A DATA ENVELOPMENT ANALYSIS STUDY OF NIGERIAN UNIVERSITIES' EFFICIENCY

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Abstract

The study was carried out to determine the efficiency of Nigerian Universities. This is to determine the extent to which the institutions were performing relative to one another. The questions of how well the universities minimize their input relative to their output were also addressed in the study. The researcher adopted a descriptive type of ex-post-facto research design. Stratified random sampling technique was used to select 30 out of the 84 public universities. The stratification was based on geographical location, state, federal, conventional and specialized universities. A researcher-designed instrument tagged, "University Cost and Efficiency Checklist" (UCEC) was used to gather data for the study. The instrument was validated by five experts in Measurement and Evaluation, Educational, Management, Operation research and statistics. Four research questions were raised. Statistical techniques such as percentage, mean score and standard deviation were used in the descriptive analysis of the data collected. A Linear Programming technique called Data Envelopment Analysis (DEA) was used to evaluate university efficiency. The study showed that the mean technical efficiency of the institutions was 77.1%. In addition, about 66.7% of the institutions were small in size and had not exhausted their productive capacity. Based on the findings of this study, it was recommended that, allocation of resources to the universities should be made to be highly competitive and this should be based on the performance of the institutions in the previous year. In formulating policy for the universities, the government should eliminate systemic factors that could cause wastage in the use of resources.

Keywords: Data Envelopment Analysis, Technical Efficiency, Scale Efficiency, Nigerian Universities

Introduction

The relative effectiveness and efficiency with which university education is being provided in Nigeria guides a number of important policy decisions relating to the allocation of public resources. The ultimate concern of the policy makers is to allocate scarce resources in efficient and effective manners. Considering the huge amount of public funds committed to university education and the quality of products from the universities, the government is highly concerned about the efficiency and effectiveness of these institutions. This is to identify the extent to which the resources accrued to universities are utilized to achieve the objectives for which they were established and from which a number of decisions can be made regarding the institutions that are not efficient in the use of resources. The measurement of public sector efficiency, especially when it involves service provision as the case of universities is a difficult empirical issue because it involves value judgement. However, this is viewed in comparing public resources in term of total amount money

expended, personnel and other resources used by Nigerian universities and output indicators of universities such as student' academic performance, graduation rate and research quality. Blanchard (2004) opined that good performance in higher education is expected provide positive growth. But Nigerian universities are far behind this level when compared with other universities in Europe and America. This is why there is a need for the measurement of efficiency in Nigerian universities to determine those institutions that produced maximum output from a given quantity of inputs and those that used minimum cost to produce a vector of outputs and to suggest ways of improvement to institutions which are yet to be efficient.

In addition, with increasing ennoblement in Nigerian universities, the Federal Government is faced with the problem of providing university education in a more effective manner that will enable the existing resources to be used to meet the increasing demand for university education. Since 1999 the federal Government had shown great interest in trying to reduce the burden of public finances of university education by attempting to raise the efficiency of Nigerian universities. This is being done by allowing private participation in the provision of university education in Nigeria. Other initiatives in the last decade are: introduction of policies and reforms in Nigeria universities such as the auditing of all universities and associated parastatals, revocation of vice chancellors privilege of personally selecting 10% of student intake each year, reconstitution of all universities Governing councils with broader representation, licensing of new private universities, exemption of university from public salary scales and regulation and a 180% increase in funding of university system that raised a student allocation from the equivalent of $970 per annum (NUC,2000). This reorganization and growth in Nigerian universities has raised concerns about whether possible level of efficiency can be achieved, such that universities cost and production functions will be consistent with the universities reforms of the Federal government of Nigeria.

The first step in determining university efficiency is to identify some standard or benchmarks from which estimates could be derived. This is done by identifying those institutions using the least amount of input to produce its present level of output. The empirical studies of higher education production function represent the process of transformation, which is central to production theory can be applied in principles to all areas of economic activities including education. The notion of improving the standard of education is also viewed as a productive activity involving the combination of various inputs such as capital and labour to transform one set of input to another set of outputs. This is because a number of indicators will be brought to the limelight in order to assess the efficiency of the universities. Moreover, in assessing the efficiency of universities, the question of how well the universities were performing compared to one another and the levels at which they were able to minimize their inputs relative to their output will be addressed.

In view of the fact that universities are multi input and output organisation, there is a need to conduct performance evaluation of universities based on measuring of relative efficiency of one university to the others. This will give a practical and productive efficiency measures as well as information on where to improve efficiency. This study is therefore design to examine scale and technical efficiency of Nigerian Universities. This is to examine the theoretical understanding of the concept of university efficiency. It is this gap on the perception of the need for efficiency, productivity and cost effective management in Nigerian universities that has motivated the researchers to carry out this study.

The study was carried out to achieve the following specific objectives: (i) to address the question how well Nigerian universities are performing relative to one another, (ii) to examine the extent to which universities are able to minimize their level of inputs for a given

level of outputs, (iii) to determine the levels at which universities operate at an optimal size, (iv) to determine the wastage rates in the universities.

DEA Theory

DEA is commonly used to evaluate the efficiency of a number of producers. It is an extreme point method that compares each producer with only the "best" producers. A fundamental assumption behind DEA is that if a given producer A is capable of producing Y (A) unit of output with X (A) inputs, then other producers should be able to do the same if they are to operate efficiently. In the same vein, if producer B is capable of producing Y (B) unit of output with X (B) inputs then other producers should also be capable of the same production schedule. Producers A, B and others can be combined to form a composite producer, since this composite producer does not necessarily exist it is sometimes called virtual producer (Anderson, 1996).

The measurement of relative efficiency where there are multiple, possibly incommensurate inputs and outputs, as was noted earlier, was addressed by Farrel (1957) in his classic paper on the measurement of productive efficiency. This was further developed by Farrel and Field house (1962) focusing on the construction of hypothetical efficient unit, as a weighted average of efficient unit to act as a comparator for an efficient unit.

A common measure for relative efficiency is stated as (Dyson et al., 1990):

$$Efficiency = \frac{weighted\ sum\ of\ outputs}{Weighted\ sum\ of\ inputs} \quad \text{----------(1)}$$

Written as (Dyson et al., 1990):

$$Efficiency\ of\ unit\ j = \frac{u_l y_{lj} + u_2 y_{2j} + \ldots}{v_l x_{lj} + v_2 x_{2j} + \ldots} \quad \text{——————————————(2)}$$

Where:

u_1 = *weight* given to output 1
y_{ij} = amount of output 1 from unit j
v_1 = *weight* given to input 1
x_{lj} =amount of input l to unit j

The initial assumption is that this measure of efficiency requires a common set of weight to be applied to all units. This assumption may be unsatisfactory since it raises the problem of how such an agreed common set of weights can be obtained. Charnes et al (1978) recognized the difficulty in seeking a common set of weights to determine the relative efficiency. They recognized legitimacy of the proposal that units might value inputs and outputs differently and therefore adopt different weights and proposed that each unit should be allowed to adopt a set of weights, which shows it the most favourable light in comparison to other units.

Data Envelopment Analysis as a Method of Assessing Efficiency

Data Envelopment Analysis (DEA), introduced by Charnes, Cooper and Rhodes (1978), is a linear programming method for calculating the relative efficiencies of a set of organizations that possess some common functional traits but whose efficiency may vary due to internal differences such as management style (Mahgary and Lahdelma,1994). Essentially, Charnes et al. (1978) operationalised by means of linear programming the production economic concepts of empirical efficiencies put forth by Farrel (1957). And since 1978, both theoretical developments and practical applications of DEA have advanced at an explosive pace. Far more to the point in using DEA is the building of an understanding of how transformation of

resources to outcomes works. DEA will reveal what operating practices; mix of resources, scale sizes, scope of activities e.t.c, an operating unit may adopt to improve its performance.

Furthermore, DEA is an empirically based methodology that eliminates the needs for some of the assumptions and limitations of traditional efficiency measurement approaches (Bowlin, 1998). It was originally intended for use as a performance measurement tools for organisations that lack profit motivation e.g. not-for-profit and governmental organizations. However, since its introduction, it has been developed and expanded for variety of uses in for-profit as well as not-for-profit situations. It is a multifactor productivity analysis model for measuring the relative efficiency of homogenous set of decision-making units (Talluri, 2000).

DEA is also a non-parametric method, which extends efficiency measures from a single input, single output efficiency analysis to multi-input, multi-output situations. In contrast to the parametric approach, DEA does not require any assumption about functional form; the efficiency of a Decision-Making Unit (DMU) is measured relative to all other DMUs with simple restriction that all DUMs lie on or below efficient frontier (Seiford & Thrall, 1990).

DEA Models

DEA models are essentially linear programming formulations. As it applies to universities, it involves solving a linear programming model for each university. The solution to the model consists of information about the peers of the institution and efficiency of the institution relative to its peer group. This work focuses attention on two basic DEA models: the Charnes, Cooper and Rhodes (1978) (CCR) model and the Banker, Charnes and Cooper's (1984) (BCC) model.

The Charnes, Cooper and Rhodes (CCR) Model

The model is stated by Bowlin (1998) as:

minimize: $$\Theta - \varepsilon[\sum_{i=1}^{m} S_i^{-} + \sum_{r=1}^{s} S_r^{+}]$$

Subject to: $$\sum_{j=1}^{n} \lambda_j x_{ij} = \Theta x_{io} - S_i^{-} \quad ; \quad i = 1,2,...,m \quad \text{----------(3)}$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} = y_{ro} + S_i^{+} \quad ; \quad r = 1,2,...,s$$

$$\lambda_{j,} S_i^{-}, S_r^{+} \geq 0$$

The above model yields an objective evaluation of overall efficiency and identifies sources and estimates the amounts of the inefficiencies thus identified, (Charnes et al., 1994). The model is to evaluate the relative performance of a DMU_o (the DMU being evaluated), based on observed performance of j = 1, 2.....,n DMUs. The terms $y_{r,}, x_{ij}$ in the model are constants, which represent amount of the r^{th} output and i^{th} input of the j^{th} DMU in a collection of j = 1,2....,n entities, which utilized these i = 1,2..... , m inputs and produced r = 1, 2..... , s outputs. One of the j = 1, 2..... , n DMUs is singled out for evaluation and accorded the designation DMU_o, and placed in the function to be maximized in while also leaving it in the constraints. It then follows that DMU_o's maximum efficiency score will be $\Theta_o^{*} \leq 1$ by virtue of the constraints. The star (*) indicates an optimal value obtained from solving the model.

S_i^- and S_r^+ in (1) are inputs and output slack values. If any one of these values is positive at the optimal solution to the model, it means that the corresponding input or output of DMU_o can improve further, after its input levels have been reduced to the proportion Θ_o^*. The sum of weights is represented by λ_j,

The ε in (1) represents a non-Archimedean constant which is smaller than any positive valued real number. In practice, the DEA computer software used handles this non-Archimedean constant. Hence, it needs not be specified explicitly (Bowlin, 1998).

According to the CCR model (1), a DMU is efficient if and only if the following two conditions are satisfied (Charnes et al., 1994):

i. $\Theta_o^* = 1$,

ii. All slack values (S_i^- and S_r^+) are equal to zero.

The nonzero slack values and the value of $\Theta_o^* \leq 1$ identify the sources and amount of any inefficiency that may be present (Charnes et al., 1994).

The CCR model assesses the constant return to scale (CRS) to scale and assume that an increase in inputs is expected to result in a disproportionate increase in the outputs produce by the DMUs.

Banker, Charnes and Cooper (BCC) Model

The second version of the DEA model is the Banker, Charnes and Cooper (1984) model. It distinguishes technical and scale inefficiencies by estimating pure technical efficiency at a given scale of operation and identifies whether increasing, decreasing or constant returns to scale possibilities are present for further exploitation (Charnes et al., 1986). The primary difference between this model and the CCR model is the treatment of returns to scale. The CCR version bases its evaluation on the constant returns to scale (CRS). The BCC version on the other hand is more flexible and allows variable return to scale (VRS). Below is the mathematical formulation of the BCC model:

The difference between the CCR and the BCC model is that the term 2 (also known as the convexity constraint) is now restricted to summing to one. This has the effects of removing constraints in the CCR model that DMU must be scale efficient. Consequently, the BCC model allows variable return to scale and measures only technical efficiency for each DMU. That is, for a DMU to be considered as CCR efficient, it must be both scale and technically efficient. For it to he considered as BCC efficient, it only needs to be technically efficient (Bowlin, 1998). Under the CCR it is assumed that there is no significant relationship between the scale of operations and efficiency. This implies that big universities are not more efficient than smaller ones in the transformation of their inputs to outputs.

Methodology

Population, Samples and Sampling Technique

The population for the study consists of all universities in Nigeria while the target population comprised of all the public universities. The target population is 79 universities comprising of 40 federal and 39 state universities out of which 30 universities were selected (Oyeniran,2010). This number is large enough to ensure that all the categories of public universities were adequately represented so that valid generalisation can be made for the university system as a whole. In view of this, stratified random sampling technique was used

for the selection of the sample. These strata consisted of federal, state, conventional and specialised universities. The proportional random sampling based on 40% of the total number of universities in each geopolitical zone will select at least two universities in each of the six geopolitical zone of Nigeria.

Research Instrument

The research instrument used for data collection for this study is a checklist titled "University Cost and Efficiency Checklist" (UCEC). The instrument was designed to collect data on variable of efficiency and cost. The instrument administered to each university through the Academic Planning Unit while some data were collected from the National Universities Commission (NUC). The instrument consists of eight sections, which are sections A to H. Section A has to do with biodata of each university. Section B deals with teaching inputs while section C deals with teaching outputs. Section D is on research inputs while section E is on research outputs and sections F and G is on recurrent and capital expenditures respectively. (Oyeniran, 2010)

Research Questions

The following research questions were raised to guide study:

(i) What is the technical efficiency of Nigerian Universities?
(ii) What is the scale efficiency of Nigerian Universities?
(iii) What is the wastage rate in Nigerian Universities?
(iv) At what levels of return to scale are Nigerians universities operating?

Formulation of DEA Models for Universities

In order to estimate the efficiency of universities, each university is divided into three units and a model was formulated for each of the units. This division is based on the assumption of general system theory of non-linearity and complex interaction among other parts making up the systems. Therefore, the university is considered as a system within a number of systems. It is the believe of the researchers that the degree with which these sub systems operate will to a greater extent influence the overall system. Hence we have modelled three different organizational units. These models are formulated in line with Coelli (1991) study and as follows: (1) the university model seeking to evaluate the overall performance of the university, (2) the academic model which sought to evaluate the academic activities of university and (3) the administration model which sought to examine the administrative aspect of university operation. For each model, two inputs and two outputs were specified. These are shown below:

University Model

Outputs

Total Number of students (full time equivalent)
Number of PhD degrees awarded

Inputs

Total Number of staff (academic and non-academic staff)
Total Cost (including maintenance cost, recurrent cost, capital cost)

Academic Model

Outputs

Total Number of students (full time equivalent)
Number of PhD degrees awarded

Inputs

Total Number of academic staff
Academic expenses (including direct teaching cost, research grant, teaching and research equipment and library expenses)

Administrative Model
Outputs
Total Number of staff (academic and non-academic staff)
Total Number of students (full time equivalent)

Inputs
Total number of Administrative staff
Administrative Expenses (including stationary cost and cost of administrative equipment)
Variable Return to Scale (VRS) DEA and Constant Return Scale (CRS) DEA were conducted to determine technical and scale efficiencies.

Results

Research Question 1: What is the technical efficiency of Nigerian universities?

Table 1: Analysis of technical efficiencies in Nigeria Universities.

S/N	DMUs	University Model	Academic Model	Administrative Model
1	DMU1	100	100	100
2	DMU2	71.7	76.4	95.4
3	DMU3	83.3	61.5	67.2
4	DMU4	68.5	67.5	100
5	DMU5	69.9	72.1	75.7
6	DMU6	100.	100	96.7
7	DMU7	79.3	70.7	42.2
8	DMU8	84.0	88.7	46.7
9	DMU9	86.9	100	88.1
10	DMU10	85.5	64.4	75.4
11	DMU11	62.4	99.1	61.2
12	DMU12	94.9	65.1	100
13	DMU13	100	57.4	100
14	DMU14	100	100	100
15	DMU15	95.5	88.0	94.9
16	DMU16	100	92.4	88.3
17	DMU17	100	100	90.0
18	DMU18	64.4	93.0	100
19	DMU19	72.9	89.7	64.4
20	DMU20	80.8	100	80.2
21	DMU21	100	100	100
22	DMU22	74.7	100	100
23	DMU23	100	78.3	100
24	DMU24	50.8	89.8	93.5
25	DMU25	66.5	100	65.4
26	DMU26	100	100	100
27	DMU27	83.1	100	67.0
28	DMU28	67.2	69.7	67.2
29	DMU29	99.5	97.0	79.8
30	DMU30	61.2	72.5	90.1

	Mean	81.4	86.4	84.3

Research Question 2: What is the scale efficiency of Nigerian universities?

Table 2: Analysis of scale efficiency in Nigerian universities

S/N	DMUs	University Model	Academic Model	Administrative Model
1	DMU1	76.7	65.3	53.3
2	DMU2	85.8	81.5	77.0
3	DMU3	77.9	78.0	80.6
4	DMU4	83.0	99.8	100
5	DMU5	95.9	92.3	75.9
6	DMU6	100	100	76.4
7	DMU7	90.6	89.2	86.3
8	DMU8	69.9	78.8	86.7
9	DMU9	76.3	94.8	51.6
10	DMU10	75.0	72.5	77.5
11	DMU11	79.9	75.8	79.6
12	DMU12	96.5	99.5	59.4
13	DMU13	100	98.2	64.1
14	DMU14	55.8	55.2	55.2
15	DMU15	64.6	60.8	91.3
16	DMU16	65.7	57.6	94.3
17	DMU17	63.2	53.1	85.2
18	DMU18	62.5	64.8	100
19	DMU19	99.3	99.5	93.3
20	DMU20	61.5	85.3	95.5
21	DMU21	81.6	100	61.3
22	DMU22	79.8	95.7	100
23	DMU23	100	93.0	100
24	DMU24	99.5	99.5	76.4
25	DMU25	78.1	90.8	99.4
26	DMU26	83.7	92.1	88.8
27	DMU27	100	97.0	89.4
28	DMU28	88.2	100	88.2
29	DMU29	77.5	100	92.2
30	DMU30	98.2	88.9	69.4
	Mean			

Research Question 3: What is the wastage in Nigerian Universities?

Table 3: Analysis of wastage rate in Nigeria Universities.

S/N	DMUs	University Model	Academic Model	Administrative Model
1	DMU1	00	00	00
2	DMU2	28.3	23.6	44.6
3	DMU3	16.7	38.5	32.8
4	DMU4	31.5	32.5	00
5	DMU5	30.1	27.9	24.3
6	DMU6	00	00	24.3
7	DMU7	20.7	29.3	57.8
8	DMU8	16.0	11.3	53.3
9	DMU9	13.1	00	41.9
10	DMU10	14.5	35.6	24.6
11	DMU11	37.6	0.9	38.8

12	DMU12	5.1	34.9	00
13	DMU13	00	42.7	00
14	DMU14	00	00	00
15	DMU15	4.5	12.0	55.1
16	DMU16	00	8.0	61.7
17	DMU17	00	00	60
18	DMU18	35.6	7.1	00
19	DMU19	27.1	12.1	35.6
20	DMU20	19.2	00	59.8
21	DMU21	00	00	00
22	DMU22	25.3	00	00
23	DMU23	00	21.2	00
24	DMU24	49.2	10.2	66.5
25	DMU25	33.5	00	34.6
26	DMU26	00	00	00
27	DMU27	16.9	00	33
28	DMU28	32.8	30.3	32.8
29	DMU29	0.5	3.0	20.2
30	DMU30	38.8	27.5	99
	Mean	16.6	13.6	18.6

Research Question 4: At what levels of return to scale are Nigerians universities operating?

Table 4: Analysis of return to scale in Nigeria universities

S/N	DMUs	University Model	Academic Model	Administrative Model
1	DMU1	DRS	DRS	DRS
2	DMU2	IRS	IRS	DRS
3	DMU3	IRS	IRS	DRS
4	DMU4	DRS	IRS	CRS
5	DMU5	IRS	IRS	DRS
6	DMU6	CRS	CRS	DRS
7	DMU7	IRS	IRS	DRS
8	DMU8	IRS	IRS	DRS
9	DMU9	DRS	DRS	DRS
10	DMU10	IRS	IRS	DRS
11	DMU11	IRS	IRS	DRS
12	DMU12	DRS	IRS	DRS
13	DMU13	CRS	IRS	DRS
14	DMU14	DRS	DRS	DRS
15	DMU15	IRS	IRS	IRS
16	DMU16	IRS	IRS	IRS
17	DMU17	IRS	IRS	IRS
18	DMU18	IRS	IRS	CRS
19	DMU19	IRS	DRS	DRS
20	DMU20	IRS	IRS	IRS
21	DMU21	DRS	CRS	DRS
22	DMU22	IRS	IRS	CRS
23	DMU23	CRS	IRS	CRS
24	DMU24	IRS	IRS	DRS
25	DMU25	IRS	IRS	IRS

26	DMU26	CRS	IRS	DRS
27	DMU27	IRS	CRS	DRS
28	DMU28	IRS	CRS	DRS
29	DMU29	IRS	IRS	DRS
30	DMU30	IRS	IRS	DRS

Discussion

Table 1 showed that the mean technical efficiency scores for the university, academic and administrative models are 81.4%, 86.45 and 84.3% respectively. The findings also showed that about 16 universities (53%) had technical efficiency value above the mean score. Furthermore 9 universities (30%) of the universities were 100% technically efficient in the university model. For the academic model, about 19 universities (63%) had the technical efficiency score above the mean technical efficiency. In addition, 11 universities (37%) had the technical efficiency score of 100%. In the administrative sector, about 18 universities (60%) had the technical efficiency score above the mean efficiency score. About 10 universities (33%) had technical efficiency score of 100%. Only four universities are efficient in all the three models. Therefore, it could be concluded that the efficiency score reported in this study are likely to be influenced by management factors and other changes in government policies such as carrying capacity that could influence the efficiency of these institutions.

The wastage rate was found to be 16.6% for the university model, 13.6% for the academic model and 18.6% for the administrative model. This showed inefficiency and that there were potentials for them to reduce their input usage by 16.6% for the university model,13.6% for the academic model and 18.6% for the administrative model or increase their outputs by the same amount in order for them to be adjudged efficient. This indicated that most resources are not used to the fullest capacity in most of the institutions. The existence of unused capacities at level of these inputs points is inefficiency or outright wastefulness in the use of resources in the universities. The universities should reengineer their service processes that may lead to lean management practices which in turn may reduce inputs or ability to produce more outputs.

Table 3 showed that the mean scale efficiency score for the university, academic and administrative models were 80.8%, 85.3% and 81.6% respectively. For the academic model, 14 universities (47%) had the efficiency score above the mean score, and in the academic model, 19 universities (63%) had the efficiency score above the mean score while 15 universities (50%) had efficiency score above the mean score in the administrative model.

The result also showed that about 67% of the total number of universities were operating at increasing return to scale.(IRS). IRS is associated with increasing long-run unit cost, and for these universities to bring down the unit cost and operate at the optimum scale they need to upsize their enrolment and an increased investment in research. Hence, there is a need for the expansion of university system. This implies that most of the universities are too small in size and they have not exhausted their productive capacity. Furthermore, for them to operate at the optimum scale, they could still reduce their input usage by 16.6%, 13.6% and 18.6% for the university, academic and administrative models respectively or increase their output by the same amount. This therefore indicate source of inefficiency in the resources in the universities. In terms of return to scale 73.3 %(22 Universities) were operating increasing return to scale. This implies that the academic unit of most university need to be expanded. In the same vein, 13 (4 universities) are operating at decreasing and constant return to scale.

In the administrative model about 73% (22 universities) were operating at decreasing return to scale (DRS). DRS is associated with decreasing long-run unit cost. This implies the administrative unit of most universities were large, while 13% (4 universities) were operating at increasing return to scale. Only 13% (4 universities) were operating at optimal scale.

Conclusion

Considered as a group, Nigerian universities are performing fairly well against each other. In the overall, the level of scale efficiency in the university system appears to be high. However, it cannot be concluded there is no scope for improvement in efficiency. The efficiency measure presented in this study are intended as a guide to managerial action or policy making, it is therefore important to recognize that the calculated improvement in inputs or outputs are indicative of potential efficiency or performance increases by universities located below the efficient frontiers. Therefore, the efficiency of each university should be used as an attention-directing device. Furthermore, efficiency score presented can direct management attention toward developing a deeper understanding of why some institutions are located on the efficient frontier and others are relatively inefficient universities.

Universities are very important in the formation human capital. They are also a major expenditure component for tax payers. Moreover, with increasing number of students seeking admission into Nigerian universities and a reduction in the resources made available to these institutions, the efficiency by which inputs produce desired output must be critically examined and should be considered as an important policy issue. This is because university efficiency is an international issue.

In this study, DEA was used to estimate technical and scale efficiency for 30 public universities in Nigeria using five years' data. A number of different measures of output and input were used. Technical and scale efficiency results suggest that the problem confronting Nigeria universities has to do with managerial inefficiency and that which relates to their scale of operation.

Recommendations

Based on the findings of the study, the following recommendations were made: The government should set up a national goal of increasing the Higher Education Participation Rate (HEPR). According to UNESCO's Institute of statistics; HEPR is the proportion of eligible population who have access to higher education. It put Africa's HEPR at 10%, United State of America 50%, Europe 60%, South Africa 18%, Britain 50% and Nigeria 8%. (Okebukola 2008) with the present population of Nigeria, a national target of 20% should be set for University Education Participation rate (UEPR) and to be met at least within a period of ten years' time. This shall also include the expansion and upgrading of the physical facilities such as classroom, laboratory, and offices to accommodate the increased enrolment. Based on this target, National University Commission (NUC) should determine the carrying capacity for each university. In addition to the above, there should be huge investment in research. This is to benefits immensely from economics of scale.

The university authority should embark on cost-saving activities that will reduce unnecessary cost and wastage such as optimal utilization of spaces and optimum enrolment. In order to minimize resource wastage as identified by the finding of this study, resources allocation should be based on the need of each university and should be made to be highly competitive. This should be based on the performance of each university in the previous year. This will improve universities efficiency in Nigeria.

Rigorous quantitative performance assessment technique such as DEA and cost function should be incorporated into universities' accreditation exercise. This will assist the NUC in ranking universities in Nigeria and this will in turn improve efficiency in these institutions.

The federal Government should establish a National Institute of Higher Education Research and Development (NIHERD) to carry out research activities in various aspect of higher education development. This is in recognition of the roles of higher education in human capital formation and sustainable economic development.

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