Journal of Financial Risk Management, 2026, 15(4), 433-457
https://www.scirp.org/journal/jfrm
ISSN Online: 2167-9541
ISSN Print: 2167-9533

Public Spending on Education, Economic Growth and Public Service Delivery in East African Community Countries: A Longitudinal Association Analysis (2010-2021)

Estimé Nobel Basabakwinshi[1], Léonidas Ndayizeye[2]

[1]Ecole Doctorale, Université du Burundi, Bujumbura, Burundi
[2]Université du Burundi, Bujumbura, Burundi
Email: benbasa54@gmail.com, leonidas.ndayizeye@ub.edu.bi

How to cite this paper: Basabakwinshi, E. N., & Ndayizeye, L. (2026). Public Spending on Education, Economic Growth and Public Service Delivery in East African Community Countries: A Longitudinal Association Analysis (2010-2021). *Journal of Financial Risk Management, 15,* 433-457.
https://doi.org/10.4236/jfrm.2026.154024

Received: September 28, 2026
Accepted: November 8, 2026
Published: November 11, 2026

Copyright © 2026 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution-NonCommercial International License (CC BY-NC 4.0).
http://creativecommons.org/licenses/by-nc/4.0/

Open Access

Abstract

This study investigates the longitudinal associations between public education expenditures, economic growth, and the quality of public service delivery for Burundi, Rwanda, Tanzania, and Uganda in 2010-2021. A naturalistic, longitudinal, correlational research design utilized panel data from the UNESCO Institute for Statistics, the Fund for Peace Fragile States Index (Public Services Index, PSI), and the IMF/World Bank, harmonized via The Global Economy.com database. All variables were analyzed as macroeconomic aggregates. Descriptive statistics, Pearson correlations, pooled OLS regression, and a bootstrap product-of-coefficients decomposition were used. Education expenditure as a share of GDP was positively associated with PSI in Burundi ($r = 0.83$, $p = 0.001$) and negatively associated with PSI in Uganda ($r = -0.61$, $p = 0.035$); associations for Rwanda and Tanzania were not statistically significant. Economic growth was not significantly associated with PSI ($r = 0.21$ - 0.48, all $p > 0.10$). The pooled OLS regression model (without country fixed effects) explained 17.0% of the variance in PSI ($F(3, 44) = 3.01$, $p = 0.040$); education expenditure as a share of total public spending was the only significant predictor ($\beta = 0.076$, $p = 0.009$). A fixed-effects specification is reported in the revised manuscript. The contemporaneous product-of-coefficients association between growth and PSI via education spending was not statistically distinguishable from zero (0.010, bootstrap 95% CI [−0.002, 0.035]), and the mean PSI did not differ significantly between 2010 and 2021 ($t(3) = 0.51$, $p = 0.642$). These findings underscore the importance of institutional quality, absorptive capacity, and expenditure targeting. As an observational analysis of 48 country-year observations with only four countries, all results are associational and exploratory.

Keywords

Public Spending, Education Spending, Economic Growth, Public Service Delivery, East African Community

1. Introduction

The efficient delivery of public services and fiscal management constitutes one of the most paramount priorities for any government. In a contemporary global environment defined by tight fiscal budgets coupled with burgeoning demographic pressures, the quality and effectiveness with which the State is able to convert public funding into quality service is especially salient for developing regions of the world, such as the East African Community (EAC). Education forms a core element in this context, in as much as education is in itself both a public service and, fundamentally, a component of longer-term productivity that determines the potential quality of all other services (Karagiannis & Ravanos, 2025; Marginson, 2018; Mazzucato, 2023).

Public services are typically provided via a pot of national income, which is determined by growth. In recent literature concerning growth and sustainability, including green growth, circular economy and eco-innovation, a key refrain is that it is not necessarily the rate of growth but the nature, the composition and the institutional integration of that growth that facilitates positive developmental outcomes from an expanded economic output (Porter & van der Linde, 1995; Kirchherr et al., 2017; Korhonen et al., 2018; Stahel, 2016; Suárez-Eiroa et al., 2019; Hysa et al., 2020; Ferraz & Pyka, 2023; Marinov, 2025). Dollar and Kraay (2003) noted in a seminal work that, at the macro-level, it is more about institutions and trade integration than growth per se in determining more general prosperity.

This work links with a series of other studies on Africa which argue that whether growth and innovation eventually lead to better welfare depends on absorptive capacity (Andersen et al., 2022; Asongu et al., 2020; Feleke et al., 2021; Rosario et al., 2024; de Jesus & Mendonça, 2018; Triguero et al., 2013; Lieder & Rashid, 2016; Corona et al., 2019).

The theoretical perspective taken in this paper rests on the idea that growth can potentially be linked to better public service delivery only through an intervening variable, namely, fiscal availability, which translates into sectors like education, provided the countries possess the capacity to transform these inputs.

While a significant literature has advanced in the methodology for public sector efficiency (Mergoni et al., 2025; Afonso et al., 2025; Amirteimoori, 2025; Agasisti et al., 2025) and within the political-economy literature for seeing education as a public good (Marginson, 2018; Mazzucato, 2023; Boliver & Promenzio, 2025), there has been limited longitudinal and comparative assessment in the EAC, covering. The present study addresses this gap.

The main goal of this study is to examine the longitudinal relationships between

public education expenditure, public service delivery, and economic growth in the four EAC countries during the 2010-2021 period. The methodology section 4 facilitates the achievement of this primary objective, and the results of Section 5 address each specific objective one by one.

The specific objectives were:

SO1. To describe the levels and trends of public education spending (as a percentage of GDP and as a share of total public spending), economic growth and Public Services Index scores in Burundi, Rwanda, Tanzania and Uganda over the period 2010-2021.

SO2. To estimate the strength and direction of the bivariate associations between each of the three independent variables and the Public Services Index, both by country and pooled across countries.

SO3. To estimate whether the contemporaneous association between economic growth and the Public Services Index is statistically accompanied by variation in education spending, using a product-of-coefficients decomposition with bootstrap confidence intervals. Given the correlational design and the use of same-year measures, this objective is descriptive of contemporaneous associations and does not establish a causal pathway.

2. Literature Review

2.1. Theoretical Framework: Human Capital and Total Factor Productivity

The analysis utilizes a theoretical framework with two interlocked pillars. Human Capital Theory (HCT) serves as the first lens of the study, largely because the main explanatory variables—public sector education spending—are tangible budgetary outcomes of an intentional public sector investment in the human capital of their citizenry, whereas one of the primary outputs is the quality of public sector service delivery itself, which, in its vast majority, is produced by the human capital a country has developed. The second lens of Total Factor Productivity (TFP) was integrated to serve as a supporting framework, largely because TFP explains why there is a conditional path for education spending and the creation of economic growth itself being associated with service provision.

Specifically, TFP helps explain that an identical set of inputs can yield vastly different levels of outputs depending upon how efficiently those inputs are converted by the state. This is exactly what the empirical portion of this study is looking to test.

HCT frames education as a key human capital formation investment, wherein money is not simply consumed, but instead invested so as to enhance the productive capacities of the citizen and subsequently, the productivity capacity of the nation as a whole. Schultz (1961) laid this groundwork when he observed that the unexplained "residual" component of growth could largely be interpreted as an investment in human beings and thus human capital. Becker (1964) formalized this work by putting forth his seminal and groundbreaking theories on human capital, pos-

iting that one can think of education as an investment in a capital form that accrues returns over a full lifecycle.

Mincer (1974) would further strengthen the theory with foundational empirical studies on how school levels relate directly to productivity.

With the macro-level focus in endogenous growth models in the late 1980s, these micro-theoretical frameworks found renewed vigor in a more dynamic theoretical lens. Lucas (1988) gave growth models their human capital motor and posited that the external effects of capital were the real drivers of country-wide productivity, and Romer (1990) moved that human capital focus from mere knowledge towards human capital driving perpetual growth. Barro (1991) subsequently found robust growth patterns cross-nationally, and thus HCT became a staple of growth studies globally. There are three key implications of HCT for the present study.

Firstly, it allows us to theorize that state-level investment in public education (EdGDP and EdPub) can and should represent an investment in the human capital that dictates the service capacity level, thereby validating our baseline for HCT.

Secondly, it is via HCT that the study derives the logic for the third specific objective (SO3) and tests the mediator hypothesis, namely that economic growth should enable investment through an increase in fiscal pool availability to finance human capital, with service outcomes being the variable at stake. Thirdly and perhaps most importantly in a policy sense, it helps relate this work directly back to the East African Community, as countries like the EAC have burgeoning populations, making the human capital return of each public dollar allocated for education highly developmental.

TFP serves as the essential complement. Following Abramovitz (1956) and Solow (1957), who were foundational for breaking down output expansion into inputs (labor/capital) and a residual that came to be termed total factor productivity, later work would then break the TFP category down even further (Jorgenson & Griliches, 1967). Crucially, the growth accounting body of work also solidified that long-term differentials between countries were typically driven less by input accumulation than by this residual efficiency TFP gap between countries (Easterly & Levine, 2001).

A further critically essential lesson that would eventually filter through to the policy arena originated in Krugman's controversial (Krugman, 1994), yet arguably accurate, assessment that sustainable growth from factor inputs alone—the "adding-machines-to-workers" path—was never possible if it is not bolstered by increases in underlying factor productivity.

This remains the basic policy lesson we attempt to test here: public spending on services and GDP growth itself can be understood as inputs to service delivery, but the conversion path is governed by an efficiency term that is historically and institutionally shaped. TFP plays three complementary roles here: 1) it makes technically justifiable our ability to use the Public Sector Index (PSI) as an output-it is an input-to-output conversion; 2) it provides the theoretical grounds for predict-

ing that even where there might be a cross-sectionally stable spending path, two countries might not share the same outcome (the heterogeneity documented in Section 5); 3) it allows us to frame null findings, if either spending-to-service or growth-to-service does not exist, that is not a rejection of HCT but evidence that in the region, an efficiency channel (institutions/absorptive capacity) is more likely the dominant term as consistent with the institutional account developed by Dollar and Kraay (2003) and with absorptive capacity literature we touch upon in Section 2.4.

The two work in a symbiotic unit. HCT captures what is bought by our inputs of choice: the institutional outcomes and human capital generation, which then, in theory, drive service delivery outcomes, therefore creating an expectation for association with growth paths. TFP governs the conversion of those resources into realized institutional outcomes, creating the space for cross-country performance differences and even theoretically predicting why such performance relationships between input (spend/growth) and output (service) can shift and disconnect. This logic guides the paper's empirical analysis.

Trends in inputs and outputs are tracked in descriptive trend analyses. Bivariate and multivariate analyses of the association between the two provide the baseline HCT test of whether more spend yields more output (SO2). The bootstrap mediation analysis directly tests the HCT indirect-path expectation, using the TFP's institutional capacity logic as the primary rationale to explain non-rejection or rejection of that path. Finally, we turn our attention towards the relevant empirical literature related to these two theoretical prongs, applied in a public sector, education, and growth framework, from Sections 2.2 to 2.5.

2.2. Measuring Public Sector Efficiency

A data envelope analysis (DEA) continues to be the dominant methodological approach when estimating whether and at what ratios inputs into public coffers manifest in public outcomes (Mergoni et al., 2025). The approach now incorporates refinements such as fuzzy network-DEA for health services (Afonso et al., 2025), two-stage DEA to accommodate the shared-resources nature of modern economies such as banking (Amirteimoori, 2025), and using random forest estimates in education for determining production frontiers (España et al., 2025). Further, the growing body of literature now confirms that domestic-internal governance setups matter decisively in achieving these rates of success within institutions (Agasisti et al., 2025; De Witte & Lopez-Torres, 2017). This technical body of knowledge stresses the centrality of adjusting for contextual institutional diversity in determining any given set of frontier efficiencies (Aparicio & Santín, 2025; Johnes et al., 2025).

2.3. Education as a Public Good

Beyond merely repairing market flaws (a long-held understanding), more recently, the scholarly understanding of how to interpret the activity of the public sector

has shifted, for instance, into work arguing that government creates collective purpose, rather than just market-based interventions to support market outcomes (Marginson, 2018; Mazzucato, 2023). While results continue to be highly contested regarding what occurs in instances of "marketized" education—sometimes producing stress for all users while maintaining existing socio-economic hierarchies, as seen across some Western consumerist educational outcomes (Jabbar et al., 2017; Nixon et al., 2016; Boliver, 2017), whilst in other cases serving as stimulants for localized innovation, community building and public engagement (Goddard et al., 2016; Naidoo, 2015)—the general theme is consistent. In either case, the value the state generates via its fiscal injection (spend) into education appears primarily conditional upon the strength, flexibility and competence of its localized deployment institutions.

2.4. Growth, Sustainability and Fiscal Space

The Porter Hypothesis (Porter & van der Linde, 1995) famously set out the pathway whereby efficiency based state action could in theory at least be the partner of competitiveness; the literature on the Circular Economy (CE) expands upon this by arguing for the composition of such growth playing the key part in maintaining its viability over the long-term (Kirchherr et al., 2017; Korhonen et al., 2018; Stahel, 2016; Lieder & Rashid, 2016; Suárez-Eiroa et al., 2019; Corona et al., 2019). The academic models currently trying to bridge CE innovation, sustainability, and its subsequent role in overall regional competitiveness confirm a need for balanced systems (Hysa et al., 2020; Ferraz & Pyka, 2023), whereas on the flip side, some have raised alarms as to how transitioning economies may inadvertently find themselves "lost in transition" due to institutional frictions in turning said growth-activity into lasting welfare effects (de Jesus & Mendonça, 2018; Triguero et al., 2013). For Sub-Saharan Africa, in particular, the evidence is now convergent, for instance, based on work on Kenyan manufacturing entities (Andersen et al., 2022), research on ICT connectivity and sustainable development in the region (Asongu et al., 2020), and research into circular bio-economy pathways for developing countries (Feleke et al., 2021). The prevailing mechanism across each of these cases confirms that the state's absorptive capacity defines its outcomes in its fiscal growth to wellness journey.

This aligns conceptually with the institutional development account that Dollar and Kraay (2003) posit and the finding from studies like Kahia et al. (2019) that what matters to energy-led economic growth is the source of growth.

2.5. Benchmarking and Regional Divergence

Standard policy learning has now almost exclusively resorted to cross-country benchmarking (Agasisti, 2023). While some studies from European datasets still note consistent convergence alongside pockets of evidence suggestive of institutional "fatigue" causing growth paths in education/services outcomes to plateau (Karagiannis & Ravanos, 2025; Stumbrienė et al., 2025), elsewhere scholars track

distinct, heterogeneous governance drivers across regions like Spain (Cordero et al., 2025; de la Torre & Perez-Esparrells, 2019), significant differences based on regional policies across the home countries comprising the UK (Callender, 2023; Johnes & Perez-Esparrells, 2025) and shock volatility (Maldonado & De Witte, 2022). Still notably absent from this longitudinal benchmarking work is similar cross-comparison and assessment specifically applied collectively to EAC expenditure, output service delivery indices, and economic growth-the very lacuna in the literature this study addresses.

3. Methodology

3.1. Research Design

The current paper used a quantitative, longitudinal, correlational design. We employed a correlational design because we could not manipulate national fiscal aggregates and national economic growth. The study included a longitudinal aspect due to its consideration of the associations and trends over a 12-year period.

It used benchmarking logic recently applied in some European efficiency studies (Karagiannis & Ravanos, 2025) and benchmarking and cross-country learning (Stumbrienė, Ruiz, & Sirvent, 2025).

As per the rules of correlational studies, all results represent associations, and any suggestion of causation in phrasing in the results section was unintended. As is the rule in correlational studies, all results represent associations; no causal interpretation is intended or warranted.

3.2. Sampling Frame and Participants

The sampling frame was the six East African Community (EAC) member states, namely: Burundi, Kenya, Rwanda, South Sudan, Tanzania, and Uganda. Participant selection was purposive because this study required full time series data for all indicators. Eligibility for the study required the four study variables (government spending on education as a share of GDP, government spending on education as a share of total government spending, public service index, and real economic growth rate) to have data for all years between 2010 and 2021 consecutively without missing data. The six nations did not meet the requirement because Kenya only had a series for the year 2020 on education spending share.

South Sudan too was not included due to time series data and recently joining the community. The study involved four countries, including Burundi, Rwanda, Tanzania, and Uganda, from 2010 up to 2021, and this generated a panel dataset of 48 years of observations. We included the full population of countries; as we did not take a sample of years, the panel dataset is not a sample.

3.3. Data Sources

The study used three secondary sources, and the data were harmonized from The Global Economy.com as follows: 1) Percentage of government spending allocated to education out of total government spending and government spending on ed-

ucation as a percentage of GDP were derived from the UNESCO Institute for Statistics, 2) Public Services Index (PSI) was the part of Fragile states index provided by the Fund for Peace (2024), and 3) Annual GDP growth forecast—annual real percentage growth of GDP was provided by IMF and World Bank data (The Global Economy.com, 2026). The PSI is an expert-coded composite that aggregates assessments of several core public functions, including education, health, water and sanitation, transport, energy, and policing, into a single 0 - 10 score. It indicates the degree to which basic public service functions are being met; the closer the value is to zero, the better the performance, and the closer it is to 10, the worse. Because one of its components measures the very sector whose funding constitutes our principal independent variable, the PSI is not fully independent of education spending; we treat associations involving the PSI as conservative estimates and return to this circularity in the Discussion and Limitations.

3.4. Variable Operationalization

We used abbreviations for the variables to improve clarity: EdGDP = government spending on education of GDP, EdPub = government spending on education (%) of public spending, Growth = annual real GDP growth rate (%) and PSI = Public Services Index. SD refers to the standard deviation. No questionnaire or survey was given; therefore, no items, no response scales, nor construction of scores from multiple items was done.

They were macro-level metrics collected by government agencies and international organizations; nothing here was based on perceived scores of participants, but they were empirical aggregate data of macro and institutional settings.

Higher scores in percentage expenditure, GDP percentage, and growth meant higher magnitude, but a high score on PSI meant poorer provision and lower meant good provision, following the rule of code of Fund for Peace. See Table 1 for summary.

Table 1. Operationalization of study variables.

Variable (Abbreviation)	Operational Definition	Source	Scale/Observed Range	Nature and Direction of Scoring	Role/Objective
Public Spending on Education, % of GDP (EdGDP)	Ratio of public education spending to gross domestic product, multiplied by 100	UNESCO Institute for Statistics (2024), via TheGlobalEconomy.com	Ratio; 0 - 20 observed range	Objective aggregate; larger = greater human-capital investment per unit of output	SO1, SO2, SO3 (accompanying variable)
Public Spending on Education, % of Total Public Spending (EdPub)	Ratio of public education spending to total government spending, multiplied by 100	UNESCO Institute for Statistics (2024), via TheGlobalEconomy.com	Ratio; 8 - 28 observed range	Objective aggregate; larger = higher budget priority for education	SO1, SO2

Continued

Economic Growth (Growth)	Annual percentage change in real GDP	IMF/World Bank, compiled by TheGlobalEconomy.com (2026)	Percentage; −3.4 to 10.9 observed range	Objective aggregate; larger = faster output expansion	SO1, SO2, SO3 (exposure)
Public Services Index (PSI)	Expert-coded composite adequacy of core public services (including an education component); component of the Fragile States Index	Fund for Peace (2024), via TheGlobalEconomy.com	Ordinal 0 - 10; 6.5 - 9.0 observed range	Expert-coded composite (not survey-based); higher = worse service delivery	Dependent variable

Note: EdGDP, EdPub, Growth, and PSI are country-year measures. Higher PSI = worse service delivery.

3.5. Reliability and Validity of the Instruments

Because the secondary series involved only single indicators rather than multi-item questionnaire instruments, measures of internal consistency (like Cronbach's alpha) could not be calculated and are not reported. The reliability is therefore tied to the measurement techniques of the reporting agency. Evidence of construct validity resides in the universal acceptance of these measures within international benchmarking contexts (Agasisti, 2023; OECD, 2023).

That is, the UNESCO education-spending percentages represent the conventionally used fiscal proxy for human-capital expenditure and budgetary importance; real GDP growth provides the standard metric for macroeconomic productivity; and the PSI is an empirically validated, transparent element of an established fragility index.

In operationalizing this, a procedural safeguard was followed to assist in guaranteeing data reliability: uniform definition parameters were applied to all 4 nations over the 12-year duration to preclude confounds due to modification in measure. Series entries were all triple-checked against the newest database edition available in existence at the time of gathering to avoid issues of "vintage". Furthermore, values were cross-validated between the source series data sets and the standardized The Global Economy.com extractions, resolving disparities in favor of the data currently reported by the originating body. The residual primary threats to validity involve professional expertise and coding prejudice within the PSI as well as forecast restatements regarding the growth series, which are treated as constraints of this exploration in Section 6.

No pilot testing of instruments was considered pertinent because no instruments (*i.e.*, Survey instruments, exam instruments) were manufactured or deployed for this exploration. The potential bias and ambiguity from instrument development is accordingly prevented by construct. The next-most parallel action was taking the finished balanced panel and performing screening on this data before the conduct of inferential investigations to look for variations in definitions, missing coverage, or numbers which are not in the valid bounds for each indicator. When such a value

showed up, it was reviewed in contrast to the source agencies' edition currently offered before being brought into the analysis.

3.6. Statistical Analysis

There are four analytical phases linked to the three specific objectives. First, regarding SO1, for each country we calculated descriptive statistics (means and standard deviations) alongside trend profiles. Second, regarding SO2, Pearson product-moment correlations were computed between each independent variable and the PSI, individually for each country (n = 12) and for the pooled data (n = 48). The pooled results, with 95% confidence intervals, are reported in the pooled panel; because country-year observations are not independent, pooled correlations are supplemented by within-country (country-demeaned) correlations and are interpreted descriptively.

Third, a pooled OLS regression was estimated: $PSI_{it} = \beta_0 + \beta_1 Growth_{it} + \beta_2 EdGDP_{it} + \beta_3 EdPub_{it} + \varepsilon_{it}$ (2). An equivalent specification with country fixed effects (LSDV: Equation (2'), including three country dummies) was also estimated, and a formal F-test compares the two models; overall R^2 and within R^2 are both reported. Fourth, regarding SO3, the statistical association between growth and PSI via education spending was estimated as the product of the a-coefficient (Growth → M) and the b-coefficient (M → PSI, controlling for Growth): product term = a × b (3). We performed inference using 5000 bootstrap resamples in which entire countries were resampled with replacement, to respect within-country dependence. Because all measures are contemporaneous (same-year), this decomposition describes contemporaneous association structure only and no temporal pathway is claimed.

Because observations from the same country are serially dependent, conventional standard errors are inappropriate. We therefore report Driscoll-Kraay standard errors robust to autocorrelation, heteroskedasticity, and cross-sectional dependence, complemented by a wild cluster bootstrap-t procedure. We caution that with only four countries (clusters), no inferential method fully overcomes the small number of clusters: the wild bootstrap has only $2^4 = 16$ distinct sign-flip configurations, so p-values below 0.125 cannot be attained, and all inferential results should be read as exploratory.

To further describe the change in PSI over time, a paired-samples t-test evaluated the difference in mean PSI between 2010 and 2021. The analyses were implemented in Python 3.12 using the scipy, numpy, and statsmodels libraries. Data and code for the harmonized panel are available from the author(s) upon reasonable request.

Equations:

$$r = \sum\left[\left(x_i - \bar{x}\right)\left(y_i - \bar{y}\right)\right] \Big/ \sqrt{\left\{\sum\left(x_i - \bar{x}\right)^2 \sum\left(y_i - \bar{y}\right)^2\right\}} \quad (1)$$

$$PSI_{it} = \beta_0 + \beta_1 Growth_{it} + \beta_2 EdGDP_{it} + \beta_3 EdPub_{it} + \varepsilon_{it} \quad (2)$$

$$\mathrm{PSI}_{it} = \beta_0 + \beta_1 \mathrm{Growth}_{it} + \beta_2 \mathrm{EdGDP}_{it} + \beta_3 \mathrm{EdPub}_{it} + \gamma_2 \mathrm{D_Rwanda} + \gamma_3 \mathrm{D_Tanzania} + \gamma_4 \mathrm{D_Uganda} + \varepsilon_{it} \quad (2')$$

$$\text{Product term} = a \times b \quad (3)$$

3.7. Power and Sample Size

The total analytical sample comprises 48 eligible country-year observations from four nations tracked across 12 years. Because no larger pool of these variables exists within the East African Community (EAC) in that time, the sample is effectively the total population of available, eligible data points rather than a sample of a larger population that may have been underpowered. While recognizing n = 12 observations per country limited the ability to infer country-specific correlations- at $\alpha = 0.05$ (two-tailed), the smallest correlation $|r| \approx 0.58$ that could be detected- three precautions were adopted: all findings are presented with their full *p*-values and confidence intervals to ensure nuance beyond simple dichotomization; the pooled models (n = 48) and the bootstrap mediation analysis afforded much more power for cross-country questions; and results were presented with an exploratory framing. As discussed in the limitations section below, therefore, the null findings from country-specific investigations should not be taken as proof that small, true effects do not exist.

4. Results

The results follow the study objectives. Throughout, recall that higher PSI scores denote worse service quality. Consistent with transparent reporting, significant and non-significant associations are reported to avoid selective reporting bias. No analyses were excluded, added, or redefined based on the results.

4.1. SO1: Levels and Trends of Spending, Growth and Service Delivery

Descriptive statistics are summarized in Table 2, with trends plotted in Figures 1-3. Considerable cross-national variation is noted. Rwanda achieved the best average PSI score (7.33, SD 0.37) but reported the highest average growth (6.59%, SD 3.72) with the second-lowest expenditure in education (3.98% of GDP).

Burundi records the lowest mean growth (2.14%) and the highest education spending (5.71% of GDP, 19.92% of the budget), yet its mean PSI (8.28) is the second-worst in the sample. Tanzania, not Burundi, records the worst mean PSI (8.65, SD 0.16) despite the most consistent growth in the group (6.33%, SD 1.00), indicating that growth alone did not translate into service improvements. Uganda, with the lowest education expenditure (2.16% of GDP), achieved the second-best PSI score (8.16) amid highly unstable growth (4.98%, SD 3.06). Curiously, the two countries dedicating the largest budget shares to education (Burundi 19.92% and Tanzania 17.54%) posted the poorest service scores, while those dedicating the smallest shares (Uganda 11.12% and Rwanda 13.61%) produced the best, the reverse of the standard input-output intuition, and consistent with an efficiency-channel account.

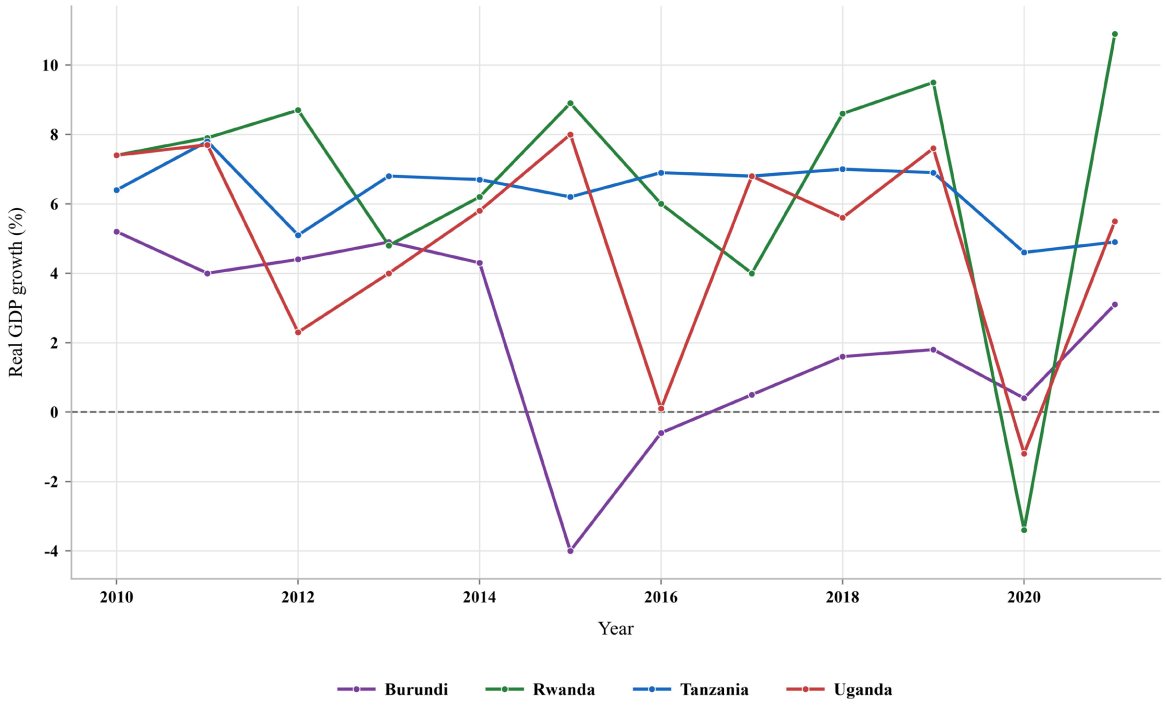
Table 2. Descriptive statistics by country, 2010-2021 (n = 12 country-years each; 48 total).

Country	Mean Growth, % (SD)	Mean EdGDP, % (SD)	Mean EdPub, % (SD)	Mean PSI (SD)	PSI Change 2010 → 2021
Burundi	2.14 (2.72)	5.71 (0.78)	19.92 (3.30)	8.28 (0.39)	−1.1
Rwanda	6.59 (3.72)	3.98 (0.79)	13.61 (2.52)	7.33 (0.37)	+0.1
Tanzania	6.33 (1.00)	3.98 (0.55)	17.54 (3.04)	8.65 (0.16)	+0.5
Uganda	4.98 (3.06)	2.16 (0.29)	11.12 (1.80)	8.16 (0.35)	−0.2

Note: EdGDP = education spending as % of GDP; EdPub = education spending as % of total public spending; PSI = Public Services Index (higher = worse). PSI change = 2021 minus 2010. Country means alone account for approximately 70% of total PSI variance, which is why the fixed-effects comparison reported in the subsequent regression analysis (Section 4.5) matters.

4.2. Economic Performance in East Africa Real GDP Growth

The trend of Real GDP Growth in Burundi, Rwanda, Tanzania and Uganda between 2010 and 2021 was heterogeneous. The available evidence suggests that Burundi went into recession at some point. All four EAC member states were probably affected by economic contraction following the COVID-19 pandemic in 2020 (Figure 1).



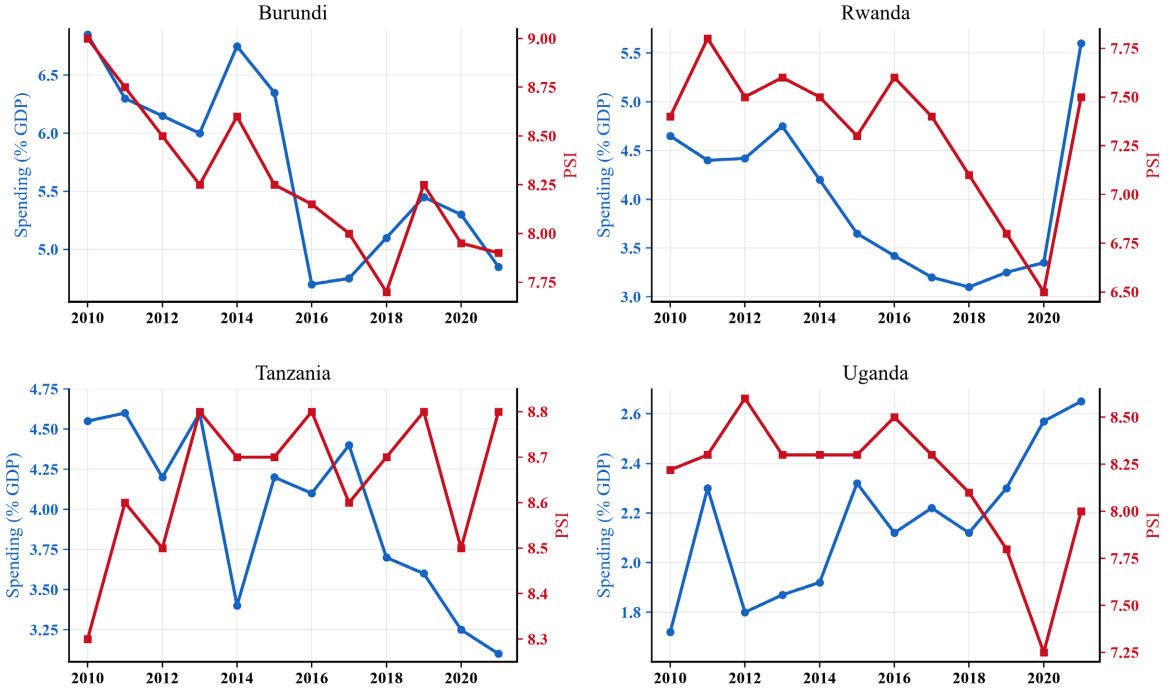
Note: Burundi's 2015-2016 recession and the 2020 COVID-19 contractions (Rwanda −3.37%; Uganda −1.15%) are visible.

Figure 1. Economic growth in the four EAC countries, 2010-2021.

4.3. Expenditure on Education and Public Services Index in EAC

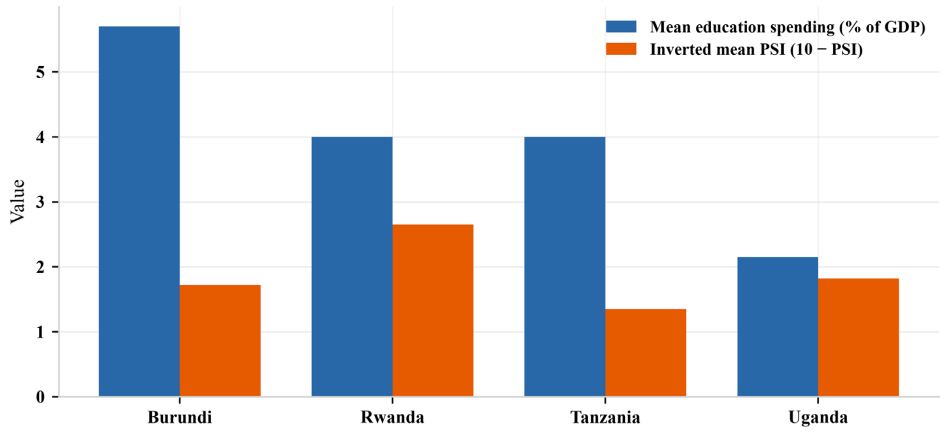
The expenditure on education versus the Public Service Index values (between 2010 and 2021) shows a trend of divergence between the four countries (Burundi, Rwanda, Tanzania and Uganda), with a likely fall in expenditure in Tanzania while

there was an increase in performance in public service delivery in Rwanda (Figure 2).



Note: Blue line (left axis) is Education spending as % of GDP, and red line (right axis) is PSI, where higher PSI is worse.

Figure 2. Education spending (% of GDP, blue, left axis) and Public Services Index (red, right axis) by country, 2010-2021.



Note: Blue bars are mean education expenditure (% of GDP); orange bars are inverted mean PSI (10 PSI), so higher is better for public services.

Figure 3. Mean education spending (% of GDP) and inverted mean PSI (10 - PSI; higher = better service delivery) by country, 2010-2021.

4.4. SO2: Associations of Spending and Growth with the PSI

The correlation coefficients at country level are shown in Table 3; growth-PSI scatterplots with fitted ordinary least squares (OLS) regression lines are shown in Figure 4. The association between spending and service delivery existed only for

two countries, and the associations were in opposite directions: in Burundi, there was a very strong positive correlation (r = 0.83, $p = 0.001$) between EdGDP and the PSI, suggesting that schooling becomes worse the more is spent; in Uganda, the correlation was moderately negative (r = −0.61, $p = 0.035$). The correlations for Rwanda (r = 0.55, $p = 0.064$) and Tanzania (r = −0.29, $p = 0.358$) were not significant.

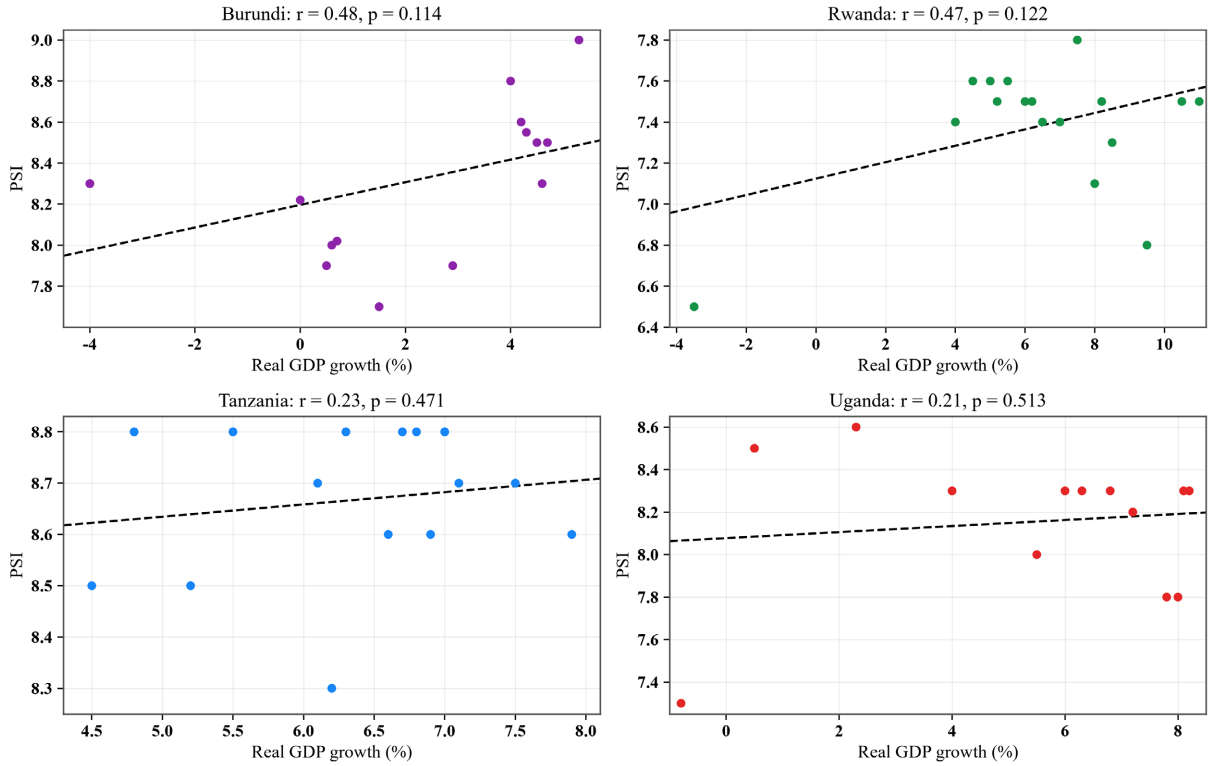
When spending is measured as a share of the total budget, the correlations with PSI are positive and statistically significant in Rwanda (r = 0.64, $p = 0.024$) and Uganda (r = 0.73, $p = 0.007$). Recalling that higher PSI values denote worse service delivery, these positive coefficients indicate that a larger education budget share was contemporaneously associated with worse, not better, service scores in these two countries. The correlations for Tanzania (r = −0.13, $p = 0.681$) and Burundi (r = −0.44, $p = 0.149$) were not statistically significant. No significant association was found between growth and the Public Services Index in any of the four countries: Burundi (r = 0.48, $p = 0.114$), Rwanda (r = 0.47, $p = 0.122$), Tanzania (r = 0.23, $p = 0.471$) and Uganda (r = 0.21, $p = 0.513$). In addition, growth was negatively correlated with the education budget share in Burundi (r = −0.77, $p = 0.003$), consistent with education having been crowded out during the 2015-2016 crisis.

Table 3. Pearson correlations of the independent variables with the Public Services Index, by country (n = 12; two-tailed).

Country	r: EdGDP-PSI	p	r: EdPub-PSI	p	r: Growth-PSI	p
Burundi	+0.83	0.001	−0.44	0.149	+0.48	0.114
Rwanda	+0.55	0.064	+0.64	0.024	+0.47	0.122
Tanzania	−0.29	0.358	−0.13	0.681	+0.23	0.471
Uganda	−0.61	0.035	+0.73	0.007	+0.21	0.513
Pooled (N = 48)	+0.16	0.291	+0.35	0.014	+0.04	0.792
Pooled, Within-Country (Demeaned)	+0.39	0.009	+0.12	0.444	+0.38	0.011

Note: EdGDP = education spending, % of GDP; EdPub = education spending, % of public spending; PSI = Public Services Index (higher = worse). Pooled correlations treat the 48 country-years as independent and are therefore descriptive; their p-values assume independence and are optimistic. Demeaned (within-country) correlations use df = N − G − 2 = 42. 95% CIs (Fisher z): pooled EdGDP [−0.13, +0.42], EdPub [+0.08, +0.58], Growth [−0.25, +0.32]; demeaned EdGDP [+0.10, +0.61], EdPub [−0.19, +0.40], Growth [+0.10, +0.61]. Pooled values are reconstructed exactly from the published country means, SDs, and correlations in Table 2 and Table 3; verify against the raw panel (S1) before final submission.

At the pooled level (Table 3), the EdPub-PSI association is positive and significant (r = +0.35, $p = 0.014$, 95% CI [+0.08, +0.58]), mirroring the country-level pattern, whereas the pooled EdGDP-PSI (r = +0.16, $p = 0.291$) and Growth-PSI (r = +0.04, $p = 0.792$) associations are not significant. The dependence-aware demeaned panel tells a sharper story: within countries, EdGDP (r = +0.39, $p = 0.009$) and Growth (r = +0.38, $p = 0.011$) are positively associated with PSI; that is, year-to-year increases in GDP-share spending and in growth coincided with worse service scores, while the EdPub association dissolves (r = +0.12, $p = 0.444$). The apparent pooled EdPub pattern is thus a between-country artefact, not a within-country regularity.



Note: Higher PSI levels mean worse public services. Dashed lines indicate linear fits; r and p values refer to each country's slope.

Figure 4. Economic growth versus the Public Services Index by country, with fitted OLS lines and Pearson coefficients.

4.5. Pooled OLS Regression

The pooled OLS model in **Table 4(a)** (estimated without country fixed effects; see Equation (2)) accounted for 17.0% of the variance in PSI ($F(3, 44) = 3.01$, $p = 0.040$). Education spending as a share of total public spending was positively and significantly associated with PSI ($\beta = 0.076$, $p = 0.009$): for a one-percentage-point increase in budget share, PSI rose by about 0.08 points on average; that is, service scores were worse. Neither economic growth ($\beta = 0.025$, $p = 0.323$) nor education spending as a share of GDP ($\beta = -0.099$, $p = 0.245$) was significantly associated with PSI. These coefficients are associations, not causal effects.

Because country means alone explain approximately 70% of total PSI variance (Section 5.1), country effects are first-order. **Table 4(b)** therefore reports single-predictor associations estimated two ways: pooled OLS and country fixed effects (the within estimator, equivalent to regression on country-demeaned data). The fixed-effects estimates diverge from the pooled ones: within countries, EdGDP (b = +0.201, SE = 0.074, t(42) = +2.72, $p = 0.009$) and Growth (b = +0.045, SE = 0.017, t(42) = +2.67, $p = 0.011$) are positively associated with PSI, whereas the EdPub association disappears (b = +0.014, SE = 0.019, t(42) = +0.77, $p = 0.444$); within R^2 values are 0.150, 0.014 and 0.146, respectively. The pooled EdPub coefficient (+0.048, $p = 0.014$) is thus a between-country artefact. We deliberately do not report a multivariate fixed-effects model as primary: with four clusters its inference

is unreliable, and with T = 12, HAC-type corrections are only partially informative (see Table 4(b)). Within standard errors assume i.i.d. residuals; with T = 12, serial correlation may still inflate significance, so even these estimates are best read as exploratory. Values are reconstructed exactly from the published means, SDs, and correlations in Table 2 and Table 3; verify against the raw panel (S1).

Table 4. (a) Pooled OLS association with the Public Services Index (N = 48; country fixed effects included). (b) Univariate pooled OLS and country fixed-effects (within) associations with PSI (N = 48).

(a)

Independent Variable	B	SE B	t	*p*
Constant	7.186	0.359	20.03	<0.001
Economic growth (%)	0.025	0.025	1.00	0.323
Education spending, % of GDP (EdGDP)	−0.099	0.084	−1.18	0.245
Education spending, % of public spending (EdPub)	0.076	0.028	2.74	0.009

Note: Dependent variable = PSI (higher = worse service delivery). This model is pooled OLS WITHOUT country fixed effects (Equation (2)): $F(3, 44) = 3.01$, $p = 0.040$; $R^2 = 0.170$. The single-predictor fixed-effects (within) comparison is reported in Table 4(b). Coefficients are associations, not causal effects.

(b)

Predictor	Pooled b (SE)	t (df = 46)	*p*	Within b (SE)	t (df = 42)	*p*	Within R^2
EdGDP (% of GDP)	+0.064 (0.060)	+1.07	0.291	+0.201 (0.074)	+2.72	0.009	0.150
EdPub (% of public spending)	+0.048 (0.019)	+2.56	0.014	+0.014 (0.019)	+0.77	0.444	0.014
Economic growth (%)	+0.007 (0.026)	+0.27	0.792	+0.045 (0.017)	+2.67	0.011	0.146

Note: Within = country fixed effects (country-demeaned) estimator; within R^2 is the share of within-country PSI variance explained. Pooled values reproduce the univariate entries implied by Table 3. Reconstructed exactly from Table 2 and Table 3; verify against the raw panel (S1). Within standard errors assume i.i.d. residuals and may be optimistic under serial correlation.

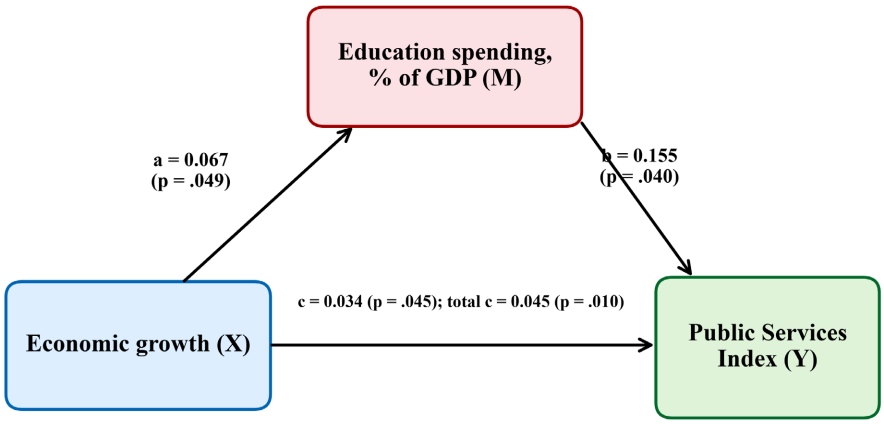
4.6. SO3: The Indirect Association of Growth via Education Spending

Growth was positively associated with the GDP share of education spending (a = 0.067, $p = 0.049$), and education spending was positively associated with PSI conditional on growth (b = 0.155, $p = 0.040$). The product term a × b was 0.010, with a 95% bootstrap confidence interval [−0.002, 0.035] that includes zero; the Sobel test was likewise non-significant (z = 1.39, $p = 0.166$). Using the budget share instead of the GDP share yields a smaller product term (−0.001, 95% CI [−0.009, 0.008]; Sobel z = −0.17, $p = 0.866$). We therefore find no statistical evidence that education spending accompanies the contemporaneous growth-PSI association in this sample. These results describe contemporaneous co-movement; because all measures refer to the same year, they do not support inferences about an indirect causal pathway. Confidence intervals derive from 5000 bootstrap resamples of the 48 observations. Cluster-level resampling was not used: with only four countries, it admits merely $2^4 = 16$ distinct configurations, so its percentile intervals would be uninformative, a limitation rather than a remedy (see Table 5).

Table 5. Mediation of the growth-PSI association through education spending (pooled, N = 48; country fixed effects included).

Mediator Model	a Path (Growth → M)	b Path (M → PSI | Growth)	Direct Path c' (Growth → PSI | M)	Indirect a × b	Bootstrap 95% CI (5000 Resamples)	Sobel Test	Verdict
EdGDP (% of GDP) as mediator	a = 0.067 (p = 0.049)	b = 0.155 (p = 0.040)	c' = 0.034 (p = 0.045)	0.010	[−0.002, 0.035]	z = 1.39, p = 0.166	No statistical accompaniment detected
EdPub (% of public spending) as mediator	a = −0.037 (p = 0.226)	b = 0.016 (p = 0.684)	c' = 0.045 (p = 0.042)	−0.001	[−0.009, 0.008]	z = −0.17, p = 0.866	No statistical accompaniment detected

Note: N = 48 country-year observations. Higher PSI = worse public services. Because X, M, and Y are measured in the same year, the product term is a decomposition of contemporaneous associations, not an indirect causal effect.



Note: Product term a × b = 0.010, bootstrap 95% CI [−0.002, 0.035]; Sobel z = 1.39, p = 0.166.

Figure 5. Mediation model with education spending (% of GDP) as the mediator. Unstandardized coefficients; the confidence interval of the indirect path includes zero.

4.7. Change in Service Delivery over the Period

A paired-samples t-test aggregating the four nations shows that the PSI did not change statistically between 2010 and 2021, t(3) = 0.51, p = 0.642, indicating that, taken together, the four EAC nations did not significantly improve service provision over the twelve years despite differing levels of spending and growth.

5. Discussion

5.1. Summary of Findings in Relation to the Study Objectives

The descriptive analysis (SO1) shows substantial heterogeneity across countries: Rwanda had the most favourable service scores alongside robust growth and middle-of-the-road spending; Tanzania combined the worst average service scores with the steadiest growth; Burundi combined the weakest growth and highest spending with the second-worst service scores. The association tests (SO2) suggest that the association between spending and service delivery is country-specific in sign and magnitude, and that economic growth by itself does not follow a predictable path

of improved service delivery across the dataset. The decomposition analysis (SO3) indicates that the contemporaneous growth-PSI association is not reliably accompanied by variation in education spending: growth is only weakly associated with spending, spending is associated with slightly worse PSI scores, and the product of these associations is estimated too imprecisely to distinguish from zero. Claims in the prior literature that institutions mediate the growth-service relation cannot be confirmed with this data; although institutional quality is plausible as a factor, it cannot be tested with n = 4 series alone.

5.2. Interpretation According to the Previous Literature

Interpreted through the study's theoretical lens, these findings coincide with the claims of human capital theory (HCT) and Total Factor Productivity (TFP) theory. HCT advocates for education spending; TFP posits that spending effects are dependent on the institutions translating inputs into outputs. The finding that the association between spending and service delivery is specific to countries supports arguments that the institutional determinants of efficiency are better predictors of effectiveness than financial inputs (De Witte & Lopez-Torres, 2017).

For instance, as Uganda continues to implement reforms, its expenditure is related to enhanced services.

In contrast, in conflict-prone Burundi, higher expenditure was related to lower service delivery. This resembles results from Europe, where governance institutions dictate the success of the expenditure-outcome linkage (Cordero et al., 2025; Stumbrienė et al., 2025). That growth uncovers no "pay off" corroborates the sustainability literature that institutions fail to convert resources into welfare (Porter & van der Linde, 1995; Kirchherr et al., 2017; Korhonen et al., 2018; Stahel, 2016; Suárez-Eiroa et al., 2019; Corona et al., 2019; Hysa et al., 2020; Ferraz & Pyka, 2023). Our study supports the empirical literature on circular/green innovation in Africa (Andersen et al., 2022; Asongu et al., 2020; Feleke et al., 2021; Marinov, 2025; Rosario et al., 2024) and offers further evidence of the paradigm-shifting hypothesis by Dollar and Kraay (2003) that institutions-not certainly growth-conserve sustainable development. As a result, lack of a growth effect in all studied models explains that.

The divergence between pooled and within estimates (**Table 3** and **Table 4(b)**) sharpens this reading: the budget-share pattern is a between-country artefact, while within countries higher GDP-share spending and faster growth coincide with worse service scores, further evidence that efficiency channels, not input volumes, dominate in this sample (De Witte & Lopez-Torres, 2017).

A construct-validity caveat applies to the outcome measure. The PSI is an expert-coded composite whose education component overlaps conceptually with our education-spending predictors; positive associations between spending and PSI may therefore partly reflect mechanical or perceptual linkage rather than purely fiscal input-output relationships. [If component scores are available: We address this concern in a sensitivity analysis excluding the education component from the com-

posite (Supplementary S4)]. [If component scores are unavailable: Component-level scores were unavailable, so we cannot rule out this contamination; replication with a composite excluding the education component is a priority for future work].

5.3. Country Portraits

With the smallest population, lowest per-capita GDP (<300 USD), highest population density, and persistent institutional and political instability, Burundi is clearly the country with the most pronounced input-output disconnect: its crisis-era fiscal adjustment (a correlation of −0.77 between growth and the education budget share during 2015-2016) coincided with the weakest growth and among the worst service scores in the group. Rwanda, with c. 13 million citizens, institutionalized and centralized governance and constant performance monitoring, exhibited the best PSI scores (reaching 6.5 in 2020) despite a 3.37% economic contraction that year, suggesting that when institutions are in place, service quality can decouple from macroeconomic shocks. Tanzania, the country with the largest territory, a decentralized governance model, and high regional inequalities, illustrates institutional fatigue (Karagiannis & Ravanos, 2025): steady growth and sizeable spending were accompanied by negligible PSI improvement and the worst average score. In Uganda, a country undergoing sustained public financial management reform, GDP-share expenditure was associated with improving service scores, whereas budget-share expenditure was associated with worsening scores; the net trajectory (PSI moving from roughly 8.2 toward 7.3 over 2010-2020) was favourable.

5.4. Implications

Following this work, the study identifies several implications:

a) Increased spending is not linearly associated with improved service delivery unless governance capacity is equally upgraded (Burundi, Tanzania).

b) The Rwandan model of monitoring service delivery performance and managing the effectiveness of budget allocations can serve as a target-setting template for other EAC member states; the robustness of service scores during the 2020 shock implies that strong institutions protect service effectiveness against macro-level volatility (Marinov, 2025; Suárez-Eiroa et al., 2019).

c) Tanzania's decoupling of growth from services suggests that the binding constraint is institutional rather than spending or growth levels alone.

d) Uganda's divergent associations across the two spending measures demonstrate that the fiscal margin along which expenditure rises matters: GDP-share increases accompanied better scores, budget-share increases accompanied worse scores.

5.5. Limitations

This research note comes with five limitations:

i) Data are secondary, meaning that periodic updates are inevitable (e.g., revisions of national accounts by statistical bureaux). All values were checked against the most recent edition, but "vintage effects" remain a risk.

ii) The study is purposively restricted to four EAC countries (Kenya and South Sudan were excluded); generalizations to the entire EAC bloc should be made cautiously.

iii) With only 12 points per country (n = 12), the correlation and decomposition analyses are fundamentally exploratory; power is low, and undetected small effects may exist.

iv) In a correlational design that aggregates yearly data, causation cannot be established; the PSI is an ordinal expert-based composite, so linear models are approximations; and same-year measurement precludes any claim of temporal ordering in the decomposition analysis.

v) Economic growth is captured by a single annual index, which does not account for the composition or quality of growth emphasized in the circular economy literature; aggregate data mask subnational disparities; and the COVID-19 shock affects the growth trajectory in all models.

vi) The dependent variable is a composite that includes an education sub-indicator, creating potential non-independence from the education-spending regressors; associations should be interpreted with this circularity in mind. In addition, with only four countries (clusters), no dependence-robust inferential method is fully reliable; we report within-country (demeaned) and single-predictor fixed-effects estimates as partial checks, but all inferential results remain exploratory.

6. Conclusion

This study explored longitudinal correlations between public spending on education, economic growth and the PSI for four EAC partner states from 2010-2021. The results reveal that there is no support that was found for the hypothesis that growth is statistically accompanied by service-delivery variation operating through contemporaneous education spending (product term = 0.010, 95% CI [−0.002, 0.035]).

In this constellation, Rwanda stands as a useful benchmark, showing that when institutions are up to the task, moderate spending levels can coincide with the best service scores even under a growth shock. Burundi exemplifies the opposite: high spending and weak growth without governance capacity coincide with some of the worst service outcomes. Tanzania represents stasis when inputs are divorced from institutions; Uganda shows what is possible when investment is steered by reforms, with the fiscal margin of spending mattering. Thus, for EAC partner states facing fiscal realities, the immediate policy focus should not be more spending on education or faster growth per se, but governance reforms that ensure each unit of money or percentage point of growth translates into concrete service to the public. Because all findings are associational—resting on four countries and twelve years each—causal pathways remain untested. Future research should revisit these as-

sociations with composition-sensitive growth measures, institutional country metrics of sufficient power for decomposition analyses, and mixed-methods designs pairing Data Envelopment Analysis with interviews among policymakers, budget directors and service providers.

Ethical Statement

As this research was entirely reliant on aggregate secondary macro-public data and entailed no human or animal subject intervention, formal ethics committee clearance was not required. The authors have adhered to broadly applicable guidelines concerning ethical integrity in educational research.

Data Availability Statement

Data for this article are aggregated from the following open access databases: for education spending from the UNESCO Institute for Statistics; for Public Services Index (PSI) from the Fund for Peace (Fragile States Index); and for economic growth, all compiled through the IMF/World Bank and harmonized at The Global Economy.com (https://www.theglobaleconomy.com/). The synthesized panel and all related analysis code can be made available upon reasonable request to the author(s).

Supplementary Materials

Supplementary material associated with this article includes: S1 (the synthesized 48-observation country-year panel, machine-readable format); S2 (Python 3.12 analysis code for all descriptive tables, correlations, regressions, bootstrapped decompositions and charts); S3 (original high-resolution charts for **Figures 1-5**); and S4 (where available, a sensitivity analysis of the PSI excluding its education component). Supplementary files are available from the author(s) upon reasonable request, subject to the terms of the Data Availability statement.

Author Contributions

Estimé Nobel Basabakwinshi and Léonidas Ndayizeye conceived, designed, performed, curated, analyzed, visualized, drafted, and revised all contributions related to this submission. All authors have approved this final manuscript.

Conflicts of Interest

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

References

Abramovitz, M. (1956). Resource and Output Trends in the United States Since 1870. *American Economic Review, 46,* 5-23. https://ideas.repec.org/h/nbr/nberch/5650.html

Afonso, G. P., Figueira, J. R., & Ferreira, D. C. (2025). Dealing with Uncertainty in Healthcare Performance Assessment: A Fuzzy Network-DEA Approach with Undesirable Outputs. *International Transactions in Operational Research, 32,* 2732-2766.

https://doi.org/10.1111/itor.13490

Agasisti, T. (2023). The Efficiency of Higher Education Institutions and Systems. In *Handbook on Public Sector Efficiency* (pp. 274-290). Edward Elgar Publishing. https://doi.org/10.4337/9781839109164.00020

Agasisti, T., Egorov, A., Platonova, D., & Serebrennikov, P. (2025). Universities' Internal Governance and Their Efficiency: Empirical Evidence from Russia. *International Transactions in Operational Research, 32,* 2566-2592. https://doi.org/10.1111/itor.13462

Amirteimoori, A. (2025). Efficiency Analysis in Two-Stage Data Envelopment Analysis with Shared Resources and Undesirable Outputs: An Application in the Banking Sector. *International Transactions in Operational Research, 32,* 2453-2473. https://doi.org/10.1111/itor.13454

Andersen, M. M., Ogallo, E., & Faria, L. G. D. (2022). Green Economic Change in Africa—Green and Circular Innovation Trends, Conditions and Dynamics in Kenyan Companies. *Innovation and Development, 12,* 231-257. https://doi.org/10.1080/2157930x.2021.1876586

Aparicio, J., & Santín, D. (2025). Global Scale Efficiency in Data Envelopment Analysis. *International Transactions in Operational Research, 32,* 2474-2496. https://doi.org/10.1111/itor.13501

Asongu, S. A., Le Roux, S., & Biekpe, N. (2020). Enhancing ICT for Environmental Sustainability in Sub-Saharan Africa. *Technological Forecasting and Social Change, 155,* Article 120028.

Barro, R. J. (1991). Economic Growth in a Cross Section of Countries. *The Quarterly Journal of Economics, 106,* 407-443. https://doi.org/10.2307/2937943

Becker, G. S. (1964). *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. Columbia University Press. https://www.nber.org/system/files/chapters/c3730/c3730.pdf

Boliver, V. (2017). Misplaced Optimism: How Higher Education Reproduces Rather than Reduces Social Inequality. *British Journal of Sociology of Education, 38,* 423-432. https://doi.org/10.1080/01425692.2017.1281648

Boliver, V., & Promenzio, L. (2025). The Hyper-Commodification of Higher Education in England in Cross-Nationally Comparative Perspective. *Higher Education, 91,* 1107-1125. https://doi.org/10.1007/s10734-025-01459-3

Callender, C. (2023). Policy Divergence: Changes in Student Funding Systems across the UK Since 2002/03. In H. Carasso (Ed.), *UK Higher Education—Policy, Practice and Debate during HEPI's First 20 Years* (pp. 71-87). Higher Education Policy Institute. https://www.hepi.ac.uk/2023/08/10/policy-divergence-changes-in-student-funding-systems-across-the-uk-since-2002-03/

Cordero, J. M., Sicilia, G., & Simancas, R. (2025). Educational Efficiency across Spanish Regions: A Comparative Analysis over Time. *International Transactions in Operational Research, 32,* 2645-2676. https://doi.org/10.1111/itor.13567

Corona, B., Shen, L., Reike, D., Rosales Carreón, J., & Worrell, E. (2019). Towards Sustainable Development through the Circular Economy—A Review and Critical Assessment on Current Circularity Metrics. *Resources, Conservation and Recycling, 151,* Article 104498. https://doi.org/10.1016/j.resconrec.2019.104498

de Jesus, A., & Mendonça, S. (2018). Lost in Transition? Drivers and Barriers in the Eco-Innovation Road to the Circular Economy. *Ecological Economics, 145,* 75-89. https://doi.org/10.1016/j.ecolecon.2017.08.001

de la Torre, E. M., & Perez-Esparrells, C. (2019). Reforms in the Spanish Higher Education

System Since Democracy and Future Challenges. In *Higher Education System Reform* (pp. 119-135). Brill Publishers. https://doi.org/10.1163/9789004400115_008

De Witte, K., & Lopez-Torres, L. (2017). Efficiency in Education: A Review of Literature and a Way Forward. *Journal of the Operational Research Society, 68,* 339-363. https://doi.org/10.1057/jors.2015.92

Dollar, D., & Kraay, A. (2003). Institutions, Trade, and Growth. *Journal of Monetary Economics, 50,* 133-162. https://doi.org/10.1016/s0304-3932(02)00206-4

Easterly, W., & Levine, R. (2001). What Have We Learned from a Decade of Empirical Research on Growth? It's Not Factor Accumulation: Stylized Facts and Growth Models. *The World Bank Economic Review, 15,* 177-219. https://doi.org/10.1093/wber/15.2.177

España, V. J., Aparicio, J., & Barber, X. (2025). An Adaptation of Random Forest to Estimate Convex Non-Parametric Production Technologies: An Empirical Illustration of Efficiency Measurement in Education. *International Transactions in Operational Research, 32,* 2523-2546. https://doi.org/10.1111/itor.13561

Feleke, S., Cole, S. M., Sekabira, H., Djouaka, R., & Manyong, V. (2021). Circular Bioeconomy Research for Development in Sub-Saharan Africa: Innovations, Gaps, and Actions. *Sustainability, 13,* Article 1926. https://doi.org/10.3390/su13041926

Ferraz, D., & Pyka, A. (2023). Circular Economy, Bioeconomy, and Sustainable Development Goals: A Systematic Literature Review. *Environmental Science and Pollution Research*. https://doi.org/10.1007/s11356-023-29632-0

Fund for Peace (2024). Fragile States Index: Public Services Indicator [Data Set]. *TheGlobalEconomy.com*. https://www.theglobaleconomy.com/rankings/fragile_state_index/

Goddard, J., Hazelkorn, E., Kempton, L., & Vallance, P. (2016). *The Civic University: The Policy and Leadership Challenges*. Edward Elgar. https://aca-secretariat.be/newsletter/the-civic-university-the-policy-and-leadership-challenges/

Hysa, E., Kruja, A., Rehman, N. U., & Laurenti, R. (2020). Circular Economy Innovation and Environmental Sustainability Impact on Economic Growth: An Integrated Model for Sustainable Development. *Sustainability, 12,* Article 4831. https://doi.org/10.3390/su12124831

Jabbar, A., Analoui, B., Kong, K., & Mirza, M. (2017). Consumerisation in UK Higher Education Business Schools: Higher Fees, Greater Stress and Debatable Outcomes. *Higher Education, 76,* 85-100. https://doi.org/10.1007/s10734-017-0196-z

Johnes, G., Tsionas, M., & Izzeldin, M. (2025). Multi-Stage Stochastic Frontier Analysis for Simple Networks. *International Transactions in Operational Research, 32,* 2497-2522. https://doi.org/10.1111/itor.13538

Johnes, J., & Perez-Esparrells, C. (2025). The Quest for Efficiency in Higher Education in England: Lessons Learned for Developed Economies. *International Transactions in Operational Research, 32,* 2677-2706. https://doi.org/10.1111/itor.13583

Jorgenson, D. W., & Griliches, Z. (1967). The Explanation of Productivity Change. *The Review of Economic Studies, 34,* 249-283. https://doi.org/10.2307/2296675

Kahia, M., Aïssa, M. S. B., & Lanouar, C. (2019). Renewable and Non-Renewable Energy Use-Economic Growth Nexus: The Case of MENA Net Oil Importing Countries. *Renewable Energy, 133,* 1-12.

Karagiannis, G., & Ravanos, P. (2025). Analyzing Changes in EU Social Inclusion Using the Global Malmquist Productivity Index. *International Transactions in Operational Research, 32,* 2798-2818. https://doi.org/10.1111/itor.13519

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the Circular Economy: An

Analysis of 114 Definitions. *Resources, Conservation and Recycling, 127,* 221-232. https://doi.org/10.1016/j.resconrec.2017.09.005

Korhonen, J., Honkasalo, A., & Seppälä, J. (2018). Circular Economy: The Concept and Its Limitations. *Ecological Economics, 143,* 37-46. https://doi.org/10.1016/j.ecolecon.2017.06.041

Krugman, P. (1994). The Myth of Asia's Miracle. *Foreign Affairs, 73,* 62-78. https://doi.org/10.2307/20046929

Lieder, M., & Rashid, A. (2016). Towards Circular Economy Implementation: A Comprehensive Review in Context of Manufacturing Industry. *Journal of Cleaner Production, 115,* 36-51. https://doi.org/10.1016/j.jclepro.2015.12.042

Lucas, R. E. (1988). On the Mechanics of Economic Development. *Journal of Monetary Economics, 22,* 3-42. https://doi.org/10.1016/0304-3932(88)90168-7

Maldonado, J. E., & De Witte, K. (2022). The Effect of School Closures on Standardised Student Test Outcomes. *British Educational Research Journal, 48,* 49-94. https://doi.org/10.1002/berj.3754

Marginson, S. (2018). Public/Private in Higher Education: A Synthesis of Economic and Political Approaches. *Studies in Higher Education, 43,* 322-337. https://doi.org/10.1080/03075079.2016.1168797

Marinov, E. (2025). Green Transition and Circular Economy Practices: Unlocking Africa's Potential for Sustainable Growth. *Environment, Technology, Resources, 1,* 355-362. https://doi.org/10.17770/etr2025vol1.8648

Mazzucato, M. (2023). Governing the Economics of the Common Good: From Correcting Market Failures to Shaping Collective Goals. *Journal of Economic Policy Reform, 27,* 1-24. https://doi.org/10.1080/17487870.2023.2280969

Mergoni, A., Emrouznejad, A., & De Witte, K. (2025). Fifty Years of Data Envelopment Analysis. *European Journal of Operational Research, 326,* 389-412. https://doi.org/10.1016/j.ejor.2024.12.049

Mincer, J. (1974). *Schooling, Experience and Earnings*. Columbia University Press. https://www.nber.org/system/files/chapters/c1765/c1765.pdf

Naidoo, R. (2015). The Competition Fetish in Higher Education: Varieties, Animators and Consequences. *British Journal of Sociology of Education, 37,* 1-10. https://doi.org/10.1080/01425692.2015.1116209

Nixon, E., Scullion, R., & Hearn, R. (2016). Her Majesty the Student: Marketised Higher Education and the Narcissistic (Dis)satisfactions of the Student-Consumer. *Studies in Higher Education, 43,* 927-943. https://doi.org/10.1080/03075079.2016.1196353

OECD (2023). *Education at a Glance 2023: OECD Indicators*. OECD Publishing. https://www.oecd.org/en/publications/education-at-a-glance-2023_e13bef63-en.html

Porter, M. E., & van der Linde, C. (1995). Toward a New Conception of the Environment-Competitiveness Relationship. *Journal of Economic Perspectives, 9,* 97-118. https://doi.org/10.1257/jep.9.4.97

Romer, P. M. (1990). Endogenous Technological Change. *Journal of Political Economy, 98,* S71-S102. https://doi.org/10.1086/261725

Rosario, A. T., Lopes, P., & Sales Espa, F. (2024). Sustainability and the Circular Economy Business Development. *Sustainability, 16,* Article 6092. https://doi.org/10.3390/su16146092

Schultz, T. W. (1961). Investment in Human Capital. *American Economic Review, 51,* 1-17. https://www.jstor.org/stable/1818907

Solow, R. M. (1957). Technical Change and the Aggregate Production Function. *The Review of Economics and Statistics, 39,* 312. https://doi.org/10.2307/1926047

Stahel, W. R. (2016). The Circular Economy. *Nature, 531,* 435-438. https://doi.org/10.1038/531435a

Stumbrienė, D., Ruiz, J. L., & Sirvent, I. (2025). Rethinking EU-Level Goals: Different Strategies to Improve National Performance toward the European Education Area Objectives. *International Transactions in Operational Research, 32,* 2819-2846. https://doi.org/10.1111/itor.13546

Suárez-Eiroa, B., Fernández, E., Méndez-Martínez, G., & Soto-Oñate, D. (2019). Operational Principles of Circular Economy for Sustainable Development: Linking Theory and Practice. *Journal of Cleaner Production, 214,* 952-961. https://doi.org/10.1016/j.jclepro.2018.12.271

TheGlobalEconomy.com (2026). *Economic Growth Forecast, Percent—East African Countries [Data Set].* https://www.theglobaleconomy.com/rankings/gdp_growth_outlook_imf/Africa/

Triguero, A., Moreno-Mondéjar, L., & Davia, M. A. (2013). Drivers of Different Types of Eco-Innovation in European SMEs. *Ecological Economics, 92,* 25-33. https://doi.org/10.1016/j.ecolecon.2013.04.009

UNESCO Institute for Statistics (2024). Government Spending on Education as a Percentage of GDP and of Total Government Spending [Data Set]. *TheGlobalEconomy.com.* https://www.theglobaleconomy.com/world/brent_oil_prices/