

Private and Public Investment in Africa: A Time-Series Cross-Country Analysis

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Abstract

Times-series cross-country approach is used to empirically investigate the relationship between private investment and public investment. We use panel data for the period 1980–2010. Independent variables like public investment, gross domestic product, trade openness, external debt stocks, domestic credit to private sector are integrated in the model. This helps to take into account the impact of gross domestic product, external debts stocks and domestic credit policy on how public investment affects private investment. Empirical results of this paper demonstrate that these independent variables (except, credit to private sector) are significant at 1% level and that the associate parameter η is equal to -66.972 means that public investment negatively affect private investment. Public investment crowds out private investment. There is a substitution effect between private investment and public investment. Improvements in public expenditures may not directly increase private investment.

Keywords: private investment, public investment, crowding effect, times-series cross-country

1. Introduction

Private and public investment evolution is a critical topic for Africa's economic growth and poverty alleviation nowadays. Since, the analysis of the productive role of private and public financial and physical capital has been early developed in the years 1940–1950, following by the discussions around the balanced growth initiated by development theorists (Rosenstein-Rodan, 1943; Nurkse, 1952; Hirschman, 1958), the debate related on the theme of economic take-off has also been awarded to date, in particular through new models inspired by the problem of Big Push (Murphy, Scheiffer, & Vishnu, 1989).

Investment is a mechanism use to accumulate the innovative produced financial and physical capitals, such as factories, machineries, buildings, and goods inventories. Also, investing in finance is the act of buying a personal asset and expecting that the financial capital will produce revenues, like interest and/or dividends. All categories of financial and physical investments are involving in some type of risk. These risks are investment in equities, property, and even fixed interest securities (subject to inflation risk). To manage the risks related to the investment, it is important for public and private project investors to first identify it and second to integrate it in the financing process. In the related literature, many forms of investment are found: direct or indirect (portfolio), internal (national) or external (foreign), public or private.

The main role of the private investment is to increase the capital stock of the productive assets held by the national or domestic private sector. The replacement of the existing capital stock and the creation of additional capital stock embodying new and innovative technology are the very important motivations. The literature related on endogenous growth nowadays includes human capital in this definition. In essence, investing in education and training the workforce (managers, entrepreneurs and the society) are considered as variables of human capital (Paterson, 1999). The private physical investment can be categorized in two: the infrastructures (buildings, housing, logistic sites) and equipments (machineries and transport). Investments in equipments are considered to be the key factors which influence short-run economic growth, and investments in human capital impact endogenous growth models in long-run.

Public investment can be dividing into many broad forms: investment in physical capital, in infrastructure, for example, including transport and telecommunications networks; investment in human factors such as human

capital, for example, investment in education and in training; investment in technical progress, for example, research and development; investment in plant and equipment (Paterson, 1999). Public investments in some key and training effect sectors are closely in relationship to the enhancement of the innovative and productive capacity of the domestic economy. Indeed, without public investment in different domains like: road, rail, air, and waterway transport, and telecommunications networks production, private or public financial, physical transaction and trade would not be possible. In these areas, investments whether or not involving public/private partnerships (PPP), should be regarded in the same way as domestic private investment in productive assets. The implications of this point for the financing of such projects impact on national government budgets. Private capital, as far as development of the physical investment base of the economy is concerned, is clearly not competitive with this form of public investment. Such investment should be protected because it can either be provided with public expenditures, and/or a mixture of public and private funding.

Essentially, a fundamental distinction can be made when comparing both public capital and private capital. In fact, public capital directly managed through governments is discretionary. While private investments are influenced by expectations of anticipated returns, uncertainty and cyclical economic variations, public investments are not. Therefore public investments can be provided on a stable basis, without regard to any uncertainty and cyclical economic variations, more correctly designated as uneven economic growth patterns. Public investment is argued and considered as one of the important business stimulus and engine to private investment. Public and private capital can be correlated or can be in relationship by a complementarity or substitute link if public investment exerts positive or negative stimulus on the private sector through private investment. The positive effect pushed by public investment towards private investment may be explained by the public capital hypothesis (Aschauer, 1989). According to this hypothesis, when public investments raise the consequence is that the private investments also increase.

The effect of private capital on public capital or the impact of public investment on private investment is theoretically ambiguous and indeterminate. These effects may be insignificant (neutral effect), negative (substitution effect or crowding) than positive (complementarity effect or training). Previous empirical studies on the effects and existing inter-linkages between aggregate private and public investment have generally followed two methods. The first method is the use of national aggregates as explanatory variables for the topic under review. The second approach entails using individual firm and/or industry-specific explanatory variables to explain investment behavior. Most of these studies have used time series analysis with a few opting for panel data analysis. The flexible accelerator model was one of the models used to empirically estimate investment behavior (Muyambiri et al., 2010). The accelerator model was propounded by Clark (1917). However, it has been less preferred as a model because of its stringent assumptions and an adjustment coefficient of investment equal to unity. The accelerator model with an adjustment coefficient equal to unity was rejected in tests by Kuznets, Tinbergen, Chenery, Koyck and Hickman (Jorgenson, 1971). The flexible accelerator model is used as an alternative in most investment studies.

Is the link between private and public investment found to be significant or not significant? Is the direction of causality found to be unidirectional or bidirectional? Do public investments exert positive, neutral or negative effects on private investment? Do private investments influence positively, negatively or neutralize public investments? The aim of this paper is to analyze the relation between private investment and public investment. This paper provides evidence on the correlation between private investment and public investment by using a time-series cross-country analysis approach in fourteen African countries. The contribution of this research lies in the fact that the application of time-series cross-country approach has never been widely used in this kind of study in Africa, particularly in private and public investment analysis. Thus, the contents of the study are as follows. Literature review is presented in section 2. The methodology with the econometric model and the data sources is presented in section 3. Section 4 presents and discusses empirical results, and the last section concludes.

2. Review of the Literature

A considerable number of previous theoretical studies and empirical researches have generally been done on the investment and particularly on the determinants of investment, on the public capital and on the private investment. Some authors have agreed that private and public investments positively impact economic growth. There is not a consensus on the link between public or private investment (Erden & Holcombe, 2006). Using the case of developed economy in 1980s, (Aschauer, 1989) shows that the decreasing in public infrastructure expenditures confirms that the part of the productivity does not increase. A large part of literature and researches that analyzed whether public capital leads to participate in increasing output growth and/or the productivity of private investment have followed these studies: (Munnell, 1990; Khan & Reinhart, 1990; Barro, 1990; Easterly & Rebelo, 1993; Tatom, 1991, 1993; Evans & Karras, 1994a, 1994b; Ramirez, 1998; Khan & Kumar, 1997).

The literature related on the investment in the underdevelopment countries (Gankou, 1985) and on the effect of public investments on private investments in developing economies gives inconsistent results on whether the complements each other, substitutes or public investment crowds out private investment. Erden & Holcombe (2005) have applied several pooled specifications of a standard investment model to a panel of developing economies for 1980 to 1997 and identify that public capital complements private capital. They also run the same empirical models on a panel of developed economies to show that public investments crowd out private investments in developed economies. The empirical evidences show that in some important ways, private investments in developed economies are influenced by different factors than private investments in developing economies. Investigations made by Ahmad and Qayyum (2008), Ghura and Goodwin (2000), Oshikaya (1994), Ramirez (1994) have found that the two types of investment are positively correlated (Muyambiri et al., 2010). Faini (1994) analyzes whether there is a training effect or a substitute (crowding out) effect between public investment and private investment in Africa. Touna Mama, Kamgnia Dia, Ouédraogo and Zeufack (2002) using vector auto-regressive (VAR) estimates to empirically indicate the key determinants of the private capital in some francophone African countries, have showed that private investment can be substituted to public investment. In the case of the developed countries, Pereira (2001) has tested the impacts of governmental investment on the evolution of private investment and the empirical findings suggest that at the macro level, private investment can be substituted to private investment.

Crowding out is argued and considered by some authors to appear when government borrowing increased, fiscal policy expansion reduces investment spending. Basically, crowding out was reflected the increasing in the interest rates from the borrowing. But that was broadened to multiple channels (Blanchard, 2008). One of the channels of crowding out is the reduction in private investments. This occurs because government increases his borrowing to finance his infrastructural expenditures. A rising in government expenditures and/or a decrease in revenues from taxation lead to a deficit that is financed by increased borrowing. The borrowing can, then, increase interest rates and conduct to a reduction in private capital.

The hypothesis of crowding out raises an important issue that concerns the opposition between the financing of public investment and the private investment. But when the investment in question addresses a large proportion of infrastructure, in education or in research and development rather than public consumption, the case of crowding out can not clearly be applied. In addition, the threat is that public investment is the expense item as easily penalized in case of budget restrictions.

Investment in public infrastructure and governmental capital also affect private investment through other various channels: complementarity impacts, output and relative price effects (Agénor, Nabli, & Yousef, 2005). The complementarity effect asserts that public capital (as opposed to public investment) in infrastructure may stimulate private physical capital formation because of its impact on private economic activities. By raising the marginal productivity of private inputs (both labor and capital), it raises the perceived rate of return on, and increases the demand for, physical capital by the private sector. Alternatively, a complementarity effect between public capital in infrastructure and private investment may operate through adjustment costs. In a context of economic growth, this idea is found on the availability and the quality of public capital in infrastructure (Turnovsky, 1996). For example, a better integrated road can reduce costs associated with the construction of innovative and new factories or the displacement of heavy equipments. Cohen and Paul (2004) analyze that in many countries, the effect of private investment on unit production expenses and the productivity can be substantial. By reducing production expenses and increasing the expected rate of return, public investment in basic infrastructures can have a strong effect on building private investments.

Public investment and governmental capital in basic infrastructure can not directly affect private investment in formation, through changes in outputs and relative prices. Public investment in infrastructure may increase the marginal productivity of existing factor inputs (both capital and labor), thereby reducing marginal production expenses and increasing the level of private production. In turn, this scale impact on output can conduct, through the accelerator effect, to higher private capital (Chirinko, 1993). Moreover, if there are externalities associated with the use of some production factors a positive growth effect can result. Agénor, Nabli and Yousef (2005) analyze that public infrastructure can also indirectly impact private investment through its flow effect on the price of domestic consumption goods relative to the price of imported goods: that is, the consumption-based real exchange rate. An increase in public investment in infrastructure for example will increase aggregate demand and domestic prices in addition to stimulating output.

In the context of countries in the developing world the relationship between private and public investment (in terms of crowding in and crowding out) has been a major focus of analysis. Beyond the relationship between private and public investment, the concern for private investment has been in terms of its impact on economic

growth. The authors who have contributed to investment analysis in Africa are: Oshikoya (1994), Mlambo and Oshikoya (1999), Devarajan et al. (1999), Mataya and Veeman (1996), Khan and Reinhart (1990), and Gunning and Mengistae (1999). Writing on the macroeconomic determinants of domestic private investment in Africa, Oshikoya (1994) found a positive relationship between public investment and private investment. The study spanned 1970 to 1988 and covered seven African countries, namely, Cameroon, Mauritius, Morocco, Tunisia, Kenya, Malawi and Tanzania. Though public investment ratios had fallen in some of the countries, particularly in Mauritius and Morocco, a strong positive effect of public investment on private investment was observed. The results suggested that: the productivity of these forms of investment may be as important as their magnitude in influencing private investment (Oshikoya, 1994). Analyzing the same relationship, Mlambo and Oshikoya (1999), using a sample of 18 African countries for the period 1970 to 1996, found that fiscal, financial and monetary policy, macroeconomic uncertainty and trade variables were significant determinants of private investment in Africa. The study also found political stability to be a major factor in the determination of private investment rates on the continent.

Shafik (1992) found that public investment tends to crowd out private investment through its effect on credit markets, and to crowd it in through investment in infrastructure. Dhumale (2000) finds that public investment in basic infrastructure appeared to have a crowding out effect in oil-exporting countries, and a crowding-in effect in the non oil-exporting countries. The author has used a model that accounts for credit to the private sector and the accelerator effect. Everhart and Sumlinski (2001) find a neutral effect which means that the effect of public investment on private investment is not significant. The authors used a methodology found on the panel tools and a proxy to capture the quality of public investment to empirically analyze the relationship.

3. Methodology: Model and Data

3.1 Model

From Paterson (1999), neoclassical models, first, with technology considered as given or exogenous to the model (Solow, 1956) and, second, with technology determined inside the model or endogenous to the model (Romer, 1986; Lucas, 1988) we have constructed a theoretical model based on Cobb-Douglas function. From Sundararajan & Thakur (1980), Ram (1993), and Erden and Holcombe (2006), the model developed by these authors is a modification of the neoclassical model that incorporates the effects of public investment and uncertainty, and specifies the dynamic structure of private investment as an error correction mechanism. According to the neoclassical model of investment, incorporating public capital into the optimization problem of a representative firm under certainty, the optimal or steady state level of the private capital stock is expressed as a function of quantity of public capital (PUI_{it}), output (GDP_{it}), and the user cost of capital (C_t which can be expressed by external debt stock, domestic credit to private sector among others):

$$PRI_{it} = F(PUI_{it}, GDP_{it}, C_{it}) \quad (1)$$

The model constructed for time-series cross-country estimation shown by equation (2) is based on the modification of models developed from the previous studies. In contrast to other models, this model incorporates the effects of interaction variables (gross domestic product, trade openness, external debt stocks, domestic credit to private sector and population) and the dummy variable to establish the corresponding correlation between private investment and public investment:

$$PRI_{it} = \phi + \eta \ln PUI_{it} + \omega_1 \ln GDP_{it} + \omega_2 \ln TO_{it} + \omega_3 \ln EDB_{it} + \omega_4 \ln CRP_{it} + \omega_5 \ln POP_{it} + \sum_{1 \leq j \leq 2} \alpha_j D_j + \zeta_i + \varepsilon_{it} \quad (2)$$

where, PRI , our dependent variable, represent the private investment; PUI , GDP , TO , EDB , CRP and POP are the explanatory variables and respectively represent public investment, gross domestic product, trade openness, external debt stocks, domestic credit to private sector and population; Φ the constant parameter, η , ω_k for $k=1, \dots, 5$ the associate parameters; D_j represent regional dummy variables. More precisely, D_1 represent the Economic Community of African States (hereafter Central African Countries Economic Community- CEEAC) dummy variable and D_2 , the West African Country-CEDEAO. The letter \ln before the explanatory variables indicates the natural logarithm operator; ε is the rest of the disturbance and ζ is the cross section specific effect; the subscripts $i = 1, 2, \dots, 14$ and $t = 1, 2, \dots, 30$ respectively indicate the country and the time. In this study, our main focus is the private-public investment relationship, and we attempt to investigate it by analyzing the statistical significance of the associate parameter η . The sign (negative and/or positive) of this parameter of our econometric model will indicate the effects of the dependent variable PRI on the independent variable PUI with panel data.

3.2 Data

To conduct this regression, we use panel data drawn out from World Bank contained in the World Development Indicators (2012). The sample contains fourteen countries which are regrouped in three; the West African Countries (CEDEAO)–Benin, Côte d’Ivoire, Gambia, Ghana, Mauritania, Senegal, Sierra Leone, the Central African Countries (CEEAC)–Cameroon, Chad, Congo Democratic Republic, and Gabon–and the other countries which contains Tunisia, Zambia and Zimbabwe. The sample period is from 1980 to 2010.

We calculated the trade openness as the aggregate values of imports and exports of commodities and services. Exports of goods and services represent the value of all goods and other market services provided to the rest of the world. Imports of goods and services represent the value of all goods and other market services received from the rest of the world. Data are currently expressed in U.S. dollars. GDP (gross domestic product) at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. Domestic credit to private sector refers to financial resources provided to the private sector through loans, purchases of non-equity securities, trade credits and other accounts receivable that establish a claim for repayment. For some African countries in our sample these claims include credit to public enterprises.

4. Empirical Results: Presentation and Discussion

Equation (2) is estimated using time-series cross-country analysis with data over the period 1980 to 2010 for 14 selected African countries. The procedure and empirical results are reported in the following Tables.

4.1 Test on the Cross Specific Effects

The fixed effects test (Table 1) was used to analyze the significant cross specific effects or not of the correlation between private investment and public investment in the 14 African countries.

Table 1. Test of fixed effects

Fixed effects (within) regression	Number of obs = 434					
Group variable: id	Number of groups = 14					
R-sq:	within = 0.5115		min = 31			
	between = 0.9368		obs per group: avg = 31			
	overall = 0.7840		max = 31			
Corr (u _i , xb) = 0.5629	F (5, 415) = 86.89					
	Prob > F = 0.0000					
pri	Coef.	Std-err	t	P > t	[95% conf. interval]	
lpui	-68.58039	3.702072	-18.52	0.000	-75.85755	-61.30324
ledb	-2.460473	.8280758	-2.97	0.003	-4.088219	-.8327273
lpop	-.8627238	2.065009	-0.42	0.676	-4.921906	3.196458
lgdp	6688411	3.522309	18.99	0.000	59.96032	73.80791
ltot	6.192772	1.080413	5.73	0.000	4.069008	8.316537
_cons	-1378032	20.23239	-0.68	0.496	-53.55106	25.99043
sigma_u	4.1533107					
sigma_e	5.85555009					
rho	.33471156	(fraction of variance due to u _i)				

Note. F test that all u_i = 0; F (13, 415) = 5.70; Prob > F = 0.0000.

Table 1 presents the within analysis and following by the related results. The F test demonstrates that there is a significant specific effect in the model since the *p*-value is less than 1 %. Thus the pooled regression cannot be applied here. The individual-specific effect is now subject to be considered as random variable. That is uncorrelated with the explanatory ones -and then, a part of the error term- then, random effects estimation will be applied. So the Hausman test will be conducted to choose the appropriate approach: fixed effects method or random effects method.

4.2 The Hausman Test

The results of the Hausman test are presented in Table 2.

Table 2. The Hausman test

	Coefficients			
	(b) Fixe	(B)	(b-B) difference	sqrt[diag V_b-V_B] S E
lpui	-66.68228	-66.97193	.2896532	.8292147
lgdp	63.72903	65.187	-1.457968	1.167011
ltot	6.809182	7.023786	-.2146035	.4246522
ledb	-2.079959	-1.036111	-1.043848	.3995225
lcrp	.022724	-.0947879	.1175119	.2836501
lpop	-.0732393	-4.319802	4.246563	1.471868

Note. b = consistent under Ho and Ha; obtained from xtreg;

B = inconsistent under Ha, efficient under Ho; obtained from xtreg;

Test: Ho: difference in coefficients not systematic;

chi2 (6) = (b-B)' [(V_b-V_B) ^ (-1)] (b-B) = 18.58;

prob > chi2 = 0.0049.

The p -value is less than 1%, so that the random effects regression is preferred. The equation (2) will be estimated using random effects method.

4.3 The Random Effects Estimation

Table 3. Test of random effects

Random effects GLS regression	Number of obs = 407					
Group variable: id	Number of groups = 14					
R-sq:	within = 0.6076		min = 18			
	between = 0.9795		obs per group: avg = 29.1			
	overall = 0.8760		max = 31			
Corr (u_i, x) = 0 (assumed)	Wald chi2 (9) = 1040.85					
	Prob > chi2 = 0.0000					
Pri	Coef.	Std-err	z	P > z	[95% conf. interval]	
lpui	-66.97193	3.022489	-22.16	0.000	-72.8959	-61.04796
lgdp	65.187	2.836437	22.98	0.000	59.62768	70.74631
ltot	7.023786	.8199209	8.57	0.000	5.41677	8.630801
ledb	-1.036111	.5427919	-1.91	0.056	-2.099964	.0277411
lcrp	-.0947879	.4796125	-0.20	0.843	-1.034811	.8452353
lpop	-4.319802	.8805288	-4.91	0.000	-6.045607	-2.593997
CEMAC	-.1458061	2.791192	-0.05	0.958	-5.616442	5.32483
WAC	-3.848548	2.563275	-1.50	0.133	-8.872475	1.175379
OTH	-1.973126	2.733622	-0.72	0.470	-7.330926	3.384675
_cons	-3.606334	11.05021	-0.33	0.744	-25.26434	18.05167
sigma_u	1.8183582					
sigma_e	4.6194485					
rho	.13415818 (fraction of variance due to u_i)					

From Table 3, the R-squared between is equal to 0.9795 and is upper than 75 %. This means that the specification of the model is well done.

Table 4. Presentation of the results of the relationship between private and public investment

	F. E. regression	R. E. regression	GLS regression
Pub. Inv.	-66.682 (3.134)***	-66.972 (3.022)***	-64.848 (2.774)***
GDP	63.729 (3.067)***	65.187 (2.836)***	64.653 (2.546)***
Trade Openness	6.809	7.024	6.037

	(0.923)***	(0.820)***	(0.745)***
Ext. Debt	-2.080	-1.036	-0.384
	(0.674)***	(0.543)*	(0.462)
Cred. to P. Sec.	0.023	-0.095	-0.414
	(0.557)	(0.480)	(0.383)
Pop	-0.073	-4.320	-5.897
	(1.715)	(0.881)***	(0.565)***
CEMAC		-0.146	-1.430
		(2.791)	(1.376)
CEDEAO (WAC)		-3.849	-4.510
		(2.563)	(1.291)***
OTH		-1.973	-2.735
		(2.734)	(1.376)**
Constant	-19.882	-3.606	-5.252
	(17.635)	(11.050)	(6.256)
R^2	0.61	0.97	
N	407	407	407

Note. standard errors are in brackets; and the stars ***, **, * indicate the significant level respectively at 1%, 5% and 10%.

From the Table 4, we note that the explanatory variables like public investment, gross domestic product, trade openness, external debt stocks and population are significant at 1 % level. Their estimated associate coefficients are respectively: $\eta = -66.972$, $\omega_1 = 65.187$, $\omega_2 = 7.024$, $\omega_3 = -1.036$, and $\omega_5 = -4.320$. Only the credit to private sector is non-significant. The reason could be the fact of the existence of some missing values. The membership of some African countries to Central Africa economic zone, West Africa region and other African regions is clearly specified in the model. The corresponding estimated coefficients are -0.146 for CEEAC, -3.849 for CEDEAO and -1.973 for others (Tunisia, Zambia and Zimbabwe).

Using the random effects, the R-square is equal to 0.97 showing the strong correlation between the two variables. In Africa, private investment and public investment are in relationship. The associate parameter $\eta = -66.972$ shows the negative effect of public investment on private investment. The results present not a complementarity effect between the two types of investments but a substitution effect, suggesting that government investments not encourage more private investments. These evidences corroborate with the contribution of Sundararajan & Thakur (1980) in the case of India and Korea. But with Faini (1994) and considering the basic public expenditures done by some African countries in sectors like energy (for example, electricity), telecommunication and transport, we can discuss the impact of crowding out and the training effect of the public investment on the private investment in Africa. African governments usually take many years to build basic infrastructures in the complementary and training sectors. Oshikaya (1994) and Ramirez (1994) respectively for empirical analysis in Africa and in Mexico have shown the complementarity of the two investments. Our empirical findings support the idea that private investment substitutes public investment in the 14 selected African countries.

5. Conclusion

This study aimed to investigate the relationship between private investment and public investment in some African countries. Some main conclusions from the econometric results are highlighted. The complementarity effect between private investment and public investment is not justified. The findings support the idea that private investment is a substitute of public investment, and also suggest that government expenditures do not encourage more private investment.

The ultimate objective is to promote private investment. Public and private investments are linked by a substitution relation. Public capital and basic infrastructural expenditures have positive impacts on the private sector. It could be counterproductive if some private investment led to unsustainable infrastructure development that posed a huge financial burden on the host government. The main goal is to sustain economic growth and poverty reduction that could happen at the end of a long and complex process involving many actors and interventions.

Nevertheless, when private investment is deemed to make major contributions to this goal through a specific public infrastructure plan, then development partners should collectively look at what they can do more (ameliorate for example business climate) to help improve the enabling environment and provide effective public or private financing tools. The implication for policy is to foster and support economic growth in African

countries. Closer attention should be given to key factors that promote private investment like public investment in basic infrastructures: energy offer, transport and telecommunications networks. African governments have to improve the productivity of their investments so as to generate positive returns and enhance their complementary role to private sector and private investment. Further researches in this area have to perhaps use the same methodology with disaggregated public investment data.

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