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Efficiency Assessment of the Tanzanian Universities

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Abstract
The purpose of this study is to examine the efficiency and its determinants of the Universities in Tanzania by means of deterministic frontier non-parametric approach. The analysis is based on a sample of 16 colleges and Universities 8 public, and 8 private across time period of 2008 - 2012 panel data. The data obtained from sampled universities, Tanzania Commission for Universities (TCU), Ministry of Education and Vocational Training (MoEVT) and the National Bureau of Statistics (NBS) are used. We include three inputs and three outputs in a two-stage data envelopment analysis (Wen-Bin-LIU et al (2013), first evaluating DEA scores and then regress them through Tobit regression model. The findings from the study suggest that there is variability of efficiency among Universities across years. It is revealed from the study that Universities are efficient in generating graduates through available human capital, whereas research publications and consultancy services are influential factors for University efficiency. Majority of University efficiency is observed to be above average. Thus, Universities are recommended to use their input resources for research and consultancy services to improve efficiencies. Other extraneous variables which might have contributed to these findings have not been considered in the study.
Keywords: efficiency, Universities, Data envelopment analysis (DEA), Tobit regression Model

1.0 Introduction

There has been an increase of both higher learning institutions and enrolment therein. Stakeholders need both quantity and quality of graduate human capital from these institutions. Therefore, Efficiency measurement in higher education is inevitable today as result of increased stakeholders' demand. The studies show that there is mismatch between the increase of higher learning institutions and their efficiency justified by employed graduates who cannot demonstrate the required skills (UNESCO, 2007; Lawden, 2011; and Obanya, 2013).

In 1960s there was only one Government University in Tanzania and today there are more than 40 Universities and University colleges. Among these only 11 are public and the rest are private. Besides, there are more than 490 non-Universities which are also part of higher learning institutions. Mushrooming of these institutions has been driven by households' demands for employment oriented courses; this need has not been met by government Universities due to financial constraints. The increase of these institutions has accelerated enrolment in both public and private Universities (Ishengoma, 2004).

In Tanzania, today higher learning institutions comprise of both public and private ownership (Kapinga, 2010). This is different from what prevailed before privatization in 1980s when the government was the sole owner and controller of all higher learning institutions. Following the world paradigm shift of free market economy and privatization in 1980s, Tanzania had to welcome private owners to engage in provision of education. Mushrooming of higher education then started and efficiency started to decline.

Recent increase of higher learning institutions has been triggered by education expansion of the preceding levels of Secondary and Primary education. These two levels of enrolment, especially at the former level, have accelerated enrolment in higher education institutions. This phenomenon led the government to introduce the Higher Education Development Programme (HEDP) which was introduced in 2010 (URT, 2010) to cater for the increased demand.

Despite the increase of higher learning institutions and enrolment, the efficiency of these institutions is low as revealed by a survey study by Aubyn et al (2008). The study reveals that stakeholders are concerned with the quality of University graduates to meet the market demand. Most graduates are unable to link between theories and practice due to more emphasis on knowledge based education training (KBET) at the expense of competence based education training (CBET). Mbalamula (2014) also supports that there is inefficiency and quality challenge in educational institutions which is influenced by privatization of education. Galabawa, et al (2000), Alam (2007) and Saint (2009) argues that inefficiency of higher learning institutions is largely contributed by external factors. These studies encourage the current study to explore the efficiency of Universities as a whole to determine their efficiencies and influencing factors.

Table 1 Higher Education Enrolment Trend in Tanzania (2006/2007-2011/2012)

Institution	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012
University Enrolment	49,967	82,529	101,222	101,222	123,434	135,367

Source: Extracted from TCU website[1]

This enrolment trend is also shown in figure 1 below.

Figure 1 University Enrolment Trend in Tanzania (2007/08-2011/12

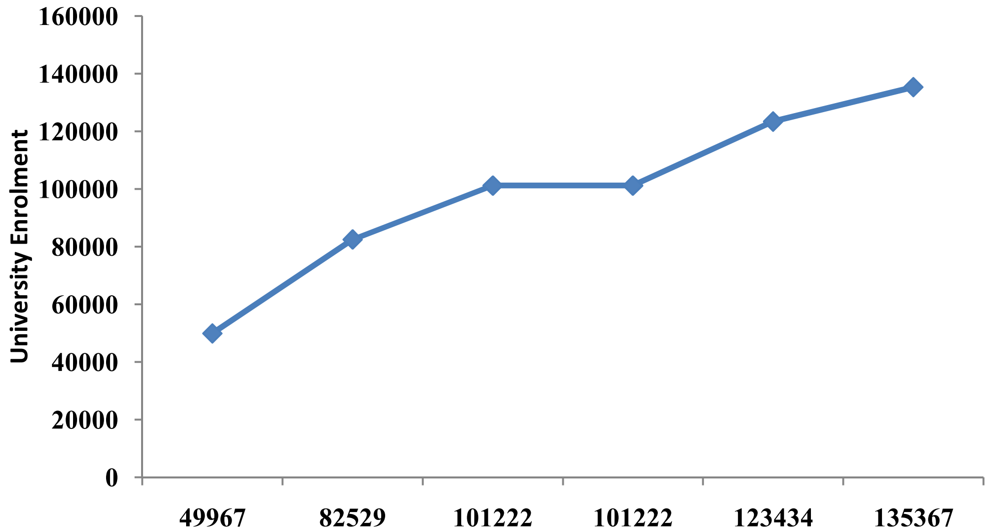


Figure 1.1 indicates that the total University enrolment is increasing over time. This includes both public and private Universities regardless of their enrolment differences. This trend is likely to continue rising as the demand for higher education increases.

This paper presents literature review in section two followed by methodology and analysis of results in section three. Finally section four presents discussions and conclusion.

2.0 REVIEW OF LITERATURE

Before we get into literature review, the definitions of key terms; higher education, efficiency, data envelopment analysis and tobit regression model is provided below.

2.1.1 Higher Learning Institutions.

Higher learning institutions refer to all post secondary education institutions such as technical colleges, Universities and University colleges. It is part of the broader tertiary education system (URT, 1999). They are also categorized into Universities and non-University institutions. Universities are knowledge based institutions leading to higher professions, whereas non-Universities are intermediate professional based institutions.

2.1.4 Universities

Universities are post secondary education institutions or broader part of higher education institution basically offering degrees and other related qualifications. They are knowledge based institutions. Several studies have been done in higher learning institutions where the efficiency was examined using DEA approach. These studies include; (Kempkesa and Pohl, 2010; Wolszczak-Derlacz, and Parteka, 2011; Kokkelenberg, E.C. et al., 2008; Johnes, (2006) to name a few. No such study has been done in case of Tanzania.

2.1.2 Efficiency

The concept of efficiency is rooted in Debreu (1951) and Ferrell's (1957) definition. Specifically, the term efficiency refers to the degree of linkage observed in the production process to a given standard of optimality (Barra, 2013). However, education efficiency differs from any other regular production efficiency in two ways; first it uses multiple inputs to generate multiple outputs making it difficult to use general techniques to measure efficiency. Secondly, some of outputs of higher education institutions cannot be measured because of the output nature as social externalities. In this context therefore, education efficiency refers to the way Universities allocate economically their available inputs in form of human capital to produce the given level of output

[1] http://www.tcu.go.tz/index.php/student-register, Retrieved on 21st April, 2014

explained by graduates, research publications and consultancy services (Al-Bagoury, 2013).
Taking a decision making unit (DMU) which transforms inputs (productive resources) over a set of outputs (products or services), efficiency can be defined in four different notions: technical, allocative, scale and scope efficiency. This paper focuses on technical efficiency which refers to the capacity of the DMUs. Given the technology used, to produce the highest level of output from a given combination of inputs, or alternatively, to use the least possible amount of inputs for a given output leads to higher efficiency. According to Abbott and Doucouliagos (2004), "the technically efficient University is not able to deliver more teaching plus research output (without reducing quality) given its existing labour, capital and other inputs". They also argued that measuring the technical efficiency is also supported by the fact that "the provision of education and research by Universities at a given level of quality, within resource constraints, is a major objective of universities.

2.1.3 Data Envelopment Analysis (DEA)

DEA is a non-parametric frontier estimation methodology originally introduced by Charnes, Cooper, & Rhodes (1978) (CCR model) extended from Farrell (1957) work. It is non-parametric model in measuring efficiency which is a common set of multiple numerical attributes. DEA classifies entities into "efficient" or "performers" versus "inefficient" or "non-performers." According to the DEA framework, inefficiencies are degrees of deviance from the frontier. Input inefficiencies show the degree to which inputs must be reduced for an inefficient decision making unit (DMU) to lie on the efficient practice frontier, whereas output inefficiencies are the increase in outputs needed for a DMU to become efficient.
The efficiency score in DEA model ranges from zero to one (0 to 1). The high score (1) defines maximum efficiency, while any score less than one indicates a firm's inefficient and relative dislocation from the frontier. The two ways to consider efficiency are to produce a greater quantity of outputs with the same number of inputs and to use fewer levels of inputs with the same quantity of outputs. The different concept of DEA depends on whether it is an input-oriented or output-oriented model and whether its condition presents a constant or variable-return-to-scale model. The input-oriented DEA model tries to minimize quantity of input, producing the same level of outputs as the unit in question. The constant-return-to-scale (CRS) model supposes that output level is proportional to the input level for a given unit. On the other hand, the variable-return-to-scale (VRS) model allows the output level to be proportionally higher or lower than an increase in inputs. This model recognises the presence of unanticipated factors that may affect efficiency.
The BCC DEA model was also introduced by Banker, Charnes and Cooper in (1984) to accommodate the variation of decision making unit (DMU), inputs and outputs disregarded by CCR model. A number of survey studies have been conducted using DEA model in assessing education efficiency (Toth, 1996; Johnes, 1999; Thursby, 2000; Stevens 2001, Worthington 2001; Abbot, 2001; Worthington, 2001; Doucouligos, 2002; Warning, 2004; Barr, 2005; Badri, M.A et al, 2006; Salerno 2006; Casu and Thanassoulis 2006; Aleksander Aristovnik, 2011; Curhan & Rocha, 2011 and Coller, 2012;).

2.1.5 Tobit regression Model

Tobit model is a statistical non-linear model proposed by James Tobin to describe the relationship between a non-negative dependent variable Y_i and an independent variable X_i. The word Tobit is taken from the name Tobin and "it" is added to it. It is also known as censored regression model designed to estimate linear relationships between variables if the value of dependent variable is non-negative whereby negative variables ($Y_i<0$) are not observed. This model has been extensively used in estimating the relationship between dependent and independent variables in various aspects including education (Lin, J et al, 2007; Jackson & Fethi, 2000; Bastedo, 2008; Al-Bagoury, 2013).

2.5 Empirical Literature Review

Many studies affirm that measuring efficiency of education institutions is complex due various factors. Multiple inputs and outputs, and existence of uncontrolled factors are some of the major causes of complexity (Ferreraa, 2011). In education there is no direct relationship between inputs and outputs rather a proximal relationship is generally accepted. There are three core activities of Universities namely; knowledge dissemination (training), knowledge generation (research) and knowledge sharing to the society (consultancy). These can be linked to proximal input and output such as enrolled students, number of teaching staff, available learning facilities, and number of non-teaching staff as inputs. Whereas number of graduates, research publications, consultancy services, and running expenses are linked to outputs. However, education efficiency is beyond output as it also considers the outcome such as the number of graduates employed. This distinguishes it from economic efficiency of other aspects (Rayeni, M.M and F.H, Saljooghi, 2010).
Toth (2009) in his study on higher education efficiency contends that efficiency measurement in higher education is not only driven by the decrease of state support but more attention should be focused on enrolment increase. This assertion is in line with the current University enrolment increase which affects efficiency. The paper further affirm that DEA model is an appropriate method to measure education efficiency since it is capable of accommodating multiple input and output. Findings from this study indicated that there was a positive influence of GDP on higher education institution efficiency among European countries.

Despite the drawbacks of DEA model, it is widely used in examining education efficiency than other approaches (Johns, 2006). More than 100 higher learning institutions were involved in measuring the technical efficiency (TE) and Scale efficiency (SE). The findings showed that the efficiency score results appeared to be higher in average. Halkos et al (2010) used DEA model with bootstrap technique to evaluate the efficiency of Thessaly University departments. Both constant return to scale (CRS) and variable return to scale (VRS) were evaluated. Results from the study identified that there was misallocation or strong inefficiency among University departments.

In line with other authors, Kempkes and Pohl (2010) assessed the efficiency of German Universities through DEA and SFA and the obtained results were compared among University efficiency scores. The result showed that Western Universities were more relatively efficient than the Eastern. The faculty composition was observed to influence the University efficiency. Similarly a study on higher education done by Aubyn et al (2008) in European countries employed both DEA and SFA to assess efficiency and effectiveness. Results suggested a positive relationship between public spending in tertiary education with labour productivity and growth. Though results from the two models were related, still the differences in efficiency among studied countries were reported. Conclusively the study suggests that there are other factors influencing efficiency besides the used inputs and identified output.

Institutional arrangement can positively or negatively influence student achievement in schools (Collier, 2012). The paper wanted to ascertain if the same can affect efficiency in schools. In this study a two stage regression model and DEA model were employed. The obtained results from DEA model were compared with regressed results to determine their relationships. Preceding studies indicates that there has been a relationship between education inputs like salaries and teachers on school efficiency. Thus, there are other factors more than the selected inputs contributing to education efficiency of which researchers need to be aware of. Universities in Tanzania are diverse in terms of size and geographical locations suggesting the possibility of having different results from efficiency model.

Another related study is that of Wolszczak-Derlacz and Prteka (2011) who analysed efficiency and determinant of higher education from several European countries. They used DEA analysis and bootstrapped truncated regression in a time period of 2001 - 2005. Findings indicated variations in efficiency scores among and between countries. On the other hand unit size, number and faculty composition, source of funding and gender staff composition were observed to be the crucial determinants of efficiency. In contrast to other studies a study by Agasisti and Bonomi (2013) focused on University benchmarking. The study affirms that it is rational to have different benchmarks for individual units, rather than the entire institution due to their variations. The study was carried out in 12 Italian Universities and results indicated differences in technical efficiency and average efficiency among University schools. However, it is very difficult to have 100% similar environment even within a school when exogenous variables are to be considered. Thus, a relative efficiency of institutions is compared.

In Tanzania, several studies have focused on other areas of higher education such as education quality, education financing and equity and access ignoring efficiency. An interesting study by Kipesha and Msingwa (2013) on the efficiency, however, paves the way to the current study. The research employed input oriented DEA model to ascertain technical efficiency scores, among seven selected public universities. Total enrolment, total academic staff and total non-academic staff were used for inputs; while post graduates and total graduates were outputs. Findings from the study revealed that public Universities in Tanzania were on average efficiency in utilizing human resource to generate expected output. Furthermore, it was observed that Universities were inefficient in income generation through research, fees and consultancy. The study recommended the public Universities to emphasise on income generation which could minimize government deficit budget in achieving University objectives. The study has created a room for this study by excluding private Universities and not determining efficiency influential factors.

Generally, it is learned from reviewed literature that DEA model is the dominant approach to measure efficiency in education. There is only one study done in higher education focusing on efficiency and employing DEA model. The general purpose of the current study therefore, is to examine the technical efficiency (TE) of Universities and determine factors that influence TE. A DEA and Tobit regression models are sequentially employed.

The impetus to this study is provided by the following significant factors; first, it is worthwhile to assess University efficiency to cope with market demand by improving both quantity and quality of output. Secondly, the TE of Universities has not been assessed despite their increase in number. Thirdly, inefficient Universities are possibly able to improve through the best practice frontiers. Lastly, Universities can determine the influencing factors that enable the efficiency increase.

3.0 Methodology and Data

3.1 Data

Parametric method as Stochastic Frontier Analysis (SFA) and the non-parametric method Data Envelopment

Analysis (DEA) are the widely used approaches in assessing TE of higher education. However, a hybrid method that combines both parametric and non-parametric is also used. This study uses DEA to get the efficiency score of Universities in the first stage and then regress them using Tobit regression model. DEA model is preferred due to its dominancy in measuring efficiency of higher education institutions compared to other parametric models. Studies by (Johnes, 1999; Thursby, 2000; Abbot, 2001; Stevens 2001, Barr, 2005; Badri, Athanassopoulos and Shale, 2006; M.A et al, 2006; Casu and Thanassoulis 2006; Salerno 2006; Aleksander Aristovnik, 2011Worthington 2001) have employed this model coming up with various efficiency results.

In the present study, we also use CCR model, named after Charnes, Cooper, and Rhodes (1978) and BCC model, named after Banker, Charnes and Cooper (1984) to obtain efficiency measures under constant return to scale (CRS) and variable return to scale (VRS) assumptions, respectively. Since higher education institutions can only control their inputs and not outputs, the orientation of the model is input orientation aimed at minimizing the used inputs in education to produce the expected output/outcome. Thus, DEA model determine the technical efficiency (TE) score of Universities which is followed by stage two of Tobit regression model to determine the effect of involved variables.

The study uses both primary and secondary data. Primary data were obtained from universities, whereas secondary data emanated from (multiple sources); the Ministry of Education and Vocational Training (MoEVT), Tanzania Commission for Universities (TCU) website and National Bureau of Statistics (NBS). Sixteen (16) Universities and colleges 8 public and 8 private were selected. The selection of the University was based on data availability for at least five years of operation. A panel data was used from 2007/2008 - 2011/2012. A list of reviewed Universities is shown in Appendix 1.

3.2 DEA models

The resulting DEA model that exhibits the VRS is called BCC model (Banker, Charnes and Cooper, 1984). The input-oriented BCC model for the DMU_o can be written formally as:

$$Min\ z_o = \theta$$

Subject to:

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{ro} \qquad r = 1, 2 \ldots s \qquad (1)$$

$$\theta_o x_{io} - \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0 \qquad i = 1, 2 \ldots m \qquad (2)$$

$$\sum_{j-1}^{n} \lambda_j = 1 \qquad (3)$$

$$\lambda_j \geq 0 \qquad j = 1, 2 \ldots n \qquad (4)$$

Where x_{ij} is the observed amount of input ith of the jth DMU ($x_{ij} > 0$, j = 1, 2 …n, i= 1, 2…n) and y_{ij} = observed amount of output of the rth type for the jth DMU ($y_{ij} > 0$, r = 1, 2…3, j = 1, 2…n)

The dual for BCC is CCR which is also used in this study in order to learn the differences of both VRS and CRS respectively. CCR introduced the following fractional programming problem to obtain values for input weights and output weights. Basic CCR formulation is;

$$\max\ ho(u,v) = \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{n} v_i x_{io}} \qquad (5)$$

Subject to:

$$\frac{\sum_{i=1}^{n} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1 \qquad j=1, 2\ldots n \qquad (6)$$

$$u_r \geq 0 \qquad r=1, 2\ldots s \qquad (7)$$

$$v_i \geq 0 \qquad i=1, 2\ldots m \qquad (8)$$

Where x_{ij} is the observed amount of input ith of the jth DMU ($x_{ij} > 0$, j = 1, 2 …n; i= 1, 2…m) and y_{ij} = observed amount of output of the rth type for the jth DMU ($y_{ij} > 0$, r = 1, 2…s; j = 1, 2…n)

3.2 Definition of Inputs and Outputs

Education inputs are different from others used in other economic efficiencies. It is difficult to establish direct relationship between input and output when measuring education efficiency. But a proximal relationship is applied to determine its efficiency, for instance, it is not only enrolments which lead to graduates in Universities but there various factors which contribute to that. This study employs three inputs and three outputs as indicated in table 2 below.

Table 2 Input and Output variables and their definitions.

Input	Definition	Output	Definition
Number of enrolment (SE)	Total number Enrolled students both undergraduates and post graduates in each year of review	Number of Graduates (GR)	Number of graduates both bachelors and post graduate students in each year of review
Number of academic staff (AS)	All teaching staff/professors (Tutorial assistants, Lecturers, and Senior Lecturers) in each year of review	Number of research Paper (RP)	Number of research publications in each year of review.
Number of non-academic staff (NAS)	All staff forming the management team and other supporting staff	Number of consultancies (CS)	Number of consultancy services provided by the University in each year.

Source: Own formulation

The selection of these variables is based on proximal relationships between input and output from literatures and availability of data (Agha, 201; Al-Bagoury, 2013; Kipesha (2013)

3.3 Tobit Regression model

In the second stage of efficiency analysis we adopt a Tobit regression model to analyze the effect of each input and output on efficiency. Tobit model is selected for this analysis due to its characteristic of accepting limited range of dependent variables whereby in this case is limited to 0 and 1 which are the efficiency scores. For that reason, Tobit regression equation created in this study has efficiency scores of each University as dependent variable and factors that are considered to influence the efficiency scores are independent variables. The similar model has been used by Jin-seok HAHN (2009) in evaluating transport efficiency in Asia. Though the study was not from education the model fits to the current study. Ordinary Least Squire (OLS) regression model is not preferred in this study due to drawback of producing inconsistence results of regression parameters (Kumar and Gulati, 2008). This model is similar to Al-Bagoury (2013) who applied in comparing the efficiency of higher education institutions in Africa. The results indicated that influential factors affecting efficiency are the growth rate, private share, and public expenditure on education.

3.4 ANALYSIS OF EMPIRICAL RESULTS

The analysis of efficiency of Universities in Tanzania is done for the period of 5 years from 2007/08 to 2011/12 using the input-oriented DEA model. The input oriented model is employed to determine efficiency scores of Universities for both CCR and BCC models.

Table 3 Efficiency score results from input oriented CCR DEA Model

NO	DMU	2007/08	2008/09	2009/10	2010/11	2011/12	Mean
1	AKU	0.744	0.614	0.613	0.531	0.871	**0.675**
2	ARU	1.000	1.000	1.000	1.000	1.000	**1.000**
3	DUCE	0.633	0.639	0.541	0.786	0.747	**0.669**
4	HKMU	1.000	0.517	0.778	0.774	0.671	**0.748**
5	IMTU	0.653	0.753	0.995	1.000	0.804	**0.841**
6	MU	1.000	0.623	1.000	0.693	0.454	**0.754**
7	MUCE	1.000	1.000	0.975	0.910	0.842	**0.945**
8	MUHAS	0.401	0.656	1.000	0.741	0.679	**0.695**
9	MWUCE	0.422	0.243	0.756	1.000	1.000	**0.684**
10	OUT	1.000	1.000	1.000	1.000	0.879	**0.976**
11	SJUT	0.288	0.622	0.488	0.528	1.000	**0.585**
12	SUA	1.000	1.000	1.000	1.000	1.000	**1.000**
13	TUDARCO	1.000	1.000	1.000	1.000	1.000	**1.000**
14	TUMA	0.615	0.814	1.000	1.000	0.925	**0.871**
15	UDSM	0.986	1.000	0.965	1.000	1.000	**0.990**
16	UoA	0.363	1.000	0.655	0.527	0.469	**0.603**
	Overall average	**0.757**	**0.780**	**0.860**	**0.843**	**0.834**	**0.815**

Source: Own calculations

From Table 3 above the efficiency score results from CCR model show that, 7(44%), 7(44%), 7(44%), 8(50%) and 6(38%) Universities were fully efficient with efficient score of 100% in 2007/08, 2008/09, 2009/10, 2010/11 and 2011/12 respectively, and the rest were relatively inefficient except six (08%) Universities in a period of five years of review their efficiencies were below average. This makes a total of 35(44%) efficient DMUs under this model in all five years of review. However, the mean scores of technical efficiency (CRS) were 0.757, 0.780, 0.860, 0.843, and 0.834. This implies that, Universities required 75.7%, 78%, 86%, 84.3% and 83.4% of the input used to produce the same amount of output in respective five years of the study. Another implication of these results is that reviewed Universities in Tanzania operated at an average efficiency score above 81.5% in the last three years of review. This is an overall average which is maximum percentage of inputs for optimal operation of a University to become efficient. It also signifies that, only 24.3%, 22%, 14%, 15.7% and 16.6% of inputs were wasted due to incapability to transform them into outputs. The average efficiency trend can also be explained graphically as shown in figure 1 below.

Figure 2 University Average Efficiency Trend - CCR Model

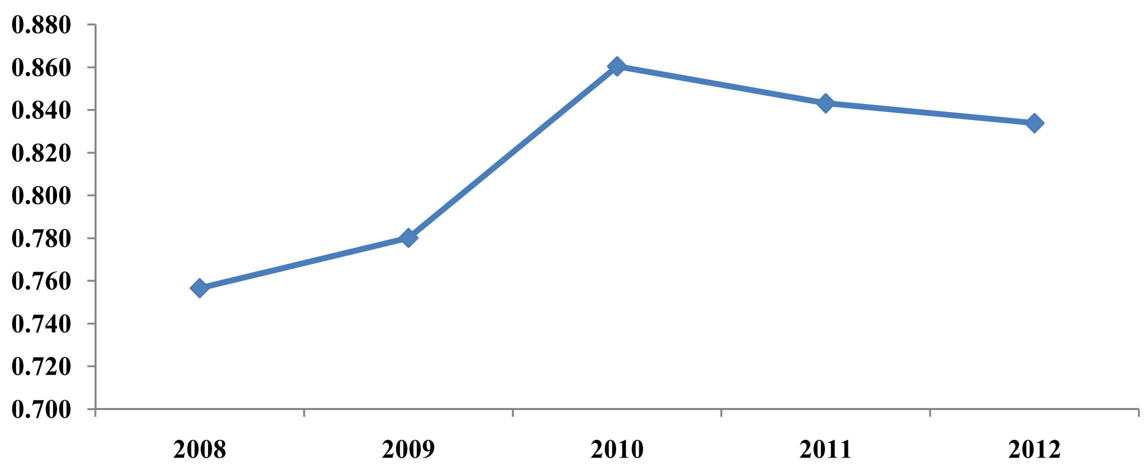


Figure 1 above show a slow increase in efficiency average of Universities from 75.7% to 86% in year one to year three respectively and started to decline from 86.7% to 84% in year three to year five respectively based on CCR model. The trend implies the decline of proportional relationship between University input and output due their variability.

Table 4 Efficiency score results from input oriented BCC DEA Model

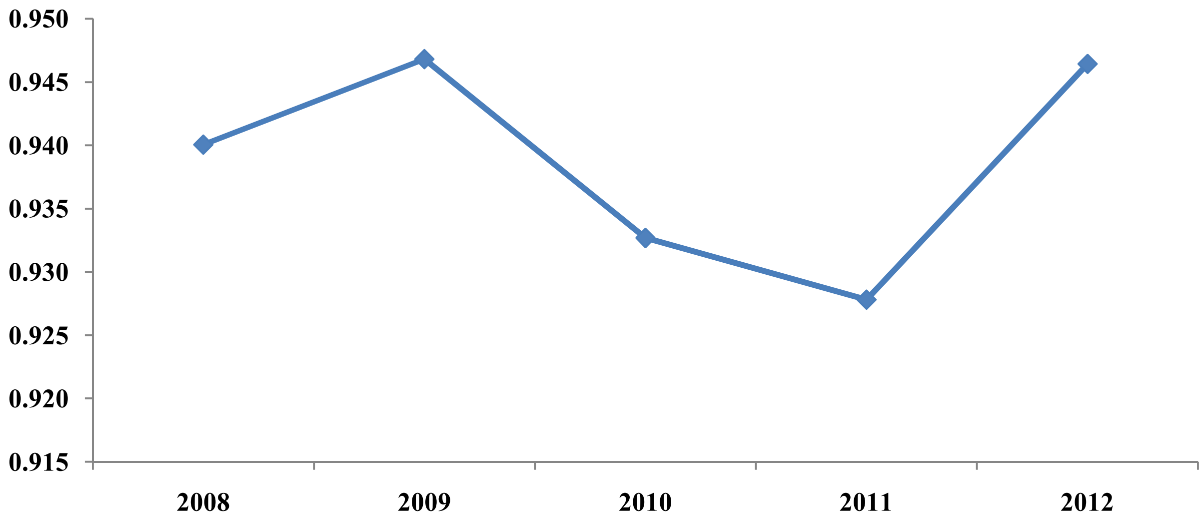
NO	DMU	2007/08	2008/09	2009/10	2010/11	2011/12	Mean
1	AKU	1.000	1.000	1.000	1.000	1.000	**1.000**
2	ARU	1.000	1.000	1.000	1.000	1.000	**1.000**
3	DUCE	0.642	0.842	0.543	0.790	0.911	**0.746**
4	HKMU	1.000	0.672	0.807	0.775	0.813	**0.813**
5	IMTU	1.000	1.000	1.000	1.000	1.000	**1.000**
6	MU	1.000	0.958	1.000	1.000	0.773	**0.946**
7	MUCE	1.000	1.000	1.000	0.923	1.000	**0.985**
8	MUHAS	1.000	1.000	1.000	0.849	1.000	**0.970**
9	MWUCE	1.000	1.000	1.000	1.000	1.000	**1.000**
10	OUT	1.000	1.000	1.000	1.000	1.000	**1.000**
11	SJUT	0.444	0.677	0.573	0.690	1.000	**0.677**
12	SUA	1.000	1.000	1.000	1.000	1.000	**1.000**
13	TUDARCO	1.000	1.000	1.000	1.000	1.000	**1.000**
14	TUMA	0.955	1.000	1.000	1.000	1.000	**0.991**
15	UDSM	1.000	1.000	1.000	1.000	1.000	**1.000**
16	UoA	1.000	1.000	1.000	0.818	0.646	**0.893**
	MEAN	**0.940**	**0.947**	**0.933**	**0.928**	**0.946**	**0.939**

Source: Own calculations

From figure 3 above it is learned from the results that Universities 1, 2, 5, 9, 10, 12, 13, and 15 were fully efficient in all the reviewed five years, which is 50% of all the reviewed universities. Similarly, the average efficiency scores of Universities increased gradually from 94% to 94.7% in 2007/08 and 2008/09 respectively, and then had a sharp decline to 92.8% in 2010/11 before rising again to 94.6% in 2011/12. Even though, the average efficiency scores under BCC model are higher than those in CCR model ranging from 94% to 94.6%. This is in line with Vincová (2005) that BCC efficiency score is higher than the CCR efficiency score due to exclusion of CRS and inclusion of VRS behaviours respectively.

Furthermore, it is added that efficient DMU in CCR model is also efficient in BCC model but not the vice versa. In BCC model, results indicate that only 0.06%, 0.03%, 0.067%, 0.072% and 0.054% of inputs were misused in the five years respectively. Though the amount of input wastage is Meagre Universities need to be keen in their utilization of human resources. It is also shows that the number of efficient Universities increased from 35(44%) in CCR model to 58(74%) DMUs in BCC input oriented model in the entire five years from 2008-2012. Three Universities (ARU, SUA and TUDARUCO) are identified fully efficient in both CCR and BCC models.

Figure 3 University Average Efficiency Trend - BCC Model



The trend of average University efficiency shown in figure 2 above indicates steady increase in the first two years before gentle decline from 94.7% to 92.8% in 2009 and 2011 respectively. From this downfall in 2011 the average resumes to 94.6% in 2012. The trend of University efficiency indicates variability over time implying inefficient use of inputs to generate expected output at a given time. However, the averages of efficiency under BCC model are very high compared to that of CCR.

3.5 Identifying Bench Marks/reference set in BCC model

Benchmarks or reference set of DMUs are efficient DMUs which inefficient DMUs need to experience to become efficient. It is also known as peer group of inefficient DMUs which also need to be fully efficient with 100% technical efficiency score (Khezrimotlagh et al, 2012). Table 4 below indicates summary of peer count efficient Universities extracted from appendix 2. From the peer count summary, it shows that SUA, OUT, UDSM, MWUCE and ARU Universities are ranked higher in terms of peer count reference set compared to other efficient DMUs. Thus, inefficient Universities might benchmark to these reference sets to rise their efficiency scores to 100%.

Table 5 Reference set peer count summary of Universities in 2008-2012

DMU NO.	Reference	2007/08	2008/09	2009/10	2010/11	2011/12
1	SUA	4	2	1	**5**	1
2	OUT	4	3	4	5	2
3	UDSM	2	3	3	4	3
4	MWUCE	3	2	2	4	3
5	ARU	1	4	1	1	1
6	AKU	1	1	1	2	3
7	TUMA	1	2	2	2	1
8	TUDARCO	1	1	1	2	2
9.	MUCE	2	3	1	0	1
10	IMTU	1	1	1	1	1
11	MUHAS	1	1	2	0	1
12	UoA	1	1	1	0	0
13	MU	1	0	1	1	0
14	SJUT	0	0	0	0	4
15	HKMU	1	0	0	0	0

Source: Own calculation

3.6 Tobit regression model

In this section we use Tobit regression model to find out the factors affecting efficiency. The recognition of efficiency drivers helps inefficient DMUs to focus on those so as to become efficient. Tobit regression model is applied for both CCR and BCC and the results are shown in table 6 and 7 respectively. Tobit regression model used the following equation:

$$E_{i,t} = \beta_0 + \beta_1 SE_{i,t} + \beta_2 AS_{i,t} + \beta_3 NAS_{i,t} + \beta_4 GR_{i,t} + \beta_5 RP_{i,t} + \beta_6 CS_{i,t} + \square_{i,t}$$

Where,

$E_{i,t}$ = efficiency score, SE_{it} = student enrolment, AS_{it}= academic staff, $NAS_{i,t}$ = non-academic staff, GR_{it} number of graduates, $RP_{i,t}$ = research publications, CS_{it} = consultancy services, β_0 is a constant term, β1 - β6 = coefficient of independent variables, and $\square_{it}$ is the error term. The dependent variable in this model is the University efficiency $E_{i,t}$, where input and output are treated as independent variables. A positive coefficient implies an efficiency increase, whereas a negative coefficient means an association with an efficiency decline or inverse relationship at 5% significance level. A significant P-value ranges from 0.01 to 0.05 ($0.01 \le P \le 0.05$).

Table 6 Tobit Regression Model Results under CCR model

Variables	Coefficient	Std. Error.	t-value	P-value
Enrolment	0.0000559	0.0000292	1.91	0.059
Academic staff	-0.0011289	0.000763	-1.48	0.143
Graduates	-0.0000328	0.0000986	-0.33	0.74
Research publications	0.000886	0.0008034	1.1	0.274
Consultancy services	0.0132653	0.005793	2.29	0.025

Source: Own calculation

In table 6 above only consultancy services with P-value 0.025 show a statistical significant relationship with University efficiency. This implies that for any increase of one unit of consultancy service will increase the efficiency by 1.33%. We also learn that enrolment, academic staff and graduates are observed to be insignificant to University efficiency as their p-values fall out of the accepted range of 5% to 1% significance level.

Table 7 Tobit Regression Model Results under BCC model

Variables	Coefficient	Std. Error.	t-value	P-value
Enrolment	0.0000186	0.0000145	1.29	0.202
Academic staff	-0. 0002996	0.0001421	-2.11	**0.038**
Non-academic staff	0.0000291	0.0000428	0.68	0.498
Graduates	0.0001689	0.0002944	0.57	0.568
Research	0.0075454	0.0028379	2.66	**0.01**
Consultancy Services	0.7524543	0.031138	24.17	**0.03**

Source: Own calculation

The Tobit regression model result in table 7 indicates that academic staff, research publications and consultancy services with p-value 0.038, 0.01 and 0.03 respectively are statistically significant to the University efficiency. This suggest that for any increase of one unit of research publications, and one unit of consultancy services will cause an increase of 0.76% and 75.3% in University efficiency respectively. Whereas research and consultancy indicates a positive relationship with University efficiency, the academic staff variable shows a negative relationship. This implies that any increase of one unit of academic staff will lead to University efficiency decline. However, the significance of academic staff is very low (0.3%). Therefore, Universities could increase the number of research publications and consultancy services so as to increase their efficiency. The main focus could be on consultancies due to high significance shown above.

4.0 Discussions and Conclusion

4.1 Discussions

Overall findings from the study suggest that there is variation of University efficiency in Tanzania across time. It is observed that Universities are efficient in generating graduates using their available inputs in form of human capital. They are observed to be inefficient in generation of research publications and consultancy services. This is justified through Tobit regression model which shows a positive relationship between University efficiency and research and consultancy through observed p-values. Among reviewed Universities, 8(50%) Universities appear to be efficient in all the five years of review. The study also shows that research and consultancy are the most influential factors to University efficiency which Universities are not doing properly.

The implication of these findings is that Universities in Tanzania spend much resource for production of graduates at the expense of research and consultancy. Despite knowledge dissemination being one of the core University roles, research and consultancy are disregarded. These findings are similar to that of Kipesha (2013), which indicates public University inefficiency in generating internal resources through research and consultancy. With an involvement of entire Universities, the variation of efficiency scores might have resulted from different settings and orientations. Whereas, public Universities focus on service provision, private Universities services are no more than a business (Makulilo, 2013). Thus, capitalizing on research and consultancy is not a priority. This difference has an impact on resource availability and allocations, hence affect their efficiencies. This failure of Universities in meeting these important roles will continue to destroy their market image. Both Bett and Brennan (2004) emphasizes on the importance of research and consultancy in Universities that they transform the society. Thus, Universities need to redress the situation to ensure holistic University functions.

4.2 Limitations and Recommendations for Future Research

Our study had several limitations. Primarily this study was limited by a small sample of only 16(37.2%) universities out of 43. This sample could have been expanded if Universities were ready to provide the required data. Tanzania Commission for Universities (TCU) could have also improved the sample if it had an exhaustive data base with all required variables. Thus, only those universities which were ready to provide data are included in the study. Time period of study was another limitation. We had planned to include data for 2013 but they were not available from any source nor were the concerned officials ready to provide directly. We included only three inputs and three outputs against our target of four variables each as some of the Universities' data was available only for three variables. Therefore, the result obtained in this study may vary from those when all universities are included and number of variables is increased.

Thus, future studies can focus on (i) Improving the current study by including all 43 Universities and increasing the number of variables, (ii) A comparative study on efficiency assessment with other regional Universities in East Africa or all the African Universities and (iii) A comparative study by the use of ranking of African/Global Universities. Results from the suggested studies may provide opportunity for Universities to position themselves locally and globally through efficiency determination and work for improving their efficiency.

4.3 Conclusion

Demand of higher education today has increased in both public and private sectors. Man power with required skills is expected from various higher learning institutions which are also growing very fast. Thus, it is the role of these institutions to capitalize on efficiency assessment to guarantee their sustainability in a competitive market. This study examines the efficiency of Universities in Tanzania and identifies the determining factors.

The findings from the study suggest that there is variability of efficiency among Universities across years. It is revealed from the study that Universities are efficient in generating graduates through available human capital, whereas research publications and consultancy services are lagging behind resulting in lower University efficiency. The efficiency in majority of Universities is observed to be above average. Thus, Universities in Tanzania need to use their inputs more efficiently for research and consultancy which in turn will improve their efficiency. Inefficient Universities could learn from good practices of five benchmark Universities namely; SUA, OUT, UDSM, MWUCE and ARU to become efficient. Other extraneous variables which might have contributed to these findings could not be considered in the study.

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Appendix 1
Review Universities in 2008 - 2012

	University Name	Location	Ownership
1.	Ardhi University (ARU)	Arusha	Public
2.	Dar es Salaam University College of Education (DUCE)	Dar es Salaam	public
3.	Mzumbe University (MU)	Morogoro	Public
4.	Mkwawa University College of Education (MUCE)	Iringa	Public
5.	Muhimbili University of Health and Allied Sciences (MUHAS)	Dar es Salaam	Public
6.	The Open University of Tanzania (OUT)	Dar es Salaam	Public
7.	Sokoine University of Agriculture (SUA)	Morogoro	Public
8.	University of Dar es Salaam (UDSM)	Dar es Salaam	Public
9.	Hubert Kairuki Memorial University (HKMU)	Dar es Salaam	Private
10.	International Medical & Technology University (IMTU)	Dar es Salaam	Private
11.	Muslim University of Morogoro (MUM)	Morogoro	Private
12.	Mwenge University College of Education (MWUCE)	Kilimanjaro	Private
13.	St. John University of Tanzania (SJUT)	Dodoma	Private
14.	Tumaini University Dar es Salaam College (TUDARCO)	Dar es Salaam	Private
15.	Tumaini University Makumira Arusha (TUMA)	Arusha	Private
16.	University of Arusha (UoA)	Arusha	Private

Source: TCU website 2014

Appendix 2

Reference set from BCC model

University	2008	2009	2010	2011	2012
AKU	AKU(1.000)	AKU(1.000)	AKU(1.000)	AKU(1.000)	AKU(1.000)
ARU	ARU(1.000)	ARU(1.000)	ARU(1.000)	ARU(1.000)	ARU(1.000)
DUCE	MUCE(0.795); OUT(0.032); SUA(0.162); UDSM(0.012)	ARU(0.038); MUCE(0.957); UDSM(0.005)	MUHAS(0.253) OUT(0.729); UDSM(0.018)	IMTU(0.327);OUT(0.645) UDSM(0.028)	IMTU(0.238); WUCE(0.362); SJUT(0.371); UDSM(0.029)
HKMU	HKMU(1.000)	ARU(0.001); MWUCE(0.021); OUT(0.978)	OUT(0.997); UDSM(0.003)	MWUCE(0.125); OUT(0.807); SUA(0.037); TUDARCO(0.029); UDSM(0.002)	AKU(0.129); MWUCE(0.143); OUT(0.660); SJUT(0.047); TUDARCO(0.021)
IMTU	IMTU(1.000)	IMTU(1.000)	IMTU(1.000)	IMTU(1.000)	IMTU(1.000)
MU	MU(1.000)	ARU(0.729); UDSM(0.271)	MU(1.000)	MU(1.000)	TUDARCO(0.806); UDSM(0.194)
MUCE	MUCE(1.000)	MUCE(1.000)	MUCE(1.000)	IMTU(0.260); MWUCE(0.056); OUT(0.656); UDSM(0.028)	MUCE(1.000)
MUHAS	MUHAS(1.000)	MUHAS(1.000)	MUHAS(1.000)	IMTU(0.885); SUA(0.115)	MUHAS(1.000)
MWUCE	MWUCE(1.000)	MWUCE(1.000)	MWUCE(1.000)	MWUCE(1.000)	MWUCE(1.000)
OUT	OUT(1.000)	OUT(1.000)	OUT(1.000)	OUT(1.000)	OUT(1.000)
SJUT	MWUCE(0.451) OUT(0.091); SUA(0.457)	MUCE(0.031); OUT(0.365); SUA(0.604)	MWUCE(0.155) OUT(0.396); TUMA(0.449)	MWUCE(0.353) SUA(0.029); TUMA(0.618)	SJUT(1.000)
SUA	SUA(1.000)	SUA(1.000)	SUA(1.000)	SUA(1.000)	SUA(1.000)
TUDARCO	TUDARCO(1.000)	TUDARCO(1.000)	TUDARCO (1.000)	TUDARCO(1.000)	TUDARCO(1.000)
TUMA	MWUCE(0.382); OUT(0.207); SUA(0.411)	TUMA(1.000)	TUMA(1.000)	TUMA(1.000)	TUMA(1.000)
UDSM	UDSM(1.000)	UDSM(1.000)	UDSM(1.000)	UDSM(1.000)	UDSM(1.000)
UoA	UoA(1.000)	UoA(1.000)	UoA(1.000)	AKU(0.547); OUT(0.221); SUA(0.232)	AKU(0.662); SJUT(0.338)

Source: Own calculation