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Productivity of Education Expenditure in Ethiopia: The Case of Selected Public Universities (Malmquist Productivity Index Model)

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ABSTRACT

This study is conducted on the productivity of education expenditure to analyze the productivity of education expenditure in selected Ethiopian public universities. This research applied descriptive research designs as well as quantitative research approach to analyze the problem. Secondary data was used. The target population of this research was the whole public universities under the Ministry of Science and Higher Education (MoSHE). Data were gathered from the ministry of science and higher education and public universities selected for the study. Malmquist productivity index was applied to determine total factor productivity change. Regarding the productivity analysis, the total factor productivity study showed that the majority of universities are not at a good productivity level. According to the major findings, only seven or 32% of universities score productivity growth. The mean of total factor productivity for the entire study period for the whole 22 university-level shows a decline in productivity change, but it is an increase in productivity change relative to the base year (2010/11). Total efficiency change and scale efficiency change are the major productivity components that affect the total factor productivity change in the technological aspect. The majority of universities do not have positive productivity growth.

KEYWORDS: *productivity, Malmquist productivity index, and total factor productivity change.*

INTRODUCTION

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 objective of higher education consists of establishing 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.

In Ethiopia; higher education was initiated in 1943 with the founding of the university college of Addis Ababa. Until 1998, Ethiopia had two universities, the rest were 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. In Ethiopia; education is identified as one of the primary sectors for poverty reduction and building fast and inclusive economic growth and development. The budget is increasing in huge amount from time to time. Higher education expenditure in 1993 was less than half a billion, but in 2010/11 MoFED reported that total higher education expenditure exceeds 6 billion. Higher education expenditure growth is even greater than expenditure growth at a national level. In the Ethiopian growth and transformation plan (GTP II) documents (2015/16-2019/20), the Ethiopian public expenditure policy focuses on investing in growth-enhancing pro-poor sectors and covering recurrent expenditure of domestic resources. In recent years, the productivity of government expenditure has been seen as an important study area in the research community. This is because productivity of education expenditure is used as the performance measure of output and input relationship and to know the proper utilization of resources in the government organizations.

Government expenditure has received good considerable attention from both the government and taxpayers due to the impact of expenditure on economic growth. However, evidence from several studies indicated that the role of government has shifted towards the productivity of public sector activities (Afonso, Schuknecht, & Tanzi, 2010). Globalization has raised public pressure on the on productive use of resources since globalization creates a more dynamic

environment for capital flow (Schuknecht, Tanzi, & Afonso, 2006). According to Hanushek and Ettema (2017) productivity means the rate at which the goods are produced by the organization, which means the higher the number of goods produced, the greater would be the productivity.

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. In addition, the number of universities rises dramatically; performance measurement is currently used as one of the criteria to ensure that the expected level of performance is met. The UNESCO Institute of Statistics data indicates that the proportion for tertiary education was as high as 42.7 per cent in 2013 (UIS, 2018). The share of the higher education budget of the total education budget in Ethiopia is among the highest in Africa. The education share of GDP in Ethiopia is higher than the Sub-Saharan African average (Mamo, 2015). The Ethiopian government invests more than 40% of its education budget on higher education (UNESCO, 2015; Raynor & Ashcroft, 2012). Even though there is large expansion, it is that the country's higher education system is still considered elitist when it is compared at global level. The current gross enrolment ratio which stands at a little over 8 % (UNESCO, 2015) has not reached the minimum 15% gross enrolment margin theorized by Trow (2007). As per unirank in 2020 from top 200 African universities; only four Ethiopian public universities exist. Unirank evaluates universities mainly using offering at least four-year undergraduate degrees (bachelor degrees) or postgraduate degrees (master or doctoral degrees).

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

Hence, this study focuses on the analysis of productivity in Ethiopian public universities. It sets out to examine the actual productivity trend in terms of the higher education's objectives and goals in the universities. This study also seeks to derive theoretical explanations for the existing productivity level to identify priorities for improvement at the universities.

Even though there is no productivity research in Ethiopian public universities, there are researches conducted globally, like Ryan (2004) examined the relationship between institutional expenditure and degree attainment baccalaureate conferring colleges. Graduation rate was used as an output but a number of graduates are used to evaluate the performance of universities. Gansemer-Topf and Schuh (2006) examined factors that contribute to retention and graduation. In addition, Promades (2012) identified that measurable institution goals that are commonly used as indicators of institutional performance are first-year retention and graduation rates. According to Delaware study on the instructional cost and productivity Bers and Head (2014) from 60 to 75 percent of the variation in cost within the universities are associated with a volume of teaching activities, department size, number of faculty, the proportion of faculty holding tenure are the factors that affect optimal use of resource. In addition; the above studies applied DEA analysis to measure productive efficiency and cross-sectional data was used. In this paper, Malmquist productivity model was used with panel data analysis. The above study findings have a variance from study to study and this research is also interested to investigate the performance result in Ethiopian universities.

According to Khezrimotlagh, & Chen, (2018) productivity is a combination of effectiveness and efficiency. As per this definition, productivity can be achieved only when a unit becomes efficient and effective. As per Darra, (2006) in his Productivity Improvements in Education concept, productivity is a measure of how well resources are utilized to provide output. It's described as a ratio of outputs to inputs. Managing productivity contributes to the achievements of more outputs for similar inputs, usually measured in terms of monetary terms.

The National Research Council (NRC) of the United States National Academy of Sciences developed a productivity measurement technique specific for higher education called the Tornqvist index (Massy, Sullivan, & Mackie, 2013). The Tornqvist index represents productivity that accounts for all factors of production and rates of growth or decline in productivity (Massy, Sullivan, & Mackie, 2013).This type of productivity measurement has proven useful and reliable for numerous industries and is espoused by the OECD and the United States Bureau of Labor Statistics (BLS, 2007). NRC Model describes input and output indicators and potential data elements to measure the productivity of higher education. Input indicators include monetary values for labor, capital, and intermediaries to account for total factor productivity.

DEA is a linear programming-based technique Charnes et al., (1978), which provides an appropriate way to estimate multiple inputs-outputs efficient functions as labeled by (Farrell, 1996). DEA determines an efficient frontier without

prior information among inputs and outputs. In DEA deciding units (DMUs) frontiers are those with maximum output with a given level of inputs or minimization of inputs without altering the output level.

Fare, Grosskopf, Lindgren, & Roos, (1994) and Fare (1994) develops a DEA-based approach named as Malmquist Productivity Index (MPI) model to measures productivity changes over time. The MPI was first suggested by Malmquist (1953), as a quantity index for consumption of inputs analysis. Fare et al. (1992) combined the ideas from Farrell (1957) on the measurement of efficiency and therefore the measurement of productivity from Caves et al, (1982) for constructing the MPI approach. It directly deals with input-output data using DEA. This DEA-based MPI approach has proven itself to be a good tool for measuring the productivity change of decision-making units (DMUs). Fare, Grosskopf, and Lovell (1994) decompose MPI into a change in technical efficiency and measuring the technology change.

RESEARCH METHODS

For this article, productivity is defined as a change in multiple outputs to change in multiple inputs. Inputs are education expenditures specifically spent by management and administration and teaching-learning wings of universities. These expenditures are classified as labor (personnel expenditure), intermediaries (goods and service expenditure), and capital (fixed asset expenditures) were considered as inputs variables. Similarly, output variables are the number of graduates in the postgraduate programs of selected universities and also the number of graduates in the undergraduate regular programs of selected universities for this study. Here, productivity (total factor productivity change) is a change on the above-defined output with a change in inputs used in this research.

To analyze the productivity level of universities; Malmquist Productivity Index (MPI) model was used. It is one of the major well-known productivity measurement models. Malmquist's standard of living index becomes an input quantity index. The story begins with Malmquist (Malmquist), who introduced the input distance function in the context of consumption analysis. His objective was to compare alternative consumption bundles. He did so by developing a consumption quantity index as the ratio of a pair of input distance functions. Total factor productivity change is measured by the Malmquist productivity index (MPI) of (Fare, Grosskopf, et al., 1994 and Roos (1989, 1992 and Roos (1989, 1992).

For this study, a fundamental model was devised to establish a productivity indicator. Education productivity was measured by the composition of coursework completion, graduate employments, and credit hours. Research productivity was composed of publications, citations, patents, research completions, and research funds. In this research due to the unavailability of research-related data, the research productivity of public universities is excluded.

Fare, Grosskopf, Norris, and Zhang (Fare, Feare, et al.) specify an output-based Malmquist productivity change index as:

$$m_o\ (y_{1+t}, x_{1+t},\ y_t, x_t) = \sqrt{\left[\frac{d_o^t(x_{t+1,}\, y_{t+1})}{d_o^t\,(x_{t,}\, y_t)}\right] x \left[\frac{d_o^{t+1}(x_{t+1,} Y_{t+1})}{d_o^{t+1}\,(x_{t,}\, y_t)}\right]}$$

This represents the productivity of the production point ($xt_{+1,\, yt+1)}$ relative to the production point (x_t, y_t). A value; greater than one indicates

Productivity growth from period t to period t+1.

The total factor productivity growth index is decomposed into technical efficiency change and technical change. This means the Malmquist productivity index has two components, these are technical change and technical efficiency change.

Technical efficiency change (tech)= $tech = \frac{D^{t+1}(Xt+1,\ Yt+1)}{D_0^1\ (x1,y1)}$

Efficiency change measures the degree of catching up to the best practice frontier for each observation between period t and t+1 (Coelli et al.)

Technical change (Martin, Sauvageot, & Tchatchoua) =

$$tch = \left[\left(\frac{D_0^t(y^{t+1},x^{t+1})}{D_0^{1+t}(y^{t+1},x^{t+1})}\right) x \left(\frac{D_0^t(y^t,x^t)}{D_0^{1+t}(y^t,x^t)}\right)\right]\frac{1}{2}\ D_0^t(y^{t+1},x^{t+1})$$

this stands for the

The technical change index measures the shift in the frontier of technology or innovation between two adjacent periods.

Pure Technical Efficiency: this measures the extent to which a firm can decrease its inputs (in fixed proportion) while remaining within the VRS frontier. Thus, technical efficiency measures the DMU's overall success at utilizing its inputs.

Pure technical efficiency change = $\frac{D_{0,\ VRS}^{t+1}\left(x^{t+1},\ y^{t+1}\right)\ )}{D_{0,}^{t}\ VRS\ \ (y^t, x^t)}$

Scale Efficiency reflects the extent to which a firm projected to the VRS efficiency frontier can further decrease its inputs (in fixed proportions) while remaining within the constant return to scale frontier. Thus, scale efficiency measures the extent to which a firm can reduce inputs by moving to a part of the frontier with more beneficial returns to scale characteristics.

Scale efficiency change is also calculated as:

Sech = $D_{0,}^t\ CRS / D_{0,}^t, VRS$

Quantitative research approach and descriptive research design were applied in this article. The target population of this research is the public universities in Ethiopia under the Ministry of Science and Higher Education (MoSHE). To include 10-year secondary data, public universities with a minimum of ten years operational life are included and these are accounted twenty-two universities. As per MoSHE classification, these universities are grouped as first

generation (9 universities) and 13 are second generation universities. The study used secondary data type and collected from all selected universities for the study, from MoSHE and Ethiopian Ministry of Finance. In this study panel data analysis was applied (22 universities and 10-year data).

RESULTS

Statistical Results of Input and Outputs Used to Measure Efficiency and Productivity

To study expenditure efficiency, different expenditure types were used as multiple inputs. Inputs selected to measure efficiency were labor (personnel expenditure), intermediaries (goods and service expenditure), and capital (fixed asset expenditure). The following graph shows a ten-year input trend starting from the year 2008/09 to 2018/19. As it can be observed from the graph; each of the three inputs has been increasing from year to year. Among the three inputs, it was observed that the capital expenditure of universities took the largest share followed by labor and capital. The large share of capital (fixed asset expenditure) indicates that Ethiopian public universities are making capacity-building like construction of additional buildings for classroom and office purposes was the major reason identified at the time of interviews session with concerned officials in universities and MoSHE.

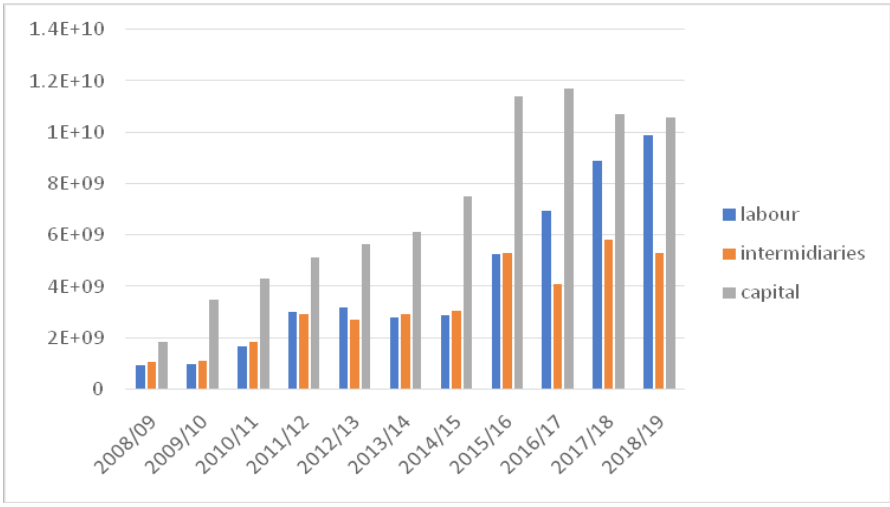

Figure 1. Types of Input Used and Their Trend

Source: Own computation based on MoFED data

According to the following graph, the output of public universities both the number of graduates in the undergraduate program and number of graduates in the postgraduate programs are considered as multiple outputs of universities. In the study period from 209/10 to 2018/19, the number of graduates increases from time to time in universities as it can be observed in the above graph. Uniformly number of graduates is increasing from year to year. This shows the output of Ethiopian public universities is increasing at an increasing rate since the graph shows that the change from year to is significant and observable.

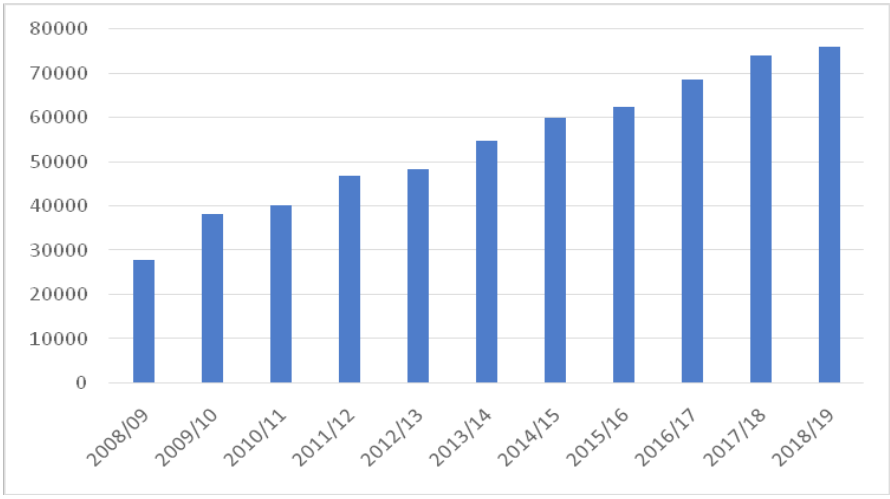

Figure 2. University Output Used and Their Trend

Source: own development based on MoSHE data

Productivity of Public Universities in Ethiopia (The Malmquist index)

To measure the productivity of public universities in this study, the Malmquist Productivity Index (MPI) was computed. According to this productivity model productivity is a change in output index to change in input index and is defined as total factor productivity change (TFPCh). Thus, a value of more than one in total factor productivity change shows the increase in productivity while a value of total factor productivity changes less than one shows a decline in productivity relative to the previous period. According to this measure, the total factor productivity change is simply the product of efficiency change and technological change.

Table 2. Malmquist Index Summary of Universities' Means

University	Efficiency Change	Technical Change	Pure Efficiency Change	Scale Efficiency Change	Total Factor Productivity Change
Adama University	1.000	0.783	1.000	1.000	0.783
Addis Ababa University	1.000	0.902	1.000	1.000	0.902
Ambo University	1.066	0.897	1.07	0.997	0.957
Arbaminch University	0.981	0.988	0.988	0.992	0.969
Axum University	0.98	0.88	0.981	0.999	0.862
Bahr Dar University	0.991	0.91	0.987	1.004	0.902
Debre Berhan University	0.938	0.855	0.939	0.999	0.802
Debre Markos University	0.965	0.91	0.954	1.011	0.878
Dilla University	0.96	0.844	0.961	0.999	0.81
Dire Dawa University	1.051	0.981	1.049	1.002	1.031
Haramaya University	1.000	0.922	1.000	1.000	0.922
Hawassa University	1.01	1.006	1.004	1.006	1.016
Jigjiga University	0.965	0.941	0.96	1.006	0.909
Jimma University	1.019	0.931	0.999	1.02	0.949
Madawelabu University	0.964	0.915	0.936	1.029	0.882
Mekele University	0.985	1.025	1.003	0.983	1.009
Mizan - Tepi University	0.943	0.957	0.922	1.022	0.902
Semmera University	1.101	0.937	1.097	1.003	1.032
University of Gondar	1.031	0.962	1.022	1.008	0.992
Wellega University	1.053	0.952	1.05	1.003	1.003
Wolaita Sodo University	1.061	0.945	0.96	1.105	1.002
Wollo University	1.114	0.956	1.105	1.008	1.065
Mean	1.007	0.926	0.998	1.009	0.932

Source: Malmquist productivity index (MPI) result, 2020

Table 2 shows a 10-year mean score of efficiency change, technical change, pure efficiency change, scale efficiency changes, and total factor productivity change of 22 public universities selected for this study.

According to the above table, seven universities or 32% have registered average productivity growth. These universities which score above one productivity change in the entire study period are Wollo University 1.065, Semmera University 1.032, Dire Dawa University 1.031, Hawassa University 1.016, Mekele University 1.009, Wellega University 1.003 and Wolaita Sodo University 1.002. These universities scored total factor productivity change greater than one; which shows productivity improvement was observed in the past 9 years from 2010/11 to 2018/19. As per the above result, the majority of universities do not have a positive productivity growth trend in the study period and mainly show a slight average productivity decline (less than 10%).

The mean of total factor productivity for the entire study period for the whole 22 university-level shows a decline in productivity change by 6.8% (1-0.932) *100, but it is an increase in productivity change relative to the base year (2010/11) by 13.6% (0.932-0.796) *100. Total efficiency change and scale efficiency change are the major factors that affect the total factor productivity change in the technological aspect.

According to G. Raphael (2013), a productivity study on

commercial banks in Tanzanian commercial banks concluded that banks' total factor productivity is dependent on the change in technical efficiency, change in scale efficiency, and change in pure technical efficiency. Similarly, as it cited in this research Deliktas (2007) and Sufian (2002) are also in support of this finding.

Table 3. Malmquist index summary of annual mean

Year	Efficiency Change	Technical Change	Pure Efficiency Change	Scale Efficiency Change	Total Factor Productivity Change
2010/11	0.976	0.815	1.01	0.967	0.796
2011/12	0.99	0.85	0.975	1.015	0.842
2012/13	1.084	0.998	1.057	1.026	1.082
2013/14	0.779	1.142	0.915	0.851	0.889
2014/15	1.127	1.106	1.03	1.094	1.246
2015/16	1.194	0.497	1.147	1.041	0.593
2016/17	0.795	1.002	0.844	0.943	0.797
2017/18	1.173	1.358	1.063	1.104	1.593
2018/19	1.039	0.844	0.976	1.065	0.877
Mean	1.007	0.926	0.998	1.009	0.932
	effch< 1=04 effch >1=05	Techch<1=05 Techch>1=04	Pech<1=04 Pech>1=05	Sech <1= 03 Sech>1=06	Tpch<1=06 Tpch>1=03

Source: Researcher computation based on Malmquist productivity index (MPI) result, 2020

Table 3 shows Efficiency change (effch), Technical efficiency change (Techch), Pure Technical efficiency change (pech), and Total factor productivity change (tfpch).

As per table 3, 56% of universities have shown improvement in efficiency change from the year 2010/11 to 2018/19. In addition; 45% of universities have shown an increase in technical efficiency change, like efficiency change; universities also have observed a 56% pure technical efficiency within the study period. Regarding scale efficiency change, 67% of universities have shown an increase. The highest total factor productivity change observed in the study period is 1.593 in 2017/18 and the lowest is 0.593 in 2015/16. As compared to 2010/11, total factor productivity change is improved from 0.796 in 2010/11 to 0.877 in 2018/19. The mean value of total factor productivity change shows a slight deterioration by 6.8% (0.932-1).

Concerning to productivity condition of all 22 universities from the year 2010/11 to 2018/19; the total factor productivity change is not linear, rather ups and downs were observed across the study period. In addition; when we observe technical change, pure efficiency changes and scale efficiency change; they also show nonstable change; ups and downs were noticed from 2010/11 to 2018/19. These efficiency changes have a relationship with the total factor productivity change since the change in various efficiency changes the productivity as well.

In table 3 annual mean of total factor productivity change in 2010/11 is 0.796; which shows a decline in productivity by 20.4% (0.796-1.00) *100; which is mainly derived from technical change decline. In 2011/12 the average productivity is increased by 34.6% (0.842 -0.796) *100 relative to the productivity score in 2010/11. Like the productivity effect in the case of 2010/11, the change in productivity in 2011/12 is influenced by Technical Change. In the year 2012/13; the productivity trend has changed from decline to growth (1.082), which scores greater than one. This is mainly due to general efficiency change. In addition; total factor productivity change declines from 1.082 to 0.889 in 2013/14. The decline in productivity is due to a decline in efficiency change. In the year 2014/15 total factor productivity shows a positive change from 0.889 to 1.246. This improvement is mainly due to a change in inefficiency. The majority of the annual mean from year 2015/16 to 2018/19 are in a declining productivity except 2017/18. In conclusion; annual mean of productivity has improved from 0.796 to 0.932, even if average productivity is still lower than one.

CONCLUSION

According to the productivity model; productivity is a change in output index to change in input index and it is named as total factor productivity change (TFPCh). The mean productivity change in 2010/11 is 0.796, which indicates a productivity decline was observed in 2010/11 in average by 23.1 percent relative to the year 2009/10. The major reason identified as a cause for the decline of average total factor productivity change is due to technical change 18.5 percent. This shows universities can improve their productivity by making an investment on appropriate technology for universities. According to the major findings, only seven or 32% of universities score productivity growth. The mean of total factor productivity for the entire study period for the

whole 22 university-level shows a decline in productivity change by 6.8 percent, but it is an increase in productivity change relative to the base year (2010/11) by 13.6 percent. Total efficiency change and scale efficiency change are the major productivity components that affect the total factor productivity change in the technological aspect. The majority of universities do not have positive productivity growth.

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