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Factors Affecting Efficiency of Higher Education Institutions: A Theoretical and Empirical Review

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Abstract: Public universities heavily depend on government for funding, hence assessment and monitoring of the efficiency of these universities and Higher Education Institutions (HEIs) become necessary due their immense importance to nation building. As inputs and outputs are used in the assessment of the efficiency scores of the HEIs and universities, there have been other factors that affect the obtained efficiency scores but usually overlooked. These factors are not within the input and output variables and still have effects on the efficiency of the HEIs. Based on the factors, the empirical results show inconsistencies regarding the theories. Therefore, this study reviews the theoretical and empirical aspects of the efficiency of higher education institutions, universities and factors affecting the efficiency within the confine of public HEIs.

Key words: Efficiency, higher education institutions, university, inputs, outputs

INTRODUCTION

Education is generally regarded as a concrete instrument in promoting socio-economic, cultural and political development of every nation. Education, especially higher education, provides the starting point for development and it is through education that people are able to navigate their way through the world (Arong and Ogbadu, 2010). For any nation to prosper and develop it must have a strong and vibrant education sector that is given due consideration and care. Due to the vitality and importance of higher education, it should be made the top priority of every nation.

Considering the importance of higher education, its efficiency and productivity is also important. The efficiency of HEI also known as Decision Making Unit (DMU) in the efficiency literature is analysed by computing and comparing between the outputs and inputs used in the production process of an HEI. It can be done through determining the maximisation of output, minimisation of cost or maximisation of profits depending on the type of DMU. The HEI efficiency concentrates more on the inputs and outputs to get the efficiency scores and mostly overlook the effects of other factors on the efficiency scores especially when the method of analysis is Data Envelopment Analysis (DEA). These other factors affecting the efficiency are often been overlooked because they do not involve in the efficiency analysis directly like the inputs and outputs, yet they have significant effects on the efficiency. There could be many factors affecting the HEI or university efficiencies within and outside the HEI or university settings. This study presents a review on the theoretical and empirical aspects of efficiency in higher education institutions universities and the factors affecting the universitie's efficiencies in order to fill the gap between the efficiency scores and the overlooked factors that are not among the inputs or outputs of the DMUs but still affect the efficiency of the HEIs.

Theoretical review: The efficiency of higher education institutions is affected by many factors, for example, Simha (2005) asserts that higher education institutions have to get financial resources in order to keep their pre eminence in research. Beside finance, there are other factors affecting the efficiency of the HEIs which these theories explain for every HEI efficiency analysis to be considered after the efficiency scores are obtained.

Theoretical factors affecting higher education institution's efficiency: These are the theories linking to the factors affecting the efficiency of higher education institutions systematically in one way or the other.

Resource based theory: Under the resource-based theory a DMU is viewed as a bundle of resources (tangible and intangible resources) suggesting that these resources are a source of sustainable competitive advantage on the off chance that they are rare, valuable, inimitable and non substitutable (Grant, 1991; Barney, 2001). This theory

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views intellectual capital, physical and financial capitals as strategic resources. Considering that DMUs have competitive advantage and giant performance through obtaining, holding and effective utilisation of those valuable resources (Zeghal and Maaloul, 2010). This is because the underutilisation or ineffective use of the resources can affect the efficiency of the DMUs.

More recently, the intellectual capital-based theory developed by Reed *et al*. (2006) has been advanced as one specific aspect of resource-based theory. They argue that intellectual capital is the only source of competitive advantage and value added to the firm because it is difficult to imitate and substitute and it has imperfect mobility whereas physical capital is a generic resource, easily imitable and substitutable. Therefore, those higher education institutions or universities with higher intellectual resources have the tendency of being more efficient than others with lower intellectual resources. Resources of an institution perhaps encourage the growth in size of the institution; hence, Divisibility and Shakeout theory explains that.

Divisibility and Shakeout theory: Two theories on the relationship between size of an institution and performance were identified by Maghyereh (2004). The Divisibility Theory stresses that there is no relationship or there is negative relationship between size and efficiency because if the technology is divisible, the large institutions will have no operational advantage when compared with the small ones as they will be able to provide services at cost per unit output. On the other hand, the Shakeout theory postulates that smaller institutions are unable to collect sufficient capital compared to large ones because they lack management ability which implies a positive relationship between size and performance. The funding allocation from the government to the higher institutions depends on their size on operation which could have a multiplier effect on their efficiency, though it also depends on how effective it has been used.

As size of the institution increase with an increasing resource, there could be increasing number of workforce in the institution which requires good industrial relation among them and between them as one body with the government. Mostly in the third world countries especially African countries there used to be a conflict on the industrial relation which cause strikes and riots by the faculty staff of the institutions; hence their efficiency will be affected, RNK and Cost-Based Microeconomic theory shows that.

RNK and cost-based microeconomic theories: The RNK Theory was developed by Reder, Neumann and Kennan in 1980. According to the hypothesis, strikes force a joint cost on both the labour employers and the employees. Both the union and the management endeavour to bring down this joint cost by creating what Reder and Neumann (1980) name as "Bargaining Protocols" in light of the fact that the activity has awful impact to all of them.

The cost-based microeconomic theory attempts to clarify strikes as a microeconomic choice-making issue where the involved parties attempt to adjust the marginal cost and benefit from optional alternatives about strikes. This theory is on the industrial actions or strike activities in the institutions, mostly happens in African higher education institutions and universities which in one way or the other affect their efficiency when occur frequently.

All the theories directly coincide with the factors affecting the efficiency of the HEIs after obtaining the efficiency scores using two basically models: production possibility frontier and/or stochastic frontier model. Koopmans (1951) gives the meaning of technical efficiency, Debreu (1951) presents its first measure with the "coefficient of resource utilisation" and Farrell (1957) develops rigorous method of measuring relative technical efficiency.

MATERIALS AND METHODS

Production possibility Frontier model: The production frontier shows the greatest amount of output obtainable from each input level. Firms could be said to be technically efficient if they produce on that frontier. For example in the production process where input (p) is been utilised for the production of output (x) the production line in that process is the production frontier which explains the relationships between the inputs and outputs used. Figure 1 shows basics of that model.

Figure 1 showing strong solid line running through efficient DMUs B to D shows the efficient frontier which expresses attained efficiency. For instance, DMU A is identified as inefficient in these 10 units of the sample. It requires shifting to A* (i.e., composite DMU) on the frontier then it can likewise be considered efficient. DMUs C and D on the efficient frontier (i.e., reference set or associates of DMU A) are the units utilised for comparing the input/output computation's configuration or setup of its efficient composite DMU A*. All other data points are enveloped by the efficient frontier; hence, the name data envelopment analysis emerges.

Holding all the assumptions of the model, it is generally used to get the efficiency scores of ≤ 1 (efficient =1 or inefficient <1). As seen from Fig. 1 when the efficiency score is <1 it is below the ticker line frontier

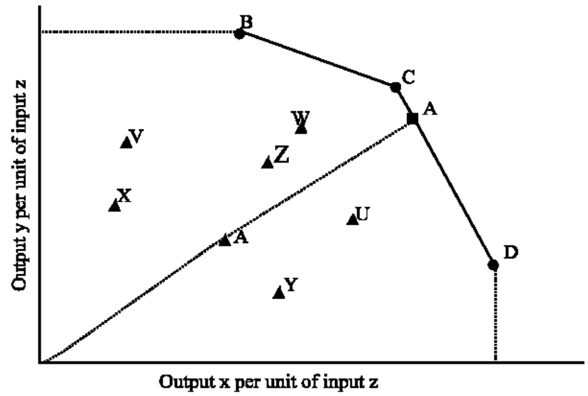

Fig. 1: Production Frontier model

and when the efficiency score is equal to 1 it is on the ticker frontier line. Getting the efficiency scores let the researcher knowing which institutions or DMUs are more efficient with the use of Data Envelopment Analysis (DEA) as the tool of analysis and overlooking other factors that are not within the production's inputs and outputs and that may have affect the efficiency scores which are equally vital. However, the DEA has no recognition of error term and it is considered as a non parametric approach without a functional form of the production relationship. Berg (2010) explains that best specification cannot be tested and the number of efficient DMUs on the frontier tends to increase with the number of input and output variables. That made the model deficient and necessitates for improvement hence, the Stochastic Frontier Analysis (SFA) tries to do that.

Stochastic Frontier model: Aigner *et al.* (1977) introduced the stochastic frontier also referred to as "composed error" model. Given the production function as $y_i = f(x_i, \beta)+\varepsilon$, q(i = 1, 2, ..., n) for which y_i is the output for observation i and x_i is the vector of inputs for the observation i while vector of parameters is β and the ith error term for the observation is ε. Meeusen and van den Broeck (1977) postulates that the error term is been made up of two independent components, representing the usual statistical noise found in any relationship and the technical inefficiency. A structure of three-component error was introduced in by Polacheck and Yoon (1987) where one non-negative error term is added to while the other is subtracted from the zero-mean symmetric random disturbance. Recently, Parmeter and Kumbhakar (2014) and Park *et al.* (2015) propose in the literature non parametric and semi-parametric approaches where no parametric assumption on the functional form of production relationship is made.

This model has in recognition error term which explains factors or other variables that were not involved in the efficiency analysis. This at least takes care of the factors affecting the efficiency of the DMUs on analysis but depends on the data sets to determine the appropriateness of model. However, in order to estimate a stochastic frontier model, strong assumptions need to be imposed, in particular about the distribution of statistical noise (normal) and of technical ineciency (e.g., one-sided normal). In addition, Schmidt and Sickles (1984) argue that if any DMU knows its level of technical inefficiency that should affect its input choices hence, the assumption that inffciency is independent of the regressor may be incorrect.

RESULTS AND DISCUSSION

Empirical reviews: In relation to the hitherto theories including the models, this shows the empirical works on the factors affecting the efficiency of HEIs which are often overlooked by those models hitherto discussed. These factors are not within the variable inputs and outputs of the analysis, rather considered after the efficiency scores especially in the production possibility frontier model.

Empirical studies on factors affecting efficiency of HEIs; funding and expenditure: Funding of institutions of higher learning and financial support has significant effect on both their internal and external economic efficiency (Jones, 1996, 2006a, b). Some of the studies about the relationship between spending on education and performance (Hanushek, 1994; Thanassoulis and Dunstan, 1994; Jesson and Gray, 1991; Mayston and Jesson, 1988). A meta-analysis on educational research studies find positive relationship exists between expenditures on education and student performance (Rosenthal, 1994). However, some performance results are positive and significant others are not. In the United States, real per pupil expenditures have risen by >100% in >25 years but all available evidence suggests that educational performance has declined (Hanushek, 1994; Anderson *et al.*, 1998). Lower performance in collaboration with real increased per capita spending suggests inefficient utilisation of educational resources (Hanushek, 1994).

The most recent studies include that of Tochkov *et al.* (2012) which find efficiency as insignificant determinant of the amounts of subsidy allocated to a university. Efficiency and funding is found to be negatively related. In the study of Caballero *et al.* (2004) show that the allocation of funds for hiring teaching staff among departments at the University of Malaga in Spain improves the average technical efficiency with respect to teaching. On another study, Tajnikar and Debevec (2008) report that inefficient departments within the University of Ljubljana in Slovenia receive disproportionately more funds than efficient ones.

Size of institution: The existing literature demonstrates contradictory results about the relationship between size and efficiency. A study by Berger *et al*. (1993) reveal that the positive relation between efficiency and size may not be visible as factors signifying so are not yet conclusive. Larger institutions are generally efficient owing to their ability to produce maximum output. Larger universities have greater outputs in terms of teaching and especially research at a particular time because they have gradually increased in size over time. On the other hand, small universities are unable to achieve this level of success in the short run. There is also the possibility that institutions with greater efficiency are more competitive and as a result, they gradually become large.

Avkiran (1999) finds the relationship between size and efficiency insignificant while find a positive and significant relationship. Isik and Hassan (2002) study indicates that size is negatively related to efficiency. Although there are higher costs recorded for the small institutions, their technical and scale efficiency are better compared to their larger counterparts.

Strike and industrial actions: Strike activity is conceived as an impression of “worker militancy” and the Hicksian notion of strike is seen as bargaining “miscalculations”. Hick’s notion is most accurately applied to strikes at contract renegotiations which are expected to affect productivity. Maki (1983,1986) clarifies that the literature on economic effects of strikes largely makes reference to the likelihood that production may be higher than generally before and/or after a strike, partially off setting the costs of the strike to the management involved, the employees involved and more broadly the society. As indicated by Flaherty (1987), the evidence demonstrates a high and in some cases complex relationship between strike activity and the rate of productivity change.

McHugh (1991) studies the extent to which strikes impaired productivity. The study shows that strikes are associated with productivity declines of greater statistical significance in the linked institutions than in the root institution experiencing the strikes. However, the study concludes that studies using only the individual institution as the unit of observation underestimate the impact of strike activity on short-run productivity. The findings are consistent with the researchs of Brown and Medoff (1978), Kendrick (1973), Mansfield 1980 and Maki (1983). Aussieker (1977) finds negative impact of faculty strike on the institution. Also Maki (1983) used a pooled cross-section time series data on twenty countries and shows that increased strike activity generally results in lower productivity growth. On a contradictory note, Maki (1986) find a negligible net impact of strike action on productivity and the same result by Dickerson *et al.* (1997) which discovered some weak evidence of the hypothesised opposite relationship between loss of output and strike’s volume utilising bivariate transfer function.

For the efficiency scores to be obtained, the input and output variables have to be used and the effects of the factors affecting the efficiency can only be realised at the second stage of the DEA or in the modeled variables of SFA. Therefore, let review studies on the input-output efficiency analysis and Table 1 shows that.

Table 1: Empirical efficiency studies

References	Country	Sample of HEIs	Data/Years	Inputs	Outputs	Main conclusions
Athanassopoulos and Shale (1997)	UK	45 universities	1992-93	Number of undergraduates postgraduates and academic staff; mean A-level entry score over the last three years; research income; expenditure on library and computing services	Number of successful leavers; number of higher degrees awarded; weighted research rating	Universities are clustered into 3 main groups: low cost and high outcome efficiency; high cost and low outcome efficiency; high cost and high outcome efficiency
Joumady and Ris (2005)	8 European countries	209 HEIs	1998	Different according to the models. e.g., teaching characteristics;equipment; course contents;intensity of graduate job search; quality of the relation between universities and the labor market	Different according to the models e.g., levels of generic and vocational competencies acquired; vertical/horizontal competencies match	UK, the Netherlands and Austria had good performance in all the specifications under test; France and Germany were located on an average level of inefficiency; Spain, Finland and Italy were at the bottom of the group
Johnes and Li (2008)	England	112 HEIs	1996/97-2004/05	Number of full-time undergraduate and postgraduate students; academic staff; administrative expenditures; expenditures on centralized academic services	Degrees awarded (graduate and postgraduate) and research income received	Rapid changes in the higher education sector appear to have had a positive effect on the technology of production but this has been achieved at the cost of lower technical efficiency

Table 1: Continue

References	Country	Sample of HEIs	Data/Years	Inputs	Outputs	Main conclusions
Johnes and Li (2008)	China	109 regular universities	2003-04	Staff time, quality of staff, postgraduate input research expenditure and capital inputs (books and area of buildings	An index of the prestige of the HEI (reputation measure), index of total number of publications, research publications per academic staff (productivity)	Geographical location is important (HEIs in the coastal zone are more efficient), but funding sources do not. comprehensive universities consistently have higher average efficiency than specialist institutions
St. Aubyn, Pina, Garcia and Pais	EU, Japan and USA	Public or government dependent HEIs	1998-2005	Academic staff and number of students	Number of graduates; THES-QS recruiter survey ranking; THES-QS peer survey ranking; published articles; citations	Ireland, Japan, Sweden UK and the Netherlands were very close to the efficientfrontier; Bulgaria, Spain, Hungary, Czech Republic, Slovakia, Estonia Portugal and Greece were found to be highly inefficient
Agasisti and P´erez (2010)	Italy and Spain	57 Italian and 46 Spanish public institutions	2004-05	Number of students, number of PhD students, number of professors, financial resources	Number of graduates; amount of external resources attracted to research activities	In Italy, the improvement of performance over time was due to major "technological changes", while in Spain it was due to "pure" efficiency (arising from new funding models)
Eckles (2010)	USA (27 states)	93 private liberal arts colleges	2006-07	Cost per undergraduate, full-time faculty (%), students in the top 10% of their high school class (%) and 25th percentile of entering student's SAT scores	6 years graduation rate	18 colleges are found to be technically efficient. Among these, it is possible to identify peers for each of the technically inefficient institutions
Kantabutra and Tang (2010)	Thailand	22 public univ. (18 govt-depnt univs and 4 autonomous univ) 267 faculties	2003-06	For TEM (Teaching Efficiency Model): annual operating budget; number of academic staff; number of non-academic staff For REM (Research Efficiency Model): amount of internal and external research fund	For TEM: number of graduates at the undergraduate/master degree levels; employment rate For REM: number of publications in internationally/ nationally refereed journals; number of PhD degrees	Public universities in Thailand were more efficient in teaching than in research
Wolszczak and Partera (2011)	Austria, Finland, Germany, Italy, Poland, UK and Switzerland	259 public universities	2001-05	Total academic staff, total number of students and total revenues	Number of graduations and number of scientific publications	Only 5% of HEIs are 100% efficient. Universities from Switzerland obtained the best efficiency scores

Review of higher education efficiency studies: The review on Table 1 shows the inputs and outputs used in the input-output efficiency analysis in different countries and the outcomes obtained.

CONCLUSION

After reviewing the theoretical and empirical aspects of the efficiency of higher education institutions and universities alongside the consideration of insputs outputs and the model to be used there are other overlooked factors that affect the efficiency and performance of the institutions which are considered not to be within the inputs and outputs variables but still have effects on the efficiencies of the higher education institutions. Most of the studies emphasize on the efficiency scores without going further to examine those external and internal factors affecting the efficiency scores. These cases are mostly seen in the DEA model; while the SFA model sometimes take that into consideration with the error term which could be those overlooked factors, even though not all the data sets are appropriate for that. Hence, appropriate model has to be used considering the data set at hand, for example using multiple inputs and multiple outputs, DEA is the most appropriate. Interestingly while existing studies have tried to explain some factors that are affecting the efficiency of the higher education institutions there has been inconsistency between the empirical results and the theory. Meanwhile, other overlooked factors could be based on the geographical focus of the study, for example strike and industrial actions in HEIs especially in African countries is to be considered and assessed in order to get it effect on the efficiency.

Furthermore, in the need to successfully and effectively segregate between efficient and inefficient HEIs, there is a requirement for a larger sample size than the product of number of inputs and outputs (Sarrico and Dyson, 2000). In any case, DEA can be utilised with small sample sizes (Evanoff and Israilevich, 1991). Another general guideline for having an appropriate sample size is to ensure that it is at least 3 times bigger than the summation of inputs and outputs (Sinuany-Stern *et al.*, 1994), thus using panel data will handle that.

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