

Efficiency of Public Expenditure on Human Capital in Selected Regions and City Administrations, Ethiopia

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Abstract

The research investigates inefficiencies in public spending on education across various regions in Ethiopia, despite generally high efficiency scores. Its primary goal is to analyze these inefficiencies and identify ways to enhance the technical efficiency of both educational and health expenditures for improved outcomes. Utilizing panel data from the 2008/09 to 2020/21 fiscal years, the study encompasses ten regions, including Afar, Amhara, Benishangul Gumuz, Gambela, Harari, Oromia, Southern Nations, Nationalities and Peoples, Somali Regional States, along with Addis Ababa and Dire Dawa City Administrations. Data Envelopment Analysis (DEA) was employed to assess the efficiency of public expenditures in the education and health sectors. The results indicate that health expenditure efficiency surpasses that of education, with average efficiency scores for health spending ranging from 0.992 to 1.000. While average efficiency scores for educational spending ranging from 0.828 to 0.981, reflecting a commendable but improvable allocation of resources. Significant potential for enhancing educational efficiency exists, which is vital for advancing educational outcomes and fostering regional development. The study stresses the importance of optimizing public spending in education to maximize its impact on learning and development. By identifying gaps and inefficiencies, policymakers can allocate resources more effectively to areas in need, leading to successful educational programs that benefit local communities. Additionally, the analysis provides insights into the current efficiency landscape and sets the stage for future research and policy initiatives aimed at improving educational outcomes in Ethiopia, thereby promoting regional development and social equity through targeted interventions and strategic planning.

Keywords: Data envelopment analysis, government expenditure, human capital, technical efficiency

1. Introduction

As the demand for higher public expenditures continues to rise, it puts pressure on budgetary allocations, highlighting the importance of evaluating the efficiency of public spending. The efficiency of public expenditure on human capital refers to the optimal use of resources to enhance the skills, knowledge, and well-being of the population. Scholars argue that efficient public spending in education and health can lead to significant improvements in human capital development, which is essential for economic growth and social progress. For example, Hanushek and Woessmann (2010) emphasize that countries investing efficiently in education achieve better learning outcomes, which correlates with higher economic performance.

However, many developing countries face challenges in this regard. Limited financial resources, bureaucratic inefficiencies, and corruption often hinder effective allocation and utilization of funds. It is noted that these challenges can result in substantial gaps in service delivery, leading to poor educational and health outcomes. Furthermore, the lack of robust data and monitoring systems makes it difficult for policymakers to assess and improve efficiency in public spending (Tiongson et al., 2000).

Several studies from developing countries illustrate these issues. For instance, a study in Nigeria by Adedeji et al. (2015) found that inefficiencies in educational spending were primarily due to inadequate infrastructure and poor management practices. Similarly, public expenditure review in Guinea highlighted that improving public spending efficiency is vital for addressing human capital challenges, as its Human Capital Index (HCI) is below expectations and rapid population growth strains education and health services. Limited fiscal space and insufficient tax revenues hinder the ability to meet regional standards, making efficiency in spending essential for better outcomes (World Bank, 2022). These examples underscore the urgent need for developing countries to enhance the efficiency of public expenditure on human capital to foster sustainable development.

Ethiopia faces a pressing issue regarding the efficiency of human capital investments, which significantly impacts its economic growth. Despite increased public spending on education and healthcare, inefficiencies persist, leading to inadequate quality in both sectors. This situation not only limits individual potential but also hinders overall economic productivity, making it crucial to examine how human capital development can be optimized (Bareke et al., 2021).

2. Related Literature

2.1. Theory of Efficiency

The efficiency of government spending is a fundamental aspect of economic policy discussions (Haurer & Kyobe, 2008). This focus on efficiency stems from the efficiency theory developed by Abram Bergson, which builds on the earlier work of Italian economist Vilfredo Pareto (1909). The primary objective of this theory is to illustrate how resources can be optimally allocated to maximize output. Pareto efficiency is

achieved when it becomes impossible to reallocate resources in a way that increases overall output, a state often referred to as Pareto equilibrium (Levin, 2006). In the context of contemporary economic challenges, particularly the need to meet Sustainable Development Goals, there is an increasing demand for enhanced efficiency in how government expenditures are allocated.

Many theoretical studies investigate the connection between government expenditure on education and economic growth, including the research conducted by Michaelowa (2000), Mankiw et al. (1992), and (Zhang, 1996). For example, Zhang (1996) suggested that funding education enhances growth and alleviates welfare losses associated with human capital externalities. Michaelowa (2000) discovered that education expenditure creates positive externalities and indirect advantages, including higher educational attainment in children, better health outcomes, and lower birth rates. These factors contribute to higher per capita economic growth through lower population growth and enhanced public health (Michaelowa, 2000).

2.1.1 Definition of efficiency

The terms "government efficiency," "quality of governance," and "effective government" are often used interchangeably to characterize the government's ability to formulate and execute strategies that significantly influence economic outcomes. These concepts reflect the importance of governmental capacity in addressing societal needs and fostering growth. When a government is efficient, it can effectively allocate resources to create and deliver public goods and services that benefit the population as a whole. This capability is crucial for ensuring that the government's actions lead to tangible improvements in living standards and overall economic performance (Acemoglu & Robinson, 2012).

Government efficiency is specifically defined as the ability of the government to allocate public resources in ways that improve the quality of public goods and services while also fostering economic growth (Afonso et al., 2010). This definition underscores the dual role of government efficiency: it must improve the welfare of the majority while simultaneously promoting a robust economic environment. By focusing on effective resource allocation and policy implementation, efficient governments can create a positive feedback loop that encourages further investments in public welfare, ultimately leading to sustained economic development and improved quality of life for citizens.

2.1.2 Measuring government expenditure efficiency scores

Measuring government expenditure efficiency involves comparing public inputs or resources to the resulting public outputs. This requires estimating both the government's spending and the associated outputs. The more output generated from a given level of inputs, the more efficient the government spending is considered to be. Conversely, lower outputs relative to inputs indicate inefficient expenditure. Rigorous analysis of this input-output relationship is crucial for evaluating and improving the efficiency of government resource allocation (Afonso & Kazemi, 2017b).

Efficiency in government spending can be assessed through various indicators, including economic factors (such as government expenditure, income per capita, inflation, commodity exports, and openness), institutional factors (like accountability, corruption control, regime stability, and democracy), and demographic/geographic factors (including population distribution, density, and climate) (Hauner & Kyobe, 2010).

There are two primary approaches to measuring government expenditure efficiency: macro-level measurements that assess overall spending and micro-level measurements that evaluate specific categories, such as education, health, or military expenditures (Afonso & Fernandes, 2008). This study adopts a macro-level perspective focused on the efficiency of government spending specifically in the education and healthcare sectors. Efficiency is evaluated by analyzing the intended objectives, represented by outputs, alongside the costs associated with these objectives, represented by inputs. Efficiency scores are determined in relation to an empirical frontier, where a government sector is considered more efficient if it can produce a given output using the least amount of input. A decision-making unit (DMU) on this efficiency frontier receives a score of one, indicating perfect efficiency, while a score of zero reflects complete inefficiency; thus, efficiency scores can range from 0 to 1 or 0 to 100 percent.

Generally, a higher efficiency score reflects a more efficient government sector. For instance, if a DMU has a score of 0.8, it means that the same output could be achieved using only 80 percent of the resources currently employed, indicating that 20 percent of the resources have been wasted or could be more effectively allocated to other area (Hauner & Kyobe, 2010).

The typical method for measuring the efficiency scores of various decision-making units (DMUs) is Data Envelopment Analysis (DEA), a non-parametric approach. This method assumes that each DMU uses a specific set of inputs or resources (X) to generate a particular set of outputs (Y). The choice of inputs and outputs is determined by government costs and the services offered, respectively (Emrouznejad et al., 2008).

Expenditure efficiency is assessed in a comparative manner. The relationship between public inputs and outputs in one country is compared to that of another. This comparison can also be applied to spending on specific functions like health, education, and infrastructure (Afonso et al., 2005). In this study, the comparison focuses on government expenditures in the areas of education and health.

2.2. Empirical literature

The efficiency of public expenditure on education has been examined through a comparative analysis of Croatia and other New Member States (NMS) within the European Union (Šonje et al., 2018). This study utilized Data Envelopment Analysis (DEA) as a methodological framework to assess the relative technical efficiency of public spending on secondary and tertiary education in these NMS. The findings highlighted a

significant concern regarding the effectiveness of education funding in Croatia, revealing a notably high level of inefficiency in its public spending on education.

This inefficiency suggests that Croatia is not optimizing its educational expenditures compared to its peers in the NMS, indicating potential areas for improvement in resource allocation and management. The study points to the necessity for a more strategic approach in the deployment of educational funds to enhance outcomes and ensure that public investments contribute more effectively to the educational system's overall performance. By identifying these inefficiencies, the research underscores the importance of reforming spending practices to better align them with educational goals and improve the quality of education delivered to students in Croatia.

An investigation into the efficiency of public education expenditure worldwide, particularly focusing on developing countries, utilized a stochastic frontier model to analyze data from 130 nations, including 96 developing countries and 34 high-income countries. The study found an overall average efficiency score of about 87%, with developing countries averaging around 84%. Notably, Ethiopia had an efficiency score of 0.744. The research aimed to set an international benchmark for the effective use of public resources in the education sector, emphasizing the differing efficiency factors among various countries (Miningou, 2019).

The findings revealed a positive relationship between education per school-age individual and the number of years of quality schooling attained. However, it also estimated that, on average, 16% of public financial resources allocated to education in developing countries are wasted due to inefficiencies. While efficiency levels differ significantly among countries, low-income nations face a dual challenge of inadequate education funding coupled with ineffective public expenditure on education. The study identified several factors that influence efficiency, including governance quality, labor market conditions, and the nature of educational aid provided.

The review of the expanding literature on the factors affecting the efficiency of public spending highlighted a significant gap in understanding what accounts for the efficiency of government expenditures, as the composition and level of spending have not yielded a general consensus (Yun, 2020). The factors influencing the efficiency of public expenditure were identified as environmental elements, including economic, demographic, geographical, and institutional factors, which can impact the levels of efficiency and effectiveness in public spending. This underscores the importance of considering these various circumstances when analyzing government expenditure efficiency. However, the findings vary considerably across different countries and spending areas.

The study on public spending in 20 OECD countries from 2009 to 2013, analyzed from an efficiency perspective, generated indicators of public sector performance and efficiency using Data Envelopment Analysis (DEA) (Afonso & Kazemi, 2017). The

results indicated that Switzerland was the only country operating on the efficiency frontier, making it the most efficient in terms of public expenditure among the sample. The average input-oriented efficiency score was 0.732, meaning that, on average, countries could have reduced their input levels by 26.8% while still achieving the same output levels. The average output-oriented efficiency score was 0.769, suggesting that, on average, the countries could have increased their outputs by 23.1% by maintaining the same input levels. However, they recommended conducting individual analyses for each country to enhance their findings, considering the varying traditions, cultures, and political economy factors in institutional settings.

The efficiency and effectiveness of government spending on education were assessed at the district and city levels in East Java, Indonesia, utilizing Data Envelopment Analysis (DEA) alongside panel data regression (Solihin et al., 2017). The findings indicated that government spending in the education sector is relatively inefficient. Government expenditure for education (PPP) did not significantly affect the educational index, whereas household spending on education (PPR) and GRDP per capita had a significant impact on the education index (IP). This suggests that government expenditure in education is not effective in enhancing the educational index

The study investigated the impact of public expenditure and its efficiency on economic growth in regencies and cities in Java, Indonesia, covering the period from 2011 to 2016. By analyzing secondary annual data that included education and health expenditures, gross fixed capital formation, inflation rates, population growth, and per capita gross regional domestic product, the findings revealed that increased public expenditure has a positive effect on economic growth in these areas (Faisol et al., 2018).

Moreover, the findings indicated that when public expenditure is effectively managed and coordinated by the government, the need for government intervention to strengthen the positive effects of public spending on economic growth decreases. This suggests that efficient governmental processes can amplify the benefits of public expenditure without requiring additional involvement.

Faisol et al. (2018) also investigated the effect of public expenditure and its efficiency on the economic growth of regencies and cities in Java, Indonesia, during the period from 2011 to 2016. Using secondary annual data on education and health expenditures, gross fixed capital formation, inflation rates, population growth, and per capita gross regional domestic product, the study found that an increase in public expenditure enhances economic growth in these areas. Additionally, the results indicated that when public expenditure is managed efficiently by the government, the need for government intervention to maximize its positive impact on economic growth becomes less essential.

The evaluation of government spending efficiency and the analysis of inefficiency scores were carried out using DEA-bootstrap analysis in Saudi Arabia from 1988 to 2013 (Ouertani et al., 2018). The empirical results indicated that public spending in Saudi

Arabia is generally inefficient, suggesting that the country could enhance its performance in health, education, and infrastructure without raising expenditures. A DEA-Bootstrap analysis revealed that unemployment and broad money have a negative impact on government spending, particularly in the areas of infrastructure and health.

The efficiency of public spending on health and education was assessed using Data Envelopment Analysis (DEA) and DEA Bootstrapping models across 16 African countries, including Ethiopia, during the period from 2006 to 2017 (Sikayena et al., 2022). The DEA findings indicated that overall, public spending in both sectors was inefficient. However, when analyzed separately, the efficiency of public spending on health was found to be higher than that on education.

Furthermore, the Simar and Wilson (2007) DEA bootstrapping model identified key factors affecting the efficiency of public spending in both health and education, including government expenditure and trade openness. Notably, urbanization, economic growth, and foreign direct investment were found to significantly influence the efficiency of public spending in health. In contrast, institutional quality was significantly associated with the efficiency of public spending in education. Interestingly, inflation did not demonstrate a significant relationship with the efficiency of public spending in either sector.

Although there is substantial theoretical support for government spending on education to promote economic growth, empirical results are inconsistent. In a study involving 129 countries, Barro and Lee (1993) identified a positive impact of education expenditure on growth a conclusion supported by several studies, including Barro and Sala-i-Martin (1995). Conversely, some research indicates a negative relationship between education spending and growth (Mo, 2007) or shows no significant connection (Keller, 2006).

3. Methods and Materials

To assess the efficiency of public spending on human capital in eight selected regions and two cities, Data Envelopment Analysis (DEA) is utilized. The data was obtained from the Ministry of Finance, focusing on total education expenditure and health expenditure related to variable inputs. Additionally, education output variables, including the primary gross enrollment rate and secondary gross enrollment rate, were sourced from the Ministry of Education. Health output variables, such as the infant mortality rate and life expectancy at birth, were collected from the Ethiopian Institute of Public Health. This study utilized balanced panel data spanning from 2009 to 2021, covering eight regions (Afar, Amhara, Benishangul Gumuz, Gambela, Harari, Oromia, Southern Nations, Nationalities and Peoples, and Somali Regional States) as well as two cities (Addis Ababa City and Dire Dawa City Administrations).

Developed by Charnes et al. (1978), DEA is a non-parametric statistical technique that assumes a convex production frontier. The linear programming method is employed to create this frontier, and the term “envelopment” refers to how the production frontier

surrounds the set of observations. DEA has gained popularity in empirical efficiency studies because it effectively accommodates multiple inputs and outputs while determining efficiency. It is also less susceptible to misspecification issues that can impact econometric models. A key advantage of this method is that it does not require a potentially flawed prior specification of the functional relationship between production inputs and outputs. Additionally, statistical inference and hypothesis testing are now feasible with DEA and other non-parametric efficiency estimators (Simar & Wilson, 2007).

4. Results and Discussions

The efficient utilization of resources invested in human capital development can have significant impacts on the long-term growth and prosperity of a country or region. Investing in quality education and vocational training programs can enhance the skills and knowledge of the workforce, enabling them to be more productive and adaptable to changing economic and technological demands. Ensuring access to affordable and high-quality healthcare can improve the overall health and well-being of the population, which in turn enhances their productivity and reduces the burden on social welfare systems.

The inputs used to assess the relative technical efficiency of education and health expenditure consist of total education expenditure and total health expenditure, respectively. For calculating these efficiencies, the outputs include life expectancy at birth and the infant mortality rate for health, as well as primary and secondary school enrollment figures at various regional levels. The analysis covers eight regions and two city administrations, excluding the Tigray regional state. The South Nations and Nationalities regional state includes Sidama region before the year 2021 the region was not split. These inputs and outputs were chosen based on a review of existing literature, such as the study by Ouertani et al. (2018).

4.1 Descriptive statistics

Table 1: Summary of Inputs Statistics (in billion ETB)

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Total Education Expenditure	104	3.610	5.250	0.0397	29.600
Total Health Expenditure	104	1.580	2.160	0.0383	11.700

Source: Researcher's Computation Using Stata17 (2025)

The summary statistics for "Total Education Expenditure" and "Total Health Expenditure" in table 1 reveal significant insights into financial allocations within the dataset. Total Education Expenditure averages approximately ETB 3.610 billion, with a considerable standard deviation of about ETB 5.250 billion, indicating substantial variability across different observations because there are large regions with large expenditure budget as well as small regions with small expenditure budget in Ethiopia.,

The minimum annual educational expenditure is around ETB 0.039.7 billion, which happen in Harari Regional stated in 2009, while the maximum educational expenditure was ETB 29.6 billion in Oromia Region for the year 2021 reflecting a wide range of funding levels among various regions.

In comparison, Total Health Expenditure has a mean of approximately ETB 1.580 billion and a standard deviation of about ETB 2.160 billion, also suggesting notable variation. The minimum annual health expenditure is around ETB 0.0383 billion, which happen in Gambela regional state in 2009, while the maximum health expenditure was ETB 11.7 billion in Oromia Regional state for the year 2021. This variability highlights differing priorities and resource allocations in the education and health sectors.

**Table 2: Summary of Education Outputs: Gross Enrollment Ratios (GER)
(Grade 1-8 and 9-12)**

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
GER1-8	104	98.97	24.31	31.20	167.20
GER9-12	104	31.16	20.72	3.32	106.58

Source: Researcher's Computation Using stata 17 (2025)

The table 2 summarizes the data for Gross Enrollment Ratios (GER) at two educational levels. For GER1-8, the average enrollment ratio is approximately 98.97, with a standard deviation of 24.31, indicating relatively high and variable participation rates. In contrast, for GER9-12, the average is around 31.16, with a standard deviation of 20.72, reflecting lower enrollment rates and greater variability among regions.

Table 3: Summary of Health outputs: Infant mortality Rate and Life Expectancy

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
IMR	104	49.13	15.91	11.38	88.40
LE	104	49.15	2.87	42.68	54.67

Source: Researcher's Computation Using stata17 (2025)

Table 3 above provides the summary statistics for the Infant Mortality Rate (IMR) and Life Expectancy at birth (LE). The average IMR is approximately 49.13 deaths per 1,000 live births, with a standard deviation of 15.91, indicating noticeable variability in infant mortality across the observations. Meanwhile, the average life expectancy is around 49.15 years, with a standard deviation of 2.87 years, suggesting a relatively consistent life expectancy across the dataset.

In terms of implications, an IMR of 49.13 deaths per 1,000 live births is considered high by Sub-Saharan African standards, where rates can vary significantly but are often higher than in many other regions of the world. This suggests ongoing challenges in maternal and child health, highlighting the need for improved healthcare access, nutrition, and education in the areas under study.

Conversely, a life expectancy of 49.15 years is relatively low, especially when compared to global averages. In Sub-Saharan Africa, life expectancy has been gradually increasing

but often remains below the global average of around 72 years. This low life expectancy signals potential issues such as inadequate healthcare, high prevalence of diseases, and socioeconomic challenges that need to be addressed to improve overall health outcomes in the region.

Assuming that the government intends to maximize output in each economic sector with a fixed level of input expenditure, this research employed the output-oriented Variable Returns to Scale (VRS) model. The study used the DEA model established by Banker et al. (1984) to measure technical efficiency.

The following sections provide the technical efficiency scores obtained from evaluating the efficiency of public expenditure in the education and health sectors. As mentioned earlier, the DEA method is employed to assess the efficiency of public spending in these areas, assuming Variable Returns to Scale as proposed by Banker et al. (1984). This paper specifically examines total social sector expenditure and its two primary components: education and health, with the results discussed below.

4.2 The Technical Efficiency of Public Spending on Education

Table 4: Education Technical Efficiency Score of the DEA Analysis (VRS)

Source: Researcher's computation using DEAP 2.1 (2025)

Region	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Amhara	1.000	1.00	1.000	0.987	1.000	1.000	1.000	1.000	1.000	0.665	0.969	0.988	1.000
Oromia	0.982	1.000	0.990	0.907	0.843	1.000	0.886	0.711	1.000	1.000	0.976	0.990	0.948
SNNPR	0.930	1.000	1.000	0.934	0.785	1.000	0.823	0.740	0.960	1.000	1.000	0.931	0.995
Addis Ababa.	0.917	1.000	0.989	1.000	0.618	1.000	0.971	0.712	0.835	1.000	1.000	0.978	0.704
Afar	0.900	0.991	1.000	1.000	1.000	0.891	1.000	0.767	0.894	1.000	1.000	1.000	0.702
Somali	0.951	1.000	0.987	0.933	0.953	0.848	1.000	0.700	0.917	0.838	1.000	1.000	0.992
Benshangul Gumuz	0.982	0.964	0.967	0.904	0.990	0.722	0.984	0.779	0.986	1.000	0.838	1.000	0.958
Gambela	1.000	0.948	0.931	0.955	0.951	1.000	0.780	0.874	1.000	0.984	0.860	1.000	1.000
Harari	1.000	0.950	0.981	0.848	1.000	1.000	0.889	1.000	0.982	1.000	0.866	0.989	1.000
Dire Dawa	1.000	0.960	0.961	1.000	1.000	0.924	1.000	1.000	1.000	0.974	0.869	0.936	1.000
Mean	0.966	0.981	0.981	0.942	0.914	0.938	0.933	0.828	0.957	0.946	0.938	0.981	0.930

This analysis investigates the technical efficiency of education expenditure across different regions in Ethiopia from 2009 to 2021. The data reveals some disparities in educational expenditure efficiency for example in 2016, highlighting the strengths and weaknesses of each region's strategies for enhancing educational outcomes and, in turn, economic performance. Understanding these dynamics is crucial for policymakers looking to enhance education spending and foster sustainable economic growth across the country.

The average technical efficiency in the education sector for the ten regions in 2017 is recorded at 0.966 it was the time of ongoing political tensions, as shown in Table 4. However, this average efficiency declined to 0.930 by 2021. This reduction in average technical efficiency over the period indicates that the education sector is facing a decrease in operational efficiency, highlighting a pressing need for improvement. On average, these sectors are functioning at a level 7% lower than their maximum potential efficiency. This suggests a growing inefficiency in how inputs are utilized to generate outputs, resulting in an overall decline in operational performance.

Amhara demonstrates consistently high levels of technical efficiency, achieving a score of 1.000 in most years. Although it experienced a decline to 0.665 in 2018 due to reason mentioned above, it fully recovered by 2021, reflecting overall stability in the region's efficiency regarding educational expenditure. In contrast, Oromia shows greater variability, with efficiency decreasing from 0.990 in 2011 to 0.711 in 2016. While it rebounded to 1.000 in 2017, this fluctuation indicates that the region may encounter difficulties in consistently optimizing its educational investments.

SNNPR began with a technical efficiency score of 0.930 in 2009 but experienced fluctuations, notably a decline to 0.785 in 2013. Nevertheless, it demonstrated resilience by rebounding to 0.995 by 2013, indicating enhanced effectiveness in utilizing educational resources. In contrast, Addis Ababa, the capital, showed a mixed performance, starting with high scores but suffering a significant drop to 0.618 in 2013. Although it recovered to 1.000 by 2018, it then fell to 0.704 by 2021, highlighting instability in the efficiency of educational expenditure.

Afar initially showed strong performance but faced fluctuations, including a drop to 0.891 in 2014 and a low of 0.702 in 2021. This trend highlights difficulties in maintaining consistent efficiency in educational spending. In contrast, the Somali region demonstrated more stable efficiency, with scores between 0.700 and 1.000. Recent years have shown resilience, achieving a high score of 0.992 in 2021.

The study findings indicate that Benshangul Gumuz shows considerable variability in its educational expenditure efficiency. It experienced a significant decline to 0.904 in 2012 but generally maintained levels above 0.900, culminating in a score of 0.958 in 2021. This trend suggests a recovery in efficiency over the study period.

In contrast, the Harari region started with a perfect score of 1.000 but faced fluctuations, dropping to 0.848 in 2012. However, it stabilized at 1.000 by 2021, reflecting overall strength

despite earlier challenges. These results highlight the differing trajectories of educational expenditure efficiency in the two regions.

The average values for each year reveal that the regions consistently maintained a technical efficiency level above 0.900, reaching a peak of 0.966 in 2009 and gradually decreasing to 0.930 by 2021. This trend demonstrates a generally stable performance in the efficiency of educational expenditure across the regions, despite some fluctuations at the individual level.

Although the relative technical efficiency level appears high when compared within the country, the study by Sikayena et al. (2022) utilizing Data Envelopment Analysis (DEA) suggests that public expenditure on health and education in Africa is not efficient. The findings show that efficiency levels are notably higher for health expenditures than for education.

In summary, while certain regions exhibit strong and stable technical efficiency in educational expenditure, others encounter considerable variability and challenges. Emerging regions are by far lagging behind the central and established regions. The sources of variation were mainly the demand-side variables, especially the economic and contextual related issues like drought and conflicts. Addressing these challenges requires targeted interventions tailored to each region's unique circumstances.

Overall, the data indicates a positive trend in optimizing educational investments; however, the fluctuations in specific regions highlight the necessity for targeted policies to improve efficiency and effectiveness in educational spending throughout Ethiopia.

4.3 Technical Efficiency of Health Expenditure

In the case of health, the DEA setup considers two outputs and one input. The two conventional measures of health attainment are the Infant Mortality Rate (IMR) and life expectancy, while the input is the ratio of health expenditure to total expenditure for assessing health efficiency. The DEA techniques applied in this paper indicate that outputs are measured with the principle that "more is better." Here, the IMR is defined as the number of children who died before 12 months divided by the number of born children, multiplied by 1000. Consequently, we calculated an "Infant Survival Rate" (ISR) as follows.

$$ISR = (1000 - IMR) / IMR.$$

Ultimately, ISR and life expectancy are utilized as the final outputs in the DEA approach. The efficiency analysis for health is conducted for eight regional states and two city administrations, depending on the availability of data.

Table 5 : Health Technical Efficiency Scores of the DEA Analysis (VRS)

Region	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Amhara	1.000	1.000	1.000	0.977	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Oromia	1.000	1.000	0.995	0.987	1.000	1.000	0.996	0.998	1.000	1.000	1.000	1.000	0.997
SNNPR	1.000	1.000	1.000	0.987	1.000	1.000	0.994	1.000	1.000	1.000	1.000	0.999	0.998
Addis Ababa	1.000	1.000	1.000	0.988	0.998	1.000	1.000	1.000	0.997	1.000	1.000	0.999	1.000
Afar	0.990	1.000	1.000	0.988	0.999	0.996	1.000	1.000	0.999	0.998	0.989	0.997	1.000
Somali	0.989	1.000	1.000	0.997	0.999	0.989	1.000	0.999	1.000	0.998	0.999	0.995	1.000
Benshangul Gumuz	1.000	0.990	0.978	0.998	1.000	0.994	1.000	1.000	0.996	0.998	1.000	1.000	0.998
Gambela	1.000	0.999	0.978	0.999	1.000	0.989	0.998	1.000	0.993	1.000	1.000	1.000	0.996
Harar	1.000	1.000	0.988	1.000	1.000	1.000	0.999	1.000	1.000	1.000	0.998	0.995	0.997
Dire	1.000	1.000	0.988	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Mean	0.998	0.999	0.993	0.992	1.000	0.997	0.999	1.000	0.999	0.999	0.999	0.999	0.999

Source: Researcher's computation using DEAP 2.1(2025)

The Health Technical Efficiency Scores from the DEA analysis for various regions in Ethiopia from 2009 to 2021 reveal consistently high efficiency levels, with average scores near 1.000. Notably, Amhara and Dire Dawa maintain perfect scores, indicating optimal resource utilization in health services. Oromia shows slight fluctuations but remains stable, while SNNPR and Addis Ababa exhibit strong performance with scores around 0.988 to 1.000. Regions like Afar and Somali also demonstrate high efficiency, though Benshangul Gumuz and Gambela experience some variability. The Somali Region demonstrates high efficiency in educational expenditure due to effective resource management and community engagement. In contrast, Benshangul Gumuz and Gambela experience variability in efficiency due to inconsistent resource allocation, poor infrastructure, teacher shortages, and socioeconomic challenges. Additionally, the diverse cultural backgrounds in these regions can affect educational priorities and engagement. Overall, these findings suggest effective health service delivery across most regions, but the observed fluctuations in certain areas highlight the need for targeted interventions to enhance and stabilize efficiency.

5. Conclusion and Recommendations

5.1 Conclusion

This analysis examines the technical efficiency of education expenditure across various regions in Ethiopia from 2001 to 2013. The results indicate a decline in average technical efficiency, falling from 0.966 in 2001 to 0.930 in 2013, suggesting a decrease in operational efficiency within the education sector. While regions such as Amhara regional state maintained consistently high efficiency, others, including Oromia and Addis Ababa, experienced notable fluctuations.

In conclusion, this analysis highlights the significance of understanding the technical efficiency of education expenditure in Ethiopia. While Amhara regional state stands out for its consistent performance, other regions face challenges with variability and inefficiencies, particularly in education expenditure. The overall decline in average technical efficiency raises important concerns about the effectiveness of current educational investments.

The analysis of Health Technical Efficiency Scores in Ethiopia from 2009 to 2021 indicates that most regions demonstrate high efficiency in utilizing resources for health services, with Amhara and Dire Dawa achieving perfect scores. Oromia maintains stability despite minor fluctuations, while SNNPR and Addis Ababa also show strong performance. Regions like Afar and Somali reflect high efficiency, although Benshangul Gumuz and Gambela face variability in their scores. Overall, the findings highlight effective resource utilization in the health sector across many regions, while also identifying areas that require targeted interventions to improve consistency and efficiency.

5.2 Recommendation

Regions that demonstrate high efficiency in education, such as Amhara regional state, can serve as valuable examples for others. Sharing successful practices and strategies among regions can foster improvements in educational expenditure efficiency, allowing for a more effective allocation of resources.

To improve the overall efficiency of the education system, it is essential to explore and implement strategies that optimize resource utilization, particularly through budget allocation that transition from line-item to program-based budgeting. While this approach has already begun at the national level, it has yet to be fully adopted at the regional level. Additionally, enhancing institutional capacity and utilizing data-driven decision-making are crucial. These measures will help ensure that educational investments produce the most effective outcomes.

Establishing robust monitoring systems is crucial for regularly assessing the efficiency of education spending. Such systems will enable policymakers to identify issues early and make timely interventions, ultimately improving educational performance.

Investing in technology and innovation within the education sector can significantly improve both efficiency and productivity. By leveraging technological advancements, educational outcomes can be enhanced, making the system more responsive to contemporary needs.

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