Efficiency of Education Expenditure in Ethiopia: The Case of Selected Public Universities (Data Envelopment Analysis Model)

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Abstract
This study analyzed the efficiency of education expenditure in Ethiopian public universities. The research applied descriptive research design and mixed research approach. Both secondary and primary data types were used. The target population of this research was all public universities under the Ministry of Science and Higher Education (MoSHE). Primary data were gathered from the MoSHE and public universities selected for the study and secondary data were obtained from different official sources. Data Envelopment Analysis was used as a method of data analysis to examine the efficiency of education expenditure. The performance measurement pactices of universities were analyzed descriptively. The study found that performance measurement practice is in place at the university level with identified criteria. Concerning the efficiency level, the majority of the universities were efficient relative to other universities in the pool. The researchers recommend the revision of performance measurement indicators to include international practice and a regular performance measurement need to be undertaken by the ministry to create competition among universities. In addition, we recommend to university management to get the best experience from other universities about resource management as per the peer result.
Keywords: Efficiency, data envelopment analysis, slacks and peer

Declaration
We hereby declare that this article is our own original work and it has been written by us in its entirety. We have duly acknowledged all the sources of information which we have been used in this article. The article has not also submitted for any publication in any journal yet.

Introduction
Higher education has a fundamental role in both the economic growth and development of any nation in the world. Many agree that the achievement of a nation relies on the knowledge, skills, and competencies of citizens. A nation with highly educated and skilled people has a great chance to advance to a better living standard (Yun & Yusoff, 2019). Universities are knowledge-based organizations concerned with the generation, acquisition and transfer knowledge to the public at different levels. Higher education provides proper skills and knowledge to the people necessary for a country's economic development through technology innovations and the development of new ideas (Kipesha & Msigwa, 2013). The development of education is a symbol of national strength and the level of economic and social development. The objective of higher education consists of providing adequate experts who are capable to transfer knowledge to the students and also increasing the general theoretical and professional levels. Investment in the education system is an investment in the future of mankind. Hence, improving efficiency of higher education is a highly topical problem for a society. In evaluating the efficiency of universities, it is very important to quantify the multi-product environment of educational production (Johnes, 2004). Evidence from several studies indicated that the role of government has shifted towards the efficiency and productivity of public sector activities (Afonso, Schuknecht, & Tanzi, 2010). Globalization has raised public pressure on the efficient allocation of resources since globalization creates a more dynamic environment for capital flow (Schuknecht, Tanzi, & Afonso, 2006). Since Public spending efficiency plays a key role in economic development, a transparent government spending practice is the cornerstone to the government (Chan & Karim, 2012).

In Ethiopia; higher education was initiated in 1943 with the founding of the university college of Addis Ababa. Until 1998, Ethiopia had two universities, 17 colleges and 31,000 students from the two universities and all colleges. Currently; number of universities increased to 45 and enrollment capacity of universities under the ministry of science and higher education increased to more than 479 thousand; only in regular program. The Ethiopian government has implemented four successive education sector development programs (ESDP) and currently the fifth one (GTP II) is under implementation through 2015/16 to 2019/20. The GTP has four main

objectives. One of the major goals of higher education in the implementation of GTP is increasing the capacity of universities more focused on science and technology.

Ethiopian government higher educational institutions are financed fully by the government. The budget is increasing in huge amount from time to time. Higher education expenditure in 1993 was less than half a billion Ethiopian dollar (birr), but in 2019/20 MoFED reported that total higher education expenditure exceeds 49 billion Ethiopian dollar (birr). Higher education expenditure growth is even greater than expenditure growth at a national level. In the Ethiopian growth and transformation plan two documents (2015/16-2019/20), the Ethiopian public expenditure policy focuses on investing in growth-enhancing pro-poor sectors (that include education) and the policy also put an objective to use public resource efficiently and effectively.

Despite major expansion on higher education, access to higher education remains relatively limited graduate employment rate and admission targets have not been met. The dropout rate has been between 10% and 15% in recent years. These results show serious constraints still exist on the education system especially in terms of local staff availability. A small number of academic staff has a Ph.D. degree in addition; the share of female academic staff remains far below the target. In addition, undergraduate enrollment evolves more rapidly than qualified college instructors putting serious constraints on working conditions and the quality of education. An improvement in enrollment has been observed in all universities but an enrolment target was not achieved. The successful utilization of budget is one of the critical instruments for the achievement of organizational objectives and national development goals. As per the above ample evidence, Ethiopian government expenditure in HEI grows significantly with the expectation of output improvement, but results are not in line with the targets.

Even if large numbers of studies have been exploring the effect of public expenditure on economic growth; public organization efficiency study are still limited in Ethiopia. Researcher point out that a study in this area is enormously complicated due to the research methods, limited availability of data, measurement difficulties, and the adverse effects of many external factors on efficiency. This might be the core reason for lack of sufficient research in the area. This study aims to make a detailed analysis on the input-output relationship of public universities in Ethiopia to examine the rise of education expenditure is substantiated with the growth HEI outputs. It also aims to analyze the success of resource utilization in Ethiopian public universities in terms of education expenditure efficiency.

A nation needs to use resources better by converting from wasteful, inefficient expenditure to smart spending that contributes to growth. To do so, some governments have set up efficiency targets and reform units to derive efficiency savings from the center of government while others have undertaken large-scale spending review programs. Public expenditure is subject to scrutiny from audit bodies, central agencies, expenditure review programs, political decision-makers, media, academia, and many more (Iyer, 2009). Due to this reason governments around the world are searching for ways to reduce the cost and improve the quality of service provision (Massy, 2003); Martin and Stella (2007) and (Martin & Stella, 2007). This is also the same in the current government of Ethiopia as it was presented by the Ethiopian prime minister to the parliament in September (2019). The two key objectives of efficiency measurement in the public sector are to trace technical inefficiencies, recognizing opportunities for changes in the ways resources are converted into outputs, and find inefficiencies in the combination of production factors (Martin & Stella, 2007).

Even if there is a strong willingness and commitment by the Ethiopian government in proper utilization of public resources, the Federal Annual Audit reports show contrary with the desired result. According to the Federal Audit reports (2016/2017), the findings show that 68 public bodies make payments without sufficient documents. From these public bodies, the largest payment is made by the Ministry of Education and public universities under the ministry. In the same audit report period mentioned above, universities are among the major public institutions which made the payment in compliance with rules and regulations. As per an observation in universities, budget utilization annual reports; budget shortage, and unreasonable budget rate especially on the student service and more especially on food items are reported by universities.

These critical issues may necessitate raising a question on the efficiency status of Ethiopian public universities. As per the researchers' best knowledge there no such study available specifically at the institutional (Ethiopian public universities) level. This study practically contributes to public expenditure performance measurement. In addition, it gives pertinent and timely information concerning the existing practices of public expenditure efficiency in Ethiopian public universities.

Empirically, as per the best knowledge of the researchers, not much is researched on how the Ethiopian universities utilized their expenditure though high enrollment and program expansion exists. Since efficiency is used as an indicator of public sector quality; this study critically examined the efficiency of public expenditure in the Ethiopian public university context.

Performance measurement is used by management as a communication tool to direct employees' efforts towards the common goal of improving performance. The researchers believed that this article can be used to provide public universities' performance result for the public in general and to concerned, management in particular. This provides information on performance gaps and help to fill the gap in every aspect of the university.

Literature review
Concepts of efficiency

According to Hanushek and Ettema (2017) efficiency is described as the use of time, energy, money and other resources, in a way that the rate of wastage minimum and the output achieved is maximum. Efficiency suggests to the best utilization of the firm's resources, to obtain better results, with the least wastage. In addition; efficiency can be expressed as the ratio of actual output to the standard output. Efficiency is often measured in terms of the inputs required to get the outputs. It's about the way during which work is completed, for instance, if equivalent work is often completed using fewer inputs or resources then efficiency has improved and contrary wise as cited in (Medina-Borja, 2002). Economists describe efficiency in three aspects; allocative efficiency which implies the utilization of inputs within the correct proportions reflecting their marginal costs; scale efficiency which considers the optimal size of the establishment to reduce long-run costs; and technical efficiency which implies that a firm use a minimum quantity of inputs to get maximum output. Technical efficiency is studied in this article. Even if efficiency is defined differently by various scholars, to this article a pareto efficiency concept is applied. As per pareto efficiency, where an economical decision is

Efficiency Measurement Model and Input Output Relationship in Measuring Efficiency

Efficiency in education is measured in terms of graduate rates, research publications, consultancy services, revenue generation, etc. as output, whereas enrolment, annual expenditure, academic staff, non-academic staff and quality of enrolled students as inputs (Kokkelenberg, Dillon, & Christy, 2008). The efficiency scores in DEA are assumed to arise from managerial efficiency or managerial inefficiency in managing university functions. Lovell (1993) indicated that efficiency is a measure of how to produce maximum production by using minimum input. Full-time equivalent student enrolment and student credit hours are considered a number of the most appropriate indicators of outcomes of teaching in a university environment (Moreno, Tadepalli, & economics, 2002). Credit hours can differ significantly among programs of full-time students (science students with labs versus students of humanities), and these differences more likely to reflect input differences than learning differences. Agasisti and Salerno (2007) consider the number of undergraduate degrees awarded an important measure of the output of any university. Cohn, Rhine, and Santos (1989) maintain that the numbers of students that have graduated represent an accumulated output of several years, counting on the time length of degree; the efforts of non-graduated students are overlooked and there are no criteria measuring quality. Nonetheless, it must be recognized that students' achievements depend not only on the standard of teaching but also on the ability of the students and their initial qualifications. According to McMillan and Datta (1998), the purpose of teaching is to increase the level of education, and the purpose of research is to create a piece of new knowledge and transfer it into practice. So, the indicators of a number of successfully graduated students with a certain qualification or number of published papers and patents registered can become quantified outputs.

Data envelopment analysis is used to empirically measure the technical efficiency of decision-making units (DMUs). DEA has a strong link to production theory in economics; moreover, it is also used in operations management. The efficient DMUs, as defined by DEA, may not necessarily form a production frontier, but rather lead to a best-practice frontier (Cook, Tone, and Zhu, 2013). DEA is referred to as balanced benchmarking. DEA is service management technique developed by Charnes, Cooper, and Rhodes (1978) to measure nonprofit and public bodies. DEA approach is commonly applied by researchers for evaluating the efficiency of a set of decisions making units (DMUs) that convert multiple inputs into multiple outputs. Especially in the recent literature, several studies are carried out in academic environments to measure performance and efficiency using the DEA method. Each study is distinguished from its scope, DMUs, and input/output variables. Data envelopment analysis techniques have been used by many researchers across countries. As per the bibliography found in Deapzone, more than 30,000 articles/ papers are cited. In addition, the Productivity of higher education study panels were conducted by American national research, Asian public productivity, and Delaware instructional studies.

Research by Ileuma (2017) presents two important types of education efficiency indicators, namely physical and value indicators. Physical indicators are calculating as a ratio of the number of graduates and the number of enrolled persons, or the ratio of their total number according to education levels. The finding indicated that the efficiency of the financial resources allocated to education is being influenced by a series of variables such as the size and content of the knowledge base, convergence of the training process, and the practical use of what has been learned. Nazarko and Šaparauskas (2014) conducted a study on the application of the DEA method in the efficiency evaluation of public universities. The study used the Charnes, Cooper, and Rhodes- constant return to scale output-oriented DEA model. The input variables used were government budget subsidy, number of academic teachers, number of other employees, number of licenses to award Ph.D. degrees, and number of licenses to award doctorate degrees. In addition, the output variables are weighted number of full-time students, weighted number of full-time Ph.D. students, Percentage of students studying abroad, Percentage of international students, Percentage of students with university scholarships, Percentage of students with government ministry scholarships, employer preference for hiring alumni, and Parametric assessment of scholarly achievements of faculty.

As per a study on measuring efficiencies of Turkish Public Universities with Non-Parametric Efficiency Estimation Method; technical and cost efficiencies of public universities in Turkey between 2005 and 2010 using Data Envelopment Analysis (DEA). Overall efficiencies were computed based on certain production and cost models motivated by different sets of input/output mix. For HEIs in Turkey, variables are the number of Full-time undergraduate Students (number of registered undergraduate students within one academic year), number of Full-time Postgraduate Students (total number of registered master's and doctoral students within one academic year), number of Indexed Publications per Academic Staff (total number of publications indexes per the number of academic staff) and the total amount of research grants (total amount of funding) to the HEIs on project-based applications.

In addition number of academic staff (the total number of faculty including full and part-time staff), labor Expenditures (total amount of expenditures allocated to the salary payments of academic and non-academic staff), capital expenditures (remaining amount of expenditures in the total expenditures when labor-related as well as goods and services expenditures are subtracted),   Goods and Services Expenditures, (amount of money allocated to purchase certain goods and services needed to keep up daily operations) and total expenditures (Erkoç, 2016).

Charnes, Cooper, and Rhodes (1978) defined DEA as a non-linear programming model that provides a new definition of efficiency for use in evaluating activities of not-for-profit entities. They clearly stated that it is a measure of efficiency where each participating unit in an organization called decision-making units (DMUs) are assigned as weights based on information provided by multiple outputs and multiple inputs essential to the operations of the specific entities being evaluated. In DEA, the efficiency of a particular decision-making unit (DMU) is computed by comparing the weighted sum of the organization's inputs against the weighted sum of its outputs. As per many efficiency studies on higher educational institutions; input of universities are universities' expenditures that are grouped into different variables such as labor, material, capital, and total expenditures (Katharakia and Katharakis, 2010). As Albert (2003) notes, college graduation rate is regularly cited as an vital way to judge the accountability of colleges' and universities'. As per the understanding; the higher the graduation rate, the better the college's performance whereas the lower the graduation rate is the poorer the college's performance. Some witnesses suggest to reward colleges that ensure a good job and contrariwise withdraw some funding to institutions that are not doing well by this measure.

Gul, Yucesan, & Duman (2014) made a study on the efficiency evaluation model for academic faculties using Data Envelopment Analysis. Data envelopment analysis is a data analytic approach for measuring the relative efficiency of decision-making units with multiple outputs and multiple inputs which makes measurement difficult. Academic departments have critical importance for a university so research and comparison about faculties of the university in Turkey are essential. The objective of the study was to analyze the relative efficiency of the academic faculties and affects the efficiency in the selected universities. Multiple inputs were the number of non-academic staff, the total number of academic staff, and a number of students. Outputs were the number of publications, the number of projects, and the percentage of budget used was among the variables employed. As per the study result 90.5% of faculties were efficient and five faculties are 100% efficient.

As documented by Archibald and Feldman (2008) graduation rate is the most frequently used performance measure for public colleges and universities. Cook and Pullaro (2010) argue that from 23 criteria on quality of institution, high school seniors chose graduation rate as the fifth main vital indicator of recognized quality. Graduation rates are performance measures completion. They are easy to understand by the public and policymakers since they answer the simple yet common question about the percentage of graduating students (Kelly & Schneider, 2012). A dissertation made by Dong (2010) on cost efficiency in the Banking Sector in China from 1994 to 2007 aims to assess and evaluate the cost efficiency. Both stochastic frontier analysis and data envelopment analysis methods were used. The result showed that the banking sector in China have consistent result in both methods. As noted by Hifni (2017), a well-functioning public expenditure management system (PEM) is considered a critical pillar of government efficiency. The study discusses public expenditure management systems in developing countries based on an analytical framework on principal-agent theory and allows for associations between institutional settings. The researcher has assessed the benefits obtained by the ministry of finance of post audits and controls, and assess their value in terms of their ability to deter cheating.

Sutherland, Price, Joumard, and Nicq (2007) applied both non-parametric (DEA) and parametric (SFA) approaches to assess the public spending efficiency in primary and secondary education among OECD countries. The results of the above studies indicated that small governments have better efficiency scores compared to the larger governments. The results suggest a high correlation between the results of both approaches. In the above empirical review, efficiency analysis can be done on public organizations especially on decision-making units with similar inputs and outputs.

From the above empirical reviews, it can be concluded that efficiency analysis can be done on public organizations especially on decision-making units with similar inputs and outputs. From this, it can be concluded that data envelopment analysis is an efficient evaluation method used worldwide and, in this paper, this method is considered as an appropriate technique.

Methods

To answer the assess the performance measurement practice of universities; qualitative data were used from interviewees of plan program directorates of each university selected for this study and from policy and inspection office of MoSHE. Regarding measuring performance of education expenditure in selected public universities (the second research questions), secondary data have been used to measure efficiency. The performance measurement practice of the ministry of science and higher education and all selected universities for this study was analyzed using a descriptive design which helps to a critical analysis of various policy documents and the achievements of related objectives of the universities. In addition; descriptive research design was also used to analyze the efficiency level of universities.

The target population of this research is the public universities in Ethiopia under the Ministry of Science and Higher Education (MoSHE). According to the (MoSHE) statistical abstract 2018/19, there are forty-five public universities administered under the Ministry of Science and Higher Education. To observe the efficiency status of universities for some periods; universities with ten years operation life have been selected (known as first- and second-generation universities as per MoSHE, which are 22 universities. The primary data for the first research question was collected from officials who have a direct link with universities' spending practice from the Ministry of Science and Higher Education and officials from the Ministry of Finance are considered as the key informant of the interview respondent. In addition; plan and development directorate heads/ senior experts in each Ethiopian Public Universities Administered Under Ministry of Science and Higher Education have been interviewed. In this case sample size is determined using the saturation method. A ten-year secondary data (2008/09 to 2018/2019) was collected from 22 purposively selected public universities.

In this research, the education expenditure efficiency of a university is considered as the multiple outputs over multiple inputs of a university. A 10 ten-year output of universities and 10-year inputs of universities were used to measure expenditure efficiency in ten years and also to evaluate efficiency status in the whole ten-year study periods. To measure the efficiency of universities DEA model was used with clearly defined input and output indicators. In the model; the major inputs selected for this research are personnel expenditure, goods and service expenditure, and fixed asset expenditures. Similarly, the major output variables selected for this study are the number of graduates in the undergraduate program and the number of graduates in a postgraduate program.

Data Envelopment Analysis (DEA), which is a non-parametric mathematical programming model, was used to measure the efficiency of government expenditure. It was firstly introduced by Farrell and then extended by Banker, Charnes, and Cooper (1984). DEA is most valuable in complex situations where there are multiple outputs and inputs, which cannot be readily analyzed with other techniques like ratios, and where the numbers of units are numerous which managements do not afford to evaluate each in detail. The efficient units are relatively efficient and are identified by a DEA efficiency score of $\Theta = 1$. The inefficient units are identified by an efficiency rating of less than 1 ($\Theta < 1$). DEA provides an efficiency rating that is generally denominated between zero and 1, which will interchangeably be referred to as an efficiency percentage between the range of zero and 100%. Output-oriented, efficient measures focus on output expansion using the available inputs for the unit to be efficient. This study is based on the output-oriented efficiency of public universities.

DEA Mathematical Model:

j = number of public universities (PU) being compared in the DEA analysis

PU_j = Public university number j

$\boldsymbol{\theta}$ = efficiency rating of the public university being evaluated by DEA

y_{rj}= amount of output r produced by public university j

X_{ij}= amount of input i used by public university j

i= type of inputs used by the PUs

r = type of outputs generated by the PUs

u_r= coefficient or weight assigned by DEA to output r

v_i = coefficient or weight assigned by DEA to input i

S = number of the output variable (in this study two)

M= number of input variables (in this study, they are three in number)

Similarly, X_{ij} is the observed amount of the ith inputs used by the jth public university, and y_{rj} is the amount of rth output produced by the jth public university.

$$\max\theta = \frac{u1y1o + uy2o + \cdots u_r y_r}{v1x1 + v2x2 \ldots \ldots . v_{mx_{mo}}} = \frac{\sum_{r=1}^{s} u_{r\,y_{r0}}}{\sum_{r=1}^{s} vi_{\,xi0}}$$

Maximize the efficiency rating $\boldsymbol{\theta}$ for the decision-making unit (public university). This is subject to the constraint that when the same set of u and v coefficients is applied to all other service units being compared, no service unit (PU) will be more than 100% efficient as follows:

$$\max\theta = \frac{u1y1o + uy2o + \cdots u_r y_r}{v1x1 + v2x2 \ldots\ldots. v_{mx_{mo}}} = \frac{\sum_{r=1}^{s} u_{r\, y_{r0}}}{\sum_{r=1}^{s} vi_{\, xi0}} \leq 1$$

$$maximize \qquad \theta p + \left[\sum_{i=1}^{m} si^- + \sum_{r=1}^{s} sr^+\right] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$Subject\ to \qquad \sum_{j=1}^{n} y_{ij}\lambda_j - si^- = xip$$

$$\sum_{j=1}^{n} y_{rj}\lambda_j - si^+ = \theta p y_{rp} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

$$\sum_{r=1}^{s} \lambda j = 1$$

$\lambda j,\ sr,\ si \geq 0$

i=1, 2 ….m, r= 1, 2……………s,   j=1, 2 ….n

The output-oriented VRS approach will be obtained by solving the above linear programming equations. From the equation m stands for the number of outputs which are two in this research,

s - represents the number of input (three in this research). y_{rp} is the sum of the r outputs of the p (public university) x_{ip} is the sum of the i inputs?

Sr is the weight of output and si is the weight of inputs. The p (public university) is considered as efficient when the efficiency score Өp becomes one. To measure the efficiency of each university (from the year 2008/09 to 2018/2019), it was regressed ten times.

Results

This section is about the performance measurement practice of each public university and it also assessed how the ministry of science and higher education measures the performance of universities administered under the ministry. In addition; presents the efficiency level of public universities measured by the data envelopment analysis model (DEA) developed by Charnes, Cooper, and Rhodes (1978) based on theoretically defined input and output of universities. This research was undertaken to analyze the efficiency of selected public universities in Ethiopia.

Regarding the performance measurement practice study; it was found that the performance of universities is measured by both universities themselves and the ministry of science and higher education policy and inspection office. Key performance indicators (KPI) were constructed with the consent of universities and other concerned bodies. According to the interview made with higher officials of MoSHE; the draft of KPI was initiated based on international experience and local information needs of users. Then the draft was enriched with university representatives and it was approved and applied as a performance measurement tool of public universities.

The key performance indicators (KPI) designed by the ministry have limitations to measure all major functions of universities like research activities of universities, community service of universities. In addition; the existing KPI is not in the expected level of details to measure each activity in every major function of universities and the reporting format of universities are not in a format to provide all required information to assess different types of performance like equity, efficiency, effectiveness and economy condition of university. It is also observed that some universities do not send fulfilled reports and others do not send the annual report as per the requested format to the ministry regularly.

Accordingly, in Ethiopian public universities, education efficiency is measured based on some major indicators that each university is planned in their strategic and annual plan, such as student attrition rate, students class ratio, student's teacher ratios, and other related criteria. Similarly, the indicators used in evaluating the efficiency of consultancy and community service are community service projects; the number of beneficiaries; the number of need-based community services delivered to the community, the number of research-based community services, revenue earned per project; the number of beneficiaries. Besides; cost spent per project; the number of projects per budget; are the major inputs mentioned by the interviewee. In measuring the efficiency of consultancy and community service, the majority of the respondent believed that the efficiency of this function is not well measured due to the unavailability of required data.

As per an interview with plan and development office directors of selected universities; the majority of interviewee replied that; mostly agreement is reached on the performance report presented by the inspection directorate of the ministry, but many university managements do not agree to publish and distribute the result to the public to avoid dissemination of negative information which may have some negative perception about the university. The above national level performance measurement practice continues only for three years, but currently, due to various reasons, this evaluation practice has been interrupted. The researcher observed the reorganization of the office to start the above performance measurement practice in the coming years, but no

national-level performance analysis since 2015/16.

Table 1 Technical Efficiency Variable Return to Scale assumption (2009/10- 2018/19)

University	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2011	Mean
Adama University	1.000	1	0.591	1	0.931	0.96	1	1	0.748	1.00	0.923
Addis Ababa University	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1
Ambo University	0.430	0.462	0.573	0.528	0.513	0.605	0.819	0.726	0.803	0.813	0.6272
Arbaminch University	0.863	0.95	0.601	0.612	0.525	1	1	0.679	0.877	0.777	0.7884
Axum University	0.949	0.915	0.834	0.823	0.605	0.322	0.922	0.798	0.602	0.823	0.7593
Bahr Dar University	1.000	1	1	0.677	0.701	0.822	0.706	0.769	0.935	0.889	0.8499
Debre Berhan University	1	1	1	0.887	0.72	0.655	1	1	1	0.58	0.8842
Debre Markos University	0.972	1	0.732	0.853	0.69	0.775	0.811	0.847	0.97	0.682	0.8332
Dilla University	1	1	1	1	0.66	0.683	0.615	1	0.755	0.706	0.8419
Dire Dawa University	0.817	1	1	1	1	1	1	0.826	1	1	0.9643
Haramaya University	1	1	0.597	0.897	0.785	0.963	1	0.862	1	1	0.9104
Hawassa University	0.965	1	1	1	1	0.982	1	1	1	1	0.9947
Jigjiga University	0.746	0.638	1	1	1	1	1	1	1	0.538	0.8922
Jimma University	0.941	1	0.787	0.794	0.832	0.843	0.905	1	1	0.935	0.9037
Madawelabu University	1	0.829	0.505	0.73	0.618	0.515	0.841	0.372	0.55	0.562	0.6522
Mekele University	0.838	0.92	0.614	0.685	0.682	1	1	1	1	0.858	0.8597
Mizan - Tepi University	1	0.676	0.455	0.766	0.749	0.516	0.503	1	1	0.489	0.7154
Semmera University	0.434	0.522	1	1	1	0.347	1	0.252	1	1	0.7555
University of Gondar	0.661	1	0.842	0.875	0.816	0.912	0.848	0.783	0.869	1	0.8606
Wellega University	0.646	0.774	1	1	0.787	0.823	0.841	0.709	0.663	1	0.8243
Wolaita Sodo University	1	1	0.955	0.918	0.921	0.645	1	1	0.482	0.698	0.8619
Wollo University	0.246	0.268	1	0.677	1	1	0.911	0.606	0.825	0.623	0.7156
Mean of 1st gen. univ											0.8899
Mean of 2nd gen. univ											0.8006
Mean	0.841	0.861	0.822	0.851	0.797	0.789	0.896	0.829	0.817	0.867	

Source: researcher computation based on DEA result, 2020

Regarding efficiency evaluation using the DEA model in this research output-oriented technical efficiency from a variable return to scale is used to make efficiency analysis of public universities in Ethiopia. This is because the research aims to show universities how much improvement can be made on output with the given resource from the government. As can be seen in Table 1, the major findings inferred that more than 13% of universities selected for the study shows less than 50% technical efficiency, more than 45% scored technical efficiency from 50% to 99% and 40% of universities scored 100% (maximum) technical efficiency relative to universities selected for efficiency study.

Scale efficiency shows whether a firm is operating at optimal size or to see whether the firm is too large or too small. It measures the efficiency or inefficiency of universities which comes due to the size of the institution. The majority of universities in 2009/10 have decreasing return to scale (DRS) efficiency status. This indicates that these universities are at a diseconomy of scale, meaning that these universities exceeded their optimal size. DRS status shows the increase in output may lead to an increase in the inefficiency of a university. Rather the decrease in output may lead them to improve efficiency results. According to the scale efficiency data; it can be inferred that more than 31% of universities selected for the study show increasing return to scale, more than 40% show decreasing return to scale and 27% of universities operate at an optimal scale from the universities selected for the study.

The average technical efficiency from VRS is 0.841 and the average scale efficiency is 0.880 of all public universities selected for this study in the year 2009/10. As per the result, public universities score around 85 percent efficiency achievements or these universities need to minimize input by around 15 percent to get the max result. Concerning scale efficiency, the mean for all public universities is 0.880, which can be explained that scale inefficiency has a contribution to the technical inefficiency of universities in 2009/10. When we observe the change in efficiency level of universities as compared to the base year which is 2009/10, the technical efficiency of universities structure has changed. Ten universities or more than 45% scored 100% technical efficiency from a variable return to scale, this shows that a slight increase in the efficiency of universities. As per efficiency mean, average technical efficiency is slightly increased from 0.841 in 2009/10 to 0.867 in the year 2018/19. The highest 10-year average efficiency is recorded by Addis Ababa University with a score of 1 and the lower from the group is Ambo university 0.6272 or with 37 percent inefficiency.

Regarding efficiency at a generation of universities; the 10-year average efficiency result in first-generation universities is 0.8899 which is higher than the mean efficiency of that of second-generation universities 0.8006. It can be concluded that in average efficiency of first-generation universities are higher than that of second-generation universities by 9% (0.8899-0.8006).

Output slack shows the shortage of output relative to an input applied to produce the actual output. In the year 2009/10 output one (graduates in the undergraduate regular program) shows that the output is to the expected and no shortage was observed in all universities; whereas in the case of output two (number of graduates in the postgraduate regular program) in average universities produced by 60 graduates less than the expected output. Regarding 2010/11-year data; the average result of each university is lower than by around 84 graduates in the postgraduate regular program. The year 2011/12 is a special year for all universities since no output slack was

observed in all universities in both output types. Since 2012/13; the average output slack was showing a decreasing result except for 167 output slack in 2012/13 and 237 in 2016/17. The other year experienced an improvement in the efficiency of universities since the output slacks are decreasing from 28 in 2013/14 to 25 in 2018/19.

When we observe the resource utilization status of universities, some improvement was observed in some types of inputs but there are input types still which show an increase over input utilization than expected. Data in 2018/19 signifies that a birr 32,870,932.74 input slack in personnel expenditure and a birr in 52,752,871.81 intermediaries' types of inputs are the evidence to show still there is a problem of excess input utilization in universities. The capital resources (fixed asset expenditure) were remarkably declined to birr 10,883,087.91 in 2018/19 from input slack 165,010,907.09 in 2013/14. This is an indicator of fixed asset management improvement. When we compare the inefficiency of input utilization at aggregate level birr input slack was 185,571,723.66, but this amount was declined to birr 96,506,892.46 in 2018/19. This shows universities have registered an efficiency improvement in the input utilization perspective.

Peer universities are universities to whom the management body should look to get a lesson to improve the resource utilization practice. Only those universities with inefficient or less efficient have peer(s). An efficient university has no peer, but this efficient university will be a peer for another university.

Conclusions

This article studied the efficiency of education expenditure in Ethiopian public universities. The main objective of the study is to study the performance measurement practice of Ethiopian public universities' and to analyze efficiency of education expenditure in Ethiopian public universities. As the major findings on the performance measurement practice of universities and the ministry of science and higher education (MoSHE); it was found that there is a performance measurement practice at every university level with identified criteria to assess the performance of major functions of universities. It was also observed that some universities do not have a continuous performance report and some also they do not follow the established criteria by MoSHE to measure performance at various level of competence. To measure the annual operational performance of universities there is a responsible division in MoSHE. Regarding performance measurement practice by MoSHE; it was observed that no university performance report prepared by Moshe/ MoE was disclosed to the public due to the influence of universities. Universities argued that disclosing the weak side of university (especially about the quality problem) may impose a negative perception on the general public. The researcher observed that the checklist is not sufficient in performance indicators about research and community service but the office in the ministry is reorganizing its offices and it is also in the revision of the established criteria to measure the performance of universities under the ministry.

Concerning the efficiency analysis using DEA; a ten-year and twenty-two universities efficiency study was made. As per the data envelopment analysis model; efficiency is grouped into three forms, namely technical efficiency at constant to return to scale (CRS) assumption, technical efficiency at a variable return to scale (VRS) assumption, and scale efficiency. In the year 2009/10, it was investigated that the average technical efficiency from VRS is 0.841 and average scale efficiency was 0.880 of all public universities selected for this study. As per the result of public universities score; they only achieve around 85 percent efficiency, meaning that these universities need to minimize input by around 15 percent to get the max result. Regarding scale efficiency score of universities; 22 percent of universities score 100 percent and 78 percent score technical efficiency more than 55 percent to 98 percent. As per efficiency mean, average technical efficiency is slightly increased from 0.841 in 2009/10 to 0.867 in the year 2018/19. In 2018/19 the average efficiency score increases to 0.865; which means the inefficiency is decreased to 13 percent from 16 percent in 2009/10. In the technical efficiency concept; the increase in technical efficiency is due to an increase in technological use of that institution. From this, it can be concluded that Ethiopian public universities' technology usage is rising from year to year. The 10-year average efficiency result in first-generation universities is 0.8899 which is higher than the mean efficiency of second-generation universities 0.8006. It can be concluded that in average efficiency of first-generation universities are higher than that of second-generation universities by nine percent. Output slack shows the shortage of output relative to an input applied to produce the actual output. The total output slack (graduated students in the graduate program in ten years period was 751. This shows that universities selected for efficiency study produces 751 graduates lower than expected in ten years period. Concerning input slack; on average Ethiopian dollar, birr 79,118,071.82 was reported as input slack. This signifies that universities fail to save the stated amount of money due to the inefficiency of resource utilization.

Recommendations

The researcher recommends to the ministry and all concerned universities to organize and send research related activities like several internal staff participated, number of articles published in a reputable journal in both local and international journals, and total research made by the university staffs. These mentioned research-related data types need to be included in the KPI of the ministry and it is also advised to universities to organize and send these

data regularly. Universities do not have experience of sending community service-related information to the ministry, the researcher recommends to the ministry to design KPI related to community service functions based on international experience and local facts, moreover, universities shall experience standardized data collection and provision related to this function. The KPI of the ministry lacks some level of detail to measure effectiveness and productivity, rearranging the available indicators to measure mentioned performance type is advisable. The Ministry of science and higher education shall design and developed a system to gather the report of each university online in a standardized format and universities should give attention to the quality of information delivery to the public.

The researcher wants to recommend the establishment of a government-owned institution that is fully authorized to measure the performance of all government-owned organizations. Mandates should be given to this institution to design key performance indicators for each institution/organization type and also full authorization to collect and analyze data as per the designed KPI and report to concerned bodies. This performance evaluation shall be done based on internationally used KPI and models need to be applied for each sector as appropriate. This new institution can make advice and facilitation to those organizations which have weak accomplishment results. The institution will provide feedback to organizations on which activity is weakly undertaken, in which input or output the shortcoming is observed, and also it provides the peer organizations that sources for a lesson to be learned.

As per the major findings; even if eighty one percent of universities have a technical efficiency score greater than one; which implies the technological advancement across universities are in a good position but some universities still need improvement in technology installation and usage for efficient utilization of the public resource. It is recommended that management shall work on the improvement of technology to increase the efficiency of universities a technological aspect. As per pure efficiency change from 2010/11 to 2018/19; an average result show only 22 percent of universities scored pure efficiency change less than one. Even if there is remarkable efficiency improvement from time to time; the management of universities has an opportunity to improve efficiency more than this result. The researcher recommends to management devise a proper resource utilization approach to improve the existing efficiency levels. These universities get an experience from their peer identified in the analysis part.

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