THE LINKAGE BETWEEN ACCESS TO INFRASTRUCTURE SERVICES AND INCOME INEQUALITY IN AFRICA

"A prosperous and integrated resource efficient region, progressively free of poverty and dependency."

Our vision

CONTENTS

INTRODUCTION

Income inequality in Africa - a multifaceted issue driven by historical legacies, economic structures, other factors

Income Inequality and Infrastructure

- Infrastructure is emphasised in the United Nations Sustainable Development Goals (SDGs) and the African Union Agenda 2063.
- Sen's capability theory reinforces the argument that infrastructure is central to addressing inequality. The theory asserts that well-being is directly linked to individuals' capabilities—their ability to function and participate meaningfully in society (Sen, 2005).

Status Quo

- 7 out of the top 10 countries with the highest Gini coefficients are in Africa, with South Africa being the most unequal country in the world (World Bank, 2025). None of the African countries are amongst the top ten countries with the lowest Gini coefficients.
- To date literature on this topic has covered other economies, several studies only focus on a specific infrastructure type, and few of the studies focus on the access element of infrastructure.
- Little research has been done on the impact of access to key infrastructure services on income inequality in African countries.
- Studying the linkage between access to infrastructure services and income inequality will determine how infrastructure development can be a tool to reduce income inequality and achieve both SDG 9 (industry, innovation and infrastructure) and Goal 10 (reduced inequality) (United Nations, 2022).

RESEARCH OBJECTIVES

The research journey

Research Questions

i. To what extent does access to infrastructure services impact income inequality in Africa?

ii. Which infrastructure services most effectively reduce income inequality in Africa?

iii. How does infrastructure development contribute to achieving Sustainable Development Goals while fostering inclusive growth and sustainable development as outlined in the African Union Agenda 2063?

Research Objectives

i. To examine the relationship between access to infrastructure services and income inequality in Africa.

ii. To identify which infrastructure services—such as electricity, water, sanitation, internet connectivity, and transport—were most effective in reducing income inequality.

iii. To analyse how infrastructure development contributed to achieving SDG 9 (Industry, Innovation, and Infrastructure) and SDG 10 (Reduced Inequalities) while fostering inclusive growth and sustainable development as outlined in the African Union Agenda 2063.

Hypotheses

i. Access to electricity services reduces income inequality

ii. Access to internet services reduces income inequality

iii. Access to transport services reduces income inequality

iv. Access to water services reduces income inequality

v. Access to sanitation services reduces income inequality

THEORETICAL FRAMEWORK

Why would we expect a link between infrastructure services and income inequality

Sen's capability theory

Well-being is very much linked to what people can or cannot do.

These beings and doings represent different aspects such as activities, working, being employed.

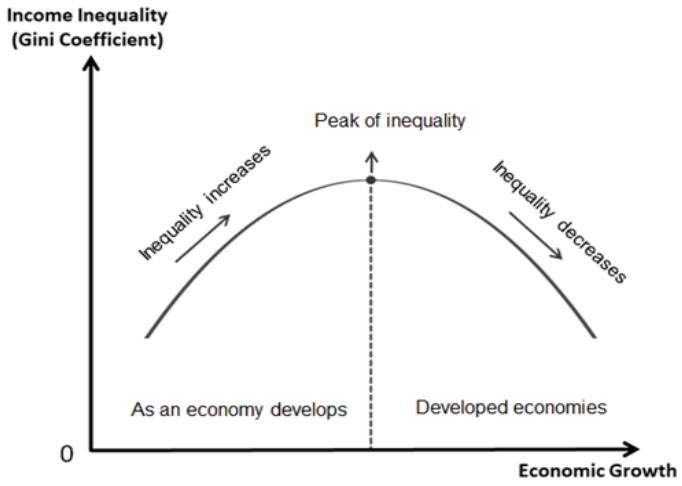
Without equal capabilities to function and to access those goods and services, inequality will persist.

Without equal access to basic services such as sanitation and piped water, capabilities to function will be unequal.

These basic services are linked to infrastructure, as well as the accessibility of that infrastructure.

Kuznets theory

Kuznets' theory is that as an economy develops, income inequality first increases, and peaks before a decrease is seen(Kuznets, 1955).



Bourguignon

The poverty-growth-inequality triangle by Bourguignon (2005). If growth occurs in labour-intensive sectors, income inequality will decrease.

Calderón & Servén

Infrastructure enables low-income earners in underdeveloped areas to connect to economic activities and access productive opportunities (Calderón & Servén, 2004)

LITERATURE REVIEW

Little research on the impact of access to key infrastructure services on income inequality in African countries

Overview

- Studies have found a link between infrastructure and income inequality (Calderón & Servén, 2004; Calderón & Servén, 2010; Hooper et al., 2017; Mendoza, 2017).
- Studies have also found that the quality and quantity of infrastructure services reduce income inequality (Seneviratne & Sun, 2013; Chotia & Rao, 2017).

Negative correlation between specific infrastructure types and income inequality across different jurisdictions

- Social infrastructure development with a focus on education and health in South Africa (More & Aye, 2017)
- Power infrastructure in Brazil (Medeiros & Ribeiro, 2020)
- Energy access globally (Acheampong et al., 2020)
- Water and sanitation in China and BRICS (2010; Mendoza, 2017; Chotia & Rao, 2017)

Mixed results or positive correlation between specific infrastructure types and income inequality across different jurisdictions

- Electricity access in South Africa (Sarkodie & Adams, 2020) – positive correlation with income inequality. (Sarkodie & Adams, 2020) maintain that access to electricity may benefit the wealthy by increasing income-producing ventures and high returns, leading to increased inequalities
- The impact of ICT for 109 countries (Richmond and Triplett, 2018)
  - Increased mobile subscriptions and internet usage decrease income inequality
  - In contrast, an increase in fixed broadband subscriptions increases income inequality, due to affordability challenges leading to limited access
- Transport infrastructure in China and India – both studies concluded that access to transport increases growth but also increases inequality
  - Transporting capital and skilled labour from rural to urban areas may increase the impoverishment of those left behind (Banerjee et al., 2018)
  - Productive opportunities arise, but their benefits are felt by the non-poor, leading to the rise in inequality (Bajar and Rajeev, 2015)

Despite the above-mentioned studies, there is a lack of research on the impact of **access** to key infrastructure services (**electricity, water and sanitation, the internet, and transport**) on income inequality in **African countries**.

RESEARCH METHOD

Quantitative panel regression

Data collection and analysis

- Panel data on 48 countries in Sub-Saharan Africa (SSA)
- World Bank Development Indicators (WDI) from 2002 to 2020
- The WDI is produced by a combination of bodies that vet global data before the indicators are published
- Statistica 14 and EViews 11 software used for data analysis

Estimation model to investigate the relationship

$$y_{it} = \delta + \phi_{yi,t} + \alpha(\text{infrastructure services access})_{it} + \beta x_{it} + v_i + e_{it}$$

y_{it} is income inequality

δ is the intercept of the equation

ϕ is the parameter to be estimated for income inequality

α represents the marginal impact of an increase in infrastructure service on income inequality

x is a vector of the control variables

β is a vector of the parameters to be estimated for the control variables

i = 1,2, …, 48 represents the countries

t = 2002, 2005, …, 2020 represents the period

v_i captures the unobserved effects of the countries

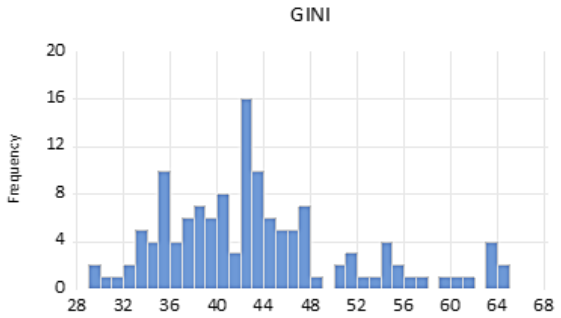
e_{it} is the random residuals.

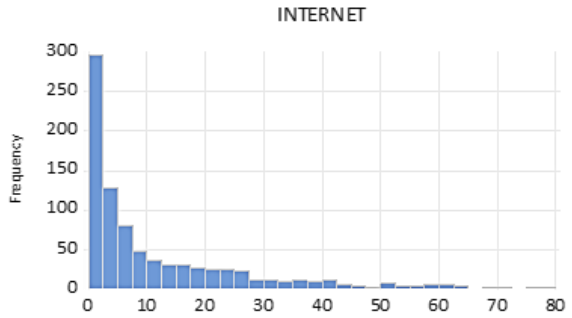
	Variable	Definition	Measure
Dependent	Gini coefficient	The extent to which income distribution amongst individuals within an economy deviates from a perfectly equal distribution.	Index
Independent	Electricity	The proportion of people with access to electricity	%
	Sanitation	The proportion of people using safely managed sanitation services	%
	Water	The proportion of people using safely managed drinking water services	%
	Internet (ICT)	The proportion of people with access to an internet connection	%
	Transport	Transport services (% of service imports and exports, BoP)	%
Control	GDP per capita	Real output per capita	number
	Education	School enrolment, secondary (% gross)	%
	Inflation	Consumer price index	%
	Trade openness	Exports and imports as a % of GDP	%

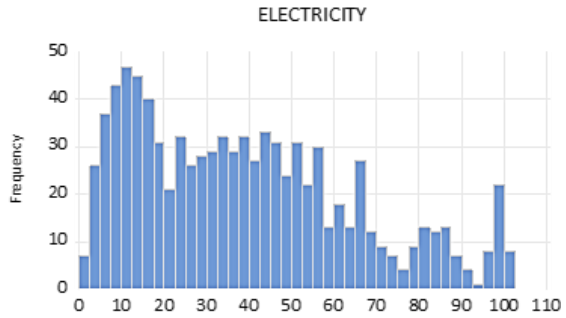
Source: WDI (World Bank Group, 2024)

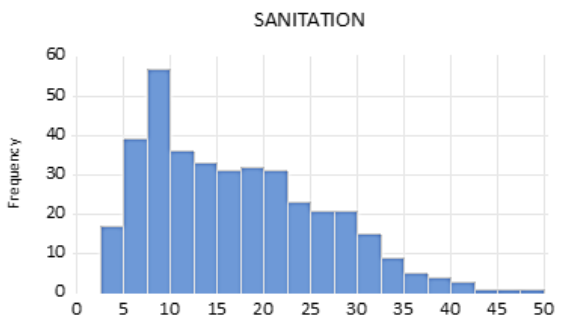
DESCRIPTIVE STATISTICS

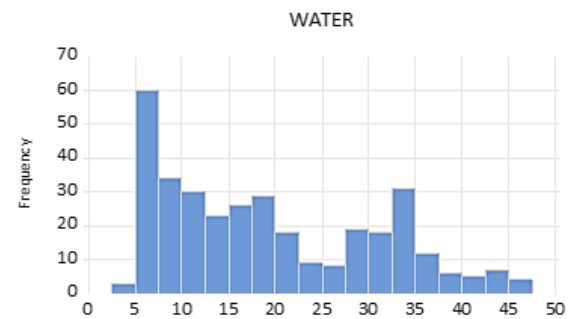
High Gini, generally low access to infrastructure services

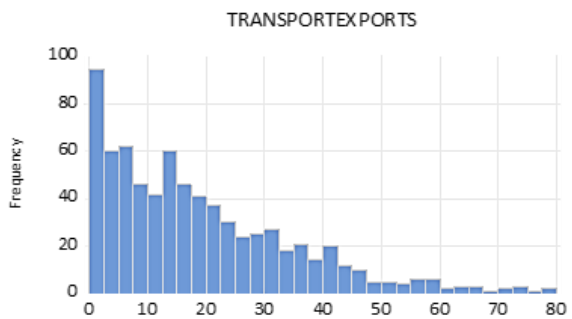


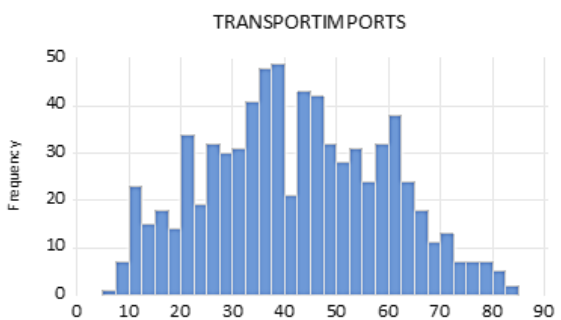












Source: WDI, Authors construction, EViews 11

Key highlights

- Jarque-Bera test indicated that the distribution of all the variables is not normal.
- Panel methods were appropriate for this dataset, as they do not require normality
- The kurtosis values showed few outliers for the variables, except for access to internet and transport
- In analysing the data, the option to balance the data was selected - to include variables that had a complete set of observation data for a particular model.
- Different variations of models were therefore required for robustness.

DIAGNOSTIC TESTS

To test the assumptions and factors which influence regression

Diagnostic test	Results	Conclusion
Variance inflation factor (VIF) test	High VIFs above 10, reduced to below 3 post PCA	Indication of multicollinearity, corrected through all-subsets regression
Durbin – Watson test	Initial value of 3.1 prior to PCA, and 1.92 post PCA	Initial autocorrelation detected, corrected by all – subsets regression
Breusch- Pagan test	A p-value of 0.20 therefore the null hypothesis is rejected	No heteroskedasticity detected
Hausman test	Chi-Sq= 6.098, p-value = 0.1919	RE model appropriate for this data set
VAR Granger **Causality/Block Exogeneity Wald tests**	GDP per capita, electricity and transport_imports p values <0.05	Some variables are not exogenous. The study employed FE and introduced control variables
The redundant fixed effects tests	Cross section chi-square = 1, p value= 0.0004	Cross-section effects had to be accounted for

Source: Authors construction using EViews 11 and Statistica 14

- Considering the diagnostic test results, particularly the multicollinearity, an all-subsets regression employing a Principal Component Factor Analysis (PCA) was carried out. The PCA resulted in the best 5 covariates, which have the highest R-square with no collinearity and no autocorrelation
- The study employed the Random Effects as the primary basis of analysis, with the FE as an additional technique for robustness
- This addressed multicollinearity and autocorrelation

RESEARCH RESULTS

Negative correlation between the Gini coefficient and the independent variables services except sanitation

For presentation purposes, the table below is a summary of the key empirical results based on the panel regression methods

Independent variable	Coefficient	Standard error	Comment
Internet	-0,251***	0,068	The most impact on the Gini, a decrease of 25% in income inequality for every 1% increase in access to internet services
Electricity	-0,161**	0,066	The second most impactful infrastructure service. For every 1% increase in access to electricity services, the income inequality was reduced by 16%
Transport (imports)	-0,109**	0.039	Significant impact on the Gini, statistically significant
Water	-0,040**	0,220	Lowest impact on the Gini, albeit statistically significant. Water and sanitation had missing data for several countries, which may have an impact on the results
Sanitation	-0,070	0,230	Statistically insignificant across all the models. Access to sanitation had very few observations due to missing data. Studying the impact of sanitation may require analysis at a micro level
Transport (exports)	0,027	0,063	Statistically insignificant. Further studies on individual countries might lead to a deeper understanding of the relationship

***p value<0.001, **p value<0.05, *p value <0.10

CONCLUSION

The research journey comes to an end

Research objective

i. To examine the relationship between access to infrastructure services and income inequality in Africa.

ii. To identify which infrastructure services—such as electricity, water, sanitation, internet connectivity, and transport—were most effective in reducing income inequality.

iii. To analyse how infrastructure development contributed to achieving SDG 9 (Industry, Innovation, and Infrastructure) and SDG 10 (Reduced Inequalities) while fostering inclusive growth and sustainable development as outlined in the African Union Agenda 2063.

Conclusion

i. The main research objective was achieved by proving the hypotheses that access to electricity, internet, transport, and water services reduce income inequality

ii. Access to the internet has the most impact on income inequality reduction. In addition, access to electricity has a significant impact, and there is a link between access to transport and water and a reduction in income inequality.

iii. By addressing the accessibility of quality, reliable, sustainable, and resilient infrastructure (United Nations, 2025), governments and private sector can contribute to the reduction of income inequality, and in doing so contribute to the achievement of SDG 9 (Industry, Innovation, and Infrastructure) and SDG 10 (Reduced Inequalities), as well as inclusive growth and sustainable development per the African Union Agenda 2063.

- **The results of the empirical study provide insight into which infrastructure services should be targeted for investment by government and private funders of infrastructure to ensure a significant reduction in income inequality.**
- **This insight will contribute to effective investment decisions and policies, supporting spending on a mix of infrastructure services which contribute to an expedited reduction of income inequality, along with other government priorities.**

RECOMMENDATIONS

Investment and spending decisions

Based on the insights provided by the empirical study, the following recommendations for investment and spending decisions are made:

- As access to the internet had the most impact, investment and spending decisions should prioritise wider access to internet services.
- Secondly, African countries have realised the importance of electrifying households and ensuring a reliable electricity supply to households and businesses. These initiatives should continue or be adopted in those countries that are lagging in providing access to electricity.
- Thirdly, countries should improve the quality of transport infrastructure, such as roads, ports and railways, to ensure the maximum impact of transport infrastructure in reducing income inequality.
- Finally, since the empirical investigation into the link between access to sanitation and income inequality gave mixed results, further studies on sanitation services are recommended.

THANK YOU