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Investing in sub-Saharan Africa for growth: Public or private?

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Investing in Sub-Saharan Africa for Growth: Public or Private?

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Abstract

This article examines the relationships between public, private, and economic growth in Sub-Saharan African countries from 1990 to 2019. The study reveals that private investment significantly contributes to long-term economic growth in the region. In contrast, the impact of public investment on long-term growth is not robust. These findings suggest that fostering economic growth in Sub-Saharan Africa requires a shift in policymaking from a public-sector to a private-sector growth approach. Prioritizing the private sector for growth and investment could be advantageous for most countries in the region, given their demographics and the imperative to create job opportunities.

Keywords: Private investment, Public investment, Economic growth, Sub-Saharan Africa.

JEL Codes: O40, R11, R42, R53.

I. Introduction

Sub-Saharan Africa (SSA) countries require substantial investment in infrastructure, education, and healthcare to sustain the progress of post-COVID recovery. Given the strained public finances, the success of these policies will depend largely on their ability to mobilize additional funding. For instance, according to Gaspar et al. (2019), annual spending estimates are needed to make substantial progress in achieving the Sustainable Development Goals (SDGs) in key sectors such as education, health, roads, electricity, water, and sanitation. Their analysis before the COVID crisis indicates that achieving these development goals would necessitate an additional annual private and public spending of US\$ 0.5 trillion for low-income developing countries and US\$ 2.1 trillion for emerging market economies by 2030. The spending requirements vary from country to country, with the most urgent needs found in the economies of the SSA region. The challenge of financing development has always been significant in the SSA region, and both public and private investment are critical in addressing this issue.

Public investment is crucial for strategic projects aimed at strengthening the economic and social foundations of the region. Initiatives such as the development of transportation, energy, and education infrastructure are essential for unlocking the economic potential of the region. Public investment enables the government to allocate resources to key infrastructure and services that may not yield important profitability but are fundamental for long-term growth, such as transportation, education, and healthcare (Barbiero and Darvas, 2014). Public investment effectively addresses market failures and targets areas where private investors may hesitate to invest due to low immediate returns. During economic downturns, public investment plays a pivotal role in stabilizing the economy by sustaining demand (Erden and Holcombe, 2006; Ramirez and Nazmi, 2003). This stabilizing role of public investment not only boosts economic growth but reassures the public about the capacity of the government to manage economic challenges, instilling a sense of confidence in the government's economic management. However, excessive reliance on public finance could lead to unsustainable public debt levels, and public sector projects may be susceptible to inefficiency, corruption, and mismanagement (Liaquat, 2019; Perotti, 2005). Since public resources to cover these needs are limited in SSA countries, alternative investment is necessary to achieve ambitious developmental goals.

The private sector holds significant potential to transform the economic landscape of the SSA region. With its unique capabilities, the private sector is being advocated to expand its involvement in furthering development goals by operating as both a financier and a provider of services. Attracting private investment, whether domestic or foreign, necessitates creating a conducive business environment through reforms that enhance transparency, reduce bureaucracy, and improve legal security. Private investment in SSA countries is rising, although it still lags other developing regions. Between 1990 and 2017, the average ratio of private investment to GDP in the SSA region rose from 10.4 percent to 13.5 percent. Despite this growth, the median ratio of private investment to GDP in SSA remains at 13.0 percent, which is lower than in most developing regions. By comparison, private investment in Asia reached around 16.7 percent of GDP in 2017 (Divine et al., 2021). In contrast with public investment, private investment is generally considered more financially sustainable and instrumental in diversifying investment sources, thereby alleviating the financial burden on the government (Nguyen and Trinh, 2018; Dreger and

Reimers, 2014; Coenen et al., 2013). The private sector plays a crucial role in financing various development sectors. Increasing the contribution of private investment in SSA countries from international sources is feasible and promising for the future economic development of the region. It is important to note that private investment flows do not increase public debt but rather generate commitments from the private sector (Divine et al., 2021).

Our research is guided by the following central question: how do public and private investments influence economic growth in SSA countries? To answer this question, we explore the nature of the links between these three variables in the short and long terms using an innovative new database built by the IMF: Investment and Capital Stock Dataset. The relationship between economic growth, private investment, and public investment involves both short-term and long-term dynamics. In the short term, private and public investment stimulates economic growth by boosting aggregate demand, creating jobs, increasing productivity, and promoting economic confidence. In the long term, public and private investment improves productivity, fosters innovation, develops human capital, improves institutional frameworks, and leads to sustainable efficiency gains throughout the economy. Public investment in infrastructure provides the foundation necessary for private investment to thrive. The revenue generated by private investment strengthens the financial capabilities of the government, facilitating funds allocation for infrastructure and services. These dynamics highlight the importance of a balanced public and private investment approach for sustained economic growth in SSA, which is the main conclusion of our study.

To account for both short-term and long-term dynamics, our methodology uses the Panel Vector AutoRegressive (PVAR) method to study short-term effects, following the approach of Love and Zicchino (2006). We employ the Panel Dynamic Ordinary Least Squares (PDOLS) and Panel Fully Modified Ordinary Least Squares (PFMOLS) estimators to assess the long-term relationship. These methodologies address endogeneity and cointegration issues, making them suitable for long-term macro-panels. After estimating the PVAR model and confirming its stability, we found bidirectional causality between economic growth and private investment and unidirectional causality between economic growth and public investment and between public and private investment. In the long term, private investment robustly enhances the economic development of SSA countries, whereas public investment does not yield long-term growth. However, public investment positively impacts private investment, which drives long-term growth. Additionally, economic growth boosts both public and private investment. In the short term, a one percent increase in per capita private investment correlates with a rise of 0.087 percent in the economic growth rate. A one percent increase in economic growth per capita leads to a corresponding surge of 0.474 percent in public investment per capita and 0.483 percent in per capita private investment. A one percent increase in per capita public investment is associated with a 0.063 percent increase in per capita private investment. In the long term, a one percent increase in public investment leads to a rise of 0.26 percent and 0.47 percent in economic growth, depending on the PFMOLS and PDOLS estimators. On the other hand, a one percent increase in private investment leads to a rise of 0.6 percent and 0.5 percent in economic growth, depending on the PFMOLS and PDOLS estimators.

Policymakers in the SSA region should focus on a model of inclusive, private sector-led economic growth to meet the development needs of the continent. They should target

public investment to complement private investment and improve the business climate and macroeconomic stability to encourage private investment further. Improving the business environment and addressing the risks of private investment attracts more private finance. Mobilizing domestic resources through better tax administration and broadening the tax base is crucial for sustainable economic growth. Exploring new sources of private finance and strengthening macroeconomic stability is essential. However, long-term strategic planning will provide reassurance about the future growth of the SSA region. This planning and better macroeconomic tools are needed to deal with growing uncertainties and social tensions.

The remainder of the article is organized as follows: Section 1 provides a comprehensive review of the literature, Section 2 establishes a conceptual framework, Section 3 introduces the data and methodology, Section 4 delineates the principal findings, Section 5 deliberates on the results and offers recommendations, and, finally, Section 6 concludes.

II. Literature review

A large body of the literature analyzes the potential risk of public investment displacing private investment financing and explores the synergies between these two types of investment.

A. Public and Private Investments Drive Economic Growth

Eberts (1986), Aschauer (1989a, 1989b), and Munnell (1990) conducted influential empirical studies that sparked a strong interest in the relationship between government investment in infrastructure and economic growth. Aschauer (1989) demonstrated that public non-defense expenditures significantly influence productive capacity more than defense or non-defense spending. The defense budget shows minimal impact on production capacity, whereas infrastructure substantially impacts productivity. Barro (1990) revealed that public investment has positive and substantial effects on growth. However, he cautioned that public investment could distort the market, emphasizing that, for a robust economy, it should not be a long-term solution. Cullison (1993) contended that government expenditure on education and labor training profoundly affects future economic growth and that spending on education, civilian safety, and labor training directly impacts human capital rather than physical capital. The consistent findings of these authors demonstrate a statistically significant positive correlation between public investment and growth.

Subsequent research continued to unveil a positive impact of public investment on growth. Khan and Kumar (1997) examined empirical findings from 95 developing countries spanning 1970 to 1990, revealing that private investment influences growth more significantly than public investment. The analysis of net returns indicated an increasing trend of net returns to private capital over time. Moreover, the study highlighted variations in the effectiveness of public and private investment and growth across different regions. Meanwhile, Ramirez and Nazmi (2003) analyzed cross-country data from nine major Latin American countries from 1983 to 1993 and argued that public and private investments contribute to economic growth. However, they found that all government spending

negatively impacts private investment and growth. Notably, public expenditure on education and health was observed to have a positive and statistically significant influence on forming private capital and long-term economic growth. Using a Cobb-Douglas function for Bangladesh, Haque (2013) found that public and private investments directly impact long-term economic development.

B. Potential Crowding-out and Crowding-in Effects

Several academic studies have investigated the crowding-out effect of public investment on private investment. This concept in economics states that an increase in government spending leads to decreased private investment, as outlined in the IS-LM model. Conversely, the “crowding in” effect refers to the situation where increased public investment leads to increased private investment.¹ Assuming constancy in monetary policy, heightened government expenditure may prompt a concomitant shift in the IS curve, precipitating a short-term surge in prices and interest rates, which could adversely affect private investment (Buiter, 1977; Sundararajan and Thakur 1980; Ram, 1986). Nazmi and Ramirez (1997) contended that while public investment bolstered output expansion, it manifested a perceptible crowding-out effect on private investment. Huzayran, Al-Nawab, and Mustafa (2021) unearthed evidence of the crowding-out effect of total public investment on private investment in the short run, observing no meaningful effect of public infrastructure investment in the long run. Heightened taxation diminishes private investment post-tax, prompting economic agents to curtail their investment decisions.

Employing an Autoregressive Distributed Lag (ARDL) modeling, Bukhari, Ali, and Saddaqaat (2007) illustrated that the crowding-out effect of private investment has obstructed growth in East Asian nations from 1971 to 2000. Their study implies that the dynamics of public investment and the restructuring of public expenditure could favor growth. Swaby (2007) used the Vector Error Correction Model (VECM) to scrutinize the interrelation between public investment and economic growth in Jamaica. The findings implied that while public investment positively influences GDP, the effect is not statistically substantive; additionally, public investment precipitates a crowding-out effect on net private investment, culminating in an amplification in domestic private investment but a drop in foreign investment. In their study of 11 Eastern European countries from 1991 to 2009, Gjini and Kukeli (2012) observed that public investment did not crowd out private investment. Using the weighted least squares method, their analysis indicated that the marginal effects of public investment on private investment were positive.

Investing public funds in infrastructure development and providing public goods and services has the potential to stimulate private investment. This type of investment helps establish a stable macroeconomic environment, making it more appealing for investment capital and reducing costs for the private sector. Government-driven demand for goods and services enhances revenue and profit expectations, encouraging private investment.

¹ The IS-LM model represents the intersection of two economic curves: the investment-saving (IS) curve and the liquidity preference-money supply (LM) curve. It analyzes how changes in market preferences affect GDP and market interest rates.

Ramirez and Nazmi (2003) demonstrated that public investment in economy-boosting infrastructure, such as new highways or expanded power plants, catalyzes private investment. Public spending has been shown to have a positive and widespread impact, increasing overall productivity and paving the way for private investment to flourish. Blejer and Khan (1984) demonstrated that substantial investment fosters economic growth, especially in developing nations. Cruz and Teixeira (1999) employed the ARDL model to examine the influence of public investment on private investment between 1947 and 1990 in the Brazilian economy. Their analysis revealed a long-term complementary relationship between private investment and public investment.

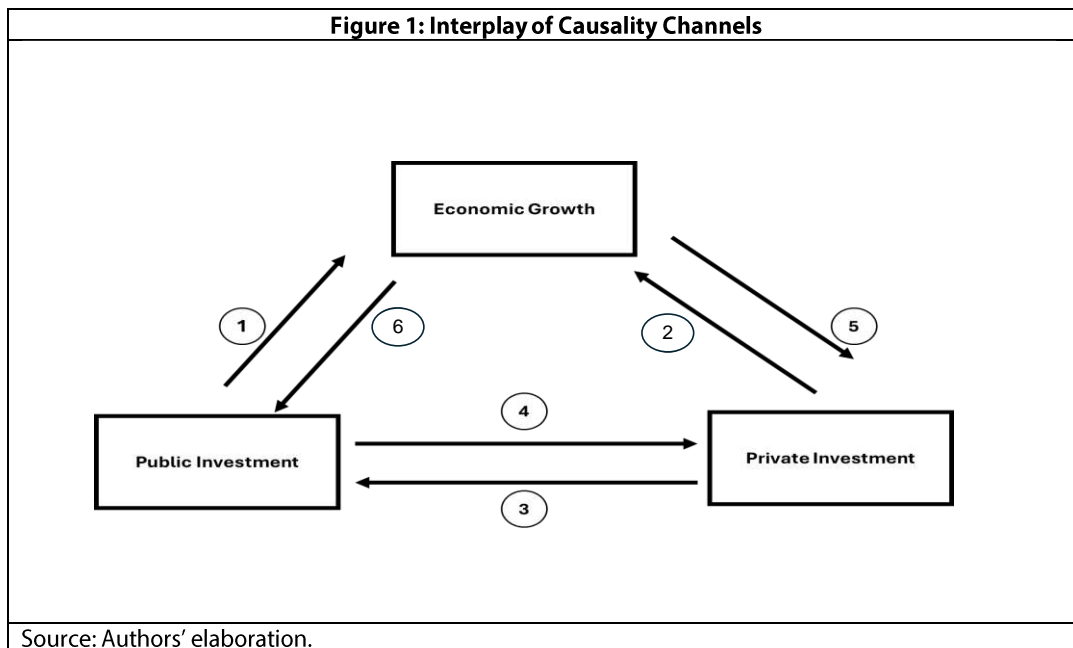
C. Literature on African Countries

Few papers have focused on the interplay between public investment, private investment, and growth in African countries, mostly due to a lack of data. Kumo (2012) utilized the ARDL model, a statistical method used to analyze the long-term relationships between variables, in empirical research for South Africa from 1960 to 2009. The findings of the study revealed a causal relationship between infrastructure investment and GDP growth, signifying the crucial role of infrastructure in long-term economic development in South Africa. Additionally, it was observed that economic development has a negative impact on infrastructure investment. Using a VAR (Vector AutoRegression) approach, a statistical method used to capture the interdependencies among multiple variables, Kollamparambil and Nicolaou (2011) demonstrated that public investment in South Africa does not directly crowd out or complement private investment; instead, it indirectly influences private investment through acceleration effects.

In light of the studies mentioned above, we note that research on the macroeconomic effects of public and private investment is a subject that continues to generate interest among various authors. In addition, we note that the need to extend the study of this relationship is becoming more imperative in the case of SSA countries, given the lack of studies on this region. However, this presents an exciting opportunity for growth and development. Therefore, this region must understand the impact of public and private investment on economic growth because regional growth strategies must be based on the effectiveness of public and private investment and improving productivity.

III. Contemplating a Framework: Public Investment, Private Investment, and Growth

The interplay between public and private investment is crucial for economic growth, and its impact hinges on various factors. The relationship between public investment, private investment, and growth is complex, with cross-feedback loops (Santiago et al. 2020; Ramirez and Nazmi 2003). Figure 1 illustrates the interplay of these causality channels, with descriptive text to follow.



- *Channel 1: Public investment to economic growth.* Investing in public infrastructure and human capital development, such as transportation and education, boosts economic growth. Government spending on education, healthcare, and social services increases workforce skills and productivity. Public funding supports macroeconomic stability and creates an environment favorable to private sector endeavors, strengthening economic resilience.
- *Channel 2: Private investment to economic growth.* Private investment drives capital accumulation and technological advancement. Increased investment in research and development leads to the creation of innovative technologies, thereby enhancing productivity and fostering entrepreneurial activities. This generates employment opportunities, diversifies markets, and stimulates demand, ultimately bolstering economic growth while impacting public finance through tax revenues.
- *Channel 3: Private investment to public investment.* Private investment stimulates public investment; for example, a PPP arrangement strengthens the government's financial capabilities by facilitating funds allocation for infrastructure and services. This highlights the proactive role private investment plays in shaping public investment. PPPs leverage private capital for public projects, enhancing efficiency, spreading risk across sectors, and prompting additional public investment to support private-sector activities, bolstering overall public funding.
- *Channel 4: Public investment to private investment.* The allocation of public investment impacts private investment by incentivizing it through subsidies, tax breaks, and grants and by enhancing market accessibility for private businesses. Public investment tools such as credit guarantees and development banks mitigate financial risks for private entities, fostering an increase in private investment.
- *Channel 5: Economic growth to private investment.* As the economy expands, it creates new investment opportunities, leading to increased private investment; sustained economic growth improves access to finance and encourages saving, resulting in a larger pool of funds for private investment. This decrease in credit risk premiums

allows financial institutions to offer more credit, supporting business expansion and new entrepreneurial ventures.

- *Channel 6: Economic growth to public investment.* Economic growth leads to higher tax revenues, enabling increasing government investment and reducing deficit spending. This reassures the audience of the autonomous nature of economic growth and its role in stimulating public investment. This results in a lower debt-to-GDP ratio and more spending on infrastructure and services, thereby stimulating overall economic activity and growth.

Understanding these relationships enables policymakers to design effective strategies for promoting economic growth, striking the right balance between them to ensure efficient and productive investments. Public investment should create a conducive environment for private businesses to thrive, while private investment should aim for long-term productivity and innovation.

IV. Data and methodology

A. Data

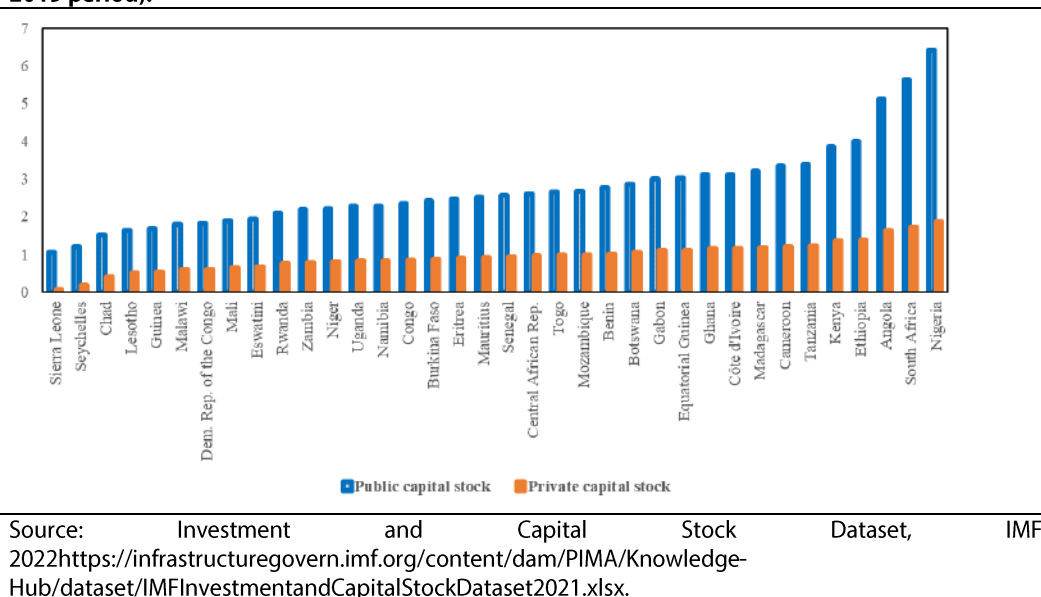
We gathered annual data from 1990 to 2019 for a panel of 43 SSA countries selected based on data availability.² In Table 1, we outlined the definitions and sources of the variables used for our analysis. The Gross Domestic Product (GDP) in billions of national currencies (Y) indicates economic growth. In addition, we used variables for general government capital stock (KPUB) and private capital stock (KPRIV) in billions of nominal national currencies to represent public and private investment. It is important to note that the actual change in the capital stock over time is a net investment, specifically gross investment, less capital depreciation. These variables are sourced from the “Investment and Capital Stock Dataset” published by the IMF (2021). The total population variable (P) is obtained from the World Development Indicators (WDI) and is used to convert the variables into per capita values (YPC, KPUBPC, KPRIVPC).

The growth of private and public capital stock in the SSA region is promising. While it has increased in recent years, it remains lower than in other developing regions. Between 1990 and 2019, the stock of public capital in Nigeria increased by an average of US\$ 603 billion per year, and the stock of private capital by an average of US\$ 825 billion per year. From 1990 to 2015, South Africa attracted an average of US\$ 6.7 billion per year in public-private partnership (PPP) contracts, far ahead of Nigeria, Kenya, and Côte d'Ivoire.

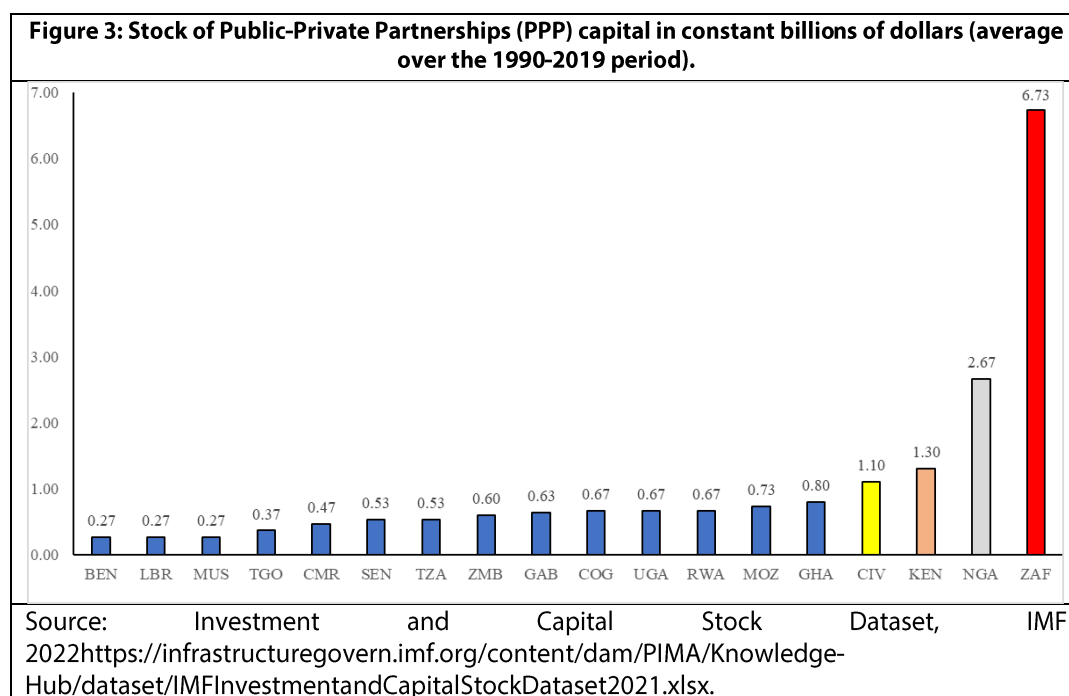
² Angola, Benin, Botswana, Burkina Faso, Burundi, Cape Verde, Cameroon, Central African Republic, Chad, Comoros, the Democratic Republic of the Congo, Republic of the Congo, Côte d'Ivoire, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, South Africa, Tanzania, Togo, Uganda, and Zambia

Table 1: Description of variables		
Variables	Definitions	Sources
Y	Gross Domestic Product in billions of national currency.	Investment and Capital Stock Dataset
P	Total population	
KPUB	General Government Capital stock in billions of national currency.	
KPRIV	Private Capital Stock in billions of national currency.	
Source: Investment and Capital Stock Dataset, IMF 2022 https://infrastructuregovern.imf.org/content/dam/PIMA/Knowledge-Hub/dataset/IMFInvestmentandCapitalStockDataset2021.xlsx .		

Figure 2: Public and private capital stock in constant billions of dollars (average over the 1990-2019 period).



Source: Investment and Capital Stock Dataset, IMF 2022<https://infrastructuregovern.imf.org/content/dam/PIMA/Knowledge-Hub/dataset/IMFInvestmentandCapitalStockDataset2021.xlsx>.



B. Estimation Strategy

Our analysis is based on the PVAR method. We use this method to study short-term effects, following the approach of Love and Zicchino (2006) and the PDOLS and PFMOLS estimators to assess the long-term relationship. The PVAR model is widely used in various research fields by economists analyzing data from multiple countries over an extended period (Koop and Korobilis, 2016). Canova and Ciccarelli (2009) emphasize that PVARs are excellent for modeling the transmission of shocks between countries. According to Abrigo and Love (2016), the advantage of the PVAR model is that it treats all variables as endogenous. However, it may be necessary to impose restrictions based on statistical procedures to disentangle the impact of exogenous shocks on the system. The use of the two estimators, PDOLS and PFMOLS, aims to verify the sensitivity of the estimated long-term parameters to the estimation method.

1. Short-term effects: PVAR model

We employ this methodology because in panels with long periods (macro-panels), such as in our case, we anticipate the presence of cointegration between variables and endogeneity. The literature suggests using PVAR models to address the issues of endogeneity and cointegration. The adoption of this methodology to tackle these phenomena is supported by its advantages, including (1) the model is useful in the absence of substantial theoretical information to guide model specification; (2) this model was specifically developed to address the issues of endogeneity and cointegration among the model variables; (3) the PVAR model accommodates any lagged effects of the variables under consideration, thereby determining whether the impacts of economic growth and energy consumption

are short-term, long-term, or both; (4) this model enables the inclusion of country fixed effects that capture time-invariant components likely to influence economic growth and overall time effects affecting all countries during the same period; and (5) this model accounts for all global shocks that simultaneously impact all countries in the model.

The estimator proposed by Love and Zicchino (2006) allows for the presence of stationary endogenous variables and unobserved individual heterogeneity. The specification of the PVAR model is described in the following equation (1):

$$Z_{it} = T_0 + T_1 Z_{it-1} + f_i + d_t + \varepsilon_{it} \quad (1)$$

where Z_{it} represents the vector of variables in our analysis for country i at time t , T_0 represents the vector of constants, $T_1 Z_{it-1}$ represents the lagged polynomial matrix, f_i represents the country fixed effects, d_t represents the time dummies and ε_{it} is the random error term. The variables used in our model are, for example, (DLYPC, DLPUBPC, and DLPRIVPC). The prefix “D” indicates the first difference. The use of variables in the first differences of logarithms is because the PVAR model requires all variables to be I (0), meaning stationary. The panel unit root test CIPS (Cross-sectionally augmented Im-Pesaran-Shin) analyzes the stationarity of variables, as shown in Table 3.

2. Long-term effects: PDOLS and PFMOLS

The long-term relationship between economic growth, public investment, and private investment is described by equation (2):

$$LYPC_{it} = \alpha + \beta LKPUBPC_{it} + \gamma LKPRIVPC_{it} + \varepsilon_{it} \quad (2)$$

α represents the constant, β et γ represent respectively the elasticities of public and private investment and ε_{it} represent the error term. The prefix “L” denotes natural logarithms. This equation has been used by authors such as Hasanov et al. (2018), Shahbaz et al. (2017), Al-Mulali et al. (2016), Farhani et al. (2014), and Santiago et al. (2020).

3. Preliminary tests

Before conducting estimations, we need to compute several preliminary tests: (i) correlation matrix, (ii) Variance Inflation Factor (VIF), (iii) cross-sectional dependence test, (iv) unit root tests, (v) Hausman test, (vi) cointegration tests, and (vii) lag order test for PVAR. The descriptive statistics of the variables and the results of the cross-sectional dependence test are presented in Table 2 below. The prefixes “L” and “D” denote the logarithms and the first differences of the variables. Based on the results, we concluded that cross-sectional

dependence is present in all variables, indicating correlation among our series across countries.

Table 2: Descriptive Statistics								
	Descriptive Statistics					Cross-sectional Dependence Test		
Variables	Observations	Mean	Std. Dev.	Min	Max	CD-test	Corr	Abs(corr)
LYPC	1261	11.481	2.842	3.139	19.756	143.79***	0.911	0.912
LKPUBPC	1265	11.433	2.81	3.081	19.767	116.66***	0.738	0.763
LKPRIVPC	1270	11.841	2.895	4.144	19.976	129.04***	0.818	0.822
DLYPC	1217	0.1018	0.1702	-0.434	2.0046	18.83***	0.119	0.223
DLKPUBPC	1222	0.0971	0.2467	-2.250	3.3805	8.60***	0.053	0.196
DLKPRIVC	1227	0.1016	0.2520	-1.662	3.3588	6.89***	0.042	0.189
Note: The CD test has a distribution N (0,1) under the hypothesis H0: cross-sectional independence, ***significant at the one percent level.								

In the next step of our analysis, we examined the correlation matrix and Variance Inflation Factor (VIF) statistics (Belsley et al., 2005). These tests helped us determine if collinearity and multicollinearity would be problematic for our estimation. After conducting both tests, the results (see Annex 2) indicated a high degree of collinearity between the logarithms of public and private investment. This outcome was expected due to the relationship between the two variables. However, the VIF values and the average VIF were low for both the logarithmic and first-difference variables. These results suggest that multicollinearity is not an issue for our analysis, allowing us to proceed with the estimation. Since all variables are cross-sectional dependent in logarithmic and first-difference terms, traditional unit root tests are ineffective for studying their stationarity. Instead, we used Pesaran's (2007) second-generation unit root test and the Panel Unit Root Test (CIPS) to address this issue. The results of these tests are presented in Table 3.

Table 3: Panel Unit Root Test			
Variables	CIPS (Zt-bar)		
	Lags	Without trend	With trend
LYPC	0	-2.189***	3.428
	1	-2.872***	2.641
	2	-6.334***	1.793
	3	-5.177***	3.943
LKPUBPC	0	-3.147***	1.982
	1	-3.686***	1.043
	2	-4.039***	1.956
	3	-3.984***	3.262
LKPRIVPC	0	-4.114***	0.496
	1	-4.836***	-0.018
	2	-4.967***	0.529
	3	-4.558***	2.305
DLYPC	0	-18.483***	-17.002***
	1	-11.618***	-9.035***
	2	-6.949***	-2.883***
	3	-4.464***	-1.049
DLKPUBPC	0	-21.769***	-20.305***
	1	-12.303***	-9.485***
	2	-6.102***	-3.065***
	3	-3.000***	0.977
DLKPRIVPC	0	-20.721***	-18.543***
	1	-12.331***	-9.232***
	2	-6.067***	-2.621***
	3	-4.349***	-0.303
Note: ***, **, and * are significant at the 1 percent, 5 percent, and 10 percent levels, respectively. Pesaran's (2007) panel unit root test assumes cross-sectional dependence in the form of a common unobserved factor, with the null hypothesis (H0) being that the series is I(1).			

After reviewing the data in Table 3, we noticed that all the variables in the logarithm show first-order integration with a trend. Still, they do not exhibit integration when a trend is not considered. However, when first differenced, all variables are stationary with and without a trend, which is essential for PVAR estimation. We then conducted the Hausman test (Hausman, 1978) to determine whether the panel had fixed or random effects. The test was carried out for three specifications, each with a different dependent variable (DLYPC, DLKPUBPC, DLKPRIVPC). Fixed effects were found in two of three specifications, with DLYPC and DLKPRIVPC as dependent variables (please refer to Annex 2). The non-stationarity of certain variables, such as LYPC, LKPUBPC, and LKPRIVPC in logarithms, suggests a potential undesirable correlation (Table 3). We proceeded with Westerlund's second-generation cointegration test to confirm cointegration among the non-stationary variables. The null hypothesis of this test is the absence of cointegration, and it requires all variables to be I (1). The results of the Westerlund test (2007) are displayed in Table 4.

Table 4: Westerlund test			
Statistic	Value	Z-value	P-value
Gt	-3.681	-8.337	0.000
Ga	-15.858	-1.847	0.032
Pt	-20.550	-7.355	0.000
Pa	-15.721	-4.709	0.000
Note: ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent levels, respectively. H0: No cointegration; Gt and Ga test cointegration for each country individually, while Pt and Pa test cointegration for the entire panel.			

According to the table, the P-values for Gt, Ga, Pt, and Pa reject the null hypothesis of no cointegration at the one percent and 5 percent levels of statistical significance. This suggests a co-integration relationship between the variables for each country and the panel. These findings provide evidence of a cointegration relationship between LYPC, LKPUBPC, and LKPRIVPC in Sub-Saharan African countries. After passing the Hansen J test, which evaluates overidentification restrictions, we find that the overidentification restrictions are valid based on the J-p value. The lag order selection test in Table 5 indicates that the optimal lag should minimize the MBIC, MAIC, and MQIC information criteria, all of which are lower with lag 1. We decided to estimate a first-order PVAR.

Table 5: Criteria for selecting the lag order						
Lag	CD	J	J-p value	MBIC	MAIC	MQIC
1	0.740	27.283	0.073	-92.994	-8.716	-41.096
2	0.758	14.745	0.098	-45.393	-3.254	-19.443
3	0.628					
Note: The optimal lag length minimizes the MBIC, MAIC, and MQIC information. The MBIC, MAIC, and MQIC criteria are lower with one lag.						

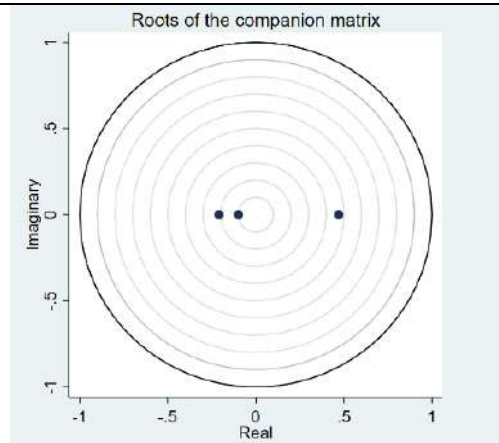
V. Results and discussions

A. Short-term effects

The findings from the first-order PVAR are detailed in Table 6. It is important to note that the model mandates all variables to be integrated of order zero, as indicated in Table 3. Results from the PVAR model suggest that the per capita public investment does not significantly influence economic growth. Conversely, a one percent increase in per capita private investment correlates with a rise of 0.087 percent in the economic growth rate. A one percent increase in economic growth per capita demonstrates a corresponding increase of 0.474 percent in per capita public investment and 0.483 percent in private investment. A one percent increase in per capita public investment appears to be associated with a 0.063 percent increase in per capita private investment.

Table 6: Results of the PVAR Model			
Variables	DLYPC (t)	DLKPUBPC (t)	DLKPRIVPC (t)
DLYPC (t-1)	0.362***	0.474***	0.483***
DLKPUBPC (t-1)	0.044	-0.033	0.0635**
DLKPRIVPC (t-1)	0.087*	-0.098	-0.1679
Note: ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent levels, respectively.			

To check the stability of our PVAR model, we calculated the eigenvalues after estimating the parameters. As all eigenvalues fall inside the unit circle, we conclude that the stability condition is confirmed and, therefore, the model is stable. This result indicates that our variables are stationary (Lütkepohl 2005). The results and the eigenvalues plot are presented in Table 7.

Table 7: Stability Condition of Eigenvalues			
Eigenvalues			<div>Graph</div> <div>Roots of the companion matrix</div> 
Real	Imaginary	Modulus	
0.4698	0	0.4698	
-0.2098	0	0.2098	
-0.0990	0	0.0990	

Note: All the eigenvalues are inside the unit circle, meaning PVAR satisfies the stability condition.

After estimating the PVAR model and confirming its stability, we conducted the Granger causality tests (Abrigo and Love 2016) to explore the causal relationships that may exist between the variables. The null hypothesis of the Granger causality test is the absence of causality, meaning that rejecting the null hypothesis indicates the presence of causality between the variables. Table 8 presents the results of the Granger causality test.

Table 8: Granger causality test			
Variables	DLYPC	DLKPUBPC	DLKPRIVPC
DLYPC	-	8.574 ***	9.577 ***
DLKPUBPC	0.656	-	0.063
DLKPRIVPC	2.740*	0.191**	-
ALL	11.404***	9.251***	10.921***
Note: ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent levels, respectively.			

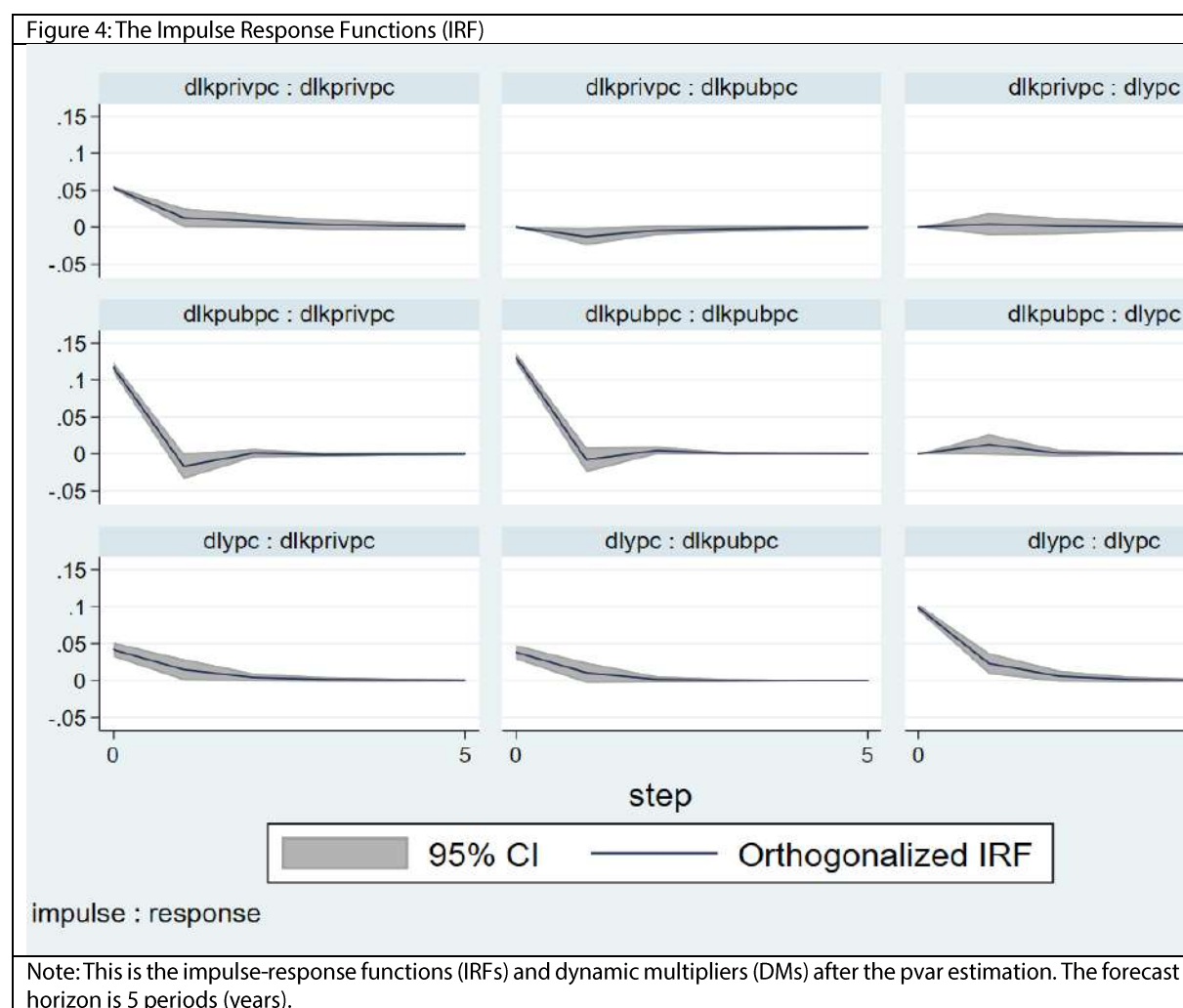
Interpreting the results from Table 8, we have identified causal relationships between the variables as follows:

- There is bidirectional causality between economic growth (DLYPC) and private investment (DLPRIVPC).
- We have observed unidirectional causality from economic growth (DLYPC) to public investment (DLPUBPC).
- Unidirectional causality exists between public funding (DLPUBPC) and private investment (DLPRIVPC).

The analysis of the exogeneity blocks (all) confirms the presence of endogeneity, which is significant at the one percent level. In addition to the Granger causality test, we have conducted the Forecast Error Variance Decomposition (FEVD) and Impulse Response Functions (IRF) (Table 9 and Figure 3). The FEVD helps determine the percentage of variance in the forecast error of one variable explained by the shocks experienced by another variable. Put differently, it provides insight into the time required for a variable to reach equilibrium and the contribution of each variable to this effect. The IRF enables an analysis of how a specific variable responds to shocks from another variable and the time needed for the response variable to return to equilibrium. The stability condition of the eigenvalues (Table 7) suggests that the FEVD and IRF have a well-established interpretation (Abrigo and Love 2016).

Table 9: Forecast Error Variance Decomposition (FEVD)				
Response variable	Forecast horizon	Impulse variable		
		DLYPC	DLKPUBPC	DLKPRIVPC
DLYPC	1	1.000	0.000	0.000
	2	0.975	0.019	0.004
	5	0.974	0.020	0.004
	10	0.974	0.020	0.004
DLKPUBPC	1	0.185	0.814	0.000
	2	0.222	0.774	0.002
	5	0.232	0.763	0.003
	10	0.233	0.763	0.003
DLKPRIVPC	1	0.313	0.430	0.256
	2	0.343	0.408	0.248
	5	0.352	0.402	0.244
	10	0.352	0.402	0.244
Note: FEVD followed the Cholesky decomposition and was performed using 1000 Monte Carlo simulations for 10 periods.				

Table 9 reveals that in the initial period, the variables DLYPC and DLKPUBPC have a significant portion of their forecast error variance explained by the shocks they experience (100 percent and 81.44 percent, respectively). In comparison, the forecast error variance of DLPRIVPC is only explained by 25.65 percent due to its shocks. During the initial period, 18.55 percent of the forecast error variance decomposition of DLKPUBPC is explained by DLYPC, compared to 31.31 percent for DLPRIVPC. DLKPUBPC explains that no percent of the forecast error variance decomposition of DLKPRIVPC occurred during the same period.



In the context of forecast error variance decomposition (FEVD), it is observed that the proportion of forecast error variance explained by endogenous shocks declines over time while the portion attributed to exogenous shocks increases. In the tenth period, 97.49 percent of the forecast error variance of DLYPC is accounted for by its shocks, 2.08 percent by DLKPUBPC, and 0.4one percent by DLKPRIVPC, suggesting a more significant impact of public investment on the growth of Sub-Saharan African countries than private investment. In the tenth period, 76.35 percent of the forecast error variance of DLKPUBPC is self-explanatory. In comparison, 23.3 percent is explained by DLYPC and 0.33 percent by DLKPRIVPC, unveiling the significant influence of economic growth on public investment variance. Lastly, at the end of the tenth period, 24.46 percent of the forecast error variance

of DLKPRIVPC is self-explained, 35.25 percent by DLYPC, and 40.27 percent by DLKPUBPC, indicating the substantial influence of economic growth and public investment on the variance of private investment. Notably, shocks in DLKPUBPC have a more significant impact on the forecast error variance of DLKPRIVPC than vice versa. Regarding the Impulse Response Functions (IRF) results (Figure 4), following a shock, all variables tend to converge to equilibrium, thus affirming the stationarity of DLYPC, DLKPUBPC, and DLKPRIVPC. The responses of variables to respective impulses are observed as follows:

- In response to an impulse on DLYPC, both DLPRIVPC and DLPUBPC react positively.
- After an impulse on DLPUBPC, DLYPC reacts positively, while DLPRIVPC reacts negatively.
- After an impulse on DLPRIVPC, DLYPC reacts positively, and DLPUBPC reacts negatively.

The outcomes derived from the FEVD and IRF are consistent with the results obtained from the Granger causality test, portraying a positive correlation between economic growth and private and public investment. Private investment positively influences economic growth, while public investment positively impacts private investment. The negative reaction of private investment to public investment shocks could suggest a potential crowding-out and crowding-in effect of public investment on private investment, at least in the short term.

Several academic studies have investigated the crowding-out effect of public investment on private investment, as outlined in the IS-LM model³. Assuming constancy in monetary policy, heightened government expenditure may prompt a concomitant shift in the IS curve, precipitating a short-term surge in prices and interest rates, which could adversely affect private investment (Buiter, 1977; Sundararajan and Thakur, 1980; Ram, 1986). Nazmi and Ramirez (1997) contend that while public investment bolstered output expansion, it manifested a perceptible crowding-out effect on private investment. Mustafa et al. (2021) unearthed evidence of the crowding-out effect of total public investment on private investment in the short run yet discerned no momentous effect of public infrastructure investment in the long run. Heightened taxation diminishes private investment post-tax, prompting economic agents to curtail their investment decisions.

B. Long-term analysis

Employing the PVAR analysis to scrutinize the variables' short-term effects, we utilized the PDOLS and PFMOLS estimators to evaluate the long-term elasticities of public and private capital investment. Figure 5 illustrates the sign and direction of the causal relationships found among the variables with PVAR estimation. Table 10 below consistently shows that public and private investment positively impacts long-term economic growth in SSA countries, and these coefficients are interpreted as long-term elasticities (Farhani 2013).

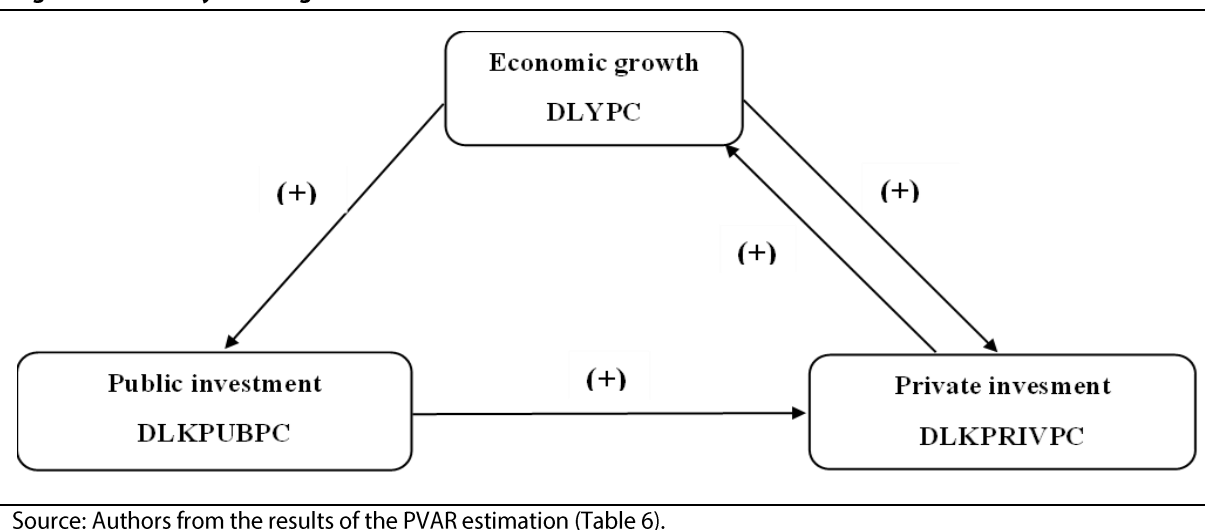
³ The IS-LM model represents the intersection of two economic curves: the investment-saving (IS) curve and the liquidity preference-money supply (LM) curve. It analyzes how changes in market preferences affect GDP and market interest rates.

Table 10: Long-run relationship (PDOLS and PFMOLS estimators)		
Dependent variable: LYPC		
Independent variables	PDOLS	PFMOLS
LKPUBPC	0.47***	0.26***
LKPRIVPC	0.50***	0.60***
Source: Authors from the data. *** denote significance at the 1 percent. The analysis was performed in STATA with the command <i>xtcointreg</i> .		

According to the calculations of FMOLS and PDOLS, an increase of one percent in public investment will result in a rise of 0.26 percent and 0.47 percent, respectively, in economic growth. On the other hand, estimates of FMOLS and PDOLS show that an increase of one percent in private investment content would result in a rise of 0.6 percent and 0.5 percent in economic growth, respectively. One plausible rationale for the favorable long-term influence of public investment on growth could be derived from the observations of Agenor and Moreno-Dodson (2006), postulating that the crowding-out effects of public capital stock primarily manifest as short-term phenomena, ultimately contributing to long-term economic growth. An additional distinction between the short-term and medium to long-term impacts of public investment on economic development, as noted by Erenburg and Wohar (1995), suggests that public investment in SSA will likely complement private investment in the long run. This shift in the impact of public investment could be attributed to its influence on long-term economic growth, which is closely linked to the levels and efficacy of public investment (Fournier, 2016; Berg et al., 2019).

Regarding the effect of private investment on long-term economic growth, the findings indicate that higher investment rates increase output levels (Solow 1956). the higher coefficient for private investment than public investment, as evidenced by Several prior studies (Bornhorst, Arslanalp, et al., 2010), suggests that private investment plays a pivotal role in enhancing output in developing countries. Research by Devadas and Pennings (2018) concluded that increased public and private capital positively affects economic growth, further underscoring the significant role of private investment in boosting output. These positive effects are closely linked to the typically low levels of private capital in these countries, resulting in relatively high returns on private investment.

Figure 5: Summary of Granger Causalities



VI. Policy recommendations

Current research and extant literature posit that public and private investments contribute to long-term economic growth in African countries. Our results show a bidirectional causality between economic growth and private investment, a unidirectional causality between economic growth and public investment, and between public and private investment. In the long term, private investment significantly enhances the economic development of SSA countries, whereas public investment does not yield long-term growth. However, public investment positively impacts private investment, which drives long-term growth. Additionally, economic growth boosts both public and private investment.

Based on these findings, the following recommendations aim to guide the formulation of growth-enhancing policies on the continent. Such policies should target public investment to complement private investment and improve the business climate and macroeconomic stability, which further encourages private investment; improving the business environment and addressing the risks of private investment attract more private finance. Below is a discussion of the dimensions to be considered.

A. General Considerations

African policymakers should strive to create frameworks that promote a business-friendly environment while establishing long-term policies and strategies to provide a solid foundation for growth.

- *Reassessing development strategies.* Due to the challenging economic environment, SSA must rethink its development strategies. Reliance on public investment has led to a substantial increase in public debt, which is unsustainable without changes in national resource mobilization. Shifting toward private sector-focused growth and

investment models could benefit most countries in the region, considering demographics and the need to generate employment opportunities.

- *Enhancing the business environment.* Private investment plays a pivotal role in SSA development. Countries must sharply reduce the risks associated with private investment. The low level of private investment in development sectors in the region indicates that the risk/return profile is often insufficiently attractive for investors. Risks, including institutional framework, market size and liquidity, and macroeconomic volatility, are higher in SSA. Most infrastructure projects are currently carried out and funded by the public sector.
- *Addressing project, macroeconomic, and exit risks.* To attract private financial investors, projects must be viable. Macroeconomic instability is a significant concern for financial investors and is a crucial aspect of their risk/return assessment. High inflation introduces volatility in relative prices, making investment decisions riskier and less predictable. Policies enhancing macroeconomic stability encourage private and foreign direct investment (FDI). Exit risk is another primary concern for international investors. The ability and range of options to exit an investment are pivotal in building a private investor ecosystem.
- *New sources of private investment.* SSA countries could tap into untapped private funding sources, such as foreign institutional investors and domestic private investment. Mobilizing additional private funds for development will require innovative solutions to enhance the project risk/return profile.
- *Mobilizing domestic resources.* Mobilizing domestic resources is key to financing public infrastructure and fostering growth. Efforts should focus on improving tax administration, enhancing land registries, strengthening tax auditing and customs administration, and overseeing tax compliance by large taxpayers. Reforms aimed at broadening the tax base, including limiting exemptions—such as reducing tax exemptions, excise taxes, and property taxes—are essential.

B. Role of Development Finance Institutions

Development Finance Institutions (DFIs) play a unique role in bridging the gap between the public and private sectors. They provide finance or capital in areas and countries to which the private sector would otherwise not have access (von Mehren, 2019). This ensures a substantial and sustainable impact, given that they provide a range of financial instruments and technical assistance to support projects that could be considered too risky or unprofitable for the traditional commercially oriented financial sector. These institutions boost private sector investment in Africa by collaborating with stakeholders and forming partnerships; bilateral and multilateral development institutions are the primary international investors in PPPs in Africa. This encompasses, but is not limited to, the following:

- **Capital mobilization:** DFIs are key in securing funding for private investment in Africa from various sources.
- **Risk mitigation:** DFIs use strategies to reduce risk aversion among private investors, potentially lowering the cost of borrowing and encouraging participation in high-risk projects.

- Sustainability focus: DFIs prioritize investing in projects with positive social and environmental impacts, such as renewable energy and climate change mitigation.
- Bankable projects: DFIs offer support to enhance the operational capacity of local financial institutions and businesses, improving project readiness for private investment.

C. Role of the African Continental Free Trade Area (AfCFTA) on Private Sector Development

Regional integration is predicted to have a positive impact on the development of the private sector. The reduction of trade barriers within regional integration is anticipated to create larger markets and provide businesses with access to new and expanded markets. This, in turn, is expected to encourage private firms to enhance their competitiveness and reduce costs due to the larger markets and improved economies of scale. Trade integration has long been recognized as a crucial driver of economic growth and private sector development in Africa. According to UNECA (2020), the African Continental Free Trade Area (AfCFTA) is projected to increase intra-African trade. The elimination of barriers will enable African enterprises to reach larger markets, facilitating economies of scale and fostering competition. For private businesses, this expansion of markets means increased access to resources, customers, and a broader consumer base. Additionally, AfCFTA is acknowledged for its potential to promote industrialization across the continent. Keita (2024) argues that the full implementation of AfCFTA could potentially raise the African GDP in 2035 by approximately 5.5 percent compared to the expected level without AfCFTA. Moreover, in the decade leading up to the full implementation of the agreement, the GDP level could increase by 0.5 to 5 percent annually. Other economic impacts include an increase in intra-Africa exports, growth in African exports to the rest of the world, job creation, welfare gains, and poverty reduction. The use of either Computable General Equilibrium (CGE) or gravity models (Saygili et al., 2018; IMF, 2019; World Bank, 2020a, 2020b; Fofack et al., 2021) strongly supports the notion that liberalizing trade and investment under the AfCFTA will significantly enhance economic diversification on the continent. Manufactured goods are expected to dominate intra-African trade, which is set to expand significantly during the implementation of AfCFTA (UNCTAD, 2019; Songwe et al., 2021).

The focus on developing regional value chains in Africa allows countries to complement mutually their industrial capacities. For example, Byiers et al. (2018) argue that regional integration allows businesses to participate in value chains that connect various stages of production across African countries. The African Continental Free Trade Area (AfCFTA) can help African economies diversify from commodity dependence by promoting manufacturing and processing industries. According to Balchin et al. (2016), industrialization driven by the free trade area will facilitate job creation, reduce poverty, and enhance the competitiveness of African goods in global markets. The agreement encourages African firms to engage in higher-value-added activities such as processing raw materials into finished products, thereby moving the value chain. The AfCFTA has the potential to transform productivity and competitiveness landscape in the region (Fofack, 2020; IMF,

2019). Under the agreement, companies will increase investment and draw on economies of scale to transition from natural resources to more labor-intensive manufacturing industries. Expected productivity gains and higher returns on investment will enhance investors' confidence and growth prospects within the region, accelerate the diversification of growth sources, and change trade patterns.

Small and Medium Enterprises (SMEs) play a crucial role in the African Continental Free Trade Area (AfCFTA). According to Karingi and Davis (2016), SMEs are essential to African economies as they contribute significantly to employment and private sector activities. AfCFTA presents a unique opportunity to enhance competitiveness by granting access to larger markets, lowering tariffs, and enabling integration into regional and global value chains.

While AfCFTA offers prospects for the private sector, especially SMEs, various authors have highlighted the challenges associated with integration. Hartzenberg (2011) emphasizes that the elimination of tariffs is particularly advantageous for SMEs, which face high production costs due to limited market sizes. These SMEs, representing over 80 percent of African enterprises, will now have improved opportunities to export and expand their operations. Abrego et al. (2019) point out that the benefits of trade liberalization may be different. Their analysis of the impact of the AfCFTA suggests that smaller firms may struggle to compete with larger, more established companies due to a lack of capital and production capacity.

The AfCFTA is positioned as a transformative initiative with the potential to develop the private sector across Africa significantly. The agreement offers numerous business opportunities by expanding markets, promoting industrialization, improving investment climates, and supporting SMEs.

VII. Conclusion

The balance between public and private investments is crucial for sustainable economic growth in Africa. Public investment is important for infrastructure and human capital development, while private investment drives technological advancement and capital accumulation. It is essential to reconsider growth models across the continent, moving away from the traditional public sector-led model. The potential benefits of this shift, such as increased job opportunities and economic growth, underscore the value of the proposed changes.

Our study uses the PVAR methodology to examine the connections between public investment, private investment, and economic growth in 43 SSA countries. Our analysis unveiled the following insights: (i) economic growth positively influences both private and public investment; (ii) private investment has a positive impact on economic growth; and (iii) public investment positively affects private investment. In the short term, we observed that a one percent increase in per capita private investment is associated with a 0.087 percent rise in economic growth. Similarly, a one percent increase in economic growth per capita corresponds to a 0.474 percent increase in per capita public investment and a 0.483 percent increase in private investment. Moreover, a one percent increase in per capita public

investment is linked to a 0.063 percent increase in per capita private investment. In the long term, our findings suggest that a one percent increase in public investment is projected to result in a 0.26 percent and 0.47 percent increase in economic growth, respectively. Similarly, a one percent increase in private investment would lead to a 0.6 percent and 0.5 percent rise in economic growth, as estimated by FMOLS and PDOLS.

Due to challenging economic conditions, SSA countries must reassess their development approaches. Relying mainly on public investment has resulted in a substantial rise in public debt, which can only be sustained with changes in how national resources are gathered. Shifting towards growth and investment strategies prioritizing the private sector could be advantageous for most countries in the region, given their demographics and the imperative to create job opportunities. However, attracting private investment presents challenges because of the heightened risks and relatively unappealing risk/return profiles. To tackle this, policies should improve macroeconomic stability and expand the tax base while reducing exemptions. Devising innovative solutions to enhance project risk/return profiles and encourage regional growth will be necessary to mobilize domestic and international private funding sources.

To address these challenges, countries in the region should prioritize growth and investment strategies that leverage the private sector and create job opportunities. Policies should improve macroeconomic stability, expand the tax base, and reduce exemptions. Innovative solutions are needed to enhance project risk/return profiles and encourage growth through mobilizing domestic and international private funding sources. To attract both domestic and foreign private investment, it is imperative to establish a conducive business environment through reforms that prioritize transparency, streamline bureaucracy, and enhance legal security. Finally, future research should consider including the capital stock in PPPs, which are gaining momentum on the continent. Policymakers should focus on creating a conducive business environment, reducing risks for private investors, leveraging DFIs to facilitate PPPs, and fostering collaboration between the public and private sectors for sustainable and inclusive economic growth in African countries.

Annex 1: Sub-Saharan African countries

1	Angola	23	Kenya
2	Benin	24	Lesotho
3	Botswana	25	Liberia
4	Burkina Faso	26	Madagascar
5	Burundi	27	Malawi
6	Cabo Verde	28	Mali
7	Cameroon	29	Mauritius
8	Central African Republic	30	Mozambique
9	Chad	31	Namibia
10	Comoros	32	Niger
11	Congo, Democratic Republic	33	Nigeria
12	Congo, Republic	34	Rwanda
13	Côte d'Ivoire	35	Senegal
14	Equatorial Guinea	36	Seychelles
15	Eritrea	37	Sierra Leone
16	Eswatini	38	South Africa
17	Ethiopia	40	São Tomé and Príncipe
18	Gabon	41	Tanzania
19	Gambia	42	Togo
20	Ghana	43	Uganda
21	Guinea	44	Zambia
22	Guinea-Bissau		

Annex 2: Correlation test

Logarithm level			
	LYPC	LKPUBPC	LKPRIVPC
LYPC	1.0000		
LKPUBPC	0.9721	1.0000	
LKPRIVPC	0.9796	0.9484	1.0000
First difference			
	DLYPC	DLKPUBPC	DLKPRIVC
DLYPC	1.0000		
DLKPUBPC	0.5128	1.0000	
DLKPRIVC	0.5859	0.9127	1.0000

Annex 3: VIF (Variance Inflation Factor) analysis

Variance Inflation Factor		
VARIABLES	VIF	1/VIF
LKPRIVPC	9.75	0.102
LKPUBPC	9.75	0.102
MEANVIF	9.75	
Variance Inflation Factor		
VARIABLES	VIF	1/VIF
DLKPRIVPC	6.26	0.159
DLKPUBPC	6.26	0.159
MEANVIF	6.26	

Annex 4: Hausman Test

Hausman Test
Test: Ho: difference in coefficients not systematic
$\chi^2(2) = (b-B)'(V_b - V_B)^{-1}(b-B)$
= 2.34
Prob> χ^2 = 0.3099
Test: Ho: difference in coefficients not systematic
$\chi^2(2) = (b-B)'(V_b - V_B)^{-1}(b-B)$
= 126.63
Prob> χ^2 = 0.0000
Test: Ho: difference in coefficients not systematic
$\chi^2(2) = (b-B)'(V_b - V_B)^{-1}(b-B)$
= 110.43
Prob> χ^2 = 0.0000

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