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The Effect of Public Investment on Private Investment in Kenya

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Public investment largely influences the socio-economic development of a country despite inefficiency concerns. A strong private sector is poised to cause GDP growth due to the efficient management of the resources compared to an economy dominated by the public sector. Nevertheless, public spending pattern influences socio-economic economic activities and welfare dynamics of a country. However, high levels of government activities could crowd-out private investment due to the competition for the scarce financial resources in the economy. This paper sought to analyze the effect of public investment on private investment in Kenya using a vector error correction model. The findings showed a strong positive impact of public investment on private investment in Kenya.

Keywords: Public investment; private investment; vector error correction model.

1. INTRODUCTION

The main driver of sustainable development in any economy is the private sector investment [1]. Studies have also revealed that growth driven by the private sector rather than the state sector has more positive impact to the economy [2]. This assertion is premised on the private sector efficiency in resource utilization compared to the public sector, something which has enactment of

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policies to increase private investment [3]. However, it is still unclear how public investment affects private investment [4]. In addition, research on how government spending affects private investment, particularly in developing nations, has become a hot topic in policy discussions [5,6]. Infrastructure spending encourages private investment [7,8]. Even so, economic literature suggests that excessive government borrowing substitute private investment eventually crowding it [5].

The economic theory about public and private investment gives inconsistent and mixed results as to whether the former compliments or crowds-out the latter [5]. Investment is important because it boosts technological development and the adoption of new practices that foster industrial expansion, which enhances the economy's capacity for production [9]. Several factors determine investment and that during business cycle; the investment volatility is a significant factor that causes fluctuation of GDP [10,11]. The classical economists believed that market forces alone may bring about national wealth and prosperity, negating the need for government intervention in the economy. On the other hand, Keynes (1936) argued for governmental involvement to control society's saving and investing habits. Several mechanisms have also been identified by which public investment may influence private investment. For example, development investment influences private investment positively through a reduction in production cost [12]. Infrastructure related investment complements private investment and improves productivity. This, in turn raises output demand and other related services that ultimately support the overall resource availability through expansion of aggregate output and savings [12].

Additionally, government consumption spending boosts aggregate demand, which benefits private investment, but it has a negative impact on investment due to rising budget deficits [13]. Moreover, the source of financing public investment whether by the taxes or debt also reduce the available resources to the private sector [14-17]. Public capital spending is important because it lowers transport costs and plays a critical role in increasing private returns. In this view, public capital increases the output generated by the private factors and in so doing affects growth significantly [19]. However, the private sector will be crowded out if the government resorts to heavy domestic borrowing of the scarce resources in the economy. In the end the effect depends on strength of the opposite forces hence it is not impossible to guarantee their substitutability or complementarity [5]. Aschauer [19], emphasizing the significance of public infrastructure for economies, blamed insufficient infrastructure expenditure for the 1980s productivity decline in the United States.

Private investment enhances the overall macroeconomic development in an economy [20]. Increasing the share of the private investment is poised to cause increase in economic growth and employment [21]. To restrain government expenditure and lower the budget deficit, policymaker have pursued fiscal consolidation strategies which have sparked discussion over the role that public investment plays in encouraging or crowding out the private sector [22]. This is due to the possibility that public expenditure depletes resources available for private sector investment, raising interest rates in the process and lowering overall levels of private investment. Private investment has been erratic in Kenya throughout the years. Public investment was 24 and 15 percent in 1970 and 2020 in that order while during the same period; private investment was 4 percent and 14 percent respectively [23-30].

Towards the end of 1990 and early 2000, there was a sharp decline in private investment attributed to the unfavorable event that affected private investment negatively. The political polarization of 1997 made the investment environment unfavorable and most of the investors relocated to other countries. In addition, the El- Nino rains of 1997 caused destruction of major infrastructure affecting the provision of essential services like power, transport and communication network (Republic of Kenya, 2003). Upward trends were again experienced in 2003 with public investment increasing while private investment fluctuated downward from one period to another an indication of a possible crowding-out effect. Public investment showed a downward trend from 2014 to 2020 while private investment indicated upward trend over the same period. Private investment is also influenced by efficient financial sector through the mechanism of transforming deposits into financial assets [31].

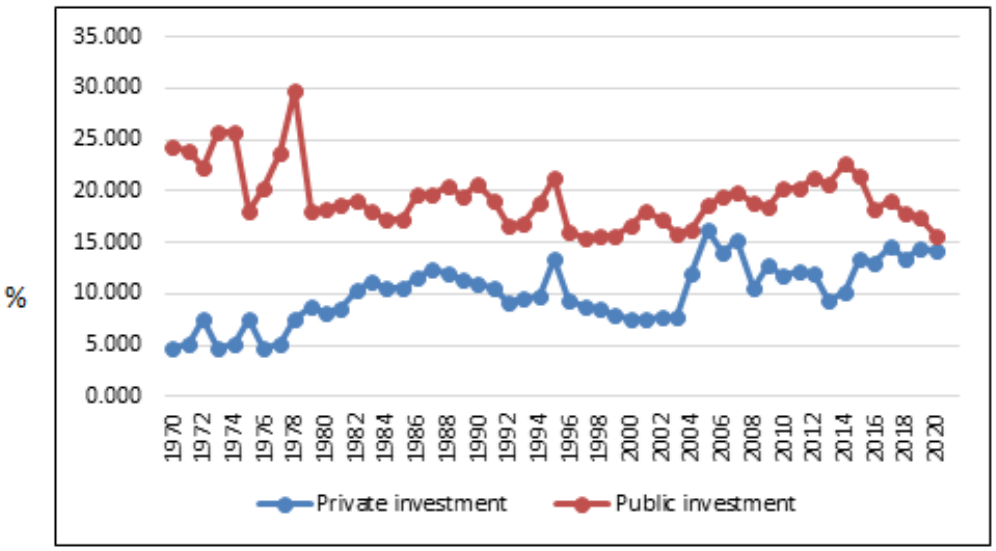

Fig. 1. Trend of public and private investment in Kenya

Private sector development is reflected in the growth of domestic credit provided by the financial institutions [32]. The financial institutions provide credit to the investors thus enhancing private sector investment [33]. Fig. 2 provides the trends of domestic credit from 1970 to 2020.

Domestic credit in Kenya rose from 17 percent in 1970 to 29 percent in 1989 mainly due to increased commercial banks liquidity ratios. Between 1991 and 1993, the domestic credit declined to about 15 percent due to quantitative credit controls introduced on commercial banks and the cash ratio requirement of 6 percent which caused commercial banks to cut back lending to the private investors (Republic of Kenya, 1994). Between 1995 and 2012 domestic credit was, however, unstable with an average of 25 percent. This was mainly due to a number of challenges that included high inflation and the "twin crisis" comprising of the ripple effects of global financial crisis and the Eurozone crisis (Republic of Kenya, 2012). The increase in credit to the national government led to a rise in domestic credit between 2014 and 2015. The reversal or removal of interest rate capping in 2019 led to a decline in domestic credit. Fig. 3 gives interest rate trends from 1970 to 2020.

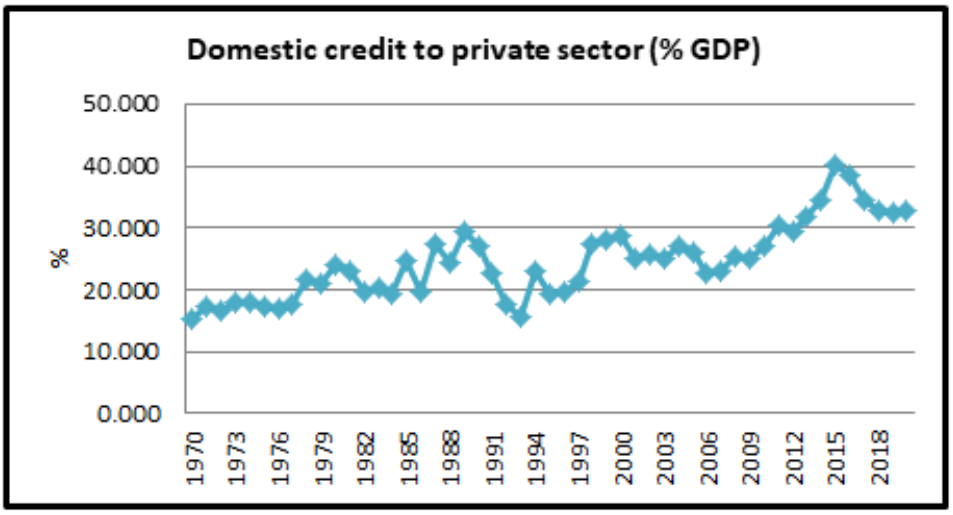

Fig. 2. Domestic credit to the private sector (%GDP)

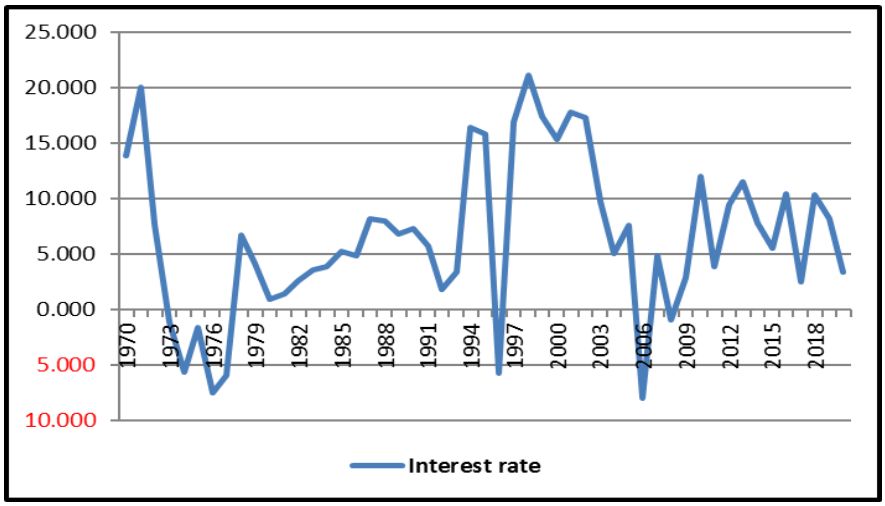

Fig. 3. Trend of interest rate (annual %)

2. METHODS

The modified flexible accelerator model developed by Blejer and Khan [34] serves as the foundation for this study as opposed to the neoclassical investment model of Jorgenson [35] and Hall et al. [36]. The fundamental neoclassical model must be adjusted due to the challenges it faces in terms of the definition and measurement of capital stock. The theoretical model for this study is, therefore, derived in consistent with the flexible accelerator framework that incorporates an explicit role for public investment. The model expresses the functional relationship between public policy instruments, in this case public investment and private capital accumulation. According to the model, the expected output Y, which relies on the level of capital, is:

$$K^*_{pt} = \alpha Y^e_t, \quad (1)$$

Where K^*_{pt} is optimal private sector capital stock in period t, while αY^e_t, is expected output. However, installation of new capital would take time, and, therefore, to address the adjustment process we introduce an adjustment cost function as follows:

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

K_{pt} is private capital stock. In equation (2), the first term depicts the disequilibrium cost, whereas the second term indicates the adjustment cost. The disequilibrium cost is minimized with respect to K_{pt} to derive adjustment equation (3) given as follows:

$$K_{pt} - K_{pt-1} = \beta\left(K^*_{pt} - K_{pt-1}\right) \; 0 \le \beta \le 1 \quad (3)$$

where β =adjustment coefficient.

Equation (3) indicates adjustment between required stock of capital in time t and the previous one. This study used gross private investment expressed as:

$$PI_t = \left(K_{pt} - K_{pt-1}\right) + \delta K_{pt-1} \quad (4)$$

δ= Depreciation rate
PI = Gross private investment

Rearranging equation (4) gives (5)

$$PI_t = [1 - (1-\delta)L]K_{pt} \quad (5)$$

The capital adjustment is specified as:

$$PI_t = PI_{t-1} = \beta(PI^*_t - PI_{t-1}) \quad (6)$$

The core of this study's contribution is Equation (6) which is modified by assuming that public investment affects the short term adjustment of the existing private investment.

Thus, β is stated as:

$$\beta = \alpha_0 + [1/(PI^*_t - PI_{t-1})](\gamma_1 GI_t + \gamma_2 X_t) \quad (7)$$

Where,

α_0= Constant
GI=Gross public investment
X_t=Other macroeconomic factors.

Plugging (7) into (6) and rearranging gives equation (8) as:

$$PI_t - PI_{t-1} = \alpha_0(PI^*{}_t - PI_{t-1}) + \gamma_1 GI_t + \gamma_2 X_t \quad (8)$$

The steady state of equation (3.4) is given as:

$$PI^*{}_t = [1 - (1-\delta)L]K^*{}_{pt} \quad (9)$$

Putting (1) into (9) and then what we get put it into (8) gives (10).

$$PI_t = a_0[(1-\delta)L]\alpha Y^e{}_t + \gamma_1 GI_t + \gamma_2 X_t + (1 - a_0) + PI_{t-1} + \varepsilon_t \quad (10)$$

The coefficient Y^e captures the accelerator effect. Equation (10) is a reduced-form gross private investment.

2.1 Empirical Model Specification

In this study, crowding out occurs indirectly through the rate of adjustment rather than directly by altering the targeted real private investment level [37-40]. Interest rate also influences private investment. For instance, a rise in demand for funds drives the interest rate up and increases credit cost [41]. Private consumption has an impact on domestic private investment through increased purchasing power brought on by an increase in household demand for commodities. Exchange rate policies affect private capital inflow by increasing or decreasing funds availability to the private sector [34]. The estimated equation is given as follows based on the aforementioned justifications and taking into account the previously mentioned macroeconomic variables:

PI = f (GI, RIR, EXR, PC) (11)

Where,

PI = Private fixed investment
GI=Government investment
RIR=Real interest rate
PC = Private consumption
EXR= Effective exchange rate

2.2 Estimation Methodology

The reviewed literature showed that public investment is not the only variable that may influence private investment but also other macroeconomic indicators could also have a bearing on private investment [42-44]. Both economic theory and empirical evidence fall short of providing adequate and clear information about private and public investment interaction. Given this shortcoming, this study applied VECM in line with Sims [45] and Sims [46]. The justification for using VECM is that all variables are considered endogenous. Secondly, the model shows how the variables gradually evolve from their common starting point in time [47,48].

The variables were modeled in a VECM as follows:

$$\Delta PI = \alpha_1 + \sum_{i=1}^{k-1} \beta_i \Delta PI_{t-i} + \sum_{j=1}^{k-1} \varphi_j \Delta GI_{t-j} + \sum_{n=1}^{k-1} \phi_n \Delta EXR_{t-n} + \sum_{m-1}^{k-1} \gamma_m \Delta RIR_{t-m} + \sum_{p=1}^{k-1} \delta_p \Delta PC_{t-p} + \lambda_1 ECT_{t-1} + \varepsilon_{1t} \quad (12)$$

$$\Delta GI = \alpha_2 + \sum_{i=1}^{k-1} \beta_i \Delta PI_{t-i} + \sum_{j=1}^{k-1} \varphi_j \Delta GI_{t-j} + \sum_{n=1}^{k-1} \phi_n \Delta EXR_{t-n} + \sum_{m-1}^{k-1} \gamma_m \Delta RIR_{t-m} + \sum_{p=1}^{k-1} \delta_p \Delta PC_{t-p} + \lambda_2 ECT_{t-1} + \varepsilon_{2t} \quad (13)$$

$$\Delta EXR = \alpha_3 + \sum_{i=1}^{k-1} \beta_i \Delta PI_{t-i} + \sum_{j=1}^{k-1} \varphi_j \Delta GI_{t-j} + \sum_{n=1}^{k-1} \phi_n \Delta EXR_{t-n} + \sum_{m-1}^{k-1} \gamma_m \Delta RIR_{t-m} + \sum_{p=1}^{k-1} \delta_p \Delta PC_{t-p} + \lambda_3 ECT_{t-1} + \varepsilon_{3t} \quad (14)$$

$$\Delta RIR = \alpha_4 + \sum_{i=1}^{k-1} \beta_i \Delta PI_{t-i} + \sum_{j=1}^{k-1} \varphi_j \Delta GI_{t-j} + \sum_{n=1}^{k-1} \phi_n \Delta EXR_{t-n} + \sum_{m-1}^{k-1} \gamma_m \Delta RIR_{t-m} + \sum_{p=1}^{k-1} \delta_p \Delta PC_{t-p} + \lambda_4 ECT_{t-1} + \varepsilon_{4t} \quad (15)$$

$$\Delta PC = \alpha_5 + \sum_{i=1}^{k-1} \beta_i \Delta PI_{t-i} + \sum_{j=1}^{k-1} \varphi_j \Delta GI_{t-j} + \sum_{n=1}^{k-1} \phi_n \Delta EXR_{t-n} + \sum_{m-1}^{k-1} \gamma_m \Delta RIR_{t-m} + \sum_{p=1}^{k-1} \delta_p \Delta PC_{t-p} + \lambda_5 ECT_{t-1} + \varepsilon_{5t} \quad (16)$$

Where

PI = private fixed investment
GI= Public investment
PC = Private consumption
RIR=real interest rate
EXR= exchange rate

K-1 = lag length which is reduced by 1

ECT_{t-1}= lagged error correction term.

β_i, φ_j, ϕ_n, γ_m *and* δ_p = short run coefficients

λ_1, λ_2, λ_3 λ_4 and λ_5= Speed of the adjustment parameter

ε_{1t} ε_{2t} ε_{3t} ε_{4t} and ε_{5t}= error terms.

2.3 Data Sources and Measurement

The study used time series data derived from the World Bank database from 1970 to 2020. Table 1 offers variable description and measurements.

3. RESULTS

The unit root test shows that the variables are *I*(*I*) except interest rate whose outcome is ambiguous. Interest rate shows that the variable is stationary without trend but non-stationary with trend in both KPSS and DF-GLS.

3.1 Cointegration Analysis

Since the trace statistics of 88.3 is greater than 5% critical value, the null hypothesis of zero cointegration equation is rejected. Similarly, one cointegration equation is rejected since the trace statistic is higher than the critical value at 5%. A maximum of two cointegrating equations can be identified in the model, according to the asterisk on the trace statistics. The maximum statistic is also larger than the 5% critical value hence zero and one cointegrating equation is rejected.

Table 1. Description and measurement of the variables

Variable	Abbreviation	Description	Unit of Measurement
Private investment	PI	The amount spent by the private sector to add to fixed assets. Fixed capital formation is used as proxy for private investment.	% of GDP
Public investment	GI	This include plant, machinery, construction of roads, railways. Gross fixed capital formation is used for the analysis.	% of GDP
Exchange rate	EXR	The price of one currency in terms of another.	Measured as a local currency unit relative to the U.S. dollar.
Real interest rate	RIR	The interest rate adjusted for inflation as measured by the GDP deflator.	Annual percentage
Private consumption	PC	Is the market value of all goods and services purchased by the households.	% of GDP

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Private investment	51	10.129	2.97	4.77	16.206
Public investment	51	19.423	2.955	15.388	29.789
Real Interest rate	51	7.975	5.422	0.943	21.096
Exchange rate	51	49.049	35.306	7.000	106.451
Private consumption	51	70.302	7.959	55.648	82.496

Table 3. Unit root test

Stationarity of variables in levels			Stationarity of variables in first differences	
Kwiatkowski–Phillips–Schmidt–Shin (KPSS) (5%) H0: the series is trend stationary				
Variable	**Without trend**	**With trend**	**Without trend**	**With trend**
Private investment	1.38	0 .233	0.0415**	0.0378**
Public investment	0 .71	0.294	0.0335**	0.0298**
Real interest rate	0.38**	0.275	0.0334**	0.0335**
Private consumption	2.31	0.155	0.0281**	0.0244**
Exchange rate	2.54	0.216	0.134**	0.0859**
Dickey-Fuller Generalized Least Squares (5%) H0: the series has a unit root				
Private investment	-1.110	-2.789	-5.863**	-5.843**
Public investment	-1.418	-2.519	-7.494**	-7.618**
Real Interest rate	-2.586**	-2.730	-5.252**	-6.722**
Private consumption	-0.602	-2.486	-4.956**	-6.544**
Exchange rate	0.814	-1.902	-4.717**	-4.917**

***p<0.05 significance level*

Table 4. Johansen tests for cointegration; H0: No cointegration

Max Rank	H_0	H_1	Test statistic	5% critical value
(a)	**Trace statistics**			
0	$r = 0$	$r = 1$	88.3164	68.52
1	$r \leq 1$	$r = 2$	50.6157	47.21
2	$r \leq 2$	$r = 3$	19.9677*	29.68
3	$r \leq 3$	$r = 4$	8.7441	15.41
4	$r \leq 4$	$r = 5$	0.0093	3.76
5	$r \leq 5$	$r = 6$	-	-
(b)	**Maximum eigenvalue statistics**			
0	$r = 0$	$r = 1$	37.7006	33.46
1	$r \leq 1$	$r = 2$	30.6481	27.07
2	$r \leq 2$	$r = 3$	11.2235*	20.97
3	$r \leq 3$	$r = 4$	8.7349	14.07
4	$r \leq 4$	$r = 5$	0.0093	3.76
5	$r \leq 5$	$r = 6$	-	-

No. of lags included=2; trend: constant

Table 5. VECM results

Dependent/Independent Variables	(1) D. Private investment	(2) D. Public investment	(3) D. Exchange rate	(4) D. Interest rate	(5) D. Private consumption
L. ECT	-0.252***	-0.164	0.00301	-0.856***	0.0974
	(0.0937)	(0.124)	(0.268)	(0.202)	(0.167)
LD. Private investment	-0.0981	-0.134	-0.620	0.280	0.120
	(0.143)	(0.190)	(0.411)	(0.310)	(0.256)
LD. Public investment	0.210**	-0.248*	-0.0364	0.405*	0.384**
	(0.106)	(0.141)	(0.305)	(0.230)	(0.190)
LD. Exchange rate	-0.0229	-0.0285	0.0761	0.354***	-0.0195
	(0.0574)	(0.0761)	(0.164)	(0.124)	(0.102)
LD. Interest rate	0.121**	0.0253	-0.0540	0.0660	0.0231
	(0.0576)	(0.0764)	(0.165)	(0.125)	(0.103)
LD. Private consumption	0.0790	-0.411***	0.226	0.272	-0.0286
	(0.0866)	(0.115)	(0.248)	(0.187)	(0.155)
Constant	0.546*	0.255	1.885**	-0.165	0.336
	(0.306)	(0.406)	(0.878)	(0.662)	(0.547)

*Source: Author's computation: standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

Table 6. VECM stability condition

Engine value stability condition	
Engine value	**Modulus**
1	1
1	1
1	1
1	1
.01663544 +.5804681i	.580706
.01663544 - .58046811	.580706
-.1069263 +.34817861	.364227
-.1069263 + .34817861	.364227
-.3414038	.341404
.3225392	.322539

The VECM specification imposes 4 unit moduli

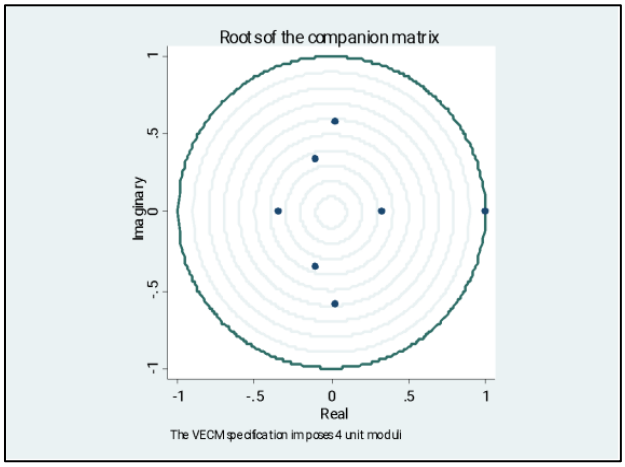

Fig. 4. VECM stability condition

The outcome of stability test shows the VECM is stable since the remaining *r* eigenvalues are less than one. This is also confirmed by the outcome in Fig. 1 about the stability of the model.

3.2 Impulse Response Functions (IRF)

IRFs were used to further ascertain a dependent variable's responsiveness to a shock in an independent variable. Modelling I(I) variables in a cointegrating VECM do not revert back to their mean. Therefore, the unit moduli in the companion matrix suggest that some shock effects won't diminish with time. As a result, a shock to an I(0) variable will only be temporary, whereas a shock to an I(I) variable may both be permanent and temporary. Fig. 5 shows the findings from the IRFs.

Fig. 5 shows that an orthogonalized shock to the exchange rate and private consumption has a transitory effect on private investment while an orthogonalized shocks to the public investment and interest rate have a permanent effect on private investment. According to this model, unexpected shock to the exchange rate and private consumption will have a transitory effect on private investment. Similarly, unexpected shock to the public investment and interest rate will have permanent effect to the private investment in Kenya.

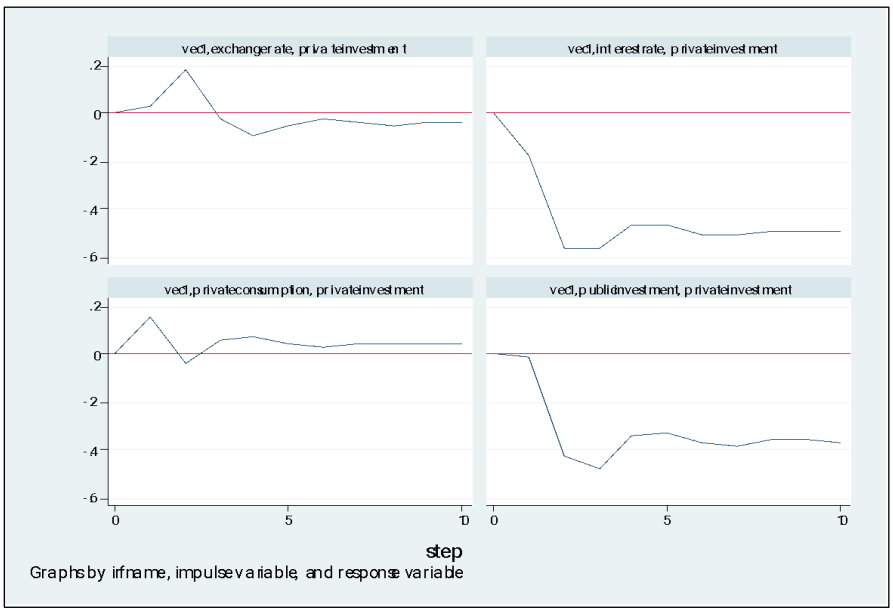

Fig. 5. Impulse response functions

4. DISCUSSION

The first row of Table 5 has the dependent variables while the first column has the independent variables. The VECM regression is made up of five equations namely private investment, public investment, exchange rate, interest rate and private consumption. The regression results show presence of long run causality at the private investment and interest rate equations as indicated by the negative lagged error correction term coefficients that are significant at one percent. The lagged ECT at the public investment equation is, however, insignificant. The ECT at the exchange rate and private consumption equations are positive and also insignificant implying absence of long run correlation for the two equations.

The short run coefficients indicate the first lag of the first difference government investment has a significant causal effect on private investment, previous public investment, interest rate and private consumption. In the short run, a one percent increase in public investment increases private investment by 0.21 percent and causes the previous public investment to decline by 0.25 percent. In addition, a percentage increase in public investment cause 0.41 and 0.39 percent increase in real interest rate and private consumption respectively. The short run coefficients also show that a one percent exchange rate revaluation causes interest rate to go up by 0.35 percent. A one percent increase in interest rate is associated with 0.12 percent increase in private investment. It is evident that an increase in private consumption leads to 0.41 percent decrease in public investment. The constant values at private investment and interest rate are also significant at 10 and 5 percent respectively.

5. CONCLUSION

It is concluded that the effect of public investment on private investment in Kenya using a vector error correction model. The findings showed a strong positive impact of public investment on private investment.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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