

**DETERMINANTS OF THE TECHNICAL EFFICIENCY PERFORMANCE OF
PRIVATIZED MANUFACTURING FIRMS IN NIGERIA: AN ECONOMETRIC
ANALYSIS**

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ABSTRACT: *This work is designed to empirically evaluate the determinants of the technical efficiency of ten privatized manufacturing firms in Nigeria. The firms were selected from the numerous firms in the four geo political zones to represent the interest of the entire country due to their age long establishment, size and government equity investment in them. The study adopted Data envelopment analysis (DEA) and ordinary least square regression as the techniques of analysis and the period of analysis is five years before and five years after privatization. The efficiency scores generated from the first stage using Data Envelopment Analysis (DEA) was used as dependent variables in the second stage against a set of explanatory variables. The investigation revealed that concentration ratio, size and age of firms were considered as determinant of technical efficiency. It also shows that, concentration ratio will lead to higher monopoly power, with age firms gain experience and with size, firms gain more strength to control or have a larger share of the market. It is recommended that there should be market competition with liberalization of entry conditions, in order to terminate monopoly and allow for new entrants to make operations competitive for production. This will be in line with the industrialization policy.*

KEYWORDS: Determinants, Technical efficiency, Privatized Manufacturing firms, Nigeria

INTRODUCTION

The historical background of Privatization dated back to 1970 when the Nigerian economy began to experience economic depression. The adverse impact of this Economic crisis became monumental in the early part of 1980, as the nation witnessed a dramatic decline in economic performance.

The Size of the public firms which grew too large constituted an impediment to the development of the less-developing countries especially in Nigeria. Towards the tail end of 1980s, the public firms began to experience fundamental problems of low capacity utilization, corruption, defective capital structures, bureaucratic excesses, internal crises, lack of modern production technology, inadequate working capital, poor management and lack of technical support and of all the 42 public firms investigated, only 6 (14.2per cent) recorded capacity utilization of about 50 per cent (Owosekun, 1991; World Bank, 1996).

In 1981, the Nigerian economy went into recession (an economic crisis marked by falling oil revenue, declining industrial output which was reflected in the inability of the Nigerian economy to finance imports, a weak agricultural sector, trade arrears worth billions of dollars and a stalemate in talks to reschedule the countries crippling external debt) until recently when the debts were settled and the remaining percentage written off by the Paris Club of creditors. Subsequently in 1985, profit losses went up from ₦96.44 million to about ₦3.7 billion in 1990's and was also reported that the amount of the joint investment in these parastatals was

put at ₦23 billion. However government equity investment in them has only yielded paltry of 1.39 per cent returns on investments. It was also observed that the issue is not that public firms had yielded poor rate of return on investment but the poor performance of these public firms have also reduced the development of the private firms in many third world countries. The problems of public firms prompted virtually all less developing countries to embark on privatization and commercialization as a way out of the quagmire. The exercise has assumed an important attention on the policy agenda of the less developing around the divestment agenda towards state enterprise reorganization and liberalization of the economy.

Despite the mixed market features of the Nigerian economy, the impact of the public sector is still high in terms of investment and infrastructure, high capital outlay, provision of sound financial structures, planning and control. But certain negative tendencies such as misappropriation of public funds and other fraudulent practices contributed to the failure of the public enterprises. Thus, the public enterprise appears to be a dominant force going by the present rates of employment, real output, gross capital formation (Afolabi, 1991).

Statement of the Problem

A review of Nigeria economic policy profile from 1986 to date has shown different policy shifts. First, she pursued import substitution industrialization (ISI) to protect the domestic industries from collapse. Secondly, she adopted export promotion as a development tool to encourage the utilization of Nigeria domestic raw materials for production. But unfortunately, she has never identified the key variable that determines the technical efficiency of privatized manufacturing firms in Nigeria.

Objectives of the Study

1. The objectives of the study is to investigate the determinants of technical efficiency of privatized manufacturing firms in Nigeria.
2. To suggest appropriate policy to be employed by the Nigeria government.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Several Studies have been carried out on the technical efficiency dimensions of manufacturing firms using the technique of data envelopment analysis (DEA). Investigations also revealed that different approaches had been adopted by researchers in determining the technical efficiency of firms using tobit regression analysis by few researchers while ordinary least squares (OLS) regression have been widely used to project the variation in calculated efficiencies. Favero and Papi (1995) investigated the determinants of efficiency using the DEA and ordinary least square and the study proved that the determinants of efficiency are size and product specialization.

Obafemi (2008) carried out a study on the efficiency of the Nigeria banking industry. She adopted a two stage analysis using data envelopment analysis and the ordinary least square (OLS) to determine the technical efficiency of 67 banks in Nigeria and concluded that public ownership of banks in Nigeria reduces the efficiency of banks. She further added that when banks are highly labor intensive the efficiency declines, thereby recommended that there is need to encourage huge bank size through mergers and acquisitions. The study also identified

capital adequacy, ownership, capital labour ratio, Market share, liquidity ratio and quality of management as key determinants used in analyzing technical efficiency in the banking industry.

Miller and Noulas (1996) adopted two stage analytical techniques: DEA and econometric programming to investigate the influence of size, profit and power of market on efficiency of firms and reported that size and profit are significant and are the determinants of efficiency. Aggrey (2010) using ordinary least square method found a negative relationship between size and efficiency and a positive relationship between foreign ownership and efficiency. Technical efficiency rises until a firm size level is attained and technical efficiency lowered with an upward movement in the firm size as explained in the study. Also, Le and Harvie (2010) examined the actions influencing efficiency and found that firm age, size, location, ownership, cooperation with a foreign partner, product innovation, competition, are significantly associated to technical efficiency.

Leachman (2005) examined the manufacturing performance of eight major automobile manufacturers using two stage DEA techniques and showed that there is a strong R&D commitment and ability to compress production time in manufacturing performance. In the first stage, the efficiency scores generated from the individual firms using DEA are used as the dependent variable in the second stage. DEA has been adopted widely to study the technical efficiency of firms while the second stage regression analysis has been used to explain variations in the calculated efficiencies to a set of independent variables. Amongst the determinants of the efficiency performance of firms, are liberalization, age of the firm, capital investment (size), ratio of equity to invested assets, number of employees, ownership, Foreign direct investment, R&D intensity (ratio of expenditure on R&D and sales), export of goods, import of capital goods, patent regime and technology. All these are cited as some of the variables determining the level of efficiency of manufacturing firm performance.

In summary, the major literatures reviewed so far, have revealed some gaps that begs to be filled. One of such gap is that from the literature reviewed so far, nobody has investigated the determinants of the technical efficiency of privatized manufacturing firms in Nigeria. In the light of the above, there is need for stronger empirical findings to investigate the determinants of technical efficiency of privatized manufacturing firms in Nigeria. The dearth of much empirical work done on determinants of privatized firm's and the need to close this gap therefore claims the attention of this study. The study is anchored on the theory of the firm and the structure of objective function theories which predicted an improvement on other theories by examining the objective functions of private investment, change of ownership role in making resource allocation and product decisions in line with the existing theories mentioned and also supported efficiency improvement within the context of privatization.

RESEARCH METHODOLOGY AND MODEL SPECIFICATION

To evaluate the determinants of the technical efficiency of these firms, three critical input variables (raw materials cost, labor and capital) and two output variables (output and profit) were used to evaluate the technical efficiency of ten manufacturing firms in Nigeria using DEA.

Using the efficiency scores as dependent variable, we use the following as explanatory variable.

Output Function

In specifying this equation, three variables are included, namely concentration ratio, age of the firm and size of the firm. The efficiency scores obtained from the output technical efficiency are used as the dependent variables in order to establish the functional relationship between the output efficiency scores and the explanatory variables. Concentration ratio is measured as the log of total assets, age of the firm is determined as the number of years of incorporation to date while size of the firm is measured as the ratio of equity to invested assets. In line with the theory of Cobb Douglas production function, these three variables are some of the determinants of technical efficiency and several empirical studies have identified and adopted concentration ratio, age of the firm, size of the firm, export propensity, patent, liberalization among others as determinants of efficiency and we expect the output function to be positively related to the variables (Barton, 1990; Caves 1992). However, we shall be adopting some of the variables already mentioned in the literature.

$$\text{Efficiency}_{\text{output}} = f(\text{conr}, \text{age}, \text{size}) \quad 5.1$$

Where:

Conr = concentration ratio

Age = age of firm

Size = size of firm

Profit function

In specifying this equation, three variables are also included, namely concentration ratio, age of the firm and size of the firm. The scores obtained from the profit technical efficiency are used as the dependent variables in order to establish the functional relationship between the profit efficiency scores and the explanatory variables. Profit is one of the determinants of manufacturing firm performance (efficiency) but the second stage regression analysis is used to explain variations in the calculated efficiencies from DEA to a set of independent variables. Reasons justifying the inclusion of the variables had already been discussed in the literature review. In line with the theory of Cobb Douglas production function, these three variables are some of the determinants of technical efficiency and several empirical studies have identified and adopted concentration ratio, age of the firm, size of the firm, export propensity, patent, liberalization among others as determinants of efficiency and we expect the profit function to be positively related to the explanatory variables (Barton, 1990; Caves, 1992). However, we shall be adopting some of the variables already mentioned in the literature.

$$\text{Efficiency}_{\text{Profit}} = f(\text{conr}, \text{age}, \text{size}) \quad 5.2$$

Where:

Conr = concentration ratio

Age = age of firm

Size = size of firm

The general model linking these sources of efficiency is hereby presented.

Linearizing the two equations we have:

$$Eff_{output} = \alpha_0 + \alpha_1 conr_i + \alpha_2 age_i + \alpha_3 size_i + v_i \quad 5.3$$

$$Apriori = \alpha_0 > 0; \alpha_1 > 0; \alpha_2 \leq 0; \alpha_3 > 0$$

$$Eff_{profit} = b_0 + b_1 conr_i + b_2 age_i + b_3 size_i + \varepsilon_i \quad 5.4$$

$$Apriori = b_0 > 0; b_1 > 0, b_2 > 0, b_3 > 0$$

Where the α, b are to be estimated.

Method of data collection and sources of data

The data for this study is basically secondary in nature and were obtained from various sources. Annual reports of the firms, offer prospectus of the firms, the internet and the Analyst Data Services and Resources Ltd (ADSRL) provided additional data for the manufacturing firms.

Estimation Techniques

In estimating the data, and since our objective is to measure the determinants of the technical efficiency of privatized firms, data envelopment analysis (DEA) was adopted to estimate the efficiency scores which would be used as explanatory variables in establishing the determinants of technical efficiency of firms in Nigeria. DEA is a linear programming methodology used to measure the efficiency of multiple decision-making units (DMUs) when the production process presents a structure of multiple inputs and outputs. DEA is also used to determine which DMU lie on the efficiency frontier. DEA identifies all the inputs and outputs of each privatized firm to obtain efficiency of the firms and the results assume a value between zero and one. The higher the value, the greater the efficiency. A value of one indicates that the firm is technically efficient. It provides the analysis of efficiencies for multiple inputs and outputs, by evaluating each DMU and comparing its performance with the best performing unit. The best performing unit should lie on the efficiency frontier. If the unit is not on the efficiency frontier, it is considered inefficient. The concept of DEA is useful because in calculating efficiency, it takes into consideration returns to scale, allowing for the concept of increasing or decreasing efficiency based on size and output levels. DEA is superior to other econometric approach because it has the following advantages:

1. DEA doesn't require explicit specification of the mathematical model.
2. DEA has proved to be important in discovering association that cannot be discovered by the use of other methods.
3. DEA has the capacity of handling multiple inputs and outputs.
4. DEA has the capacity of being used to measure with any input and output.
5. DEA identifies any sources of inefficiency that can be evaluated, analyzed and quantified.

Data Presentation and Analysis

Descriptive statistics of the output and profit technical efficiency

Table 8.1 presents some descriptive statistics on the variables used in the second stage of this study. As shown in Table 8.1, the result of the data envelopment analysis (DEA) investigating significant difference in the pre and post privatization period based on the technical efficiency obtained from output and profit function shows that the mean efficiency value for the output in the pre and post privatization is 0.5046 and 0.5642 respectively. This shows that the mean value of output after privatization was higher while the mean efficiency value from profit is 0.4805 and 0.3950 respectively. The mean value for profit was higher before privatization.

Table 8.1: Descriptive statistics of the technical efficiency

Variables	Period	Mean	Std. Deviation
Output Technical efficiency	Pre Privatization	0.5046	0.31241
	Post Privatization	0.5642	0.30408
Profit Technical efficiency	Pre Privatization	0.4805	0.38465
	Post Privatization	0.395	0.31962

Source: Author's computation from data (2017)

Data Analysis of the regression result.

In the previous section, we discovered that there is a differential in the technical efficiency of the manufacturing firms with some firms operating below the efficiency frontier. In this section, we attempt to analyze the regression results to enable us know the determinants of technical efficiency of the manufacturing firms. The result shows that the determinants of technical efficiency in the manufacturing firms are concentration ratio, age of the firm and size of the firms among others.

Regression analysis for output

Table 8.2 presents regression result for the second stage analysis that relates technical efficiency based on the output function to concentration ratio, age and size of the firm in the pre privatization periods. In the pre privatization, none of the explanatory variables significantly explain technical efficiency while after privatization only size of the firm had a significant difference.

Table 8.2: Result of output regression

Variables	Pre privatization			Post privatization		
	coefficient	t- statistic	P- value	coefficient	t- statistic	P- value
(Constant)	0.56 (-0.527)	1.063	0.294	-0.781 (-0.287)	-2.725	0.009
Concentration ratio	-0.465 (-0.811)	-0.573	0.57	-0.697 (-0.414)	-1.683	0.099
Age	0.007 (-0.008)	0.96	0.342	-0.003 (-0.005)	-0.617	0.541
Size	-0.019 (-0.056)	-0.342	0.734	0.103 (-0.029)	3.543	0.001
R-square						
F-statistic	0.06			0.363		
F(P-value)	0.944			8.347		
	0.427			0		

Source: Author's computation using Eview(2015)

Note: Standard error of coefficient is in parenthesis

The result shows that concentration ratio and size are statistically significant after privatization. The coefficient of the log of concentration ratio before privatization is negative (-0.465) while after privatization the coefficient is also negative (-0.697). The coefficient of age of the firm before privatization is positive (0.007) and after privatization it was negative (-0.003) while the coefficient of the size of the firm before privatization is negative (-0.019) and after privatization is positive (0.103) and was statistically significant. This is an indication that large public firms were problems to the less developing countries.

In the R^2 only about six per cent variation was reported in the study before privatization while after privatization about four per cent explained variations in the variables used. The F statistics before privatization was nine per cent while after while privatization it was only 8.4 per cent. The p-value before privatization is 0.427 and after privatization it was 0.000.

Regression analysis for profit

Table 8.3 presents regression result for the second stage analysis that relates technical efficiency based on the profit function to concentration ratio, age and size of the firm. In the pre privatization period, concentration ratio and age are statistically significant. In the post privatization period, concentration ratio, age and size of the firm significantly explain technical efficiency at one per cent level of significance. All the firms are making profit. The R-square from this result shows that 36.3 per cent of the variation in post privatization technical efficiency can be explained by these variables. This shows that, the higher the concentration ratio, the monopoly power will be high, with age, firms gain experience and with size, firms gain more strength to control or have a larger share of the market.

Table 8.3: Result of profit regression

Variables	Pre privatization			Post privatization		
	coefficient	t- statistic	P- value	coefficient	t- statistic	P- value
(Constant)	3.433 (-0.686)	5.005	0	1.106 (-0.333)	3.322	0.002
Concentration ratio	3.603 (-1.057)	3.409	0.001	0.592 (-0.48)	1.232	0.224
Age	0.031 (-0.01)	3.154	0.003	0.021 (-0.006)	3.513	0.001
Size	-0.31 (-0.073)	-4.248	0	-0.106 (-0.034)	-3.125	0.003
R-square						
F-statistic	0.296			0.232		
F(P-value)	6.175 0.001			4.431 0.008		

Source: Author's computation using Eview (2015)

Note: Standard error of coefficient is in parenthesis

The F statistics shows that before privatization 6 per cent while after privatization it was 4.4 per cent. In line with the existing theories mentioned in the literature and other empirical studies, the result agreed with the general expectation of the theories that these variables are the determinants of efficiency (Barton, 1990; Caves, 1992).

Summary of Findings

This study investigated concentration ratio, size and age of firm as determinants of technical efficiency. Following these objectives, related literature and empirical works on privatization in several parts of the world were reviewed in chapter two to enable us access and understand concepts and the determinants of technical efficiency. The model specified includes the DEA and second stage regression model. The framework of analysis includes the data envelopment analysis and the ordinary least square regression. From the result in Table 8.2 regression for the second stage analysis that related technical efficiency based on the output function to concentration ratio, age and size of the firm in the pre privatization period none of the explanatory variables significantly explained technical efficiency while after privatization only size of the firm had a significant difference. In Table 8.3 regression results for the second stage analysis that related technical efficiency based on the profit function to concentration ratio, age and size of the firm in the pre and post privatization period, concentration ratio and size of the firm significantly explained technical efficiency at one per cent level of significance. The R-square from this result shows that 36.3 per cent of the variation in post privatization technical efficiency can be explained by these variables. This shows that, concentration ratio will lead to higher monopoly power with age, firms gain experience and with size, firms gain more strength to control or have a larger share of the market.

Policy Recommendation

Based on the result, it is recommended that, since concentration ratio, age and size of the firm significantly explain technical efficiency. Government should note that with concentration ratio, monopoly power is still very strong and may likely affect efficiency. It is recommended that there should be market competition with liberalization of entry conditions, in order to terminate monopoly and allow for new entrants to make operations competitive for production. Ownership of firm, competition and regulation involve incentive structures which will improve performance through internal organizational responses. This will be in line with the industrialization policy.

CONCLUSION

The result supports the consensus that privatization will improve the performance of firms in Nigeria and particularly draws attention of policy makers in Nigeria the opportunity of planning, reviewing and improving on its investment portfolio and management policies that could enhance economic stability and progressiveness which are key and strategic to the economic development of the country.

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