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Efficiency of Public Expenditure on Education in Benin: A Comparative Analysis with the Countries of WAEMU

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Abstract

This paper analyzes the efficiency of public expenditure on education in Benin from 2000 to 2020. Using a Data Envelopment Analysis (DEA) approach, the paper calculates the efficiency of public expenditure on education for Benin as well as for the other countries of the West African Economic and Monetary Union (WAEMU) in order to highlight the differences in the efficiency of the use of public resources in education. The paper uses public expenditure on education as an input and the gross enrolment ratio in primary school, the primary school completion rate and the gross tertiary enrolment ratio as outputs for the DEA model. The results indicate that the efficiency score of public expenditure on education in Benin is 0.88. This shows that there is a high degree of efficiency in education. Nevertheless, this result indicates that there is room for improvement in the efficiency of public expenditure on education of 12% for Benin. Also, a comparison of Benin's efficiency score with those of the other WAEMU countries shows that Benin's score is outstripped by Togo's (0.93) and Guinea-Bissau's (0.95). The efficiency scores for Cote d'Ivoire, Senegal, Mali, Burkina Faso and Niger are estimated at 0.68, 0.67, 0.58, 0.56 and 0.51 respectively. The paper suggests that in WAEMU, Benin could draw inspiration from the management of public expenditure on education in Togo and Guinea-Bissau to better identify best practices and policies to improve the efficiency of its public expenditure on education.

Keywords

Public Expenditure on Education, Efficiency, Data Envelopment Analysis (DEA), West African Economic and Monetary Union (WAEMU)

1. Introduction

Education is a vital sector for the economic and social development of a country (Barro, 1991). As a public good, education requires public spending, lest development remains a lofty ideal (Motkuri & Revathi, 2023). Adequate public expenditure on education is therefore a crucial investment in the future of generations to come. It is in this context that the United Nations Educational, Scientific and Cultural Organisation (UNESCO) calls on governments to allocate at least 4% - 6% of their Gross Domestic Product (GDP) to education, and/or devote at least 15% - 20% of public expenditure to education. Furthermore, they must ensure that these resources are used effectively to improve the quality of education and to achieve education for all (UNESCO, 2016). Thus, the question of whether this public spending is efficient remains a concern for policymakers and citizens. This question is particularly relevant in the context of developing countries, where resources are limited and educational challenges are numerous.

Indeed, the theory of investment in human capital proposed by Schultz (1961) and Becker (1964), suggests that education is an investment that increases productivity and income in the long run. Individuals invest in education to acquire skills and knowledge that increase their future productivity and earnings. But this theory is criticised because of its focus on the private returns to education at the expense of the social returns and its positive externalities. Public expenditure should be high to maximise the economic benefits to society. Similarly, Keynes (1936) emphasises that the state should provide public goods, such as education, to promote equality and social welfare. Furthermore, the theory of the marginal efficiency of investment states that the efficiency of a public investment depends on its cost and benefit (Pigou, 1928). Thus, public spending on education is only efficient if its cost is less than or equal to its benefit in terms of future productivity gains and income.

Numerous empirical studies have been conducted on the efficiency of public financing of education (Ngobeni & Breitenbach, 2023; Konte, Sow, & Ngom, 2022; Mallaye & Gadom, 2021; Yotova & Stefanova, 2017). These studies argue that efficient public spending on education increases the level of human development, which in turn promotes economic growth (Lucas, 1988).

The education sector is in a state of crisis worldwide: 6 out of 10 children cannot read and understand a simple story by the age of 10. Also, 244 million children and young people in the world are still not in school (UNESCO, 2023). In Benin, according to data from National Institue of Statistics and Economic Analysis (INSAE), more than 5 out of 10 people (52.8%) have no level of education compared to 3 out of 10 who have primary education (27.3%), 2 out of 10 who have secondary education (17%) and less than 1 out of 10 who have attended university (2.8%). Gender analysis indicates that women are less educated than men. Indeed, 59.4% of Beninese women have no education at all, compared to 46.3% of men. Also, the proportion of the Beninese population without any level of education is higher in rural areas (62.7%) than in urban

areas (40.7%) (INSAE, 2019). However, the education sector in Benin has seen a significant increase in public spending in recent years. According to World Bank data, public spending on education (as a % of GDP) has risen from 2.11% in 2000 to 3% in 2020, an increase of 42.18% during this period. However, this increase in public spending on education has not enabled all pupils enrolled in primary and especially secondary education to complete their studies. In 2020, the primary school completion rate, which is an indicator towards the achievement of universal primary education, is estimated at 62.42%. This rate is 59.41% for girls and 65.30% for boys (Word Bank, 2023). Thus, school results are below expectations and the quality of education indicators is worrying. In this context, it is necessary to question the efficiency of public spending on education in Benin.

The West African Economic and Monetary Union (WAEMU), which includes eight West African countries, has similar economic and social characteristics, which makes it a relevant framework for a comparative analysis of public spending on education. The objective of this paper is therefore to determine whether public spending on education in Benin is efficient compared to other WAEMU countries, using indicators such as educational outcomes and access to education. The analysis focuses on the technical efficiency of translating public expenditure into results. Efficiency is assessed by comparing Benin's performance with that of other African countries in the WAEMU.

The main contribution of this study is that it follows on from this work by filling in the gaps in the literature on the efficiency of public spending on education in Benin. Indeed, to our knowledge, very few studies document the efficiency of public financing of education in Benin. This study therefore fills this gap. Ultimately, this comparative analysis should provide valuable information on the efficiency of public spending on education in Benin and offer recommendations for improving the quality of education and access to education, based on the economic theories mentioned above.

The work is structured as follows. In Section 2, we discuss the synthesis of the literature on the efficiency of public spending on education. Section 3 describes the methodology adopted in this work. Section 4 presents the results and their discussion. The last section presents the conclusion and policy implications.

2. Literature Review

2.1. Theoretical and Empirical Consideration of the Efficiency of Public Investment in Education

In a general sense, efficiency refers to a process that enables a given objective to be achieved under the most favourable conditions, i.e. at the lowest cost (Beitone, Cazorla, Dollo, & Drai, 2013). It is the capacity of an individual, a group of individuals, a machine or a technique to obtain maximum results with minimum resources, costs, effort or energy. It is the ability to obtain good performance in a rational way for a given activity or job, and to optimise the resources available or

allocated to achieve a result. Efficiency should not be confused with effectiveness, which is the ability to achieve predefined objectives independently of the means used. Effectiveness does not guarantee efficiency and vice versa. For example, a productive allocation may enable the desired volume of production to be achieved, but at the cost of wasting factors of production[1].

The debate on the measurement of efficiency in modern economics began with Debreu (1951) and Koopmans (1951). In the literature, very few studies measure the efficiency of public spending on education, especially in developing countries. Ngobeni et al. (2023) use data envelopment analysis (DEA) to determine the technical efficiency/inefficiency of macro-actors (nine provinces) in the public education sector in South Africa. The total education expenditure for the period 2017/2018 and the learner/educator ratio are used as inputs and the output is the number of public secondary schools achieving the Higher National Certificate pass rate of 60% or more. The authors found an average technical efficiency score for the nine provinces of 97.9%. KwaZulu-Natal, Limpopo and the Northern Cape are efficient provinces and the other six provinces are inefficient. The authors conclude that the six inefficient provinces were wasting resources equivalent to R24.7 billion in the 2017-2018 financial year. Likewise, the authors Kounetas et al. (2023) through a boostrap DEA model and using a unique dataset attempt to shed light on the efficiency performance of 643 Greek secondary schools, over the period 2000-2017. The authors' results reveal that there is substantial room for improvement, especially for some Greek regions.

Also, Konte et al. (2022) study the efficiency of public financing in the education sector in Sub-Saharan Africa at different levels (primary, secondary and tertiary) over the period 2011-2018 using the input-oriented Data Envelopment Analysis (DEA) method. The authors find that public spending on education in SSA countries is globally inefficient and that this inefficiency is marked by a score of 74.4% efficiency for the primary level, 67.5% for the secondary level and 78.2% for the tertiary level. For Hryhorash, Bocharov and Bondar (2022), the efficiency of government spending on higher education is higher than the efficiency of individual costs. To arrive at these results, the authors analysed the efficiency of higher education financing using the discounted cash-flow method applied to the share of public spending on higher education and GDP growth generated by the better qualified workforce. Using the DEA method to assess the performance and efficiency of government public spending in the education and health sectors in the context of emerging economies, two other authors Pula and Elshani (2022) compare Kosovo to the Western Balkan countries. The authors' results indicate that the efficiency score of public expenditure on education obtained by Kosovo is 0.4, which makes it rank among the inefficient countries in terms of public expenditure on education. Also, Cristóbal et al. (2021) evaluated for 156 countries in the world, through the DEA method, the effectiveness of national public spending, considered as inputs for the achievement of progress in

[1]https://www.toupie.org

the specific indicators of the 17 Sustainable Development Goals (SDGs) considered as outputs. For MDG 4, which aims to ensure equal access to quality education for all and promote lifelong learning opportunities, the authors find very low average efficiency scores: 50% for low-income countries, 48% for lower-middle income countries, 33% for upper-middle income countries and 26% for high-income countries.

Several recent studies have shown the positive effect of public spending on education. Mbodji (2023) uses the generalised method of moments to examine the effect of public spending on education on gender inequality in education for 25 sub-Saharan African countries over the period 2010-2019. The author's results indicate that public spending on education has a positive effect on gender equality in education at primary, secondary and tertiary levels; thus, the main policy implication of the author's work is that sub-Saharan African countries must continue to invest in inclusive schooling to ensure gender equality, which remains an unattained goal in the region.

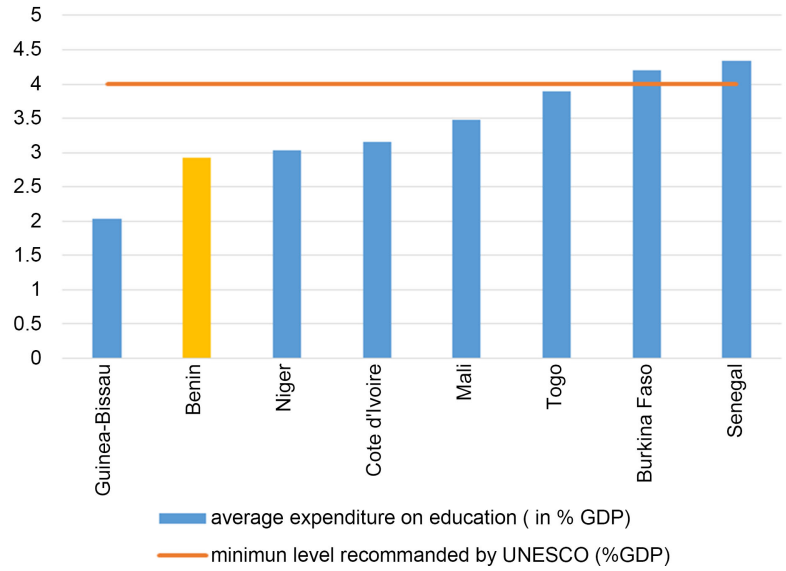
Artige & Cavenaile (2023) analyse the relationship between public spending on education, long-term growth and income inequality. They propose a model of endogenous growth with occupational choice and an endogenous supply of teachers and quality of education. They show that endogenous school quality alters the shape of these relationships in a way that has new policy implications. First, growth depends on the level of public education spending and the shape of the distribution of human capital. Second, the relationship between public education and inequality can be positive or negative. By calibrating their model on US state data, they find that a significant proportion of states face a trade-off between increasing growth and reducing inequality through public education spending. They find that this trade-off is more likely overall in states where public education spending, the employment share and relative pay of teachers, as well as intergenerational mobility, are higher. Finally, they find that the existence of such a trade-off depends on the way in which public education spending is financed.

2.2. Some Stylised Facts

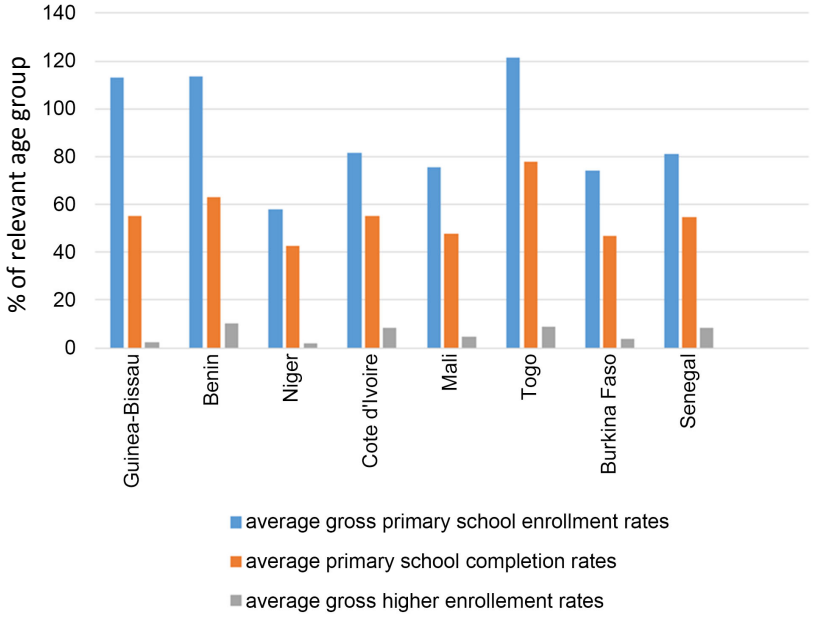
Graph 1 below shows the average public expenditure on education (as a % of GDP) for each of the WAEMU countries from 2000 to 2020. Indeed, on average, public expenditure on education amounts to 2.03% of GDP for Guinea-Bissau, 2.93% for Benin, 3.04% for Niger, 3.16% for Côte d'Ivoire, 3.48% for Mali, 3.89% for Togo, 4.2% for Burkina Faso and 4.34% for Senegal. The graph also shows that out of the eight WAEMU countries, only Burkina Faso and Senegal have exceeded the minimum level of public expenditure on education as a percentage of GDP recommended by UNESCO, which is 4%. This shows that the other countries that have not reached this level of expenditure on education, including Benin, have efforts to make to remain within the UNESCO standard.

Furthermore, **Graph 2** below presents the average gross primary school

enrolment rates, the average primary school completion rates and the average gross tertiary enrolment rates for the eight WAEMU countries from 2000 to 2020. A comparative analysis of Benin's rates with those of the other WAEMU countries shows that Benin's average gross enrolment rate and average primary school completion rate are second only to those of Togo. As for the average gross enrolment rate in tertiary education, Benin's is the best in the WAEMU. These statistics suggest that Benin is showing good returns on public investment in education compared to most other WAEMU countries.



Graph 1. Average public expenditure on education (as % of GDP) in WAEMU countries from 2000 to 2020. Source: authors, based on World Bank WDI data (2023).



Graph 2. Some indicators of public expenditure on education in WAEMU countries from 2000 to 2020. Source: authors, based on World Bank WDI data (2023).

3. Research Methodology

3.1. Methodology for Estimating the Efficiency of Public Expenditure on Education: DEA Method

In the literature, two different approaches have been developed for the estimation of efficiency or effectiveness: the parametric approach and the non-parametric approach. The main difference between the two approaches lies in the construction of the efficiency frontier. Indeed, for parametric approaches, the frontier is designed by assuming a priori a functional form of the production function (translog, Cobb-Douglas, CES, etc.). In recent studies, the most frequently used parametric method is the stochastic frontier analysis (SFA) (Alinsato, Bassongui, & Wondeu, 2022). On the one hand, the advantage of the SFA method is that the frontier is constructed by including a random error term to take into account statistical noise. This makes it possible to differentiate inefficiency from other stochastic influences (De Borger & Kerstens, 1996). Also, this technique allows for hypothesis testing. On the other hand, the SFA method requires that one has to construct a functional form. This is not the case with non-parametric methods.

Unlike the parametric approach which assumes the existence of an a priori functional form of the production function, the non-parametric approach does not make any assumptions about the functional form of the production function. It constructs the production frontier using linear programming, so that no observed point lies outside it. In addition, the non-parametric approach omits the existence of statistical noise in the efficiency measures; in this way, it truly envelops a set of observations.

The flexibility of non-parametric approaches as well as the tools available to partially correct the problems of these methods made us choose this type of method for this study. With non-parametric approaches, several methods are possible to determine the efficiency frontier. There is the FDH (Free Disposal Hull) method which does not consider any convexity assumption. It does not require the assumption that returns are constant or variable. However, the application of FDH, to be reliable, requires a large sample. There is also the DEA (Data Envelopment Analysis) method.

In general, the efficiency of a firm or organisation is described as the success in producing as many outputs as possible with a given quantity of inputs (Farrell, 1957) (output orientation) or efficiency is the minimisation of inputs for a given quantity of outputs (input orientation). According to Berger and Humphrey (1997) and Badillo (1999), these techniques give very similar scores, with an identical ranking of the firms evaluated. Lovell et al. (1994) insist that the optimal solution of the two orientations is identical. What differs is only the perspective of analysis. In an output-oriented model, the focus is more on improving jobs with the available amount of resources, whereas in an input-oriented model, the objective is to use as few resources as possible to achieve a targeted level of output.

As the name suggests, the DEA determines an envelope that contains all effi-

cient observations and their linear combinations. The remaining observations (those that are inefficient) lie below. The envelope is linear by fragment. It is interpreted as the efficient technology frontier and is called the efficiency frontier (Seiford & Thrall, 1990). The efficiency frontier is considered to be the frontier representing 'best practice'. Efficient observations are found there, and thus define it. The DEA method identifies efficient observations on the basis of the principle of iterative comparison: each observation is compared to all others. If an observation is not dominated in terms of production technology by any other observation in the sample, then it is said to be efficient and is given a score of 1 (Seiford & Thrall, 1990). Each observation is obtained by combining an output and an input and is called a decision unit (DMU).

The DEA method allows for different options in the construction of the frontier, either the CRS (Constant Scaling Return) model of (Charnes, Cooper, & Rhodes, 1978) also called CCR model, or the VRS (Variable Scaling Return) model of (Banker, Charnes, & Cooper, 1984) which is also called BCC model.

For our research, we use a non-parametric approach: the DEA method rather than the FDH method. As shown in our literature review, several authors who have recently analysed the efficiency or effectiveness of public spending have also chosen the DEA method for their efficiency calculations (Hosseinzadeh Lotfi, Allahviranloo, Shafiee, & Saleh, 2023; Alinsato & Alakonon, 2021). More specifically, we choose the VRS model rather than the CRS model since we assume that returns to scale are variable. The output orientation is used to consider that the government maximises output in this sector given an amount of expenditure on education.

Thus, the mathematical model of the DEA method, VRS model, output orientation chosen is as follows:

Maximising ϕ_k

Under constraints

$$\begin{cases} \phi_k y_{rk} - \sum_{j=1}^{n} \lambda_j y_{rj} \leq 0 \quad r = 1, \cdots, s \\ x_{ik} - \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0 \quad i = 1, \cdots, m \\ \sum_{j=1}^{n} \lambda_j = 1 \\ \lambda_j \geq 0 \quad \forall j = 1, \cdots, n \end{cases}$$

In this mathematical program, Φ represents the technical efficiency; ϕ_k is the technical efficiency of organisation k; s is the number of outputs; m is the number of inputs; n is the number of organisations to be evaluated; y_{rj} is the quantity of output r produced by organisation j; λ_j is the weight associated with the outputs and inputs of organisation j; x_{ij} is the quantity of input i produced by organisation j.

In this study, the eight WAEMU countries represent the number of organisations to be evaluated.

3.2. Description of Variables and Data Source

The study uses World Bank WDI (World Development Indicators) data for the period 2000 to 2020 for the eight WAEMU countries (Benin, Burkina Faso, Côte d'Ivoire, Guinea Bissau, Mali, Niger, Senegal and Togo). Table 1 below presents the different variables used, their descriptions and the source of the data for these variables.

4. Results and Discussion

4.1. Descriptive Statistics

Table 2 below presents the statistical properties of the variables used. It presents the mean value (Mean) of each variable, the standard deviation (Std. Dev.) of the variable, the minimum value (Min) and the maximum value (Max) of the variable

Table 1. Definition and description of variables and data source.

	Variables	Description of variables	Data source
input	**dpe**	**dpe** stands for public expenditure on education. Public expenditure on education is public current and capital expenditure on education and includes public expenditure on educational institutions (public and private) and on the administration of education as well as subsidies to private entities (students/households and other private entities).	World Bank WDI (World Development Indicators) https://data.worldbank.org/indicator
outputs	**tbsp**	**tbsp** stands for gross primary enrolment ratio. It is the total corresponding to total primary school enrolment, regardless of age, expressed as a percentage of the total population in the primary school age group. This rate may exceed 100% due to the inclusion of over-aged or under-aged students as a result of early or late enrolment and repetition.	World Bank WDI (World Development Indicators) https://data.worldbank.org/indicator
	taep	**taep** Primary school completion rate (% of relevant age group). The primary school completion rate is the total number of new entrants to the last level of primary education, regardless of age, expressed as a percentage of the total population in the theoretical age range of entry to the last level of primary education. This indicator is also known as the "gross intake rate for the last primary level". This ratio may exceed 100% due to over-aged and under-aged children as a result of late or early primary schooling and/or repetition.	World Bank WDI (World Development Indicators) https://data.worldbank.org/indicator
	tbis	**tbis** stands for Gross Tertiary Enrolment Rate. This rate is the total enrolment in tertiary education, regardless of age, expressed as a percentage of the total population of the five-year group after leaving secondary school.	World Bank WDI (World Development Indicators) https://data.worldbank.org/indicator

Source: authors (2023).

Table 2. Descriptive statistics of the variables.

Variables	Observations	Mean	Std. Dev.	Min	Max
dpe	168	3.388	0.957	1.8	5.72
tbsp	168	89.852	24.466	32.356	132.467
taep	168	55.495	15.773	18.38	92.715
tbis	168	6.115	3.852	.874	15.965

Source: authors, based on World Bank WDI data (2023).

4.2. Interpretation of Results

Table 3 below presents the results of the estimates of the efficiency of public expenditure on education in WAEMU countries, from 2000 to 2020. The lowest technical efficiency score for Benin over the study period is recorded in 2000 and estimated at 0.67 while the highest is recorded in the consecutive years 2013, 2014, 2015 and 2016 and is estimated at 1. On average, Benin's technical efficiency score over the study period is estimated at 0.88. This score can be interpreted as an indication that public expenditure is 88% efficient in achieving education targets such as primary school enrolment and completion, and tertiary enrolment. An efficiency score of 0.88 therefore indicates that public spending on education has a significant impact on educational outcomes. This means that most education spending in Benin is used efficiently to achieve educational objectives.

Table 3. Technical efficiency scores of education spending in WAEMU countries from 2000 to 2020.

Year	Benin	Burkina-Faso	Cote-d'ivoire	Guinea-Bissau	Mali	Niger	Senegal	Togo
2000	0.67	0.33	0.74	0.74	0.44	0.25	0.55	0.87
2001	0.71	0.35	0.76	0.85	0.48	0.28	0.58	0.89
2002	0.80	0.35	0.65	0.88	0.50	0.31	0.59	0.91
2003	0.80	0.37	0.63	0.88	0.51	0.35	0.59	0.89
2004	0.80	0.40	0.62	0.93	0.53	0.38	0.59	0.90
2005	0.78	0.44	0.62	0.97	0.55	0.39	0.61	0.89
2006	0.79	0.46	0.63	1	0.58	0.40	0.60	0.90
2007	0.90	0.51	0.59	0.99	0.60	0.45	0.63	0.84
2008	0.87	0.55	0.56	0.99	0.62	0.45	0.65	0.84
2009	0.89	0.58	0.56	1	0.63	0.45	0.65	0.94
2010	0.91	0.58	0.58	0.98	0.65	0.49	0.65	0.96
2011	0.92	0.62	0.64	1	0.65	0.52	0.68	0.94
2012	0.96	0.65	0.63	0.97	0.62	0.55	0.68	0.96
2013	1	0.68	0.64	0.95	0.61	0.54	0.68	0.96
2014	1	0.68	0.66	0.94	0.60	0.62	0.69	0.96
2015	1	0.69	0.70	0.94	0.58	0.73	0.69	1
2016	1	0.70	0.74	0.95	0.60	0.84	0.70	1
2017	0.95	0.72	0.78	0.98	0.60	0.78	0.73	0.99
2018	0.93	0.74	0.85	1	0.58	0.69	0.79	0.98
2019	0.88	0.73	0.84	0.94	0.59	0.68	0.82	0.98
2020	0.86	0.72	0.90	1	0.59	0.55	0.87	1
average score	**0.88**	**0.56**	**0.68**	**0.95**	**0.58**	**0.51**	**0.67**	**0.93**

Source: Authors, extract from DEA estimates from WDI data (2023).

Nevertheless, this result shows that, on average, Benin's technical inefficiency score over the 21 years of the study is approximately 0.12 (1 - 0.88). This means that 12% of public spending on education did not produce the expected results. There is therefore, on average, a 0.12 point improvement margin in the efficiency of public spending in Benin's education sector over the period 2000 to 2020. In other words, Benin could increase overall school results (outputs) by 12% while keeping the same level of public expenditure on education (input).

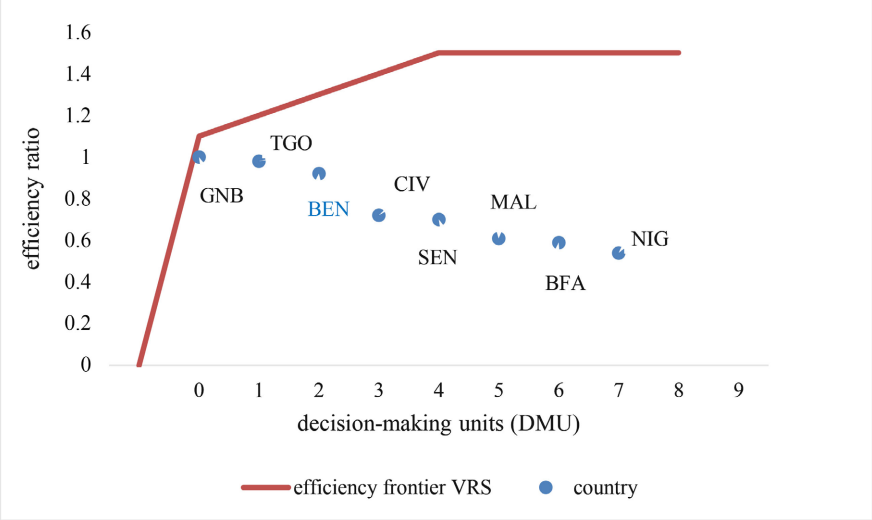
Benin's average score over the study period is compared to those obtained by the other WAEMU countries. Table 4 below presents the results of this comparison. The table shows that the average score obtained by Benin (0.88) over the study period is lower than that obtained by Togo (0.93) and Guinea-Bissau (0.95). On the other hand, Benin's score is higher than that obtained by Côte d'Ivoire (0.68); Senegal (0.67); Mali (0.58); Burkina Faso (0.56) and Niger (0.51). The score obtained by Benin places it third out of the eight countries in terms of efficiency of education spending. This means that Benin uses its public resources for education more efficiently than Côte d'Ivoire, Senegal, Mali, Burkina Faso and Niger but less efficiently than Togo and Guinea-Bissau.

Graph 3 below shows that Benin is well below the efficiency limit for public spending on education.

Table 4. Average score results for the eight UEMOA countries ranked in order of merit.

Country	Guinea-Bissau	Togo	Bénin	Cote-d'Ivoire	Senegal	Mali	Burkina-Faso	Niger
average score	0.95	0.93	0.88	0.68	0.67	0.58	0.56	0.51
ranking	1st	2nd	3rd	4th	5th	6th	7th	8th

Source: Authors, extract from DEA estimates from WDI data (2023).



Graph 3. Efficiency of education spending in WAEMU countries. Source: Authors, extract from DEA estimates from WDI data (2023).

4.3. Robustness Test

We subject our results to a robustness test. Indeed, we use the DEA-PCA method which is a combination of principal component analysis (PCA) and data efficiency analysis (DEA) to improve the precision and robustness of the results obtained using the DEA method. Three variables were identified as inputs: current expenditure on primary education; current expenditure on secondary education; and current expenditure on tertiary education. An indicator of public expenditure on education is calculated from these three variables using Principal Component Analysis (PCA). Also, the literacy rate is introduced in the variables considered as outputs. Estimates through the DEA give an average efficiency score of 0.90 in Benin (see results table in appendix). This confirms the estimation results obtained.

5. Conclusion and Economic Policy Implications

This paper highlights the importance of improving the efficiency of public spending on education in Benin, as there is a significant room for improvement of 12%. Policy makers could take measures to improve the use of public resources in the education sector. For example, they could introduce monitoring and evaluation mechanisms to measure the effectiveness of spending, or reduce non-essential spending and reallocate resources to areas of low efficiency. In addition, the results of the comparison with other WAEMU countries show that Benin can learn from the management of public spending on education in Togo and Guinea-Bissau to improve its efficiency by identifying best practices and policies to adopt. These results could be useful to policy makers in improving the efficiency of public expenditure on education in Benin and other WAEMU countries. They could therefore study closely the policies and practices of these two countries to identify practices that could be applied in Benin to improve the efficiency of public spending on education. Finally, the results of this study highlight the importance of education for Benin's economic and social development. Policy makers could therefore be encouraged to increase investment in education to improve the efficiency of public spending on education and thus contribute to the country's economic development.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix. Result of the Robustness Test

Year	Benin	Burkina-Faso	Cote-d'ivoire	Guinea-Bissau	Mali	Niger	Senegal	Togo
2000	0.84	0.35	0.84	0.67	0.47	0.30	0.77	0.90
2001	0.90	0.36	0.84	0.69	0.51	0.33	0.78	0.92
2002	0.94	0.36	0.84	0.76	0.53	0.36	0.79	0.94
2003	0.97	0.38	0.84	0.76	0.54	0.39	0.82	0.92
2004	1	0.41	0.84	0.83	0.56	0.43	0.83	0.91
2005	1	0.44	0.84	0.89	0.59	0.49	0.86	0.90
2006	0.76	0.47	0.65	0.93	0.61	0.50	0.89	0.93
2007	0.81	0.52	0.66	0.92	0.64	0.46	0.94	0.87
2008	0.85	0.56	0.66	0.92	0.67	0.43	0.94	0.87
2009	0.89	0.59	0.72	0.92	0.63	0.48	0.73	0.91
2010	0.91	0.61	0.66	0.90	0.65	0.49	1	1
2011	0.92	0.63	0.70	0.90	0.71	0.66	1	0.97
2012	1	0.65	0.75	0.90	0.62	0.70	0.7	0.99
2013	1	0.71	0.84	0.90	0.60	0.56	1	0.99
2014	1	0.70	0.72	0.91	0.60	0.62	0.97	0.96
2015	1	0.75	0.74	0.91	0.58	0.89	0.73	1
2016	0.99	0.87	0.81	0.91	0.59	0.83	0.80	1
2017	0.95	0.89	0.87	0.91	0.61	0.67	0.86	0.99
2018	0.95	0.92	0.94	0.91	0.58	0.67	0.88	0.98
2019	0.91	0.90	1	0.91	0.59	0.67	0.88	0.99
2020	0.90	0.90	1	0.92	0.60	0.55	0.93	1
average score	**0.9**	**0.61**	**0.79**	**0.93**	**0.59**	**0.54**	**0.86**	**0.94**

Source: Authors, extract from DEA estimates from WDI data (2023).