Received by Distribution Companies (MWh)	MWh	NERC Quarterly Report
3	Transmission Losses Factor	Percent	NERC Quarterly Report
4	Aggregate Technical Commercial& Collection Losses	Percent	NERC Quarterly Report

3.2 Methodology

The study determines technical efficiency of the electricity supply.[3] Specifically, the study calculates the technical efficiency of electricity supply based on the assumption of Variable Returns to Scale. Several empirical studies in the literature adopted the DEA approach to evaluate firm technical efficiency across different sectors (Jerome, 2008; Chris, 2018). These investigations also include studies on the electricity sector (Adenikinju et al., 2016; Wang et al., 2018). In this study, an output-oriented DEA technical efficiency is calculated based on maximum electricity supply by a given level of inputs. It is impossible to do a 'before' and 'after' comparison, because the distribution value chain became competitive after privatisation. Nevertheless, the outcome could provide information about the level of efficiency of each electricity distribution firms.

The DEA is a linear programming technique that analyses all potential output for a given set of inputs (Coelli, 1996); where the outcome assumes a value between zero and one. Thus, the DEA simultaneously utilizes multiple outputs and multiple inputs, each stated in different units (Theodoridis and Psychoudakis, 2008). The technical efficiency is measured relative to the highest observed performance, rather than an average, which ranges from zero to one (Hjalmarsson and Veiderpass; 1992 as cited in Hossain et al., 2012). A firm is technically efficient when its efficiency score is one. Unlike the Stochastic Frontier Analysis (SFA) that is parametric, the DEA is a non-parametric method that allows efficiency to be measured a priori without specifying the analytical form of the production function, thus making the DEA a superior model (Forsund et al., 1980 as cited in Jerome, 2008). By implication, SFA is an econometric approach, while DEA is not. The DEA also focuses on revealed best practice frontiers rather than on central-tendency properties, and it generates a set of peer units for comparison (Theodoridis and Psychoudakis, 2008).

Based on Coelli (1996), the study adopts the DEA model that assumes Variable Returns to Scale (VRS) against Constants Returns to Scale (CRS) model suggested by Charnes et al. (1978). A major setback of the constant returns to scale is that it has an infinite solution, which results in higher estimates than assuming a variable returns to scale. Also, CRS approach

[3] According to Farrell (1957), the efficiency of a firm consists of technical or allocative efficiency. The technical efficiency of a firm reflects its ability to obtain maximal output from a given set of inputs while allocative efficiency reflects the ability of a firm to use the inputs in optimal proportions, given their respective prices.

assumes that all Decision-Making Units (DMUs) operates optimally. In reality, this assumption is far from the truth, thus the VRS model by Coelli (1996) is much preferred.

The standard model provided by Coelli (1996) is specified as:

$$max_{u,v}\ (\mu' y_i / v' x_i) \quad (1)$$
$$st \quad v' x_i = 1,$$
$$\mu' v_j - v' y_i \ \leq 0, \qquad j = 1,2, \ldots, N$$
$$\mu, v \geq 0,$$

The model in eq. (1) involves obtaining values for $\mu\ and\ v$, such that the efficiency measure of the ith Decision-Making Unit (DMU) is maximized subject to the constraint that all efficiency measure is less than or equal to one. In the model a constraint $v'x \ =1$ is imposed to avoid generating infinite solution as with the case of constant returns to scale model. This transformation provides the multiplier form of the linear programming problem.

A duality linear programming is applied to the model in eq. (1) to derive an equivalent envelopment form. This form is most preferred to solve due to the lesser constraints relative to the multiplier form. An equivalent envelopment form of the model is given as:

$$min_{\emptyset,\lambda}(\emptyset), \quad (2)$$
$$st \quad -Y_i + Y\lambda \geq 0,$$
$$\emptyset X_i - X\lambda \geq 0,$$
$$\lambda \geq 0,$$

Where $\emptyset$ is scalar and λ is *Nx1* vector of constants. *X* and *Y* are the firms' input and output vectors, respectively, while, *Xi* and *Yi* are inputs and outputs of the firm that is being evaluated. The value of $\emptyset$ is the efficiency score for the *i*th (firm) DMU. This value satisfies $0 \leq 1$, where a value of 1 indicates a point on the frontier, hence a technically efficient DMU (Perez-Reyes and Tova (2009).

In this study, the output is electricity supply proxy by energy received (MWh) by each electricity distribution company. The efficiency of electricity supply across the eleven distribution companies is calculated based on their ability to maximize outputs commensurate with minimum inputs consumption. Thus, energy received by each distribution companies is the output indicators for energy supply. The input indicators are network losses (proxy by transmission losses) and aggregate technical commercial and collection losses (ATC&C).

The selection of output and inputs indicators are justified in extant studies and based on the prior knowledge of the operational characteristics of Nigeria's electricity Distribution Companies (Milliotis, 1992; Bagdadioglu, 1995; Wang, 2018; Adenikinju; 2016, NERC, 2021).

In this paper, decisions are based on the mean values and ranking of the generated peer units. This approach streamlines and eases results interpretation.

Eq. (2) is modified by adding a convexity constraint as relates to variable returns to scale assumption:

$$min_{\emptyset,\lambda}(\emptyset), \quad (3)$$
$$st \quad -Y_i + Y\lambda \geq 0,$$
$$\emptyset X_i - X\lambda \geq 0,$$
$$N1'\lambda = 1,$$
$$\lambda \geq 0,$$

In eq. (3) *N1* is an *Nx1* vectors of ones. This variable returns to scale specification forms a convex hull of intersecting planes that envelope the data points more tightly than the constant returns to scale conical hull and thus provide a technical efficiency score that are greater than or equal to those obtained using constant returns to scale (Jerome, 1998).

4. Empirical Results

The results in Table 2 summarised the technical efficiency scores of the eleven electricity distribution companies. Overall, under the assumptions of VRTS and CRTS, all electricity distribution companies are technically inefficient based on their mean values. Based on yearly estimates, only the Ikeja distribution company was technically efficient in 2019. The interpretation of results and decisions are also based on the ranking of the generated peer units, in this case, each electricity distribution company. Ikeja electricity distribution company ranked 1st among other distribution companies. This outcome suggests that the distribution company operates the highest level of technical efficiency among its peers. This could be explained partly by the optimal performance of the company in 2019. Abuja, Ibadan, and Ikeja electricity distribution companies ranked 2nd, 3rd, and 4th, respectively. The three companies performed above 65 percent level of electricity supply efficiency.

Two utilities, Jos and Yola, were the least technically efficient among the eleven distribution companies. The companies ranked 10th and 11th. Their inefficiency scores in electricity supply average around 76 percent. These poor performances can be attributed to the low level of electricity infrastructure, in their operational domain, due in part to the high rate of network losses (NERC Quarterly Report, Various Issues). The highest performed companies have lesser network losses.

Overall, the yearly inefficient performance of the distribution companies is an indication that the distribution value chain still suffers some of the legacy challenges inherent with the state-owned utility. This situation is evident in the high rate of distribution losses due to technical, billing, and collection inadequacies in the value chain. Despite intentions to reduce these inefficiencies, the distribution losses consistently offshoot the acceptable threshold set by the Nigerian Electricity Regulatory Commission (NERC). Thus, suggesting a low level of investment to deliver on the contractual obligations of distribution companies to end-users. Besides, the inadequacies permeating the companies also have implications for the liquidity of the electricity sector as a whole.

Table 2: Summary of DEA Efficiency of Electricity Distribution Companies

	Variables Returns to Scale DEA						
	2015	**2016**	**2017**	**2018**	**2019**	**Mean Score**	**Rank**
Abuja	0.82	0.74	0.80	0.85	0.89	**0.82**	2
Benin	0.67	0.50	0.55	0.60	0.55	**0.57**	5
Eko	0.52	0.57	0.71	0.76	0.79	**0.67**	4
Enugu	0.62	0.60	0.56	0.51	0.28	**0.51**	6
Ibadan	0.73	0.67	0.80	0.81	0.84	**0.77**	3
Ikeja	0.81	0.73	0.79	0.95	1.00	**0.86**	1
Jos	0.27	0.29	0.32	0.28	0.29	**0.29**	10
Kaduna	0.45	0.46	0.48	0.50	0.46	**0.47**	7
Kano	0.27	0.34	0.43	0.46	0.42	**0.38**	9
P/Harcourt	0.45	0.48	0.49	0.46	0.47	**0.47**	8
Yola	0.09	0.14	0.20	0.23	0.25	**0.18**	11

Source: *Author's Computation with STATA 16*

Table 3 presents results based on a CRS frontier on the assumption that the proportionate input increase (reduction) will be followed by the same output increase (reduction). The assumption holds only if all DMUs operates at an optimal scale. This situation does not hold in reality due to constraints like imperfect competition, lack of finance, etc. But the CRS DEA results are presented to compare and to show that the VRS model (Table 2) provides technical efficiency scores greater than or equal to those obtained by the CRS model (Coelli, 1996). The scale efficiency DEA results are also presented in Table 4.

Table 3: Summary of DEA Efficiency of Electricity Distribution Companies

	Constant Returns to Scale DEA						
	2015	**2016**	**2017**	**2018**	**2019**	**Mean Score**	**Rank**
Abuja	0.75	0.69	0.70	0.83	0.89	**0.77**	2
Benin	0.61	0.46	0.48	0.58	0.55	**0.54**	5
Eko	0.47	0.53	0.63	0.74	0.79	**0.63**	4
Enugu	0.57	0.56	0.49	0.49	0.28	**0.48**	6
Ibadan	0.67	0.62	0.71	0.80	0.84	**0.73**	3
Ikeja	0.74	0.68	0.70	0.93	1.00	**0.81**	1
Jos	0.25	0.27	0.28	0.28	0.29	**0.27**	10
Kaduna	0.41	0.43	0.42	0.49	0.46	**0.44**	7
Kano	0.25	0.32	0.38	0.45	0.42	**0.36**	9
P/Harcourt	0.41	0.44	0.43	0.45	0.47	**0.44**	8
Yola	0.08	0.13	0.17	0.23	0.25	**0.17**	11

Source: *Author's Computation with STATA 16*

5. Conclusion

The privatization of the electricity sector involved some changes in the institutional and property rights arrangement of the sector. Change in ownership structure supposedly removes some previous constraints imposed by government ownership, and as such, the electricity sector is expected to experience some efficiency gains in electricity supply due to new investment, technological change, and improved management control. Thus, this study examined the technical efficiency of the electricity supply across the eleven distribution companies after privatization. Empirical findings were reinforcing and in line with other findings in the literature. An analysis of technical efficiency within the DEA framework shows all electricity distribution utilities are technically inefficient in electricity supply to a varying degree. Four electricity distribution companies performed above 65 percent level of technical efficiency, while two operates at less than 70 percent. As such, privatization has not eradicated technical inefficiencies in the electricity supply.

The inadequacies in the electricity sector, which are partly due to technical and commercial limitations, have some implications for policy reform in the electricity distribution companies. Firstly, there is a need for infrastructure investment across all distribution companies, especially among the worst-performed companies. The strategy is to revisit the 2013 privatization and design a new roadmap for investment commitments to reduce network losses while bridging metering gaps. This capacity improvement is required yearly to meet increasing electricity demand and limits network losses to an acceptable threshold. Importantly, the implementation hinges on strict compliance to industry standards and regulations set by the industry regulator-the Nigerian Electricity Regulatory Commission.

References

Adenikinju A., H. Dikko, and G. Sanusi, G. (2016) "Impacts of privatisation on electricity supply in Nigeria" In: The Quest for Development: Essays in Honour of Prof. Iwayemi at 70, Adenikinju A., Jerome, A. and Ogunkola, O. 426-445.

Ahmed, W. (2007) "Neoliberalism and contested policies of the power industry in India" *The Industrial Geographer* **5(1)**, 44-57

Anderson, J., Y. Lee and P. Murrell. (2000) "Do competition and ownership affect enterprises efficiency in the absence of market institutions? Evidence after privatization in Mongolia" Working paper, Department of Economics and IRIS Center, University of Maryland, College Park, Maryland

Aminu, I. and Z. Peterside (2014) "The Impact of Privatisation of Power Sector in Nigeria: A Political Economy Approach" *Mediterranean Journal of Social Sciences* **5,**26

Audu, E., S. O Paul, and E.Ameh (2017) "Privatisation of power sector and poverty of power supply in Nigeria: A policy analysis" *International Journal of Development and Sustainability,* **6(10),** 1218-1231.

Chris A. O (2018) "Determinants of the technical efficiency performance of privatized manufacturing firms in Nigeria: an econometric analysis" *International Journal of Development and Economic Sustainability* **6(1)**, 19-28

Coelli, T. (1996) "A Guide to DEAP Version 2.0. A Data Envelopment Analysis (Computer Program)" Centre for Efficiency and Productivity Analysis", Department of Econometrics, University of New England, Australia

Colclough, C. (1991) "Structuralism versus neo-liberalism: an introduction", in C. Colclough and J. Manor (Eds.), States or Markets? Neo-Liberalism and the Development Policy Debate (Oxford: Clarendon Press, 1991), pp. 1-25

Domah, P. and M.G.Pollitt (2001) "The restructuring and privatisation of electricity distribution and supply businesses in England and Wales: a social cost–benefit analysis" *Fiscal Studies* **22 (1)**: 107–146

Espinal R. (1992) "Development, neoliberalism and electoral politics in Latin America" *Development and Change* 23, 4:27-47

Hjalmarsson, L. and A. Veiderpass (1992) "Productivity in Swedish electricity retail Distribution" *Scandinavian Journal of Economics*, **9,** 193-S205.

Bjurek, H., L. Hjalmarsson, F.R. Forsund (1990) "Deterministic parametric and nonparametric estimation of efficiency in service production: a comparison" *Journal of Econometrics,* **46**, 1–2:213-227.

Hossain M. K., A.A.Kamil, M.A. Baten and A. Mustafa, (2012) "Stochastic frontier approach and data envelopment analysis to total factor productivity and efficiency measurement of Bangladeshi Rice" *PLoS ONE* **7(10)**: e46081.

Jerome, A. (2008) "Privatisation and Enterprise Performance in Nigeria: Case Study of Some Privatized Enterprises" AERC Research Paper 175 African Economic Research Consortium, Nairobi February 2008

Karahan, H and M. Toptas (2013) "The effect of power distribution privatization on electricity prices in Turkey: Has liberalization served the purpose?" *Energy Policy,* **63**:614-621

Wang, K., L.Chia-Yen, Z. Jieming, and W. Yi-Ming (2018) "Operational performance management of the power industry: a distinguishing analysis between effectiveness and efficiency" Annals of Operations Research, Springer **268(1),** 513-537

Nigerian Electricity Regulatory Commission (2019) "NERC Quarterly reports" Retrieved from https://nerc.gov.ng/index.php/library/documents/NERC-Reports/NERC-Quarterly- Reports/

Perez-Reyes, R. and B. Tovar. (2009) "Measuring efficiency and productivity change (PTF) in the Peruvian electricity distribution companies after reforms" *Energy Policy*, **37,**1536-61

Pombo, H. and R. Taborda. (2006) "Performance of efficiency in Colombia's power distribution system: effects of the 1994 reform" *Energy Economics*, **28(3)**, 339-369

Samuel S.I., I. Jide and O. Ayo(2019) "Privatisation of Power Sector in Nigeria: An Evaluation of Ibadan and Ikeja Electricity Distribution Companies Performance (2005–2018)" *International Journal of Public Administration,* DOI: 10.1080/01900692.2019.1672183

Theodoridis, A. M.; A. Psychoudakis (2008) "Efficiency measurement in Greek dairy farms: Stochastic frontier vs. data envelopment analysis" *International Journal of Economic Sciences and Applied Research,* **1(2)**, 53-66

Umar, A. A. (2020) "The effect of privatisation on organizational performance of Abuja electricity Distribution Company" *International Journal of Management Research and Review* **10(1)**, 01-10