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Call for Papers by the African Union

“Investing in Infrastructure for Productive Transformation in Africa”.

The 7th Congress of African Economists (CAE)

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The "Investing in Infrastructure for Productive Transformation in Africa" theme focuses on the crucial role of infrastructure development in driving economic growth and development across the continent. The theme highlights the need for robust infrastructure to support various sectors like energy, transportation, and digital connectivity, which can unlock economic opportunities and improve the quality of life for Africans.

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Conference Paper: The 7th Congress of African Economists

“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”?



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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.

Keywords²: Education, Infrastructure, Economic Growth and Development, Policy

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² The 4 Journal of Economic Literature codes that accurately classify this paper are: F17, F43, R51, R58

Author Declarations

This declaration hereby confirms that all written and researched aspects of this African Union conference publication as well as all primary supplementary findings and secondary study data has been duly authored with the appropriate considerations made to the high standards of academic integrity imposed on the signatory, prior to a formal submission, and with all sources of information included herein being attributed to right and proper journal sources accordingly. The author also assuredly declares no evident conflicts of interest and that absolutely no funding was received either partly or indirectly to supplement any section or element of this independently produced publication.



06 MAY 2025

Signed: **A. A. B. Mayaki**³

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

Author Foreword & Acknowledgements

I would firstly like to congratulate the newly appointed Chairperson of the African Union Commission (AUC), **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 new AUC Chair every success in his professional endeavours in his capacity as AUC Chair and send our best wishes and regards to the outgoing Chairperson of the AUC, 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 AUC. We wish Mr. Sheekh every continued success in his new executive role promoting and supporting peace and security across the entire African continent as a spokesperson, on behalf of the Office of the AUC Chair.

I would secondly like to commend the industrious and favourable work being conducted by the Honourable Minister for Education, within the democratically elected Government of the Federal Republic of Nigeria, H.E. Dr. Tunji Alausa and his departmental staff for continuing to support efforts and opportunities for better research into the financing of rural education and infrastructure development in Nigeria.

Thirdly, with reference to the esteem and prevalence of this submission response, I would like to take a moment to draw our attention to the good work being conducted by the Nigerian Infrastructure Concession Regulatory Commission, and the Director-General of the commission, Dr. Jobson Oseodion Ewalefoh, whilst congratulating the Honourable Minister for the Federal Ministry of Industry, Trade and Investment, Dr. Jumoke Oduwole.

I am also continually appreciative and thankful to the **President of Nigeria, H.E. President Bola Ahmed Tinubu** for his wisdom and influence on the world stage as a leader and arbiter for rural communities in the Federal Republic of Nigeria and ongoing academic research in support of investment products such as social infrastructure public-private partnerships. To conclude, I am continually grateful to both Dr. Stefan Niemann and Prof. Joao Santos Silva who I had the joy and pleasure of being a student of in my days at the University of Essex.

Glossary of Abbreviations

AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
AU	African Union
AUC	African Union Commission
CAE	Congress of African Economists
ICRC	Infrastructure Concession Regulatory Commission
MLE	Maximum Likelihood Estimation
PICOS	Population, Intervention, Comparison, Outcome, Study Design
PPCI-1	Program to Support Private Participation and Concessions in Infrastructure
PPP	Public-Private Partnerships
SCSD	The School Construction Systems Development
SDG	Sustainable Development Goals
URBS	University Residential Building System

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Estimating the African Union's SDG Production Frontier

This article presents a research study which estimates the impact of public-private partnerships (PPP) and similar financing frameworks on what this paper refers to as the production frontier of planned economies within the United Nations (UN) Sustainable Development Goals (SDG) programme. Namely, SDG4 on quality education. It does not argue specifically for a greater scope for PPPs despite global frictions in international and cross-continental trade, nor does it argue for more business-as-usual lending frameworks in countries within Africa. Further still, the article avoids widely accepted argument for yet more inadequately designed and unsuitable long-term infrastructure funding frameworks for African governments. It is, on the other hand, a concise study of *existing* PPP studies and the economics involved.

Out of the potential 144 measurable 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 Africa, relating specifically to core social infrastructure and government-provided education 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 matters of concern. Some of the sufferers of this seismic shift are pupils enrolled in rural education.

Some published reports have highlighted how PPP is a crucial element in the financing of rural infrastructure for education (Adamson, Taneja, and Walker, 2025). However, as this paper will elaborate, when AU Member States operate by attempting to fulfil low-hanging SDGs, not only are there obvious disadvantages, but there are inefficiencies which have great comparative cost (Engel, Fisher and Galetovic, 2007). According to reports, just 12% of schools in rural parts of Africa have reliable internet, and more than 50% of schools in Sub-Saharan Africa lack adequate access to electricity, clean water and sanitation facilities⁴. 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 in rural parts of Africa, but of effective and credible financial *solutions*.

For the purposes of the study, the population is defined as participants and active users of the rural school system in African countries. The intervention is defined as social infrastructure PPPs, and government tranche loans (repayable to concessionaires at interest rate r). Comparisons are defined as a counterfactual scenario of stagnant investment from 2025 to 2030. Outcomes are defined as a more equal level-playing field in school infrastructure on the world stage, while Study Design is defined as both a systematic review and meta-analysis.

Across the simulated research timeline, the first five consecutive years encompass the span of the systematic review, 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, through to b) the date with which the AfCFTA agreement was legally enforceable. Thereafter, we shall use data sourced from the likes of the UN, and the African Development Bank (AfDB) to project two counterfactual scenarios.

The selected methodology used in modelling the forecasted scenarios with economic data will simply be a historical 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 – assuming a 20% shift in foreign direct inflows. Each event, estimated by simulated OLS and Maximum Likelihood Estimation (MLE) will then be contrasted to the AU Commission's policy environment on economic development.

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

⁴ These concerns are measured by the AfDB's infrastructure indices and semi-indices, which is elaborated on later in the paper.

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. In Engel, Fisher and Galetovic (2007) the authors explore a £190 million infrastructure upgrade in Essex, UK financed by 100% debt arguing convincingly about the concessional nature of long-term infrastructure debt.

What are we noticing here? Well, for one, social infrastructure PPPs concurrently promote the idea of wear and tear or as Mukuvuri (2020) puts it 'obsolescence' or the state of being obsolete – hence the longevity of the concession. The author explores the concept of a '*minimal acceptable standard*' related to the performance of a service facilities over the core asset's lifecycle (National Research Council, 1993).

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

Let's briefly consider a dynamic open model of a developing economy with simulated trade links, where

there is an endogenous, zero-lower bounded interest rate r . Interest is levied on all financial capital 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.

We assume there are n_t firms in this economy, each assumed to be competitive, 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:

$$(2.01) \quad F_n(e, w, x, p, q, c)$$

$$(2.01.2) \quad \max_q [e + (p - c)q + q(w - x/1 + r)]$$

Central Governments

As with the examples of Stanford, 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 through 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) and the Water Supply and Sanitation Composite Index (WSSI).

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 $\gamma = 1/x$.

Estimating the relationship between the AfDB's Infrastructure Development Index (AIDI) and what Bosire (2020) defines as foreign direct inflows into Africa Union Member States, Bosire (2020) uses simulates a 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 . This econometric model varies from Bosire (2020) but simulates a similar Maximum Likelihood Estimation (MLE) using foreign direct inflows from 10 African Union Member States.

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

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. Engels, Fischer and Galetovic (2007) argue that the effect of PPPs on the budget constraint is restricted to a maximization problem derived from a standard 'road project' in Atkinson and Stern (1974), who in turn prove in their cost-benefit analysis that a so-called public good 'conventional rule' is only breached at either side of the government's Lagrangian in such a way that the financing of any specific government project is under- or over- supplied.

State Governments

State governments are agents and efficient optimisers of Central Government budgets retaining annual residual state budget allocations B_{it} , which form a function of state-level capital allocation to infrastructure. (TBC...)

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Addendum / Appendices

Table 1.1 Maximum Likelihood Results					
Variable	Coefficient	Std. Error	t-Statistic	p-Value	95% CI
Intercept (α)	13.075	10.125	1.291	0.202	[-7.224, 33.374]
AIDI (β_1)	0.36	0.086	4.206	0.0	[0.188, 0.532]
TCI (β_2)	0.266	0.113	2.361	0.022	[0.040, 0.493]
ECI (β_3)	0.093	0.11	0.846	0.401	[-0.127, 0.312]
ICI (β_4)	0.34	0.083	4.101	0.0	[0.174, 0.506]
WSSI (β_5)	0.197	0.099	1.997	0.051	[-0.001, 0.396]
<i>R-squared</i>	0.406				
<i>Adjusted R-squared</i>	0.351				
<i>F-statistic</i>	7.388				
<i>Prob(F-statistic)</i>	0.00002				
<i>No. of observations</i>	60				
<i>Durbin-Watson stat:</i>	2.091				