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New evidence on the relationship between public and private investment in India

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Abstract

The purpose of this paper is to examine the long run relationship between public investment and private investment in India. To this end, we employ the autoregressive distributed lag (ARDL) – bounds test approach, using data for the period 1980-81 to 2015-16. Finally, an error correction model is estimated to show the short-run dynamics along with the speed of adjustment to the equilibrium relationship among the variables. The estimated results suggest that public investment crowds in private investment in India. Furthermore, the speed of adjustment parameter indicates that adjustment process towards long run equilibrium is relatively high and CUSUM and CUSUMSQ tests confirmed that the models are stable over the sample period.

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1. Introduction

The relationship between public investment and private investment is one of the contentious issues in macroeconomics (Aschauer, 1989). The central focus of this study is to evaluate empirically whether public investment crowd in or crowd out private investment in India. The answer to this question would guide the policy makers to know what is required for long-term development strategies and what policy options are appropriate for achieving higher growth via investment in India.

Although there exist many empirical studies on long-run relationship between public and private investment mainly focus on developed countries. However, the impact of public investment on private investment has become one of the central focus in policy debates in developing countries like India. For example, from mid-1980s there is substantial change in the relative contribution of public investment to the total investment in India. In particular, there is an increasing trend in the decadal average of private sector investment; while public sector investment shows a decline during 1980-81 to 2015-16. Public sector investment as a percentage of GDP was 9.17% in the 1980-81 and reached a peak level of 10.80% in 1989-90, but drastically declined since then. So the Indian economy experienced with a fall in public investment while there is an upward trend in private investment (both fixed and gross). How should such a huge change of association between public investment and private investment in India take place? Is there any occurrence of crowd in or crowd out of private investment in India?

These issues along with substitutability or complementarity between public and private investment are the subject of intense debate among Indian scholars and policy-makers. On the one hand, an increase in public investment when utilised for productive activities, especially for creation of social and overhead capital in a growing economy supplements private investment (crowding in effect). It allows reducing the cost of production or increasing the profitability of investment which helps in increasing the private sector investment and speeding up the growth process in an economy (Wai and Wong, 1982). Even to the fact that where government make investment in other secondary or tertiary sectors, there will be increase in inter industry demand for related products and thus accelerate more private sector investment. However, it can also crowd out private investment because if the government investment is met through borrowing constrains the availability of financial resources/savings for private sector investment or increase in the interest rates and/or reducing private investment. Thus the net effect depends on its substitutability and complementarity relationship with private investment (Xu and Yan, 2014).

Hence, the fiscal policy measures can be used a device to support private investment and hence economic growth, therefore, becomes crucial for policy makers in developing countries. Therefore, this study attempts to examine the validity of the crowding out hypothesis on private investment in India which has so far received relatively scant attention in the literature.

This research differs from the literature in three important ways. First, we developed a conceptual and empirical model of private investment in India. Second, we use real private sector fixed capital formation as a concrete measure of real private investment in India. Third, we employ a latest time series period into the ARDL approach that might otherwise be missed from the literature in the context of India.

The remainder of the paper is structured as follows. Section 2 documents related literature. Section 3 discusses stylized facts about private and public investment. Section 4 describes the

data, sources and methodology. Section 5 presents empirical findings and interpretation of it. Section 6 ends with a conclusion and policy implications.

2. Related Literature

Among the mainstream theoretical perspectives, Keynesian theory is the most popular among macroeconomic literature. An increase in public investment through providing basic infrastructure needs, where infrastructure is believed to act as stimulant for private investment, leads to economic growth. Higher economic growth increases income of households which promotes consumption and savings and, therefore, expansionary economic activities come out through a multiplier process. Hence, there would be crowding in of private investment in an economy. According to the classical theory, public expenditure financed by borrowings (debt-financed) raises interest rates and lowers the output after reaching an optimum higher level. In particular, there might be crowding out of private investment and thereby unfavourable effects on output growth of an economy. However, in contrast to the Keynesian arguments, New Classical argument based on neutral effect - Ricardian equivalence view of debt advocated by Ricardo (1951). Barro (1974) in his Ricardian Equivalence Theorem further revived this neutrality proposition as debt-financing leads to expected tax increase in future such that do not affect real investment and output.

Many empirical studies have shown different results regarding the relationship between public investment and private investment. Many support either “crowding out” hypothesis or “crowding in” hypothesis. Some studies in the Indian context are as follows. Serven (1996) supports crowding out of private investment in the Indian context. Ramirez (1994) and Greene and Villanueva (1990) found the existence of complementary between public and private investment thus supports “crowding in” hypothesis. Similarly, Chakraborty (2006) also found complementarity between private capital formation and public investment. While Bailey (1971) did found as support to substitutability hypothesis that public investment crowds out private investment. With a view to examine the economic effects of tax financed government spending, Barro (1989) found that real profit of the private investment is being crowded out by higher taxes. Knot and de Haan (1999) and Liu and Ma (2001) demonstrate a “crowding out” effect, for Germany and China respectively. Dong (2006) argued that crowding out of private investment in the short term, and crowding in the long-term. Mitra (2006) concludes that government investment crowds out private investment in the short run in India. But he did not examine the long run relationship between government investment and private investment and this is one of the motivations of our study. Other studies find crowding out as well, (Monadjemi, 1995; Pradhan, Ratha, and Sharma 1990; Sahu and Panda 2012).

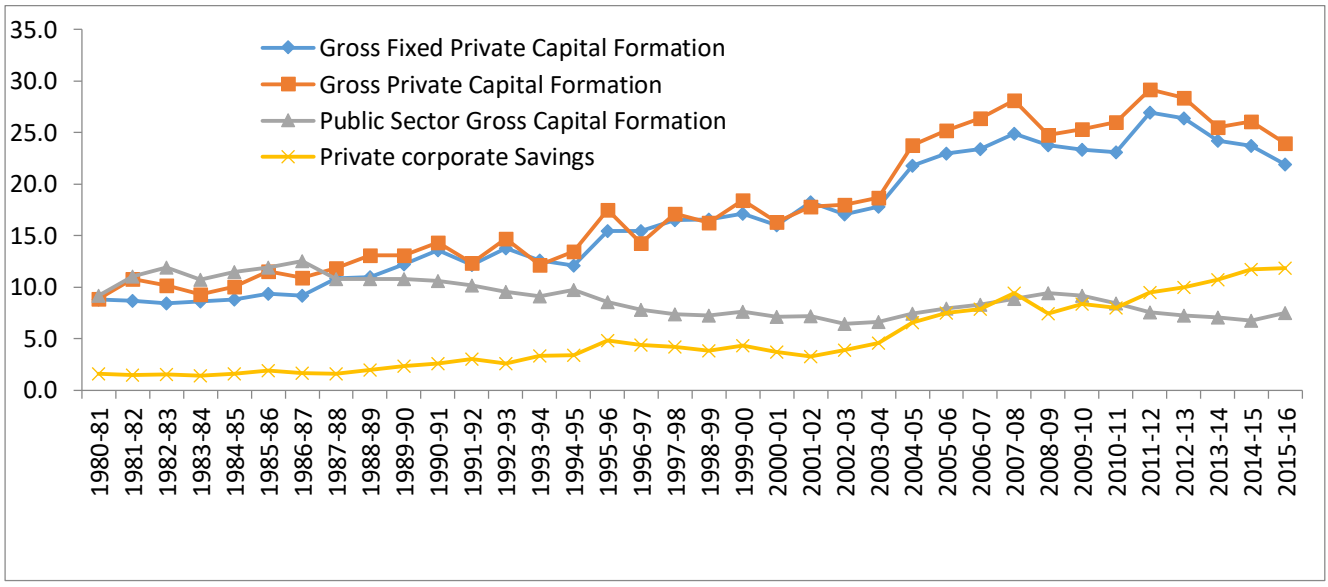
The relationship of public investment with private investment is well discussed in international context across countries as well as at a single country level context. Most these empirical studies are related to developed countries not the developing countries in general and India in particular is not very much focused. However, the countries vary in socio-economic conditions, it is better to conduct the country level analysis using time series data. Moreover, where there is significant role of public investment in developing countries, the traditional models of investment may give misleading results. Furthermore, even if traditional models are directly applied to developing countries, the problem of data availability arise during the empirical implementation (Blejer and Khan, 1984).Given these constraints, the paper attempts to apply a private investment model in the context of India with the use of concrete measure of private investment and latest available time series data. The present study is an attempt to fill these gaps in the existing literature

Given the above backdrop, it is pertinent to bring out the transmission mechanisms of nexus between public investment and private investment for the Indian economy along with other macro-variables such as private savings, net inflows, deficits, interest rates, public debt and government consumption, are discussed in the following sections.

3. Stylized Facts on Private Investment and Potential Macro Variables in India

In the Indian context, private investment as measured by gross fixed private capital formation as percentage of GDP, with 8.87% in 1980-81 reaches 14.33% in 1990-91 and 18.44% in 1999-00 and finally reaches highest level 29.16% in 2011-12 thereafter it declined to 23.94% in 2015-16 (see Figure 1). However, the private investment crossed over the public investment during early 1990s despite a very marginal decreasing trend thereafter. There is an increasing trend in the decadal average of private corporate sector savings due to a similar increasing trend in private sector investment; while public sector investment shows a decline during 1980-81 to 2015-16 (see Figure 2). Correspondingly, in India, private corporate sector savings as percentage of GDP have increased significantly over the decades and this increase is more intense after 1999-00 and onwards, barring a few fluctuations in its trends for some years. It increased from 1.56% in 1980-81 to 2.59% in 1990-91 and 4.31% in 1999-00 and further to 11.85% in 2015-16. So the Indian economy experienced a divergence between the trends in public and private sector investment (both fixed and gross) especially after industrial delicensing and trade liberalisation in 1990s and private investment is primarily fueled by the private corporate savings. However, the government consumption expenditure as measured by the government final consumption expenditure as percentage of GDP increased *vis-a-vis* fall in public investment during this period. For instance, government final consumption expenditure increased where public sector investment declined during 1990s.

Figure 1: Trends in Private Investment and Public Investment (In % of GDP)



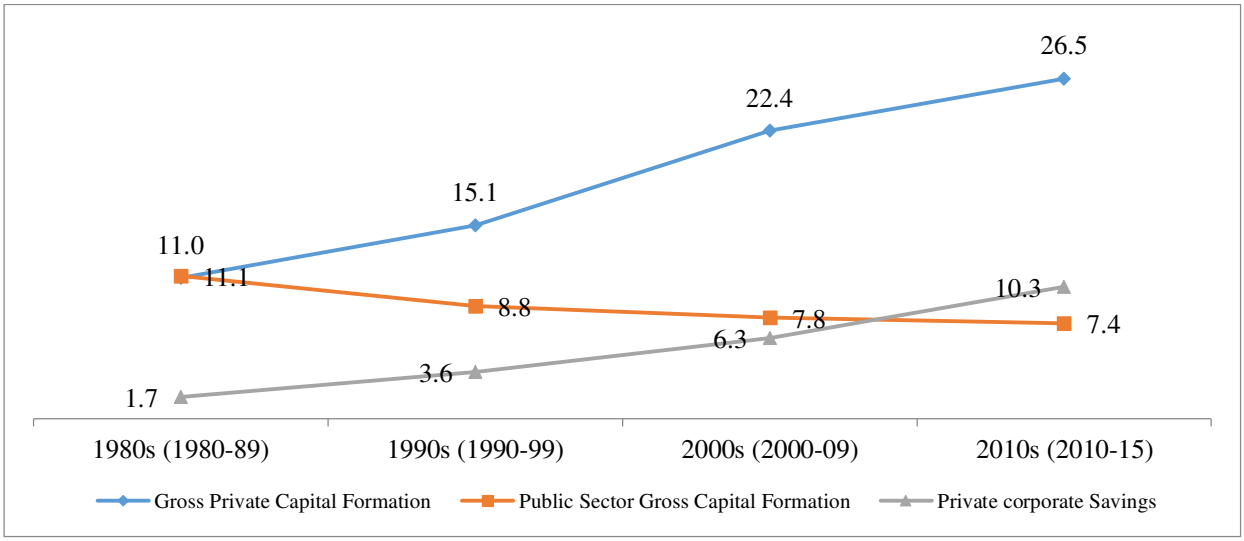
Source: Economic Survey-2016-17, Ministry of Finance, Government of India

It is worth saying that in India, the gap between public and private investment widened, but the former shows a declining trend and the later shows an inclining trend. Apart from these

co-movements of private sector savings and investment, a portion of private savings has been utilised for financing public debt which is a prolonged accumulated fiscal deficit. This could hinder the expansion in private investment if any substantial amount is devoted to financing the government deficit or debt. It is also argued that, a low level of fiscal deficit can bring down the interest rate and making it easier for investors to borrow and invests, and finally raises productivity and creates jobs, there could be a net positive effect for the economy.

Hence, the issue does not lend itself to any definite a priori conclusions and need to be investigated empirically. Therefore, the following section would like to examine the empirical relationship between public investment and private investment in India by using annual time series data from 1980-81 to 2015-16.

Figure 2: Behaviour of Private Sector Investment and Savings and Public Sector Investment (Average as % of GDP)



4. Empirical Methodology and Data

4.1 Methodology - ARDL Model Specification

The autoregressive distributed lag (ARDL) approach to cointegration (known as the bounds test) proposed by Pesaran, Shin and Smith (2001) has several advantages over other conventional cointegration tests such as the Engle and Granger (1987) two-step approach and the Johansen and Juselius (1990) multivariate framework. First, the test does not require the underlying variables to be integrated of same order, i.e. integrated of order one, I(1). This method is applicable irrespective of whether independent variables are purely I(0) or I(1) or mutually cointegrated. Second, the ARDL method is robust to small sample size.[1] Third, it identifies a unique cointegrating vector in a single equation framework.

In order to examine the long-run relationship between public investment and private investment, we estimate the following private investment model for India using the autoregressive distributed lag (ARDL) framework.

$$lnPVTINV_t = \alpha_0 + \beta_1 lnPUBINV_t + \beta_2 lnPVTSAV_t + \beta_3 LINTR_t + \beta_4 CTOTL_t + \emptyset_i Z_t + \epsilon_t$$

[1]Narayan (2005) provides critical values for small sample size i.e. for sample size of 30 and higher.

(1)

where $PVTINV_T$ stands for real private investment, $PUBINV_t$ is real public investment, $PVTSAV_t$ is real private corporate saving, $LINTR_t$ is lending rate and $CTOTL_t$ is combined total liabilities of center and states. Z_t embodies other control variables such as inflation rate(WPI_t) and trade openness ($TOPN_t$). α_0 includes deterministic term, ε_t is the disturbance term and ln denotes natural logarithm. The coefficients of Equation (1) can be interpreted as long-run coefficients provided that the variables are cointegrated i.e. there exists a long-run relationship among the variables under consideration.

Table I reports the descriptive statistics (minimum, maximum, mean, standard deviation and number of observation) of the variables used in estimation.

Table I: Descriptive statistics

	Minimum	Maximum	Mean	Median	Std. Dev.	Observations
PVTINVF	11.25	14.20	12.74	12.77	0.98	35
PUBINV	11.29	13.06	12.20	12.01	0.50	35
PVTSAV	9.51	13.32	11.34	11.40	1.24	35
TOPN	10.05	42.55	21.65	18.16	10.65	35
LINTR	8.33	18.92	13.98	13.83	2.76	35
CTOTL	48.92	83.23	68.69	68.57	7.90	35
WPI	1.24	18.20	7.05	6.60	3.30	35

Notes: 1.PVTINV, PUBINV, PVTSAV, TOPN, LINTR, CTOTL and WPI denote real private investment, real public investment, real private savings, trade openness, lending interest rate, combined total liabilities of center and state and wholesale price index respectively. All these variables are natural logarithm except TOPN, LINTR, CTOTL and WPI.

A graphical scrutiny of the co-movement of real private and public investment reveals that they move together overtime, which indicates that there is likely to be presence of long-run cointegration relationship between two series (Figure 1). Therefore, the study ensues with an in-depth econometric analysis of their connections.

We employ the ARDL approach to cointegration which starts with the bounds test. So as to implement the bounds test, we estimate an autoregressive distributed lag model (ARDL) as follows[2]:

$$\begin{aligned}\Delta lnPVTINV_t = {} & \alpha + \theta_1 lnPVTINV_{t-1} + \theta_2 lnPUBINV_{t-1} + \theta_3 lnPVTSAV_{t-1} + \theta_4 LINTR_{t-1} \\ & + \theta_5 lnCTOTL_{t-1} + \sum_{i=1}^{j} \delta_i \Delta lnPVTINV_{t-i} \\ & + \sum_{i=0}^{k} \mu_i \Delta lnPUBINV_{t-i} \\ & + \sum_{i=0}^{p} \omega_i \Delta lnPVTSAV_{t-i} + \sum_{i=0}^{q} \lambda_i \Delta LINTR_{t-i} + \sum_{i=0}^{s} \varphi_i \Delta CTOTL_{t-i} + \varepsilon_t\end{aligned} \tag{2}$$

[2]As a test of robustness, we employ the bounds test with public debt as an additional control variable in the equation.

where Δ is the first difference operator, α is the intercept. All the variables are as previously defined. We use Akaike Information Criteria (AIC) to determine the optimal lag structure of the ARDL model. Maximum lag length of 4 is used for the model, i.e. i_{max} = 4. The test for cointegration in equation (2) involves a joint significance test of the lagged level variables, i.e. the null hypothesis of no cointegration among the variables, H_0: $\theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = 0$ is tested against the alternative hypothesis H_1: $\theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq \theta_5 \neq 0$ via F-statistic[3].

An unrestricted error correction model (UECM) of the ARDL framework of Eq. (2) takes the following form:

$$\begin{aligned}\Delta lnPVTINV_t = \alpha &+ \sum_{i=1}^{j} \delta_i \Delta lnPVTINV_{t-i} \\ &+ \sum_{i=0}^{k} \mu_i \Delta lnPUBINV_{t-i} \\ &+ \sum_{i=0}^{p} \omega_i \Delta lnPVTSAV_{t-i} \\ &+ \sum_{i=0}^{q} \lambda_i \Delta LNTR_{t-i} + \sum_{i=0}^{s} \varphi_i \Delta CTOTL_{t-i} + \sum_{i=0}^{q} \eta_i \Delta Z_{t-i} + \vartheta ecm_{t-1} + \varepsilon_t\end{aligned} \tag{3}$$

where ϑ is the speed of adjustment parameter and ecm_{t-1} is the equilibrium error correction term. ϑ is expected to be negative and statistically significant to imply that any deviation from the equilibrium relationship is adjusted in the subsequent period[4]. δ_i, μ_i, ω_i and η_i represent the short-run dynamic coefficients.

Here, an important point to be noted is that although the objective of the study is to examine the long run relationship between public and private investment, we also investigate the impact of public debt[5] on private investment for wider policy implications as prescribed by many authors including Presbitero (2005). Hence, public debt has also been included as additional independent variable in the equation of investment and inflation and trade openness are used in a separate model to see the sensitivity of the results of basic model.

4.2 Data

Annual time series data covering the period from 1980-81 to 2015-16 are used in our study. The data on private sector fixed capital formation and public sector gross capital formation represents a measure of private investment and public investment respectively. Data on public sector gross capital formation (PUBINV) and private sector fixed capital formation (PVTINV), private corporate saving (PVTSAV), trade openness (TOPN), as well as public debt (CTOTL) are taken from the Handbook of Statistics on Indian Economy, 2016-17, prepared by RBI. Inflation rate is measured from the Wholesale Price Index (WPI) provided by the Office of the Economic Adviser, Ministry of Commerce and Industry, Govt. of India. For measuring the openness, we use export plus import as a percentage of GDP and sourced

[3]The F-test statistic is used to determine whether the variables are cointegrated by testing the joint significance of the lagged level coefficients.

[4]The error correction coefficient usually lies between 0 and -1. However, for the model to be dynamically stable, the coefficient should not be lower than -2.

[5]Here public debt in India is measured by the total liabilities of Centre and States combined.

from RBI; and the combined liabilities[6] (sum of total domestic liabilities of center & state and external liabilities of center) are treated as the public debt as a percentage of GDP in constant 2004-05 rupee crore. Finally, the lending rates (in %) were taken from World Development Indicators (World Bank, 2016). In order to avoid the price effect, all the variables, except openness, inflation, lending rate and public debt, are defined in real (rupees crore) terms using GDP deflator and expressed in their natural logarithm value.

5. Empirical Results

5.1. Unit root tests

We conducted augmented Dickey and Fuller, (1979) unit root tests to ensure that the series are not integrated of order two or higher. The results of unit root tests are reported in Table II and indicates that some are I(0) and some are I(1) but none of them are I(2) or higher. This finding paves the way for applying ARDL approach of cointegration to analyse the long-run relationship between private investment and public investment.

5.2 Bounds testing for cointegration results

The results of the bounds test are reported in Table III. It shows that with private investment as the dependent variable in both the models, the computed F-statistic exceeds the upper bound of the 10%, 5%, 2.5% and 1% critical values. Accordingly, we reject the null hypothesis of no cointegration among the variables under consideration and conclude that there is a long-run relationship between private investment and public investment.

Table II: Results of Unit root tests

Variables	Level		First Difference	
	Intercept	Intercept & Trend	Intercept	Intercept & Trend
LPVTINVF	-0.5900	-2.6266	-6.8375	-6.7697
	(0.8603)	(0.2717)	(0.0000)	(0.0000)
LPUBINV	-0.1354	-1.3145	-5.0252	-5.0048
	(0.9376)	(0.8677)	(0.0002)	(0.0015)
LPVTSAV	-0.0645	-2.8989	-6.0915	-5.9911
	(0.9457)	(0.1750)	(0.0000)	(0.0001)
TOPN	-0.7601	-1.7558	-4.0134	-3.8716
	(0.8179)	(0.7044)	(0.0038)	(0.0245)
LINTR	-0.9384	-2.8949	-5.7789	-5.7125
	(0.7638)	(0.1762)	(0.0000)	(0.0002)
CTOTL	-3.4793	-3.3274	-3.7070	-3.7985
	(0.0153)	(0.0800)	(0.0086)	(0.0293)
WPI	-3.5226	-3.8720	-6.9672	-6.8195
	(0.0132)	(0.0242)	(0.0000)	(0.0000)

Note: Figures in the parentheses are p-value.

[6]Sum of total domestic liabilities of Centre &State and external liabilities of centre

Table III: Bound test for cointegration

Model	F-statistics	Significance level	Bounds test critical values	
			k = 4	
			I(0)	I(1)
(PVTINV | PUBINV, PVTSAV, LINTR, CTOTL)	5.102	1%	3.29	4.37
		2.5%	2.88	3.87
		5%	2.56	3.49
		10%	2.20	3.09
			k = 4	
(PVTINV | PUBINV, PVTSAV, WPI, TOPN)	10.359	1%	3.29	4.37
		2.5%	2.88	3.87
		5%	2.56	3.49
		10%	2.20	3.09

Note: The critical values are obtained from *Eviews 10*. Narayan (2005) provides bounds critical values for small sample size.

Having found that the variables are cointegrated, we estimate the long-run coefficients and the associated unrestricted error correction model (UECM)[7]are reported in Table IV and Table V respectively. The first row of both tables reports selected models.

Table IV: Long run coefficients (Dependent variable: PVTINV)

	ARDL Model-1(1,3,2,4,3)	**ARDL Model-2(2,4,1,3,3)**
Regressor	Coefficient	Coefficient
Constant	3.353*(2.069)	-2.015(-0.789)
PUBINV	0.367**(2.614)	0.682***(2.832)
LINTR	-0.067***(-3.205)	
PVTSAV	0.433***(4.708)	0.658***(13.643)
CTOTL	0.017***(3.778)	
WPI		-0.067***(-7.224)
TOPN		-0.021*(-2.017)
Diagnostic test statistics from the estimated ARDL model		
Adjusted R-squared	0.9953	0.9969
Serial correlation	0.007 [0.993]	3.012 [0.087]
Heteroskedasticity	1.008 [0.503]	0.965 [0.534]
Jarque-Bera	1.579 [0.454]	0.601 [0.740]
D-W stat	2.000	2.525

Note: ***<.01, **<.5 and *<.10. t-statistics are in ( ) and p-values are in [ ]

[7]The ECM reconciles the long-run and short-run coefficients.

Table V: Results of error correction model (Dependent variable: ΔPVTINV)

	ARDL Model-1(1,3,2,4,3)	ARDL Model-2(2,4,1,3,3)
Regressor	Coefficient	Coefficient
D(PVTINV(-1))		-0.268**(-2.362)
D(PUBINV)	0.192(1.292)	-0.346***(-2.984)
D(PUBINV(-1))	-0.017(-0.115)	-0.707***(-4.718)
D(PUBINV(-2))	-0.583***(-3.341)	-0.219(-1.478)
D(PUBINV(-3))		-0.299***(-3.000)
D(LINTR)	0.000(0.099)	
D(LINTR(-1))	0.030**(2.642)	
D(PVTSAV)	-0.106(-1.328)	0.312***(4.889)
D(PVTSAV(-1))	-0.432***(-4.195)	-0.114*(-1.773)
D(PVTSAV(-2))	0.024(0.267)	-0.114*(-1.773)
D(PVTSAV(-3))	-0.143**(-2.302)	-0.001(-1.057)
D(CTOTL)	0.014***(3.086)	
D(CTOTL(-1))	-0.035***(-5.981)	
D(CTOTL(-2))	-0.010*(-1.907)	
D(WPI)		-0.022*** (-5.837)
D(WPI(-1))		0.033*** (5.884)
D(WPI(-2))		0.007* (1.828)
D(TOPN)		0.028***(5.472)
D(TOPN(-1))		0.026***(4.985)
D(TOPN(-2))		0.028***(5.309)
ECM(-1)	-0.823***(-6.511)	-0.768***(-9.184)

Note: ***<.01, **<.5 and *<.10. t-statistics are in ( )

As evident from Table IV, public investment has statistically significant positive effect on private investment in the long-run. The estimated long-run coefficient for public investment is 0.367 and 0.682 respectively for Model-1 and Model-2. Simply put, one percent increase in public investment increases private investment by 0.36% and 0.68% for the sample period in case of Model-1 and Model-2.

Similarly, the estimated long-run coefficient for lending rate, private saving and public debt in Model 1 are statistically significant at the 1% level or better. The negative coefficient associated with the lending rate suggests an inverse relation between the private investment and lending rate. Interpretatively, as lending rate rises, private investment falls. Furthermore, in determining private investment, private saving is proved to be effective as the sign is positive and significant at 1% significance level. For example, 1 percentage point increase in private sector saving, *ceteris paribus*, will increase private investment by 0.43 percentage point. Moving to the public debt, the result shows that positive and significant on private investment. Given these results, we conclude that in India there is strong evidence in support of the "*crowding-in*" hypothesis. Both the series are affected by the common trends. The growth in public investment is a natural consequence of economic growth and private investment varies positively with economic growth. Public investment in research and development has historically driven technological change in the economy, as the prime driver of the private firms' productivity. Moreover, there are other common factors such as the technological progress, demographic phase and institutions, etc. which improves both public and private investment increase. The results support the Keynesian views on relationship between public investment and private investment. Public investment is noted as catalyst for investment decision by private entrepreneur. These findings support the "*crowding-in*" hypothesis and in line with the works of Greene and Villanueva (1990) and Chakraborty (2006).

It is also imperative to examine the sensitivity of the results of the basic model (here ARDL Model 1) by incorporating additional independent variables such as inflation rate and trade openness replacing lending rate and public debt for a wider policy context. When the model (Model 2) is re-specified using these two variables, the results move in tandem with general consistent in terms of sign and significance of focus parameters in long run finding. The results also suggest that public investment crowds in private investment, while openness has positive influence on private sector investment in the short run but negative influence in the long run. The severe impact of an over liberalized of economy on private investment is established in the short run only. One reason may be due to that prior to 1991-92 when India evolved into trade liberalisation, the tradable sectors and import substitution industries were not benefited much from the industrial delicensing, globalisation and technical know-how and could not been able to spur the desired boost in private sector initiatives in India. Furthermore, the coefficient of inflation rate is negative and significant at 1% significance level. A high inflation rate that captures the cost of economic uncertainty or macroeconomic instability for investors, has an adverse impact on private investment in India.

The short-run estimates are reported in Table V. The error correction coefficient indicates the speed of adjustment towards the long run equilibrium relationship (i.e. the speed at which deviation from equilibrium is adjusted towards the steady state in the subsequent periods). Our results show that the error correction parameter is negative (-0.823 and -0.768 for Model-1 and Model-2 respectively) and statistically significant at 1 per cent level. This reflects quick adjustment to the long run equilibrium level.

Figure 3: Plots of the CUSUM and CUSUMSQ stability tests statistics-Model 1

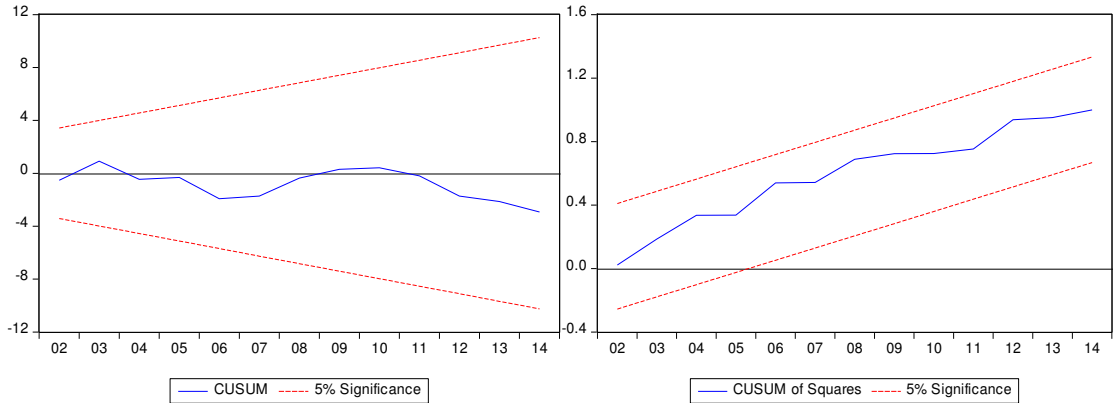
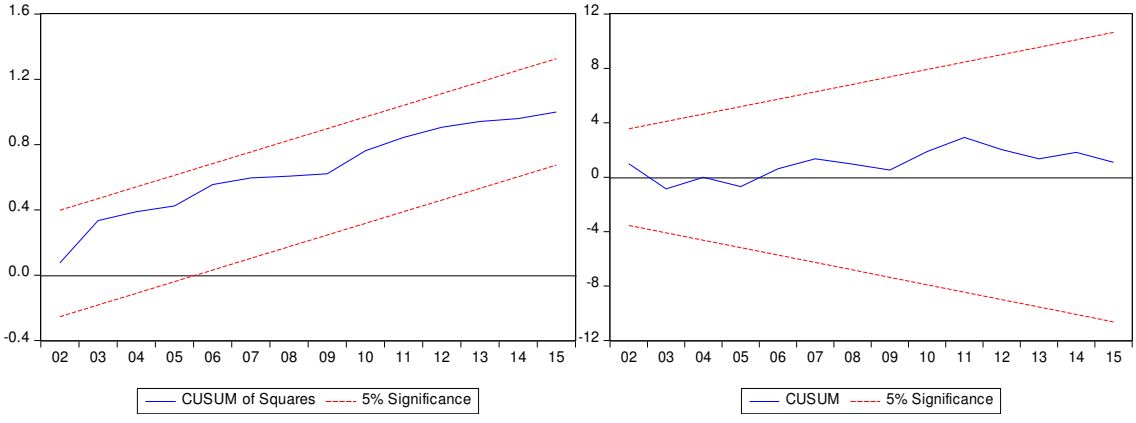


Figure 4: Plots of the CUSUM and CUSUMSQ stability tests statistics-Model 2



The diagnostic test statistics show that there is no serial correlation, normality and heteroskedasticity in the estimated ARDL models. To test for parameter constancy, the CUSUM and CUSUMSQ test statistics have been applied to the recursive residuals of the models and presented in Figure 3 & Figure 4 respectively. The charts indicate which reveal no evidence of parameter instability and ensure reliability of policy simulations based on the model.

6. Conclusion

Using the ARDL bounds test approach the paper proposes an empirical model of nexus between public investment and private investment which suggest cointegration among the variables considered. The public investment, lending rate and private savings are found to have long run impacts on private investment. The significance and sign of variables of interest, suggest the crowding in hypothesis in the Indian context indicating the complementarity between public and private investment. Our results have information on the short run speed of adjustment process to restore long run equilibrium. Various robustness diagnostics including CUSUM and CUSUMSQ tests confirmed that the models are stable over the sample period. To ensure the sensitivity of our results, re-specifications of the basic model were done, to determine the reliability of underlying relationships among the variables.

The study has important policy implications for long-term development strategies appropriate for achieving higher economic activity via investment in India. Because, in a market-led economy like India, private investment is crucial to output growth provided public investment is shifted towards critical areas by which the private investment can be induced in the long run. We must point out the weakness of the model is that our estimates are not based on the complete model of private investment that takes into account all structural features of the economy and beyond scope of this study. The future research of our analysis can also be done as to whether compositional shift in public investment towards infrastructure and non-infrastructure investment could moderate the crowding in effect on private investment in India.

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