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**Reviving Private Investment in India: Determinants and
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Reviving Private Investment in India: Determinants and Policy Levers

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Abstract

Private investment has slumped in India and its revival is vital for accelerating India's growth rate on a sustained basis. This paper analyzes the determinants of aggregate private investment and its components corporate and non-corporate private investment for the period 1980-81 to 2013-14. This paper finds that the key determinants of private investment are the size of the public sector capital stock, the real effective exchange rate, the output gap and the availability of credit to the private sector. So, higher public investment would crowd-in more private investment. When we break it down further private corporate investment is significantly explained by the real exchange rate and the availability of credit to the private sector whereas for non-corporate investment public capital stock is the most significant variable- as it crowds in private investment. Real interest rate has no significant effects on investment.

Simulations show that if India increases public investment by 5% of GDP, depreciates the real exchange rate by 10-15% and fixes the bad loan problems in the banking sector so that credit growth to the private sector is restored, India can increase its GDP growth rate by at least 2% points on a long run sustained basis and achieve 8% plus GDP growth.

Key Words: Private Investment, GDP growth, Public investment, Real Exchange rate, Credit to Private Sector, Non-performing loans (NPL's), Fiscal Deficit, Public Sector Borrowing Requirement.

JEL classification codes: C32, E22, E27, H54

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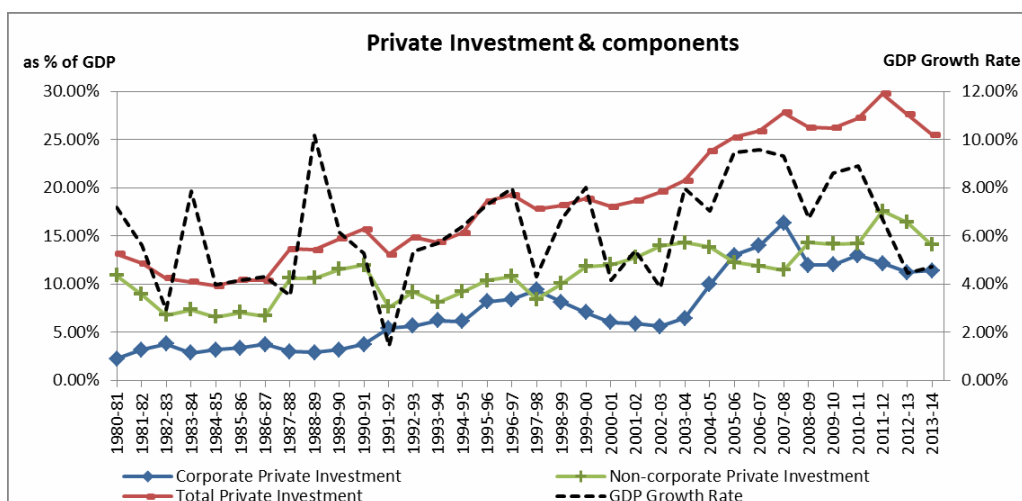
1. Introduction

Private investment has played a central role in accelerating growth in India since the mid 1980's when India began liberalizing its economy. But private investment has slumped in the last three years leading to a slowdown in economic growth. In this paper using data from 1980-81 to 2013-14 the determinants of total private investment, as well as for its sub-components i.e. corporate and non-corporate investment, are analyzed.

Private investment increased from under 15% of GDP in 1980-81 to almost 30% of GDP in 2011-12 but has since fallen to around 25% of GDP. The rise in private investment came in phases with the first phase coming from the mid 1980's to 1990 when the private investment rate rose from 10% of GDP to around 15% of GDP. The next jump came in the mid 1990's from 15% to 20% of GDP. The third jump came in 2004-05 when private investment increased sharply again to cross 25% of GDP and helped propel the economy to a period of rapid economic growth averaging over 8% from 2003-04 to 2011-12 peaking at 30% of GDP.

The components of private investment - corporate and non-corporate - present some interesting differences. Corporate investment rose sharply from 5% of GDP to almost 10% of GDP after the economic reforms of 1991 but slumped again after 1996-97. From 2004-05 we again see a very sharp increase in corporate investment to 16% of GDP in 2007-08 and falling sharply after the global economic crisis to around 12% of GDP. Non-corporate investment which is a mixed bag of Small and Medium Enterprises, household and real estate investment hovers around 10% of GDP from 1980-81 to 1999-2000 and then starts rising to around 17% of GDP by 2012-13 but since then has dropped to around 14% of GDP.

India's GDP growth fell below 5% in 2012-13 and 2013-14. Since then the GDP series has been revived and the new GDP series shows India's GDP growth rate much higher at over 7%. But there remain question marks over the new series, as many of the other real and physical indicators do not show a revival of growth which the new GDP series implies. In any case there is no time series for the new GDP series which has not yet been back dated and lacks wider credibility. For this paper the analysis is therefore based on the old GDP series.

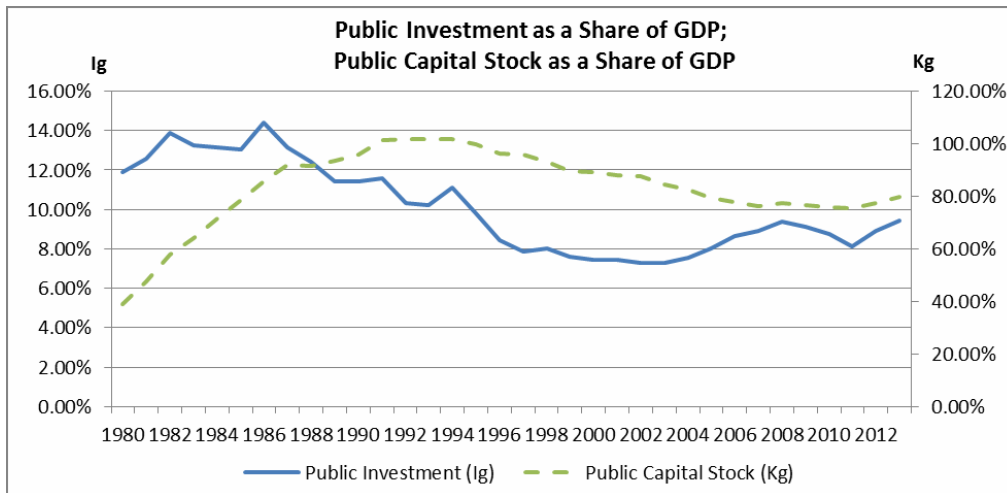
Figure 1: Private Investment and Its Components 1980-81 to 2013-14


Source: CSO, RBI

India must see a revival of private investment to around 30% of GDP, which together with public investment of at least 6% of GDP will allow GDP growth of over 8% on a sustained basis. But with slower growth and a banking system saddled with considerable non-performing loan (NPL's), reviving private investment will not be easy. India also suffers from other factors that have reduced competitiveness. India has a huge public infrastructure deficit and declining public investment. Public investment typically crowds in private investment. The public sector capital stock¹ rose from around 40% of GDP in 1980 to over 100% of GDP by 1990 due to high levels of public investment which peaked in the mid 1980's at around 14% of GDP. But once public investment fell the size of the public sector capital stock has since declined to around 80% of GDP. This pattern is also typical of many low-income and emerging economies (IMF, 2015).

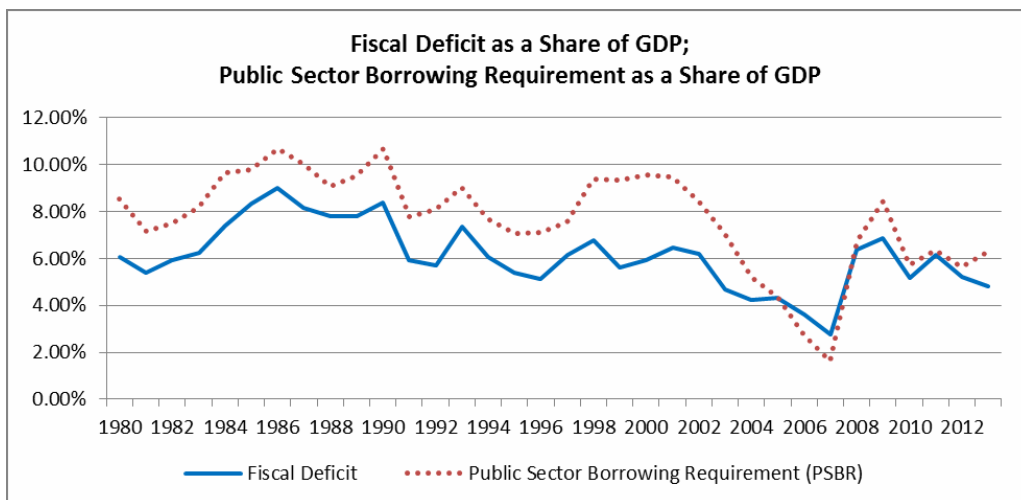
¹ We have estimated the public sector capital stock by taking the base year public capital stock as a multiple of government expenditure and then adding new public investment every year minus depreciation. This is explained further in the paper.

Figure 2: Public Investment and Public Capital Stock as a Share of GDP



Source: CSO, Authors' calculations

Figure 3: Fiscal Deficit and the Public Sector Borrowing Requirement²



Source: RBI, Authors' calculations

Fiscal deficits have also been high since the global economic crisis, initially to stimulate the economy but after that to fund large subsidy programs (Figure 3) and these also helped to crowd out the private sector. Public sector borrowing to finance public investment can be justified because it helps growth and crowds in private investment. But when public borrowing is used to finance public consumption it crowds out private investment without creating any public assets.

² We define Public Sector Borrowing Requirement (PSBR) as the sum of union fiscal deficit and state fiscal deficit along with the net surpluses of Public Sector Undertakings (PSU's).

2. Review of Relevant Literature

Much of the empirical estimation of private investment in developing countries follow an adapted version of the Jorgensen-Hall (1967) neo-classical investment model instead of Tobin's Q model- for which data is not readily available in most developing countries. Tobin's Q- the ratio between a physical asset's market value and its replacement value is hard to measure in most developing countries.

One of the few studies in a developing country using Tobin's Q is by Solimano (1992) for Chile, which uses a 3-equation model for Investment, Q and Output. In their model Q has a positive effect on investment but an insignificant effect on aggregate demand. Q is strongly affected by the output gap, negatively by the real exchange rate and the real interest rate.

Most empirical studies of investment adapt the Jorgensen-Hall model to developing country conditions. Three adjustments are important. The first is the important role played by government expenditure and investment policy when markets are underdeveloped. High public sector deficits which are financed by public borrowing crowd out the availability of credit to the private sector. Ogura and Yohe (1977) show that public spending can be divided into three categories (a) those that compete with the private sector (b) those that provide services independent of the private sector (pure public goods) and (c) those that are complementary to the private sector.

One of the earliest studies to study the effect of public investment on private investment is by Blejer and Khan (1984). They find that infrastructure investment³ has a positive effect on private investment, but non-infrastructure investment crowds-out private investment. More direct positive effects of public infrastructure investment on private investment were found by Chhibber and Wijnbergen (1992) for Turkey and Shafik (1992) for Egypt. Asante (2000) also finds a positive effect of public investment on private investment and recommend more infrastructure investment.

Wai and Wong (1982) use a modified version of the flexible accelerator theory of investment and apply it to five countries: Malaysia, Greece, Thailand, Mexico and Korea. They find that government investment is the most important explanatory variable in Greece, Korea and Malaysia, bank credit in Thailand, and capital inflow is most important in Mexico. In their model they are able to estimate the net effect of government investment on private investment, that is, the contributory effect less the financial crowding out effect, is positive in Greece, Korea and Thailand. But confirm the existence of financial crowding out effect of government investment for Mexico and Malaysia.

³ As they did not have a breakdown of public investment they used the trend in public investment as a proxy for public infrastructure investment and deviations from the trend as a proxy for non-infrastructure investment. These proxies are questionable.

In many developing countries credit is constrained and interest rates are not freely determined. This means that capital is allocated and interest rates do not clear that market, leading to financial repression. Following Mckinnon (1973) and Shaw (1973) there is by now a large body of literature Bruno (1979), Gelb (1989) that have analyzed the implications of financial repression, theoretically and empirically. In many recent studies of private investment in developing countries the real interest rate does not have a significant effect on investment but the availability of credit to the private sector does. In Egypt (Shafik 1992), Turkey (Chhibber and Wijnbergen 1992), Colombia (Schmidt-Hebbel and Müller 1992) and Morocco (Dailami 1992) credit rationing has a significant effect on investment.

The empirical literature also shows a strong impact of the real exchange rate on investment behavior. The impact of the real exchange on investment is complex. In the short-run a devaluation would drive up the cost of imported capital goods and imported inputs, thereby reducing the profitability of investment. But as the devaluation encourages exports and import substitution it makes expected profits higher and could help encourage investment. Solimano (1992) shows that in Chile the short run effect of the devaluation was negative on investment, but over time, as the economy expanded, its impact on investment was positive. Chhibber and Shafik (1992) show the same effects in Indonesia as a slower devaluation raises interest rates and slows investment. Exchange rate instability also has a negative effect on private investment. Servén (2002) shows the negative effect of exchange rate uncertainty on private investment for 61 developing countries for the period 1970-1995.

For India, there are a host of empirical studies of which we summarize those that have relevance for our study. Bhanumurthy, Bose and Adhikari (2014) attempt to construct a macroeconomic framework for India to review the macro-fiscal linkages over the 14th Finance Commission period of 2015-19. They estimate private investment functions for four sectors of the economy - Agriculture, Industry, Services and Infrastructure - as a part of a macroeconomic model for the period 1991-91 to 2012-13. The equations are specified mainly as function of public investment of that sector, along with interest rate and/or capacity utilization for some sectors. Results show that public investment crowds in private investment and interest rates negatively affect private investment. Private investment as a fraction of nominal output is positively related to capacity utilization in Industry.

Ang (2009) examines the role of financial sector policies in determining private investment in India (1950-2005) and Malaysia (1959-2005). The private investment equation is a function of GDP, public investment, user cost of capital, interest rate restraint, directed credit programs, reserve and liquidity requirements. The results suggest that, in short, some sort of financial

restraint may stimulate private investment. However, directed credit programs and high reserve & liquidity requirements tend to have an undesirable effect on private investment in India.

Mitra (2006) provides empirical evidence for India (1969-2005) that in the short run government investment crowds out private investment, whereas over medium to long term government investment complements private investment.

Bahal, Raissi and Tulin (2015), on the other hand, found public investment “crowding out” private investment in India over the period 1950-2012. But found support for crowding in of private investment over 1980-2012, attributing it to the policy reforms which started during early 1980s and gained momentum after the 1991 crisis.

Recent empirical literature has worked on understanding the role of profitability as a key determinant of capitalist investment behavior in developing countries. Basu and Das (2015) empirically analyze the contemporaneous and long run impacts of rate of profit and its components profit share, capacity utilization rate, and capacity-capital ratio – on investment for 19 major Indian states. Using three investment functions based on Keynes (1936) and Robinson (1962), Bhaduri and Marglin (1990), and Foley and Michl (1999), their results show that rate of profit has both short and long run positive impacts on investment, while profit share and capacity – capital ratio have only long run positive impacts, and the capacity utilization rate has only a contemporaneous positive impact on investment.

3. The Model

$Kp_t^* = f(r)$ Where r is the profit rate, and Kp is the capital stock of the private sector. We postulate that its desired level is a function of the profit rate.

Following Bhaduri and Marglin (1990) we can write

$$r = (R/y) (y/y^*) (y^*/K)$$

Where R/y is the profit margin, y/y^* is the output gap,

And y^*/K is the capacity output ratio at full capacity and can be assumed constant.

$$Kp_t^* = f(R/y, y/y^*)$$

We make the profit margin a function of expected demand and a vector of costs

$$R/y = f(y^e, C)$$

And we posit that expected demand is at least equal to output in the previous year.

$$R/y = f(y_{t-1}, C)$$

We introduce a simple Cobb-Douglas production function:

$$\ln y_{t-1} = f(\ln Kp_{t-1}, \ln Kg_{t-1})$$

Following Bhanumurthy (2011), the output gap is calculated using the following formulation:

$$y_y^e = \frac{y_t^e}{y_t} \times 100$$

Where, y_t^e is the expected real output in year t and $y_t^e = y_{t-1} + \Delta\tilde{y}_t$

y_{t-1} is actual GDP of the previous period and $\Delta\tilde{y}_t$ is the predicted first difference of GDP in period t.

This is derived from:

$$\Delta\tilde{y}_t = f(\Delta y_{t-1}, \Delta^2 y_{t-1})$$

Where Δy_{t-1} is the first difference of real output in the previous period and $\Delta^2 y_{t-1}$ is the second difference of real output in the previous period.

Since no price series for capital goods exists, costs are a function of the availability of public services which is a function of the public capital stock at the beginning of the year, Kg_{t-1} , the real interest rate ir and the expected real exchange rate er . We use the lagged real exchange rate er as a proxy for expected real exchange rate.

Using a lagged adjustment model:

$$Ip_t = \beta_i(Kp_t^* - Kp_{t-1}) + \delta Kp_{t-1} + U_{it}$$

Where, β_i , the speed of adjustment coefficient is a function of the availability of credit to the private sector in a credit constrained economy which we denote by the change in real credit to the private sector $\Delta CRDT_p$ and the available stream of government services and assets which are a function of the government capital stock at the beginning of the year Kg_{t-1} .

$$\beta_i = g(\Delta CRDT_p, Kg_{t-1})$$

Note that Kg enters twice: once as a determinant of the cost of doing business again as a determinant of the speed of adjustment to the desired capital stock of the private sector. To give an example if a public road exists, it helps to build a plant or expand the plant size and at the same time it lowers the cost of operating the plant. Capital Stock is calculated using the following formulations –

For the Private Sector:

For the base year,

$$Kp = [Cp + (X - M)] * \frac{\text{capital}}{\text{output}} \text{ratio}$$

Where, Cp is private consumption X is exports and M is imports and $\frac{\text{capital}}{\text{output}} \text{ratio} = 4$

For subsequent years,

$$Kp_t = Kp_{t-1}(1 - d) + Ip_t$$

Where, Ip is total private investment and the depreciation rate $d = 0.05$

For the Government Sector:

For the base year,

$$Kg = Cg * \frac{\text{capital}}{\text{output}} \text{ratio}$$

Where, Cg is government consumption and $\frac{\text{capital}}{\text{output}} \text{ratio} = 5$

For subsequent years,

$$Kg_t = Kg_{t-1}(1 - d) + Ig_t$$

Where, Ig is the total public sector investment and the rate of depreciation $d = 0.05$

In reduced log form we get the following private investment function –

$$\ln Ip_t = r_0 + r_1 \ln Kp_{t-1} + r_2 \ln ir + r_3 \ln er_{-1} + r_4 \ln \Delta CRDT_p + r_5 \ln Kg_{t-1} + r_6 \ln yGAP_{-1}$$

Where $r_1 > 0$, $r_2 < 0$, $r_3 \leq 0$, $r_4 > 0$, $r_5 > 0$, $r_6 < 0$

The sign of r_3 is indeterminate as the real exchange rate has various channels through which it affects investment. An appreciated real exchange rate lowers the cost of imported capital

goods and inputs which is positive, but also makes tradeable final goods less competitive, which is negative. These effects could also be time sensitive. The short-run effects of a real depreciation may be negative, as import costs for capital goods and imported inputs rise, but long run effects could be positive as competition increases (see Solimano, 1992; Chhibber and Shafik, 1992).

4. The Estimated Model

The model is estimated for the period 1980-81 to 2013-14 using annual data.

The OLS estimates are in Table 1. Given the causality between private investment and credit to the private sector is unclear and could go either way we use the predicted value of the change in the private credit variable, with results in Table 2.

Table 1: India: Private Investment Equations (in OGS) [1980-81 to 2013-14]

<i>Variables</i>	<i>Constant</i>	<i>Kp₋₁</i>	<i>Kg₋₁</i>	<i>er₋₁</i>	Δ <i>CRDT</i>	<i>yGAP₋₁</i>	<i>ir</i>	\bar{R}^2
Total	4.3125 (1.23)	0.7547 (6.06)***	0.3416 (2.80)***	-0.7129 (3.03)***	0.2016 (3.06)***	-1.4474 (1.68)	-0.0518 (0.92)	0.9878
Corporate	7.0342 (0.87)	0.7873 (3.30)***	0.006 (0.02)	-2.1142 (3.75)***	0.3570 (2.47)**	-0.076 (0.04)	-0.1702 (1.33)	0.9539
Non – Corporate	-0.8930 (0.15)	0.8110 (3.28)***	0.4832 (2.26)**	0.052 (0.13)	0.08 (0.68)	-1.8381 (1.25)	-0.0032 (0.03)	0.9564
Total	3.8542 (1.12)	0.7934 (6.91)***	0.3798 (3.38)***	-0.6289 (3.00)***	0.1791 (2.94)***	-1.6437 (2.03)*		0.9886
Corporate	4.5896 (2.32)	0.9332 (4.77)***		-2.0986 (8.87)***	0.3332 (2.73)**			0.9583
Non – Corporate	-8.2313 (10.58)	1.0078 (8.14)***	0.4100 (3.93)***					0.9605

Notes: t- Statistics in parentheses, * and ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Key to Variables:

Kp Private Sector Capital Stock
(Corporate and non-corporate capital stock series calculated separately)

Kg	Government Capital Stock
er	Real Exchange Rate: trade weighted, 36 currencies
$\Delta CRDT$	Change in credit to private sector
$yGAP$	Output gap
ir	Real Interest Rate (SBI lending rate minus GDP deflator)

The model has a high level of predictive power with the R-Bar squared above 0.95. As expected the public capital stock crowds in private investment. The public capital stock affects private investment in two ways. Directly by reducing the cost of doing business and indirectly by helping increase output which then help increase demand and spurs more private investment. A 1% increase in the public capital stock increases private investment by 0.42%.

A 1% change in the availability of credit to the private sector has a 0.25% positive effect on private investment. Lack of credit availability is the main variable affecting the speed of adjustment to the optimal capital stock. The output gap has a negative effect on private investment - a 1% increase in the output gap decreases private investment by almost 1% - but the coefficient is not significant.

The model results indicate that an appreciation of the real exchange rate reduces the competitiveness of the economy and dampens private investment sharply. The positive effect of the appreciation on reducing the cost of imported capital goods and imports is outweighed by the loss of competitiveness from increased imports of consumer goods and reduced exports. A 1% appreciation of the exchange rate reduces private sector investment by 0.6%. The effect of the real exchange rate comes largely through its effect on corporate investment and has no significant effect on non-corporate investment. Corporate investment falls by 2% for every 1% appreciation of the real exchange rate.

Table 2: India: Private Investment Equations (in LOGS) [1980-81 to 2013-14]

<i>Variables</i>	<i>Constant</i>	<i>Kp₋₁</i>	<i>Kg₋₁</i>	<i>er₋₁</i>	$\Delta CRDT_p$	<i>yGAP₋₁</i>	<i>ir</i>	\bar{R}^2
Total	1.7803 (0.43)	0.6562 (4.84)***	0.4212 (2.76)**	-0.6807 (2.56)**	0.2454 (3.27)***	-0.9751 (1.10)	-0.0283 (0.50)	0.9882
Corporate	12.7867 (1.33)	0.7793 (2.96)***	-0.2869 (0.83)	-2.619 (4.11)***	0.4889 (2.93)***	-0.1878 (0.09)	-0.2114 (1.63)	0.9552
Non – Corporate	-6.0475 (0.88)	0.6388 (2.48)**	0.7786 (2.96)***	0.3552 (0.81)	0.0779 (0.61)	-1.0346 (0.69)	0.0518 (0.55)	0.9595
Total	1.2807 (0.34)	0.673 (5.30)***	0.4565 (3.45)***	-0.6102 (2.75)**	0.2323 (3.39)***	-1.0815 (1.30)		0.9893
Corporate	5.0805 (2.47)	0.8285 (3.93)***		-2.1092 (9.05)***	0.4242 (3.04)***			0.9583
Non – Corporate	-8.2313 (10.58)	1.0078 (8.14)***	0.4100 (3.93)***					0.9593

Notes: t- Statistics in parentheses, * and ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Key to Variables:

<i>Kp</i>	Private Sector Capital Stock (For corporate and non-corporate separate capital stock series calculated)
<i>Kg</i>	Government Capital Stock
<i>er</i>	Real Exchange Rate: trade weighted, 36 currencies
$\Delta CRDT_p$	Change in credit to private sector (predicted)
<i>yGAP</i>	Output gap
<i>ir</i>	Real Interest Rate (SBI lending rate minus GDP deflator)

A percentage increase in credit to the private sector increases private corporate investment by 0.42%, but has insignificant effect on non-corporate investment because non-corporates have very limited access to banking sector credit. Much of non-corporate investment is self-financed or financed from sources outside the banking system. Public investment on the other hand has very strong crowding in effect on non-corporate investment, but has an insignificant impact on corporate investment. The corporates are able to manage even in the absence of public investment as they have the size and scale of investment where they can build captive infrastructure roads, power plants and other infrastructure for their business needs. The non-corporate sector on the other hand whether its real estate, or small and medium enterprises is highly dependent on public services and infrastructure.

These results explain why corporate investment fell sharply after the global economic crisis and have remained low, but non-corporate investment continued to rise due to the public stimulus that was increased to deal with the global crisis. But after 2011-12 when the stimulus ended non-corporate investment also started to decline and combined with declining corporate investment created a slump in the economy.

In order to test whether we have no specification error in the model above we check for auto-correlation among the residuals of the OLS equations and also test for time series property of the variables by applying the Augmented Dickey- Fuller (ADF) unit root tests to check for stationarity and the order of integration. We find no auto-correlation in the residuals but the unit root tests results reported in Table 1a in Appendix 1 shows that some of the variables under consideration are stationary at levels and others are stationary at first differences⁴. In other words, we have a mix of variables that are of either I(0) or I(1) process.

We employ an Autoregressive Distributed Lag (ARDL) approach (Pesaran and Shin, 1999) for the estimation of long-run relationships as it is valid in the presence of both I(0) and I(1) processes. The specification of the ARDL model is chosen by the Schwartz Bayesian Information Criterion and then estimated by OLS. Table 3 presents the results of the estimation of the long-run private investment function using the ARDL approach for the period 1980 - 2014:

Table 3: India: Private Investment Equations (in LOGS) using ARDL [1980-81 to 2013-14]

<i>Variables</i>	<i>Constant</i>	<i>Kp₋₁</i>	<i>Kg₋₁</i>	<i>er₋₁</i>	<i>ΔCRDT_p</i>	<i>yGAP₋₁</i>
Total	12.8424 (0.05)	0.6671 (4.70) ^{***}	0.5567 (3.59) ^{***}	-0.4838 (2.19) ^{**}	0.1717 (2.63) ^{**}	-3.8620 (2.96) ^{***}
Corporate	33.8628 (1.00)	-0.2498 [@] (0.25)		-2.5419 (3.14) ^{***}	1.0255 (1.78) [*]	-3.9150 (0.58)
Non – Corporate	-3.1516 (0.53)	0.7967 (5.92) ^{***}	0.4698 (3.63) ^{***}			-0.6650 (0.52)

Notes: t- Statistics in parentheses, * and ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. @ : results for private corporate investment equation using Kp_{-2} instead of Kp_{-1}

Key to Variables:

Kp Private Sector Capital Stock

(For corporate and non-corporate separate capital stock series calculated)

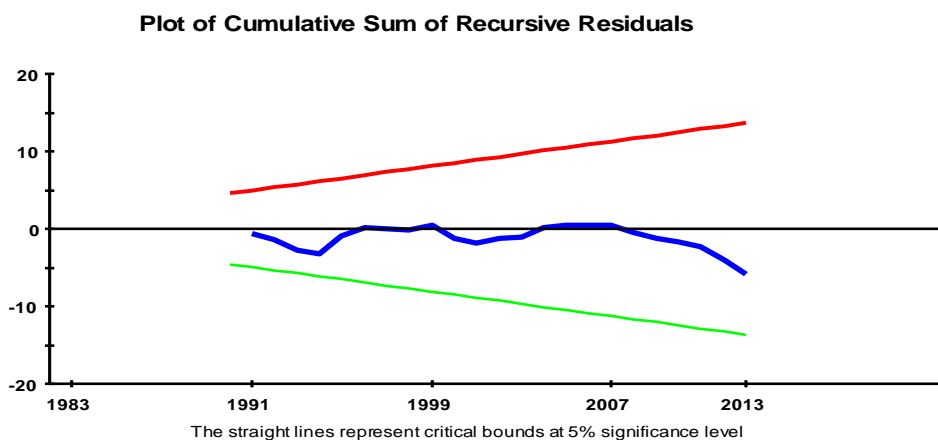
⁴ ADF test on Private Capital Stock shows that the variable is stationary in second differences with a test statistic of -5.029. With some approximations we can show that second difference of $\ln Kp$ is equal to $\ln Ip_t - (\ln Kp_{t-1} - \ln Kp_{t-2})$ where the term in the round bracket is first difference of $\ln Kp_{t-1}$ which is an independent variable in our model. Thus we conclude $\ln Kp$ to be stationary in first differences or integrated of order 1, I(0).

Kg	Government Capital Stock
er	Real Exchange Rate: trade weighted, 36 currencies
$\Delta CRDT_p$	Change in credit to private sector (predicted)
$yGAP$	Output gap

The results using the ARDL estimation are more robust in establishing the long run elasticities. The results show that a 1% increase in the size of the public capital stock increases private investment by 0.67%. The crowding in of private investment comes from its effect on non-corporate investment. The real exchange rate has a significant negative effect on private investment and much of it comes from its impact on corporate investment. Likewise the availability of credit to the private sector has a positive effect on private investment and the output gap has a strong negative effect on private investment.

The short-run elasticities of private corporate investment equation using Kp_{-1} reports an AR(1) process, i.e., one year lag of dependent variable as one of its independent variable. As this is directly correlated with Kp_{-1} , one of the independent variable, it might lead to incorrect specification of the model specially in the short run. Therefore, we present results of the private corporate investment model with two year lagged private capital stock, Kp_{-2} , above in Table 3. We find that private corporate investment is significantly explained by the real exchange rate and the availability of credit to the private sector. The long-run coefficients for the model with Kp_{-1} are presented in Table 1b in Appendix 1.

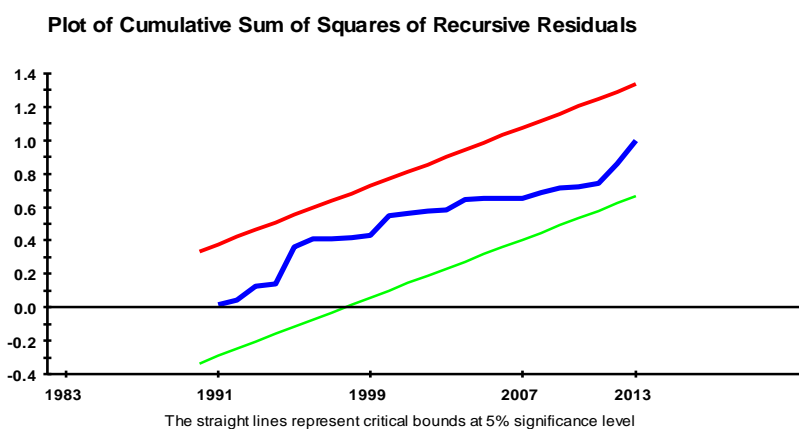
Figure 4: CUSUM test of parameter stability of the investment model



We run the following tests on the residuals of this model to check if they are well behaved. Auto-correlation in the residuals would indicate that some information is not specified in the model

and hence, is reflected through the residuals of the specified model. The Lagrange Multiplier (LM) test for auto correlation on our model indicates that the residuals are not serially correlated (Table 1c in Appendix 1). From policy perspective, an important concern is the instability of the estimated coefficients of our private investment equation. We, therefore, run two stability tests for the estimated investment function: CUSUM and CUSUMQ. Figures 4 and 5 represent these tests for total private investment model. The results show that the estimated coefficients of the model are stable. The results for corporate and non-corporate private investment model are similar and thus are omitted.

Figure 5: CUSUM Square test of parameter stability of the investment model



5. Policy Simulations

These results show that the government has three important policy levers to stimulate private investment: public investment, the real exchange rate and credit to the private sector.

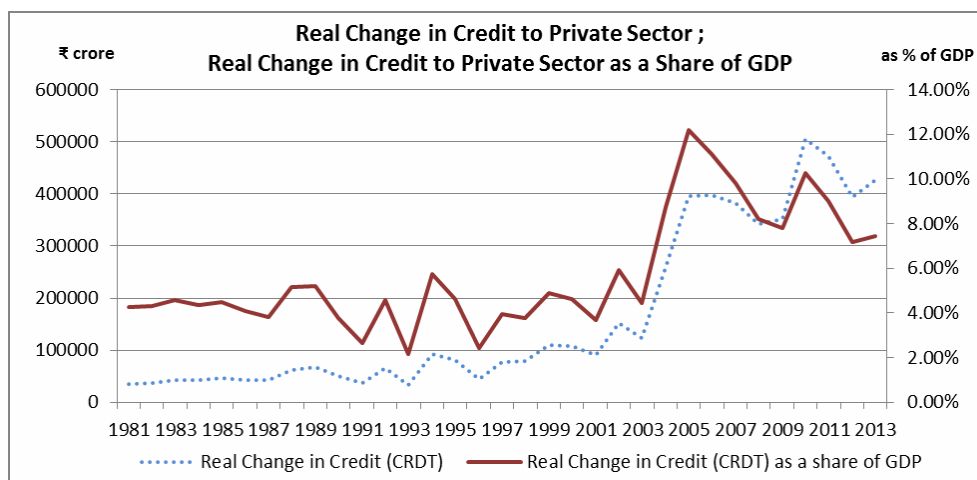
The availability of credit to the private sector is affected by the demand for credit of the government, which, in turn, is influenced by the size of the fiscal deficit. If the government borrows heavily from the banking system, by forcing banks to hold government paper it restricts the availability of credit to the private sector. It is important to recognize that the size of the public sector borrowing requirement (PSBR) is even larger than the size of the union fiscal deficit as it incorporates the state, level fiscal deficits and the net surpluses of the public sector undertakings (PSU's) (Figure 3).

The increase in credit to the private sector grew by about 4% of GDP through much of the 1980's and 1990's but then grew much faster at around 10% of GDP peaking at a growth of 12% of GDP in 2004-05 and 2005-06. Its growth has since dropped to under 8% of GDP (Figure 6), and further as the rising non- performing loans have made the banks more risk averse and are now holding back lending to new projects. If the banking sector problems are resolved then credit growth can be restored – but until then we should continue to see very low levels of new credit to the private sector. Non-bank financial institutions are now the source of new credit but they cannot be a substitute for the bulk of private sector borrowing.

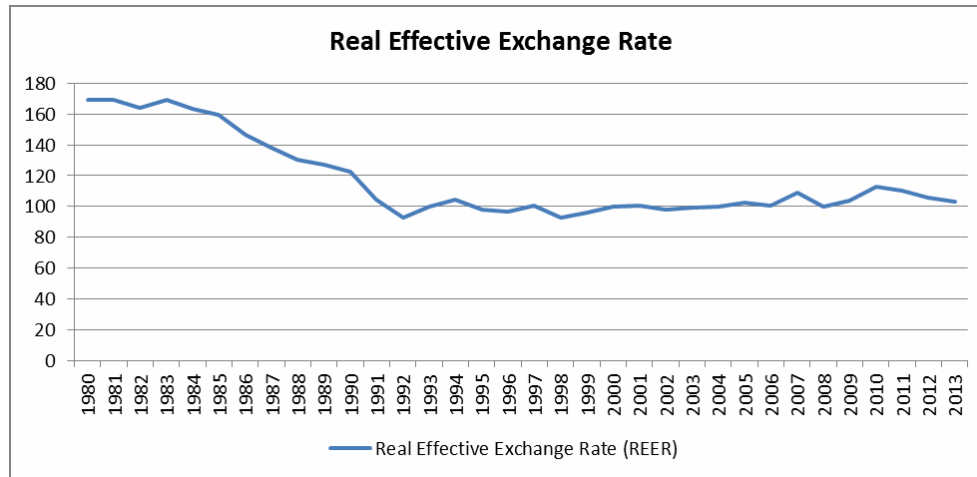
The real exchange rate which was highly appreciated in the 1980's behind trade restrictions depreciated sharply after the foreign exchange crisis in 1991 and remained at a more competitive level (see Figure 7). However, it was allowed to appreciate again after the 2008 crisis, when the Quantitative Easing (QE) in the US and other developed countries led to large inflows of capital. India should have built up reserves during this period but instead allowed the Rupee to appreciate.

This appreciation hurt corporate investment.

Figure 6: Change in Credit to the Private Sector



Source: RBI

Figure 7: The Real Effective Exchange Rate (Trade Weighted 36 Countries)


Source: RBI

As discussed earlier, public investment which had peaked at around 14% of GDP in the mid-1980's declined to under 8% of GDP but has since risen to around 9% of GDP but remains well below earlier levels. This has led to large infrastructural deficits in the country which has increased the costs of doing business and crowded-out instead of crowding-in private investment. As shown by our regression equations this lack of sufficient public investment has hurt non-corporate investment more than it has hurt corporate investment. The corporate sector is better able to cope with lack of infrastructure because its size and scale allows it to build its own captive infrastructure such as roads or power plants.

The real interest rate does not have any significant effect in our model. There has been much discussion on the need to lower interest rates to revive growth. If the interest rate has any effect it could come through a short-term impact on the output gap. Lower interest rates could increase consumption demand and reduce the output gap. But real interest rates have no direct effect on investment.

The model used for the simulation exercises is in the Appendix and is a recursive model which allows us to change certain policy variables and then examine its cumulative impact on GDP growth, private investment and the output gap, which in turn affect other variables in the following year. It's a partial equilibrium model as the real exchange rate is not endogenized in the model but kept at its actual level.

Table 4: India: GDP Equation (in LOGS) using ARDL [1980-81 to 2013-14]

<i>Variables</i>	<i>Constant</i>	<i>Kp</i>	<i>Kg</i>
<i>GDP</i>	1.9777 (3.36)	0.5942 (23.02) ^{***}	0.2403 (5.63) ^{***}

Notes: t- Statistics in parentheses, ^{**} And ^{***} denote statistical significance at the 5% and 1% levels, respectively.

Key to Variables:

<i>Kp</i>	Private Sector Capital Stock (Corporate and non-corporate capital stock series calculated separately)
<i>Kg</i>	Government Capital Stock

The model includes a simple GDP equation where it's a function of the private and public capital stock. As government sector capital stock is stationary at levels, and private sector capital stock and GDP are stationary at first differences we have a mix of I(0) and I(1) variables. Hence, the equation is estimated using the ARDL approach. The long-run coefficients of the estimated GDP equation are in Table 4.

Five simulation exercises were conducted:

Simulation 1: Public Investment increased by 5% of GDP.

Simulation 2: Public Investment increased by 5% of GDP but paid for by borrowing from the banking system: thereby reducing credit to the private sector by the same amount.

Simulation 3: Public Investment increased by 5% of GDP and the real exchange rate is depreciated by 10%.

Simulation 4: Public investment increased by 5% of GDP, real exchange rate depreciated by 10% and credit to private sector grows by at least 10% of GDP.

Simulation 5: Public investment increased by 5% of GDP, real exchange rate depreciated by 20% and credit to private sector grows by at least 15% of GDP.

The long-run GDP growth rates⁵ under the five simulations are:

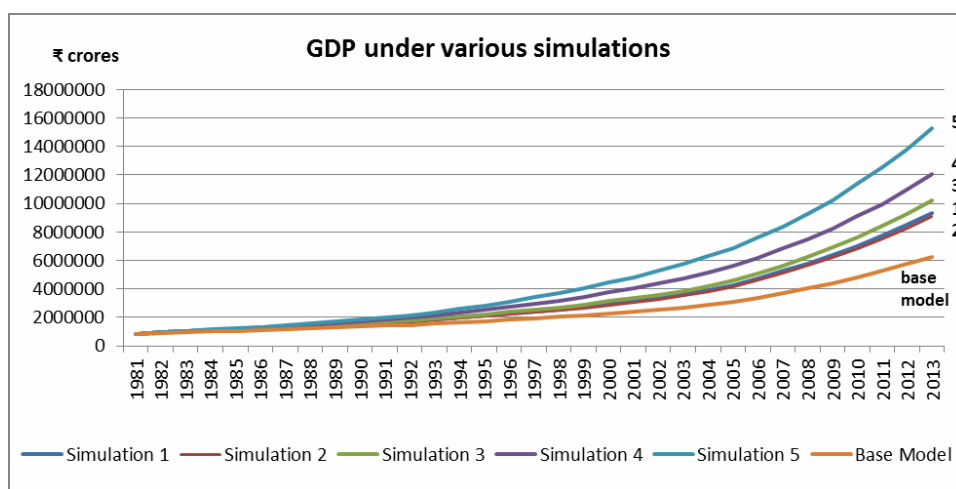
⁵ 1% was added for productivity improvements.

Table 5: GDP growth rate under different policies

Base Run	Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 5
6.07%	7.19%	7.13%	7.40%	7.76%	8.29%

Under simulation 1, higher public investment of 5% of GDP increases the long run growth rate by almost 1.12% points. This is reduced to 1.06% points in Simulation 2 once this increase is financed by borrowing from the banking sector instead of using more long term financing sources. This is because if public investment is financed by banking credit it reduces the availability of credit to the private sector. Most likely the same result holds true when banking credit is used to finance public private partnership (PPP) projects for infrastructure which has been the case in the last 10 years. The negative effects of such financing are even greater if the PPP infrastructure projects are not completed.

GDP growth increases in Simulation 3 to almost 1.3% points if the public investment increase is combined with a 10% real depreciation. If the banking sector's NPL problems are resolved and the change in credit growth is at least 10% of GDP then GDP growth increases by an additional 0.36% points in Simulation 4. If India follows an aggressive Chinese style policy package with increases in public investment by 5% of GDP, a real exchange rate depreciation of around 20% and rapid credit growth to levels reached in 2006-07 of around 15% of GDP then India's growth rate jumps to 8.29 %: at least 2.2% points higher than the base rate of growth of 6.07% using the old GDP series.⁶

Figure 8: GDP under various simulations


Source: Authors' calculations

⁶ If India is currently growing at 7.5% under new series this would bring India's growth rate close to double digit levels.

These simulations are of course illustrative and are based on a partial equilibrium econometric model of the Indian economy but they do suggest the direction of policy change needed to revive and sustain long term growth.

6. Conclusions

If India is to achieve 8% plus GDP growth on a sustained basis, it must revive private investment well over 25% of GDP – closer to 30% of GDP. Together with public investment of around 14-15% of GDP India needs an investment rate of over 40-45 % of GDP for the next twenty years. The model estimated in this paper shows that private investment is driven by three key variables: public investment, the real exchange rate and the availability of credit to the private sector. The output gap also plays a cyclical role in that a large output gap holds back private investment.

The role of public investment is critical as it helps build public capital needed for the provision of basic services but it also helps draw-in more private investment. Public investment must be increased by around 5% of GDP from its current level of under 10% of GDP and much of the increase must come from investment by the state and central government not just by the public sector undertakings.

Another key variable is the real exchange rate which was kept artificially appreciated for much of the 1980's, through import controls. With liberalization after the 1991 foreign exchange crisis the real exchange rate found its competitive level. But after the global economic crisis it was again allowed to appreciate as capital flooded into India as the developed world resorted to unprecedented QE programs. Our results show that a 10% real depreciation would add almost 0.3% points to GDP growth and a 20% depreciation would add almost 0.5 % point to GDP growth, *ceteris paribus*.

The growth of credit to the private sector is another critical variable and its growth must rise above 10% of GDP to generate more investment. Large fiscal deficits crowd out credit to the private sector. But lately what has constrained credit growth are the NPL problems in the banking system used to finance uncompleted PPP infrastructure projects which must be addressed. If credit to private sector growth is at least 10% of GDP, India's growth rate increases by around 1.7% of GDP and to almost 2.2% points if it rises to 15% of GDP.

Our analysis shows that to achieve 8% plus growth, India must increase public investment to around 14-15% of GDP, depreciate the real exchange rate by at least 10 % and increase the growth of credit to over 10 % of GDP. This is the policy package that many fast growing countries such as China followed over a 20-30 year period to sustain double digit growth.

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Appendix 1

Table 1a: Testing for Unit Roots: Augmented Dickey-Fuller (ADF) test

<i>ADF – intercept and trend</i>	<i>Variable</i>						
	<i>Ip</i>	<i>Kp</i>	<i>Kg</i>	<i>er</i>	<i>CRDT_p</i>	<i>yGAP</i>	<i>GDP</i>
Levels	-3.70**	-2.85	-11.97***	-1.11	-3.24*	-7.03***	-1.70
First Differences	-5.15***	-1.05#	-	-4.93***	-8.48***	-	-4.72***

Notes: * and ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.
refers to footnote 4

The Augmented Dickey-Fuller Test has a null hypothesis of the series having a unit root as against the alternative of stationarity. The results reported in table 1b indicate that we can strongly reject the presence of a unit-root at 1% level of significance for Output Gap and Government Capital Stock at levels, and for the rest of the variables in first differences#. We therefore conclude that we have variables that are integrated of order 0 or 1, i.e., I(0) or I(1).

Table 1b: Private Corporate Investment model with Kp_{-1} using ARDL

<i>Variables</i>	<i>Constant</i>	<i>Kp₋₁</i>	<i>er₋₁</i>	$\Delta CRDT_p$	<i>yGAP₋₁</i>
CORPORATE	36.0570 (0.94)	-0.377 (0.292)	-2.6075 (2.84)***	1.1096 (1.42)	-4.1333 (0.57)

Notes: t-statistics in parenthesis
* and ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

The long-run coefficients for private corporate investment equation using Auto-Regressive Distributed Lag (ARDL) approach are reported in Table 1b.

Table 1c: Test of Serial Correlation of residuals – ARDL model

<i>Variables</i>	<i>LM Statistic</i>
TOTAL	0.7835 (0.37)
CORPORATE	1.2273 (0.27)
NON – CORPORATE	0.1066 (0.74)

Table 1d reports the Lagrange Multiplier (LM) statistic for the test of serial correlation of residuals for our ARDL model. The null hypothesis is the absence of serial correlation. And with the results reported in the table above we cannot reject the null of no serial correlation in residuals from our ARDL estimation.

Appendix 2: The Simulation Model

Simulation exercise for this paper is conducted using the following recursive model –

$$y = e^{\ln y} \quad (1)$$

$$\ln y = 1.9777 + 0.5942 \ln Kp + 0.2403 \ln Kg \quad (2)$$

$$\ln Ip = 12.8424 + 0.5567 \ln Kg_{-1} + 0.1717 \ln \Delta CRDT_p - 3.8620 \ln yGAP_{-1} - 0.4838 \ln er_{-1} + 0.6671 \ln Kp_{-1} \quad (3)$$

$$Kp = (1 - 0.05) Kp_{-1} + Ip \quad (4)$$

$$Kg = (1 - 0.05) Kg_{-1} + Ig \quad (5)$$

$$yGAP = y^e / y \quad (6)$$

The equations are interrelated. Changing certain policy variables would first affect private investment through equation (3), and then private capital stock in equation (4), thus affecting private investment again the following year and subsequently the GDP equation each year.

For instance, if we change public investment, it would give us new values for government capital stock using equation (5). This would affect the private investment variable in equation (3) and hence private capital stock in equation (4), which would feed into the private investment equation (3) again the following year. The cumulative impact of these changes would feed into the GDP equation (2) every year.