

The Efficiency of Personnel Costs Utilisation among MDAs in Nigeria: The Data Envelopment Analysis Approach

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Abstract

The study investigated the efficiency of public sector entities in the utilisation of personnel cost releases to Ministries, Departments and Agencies in the education sector in Nigeria.

Population of the study comprised forty-five (45) DMUs made up of federal universities, federal polytechnic and federal colleges of education within four (4) geo-political zones and Abuja. Purposive sampling method was employed in selecting twenty-five (25) DMUs. Secondary data were sourced from the Annual General Warrants from the office of the Accountant-General of the Federation and Audited financial statements of the Public Sector entities on personnel costs, capital grants and overhead cost releases to the DMUs.

Data were analysed using Data Envelopment Analysis (DEA). The findings revealed that the DMUs were not efficient in personnel cost utilization. The results of the average efficiency scores with the application of both Charners, Cooper and Rhodes Model (CCR) and Banker, Charmer and Cooper Model (BCC) showed 0.70 and 0.69 efficiency frontiers respectively. The summary of the overall results therefore revealed that there was no full efficiency of 100% in the utilization of personnel cost releases among the sampled DMUs. The study recommended that a central monitoring unit be created jointly by the Federal Ministry of Finance and Accountant – General’s office to ensure full utilization of personnel cost releases among the DMUs. The study therefore concluded that only periodic assessment, regular evaluation and integration of the size of the payroll of the DMUs with the personnel cost releases by the central authorities can guarantee full efficiency scores in the utilization of personnel cost releases to the Public Sector entities in Nigeria.

Keywords: Efficiency Scores, Decision Making Units (DMUs), Data Envelopment Analysis, CCR, BCC

1.0 Introduction

The public sector entities (PSEs) are the organizations that carry out public programme and provide general services, redistribute income through the pool of wealth available and supported with statutory taxes or levies. They include government parastatals and agencies, corporations and public enterprises (Kara, 2012). These entities are in three (3) broad categories: public sector entities that are fully funded by the central authority, public sector entities that are partially funded by the central authority and the last group are the ones that are not funded by the federal government but generate enough revenue to meet its obligations. There are three (3) major sources of funding that are generally attracted to the PSEs by the federal government: the personnel cost releases, the overhead cost releases and capital grants allocations. One of the greatest puzzles of the public sector entities is the measurement of the efficiency of utilization of various public financial releases allocated to the sector. The personnel cost releases assumes the

largest size among the chains of financial releases to the public sector entities which are dedicated for the payment of salaries for the different categories of staff members in the organization as personal emolument.

Before the introduction and implementation of Integrated Personnel and Payroll Information System and Government Integrated Financial Information System, personnel cost allocations were released directly by the central authority to the entities through the designated statutory personnel cost accounts of the different Ministries, Department and Agencies with the Central Bank of Nigeria on monthly basis in line with the approved personnel cost budget for the current year. This practice enabled the entities to exercise absolute control on disbursement of the personnel cost releases. There was a shift in the operation however with the introduction of IPPIS and GIFMIS among the MDAs. These two platforms are currently used for processing the payment of salaries to employees in the public sector entities. The determination of the efficiency of various Decision Making Units in the effective utilization of personnel cost releases by the central authority is the main objective of this paper. Data Emolument Analysis (DEA) was employed as a tool in the determination of the efficiency scores of various public sector entities. DEA as a non-parametric method used to measure the technical efficiency of the entities and their capacity to minimize inputs at a given level of outputs or maximize outputs at a given level of inputs among the Decision Making Units (DMUs) was employed. A DMU is efficient when its efficiency score is 100% or 1 and is able to produce a certain amount of inputs, or use the same amount of or less inputs to produce a given amount of outputs while a revise is applicable for the less efficient DMU. The remainder of this paper is as follows: following the introductory section, section two reviewed the literature, section three discusses the methodology, section four presents and analyses and discusses results while section five gives the policy recommendations and conclusion.

2.0 Literature Review

Farrel (1957) started the modern efficiency performance measurement. He considered the Economic efficiency was considered as the ability of the public sector entities to obtain maximum output from available input resources. Conventionally, the indices used to evaluate performance in the private sector such as profitability ratios, Return on Asset, unit cost ratios are grossly inadequate measures of performance in the public sector (Coelli, 1992; Bowlin, 2018). The adoption of DEA in the determination of the efficiency of the public sector entities therefore filled this gap (Johnes & Johnes, 1993, Beasley, 1997, Madden, Savage & Icempkas (1997). Bren and Raab (1994) engaged DEA analysis to assess relative efficiency of the top 25 universities in the United States. The findings showed that the most prestigious universities always attracted a high degree of satisfaction among students. Many finance and accounting scholars have given curious attentions on the studies of efficiency of companies (Thore, Kozmetsky & Philips, 1994; HSU & LIU, 2008; Joshi & Singh, 2009). Beasley (1997) examined the relative efficiency of 45 British Universities for the years 1990-1996. The findings revealed apparent differences among higher educational institutions. Chandra (1998) assessed the performance efficiency of Canadian textile companies using the DEA-CCR with the input being number of labour and average annual investments and outputs were the annual sale values. The researches for the performance efficiency of the entities are not restricted to the developed nations alone. Similar researches were also carried out in the developing nations of the world. Canonical Correlation Analysis (CCA) was employed in line with (Friedman and Sinuany-sterm1999). Also, Basso and Funari (2001) developed a performance evaluation model for investment funds using a DEA Approach to measure the mutual fund performance of an

organisation. The conclusion supported the proposition that DEA is a useful tool used as a bench mark for determining a Mixed Portfolio for each specific fund of the enterprise. Assessment of the efficiency of a public institution in the use of various allocations received from the federal government has been a major concern to many finance practitioners across the globe. Galagedera & Silvapulle (2002) examined the Australian Mutual Fund Performance Appraisal. DEA was used to measure the relative efficiency of many investment funds in Australia. The efficiency test was carried out using different input-output variations models by the authors and concluded that some were efficient while some were not. Efficiency of an entity occurs when a set of output is maximized given a set of inputs or when a set of inputs is minimized for a given output (Saranga & Phoni, 2004). Saranga and Phoni (2004) also employed DEA to measure the technical efficiency of British Universities. Their findings revealed that only a few were efficient. Khajavi, Salami Ford and Rabiye (2005) used the DEA for determining the portfolios of efficient companies in Tehran's stock market and concluded that many of the companies were technically efficient. Numerous authors have carried out researches on the efficiency of public institutions in the developed world (Kempkes & Pohl, 2018, Warning, 2005) using DEA. The results revealed that DEA is a reliable yardstick in assessing efficiency performance of the organisations. Recent writers adopted both parametric and non-parametric approaches of Data Envelopment Analysis (DEA) and Stochastic Production Approach (SPA) respectively (Wu, 2005, Radam & Abdullah, 2008). Erkat and Hatice (2007) employed the DEA with specified inputs and outputs to analyse the performance of 500 industrial companies in Turkey. The findings indicated that only nine firms were efficient during the research periods. The primary intention of DEA was to evaluate the relative performance efficiency of public sector entities such as schools and hospital but is not limited to that because business firms and industries also employ it to analyse monetary values (Erkut and Hatice, 2007). Previous studies revealed that basic conventional ratios were engaged in the analysis of efficiency of performance of public entities by early researchers (Ponnu & Ramthandin, 2008).

Khajavi, Ghayuri Moghadam & Ghaffari (2010) conducted a research on the analysis of financial statements using different financial ratios with a DEA and financial statements of 267 corporations. The results revealed that 90 companies under investigation were adjudged efficient while the remaining 61 companies were inefficient. DEA was used to estimate the performance efficiency of manufacturing companies of China and Turkey (Liu, 2010). The study concluded that the application of DEA is suitable to estimate firms' efficiency. Tahir and Yusuf (2011) also used the DEA-CCR and DEA-BCC with inputs and outputs to appraise the efficiency of 14 Malaysian public listed enterprises. The result disclosed that only one company was relatively efficient while the others are inefficient. Tehrani, Mehragan & Golvani (2012) examined the financial position of companies in Tehran using DEA on 36 companies. Their findings revealed that only 9 companies were efficient while the remaining 27 companies were inefficient. Tehrai, Mehragan and Golvani (2012) considered 36 Australian public universities in their research and concluded that majority of them were efficient.

In Nigeria, efficiency of the public sector entities has been attempted by few authors. Igbinosa (2008) measured the relative efficiency of Nigerian universities. DEA's technique was employed in the estimation. The results of the finding indicated that not all Nigerian federal universities are technically efficient. DEA was also employed to measure efficiency of staff of a particular section of university of education with their web metric ranking (Liu and Lewis, 2010). The findings revealed that DEA was a highly valuable tool in measuring organisation's

efficiency. Abdulkareem and Oyeniran (2011) employed the DEA to determine the technical efficiency of the universities in Nigeria. The conclusion was that only a few of Nigerian universities are efficient. Inu and Maduabun (2014) also applied DEA as a tool for determining the efficiency of selected federal universities in Nigeria. The results revealed that only four (4) (23.5%) of the 17 federal universities under study were efficient.

3.0 Methodology

3.1 Data

The population of the study consists of forty -five (45) public sector entities in the education sector at the federal level within the (4) geo-political zones and Abuja. Purposive sampling was used to select twenty -five (25) Decision Making Units (DMUs) in the sector. Data were obtained from the office of the Accountant- general of the federation and the audited annual financial statements on the personnel costs, capital grants and overhead cost releases to the DMUs by the central authority. The Data Envelopment Analysis (DEA) was used to analyse the inputs and outputs in the sampled DMUs in order to evaluate their efficiency in the periods covered by the study. The study adopted both the input and output oriented versions in the assessment of the efficiency of the entities Both the Charmer, Cooper and Rhodes model (CCR,1978) based on Farrel’s research (1957) and Banker, Charmers and Cooper model (BCC) were employed. The beauty of the CCR is in optimizing the ratio of outputs to inputs by solving for a group of weights that comply with a system of linear equation (Rouse, 1997; Basso & Funari, 2001; Beasley,1997).

3.2 Model Specification

The Charmer, Cooper and Rhodes model and the Banker, Charmer and Cooper model used in optimizing the ratios of outputs to inputs is stated as follows:

Maximise ϕ_i

$$\phi_i \lambda_j \dots\dots\dots (i)$$

Subject to:

$$\phi_i y_{rj} \dots\dots \sum \lambda_j y_{rj} + S_{ri} = 0 \dots\dots\dots (ii)$$

$r = 1, \dots\dots s$ output of public sector

$j = 1$

$$X_{ki} \dots\dots \sum \lambda_j X_{kj} - e_{ki} = 0 \dots\dots\dots (iii)$$

$k = 1, \dots\dots m$, input of public sectors

$$X_j \geq 0, S_{ri} \geq 0, e_{ki} \geq 0 \dots\dots\dots (iv)$$

$j = 1$

$i, j = 1 \dots\dots n$ public sector in the sample where

ϕ_i = proportional increase in output possible;

$S_r = r - tn$ output slack

$ek = k - th$ input-slack

λ_j = weight or intensity variable used to derive all possible linear combinations of the sample observation when the value of ϕ_i , in equation (i) is 1,

$\lambda_i = 1$ and

$\lambda_i = 0$ for $j \neq i$

The $i - th$ public sector entity lies on the frontier and is technically efficient. For the inefficient entities, $\phi_i > 1$, $\lambda_i = 0$ and $\lambda_j \neq 0$ for $j \neq 1$, where j denotes the efficient public sector entity

in the sample. Inefficient public sector entities also have some positive output or/and input slacks. The output based technical efficiency index of the $i - th$ public sector entities (Tes) are computed as follows:

$$\frac{\hat{\lambda}}{y_{ri}} = \sum X_{rjy_{ri}} = \phi_{iy_{ri}} + S_{ri} \dots \dots \dots \quad (vi)$$

Equation (vi) shows that the projected output consists of two components, one representing the proportional increase in all output ($\phi_{iy_{ri}}$) and the other accounting for the non-proportional increase or output slack (S_{ri}). Beside, estimating the maximum output from fixed inputs, the output oriented DEA in equation (i) also estimated the input slacks (excess input) that was conserved for an inefficient public sector entity to be fully efficient mathematically, the projected amount of the $k - th$ resource of the $i - th$ public sector entity (X_{ki}) are expressed as follows:

$$X_{ki} = \sum X_j X_{kj} = X_{ri-eki} \dots \dots \dots \quad (vii)$$

$k = 1 \dots \dots \dots m$ input

The study adopted two DEA models with an input and output oriented versions. The first model developed by Charnes (1978) was called the CCR model. The second model was named the BCC model, developed by Banker (1984). The CCR model is built on the assumption of constant returns to scale (CRS), whereas the BCC model is built on the assumption of variable returns to scale (VRS). The relative efficiency evaluated by the CCR model is the overall efficiency score and the one estimated by the BCC model is the pure technical efficiency score. These scores are typically defined on the interval [0, 1].

The Charnes, Copper and Rhoda (CCR) Model

According to Charnes (1978), the fractional form of the CCR linear programming model is given as follows:

$$\eta_0 MA = \frac{\sum_{r=1}^s u_r y_{ro}}{\sum_{i \in ID} v_i x_{io}}$$

Subject to

$$\frac{\sum_{r=1}^s u_r y_{rj} - \sum_{i \in FV} v_i (x_{ij} - x_{io})}{\sum_{i \in ID} v_i x_{ij}} \leq 1 \quad j \in [1 \dots \dots \dots N]$$

$u_r v_i \geq \epsilon > \text{for } r \in (1 \dots \dots \dots s) \text{ and } i \in ID$

$v_i \geq 0 \text{ for } i \in F$

Where u and v are the weights of the input and output, i and r are the output and input of DMU. Liu (2010) views it as a technically complex model. The model is modified based on the Cooper’s modification (Cooper, 2000).

$$\text{Max } \phi_0 + \epsilon (\sum_{r=1}^s S_{r0}^- + \sum_{r=1}^m S_{i0}^+)$$

Subject to

$$\sum_{j=1}^N y_j y_{rj} - S_{r0}^- = s \phi_0 y_{r0} \quad r \in [1, \dots \dots \dots N]$$

$$\sum_{j=1}^N y_j x_{ij} + S_{i0}^+ = x_{i0}, \quad i \in [1, \dots \dots \dots m]$$

$$\phi_0, y_{ji} S_{r0}^-, S_{i0}^+ \geq 0$$

Where, ϕ_0 is the measure of efficiency of the Decision Making Unit (DMU) “O” in the set is $j = 1, 2, \dots, n$ DMUs rate related to other, ε is an infinitesimal positive number used to make both the input and output coefficient positive. S_{r0}^- is the slack variables for input constraints, which are all constrained to be non-negative, and S_{i0}^+ is the slack variables for output constraints, which are all constrained to be non-negative. y_j is the dual weight assigned to DMUs.

The BBC Model

According to Banker (1984), the BCC – model enables expression of the (input) technical efficiency measure for DMU. Therefore, it has the same equation employed in the CCR – model, but with convexity constraint for modification (Been and Raabi, 1994).

$$\begin{aligned} & \text{Max } \phi_0 + \varepsilon \left(\sum^s S_{r0}^- + \sum_{r=1}^m S_{i0}^+ \right) \\ & \text{Subject to} \\ & \sum_{j=1}^N y_j y_{rj} - S_{r0}^- = \phi_0 y_{r0} \quad r \in [1, \dots, s] \\ & \sum_{j=1}^N y_j x_{ij} + S_{i0}^+ = x_{i0}, \quad i \in [1, \dots, m] \\ & \sum_{j=1}^N y_j = 1 \\ & \phi_0, y_{ji}, S_{r0}^-, S_{i0}^+ \geq 0 \end{aligned}$$

If convexity constraint $\sum_{j=1}^N y_j = 1$, it implies that DMU “O” is currently operating at the most productive scale size for the discretionary inputs, given the fixed level of non-discretionary input. However, if $\sum_{j=1}^N y_j > 1$, it implies that DMU “O” is operating at a scale greater than the most productive scale size for the discretionary inputs. Conversely, if $\sum_{j=1}^N y_j < 1$ then DMU “O” is operating in the increasing return to scale region, at a scale smaller than the most productive scale size (Banker, 1984). The DEA models are technically sufficient in the efficiency measurement of the public sector entities (Yu, Barros, Tsai, Liao, 2014).

4.0 Presentation and Interpretation of Results

Figure 1 presented the summary of the analysis of the distribution of efficiency scores using CCR. In 2008, the average mean efficiency score is 0.814. The efficiency scores for individual DMUs for the year were presented in the table. From the table, it can be seen that only one DMU (WAEC) achieved a full efficiency in 2008, meaning that, there was a most productive use of its input resource to achieve 100% efficiency level. Seventeen (17) DMUs performed above the efficiency mean of 0.814 and eight (8) DMUs performed below efficiency mean. In 2009, there was a slight improvement in the number of DMUs with full efficiency. Two (2) DMUs achieved full efficiency scores of 100%. That is, only 2 (two) DMUs within the education sector maximised the input resources (personnel cost) allocated to them by the central authority for the highest productivity without any slack funds. The DMUs are WAEC and NLN. Also, with the slight improvement in the mean efficiency score for the DMUs from 0.814 in 2008 to 0.822 (1.0%), only (18) eighteen DMUs performed above the mean efficiency scores. In 2010, none of the DMUs under consideration achieved full efficiency frontiers. However, there was a general improvement on the overall efficiency performance by an increase of 14.7% over the 2009 efficiency performance. This showed that though, there was no DMU that achieved a full efficiency score, general performance of the DMUs in the effective utilisation of the personnel cost input improved the efficiency frontiers of the overall performance. By implication therefore,

it means the personnel cost inputs allocated to the DMUs during the year were effectively channeled to achieve productive output on the average. With the 0.943 as the average efficiency score, (17) seventeen DMUs operated below the average efficiency scores while (18) eighteen DMUs performed below the bench mark of average efficiency score.

Also, there was an improvement in the number of DMUs in 2011 that achieved full efficiency in 2011. The average efficiency score was 0.627. The deviation of the average efficiency score from the full efficiency score was wider than the previous years. The highest efficiency score was 0.768 while the lowest efficiency core was 0.599. With the average efficiency of 0.627, indicating an average slack resources of 0.373 (100 – 0.627) meaning that the DMUs under education sector were inefficient in the utilization of personnel costs allocated to them. Also, with the highest denominated efficiency score of 0.768 among the DMUs, it showed that entities within the sector paraded idle personnel cost funds at the yearend which were neither returned to the treasury or spent for the purpose it was meant for. The idle fund could have possibly been sources of the 13th months salaries that most MDAs within the education sector utilize to pay their workers which were neither budgeted for nor captured in the personnel cost budget of the relevant years.

In 2013, the efficiency frontier continued in the sliding fall with highest efficiency score of the sampled DMUs recorded at 0.321 with a far distance of 0.679 from the full efficiency frontier and the lowest efficiency of 0.201. The year 2013 recorded the lowest average mean efficiency score of 0.3 with a negative return to scale for all the MDAs at 0.30 average efficiency mean. Only (9) nine DMUs operated above this level while (16) sixteen DMUs performed below the average efficiency score. This implies that the DMUs under consideration poorly utilized the allocated personnel cost budgeted to the institutions. Also, that none of the DMUs achieved an average of 50% efficiency score suggested that more than 50% of the personnel costs allocated to the DMUs were not expended for the payment of salaries of staff. It is therefore curious to ask where the excess fund was channeled to in the subsisting year by the DMUs.

The trend improved slightly in 2014, 2015 and 2016 with the average efficiency score stated at 0.632, 0.849 and 0.359 respectively. It is relevant to state that in 2013, when other DMUs under the Ministry of Health joined IPPIS, all the DMUs under the education sector were not migrated to IPPIS. The situation still remains the same. While the central office of IPPIS exercises full control on the personnel cost appropriation and the disbursement among the MDAs under the health sector, personnel allocations under the education are released under the GIFMIS platform with considerable flexibility in pattern of disbursement.

Figure 1: Efficiency Scores in Personnel Costs for the 25 Sampled DMUs in Education Sector (2008-2016) using CCR

S/N	DMU	2008	2009	2010	2011	2012	2013	2014	2015	2016	AVERAGE
1	UNIAB	0.709	0.709	0.975	0.913	0.613	0.318	0.632	0.894	0.357	0.680
2	FLVB	0.999	0.999	0.99	0.908	0.605	0.319	0.633	0.883	0.35	0.743
3	FUTA	0.71	0.71	0.969	0.905	0.621	0.316	0.629	0.877	0.351	0.676
4	WAEC	1	1	0.964	0.913	0.608	0.297	0.629	0.883	0.35	0.738
5	JAMB	0.85	0.85	0.805	0.865	0.629	0.297	0.643	0.825	0.337	0.678
6	UNIABUJA	0.999	0.998	0.988	0.909	0.613	0.319	0.637	0.894	0.4	0.751
7	NOUN	0.845	0.845	0.794	0.801	0.693	0.299	0.63	0.886	0.352	0.683
8	FPI	0.80	0.85	0.943	0.924	0.615	0.297	0.629	0.885	0.351	0.610

Figure 1: Efficiency Scores in Personnel Costs for the 25 Sampled DMUs in Education Sector (2008-2016) using CCR

9	YCT	0.364	0.364	0.957	0.897	0.633	0.297	0.63	0.886	0.352	0.598
10	FCEAB	0.85	0.85	0.956	0.895	0.624	0.297	0.576	0.899	0.39	0.704
11	FCEAR	0.849	0.849	0.944	0.9	0.623	0.295	0.63	0.877	0.396	0.707
12	NEN	0.798	1	0.778	0.78	0.768	0.201	0.71	0.877	0.394	0.701
13	FCEOKENE	0.85	0.85	0.93	0.883	0.636	0.298	0.629	0.877	0.22	0.686
14	FCEONDO	0.85	0.85	0.955	0.895	0.625	0.299	0.63	0.877	0.415	0.711
15	FCEOYO	0.85	0.85	0.942	0.891	0.626	0.297	0.629	0.821	0.405	0.701
16	UI	0.721	0.721	0.987	0.917	0.608	0.318	0.629	0.932	0.299	0.681
17	UNILAG	0.707	0.707	0.985	0.915	0.607	0.32	0.641	0.904	0.385	0.686
18	OAU	0.723	0.723	0.989	0.915	0.608	0.312	0.629	0.884	0.351	0.682
19	UNIBEN	0.707	0.707	0.967	0.921	0.602	0.321	0.633	0.889	0.354	0.678
20	UNILORIN	0.853	0.853	0.976	0.906	0.609	0.27	0.63	0.074	0.424	0.622
21	FEDPOLYADO	0.85	0.85	0.926	0.884	0.632	0.299	0.629	0.878	0.376	0.703
22	FEDPOLYOKO	0.852	0.851	0.964	0.903	0.621	0.297	0.629	0.854	0.342	0.701
23	FEDPOLYOFA	0.85	0.85	0.948	0.787	0.631	0.313	0.629	0.879	0.318	0.689
24	FEDPOLYEDE	0.85	0.85	0.956	0.891	0.599	0.298	0.63	0.916	0.352	0.705
25	FEDPOLYAUCHI	0.853	0.852	0.973	0.721	0.623	0.298	0.629	0.877	0.35	0.686
	MEAN	0.78	0.861	0.945	0.882	0.627	0.3	0.633	0.85	0.359	0.70

Source: Author's Compilation (2019)

Figure 2 showed the number of DMUs that achieved 100% full efficiency during the research periods. From the table, out of (25) twenty-five sampled DMUs among the education sector, only (1) one DMU achieved a full efficiency in the utilisation of personnel cost allocation during 2008 and 2009. In other word, only WAEC operated at the optimal level of efficiency with fully efficiency frontiers of 100% in personnel cost utilisation . Any deviation from full efficiency suggests that the entities need improvement so as to upgrade to full efficiency. That implies that apart from this DMU, others were inefficient in the use of personnel cost allocations. The direct implication is that most of the MDAs within the education sector have unspent personnel cost balances at the end of every budget year. This excess amount could have arisen as a result of bloated personnel budget by the MDAs during the budget years. It can also be seen that after 2009, WAEC also ceased to achieve this feat of full efficiency but rather joined other inefficient MDAs for the rest part of research periods.

Figure 2: Efficiency Scores of DMUS in Personnel Cost Utilisation in Education Sector using CCR

S/N	Year	Name of MDA	CCR Scores
1.	2008	WAEC	1 or 100%
2.	2009	WAEC	1 or 100%
3.	2010	-	-
4.	2011	-	-
5.	2012	-	-
6.	2013	-	-

S/N	Year	Name of MDA	CCR Scores
7.	2014	-	-
8.	2015	-	-
9.	2016	-	-

Source: Author's computation 2019

Figure 3 showed the categorisation of inefficiency among the (25) twenty-five sampled DMUs within the education sector based on their level of inefficiency by comparing individual average range of efficiency scores with the overall mean.

The marginally inefficient DMUs are in the first category with efficiency scores above 0.70 but less than 1 or 100% efficiency frontier. This category of MDAs can achieve full efficiency by raising their standard of output or cutting down on input costs with relatively a little improvement in their operation.

The second category is averagely inefficient MDAs. This group of entities has their efficiency scores greater than 68 but less than 0.70. The MDAs are middle level performing MDAs. To attain full efficiency scores and maximum scale of operation, the MDAs should cut the input resources and increase the output so as to reduce the level of slack fund available for the institution. The third category of DMUs is the distinctively inefficient DMUs. Their efficiency scores range from 61-68. This category is a low-level performing DMUs who could not effectively utilise greater percentage of the appropriated personnel costs during the research periods. Drastic efforts are needed to boost the efficiency level of the entities within this group. It is therefore suggested that proper scrutiny of the personnel payroll of these DMUs will essentially reduce the personnel cost leakages and prevent wastages. In summary therefore, it can be said from the analysis above that DMUs under the education sector are not efficient in the utilisation of personnel cost allocation. From 2008 – 2009, only one DMU achieved the full efficiency of 1 or 100% in personnel cost resource utilisation. All other DMUs from the (25) twenty-five sampled size are either marginally inefficient, averagely inefficient or distinctively inefficient. From 2010 – 2016, none of the DMU attained full efficiency frontier of 1. It is curious to see that majority of the DMUs during the research periods recorded low CCR scores which suggests their needs for over-hauling and appropriate inputs – outputs mix. Part of the measures for those MDAs to achieve a full scale efficiency is a strict examination of their personal cost budgets vis-à-vis the size of the MDA. The management of the MDAs should find a way of reducing the personnel cost inputs and increase the value of salaries payable to the employees.

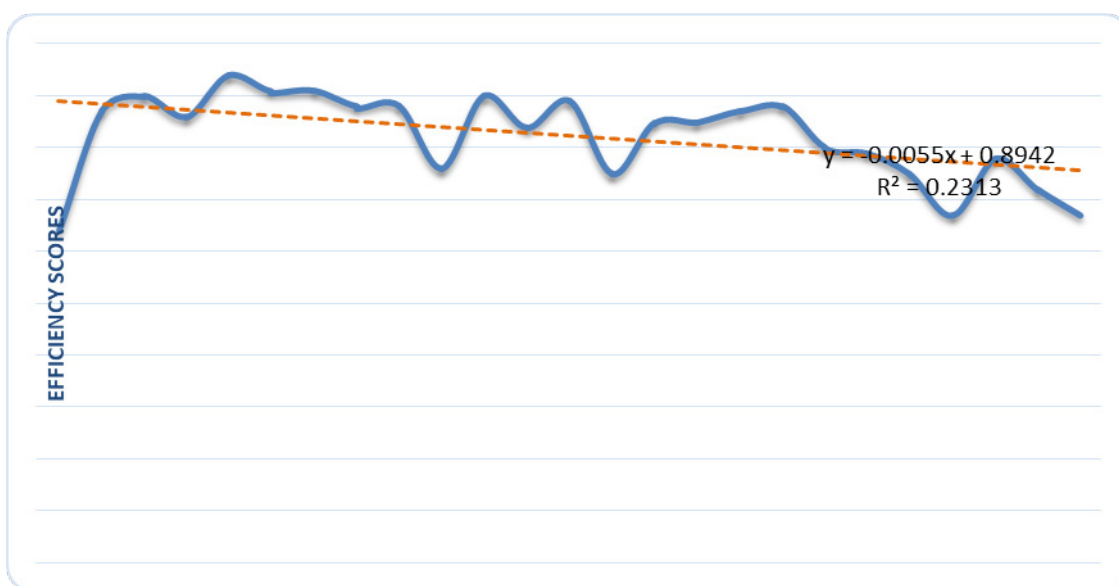
Figure 3: Categorisation of Inefficient MDAS in Education Sector using CCR

S/N	Level of Inefficiency	No of MDAs	Range of efficiency scores	Names of MDAs
1	Marginally inefficient MDAs	12	0.70 < 1	FLVB, WAEC, UNABUJA, FPI, FCEAB, FCEAK, NLN, FCEONDO, FEDPOLYADO, FEDPOLYEDE
2	Averagely inefficient MDAs	04	0.68 < 0.70	FCEOKENE, UI, UNILAG, FEDPOLYOFFA

S/N	Level of Inefficiency	No of MDAs	Range of efficiency scores	Names of MDAs
3	Distinctively inefficient MDAs	09	0.61 < 0.69	
	Total	25		

Source: Author's Computation (2019)

Figure 4: Pattern of Average Efficiency Scores for (DMUS) on Personnel Costs Utilisation under Education Sector with CCR Model



Source: Author's Computation (2019)

The Figure 4 shows the pattern of behaviour of the pool of average efficiency weight attached to the use of personnel cost among DMUs in Education Sector. DMUs capacities in the efficient usage of personnel cost in Education Sector ranges between 60% and 75%. Average efficiencies are steady across the DMUs except in the case of UNIABUJA which shows a spike to the peak in the overall class of scores.

Figure 5 showed the average efficiency scores ranking in on personnel cost usage among the 25 sampled DMUs in the education sector. DMUs (UNIABUJA) had the highest average efficiency score in the overall class of scores with 75% while YCT recorded the lowest average performance of 60%. The average efficiency score performance of other DMUs were stated in between the high and low extreme average efficiency scores performance. The average efficiency performance of the DMUs on personnel cost usage was remarkable.

Figure 5: Ranking of Average Efficiency Scores on Personnel Costs Utilisation for DMUS in Education Sector using CCR Model

DMU	Efficiency Scores	Efficiency Ranking
UNIABUJA	0.75	1 st
FLUB	0.74	2 nd
WAEC	0.74	2 nd
FCEAK	0.71	4 th
FCEDNDO	0.71	4 th
FPL	0.7	6 th
FCEAB	0.7	6 th
NLN	0.7	6 th
FCEOYO	0.7	6 th
FEDPOLYADO	0.7	6 th
FEDPOLYOKO	0.7	6 th
FEDPOLYEDE	0.7	6 th
FCEOKENE	0.69	13 th
UI	0.69	13 th
UNILAG	0.69	13 th
FEDPOLYOFFA	0.69	13 th
UNIAB	0.68	17 th
FUTA	0.68	17 th
JAMB	0.68	17 th
NOUN	0.68	17 th
OAU	0.68	17 th
UNIBEN	0.68	17 th
UNILORIN	0.62	23 rd
FEDPOLYAUCHI	0.61	24 th
YCT	0.6	25 th

Source: Author's Computation (2019)

Figure 6 shows the summary of analysis of result for the efficiency scores in personnel costs for the (25) twenty-five sampled DMUs in Education Sector using BCC. With the average mean 0.845 in 2008, only (3) three DMUs are technically efficient having the efficiency scores of 100% or 1. These DMUs are FLVB, WAEC and UI. Also, (3) three other DMUs operated close to the full efficiency frontiers but were technically inefficient. This therefore is suggestive of the need for an upgrade to full efficiency. This improvement can be achieved by altering the ratio of either input resources or output resources to attain full efficiency. The efficiency scores and the DMUs are 0.999, 0.957 and 0.933 for MDAs UNIABUJA, OAU and UNILORIN respectively. In 2009, only WAEC, NLN and UI are technically efficient in the personnel cost utilisation with efficiency scores of 100%. In other words, they were able to minimise input at a given level of outputs without idle fund. In between these (3) three efficient MDAs are deviations of inefficient MDAs who were not able to fully use up the total input costs (personnel costs allocations) at their disposal in 2009. Four DMUs – FLUB, UNIABUJA, OAU and UNILORIN belong to this category with efficient scores of 0.999, 0.999, 0.957 and 0.933. In 2010, there were only (3) three DMUs that were technically efficient and 3 DMUs were recorded technically efficient in years 2011, 2012, 2013 2014, 2015 and 2016 respectively while other DMUs are technically inefficient.

Figure 6: Efficiency Scores in Personnel Costs for the 25 Sampled MDAs in Education Sector (2008-2016) using BCC

S/N	DMU	2008	2009	2010	2011	2012	2013	2014	2015	2016	AVERAGE
1	UNIAB	0.758	0.709	0.975	0.913	0.613	0.318	0.632	0.894	0.357	0.685
2	FLVB	1	0.999	0.99	0.908	0.605	0.319	0.633	0.883	0.35	0.350
3	FUTA	0.71	0.71	0.969	0.905	0.621	0.316	0.629	0.877	0.351	0.676
4	WAEC	1	1	0.964	0.913	0.608	0.297	0.629	0.883	0.35	0.738
5	JAMB	0.851	0.85	0.805	0.865	0.629	0.297	0.643	0.825	0.337	0.678
6	UNIABUJA	0.999	0.998	0.988	0.909	0.613	0.319	0.637	0.894	0.4	0.751
7	NOUN	0.849	0.845	0.794	0.801	0.693	0.299	0.63	0.886	0.352	0.683
8	FPI	0.851	0.85	0.943	0.924	0.615	0.297	0.629	0.885	0.351	0.687
9	YCT	0.499	0.364	0.957	0.897	0.633	0.297	0.63	0.886	0.352	0.613
10	FCEAB	0.851	0.85	0.956	0.895	0.624	0.297	0.576	0.899	0.39	0.704
11	FCEAR	0.85	0.849	0.944	0.9	0.623	0.295	0.63	0.877	0.396	0.707
12	NEN	0.801	1	0.778	0.78	0.768	0.201	0.71	0.877	0.394	0.701
13	FCEOKENE	0.851	0.85	0.93	0.883	0.636	0.298	0.629	0.877	0.22	0.686
14	FCEONDO	0.851	0.85	0.955	0.895	0.625	0.299	0.63	0.877	0.415	0.711
15	FCEOYO	0.851	0.85	0.942	0.891	0.626	0.297	0.629	0.821	0.405	0.701
16	UI	1	0.721	0.987	0.917	0.608	0.318	0.629	0.932	0.299	0.712
17	UNILAG	0.875	0.707	0.985	0.915	0.607	0.32	0.641	0.904	0.385	0.704
18	OAU	0.957	0.723	0.989	0.915	0.608	0.312	0.629	0.884	0.351	0.708
19	UNIBEN	0.799	0.707	0.967	0.921	0.602	0.321	0.633	0.889	0.354	0.688
20	UNILORIN	0.933	0.853	0.976	0.906	0.609	0.27	0.63	0.074	0.424	0.631
21	FEDPOLYADO	0.85	0.85	0.926	0.884	0.632	0.299	0.629	0.878	0.376	0.703
22	FEDPOLYOKO	0.852	0.851	0.964	0.903	0.621	0.297	0.629	0.854	0.342	0.701
23	FEDPOLYOFA	0.851	0.85	0.948	0.787	0.631	0.313	0.629	0.879	0.318	0.690
24	FEDPOLYEDE	0.851	0.85	0.956	0.891	0.599	0.298	0.63	0.916	0.352	0.705
25	FEDPOLYAUCHI	0.855	0.852	0.973	0.721	0.623	0.298	0.629	0.877	0.35	0.665
	MEAN	0.854	0.822	0.943	0.882	0.627	0.3	0.633	0.85	0.359	0.697

Source: Author's Compilation (2019)

From Figure 7, it is clearly shown that in 2008, out of total number of 25 twenty five MDAs investigated on personnel cost utilisation using BCC model, only 3 three MDAs achieved full efficiency which translated to 12% of the total number. The remain (22) twenty MDAs which represent about 88% of the total number were technically inefficient in personnel cost utilisation. The same level of operation repeated itself in 2009, 2010 and 2016, year 2011 differs with only one (1) MDA on the full efficiency list. This represents 4% of total number while 96% of the sampled number were technically inefficient. The same scenario was repeated in 2011, 2013 and 2014. Year 2015 witnessed the highest number of MDAs with full efficiency scores with (6) six MDAs which translate to 24% of the total number while 76% of the total were technically inefficient.

Figure 7: Efficiency Scores of DMUS in Personnel Cost Utilisation using BCC Model in Education Sector

S/N	Year	Name of MDA	CCR Scores
1.	2008	FLVB, WAEC, UI	1
2.	2009	WAEC, NLN, UI	1
3.	2010	UI, OAU, UNIBEN	1
4.	2011	UI	1
5.	2012	NLN, UI, FEDPOLYOKO	1
6.	2013	NLN	1
7.	2014	FCEOKENE	1
8.	2015	FLVB, JAMB, UNIABUJA	1
9.	2016	JAMB, FCEAK, FEDPOLYEDE	1

Source: Author's Computation (2019)

There are three (3) levels of technical inefficiency: The technically marginally inefficiency technically averagely inefficiency and technically distinctively inefficiency.

An MDA is inefficient if it fails to attain a full efficiency score during the evaluation period. That is, when there are slack or idle fund that cannot be used up as input resources to generated need optimal output.

The table below shows the different levels of inefficiency of an entity compared with the average efficiency scores.

Figure 8 showed the categorisation of MDAs under the education sector based on their level of inefficiency with the number of MDAs in each category and their average range of their efficiency scores.

The category of technically inefficient MDAs have their efficiency scores in the range of $0.89 < 1$. This category of MDAs can still achieve a level of full efficiency with minimum effort.

The averagely technically inefficient MDAs are the middle level performing MDAs who need a moderately increase in the level of input resources to achieve a full efficiency scale or a cut in output to attain a fully technically efficiency frontiers.

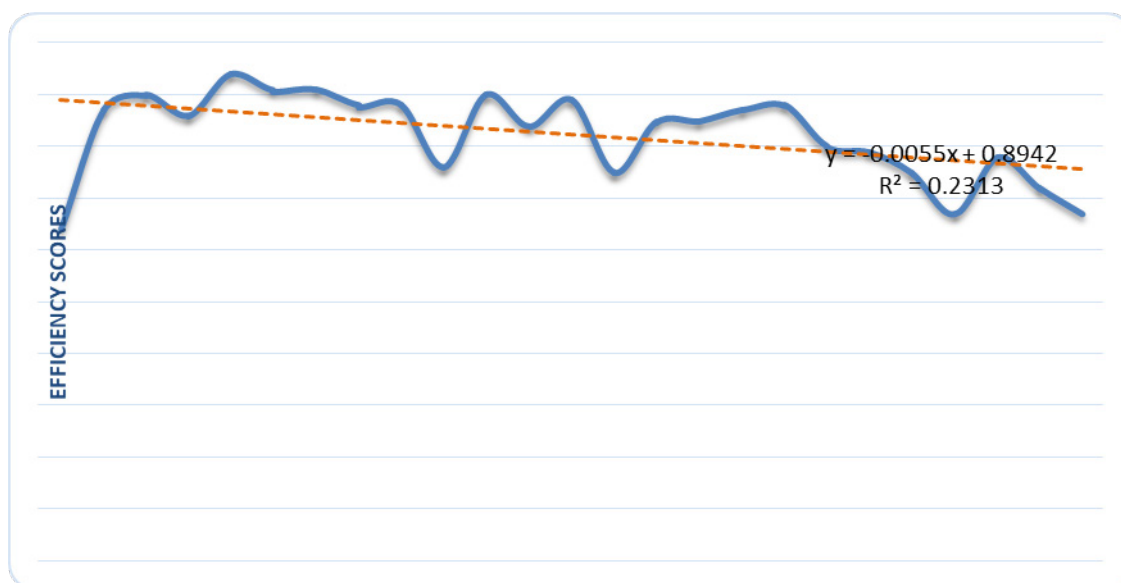
A distinctively technically inefficient MDAs lies between $0.72 < 0.82$. This group of MDAs fell into category of MDAs who could not effectively utilised the allocated personnel cost over the years for absorbing the liabilities on personnel matters. In other words, the MDAs had a greater proportion of unused personnel costs at the end of each year. To attain full technical efficiency, this category of MDAs needed a drastic adjustment of personnel cost inputs – output. In summary therefore, out of total number of 25 sampled MDAs, (4) four of the number were technically marginally efficient which represented 16%, while (10) ten were averagely inefficient (40%) and distinctively inefficient MDAs were put at 12 which stood for 48% of the total.

Figure 8: Categorisation of Inefficient MDAS within the Education Sector using BCC Model

S/N	Types of Inefficiency	No of MDAs	Range of efficiency scores	Names of MDAs
1	Technically Marginally inefficient MDAs	4	0.9 < 1	FLVB, UNIABUJA, UI, OAU
2.	Averagely technically inefficient MDAs	10	0.82 < 0.89	FUTA, WAEC, JAMB, FCEAR, NOUN
3.	Distinctively Technically inefficient	12	0.72 < 0.82	
	Total	25		

Source: Author's computation(2019)

Figure 9: Pattern of Average Efficiency Scores of Decision Making Units (DMUS) for Personnel Cost Utilisation for 25 Sampled DMUS under Education Sector using BCC Model



Source: Author's Computation (2019)

The Figure 9 shows the pattern of behavior of pool of average efficiency weight attached to the use of personnel cost among the DMUs in Education sector. DMUs capacities ranges between 70% and 91% in the efficient usage of personnel cost in the sector. There is a steady efficiency score performance across the DMUs except in the case of FLVB which shows a spike to the peak in the overall class of scores.

Figure 10 showed the average efficiency scores in descending order on personnel cost usage among the 25 sampled DMUs in the education sector. DMUs (FLVB and OAU) have the highest

average efficiency scores in the overall class of scores with 91% while UNIAB recorded the lowest average performance of 73%. The average efficiency score performance of other DMUs were stated in between the high and low extreme average efficiency scores performance. The average efficiency performance of the DMUs on personnel cost usage is remarkable.

Figure 10: Ranking of Average Efficiency Scores for the 25 DMUAS in Education Sector on Personnel Costs using BCC Model

DMU	Efficiency Scores	Efficiency Ranking
FLVB	0.91	1 st
OAU	0.91	1 st
UNIABUJA	0.9	3 rd
UI	0.9	3 rd
WAEC	0.89	5 th
UNKAG	0.88	6 th
JAMB	0.87	7 th
FCEAK	0.87	7 th
FCEOKENE	0.87	7 th
FPI	0.84	10 th
FCEONO	0.84	10 th
FUTA	0.83	12 th
NOUN	0.83	12 th
NLN	0.83	12 th
FEDPOLYEDE	0.82	15 th
UNIBEN	0.81	16 th
UNKORIN	0.80	17 th
FEDPOLYOFFA	0.79	18 th
FEDPOLYACH	0.78	19 th
FEDPOLYADO	0.77	20 th
YCT	0.76	21 st
FCEDNDO	0.75	22 nd
FEDPOLYAKO	0.74	23 rd
FCEAB	0.74	23 rd
UNIAB	0.73	25 th

Source: Author's Computation (2019)

Figure 10 showed the efficiency score generated from the decision making units classified in terms of education and health sectors using overhead cost in 2010. It is observed that the mean efficiency level as depicted by the average efficiency score was 0.895 for CCR and 0.904 for BCC. In comparison with the overall average, 80% of the ministries in the health sector operated above the sectoral average of 0.899 and the remaining 20% were inefficient. Similarly, in comparison with the overall average, only 72% of the ministries in the education sector operated above the sectoral average of 0.945 (BCC) while the remaining 28% were inefficient. The highest mean obtained in the Southwest region was 100% efficiency. In the North central zone, the highest mean score was 0.317 while the highest mean obtained in Eastern zone was 0.312. By implication, Southwestern region had the highest mean score among the three regions captured in the study in the health sector. In contrast, for education sector, 0.974 was the highest attainable

efficiency score among the DMUs in the Southwestern part of the country. Also, the North central region was 100% efficient. Lastly, in the Eastern zone, 0.942 was the highest efficiency score attainable. By implication, North central region was performing better than the other regions in consideration.

5.0 Conclusion and Policy Recommendation

The objective of this paper is to evaluate the efficiency of the public sector entities under the education sector in the utilization of personnel cost releases to the various Decision Making Units (DMUs) by the central authority in Nigeria. In order to achieve full efficiency frontiers in the personnel cost allocations in the public sector entities, the following recommendations become imperative:

The budget office should set up the monitoring team to regulate the activities of low performing DMUs in terms of the personnel costs releases vis-à-vis size of the institution's payroll.

- The DMUs need close monitoring and supervision in order to enhance their efficiency scores and boost their efficiency frontiers to improve the overall efficiency position in resource utilization.
- The DMUs should either reduce their personnel cost inputs or increasing the size of the payroll to achieve full efficiency.
- The DMUs with idle personnel cost balances or unspent balances in their personnel cost accounts should be made to remit the balance to the treasury.
- Personnel cost allocation should be based strictly on the size of the institution's audited payroll.
- Both personnel audit and personnel cost audit should be regularly carried out among the MDAs to stem the tide of personnel cost leakages in the public sector entities.
- There should be a direct linkage between personnel cost releases and the needs assessment on the category of personnel staff in the MDAs.

In conclusion therefore, it is only a continuous assessment and evaluation of the personnel cost releases together with the size of the institution's payrolls on a regular basis that can guarantee a full efficiency score of the personnel cost utilization among the Decision Making Units in Nigeria.

References

- Abdulkareem, A Y & Oyenira, S (2011) 'Managing the Performance of Nigerian Universities for Suitable Development using Data Envelopment Analysis'. *International Journal of Academic Research in Business and social Science*, Vol. 15, No. 1. pp. 54-67.
- Basso, A & Funari, S (2001) 'Theory and methodology: A Data Envelopment Analysis approach to measure the mutual fraud performance'. *European Journal of operation Research*, Vol. 135, No. 3. pp. 477-492.
- Beasley, J (1997) 'Determining teaching and research efficiencies', *Journal of Operational Research Society*, Vol. 11, No. 9. pp. 441-452.

- Chandra, P, Cooper, W W; Shanling, Li, & Rahman, A (1998) 'Using DEA to evaluate 29 Canadian textile companies considering returns to scale'. *International Journal of Production Economics*, Vol. 54, No. 2. pp. 129-141.
- Coelli, T (1992) *Assessing the performance of Australian using data envelopment analysis. Internal Report, Centre for Efficiency and Productivity Analysis, University of New England.*
- Erkut, D and Hatice, D (2007) 'Measuring the performance of manufacturing firms with super slacks based model of data envelopment analysis: An application of 500 major industrial enterprises in Turkey'. *European Journal of Operational Research*, Vol. 182, No. 3. pp. 1412-1432.
- Freeman, L & Sinuany-Stern (1984) 'Combining ranking scales and selecting variables in the DEA context; The case of industrial branches'. *Computers and Operations Research*, Vol. 25, NO. 9. pp. 781-791.
- Friedman, L & Sinuany-Stern, Z (1999) 'Combining ranking scales and selecting variables in the DEA context; The case of industrial branches'. *Computers and Operations Research*, Vol. 25, No. 9, pp. 781-791.
- Farrell, M J (1957) 'The Measurement of Production Efficiency'. *Journal of Royal Statistics Society*, Vol. 120. pp. 253 – 281.
- Galagedera, U A & Silvapule, P (2002) 'Australian mutual fund performance appraisal using Data Envelopment Analysis'. *Manageria Fiance*, Vol. 28, No. 9. pp. 60-73.
- Inua, O I & Maduabum, C (2014) 'Performance Efficiency Measurement in the Nigerian Public Sector: The Federal Universities, Dilemma'. *Mediterranean Journal of Social Sciences*, Vol. 5, No. 20. pp. 838 – 846.
- Johnes, G and Johnes, J (1993) 'Measuring the research performance of UK economics departments', application of data envelopment analysis *Oxford Economic Papers*, Vol. 45, No. 2. pp. 332-345.
- Kara, E (2012) 'Financial Analysis in Public Sector Accounting. An Example of EU, Greece and Turkey', *European Journal of Science Research*, Vol. 6, No. 1. pp. 81-89.
- Kempkes, G and Pohl C (2018) *The efficiency of German Universities some evidence from non-parametric methods Applied Economics- on-line First.*
- Khajavi, S, Salimifard, A, Rabieh, M (2005) 'The Function of Data Envelopment Analysis (DEA) in Determining a Portfolio of most Efficient Firms Accepted in Tehran Stock Exchanges'. *Journal of Humanities and Sociologies*, Shiraz University, Vol. 22, No. 2. pp. 75 – 90.
- Maddan, G; Savage, S and Kemp, S (1997) 'Measuring public sector efficiency; A study of the Economics Department at Australian Universities', *Education Economics*, Vol. 5, No. 2. pp. 153-168.
- Ponnu, C H and Ramthandin, S (2008) 'Governance and performance; Publicly listed companies in analysis', *Journal of Business System, Governance and Ethics*, Vol. 3, No. 1. pp. 35-53.

- Tehrani, R; Mehragan M E and Golkani, M R (2012) 'Armodel for Evaluating Financial Performance of companies by Data envelopment Analysis', *International Businessmen Research*, Vol. 5, No. 8. pp. 8-16.
- Saranga, H & Phani, B V (2004) 'The Indian pharmaceutical industry – an overview of internal efficiencies using data envelopment analysis', *Indian institute of Management calcutt*, Vol. 3, No. 2. pp. 485-495.
- Wu, C C, Kao D C and Cheng; H H (2006) 'Examining retailing performance via financial index'. *Asia pacific management Review*, Vol. 11, No. 2. pp. 83-92.
- Wu, H L (2005) 'A DEA Approach to understanding the performance Taiwan's steel industries 1970-1996'. *Asia Pacific management Review*, Vol. 11, No. 2. pp. 83-92.
- Thore, Sr, Kozmetsky, G and Phillips, F (1994) 'DEA of financial statements data: the U.S. computer industry'. *The Journal of productivity Analysis*, Vol. 5, No. 2. pp. 229-248.