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The Effect of Public Capital on Private Investment in Kenya

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Abstract:

This paper analyses the effect of public capital on private investment in Kenya using time series data from 1980-2014. Vector Auto regression (VAR) model was applied to analyze the data. The empirical findings show that public investment promotes private investment in the short-run and in the long-run. This implies that a well-targeted public investment is important in minimizing bottle-necks thereby stimulating private investment. Based on the findings, the study recommends that the government to continue strengthening and pursuing investment policies in various sectors of the economy that could foster private investment. The government needs also to pay more attention to prudent investment to ensure reduction in private transactions costs thereby creating more opportunities for private investment.

Keywords: Vector Auto Regression (VAR), public investment, private investment

1. Introduction

It is widely agreed that investment is important because it raises economy's productive capacity by accelerating advancement in technology and adoption of new techniques that enhances industrial growth (Ahmad et al, 2009). According to Dornbush (1999) investment depends on number of factors and is therefore volatile thus a major cause of fluctuations of GDP during business cycle. The classical economists, Smith and Ricardo argued that national prosperity and growth can be achieved through market mechanisms without government intervention which was seen as unnecessary in regulating the economy. Keynes (1936), on the other hand advocated for government intervention to regulate savings and investment behavior of the society. Development investments such as provision of infrastructure may positively affect private investment through reduction in cost of production. In addition, government consumption expenditure positively affects private investment through increased aggregate demand channel but may also have negative effect on investment due to increased budget deficits and future taxes caused by lack of complementary effects on private investment (Alfred and Sagales, 2001).

The above position notwithstanding, literature on public investment stimulating or crowding-out private investment has taken a center stage in policy debate especially in developing countries (Ismihan et al., 2005; Rashid and Ahmad, 2005). Public investment plays important role in the socio-economic development of a country even though these investments are generally considered to be less efficient compared to private investment (Agyie, 2017). Consequently, policy-makers generally assert that effective public investment will result in high relative return in the private sector. However, one view suggests that high levels of government borrowing from domestic market to finance public spending acts as substitute to private investment (Hermes and Lensink, 2003).

Further, literature alludes that economic agents are rational and therefore when government spending is increased private saving also goes up in equal measure which results in no first-order effect on private investment (Barro, 1974). These divergent views have given rise to several studies assessing the relationship between public and private investment albeit mixed results (Laopodis, 2001b). While the argument about the effect of public investment in the economy mainly seems to validate crowding-in effect in developing countries and the opposite in developed economies, evidence of such findings remain inconclusive across countries and regions (Munthali, 2012).

Several studies have looked into the effect of public investment on output growth (for example, Ahmed, 2009; Erden and Holcombe, 2006; Ahmed and Qayyum, 2007; Bucci and Del 2012). Other studies have analyzed the factors influencing private investment (for example, Martinez-lopez, 2006; Kamrul and Ruhul, 2011). However, the findings vary from one study to another with some of the studies having found private capital to be more productive compared with public capital (Hassan and Salim, 2011). Ramirez (2001) using panel data for Latin American countries investigated the association between public and private and established that public investment is important in determining private investment. Voss (2002) and Narayan (2004) in their studies found that rather than complementing private investment public capital acts as a substitute for private investment.

Fujita and Thisse (2002) argued that public capital spending is fundamental in the reduction of transport costs and in the supply of local public goods hence it plays a critical role in the trade-off between increasing returns and transport costs. In this view, it is understood that public capital could increase the productivity of private factors thereby generating a significant impact on growth (Dannefer et al., 2016). Aschauer (1999) highlighting the importance of public capital in an economy attributed the United States productivity slowdown in 1980s to inadequate infrastructure spending.

Questions on the role of public sector stimulating or crowding private sector have also gained momentum in Kenya as policy makers pursue fiscal consolidation policies to control government spending and to reduce budget deficits. This is because high levels of public spending may leave fewer resources for private sector investment thereby causing interest to go up which ultimately lowers the level of private investment. Over the years, Kenya has experienced a bumpy and unsteady private investment as shown in Figure 1

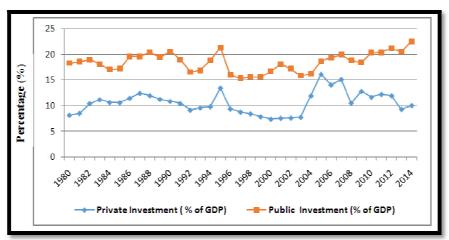


Figure 1: Public and Private Investment (1980-201 Source: Research Data

For the last three decades private sector investment in Kenya has on average been declining averaging at 10.6 percent of GDP while public investment has remained high averaging 18.5 percent of GDP. Despite efforts by the government to allocate resources for public capital formation, private sector investment has been disappointing. Further, how public investment affects private sector activity in Kenya has not received much attention. Thus, this study is aimed at analyzing the effect of public capital formation on private investment in Kenya, and to establish whether public investment complements private investment.

2. Literature Review

There exists vast theoretical and empirical literature that has evolved over time explaining the mechanism through which investment takes place in an economy as well as the effect of public investment on private investment. Investment is made up to the point where present value of expected future marginal return equal the opportunity cost of capital (Magableh and Ajlouni, 2016). According to Keynes (1936), investment occurs when firms put into consideration the returns they expect to receive on new capital which is determined by the real interest rate. Keynes further believed that shifting demand curve as opposed to the movement along the curve causes investment to fluctuate. Investment is volatile because it depends partly on the expectation of the firm about the profits the investment will generate which represents a strong case in explaining business cycle.

The accelerator theory of investment follows the Keynesian approach and it assumes prices are fixed. The principle of acceleration was applied by Samuelson (1939) and postulates a linear relationship between investment and output. The key feature of the accelerator theory is that given incremental capital output ratio it is possible to calculate the level of investment needed to attain specific amount of output. This theory also assumes the ratio of desired capital to output is fixed and there is always enough investment to keep desired and actual capital stock equal (Christie and Rioja, 2017).

Tobin (1969) advanced one of the most challenging investment theories known as the Q-theory of investment. Tobin argued that investment is made until the market value of asset equals replacement cost. The central idea behind Q-theory is that it focuses on measuring the difference between desired and the current level of capital stock. Further, Tobin postulated that the level of investment of a firm is determined by the ratio of the current value of installed capital and the cost of replacing it, which is known as Tobin's q. Moreover, when q>1 firms will increase their capital stock and decrease it when q<1. Investment would be worthwhile if the adjustment cost is less than the marginal return on investment. When q>1 firms expect to get more profits increase investment of capital goods raising overall investment level. On the other hand, when q<1, the present value of profits that firms will earn when they make new investments will be less than the costs incurred and therefore firms' will choose to reduce the amount investment to be undertaken.

Jorgenson (1963) developed a neoclassical theory of investment represented as a firm's optimization problem in which profits are maximized each period to yield optimal capital stock. The production function associated with this theory is in the form of Cobb-Douglas written as:

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 $Y(t) = AK^{\alpha}L^{1-\alpha}...(2.1)$

The representative firm's objective is to maximize profit which is determined by the price of output and capital as well as the wages paid on labor. The basic assumption of this theory is that K(t) fully adjusts instantaneously to K*(t) implying there is an immediate adjustment of capital to desired capital stock. The Jorgenson's theory of investment describes firm's optimal investment behavior where it is possible to quickly adjust capital stock so that it does not deviate from its optimal path. However, in case of sudden jump in returns to capital possibly due to sudden changes of interest rate firm will then consider changing its capital stock in to raise or lower the marginal product of capital. Different channels have also been identified in the literature that relates public capital to private investment.

For example, Erenburg and Wohar, (1995) argued that public investment increases national output thus enhancing economy's physical and financial resources. In addition, investment in physical infrastructure among such as roads, railways, energy and water systems may lead to a reduction in private sector production cost. State investment in the infrastructure compliments private investment which ultimately raises the productivity of private capital.

Holcombe, (2006) noted that public investment negatively affects private investment if the two are competing for the scarce domestic resources in the economy. As result, interest rate would go up and hence the cost of financing private investment due to a reduction in the availability of credit to the private sector. Besides, most of the state economic enterprises investments through domestic borrowing which further reduces the available credit and raises interest rates (Qayyum, 2001). Moreover, when both public and private sectors are involved in the production of goods and services that compete in the market especially when public production is subsidized by the government, public investment will then substitute for private investment rather than complementing it.

Empirical studies on the relationship between public and private investment is faced with conflicting results either supporting positive or negative effects (Laopodis, 2001a).

Ghani and Ud Din (2006) examined growth effect of public investment for Pakistan economy using Vector Autoregressive approach. The results revealed public investment and consumption spending had no significant effect on economic growth. Using time series data for Bangladesh, Hassan and Salim (2011) carried out a study aimed at analyzing key determinants of private investment and established that government expenditure was important in explaining private investment in Bangladesh. The findings also indicated high level of crowding-out.

Erden and Holcombe (2006) in their study investigated the causal relationship between public and private investment using panel data obtained from 19 developing countries over the period 1980 to 1997. They used reduced-form neoclassical approach and cointegration techniques to analyze the data. The findings showed public investment complements private investment. Specifically, the study established that increasing public investment by 1 percent will cause private investment to go up by 0.5 percent.

Fatima and Waheed (2011) sought to examine the effect of government expenditure and other macroeconomic factors on private investment in Pakistan. The results showed that private investment, expenditure on government purchases, development expenditure, and economic growth have long-run relationship. The results also indicated that development expenditure promotes private investment while government purchases were detrimental to private investment. From the results, it was evident that persistent uncertainty in an economy led to macroeconomic instability resulting into reduction of private investment.

In another study, Laopodis (2001) investigated the effect of military and non-military expenditure on private investment for Greece, Ireland, Portugal and Spain. The study used cointegration and error-correction analysis where non-military expenditures were categorized into those that are used for infrastructural development and government purchases. The empirical findings showed that public capital had ambiguous effect on private investment. Moreover, spending on defense had no impact on private investment.

In an attempt to investigate the crowding in-out hypothesis using South Africa data, Munthali (2012) carried out dynamic panel analysis relating public and private investment. The empirical finding could not confirm evidence of crowding-in even when transport and communication were used as the investment components in the regression equation. Nevertheless, the study did find the main constraints to South Africa's private investment were uncertainty caused by macroeconomic, the size of market size, and the availability of capital.

Wawire et al (2014) sought to determine the impact of government spending on private investment in Kenya using vector autoregressive technique from 1963-2012. The empirical results showed that recurrent and development expenditures accelerate private investment. The analysis also showed that public expenditure reforms deterred private sector activities.

Hassan and Salim (2011) examined the determinants of private investment in Bangladesh using vector autoregressive model and Johansen Cointegration method. The empirical results supported the flexible accelerator hypothesis. The results further indicated that real interest rate was not statistically significant in explaining private investment whereas national income was significant in the long term. In addition, government expenditure was found to have negative impact by crowding out private investment although the effect was negligible because investment was responsive to changes in interest rate. The empirical findings suggested that government expenditure was a useful tool to get economy out of recession while the use of monetary policy during recession was not effective since a reduction in interest rate did not cause private investment to increase.

3. Methodology

The theoretical literature asserts that public investment increases aggregate output which in turn enhances the economy's physical and financial resources. Additionally, infrastructure investment such as the construction of roads, highways, sewer and water systems as well as energy leads to a reduction in costs incurred by the private sector during the

production of goods and services. State investments tend to complement private investment and raise the productivity of private capital. However, at times public investment affects private investment negatively especially when public and private sector compete for the limited resources in the economy which may raise interest rate hence increasing the cost of financing private investment due to decline in availability of credit. This results in crowding out private sector investment. In addition, public investment may act as a substitute for private investment. This will be the case if both sectors engage in the production of goods and services that directly compete in the market (Holcombe, 2006).

Following Blejer and Khan (1984), this study uses a variant of the flexible accelerator model to accommodate the effect of public capital among other macroeconomic variables that could influence the accumulation of private capital. The capital stock required depends on the level of expected output Y, which is expressed as:

$$K^*_{pt} = \alpha Y^e_{t'} \qquad (3.1)$$

Where K^*_{pt} represents optimal capital stock desired by the private sector in period t, αY^e_t is the expected level of output which can be taken as the future aggregate demand. However, technical constraints such as time taken to plan, build, and install new capital would make actual capital stock not to fully adjust to reach the desired level. To capture this dynamic structure of private capital, a one-period quadratic adjustment cost function is introduced as follows:

$$\beta(K_{pt} - K^*_{pt})^2 + (1 - \beta)(K_{pt} - K_{p,t-1})^2....(3.2)$$

 $\beta(K_{pt}-K^*_{pt})^2+(1-\beta)(K_{pt}-K_{p,t-1})^2....(3.2)$ Where K_{pt} is the actual private capital stock. The first term in equation (3.2) shows the cost of disequilibrium, while the second term represents the cost of adjusting toward equilibrium. Minimizing the cost of disequilibrium with respect to K_{nt} yields a partial adjustment mechanism given as follows:

$$K_{pt} - K_{pt-1} = \beta (K_{pt}^* - K_{pt-1}) 0 \le \beta \le 1,$$
 (3.3)

where β is the coefficient of adjustment. Equation (3.3) indicates that actual private capital will adjust to the difference between desired private capital in time t and actual private capital in the previous period. Since getting data on capital stock pose a challenge, this study makes use of gross private investment which by definition is expressed as:

$$PI_{t} = (K_{pt} - K_{pt-1}) + \delta K_{pt-1}$$
 (3.4)

where δ is the rate of depreciation of the private capital stock and PI is gross private investment.

Rearranging equation (3.4) we get

$$PI_{t} = [1 - (1 - \delta)L]K_{pt}$$
 (3.4a)

Similarly, for empirical purposes, the partial adjustment mechanism can be specified in terms of PI as follow:

$$PI_t = PI_{t-1} = \beta(PI_{t-1}^* - PI_{t-1}^*)$$
 (3.5)

Equation (3.5) forms the basis of the contribution of this essay. In this regard, the specification is modified by assuming that government investment and other related variables affect the speed of adjustment at which the gap between the desired and actual gross private investment close up in the short-run period. Therefore, a linear representation of β is defined as follows:

$$\beta = \alpha_0 + [1/(PI_t^* - PI_{t-1})](\gamma_1 GI_t + \gamma_2 X_t), \qquad (3.6)$$

Where α_0 is the intercept, GI is gross public investment, and X_t , is a vector of other relevant macroeconomic variables. Equation (3.6) implies that the lagged effects of these variables on private investment are also captured by the coefficient of adjustment. If public investment compliments private investment, it will speed up the adjustment of desired private investment to its actual level, and vice versa. Plugging (3.6) into (3.5) and rearranging gives rise to the following equation:

$$PI_{t} - PI_{t-1} = \alpha_{0} (PI_{t-1}^{*} - PI_{t-1}) + \gamma_{1}GI_{t} + \gamma_{2}X_{t}$$
(3.7)

It is important to note that in the steady state, equation (3.4a) is given by:

$$PI_{t}^{*} = [1 - (1 - \delta)L]K_{pt}^{*}...$$
(3.8)

plugging equation (3.1) into (3.8) and the resulting equation into (3.7) and then rearranging, we obtain the following dynamic reduced-form equation for gross private investment that includes public investment and other relevant macroeconomic variables.

$$\mathsf{PI}_{t} = a_{0}[(1-\delta)\mathsf{L}]\alpha\mathsf{Y}^{e}_{t} + \gamma_{1}\mathsf{GI}_{t} + \gamma_{2}\mathsf{X}_{t} + (1-a_{0}) + \mathsf{PI}_{t-1} + \varepsilon_{t} \dots (3.9)$$

The model specified in equation (3.9) is quite flexible because it allows private investment to be specified not only as a function of the expected level of real output but also of several relevant variables that influence private investment. The coefficient Yecaptures the accelerator effect and is expected to be positive. However, the coefficient GI can either be negative or positive depending on which is greater between substitution and complementary effect of public capital.

3.1. Empirical Model

To make the model consistent with the flexible accelerator framework, this study follows the approach suggested by Coen (1971). In this case, the change in private investment is determined by the underlying economic conditions. Essentially, it is assumed that private investment will systematically respond to the gap between the desired and actual investment, as measured by the coefficient β, depending with economic factors that influence the ability of private investors to attain the desired level of investment. In this regard, private investment is assumed to depend on the level of public sector investment, GI. Therefore, crowding out phenomenon will be captured through the effect on the speed of adjustment and not directly by changing the level of the desired real private investment. The functional form of equation (3.9) is therefore expressed as:

PI=f (GI)......(3.10)

Where PI is gross domestic private investment, GI is gross fixed public investment.

The level of economic growth would also influence private investment. If the economy is expanding, the aggregate demand will be buoyant and therefore investors are expected to respond faster to changes in desired investment. When the economy is doing well, investment is likely to go up and vice versa. Incorporating GDP into equation (3.10) yields:

PI=f(GI,GDP(3.11) where GI is as previously defined and GDP is Gross Domestic Product.

The availability of credit could affect private investment through interest rate on loanable funds. Generally, an increase in real credit to the Private sector will encourage real private investment and rolling over of bank loans can sufficiently lengthen the time taken for debts to mature. Private consumption and foreign direct investment may also affect domestic private investment. For example, higher government expenditures from increases in demand for loanable funds exert upward pressure on interest rate raising the cost of capital (Laopodis, 2001b). Foreign capital flows either in the form of foreign direct investment or portfolio investment will also have a bearing on private investment (Weisskopf, 1972; Stillson, 1976). These types of financing tend to increase investment because they add to the pool of financial savings. Similarly, Investment will be influenced by interest rate and exchange rate policies because they affect changes in private capital inflows by augmenting or reducing the availability of financial resources to the private sector. Based on the above arguments and by incorporating the fore-mentioned macroeconomic variables, equation (3.11) is extended to specify an empirical equation to be estimated as:

 $PI_{t} = f(GI, GDP, CG, RIR, INFL, DCRT, FER, FDI, PC, \varepsilon)$ (3.12)

Where,

PI = private fixed investment INFL = inflation

GDP= GDP growth rate DCRT = domestic credit to private sector

 $\begin{array}{ll} \text{GI= Public investment} & \text{FER=foreign exchange rate} \\ \text{CG = public consumption spending} & \text{FDI=foreign direct investment} \\ \text{PC = Private consumption} & \epsilon_t = \text{error term} \\ \end{array}$

PC = Private consumption RIR= real interest rate

Equation (3.12) can formally be expressed in linear form as:

 $PI = \alpha_0 + \alpha_1GI + \alpha_2GDP + \alpha_3CG + \alpha_4RIR + \alpha_5INFL + \alpha_6DCRT + \alpha_7FER + \alpha_8FDI + PC + \epsilon.....(3.13)$

Equation (3.13) shows that the response to private investment depends on these factors, measured in relative terms with respect to the size of the difference between desired and actual investment. Nevertheless, changes in private investment could also affect the independent variables. Sims (1972) argued that it is arbitrary to categorize variables into endogenous and exogenous as in the case of structural models. To overcome this problem, this study will use vector auto regression (VAR) model which treats all the variables as endogenous. VAR model is chosen because it automatically includes cross variable effects since each variable is regressed on its own lagged value and those of other variables.

3.2. Source of Data and Description of Variables

This study used a time series data for the period 1980-2014 sourced from the World Development Indicators, World Bank data base.

- Private investment-This is gross outlay from the private sector which is as an addition to domestic fixed assets. Fixed capital formation is used as proxy for private investment measured as a percentage of GDP.
- Gross Domestic Product (GDP) –This is the total sum of value of goods and services produced by domestic residents measured as annual percentage at market prices based on local currency.
- Public investment- This is gross fixed capital formation which includes plant, machinery, construction of roads, railways, among others. This variable is measured as percentage of GDP.
- Public consumption spending- Comprises of government consumption purchases including workers compensation measured as percentage of GDP.
- Real Interest rate –This refers to the lending interest rate adjusted for inflation as measured by the GDP deflator.
- Inflation –inflation is used as measure of uncertainty in macroeconomic environment which affects firms' investment behavior and is measured as annual percentage over the period of analysis.
- Domestic credit This is the amount of financial resources mostly loans and securities provided to the private sector by financial institutions. This variable is measured as percentage of GDP.
- Foreign exchange rate This is the official exchange rate as determined by national authorities calculated as annual average (local currency units relative to the U.S. dollar).

Foreign direct investment –This is net inflows of investment capital from foreign countries and is measured as a percentage of GDP.

Private consumption –This is the market value of all goods and services bought by households. This variable is measured as a percentage of GDP.

4. Empirical Results

The data was subjected to unit root test before analyzing it. Augmented Dickey Fuller and Philips-Perron were used to test for the presence of unit root. The results are presented in Table 1.

	Level			First difference				
	ADF		PP		ADF		PP	
Variable	Intercept	Intercept	Intercept	Intercept	Intercept	Intercept	Intercept	Intercept
		+Trend		+Trend		+Trend		+Trend
Private investment	-2.838	-2.746	-2.906	-2.826	-6.676**	-6.623**	-6.716**	-6.655**
GDP	-3.437**	-3.638**	-3.468**	-3.638**	-6.327**	-6.232**	-6.719**	-6.588**
Public investment	-2.134	-2.259	-1.993	-2.087	-5.698**	-5.712**	-5.941**	-6.070**
Govt.Consumption	-1.147	-2.838	-1.002	-2.878	-6.605**	-6.508**	-6.691**	-6.593**
Real Interest Rate	-3.953**	-3.915**	-3.978**	-3.959**	-8.437**	-8.314**	-9.830**	-9.702**
Inflation	-3.339**	-3.415	-3.331**	-3.403	-6.543**	-6.448**	-6.977**	-6.859**
FDI	-6.880**	-6.904**	-7.093**	-7.188**	-9.537**	9.422**	-13.845**	-13.597**
Domestic credit	-1.989	-3.006	-1.991	-3.059	-7.454**	-7.499**	-7.541**	-7.600**
Exchange Rate	-0.942	-1.614	-0.94	-1.761	-5.438**	-5.393**	-5.431**	-5.384**
Private Consump.	-1.012	-2.786	-0.838	-2.822	-6.454**	-6.358**	-6.573**	-6.474**

Table 1: Results for Unit Root

Source: Owner's Computation Using STATA

HO: The Variable Has Unit Root. ** Denotes Rejection of The Null Hypothesis at 5% Level

Table 1 presents results for unit test using ADF and PP test in levels and in first difference. The results indicated variables GDP, real interest rate and foreign direct investment are stationary in levels and in their first difference while all other variables are stationary in first difference. The results further reveals that GDP growth, real interest rate and FDI are integrated of order I(0), while private investment, public investment, public consumption, inflation, Private consumption expenditure, domestic credit and exchange rate are integrated of order I(1).

4.1. Co-integration Analysis

The stationarity test showed that most of the variables were stationary in their first differences implying they are I(1) variables. Hence, this necessitated the need to perform co-integration analysis to confirm whether the variables are cointegrated. The results are presented in Table 2.

Variables	GDP, Private investment, Public investment, Public consumption, Private consumption,						
	Real interest rate, FDI, Inflation, Domestic credit, Exchange rate.						
		Lag length included = 3					
Max. Rank	Eigenvalue	Likelihood ratio	Trace statistics	5% critical value	Null hypothesis		
0	-	-662.45121	523.4316	233.13	$H_0: r = 0$		
1	0.98924	-589.93904	378.4073	192.89	$H_{0:} \leq 1$		
2	0.94888	-542.36315	283.2555	156.00	$H_{0:} \leq 2$		
3	0.92183	-501.5807	201.6906	124.24	$H_{0:} \leq 3$		
4	0.90178	-464.45121	127.4316	94.15	$H_{0:} \le 4$		
4	0.70909	-444.69542	87.9201	68.52	$H_{0:} \leq 5$		
6	0.67487	-426.71888	51.9670	47.21	$H_{0:} \le 6$		
7	0.51312	-415.20312	28.9355*	29.68	$H_{0:} \leq 7$		

Table 2: Johansen Cointegration Test Results Source: Own Computation

HO: No Cointegration. * Indicates the Number of Cointegrating Equations Selected Corresponds to This Row of the Table

The estimated results for cointegration presented in Table 2 showed the null hypothesis was rejected at all ranks implying the variables have long-run relationship. For example, the null hypothesis (r=0) was rejected at 5 percent level when tested against the alternative of one cointegrating vector (r=1), because 523.4316 is greater than the critical value 233.13. The likelihood ratio test indicated seven cointegrating equations at 5 percent level of significance. Further, evidence of the variables being cointegrated ruled out the possibility of spurious correlation.

Dependent Variable: Private Investment (PI)					
Variable	Coefficient	Std.Error	z-statistics	z>t	
Δ Private Investment(-2)	-0.1580627	0.1013081	-1.56	0.119	
ΔGross Domestic Product(-1)	0.2312922	0.077521	2.98***	0.003	
ΔPublic Investment (-1)	0.5083784	0.1540867	3.30***	0.001	
ΔPublic Consumption (-1)	0.3494162	0.177833	1.96**	0.049	
ΔInterest Rate (−2)	-0.0476579	0.0271731	-1.75*	0.079	
ΔUncertainty (-2)	-0.0115551	0.0286243	-0.40	0.686	
ΔDomestic Credit (-1)	0.1045727	0.0476323	2.20**	0.028	
Δ Exchange Rate (-1)	-0.015666	0.0324655	-0.48	0.629	
ΔPrivate Consumption (-1)	-0.3824653	0.1568387	-2.44**	0.015	
ΔForeign Direct Investment (-2)	-0.0516417	0.2836308	-0.18	0.856	
Constant	0.4368414	0.1321106	3.31***	0.001	

Table 3: VAR Regression Results

*(**) (***) Denotes 10%, 5% And 1% Significance Levels

Source: Owner's Computation

R-Squared = 0.9175, Log Likelihood = -409.0185, Fpe = 403872.1, Det (Sigma_MI) = 0.059898

The regression results presented in Table 3 indicates that the measure of goodness of fit R squared is 0.9175 implying the independent variables explain 92 percent in the variations of private investment. The variables, previous investment, uncertainty, exchange rate and foreign direct investment are insignificant. However, economic growth, public capital investment, government consumption spending, domestic credit, private consumption, and interest rate are significant in explaining private investment in Kenya. The VAR model was subjected to diagnostic test in order to avoid spurious results. The diagnostic results are reported in Table 4.

Condition Evaluation Check	Statistics	Conclusion
Stability check	All the eigenvalues lie inside the unit circle. The highest eigenvalue is	VAR satisfies stability condition.
	0.5758691	
Lag exclusion check	Wald test for 2 lags, chi2 = 4.749039, p-value = 0.029	The selected lags are optimal
Residual serial correlation	LM test statistics = 0.2269; P-value = 0.63387	No serial correlation
Residual multivariate normality	Jarque-Bera test statistics (AII) = 18.092;P-value = 0.00012	Residuals are normally distributed

Table 4: VAR Diagnostic Results

The stability of the VAR model is guaranteed if the estimated eigen values are less than one and lie inside the unit circle. The stability result is given in Figure 2

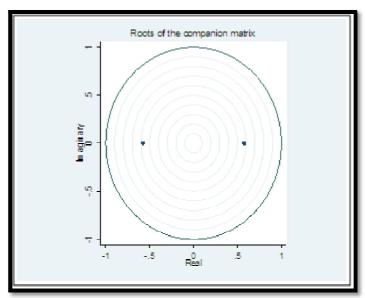


Figure 2: VAR Stability Results Source: Research Data

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Dependent Variable: Private Investment (PI)					
Variable	Coefficient	Std.Error	z-statistics	z>t	
ΔPrivate Investment(-2)	-0.187586	0.1582998	-1.19	0.236	
ΔGross Domestic Product	0.4400266	0.0990628	4.44***	0.000	
ΔPublic Investment	0.6977983	0.2258137	3.09***	0.002	
ΔPublic Consumption	0.171852	0.2431356	0.71	0.480	
ΔInterest Rate	0.0473895	0.0315014	1.50	0.132	
ΔUncertainty	0.0601971	0.0310131	1.94*	0.052	
ΔDomestic Credit	0.2277594	0.0586574	3.88***	0.000	
ΔExchange Rate	0.0918082	0.050818	1.81*	0.071	
ΔPrivate Consumption	0.0444071	0.231421	0.19	0.848	
ΔForeign Direct Investment	-0.5865755	0.2731854	-2.15**	0.032	
EC ₁ (-1)	-0.5286184	0.1308205	-4.04***	0.000	
Constant	-0.1161572	0.2473288	-0.47	0.639	

Table 5: Error Correction Regression Results
Source: Owner's Computation Using Stata
*(**) (***) Denotes 10%, 5% And 1% Significance Levels
R-Squared = 0.8579, Log Likelihood = -614.2356, Det (Sigma_MI) = 22269.05

5. Discussion of the Results

Results of our analysis (Table 3 and 4.5) show that government investment in Kenya complements private investment in the short-term as well as in the long-term. These findings are in line with economic theory which stipulates that public sector investment facilitates private sector's productivity. The positive relationship suggests that well-targeted public investment projects are important in minimizing bottle-necks thereby stimulating private investment. The findings compare closely to those of Erden and Holcombe (2006) who found that public capital exerts positive effect on private investment. The results also support the empirical finding by Ahmed and Qayyum (2007) who established that public capital compliments private capital. However, the results contradict the empirical findings by Salim and Hassan (2011) who found public investment crowds out private investment. The error correction term indicates about 53 percent of disequilibrium in private investment is corrected immediately. This signifies high speed adjustment towards the equilibrium in the event of an occurrence of disequilibrium shock.

6. Conclusion

This study sought to analyze the effect of government investment on private investment. Private investment was taken as a function of public capital among other covariates. Before analyzing the data, co-integration test was done using Johansen trace test method to confirm the co-integration relationship among the variables. To achieve the objective, vector auto regression (VAR) model was applied to analyze the long-run dynamic effect of public capital investment on private investment. Error correction model applied used to analyze the short-run impact of public capital formation on private investment. The finding shows that investment in the public sector complements investment in the private sector both in the short-term and in the long-term. The findings indicated that increasing public investment by 1 percent will increase private investment by 0.51 percent. The effect is also positive in the short-term.

7. Policy Implications

The empirical finding underpins the importance of public investment in stimulating private investment. The results point to the need by government to strengthen and pursue investment policies in various sectors of the economy that could foster increased private investment. The results also point to the need to articulate strategies and polices that would minimize bottlenecks associated with the shortage of physical capital in Kenya. The government should pay more attention to ensure prudent investment in order to ensure a reduction in private transactions costs thereby enhancing economic growth.

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