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What policy-relevant evidence exists to support the use of alternative financing models (PPPs) in reducing Sub-Saharan Africa's rural education infrastructure gap relative to inaction or stagnant investment?

Mayaki, Alfred Anate Bodurin[1]
Nigeria

Royal Economic Society (UK)
Open University Business School, Open University (UK)

Office: +44 203 745 5372
ibrdigital.london@gmail.com

Abstract

Sub-Saharan Africa faces a substantial education infrastructure investment deficit, with an estimated annual financing gap of US$70 billion required to achieve Sustainable Development Goal 4 (SDG4) by 2030. This shortfall is exacerbated by rapid population growth, urbanization, and limited fiscal space, leading to overcrowded classrooms, inadequate facilities, and significant disparities in access to quality education. This paper examines the magnitude and implications of the education infrastructure deficit in the region, analyzing current investment levels, demographic trends, and the effectiveness of existing financing mechanisms. It also explores innovative financing solutions, including public-private partnerships and blended finance models, to mobilize additional resources. The study underscores the urgency of addressing the infrastructure gap to ensure equitable access to education and to harness the demographic dividend for sustainable economic growth.

Keywords[2]: African Union, Education, Infrastructure, Development, Trade, Policy

[1] alfred.mayaki@ou.ac.uk
[2] The four Journal of Economic Literature codes that classify this paper are: F17, F43, R51, R58

DECLARATION

All aspects of this conference publication and all supplementary data has been authored by the signatory, prior to formal submission, and all sources of information included herein have been attributed to the appropriate sources accordingly.

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Alfred Anate Bodurin Mayaki[3]

Date

Open University ID: O8309334

[3] At the time of publication, the author was a Student in Human Resource Management at Open University

Foreword & Acknowledgements

I would firstly like to congratulate the newly appointed Chairperson of the African Union Commission, H.E. Mahamoud Ali Youssouf of Djibouti, on his recent appointment to High Office in March 2025, subsequent to the proceedings of the 38th Ordinary Session of the Assembly of Heads of State and Government. Nigeria wishes the Chair every success in his professional endeavours in his capacity as Chair and send our best wishes and regards to the outgoing Chairperson of the AU Commission, H.E. Moussa Faki Mahamat of Chad. Secondly, Nigeria sends compliments to Mr. Nuur Mohamud Sheekh, the newly appointed Spokesperson for the Chairperson of the African Union Commission. We wish Mr. Sheekh every continued success in his new executive role promoting and supporting peace and security across the African continent as a spokesperson, on behalf of the Office of the Chair.

GLOSSARY

AfCFTA	African Continental Free Trade Area
AU	African Union
CAE	Congress of African Economists
PICOS	Population, Intervention, Comparison, Outcome, Study Design
PPCI-1	Program to Support Private Participation and Concessions in Infrastructure
PPPs	Public-Private Partnerships
SCSD	The School Construction Systems Development
SDGs	Sustainable Development Goals

INTRODUCTION

This article is not intended to be another rebuffed effort which argues for a greater scope for public-private partnerships (PPPs), more business-as-usual lending frameworks, or for more unsuitably designed infrastructure- funding for Sub-Saharan African governments. It is, however, a concise study *of* existing PPP studies, so to speak. Using Cochrane's PICOS framework (A framework which examines the *Population, Intervention, Comparison, Outcomes, Study Design* approach) to define the specific research question, it is possible to survey what solutions have been proposed and what findings have emerged from the literature.

Many in academia will agree that AfCFTA presents a strategic opportunity for many African states to mobilize regional investment for social infrastructure, specifically for a medium-term horizon targeted at the alleviation of conditions of resource scarcity and deficiency in rural education in Sub-Saharan Africa. Over four years in, as Member States continually align with one another, creating greater trade links, investment prospects, and frameworks of co-operation, AfCFTA serves as a catalyst for other scalable, cross-border financing models. This review highlights the potential for AfCFTA-aligned strategies to diminish infrastructure gaps in the design of mechanisms to finance rural education, enabling broader access to better quality education and supporting the development of a skilled, trans-continental workforce essential to Africa's single market ambitions. Closing this infrastructure gap is not only a social imperative but a foundational enabler of inclusive growth under AfCFTA.

Indeed, out of the 144 measurable Sustainable Development Goal (SDG) targets, Africa is on track to achieve only 10 SDG targets by 2030 (Ramaite and Le Roux, 2024). Social infrastructure PPPs and the other capital investment needs of countries in Sub-Saharan Africa, relating specifically to core social infrastructure and government-provided educational facilities is in a circumstance of small-scale crisis, a crisis within a crisis. As attention is drawn away, and funding deflected away from social infrastructure in support of climate change, deforestation and biodiversity, the take up of the lion share of SDG gap financing is shifting, policy aspects such as the Pareto-effect created via free continental trade, fall by the waste-side, becoming nonchalant issues.

However, as we will come to see, when Member States operate inwardly like this, not only are there disadvantages, but there are inefficiencies which have great cost. According to reports, just 12% of schools in rural Sub-Saharan Africa have reliable internet, and more than 50% of schools in Sub-Saharan Africa lack adequate access to electricity, clean water and sanitation facilities. Teaching quality and academic retention is also a matter of concern. While the perceived investment gap (i.e. the gap between the *actual* and the *required* level of social infrastructure investment) varies in range by country-specific requirements in educational resources across studies on the subject, what continues to characterise this crisis is an inadequacy, not merely of *access* to basic amenities, but of effective and credible financial *solutions*.

RESEARCH DESIGN AND EMPIRICAL METHODOLOGY

This research takes the form of an evidence-based, empirically designed systematic literature review into the financial outcomes of investment into social infrastructure in Sub-Saharan Africa. It will aim to assess the contribution of a narrow theme of literature taken from specific academic journals. PICO is a valuable framework for assessing the relevant aspects which underpin a systematic review. We attribute a significant proportion of the paper to this concept.

- *Population*: The population is defined as participants and active users of the rural school system in Sub-Saharan African countries
- *Intervention*: Social infrastructure PPPs, private sector philanthropy, social bonds, and government tranche loans (repayable at interest)
- *Comparison*: A counterfactual scenario of stagnant investment from 2025 to 2030
- *Outcomes*: A level-playing field in school infrastructure on the world stage
- *Study Design*: Systematic review and Meta-Analysis

Across the nine-year research timeline, the first five consecutive years encompass the span of the systematic review[4], and the remaining consecutive years make up the empirical element of the study with monthly data. Crucially, we shall navigate around the 1 January 2021 as a key date where a discursive turn of AfCFTA enforcement takes place. The dedicated timescale of the study will range from a) the date of inauguration of the SDG programme itself, beginning 1 January 2016 through to b) the date with which the AfCFTA agreement was legally enforceable - on 1 January 2021. Thereafter, we shall use data sourced from the likes of the United Nations, and the African Development Bank to project two counterfactual scenarios.

Table 1.1 - *Timeline for Primary Research*

Timeline for Study[5]	**Start / End**	**Significance to the Study**
1 January 2016	Start of sys review	Inauguration date of SDG programme
1 January 2021	End of sys review	Enforcement date of AfCFTA
1 January 2021	Start of analysis	Enforcement date of AfCFTA
1 January 2025	End of analysis	Cut-off date for empirical analysis
1 January 2025	Start of forecast	Start date for statistical forecast
31 Decembre 2030	End of forecast	Completion date of SDG programme

The selected methodology used in modelling the forecasted scenarios with economic data will simply be an extrapolation of two counterfactual events 1) a standard forecasted event premised on data from real world sources and 2) a *Pareto-optimal* forecasted event which assumes the required level of infrastructure investment is achieved. Each event, estimated by Maximum Likelihood Estimation will then be contrasted to the AU Commission's policy environment on economic development.

[4] There are a total of sixty-two articles presently being returned upon an initial search for the term "social infrastructure PPPs" and thirty-six results for the term "infrastructure for educational institutions" both including specific reference to the situation in Africa.

[5] To be absolutely clear, the empirical research dates are representative of projections using real world data (as opposed to synthetic data), whereas the applied systematic review dates apply to dates with which selected pieces of academic literature were originally published.

A Systematic Review of Literature

Geng *et. al* (2020) argue that unlike economic PPPs, social infrastructure PPPs are procured with a '*more performance-based'* service specification(s). Their comparative study sides with the view that '*perceived service quality*' frameworks have KPI-ready factors – so to speak – that can be used to assess investment in the schools within the study's reach. Michelitsch *et. al* (2017) propose the example of Colombia in the region classified as Latin America and the Caribbean, who's National Planning Department procured on several occasions social infrastructure funding via the Inter-American Development Bank Group for its '*Program to Support Private Participation and Concessions in Infrastructure* (PPCI-1)'.

Michelitsch *et. al* (2017) explore synergies and operation efficiencies in social infrastructure PPP more broadly but focuses on the example of investment in health and education, namely an approved US$165 million loan to modernize and expand El Dorado International Airport in Bogotá and a US$158 million loan, approved in 2015, to co-finance the Perimetral Oriental de Bogotá, a 154 km highway upgrade.

'*Colombia's objectives were to (i) consolidate and strengthen the regulatory framework and technical and institutional capacity of policy, regulatory, and oversight agencies in several sectors (transport, energy, water, and social infrastructure such as health and education); and (ii) support the technical, economic, financial, and/or legal development of processes for private participation*' (pp. 18).

But more relevant to social infrastructure PPPs is the idea of wear and tear or as Mukuvari (2020) puts it 'obsolescence' or the state of being obsolete. The author explores the concept of a '*minimal acceptable standard*' related to the performance of a service facilities (namely, hospitals) over the core asset's lifecycle (National Research Council, 1993).

'The School Construction Systems Development (SCSD) project—initiated in 1962 with funds from the Ford Foundation's Educational Facilities Laboratories—was intended to reduce construction costs; improve the ability to accommodate change; enhance lighting, acoustics, and air conditioning standards; and demonstrate the viability of involving manufacturers in building research based on a common set of modular specifications' (pp. 40).

More notably, the article's audience are redirected to the construction and design of Stanford University's Palo Alto campus, originally designed and constructed in 1967 using SCSD project specifications. Ostensibly, this view, which permeates throughout various other books (Lee, 2018) defines SCSD as an applaudable architectural context worth studying further. Lee (2018) also establishes how the University of California's University Residential Building System (URBS) is an important context to discern for African social infrastructure PPPs, albeit, to a less comparative extent.

While SCSD systems-based, modular, and performance-focused specification demonstrate contextuality in the aforementioned setting. There is no evidence that duplication in the context of African Union Member States would invoke '*parallel*' and efficient built infrastructure performance levels across states. What may be required is a further assessment of SCSD's credibility as a trans-continental project model.

Model Specification

Consider a dynamic open model of an economy with simulated trade links where there is an endogenous, zero-lower bounded interest rate r. Interest is levied on all financial capital[6] by an independent monetary authority and adjusts to inflation and output imbalances over time. The lower bound assumption serves initially to derive an optimal level of asset depreciation over time. Assuming infrastructure asset accumulation or capital ownership yields economic growth based on a principle of labour effectiveness. We measure capital accumulation through an annual balance of payments account which is measured as a proportion of output, which is in turn correlated positively with the economy's trade surplus.

Firms

There are n_t firms in this economy, each assumed to be competitive in a Walrasian sense, with venture capital endowment of e_n, core allocations at market equilibrium, and revenues subject to corporation tax, x_n. Firms employ workers at a given wage subsidy w_t, which can be negotiated with government. Firm n's revenue function is thus interpreted in reduced form as:

$$F_n(e, w, x, p, q, c) \tag{2.01}$$

$$(e, w, x, p, q, c) = \max_q \ [e + (p - c)q + q(w - x)] \tag{2.01.2}$$

Governments

Now, let G_t denote central government revenues, which are collected electronically, by an administration that is elected every five years. An administration chooses G to optimise revenues via a function that levies an optimal tax rate along a Laffer curve γ given by $\gamma = 1/x$.

As with the examples of Stanford and California, and to a less direct extent, Colombia and Latin America and the Caribbean, we find a similar theme espousing. One where a) a formal investor provides Member State governments with financial and institutional capacity and b) Member State government rural or land planning departments themselves focusing on extended performance evaluation (KPIs and SCSD or URBS design control), operational cost synergies, and the minimising of obsolescence over the life cycle of the infrastructure asset. In Western circles, these aspects refer to a concept known formally as the balancing of 'core, core plus or value-add' infrastructure investment outcomes. In Sub-Saharan Africa, the African Development Bank (AfDB) measure this context though the African Infrastructure Development Index (AIDI) via its four semi-indicators:

- The Transport Composite Index (TCI)
- The Electricity Composite Index (ECI)
- The ICT Composite Index (ICI)
- The Water Supply and Sanitation Composite Index (WSSI)

[6] The term '*social infrastructure*' retains a convoluted definition. On the one hand, in Moser (2008), Mahajan argues correctly in 'Beyond Microfinance' how '*physical capital'* generally includes *'buildings, industrial plants, machinery, and infrastructure'*. Whereas, in this context, this is made distinctive to '*social capital*' which Mahajan as found in Moser (2008) argues consists of '*kinship groups, associations, institutions, and trust and norms'*.

GOVERNMENTS (CONTINUED)

Estimating the relationship between the aforementioned AfDB's Infrastructure Development Index (AIDI) and what Bosire (2020) define as foreign direct inflows into Africa's Member States, Bosire (2020) uses the following baseline econometric panel model which includes two additional independent variables, omitted from the below model (2.02) found in this paper. One is MS which represents market size and the second is $TTCR$ which represents a total tax contributions rate. Where FDI_{it} is a dependent variable comprised of the IMF's Balance of Payments Index, and where $AIDI_{it}$, TCI_{it} ECI_{it}, ICI_{it} and $WSSI_{it}$ are independent variables. The MLE error term is ε_0.

(2.02) $$FDI_{it} = \alpha + \beta_1 AIDI_{it} + \beta_2 TCI_{it} + \beta_3 ECI_{it} + \beta_4 ICI_{it} + \beta_5 WSSI_{it} + \varepsilon_0$$

In this model, the government's intertemporal budget constraint is a function that is programmed to maximise industrial asset or capital accumulation given a quasi-concave tax function which is optimised itself under specific conditions.

Research Findings

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