Public and Private Corporate Investment: An Empirical Analysis of the "Crowding –in" Effects of Fiscal Policy in India

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Abstract

Using the high frequency data, the paper analyses the link between public investment and the private corporate investment in India for the post pandemic period. The results of ARDL models reinforced that there is no crowding out effects in India. The monetary variables including cost of credit – both long term and the short-term rates of interest - have been as significant in determining private corporate investment in the medium and long terms, which has crucial policy implications. The output gap uncertainties due to the global economic headwinds and geopolitical risks, cause lags in the responsiveness of private corporate investment to public investment.

Key words: Public Investment, Infrastructure, Private Corporate Investment, Crowding –in effects, Fiscal policy, Public Sector.

JEL Code: E62, C32, H6.

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Introduction

Against the backdrop of post pandemic fiscal stance in India, the paper examines the link between public investment and the private corporate investment links in India. High deficit and debt of the post-pandemic period has been substantiated on the ground that fiscal policy needs to be accommodative for the economic growth recovery process through strengthening the public investment. Blanchard (2019) noted that in the period of low-interest rate regime, high public debt can be substantiated if it is used for reducing the output gaps and strengthening the public infrastructure investment. In India, it is pertinent to analyze the links between high public investment and the private corporate investment links.

The macroeconomic effects of public investment have been analyzed and its effects on crowding in of private investment has been tested predominantly in the context of developed countries. For instance, Abdul d Abiad, Davide Furceri, and Petia Topalova (2015) in their IMF paper provided new evidence of the macroeconomic effects of public investment in the case of advanced economies, analysing a sample of 17 OECD countries. Using public investment forecast errors to identify the causal effect of government investment since 1985 and model simulations, the IMF paper found that increased public investment is effective in boosting output, however in the countries with higher public expenditure efficiency and also when it is financed by issuing public debt. They also inferred that public investment "crowds in" private investment in the long term, and reduces unemployment. In the context of India, Vinod, Karun and Chakraborty (2020) has reviewed the existing literature on crowding out in India and tested the link between public and private corporate investment for the period till 2019-20 using Maximum Entropy Ensembles and Bootstrap (Meboot). Chakraborty (2016) in the context of India analyzed the links between fiscal deficit and gross capital formation in India using an asymmetric VAR model to analyse the crowding–in effects of the fiscal policy. Chakraborty (2007) also found evidence for public investment as significant determinant of private corporate investment in India.

The taxonomy of crowding out– real and financial – has been treated in detail in theoretical literature (Blinder and Solow, 1973, Buiter, 1990). The *real* (direct) crowding out occurs when the increase in public investment displaces private capital

formation broadly on a *dollar-for-dollar* basis, irrespective of the mode of financing the fiscal deficit. The *financial crowding out* is the phenomenon of partial loss of private capital formation, due to the increase in the interest rates emanating from the pre-emption of real and financial resources by the government through bond-financing of fiscal deficit. This paper empirical examines the direct crowing out in the context of India.

The Economic Survey 2024-25 has highlighted the need for the judicious fiscal management that has helped to rein in general government dissaving since the COVID-19 pandemic. This has had a crucial role to play in sustaining the overall savings in the economy. In contrast, stable private corporate savings coupled with rising government deficits could have implied a greater reliance on the external account.

The paper has been organised into four sections. Apart from the introduction, Section 2 interprets the data and Section 3 discusses the econometric results. Section 4 summarizes the major findings of the paper and draws conclusions.

2. Interpreting Data

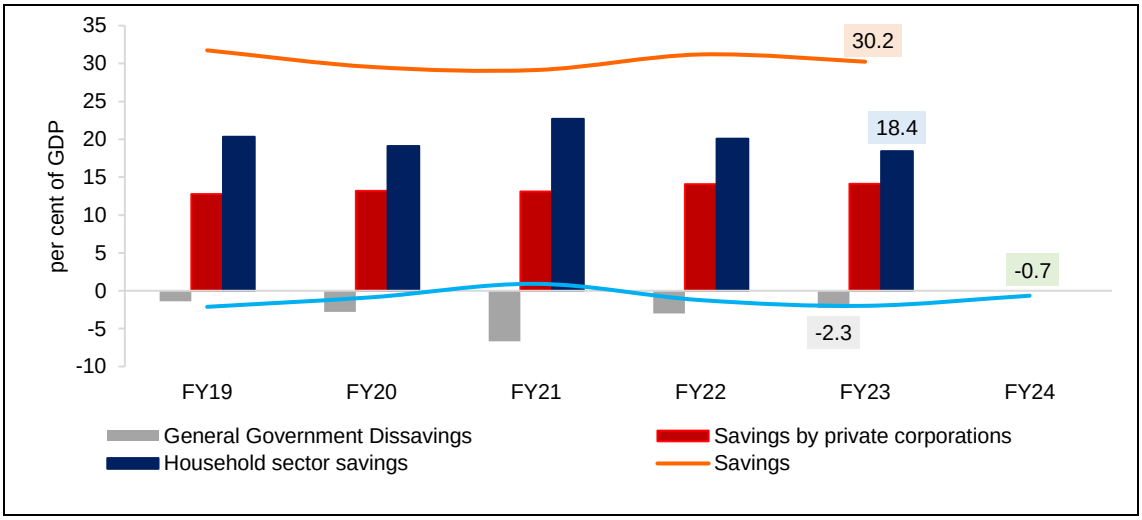
Data on capital formation in public and private sectors is drawn from the new series of National Account Statistics published by Central Statistical Organisation. Data on other macroeconomic variables of study including the rate of interest, rate of inflation, the availability of credit to private sector, gross domestic product, gross fiscal deficit, exchange rate and money supply are drawn from various issues of Handbook of Statistics on Indian Economy, published by Reserve Bank of India.

In the context of India, for the estimation of gross capital formation, the economy is divided into three broad institutional sectors, viz., public sector, private corporate sector and household sector. The household sector is conceived as the 'residual' sector embracing all economic entities other than the units of public and private corporate sector essentially as clubbing together the left-over or the unknown of all units. In the light of these data problems, it should be noted that the household investment data is not entirely reliable and kept outside the purview of private

investment in this paper. The gross capital formation noted a declining trend in the public sector especially in the late 1990s while private corporate sector investment has shown an increase (Figure 1).

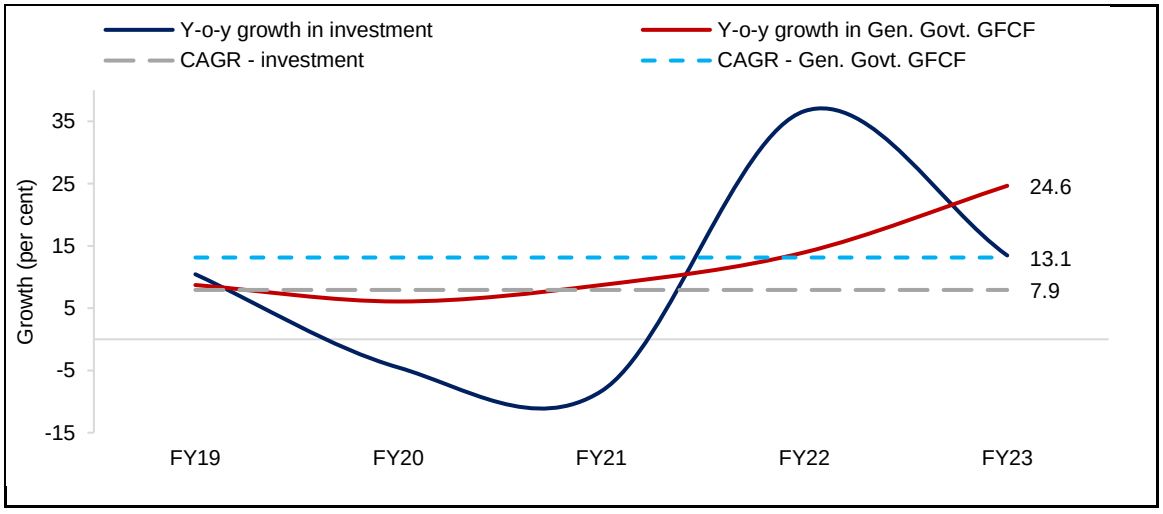
Prudent fiscal management with a strong emphasis in boosting capital expenditure notwithstanding the negative shock of the covid pandemic has contributed to the resilience of overall investments in the Indian economy (Figures 1 and 2).

Figure 1: Containment of general government dis-savings has contributed to macro-stability



Source: Economic Survey 2024-25.

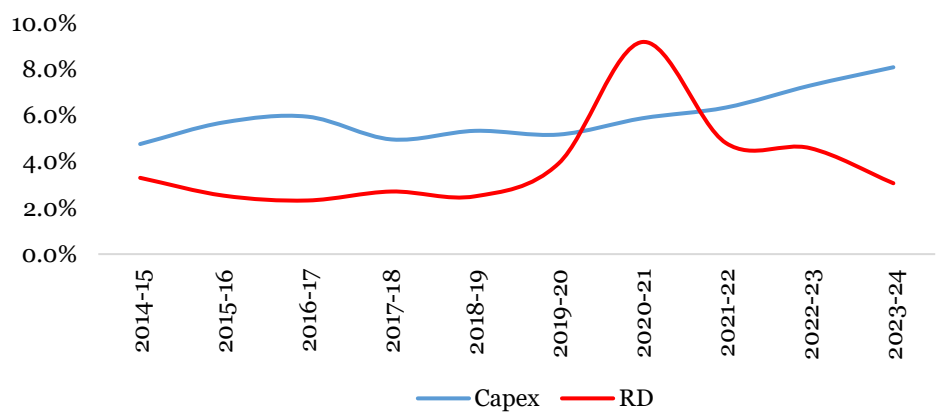
Figure 2: General Government GFCF growth has outpaced overall investment growth



Source: Economic Survey 2024-25.

The general government's indicators of fiscal discipline have improved progressively (figure 3). The combined capital expenditure of the centre and states has shown an increase from about 4.8 per cent of GDP in FY15 to 8.1 per cent in FY24. Concomitantly, the combined deficit has been contained to a lower level compared to the beginning of the decade in consideration, notwithstanding the interim fiscal stimulus to mitigate the impact of the covid pandemic. Thus, while allocation for capital expenditure has significantly risen, this has not been at the expense of rising deficits, indicating prudent fiscal policy.

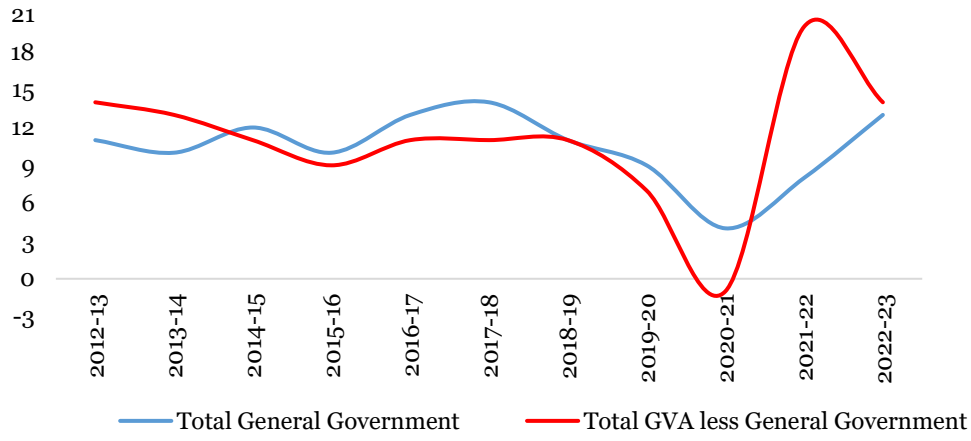
Figure 3: Capex *vs* Deficits of centre and states as per cent of GDP at Current prices



Source: Reserve Bank of India.

The trend in the contribution of general government consumption and investment to total GVA reveals the counter-cyclical nature of fiscal policy. The Figure 4 depicts y-o-y growth in general government GVA (gg_gva) and growth in total GVA excluding general government GVA (gva_less_gg). In the initial period shown in the chart, growth in gva_less_gg has surpassed that of gg_gva. From FY15 to FY20, gg_gva has shown relatively greater growth compared to relatively lesser growth in gva_less_gg. Post the pandemic, the growth of gg_gva has risen at a stable pace compared to the sharp increase in growth of gva_less_gg. These reveal the counter-cyclicity of fiscal stance.

Figure 4: Total GVA less of General Government and total general government GVA



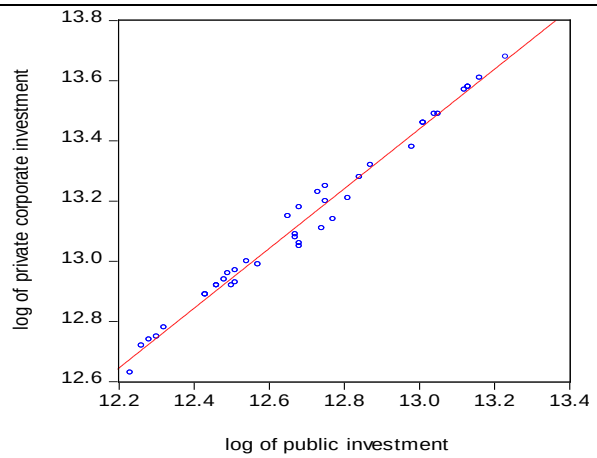
Source: National Accounts Statistics 2024, Ministry of Statistics and Programme Implementation

2.1: The stylised facts

As far as public investment and private corporate investment is concerned, data on gross fixed capital formation (GFCF) is available in the National Accounts Statistics' database published by the Ministry of Statistics and Programme Implementation (MoSPI) on a quarterly and annual basis. Moreover, the annual series contains GFCF data at a dis-aggregated level for general government, household sector, public corporations and private corporations is also available. The inter-se annual share for private corporations and public sector (general government and public corporations) has been used to compute shares for quarterly time period within a given annual period.

Over a 10-year period, public and private investment exhibit a strong positive correlation. The concentration of data points along the regression line suggests a consistent and proportional relationship between public and private investment levels.

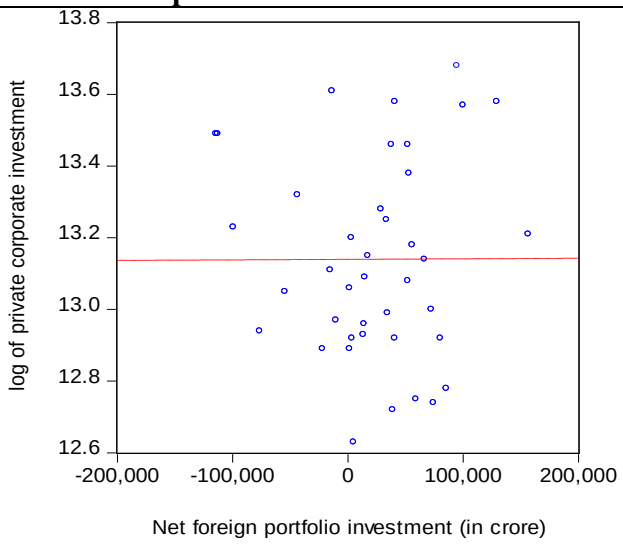
Figure 5: Bivariate scatterplot of private corporate investment and public investment



Source: Authors' computations

The relationship between net foreign portfolio investment (FPI) and private investment is weak, as indicated by the dispersion of data points around the regression line. The regression line being parallel to the X-axis suggests that changes in net FPI have little to no systematic impact on private investment levels. This may be because FPI, which involves passive holdings of financial assets like stocks and bonds, does not exert direct control over companies or ventures and subsequently on decisions of productive investment. The weak relationship could also indicate that other factors have a more significant influence on private investment decisions.

Figure 6: Bivariate scatterplot of private corporate investment and net foreign portfolio investment

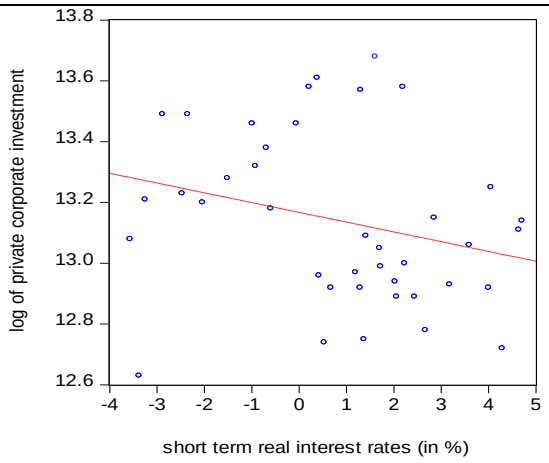


Source: Authors' computations

The relationship between the short-term real interest rate (yield on 91-day treasury bill adjusted for CPI inflation) and the log of private corporate investment exhibits an overall negative trend aligning with the basic economic principle that higher real interest rates tend to discourage investment. While a negative relationship aligns with the conventional view that higher real interest rates increase borrowing costs and reduce investment, this clustering of variables when the real interest rates in the negative and positive segment may suggest that when negative real interest rates correlate to relatively higher private corporate investment and positive real interest rates with relatively lower levels of private corporate investment. Moreover, predominant factors influencing investment decisions may include demand expectations and confidence; and business cycle dynamics as short-term interest rates tend to fluctuate more over the business cycle. The clusters might represent different phases of the cycle (owing to the pandemic and global supply chain disruptions) where the sensitivity of investment to interest rates varies. Therefore, while the negative slope suggests a standard inverse relationship, the clustered data emphasizes the importance of considering other factors and the potential for non-linearities when analyzing the impact of real interest rates on private corporate investment.

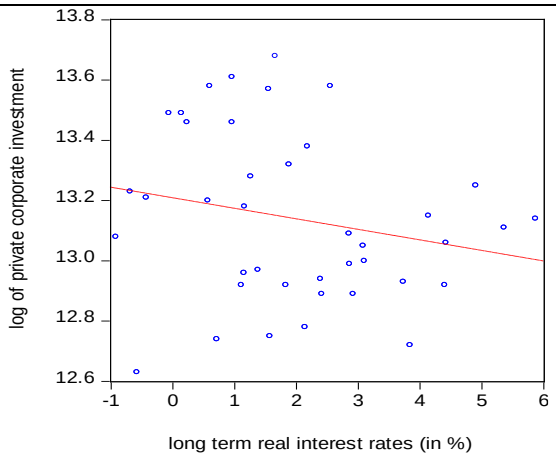
The relationship between long-term real interest rates (yield on 10-year government securities adjusted for CPI inflation) and private corporate investment reflects the fundamental cost of capital principle. Economic theory posits that higher long-term interest rates increase the cost of borrowing for firms, reducing the net present value of long-term investment projects and discouraging capital expenditures. This is because long-term rates directly influence the discount rate applied to future cash flows from investment projects, making investments less attractive as rates rise. The impact is particularly pronounced for projects with longer time horizons, aligning with the greater sensitivity of long-term bonds to interest rate changes. Moreover, elevated long-term rates can signal tighter monetary policy or increased inflationary expectations, further dampening business confidence and investment. Overall, private corporate investment has been resilient notwithstanding the negative shocks of the pandemic and global supply chain disruptions.

Figure 7: Bivariate scatterplot of private corporate investment and short term real interest rates



Source: Authors' computations

Figure 8: Bivariate scatterplot of private corporate investment and long term real interest rates



Source: Authors' computations

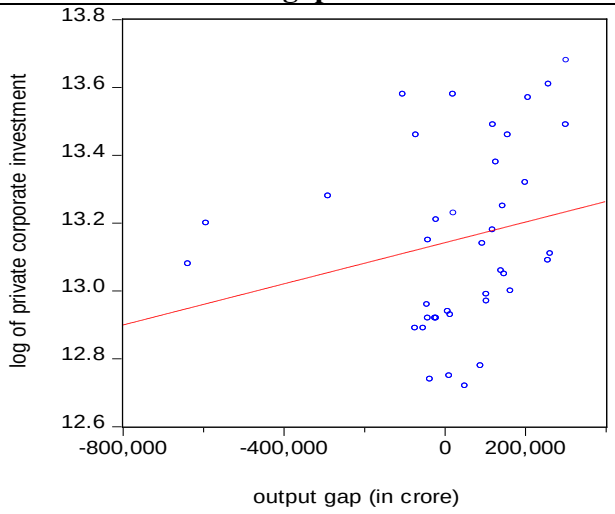
The output gap—a deviation of an economy's output from its "potential" level reflects the position of the economy in the business cycle: a negative output gap indicates a recession or an initial stage of a recovery, while a positive output gap signals a period of economic overheating. Yet, the output gap is not directly observed, because it is a function of potential output, a latent variable itself. As a result, economists and policymakers have to rely on estimates of the output gap. The filtering methods typically identify potential output by fitting real GDP series to a slow moving trend. The filtering method utilised herein is Hodrick-Prescott (HP) filter which is the simplest and transparent filtering methods, despite documented limitations. It identifies potential output by fitting a "smooth" trend $\tau_{t=1}^{T}$ into the actual output series $y_{t=1}^{T}$:

$$\min_{\tau} \left(\sum_{t=1}^{T} (y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} [(\tau_{t+1} - \tau_t - (\tau_t - \tau_{t-1})]^2 \right)$$

The larger the value of the smoothing parameter λ, the higher is the penalty for variations in the growth rate of the trend component. The key advantage of the HP filter is that it is a simple and transparent method that can be applied to any country where GDP data exists.

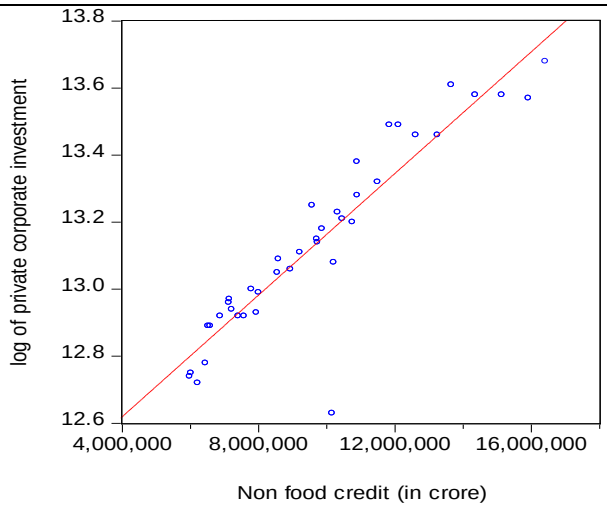
The relationship between the output gap and private investment shows a mild positive trend, indicating that private investment is observed to relatively higher on an average, when the output gap is positive (actual output exceeds potential output) and lower when the output gap is negative (actual output falls below potential output). The presence of a single outlier pertaining to FY21Q1 depicted a rare instance where both the output gap and private investment were simultaneously low, representing a significant economic downturn owing to the covid pandemic, has been excluded from the scatterplot.

Figure 9: Bivariate scatterplot of private corporate investment and output gap



Source: Authors' computations

Figure 10: Bivariate scatterplot of private corporate investment and non-food credit

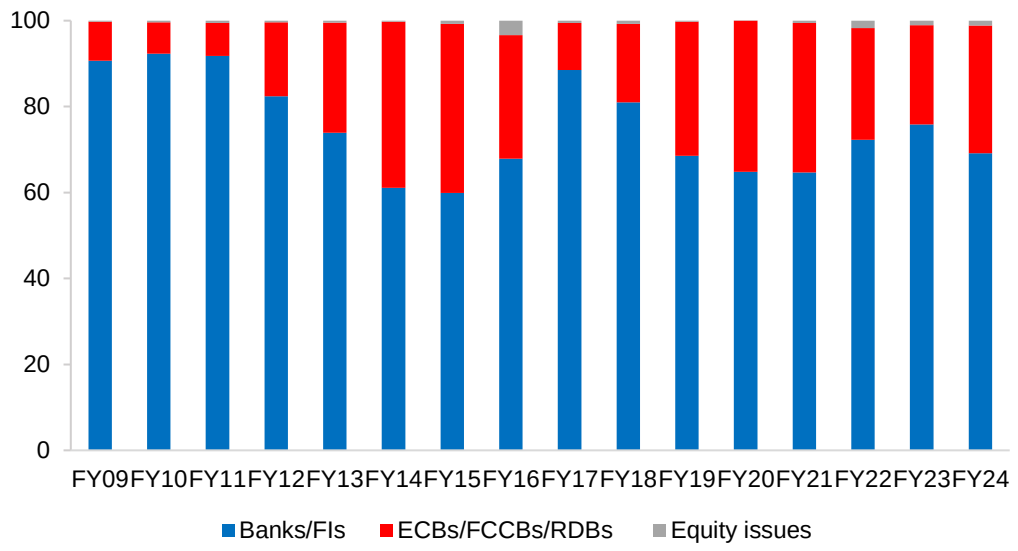


Source: Authors' computations

Non-food bank credit (NFC) has been taken as credit to private sector. NFC and private investment exhibit a strong positive correlation. The clustering of data points around regression line suggests a consistent, proportional relationship. This observation aligns with the broader understanding that credit offtake plays a crucial role in facilitating private sector investment. The observed correlation suggests that increased access to credit beyond the food sector enables businesses to expand operations, invest in new projects, and contribute to overall economic growth. This is further supported by data indicating that private credit, a subset of non-food credit, can offer tailored financing solutions to firms.

Parker (1995) provides an insight into behaviour of private investment during the two decades until the mid 1990's. While both real lending rate and real credit to the private sector were taken amongst other explanatory variables, it was observed that deregulation and heightened competition would increase the influence of interest rates and reduce that of credit, as primary determinants of private investment. Figure 11 reveals that while banks and financial institutions continue to majorly source private corporate capex projects, share of external financing has risen in the past decade, on an average. The financing from equity issues has also seen exponential rise, in absolute terms during recent years.

Figure 11: Trend in source of financing for private capex projects

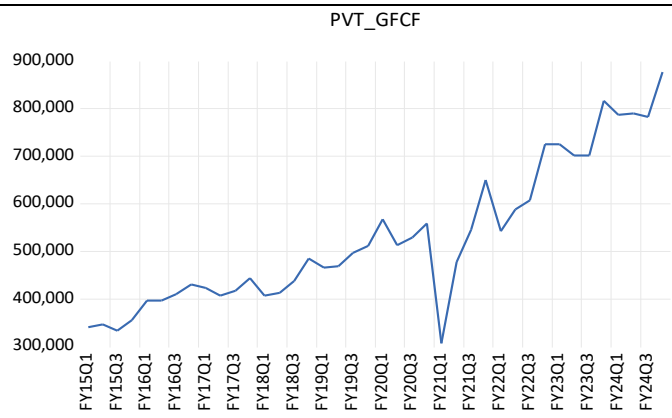


Source: Database on Phasing of Private Capex Projects by Source of Financing provided by the Centre for Monitoring Indian Economy.

3. Econometric Investigation and the inferences

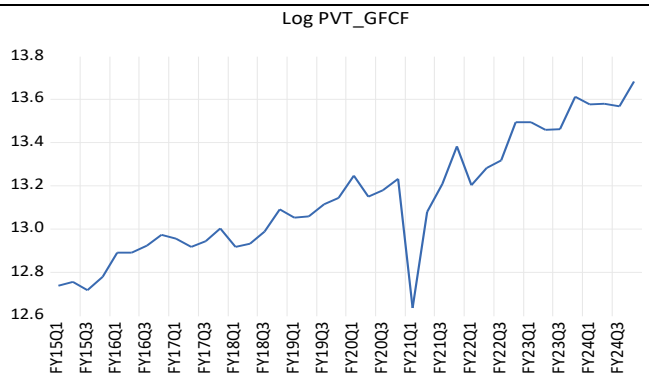
Chakraborty (2007) and Chakraborty (2016) analysed the real crowding out in the context of India using asymmetric VAR models, and identified public investment as a significant determinant for the private corporate investment. Karun, Vinod and Chakraborty (2020) used the maximum entropy bootstrap (meboot) methodology and provided evidence in favour of 'crowding-in' of private investment through public investment. For this, they relied on quarterly data (2011-2016) and used the following specification equation which incorporated both monetary and fiscal policy instruments for encouraging private investment: In this paper, we attempt to investigate into the evidence of 'crowding-in' of private investment through public investment for the decade spanning financial year 2014-15 (FY15) to FY24 using quarterly data using the ARDL methodology. The plots of the private investment data series at level, in logarithm and logarithm at first difference is given in Figures 12-14.

Figure 12: Plot of private corporate investment in Level (in Rs. Crore)



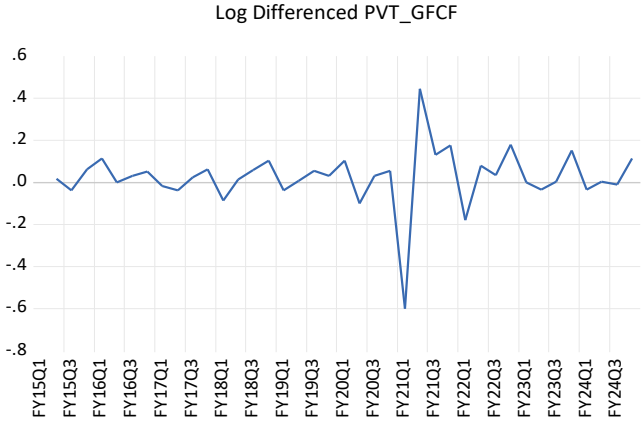
Source: Authors' computations

Figure 13: Plot of private corporate investment in Logarithm



Source: Authors' computations.

Figure 14: Plot of private corporate investment in first-difference on logarithm



Source: Authors' computations.

Table 1: Pre-Tests using ADF: private corporate investment

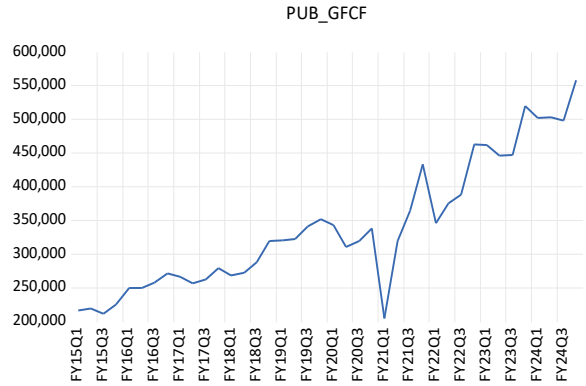
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.851435	0.0000
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Source: Authors' computations.

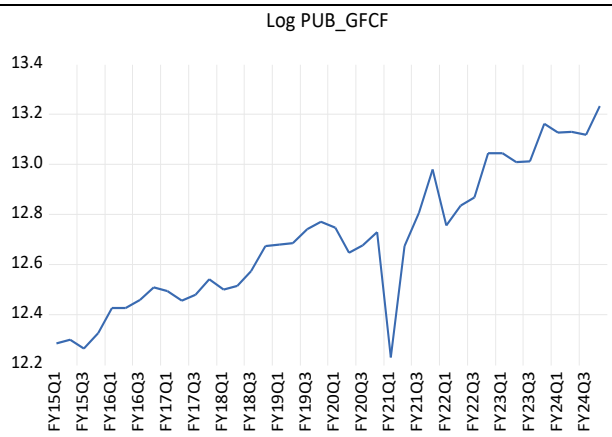
Since the p-value of the t-statistic is less than 0.05, the null hypothesis of unit root is rejected and df_ln_pvtgfcf is stationary. The plots of the public investment data series at level, in logarithm and logarithm at first difference is given in Figures 15-17.

Figure 15: Plots of Public Investment in level (in Rs. Crore)



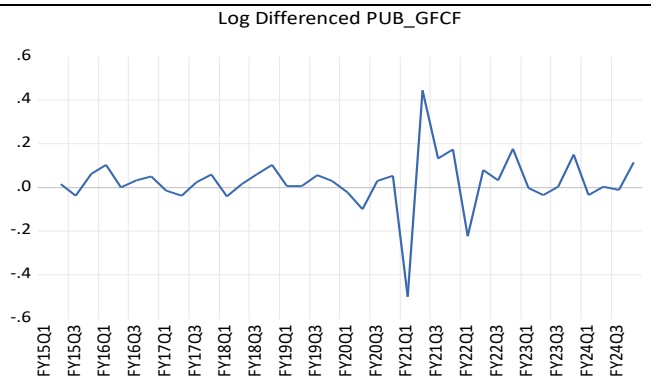
Source: Authors' computations

Figure 16: Plots of Public Investment in log



Source: Authors' computations

Figure 17: Plots of Public Investment in first-difference on log



Source: Authors' computations

It is revealed that public investment has picked up pace in the post-pandemic period.

Table 2: Pre-Tests using ADF – Public Investment

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.653998	0.0000
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

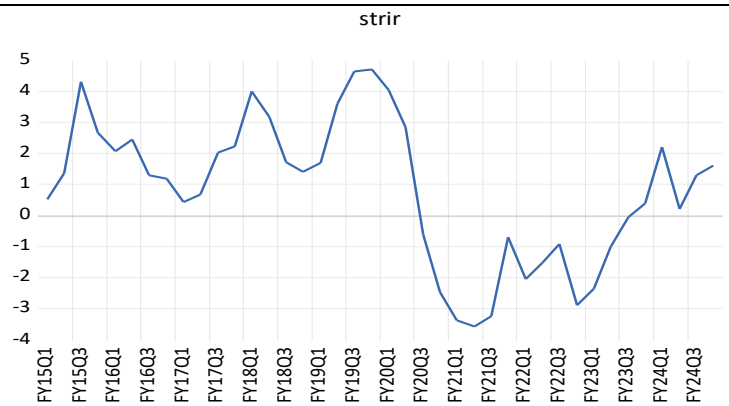
*MacKinnon (1996) one-sided p-values.

Source: Authors' computations

Since the p-value of the t-statistic is less than 0.05, the null hypothesis of unit root is rejected and df_ln_pvtgfcf is stationary. Thus, both the public and private GFCF variables are non-stationary at level and log-levels and become stationary at first difference of log-levels.

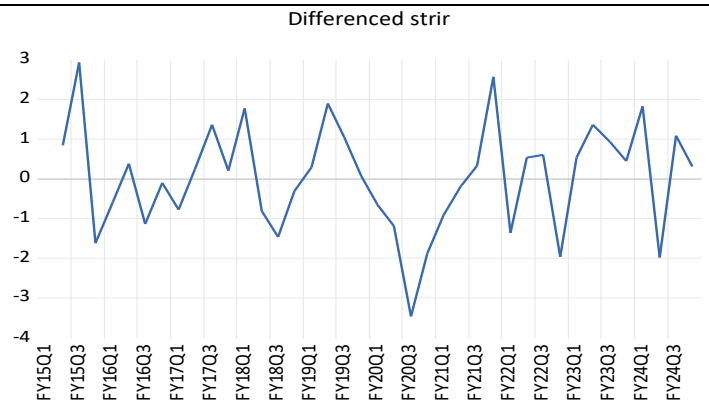
In the case of interest rates, yield of 91 day treasury bills and 10 year government securities have been considered as short term and long term interest rates, respectively. Further, real rates have been arrived at by deducting consumer price index inflation from these. It is revealed that real interest rates in the post-covid period have been relatively lower compared to the pre-covid period.

Figure 18: Plot of short term real interest rates in levels



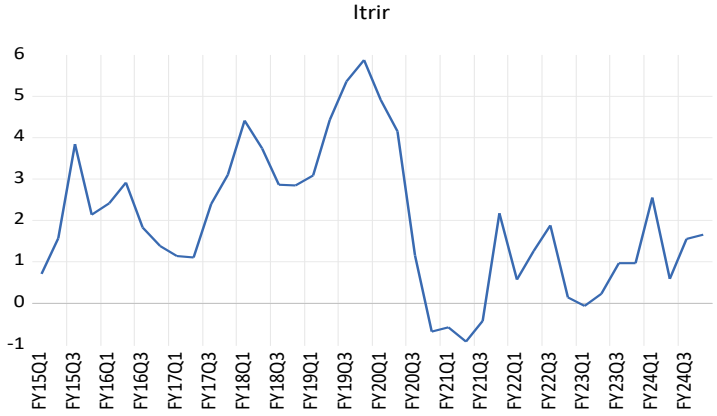
Source: Authors' computations

Figure 19: Plot of short term real interest rates in first difference



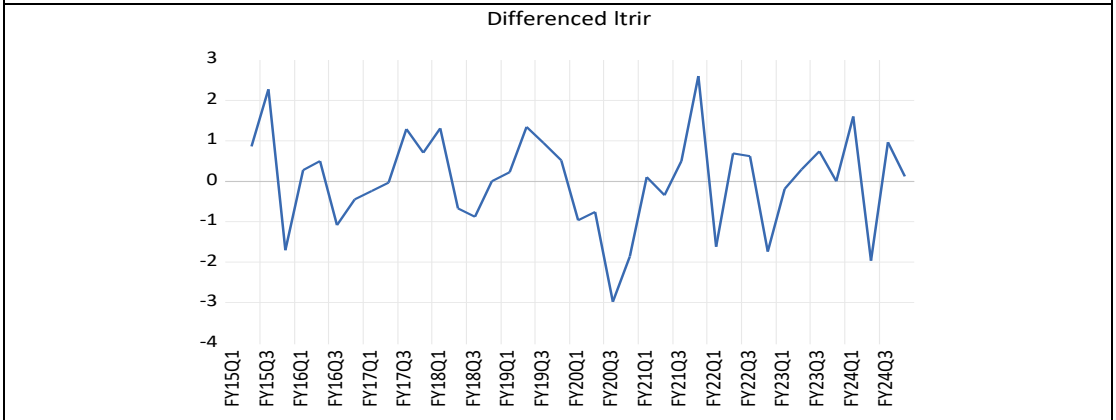
Source: Authors' computations

Figure 20: Plot of long term real interest rates in levels



Source: Authors' computations

Figure 21: Plot of long term real interest rates in first difference



Source: Authors' computations

Table 3: Pre-Tests using ADF – short term real interest rates

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.421052	0.0001
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Source: Authors' computations

Table 4: Pre-Tests using ADF – long term real interest rates

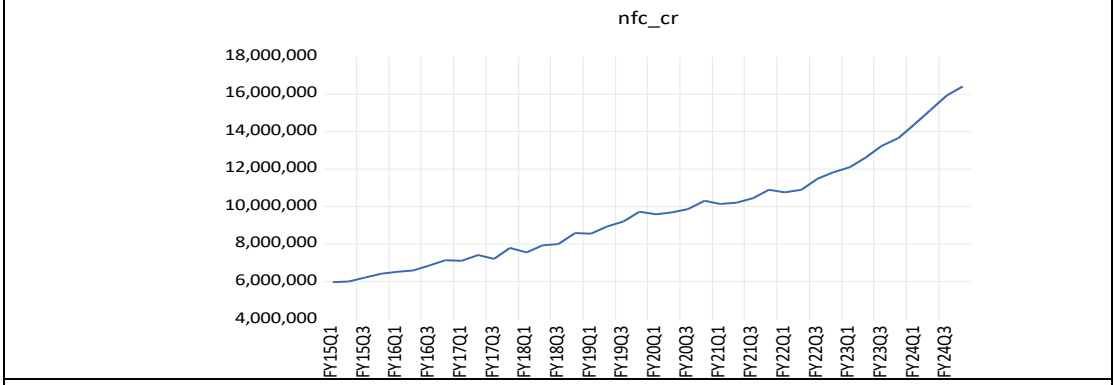
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.050634	0.0000
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Source: Authors' computations

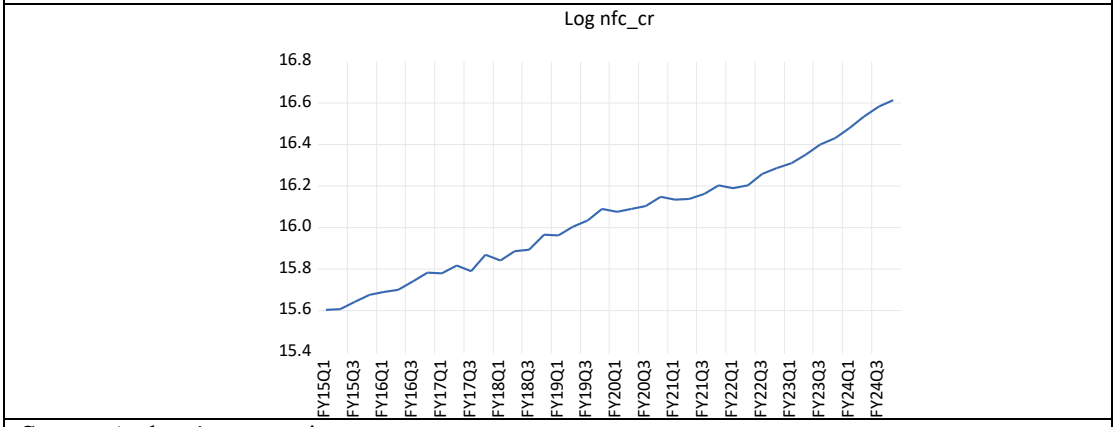
Since the p-value of the t-statistic is less than 0.05, the null hypothesis of unit root is rejected and both df_strir and df_ltrir are stationary. The plots for credit to private sector, foreign capital and output gap are given in Figures 22-25.

Figure 22: Plot of non-food credit in levels



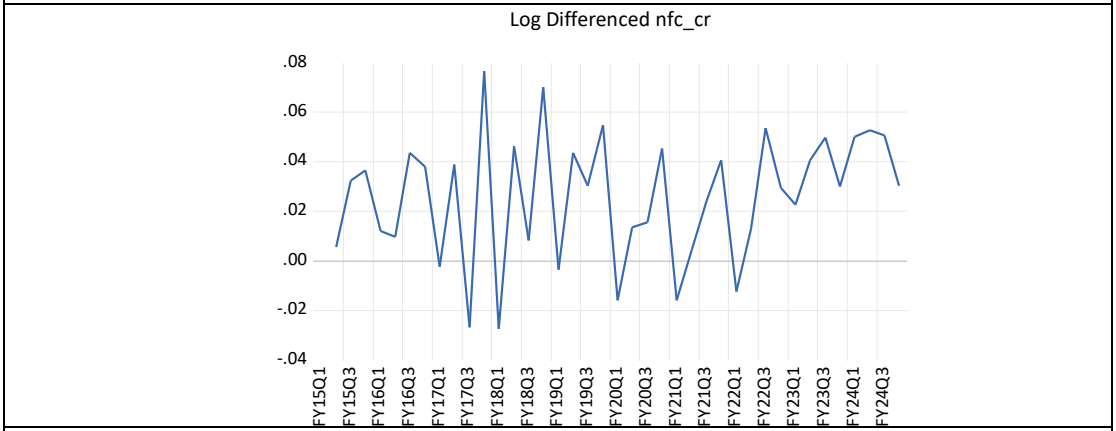
Source: Authors' computations

Figure 23: Plot of non-food credit in logarithm



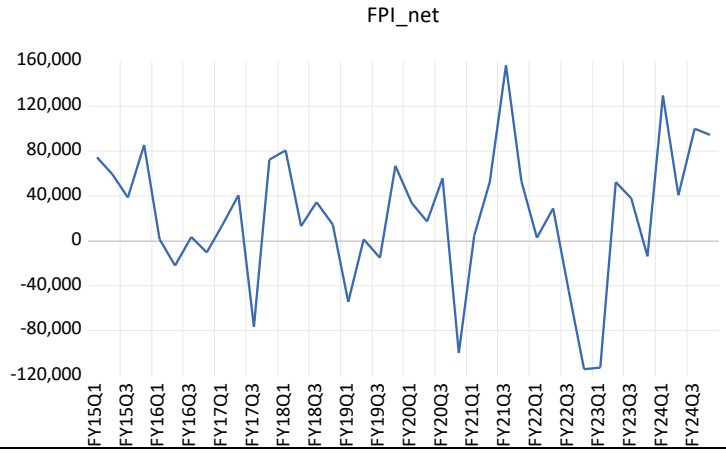
Source: Authors' computations

Figure 24: Plot of non-food credit in first difference of logarithm



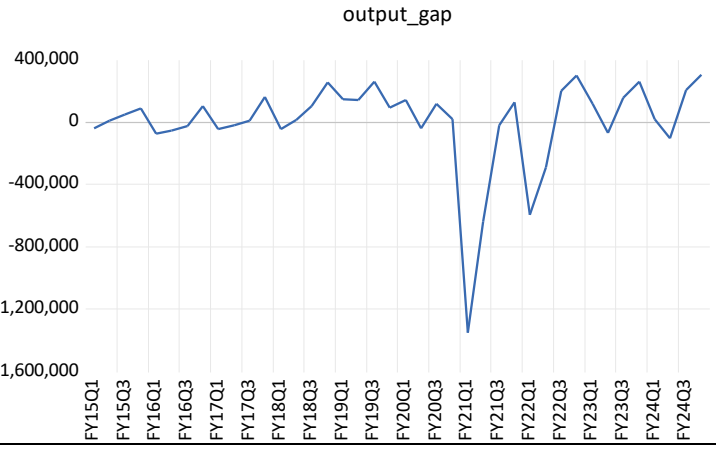
Source: Authors' computations

Figure 25: Plot of net foreign portfolio investment in levels



Source: Authors' computations

Figure 26: Plot of output gap in levels



Source: Authors' computations

Table 5: Pre-Tests using ADF- net foreign portfolio investments

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.638560	0.0006
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Source: Authors' computations

Table 6: Pre-Tests using ADF- output gap

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.093667	0.0028
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.
Source: Authors' computations

Table 7: Pre-Tests using ADF- non-food credit

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.224347	0.6520
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.
Source: Authors' computations

Since the p-value of the t-statistic is less than 0.05, the null hypothesis of unit root is rejected and both fpi_net and output_gap are stationary. However, credit to private sector continues to be non-stationary even in its first-differenced log form, as evidenced in Table 7.

An autoregressive distributed lag (ARDL) model is an ordinary least square (OLS) based model which is applicable for both non-stationary time series as well as for times series with mixed order of integration (Shreshtha and Bhatta 2018). It is used for analyzing long and short run relationships between different time series variables. However, a co-integrating relationship is not envisaged for the variables being studied in this paper. Accordingly, to examine evidence for crowding-in of private investment, this paper attempts to use an ARDL model with variables in their stationary form, since there is no evidence of cointegration. Since credit to private sector has been found to be non-stationary in its first differenced log form too, it has been excluded from the model specification, which is as under:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \sum_{i=0}^{q} \alpha_i \Delta x_{t-i} + e_t$$

3.1: Model 1 – using short term real interest rates

The Akaike information criterion (AIC) suggested a lag-length of 4. Accordingly, the ARDL model -1 with short term real interest rates was run with a specification of maximum 4 lags.

Table 8: Determining optimal lag length for model 1

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-882.8213	NA	7.42e+15	50.73264	50.95484*	50.80934
1	-848.5264	56.83144	4.44e+15	50.20151	51.53467	50.66171*
2	-818.7525	40.83279*	3.71e+15	49.92871	52.37283	50.77242
3	-796.3832	24.28669	5.56e+15	50.07904	53.63412	51.30625
4	-754.1778	33.76434	3.67e+15*	49.09587*	53.76192	50.70659

Source: Authors' computations

The results of determinants of private corporate investment using model-1 are depicted in table 9. Public investment is significant at 1% level of significance, with magnitude of impact being higher than any other variable. This reveals strong evidence of crowding-in of private investment. Further, public investment at lag 4; short term real interest rates at the current period and lag 3 and output gap at lag 1 are significant at 5% level of significance. Moreover, public investment at lag 2; net foreign capital flows at 1 and 4 lags and output gap are significant at 10%. Thus, public investment also show an impact on year-on-year basis given the dataset is of quarterly frequency. Negative co-efficient for output gap is encouraging. The negative coefficient for short term real interest rates supports private corporate investment improving when real rates fall and vice versa. Spillover effects of foreign capital at fourth lag is weak with inverse relation. Overall, incremental positive percent changes in public investment over current and lagged periods has been the motivating force for undertaking private investments, compared to lagged values of private investment themselves. Diagnostic checks of the model at Annexure 1 reveal that residuals are normally distributed, and

the absence of heteroscedasticity, auto-correlation and serial correlation. CUSUM of squares test show that estimates are fairly stable.

Table 9: Determinants of Private Corporate Investment using Model 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
DF_LN_PVTGFCF(-1)	-0.113091	0.215835	-0.523972	0.6117
DF_LN_PVTGFCF(-2)	-0.345755	0.227954	-1.516777	0.1603
DF_LN_PVTGFCF(-3)	0.280183	0.240784	1.163629	0.2716
DF_LN_PVTGFCF(-4)	-0.807848	0.288715	-2.798077	0.0189
DF_LN_PUBGFCF	0.764280	0.122872	6.220112	0.0001
DF_LN_PUBGFCF(-1)	0.107734	0.226509	0.475630	0.6446
DF_LN_PUBGFCF(-2)	0.522499	0.246672	2.118196	0.0602
DF_LN_PUBGFCF(-3)	-0.221257	0.247779	-0.892959	0.3929
DF_LN_PUBGFCF(-4)	0.762085	0.295140	2.582118	0.0273
DF_STRIR	-0.013003	0.005017	-2.591763	0.0269
DF_STRIR(-1)	-0.000933	0.005025	-0.185698	0.8564
DF_STRIR(-2)	0.003414	0.005195	0.657050	0.5260
DF_STRIR(-3)	0.015634	0.005561	2.811361	0.0184
DF_STRIR(-4)	-0.009215	0.005838	-1.578440	0.1455
FPI_NET	-7.54E-08	1.10E-07	-0.685934	0.5083
FPI_NET(-1)	-2.36E-07	1.26E-07	-1.881326	0.0893
FPI_NET(-2)	-1.85E-07	1.03E-07	-1.798628	0.1023
FPI_NET(-3)	6.60E-08	1.01E-07	0.653240	0.5283
FPI_NET(-4)	-2.30E-07	1.07E-07	-2.154731	0.0566
OUTPUT_GAP	9.19E-08	4.95E-08	1.855558	0.0932
OUTPUT_GAP(-1)	-1.22E-07	4.98E-08	-2.442787	0.0347
OUTPUT_GAP(-2)	-2.65E-08	6.15E-08	-0.430861	0.6757
OUTPUT_GAP(-3)	-3.03E-08	5.49E-08	-0.552311	0.5929
OUTPUT_GAP(-4)	7.49E-08	4.59E-08	1.632433	0.1336
C	0.008856	0.009708	0.912283	0.3831

R-squared	0.992429	Mean dependent var	0.022629
Adjusted R-squared	0.974258	S.D. dependent var	0.149298
S.E. of regression	0.023954	Akaike info criterion	-4.449554
Sum squared resid	0.005738	Schwarz criterion	-3.338591
Log likelihood	102.8672	Hannan-Quinn criter.	-4.066049
F-statistic	54.61600	Durbin-Watson stat	1.855655
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

Source: Authors' computations

3.2: Model 2 – using long term real interest rates

The AIC suggested a lag-length of 4. Accordingly, the ARDL model -1 with short term real interest rates was run with a specification of maximum 4 lags.

Table 10: Determining optimal lag length for model 2

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-877.4094	NA	5.45e+15	50.42339	50.64559*	50.50010
1	-843.3100	56.50752	3.29e+15	49.90343	51.23659	50.36364*
2	-815.2843	38.43526*	3.04e+15*	49.73053	52.17465	50.57424
3	-792.3229	24.92954	4.41e+15	49.84702	53.40210	51.07424
4	-752.6025	31.77631	3.35e+15	49.00586*	53.67190	50.61658

Source: Authors' computations

The results of determinants of private corporate investment using model-2 are depicted in table 11. Public investment is significant at 1% level of significance, with magnitude of impact being higher than any other variable. This reveals strong evidence of crowding-in of private investment. Further, public investment at lag 4; output gap at lag 1 are significant at 5%. Moreover, long term real interest rates are significant at 10%. Thus, public investment show an impact on year-on-year basis given the dataset is of quarterly frequency. Negative co-efficient for output gap is encouraging. Spillover effects of foreign capital at fourth lag is weak with inverse relation. Diagnostic checks of the model at Annexure 2 reveal that residuals are normally distributed, and the absence of heteroscedasticity, auto-correlation and serial correlation. CUSUM of squares test show that estimates are fairly stable.

Table 11: Determinants of Private Corporate Investment using Model 2

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
DF_LN_PVTGFCF(-1)	-0.131281	0.205922	-0.637531	0.5348
DF_LN_PVTGFCF(-2)	-0.249137	0.213756	-1.165516	0.2648
DF_LN_PVTGFCF(-3)	0.039904	0.252982	0.157734	0.8771
DF_LN_PVTGFCF(-4)	-0.778421	0.321470	-2.421440	0.0308
DF_LN_PUBGFCF	0.779218	0.124041	6.281952	0.0000
DF_LN_PUBGFCF(-1)	0.105851	0.228238	0.463776	0.6505
DF_LN_PUBGFCF(-2)	0.266912	0.222382	1.200244	0.2515
DF_LN_PUBGFCF(-3)	-0.117957	0.259223	-0.455042	0.6566
DF_LN_PUBGFCF(-4)	0.765283	0.331715	2.307047	0.0382
FPI_NET	-8.77E-08	1.05E-07	-0.838936	0.4167
FPI_NET(-1)	-1.22E-07	1.02E-07	-1.193970	0.2538
FPI_NET(-2)	-9.79E-08	9.25E-08	-1.058410	0.3091
FPI_NET(-3)	2.29E-08	9.39E-08	0.244047	0.8110
FPI_NET(-4)	-2.38E-07	1.10E-07	-2.169311	0.0492
OUTPUT_GAP	8.77E-08	4.88E-08	1.796943	0.0956
OUTPUT_GAP(-1)	-1.00E-07	4.31E-08	-2.325505	0.0369
DF_LTRIR	-0.012463	0.005983	-2.083037	0.0576
DF_LTRIR(-1)	-0.000345	0.005498	-0.062773	0.9509
DF_LTRIR(-2)	0.002732	0.005107	0.534890	0.6018
DF_LTRIR(-3)	0.010117	0.005411	1.869655	0.0842
DF_LTRIR(-4)	-0.005570	0.006158	-0.904507	0.3822
C	0.013278	0.009105	1.458352	0.1685

R-squared	0.989075	Mean dependent var	0.022629
Adjusted R-squared	0.971428	S.D. dependent var	0.149298
S.E. of regression	0.025236	Akaike info criterion	-4.254318
Sum squared resid	0.008279	Schwarz criterion	-3.276671
Log likelihood	96.45056	Hannan-Quinn criter.	-3.916834
F-statistic	56.04605	Durbin-Watson stat	1.827929
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

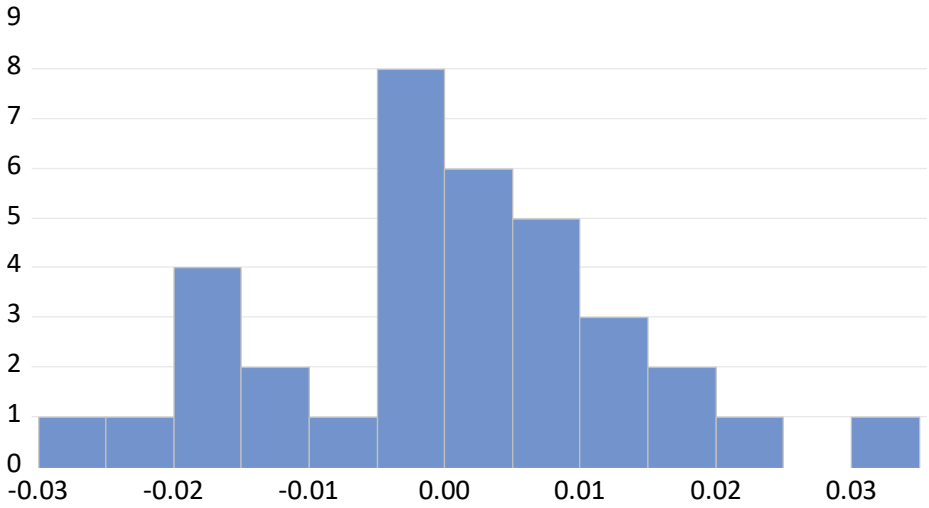
Source: Authors' computations

4. The Conclusions and Policy suggestions

Amidst disruptions in global supply chains, regional geo-conflicts and growing trade protectionism and uncertainty, resilient public investment has played a crucial role in the Indian context in aiding resilience and facilitating crowding-in of private corporate investment. This has been achieved with prudence and without taking recourse to fiscal profligacy well recognizing worsening risk-premia that could accompany fiscal slippages. In addition, the economic survey 2024-25 has gone a step forward by laying a strong emphasis on 'lowering the cost of business through

deregulation', contributing towards accelerating economic growth and employment amidst unprecedented global challenges. It is then for the private corporate sector to play its part with a sustained and robust reciprocation to meet the evolving requirements of the Indian economy. The results of ARDL models reinforced that there is no crowding out effects in India. The macroeconomic variables including cost of credit – both long term and the short-term rates of interest - and the output gap have been as significant as public investment in determining private corporate investment in the medium and long terms, which has crucial policy implications.

Annexure -1: diagnostic checks for model 1



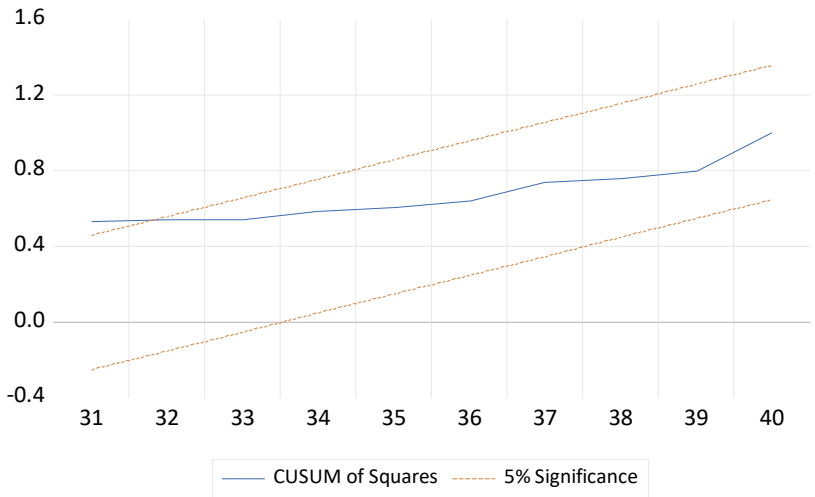
Series: Residuals	
Sample 6 40	
Observations 35	
Mean	-1.85e-17
Median	0.000786
Maximum	0.031110
Minimum	-0.029037
Std. Dev.	0.012991
Skewness	-0.062901
Kurtosis	3.103571
Jarque-Bera	0.038723
Probability	0.980825

Breusch-Godfrey Serial Correlation LM Test:

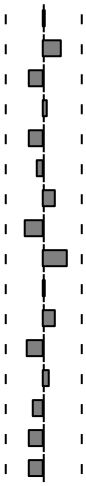
F-statistic	0.230362	Prob. F(4,6)	0.9116
Obs*R-squared	4.659521	Prob. Chi-Square(4)	0.3240

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.128203	Prob. F(24,10)	0.4414
Obs*R-squared	25.56016	Prob. Chi-Square(24)	0.3759
Scaled explained SS	2.194596	Prob. Chi-Square(24)	1.0000



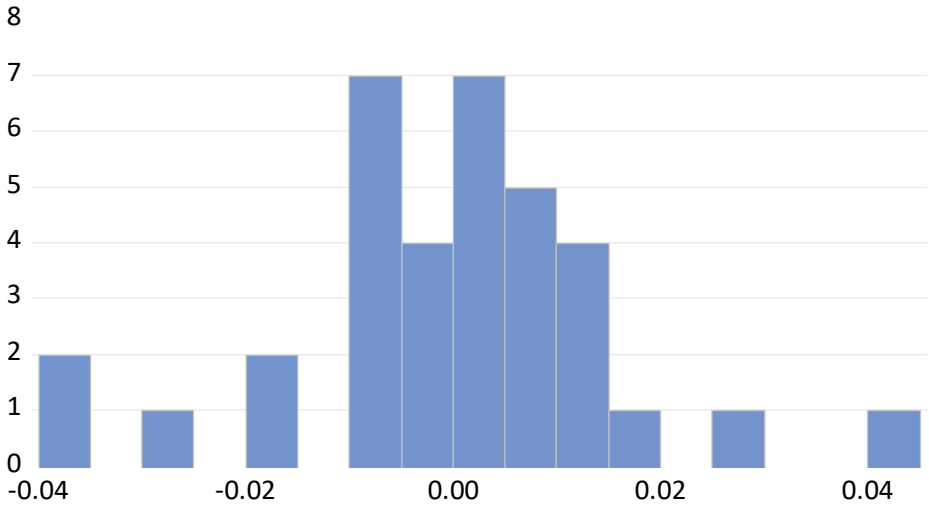
Date: 03/18/25 Time: 16:56
Sample: 1 40
Included observations: 35
Q-statistic probabilities adjusted for 4 dynamic regressors

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.017	0.017	0.0107	0.917
		2	0.157	0.157	0.9803	0.613
		3	-0.132	-0.140	1.6863	0.640
		4	0.032	0.015	1.7298	0.785
		5	-0.130	-0.093	2.4587	0.783
		6	-0.056	-0.077	2.5965	0.858
		7	0.105	0.158	3.1033	0.875
		8	-0.161	-0.197	4.3395	0.825
		9	0.213	0.209	6.6076	0.678
		10	0.020	0.073	6.6276	0.760
		11	0.105	-0.043	7.2254	0.781
		12	-0.140	-0.054	8.3295	0.759
		13	0.048	0.006	8.4635	0.812
		14	-0.089	-0.045	8.9548	0.834
		15	-0.129	-0.099	10.029	0.818
		16	-0.115	-0.153	10.931	0.814

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	46.86618	(20, 10)	0.0000
Chi-square	937.3235	20	0.0000

Annexure-2: Diagnostic checks for model 2



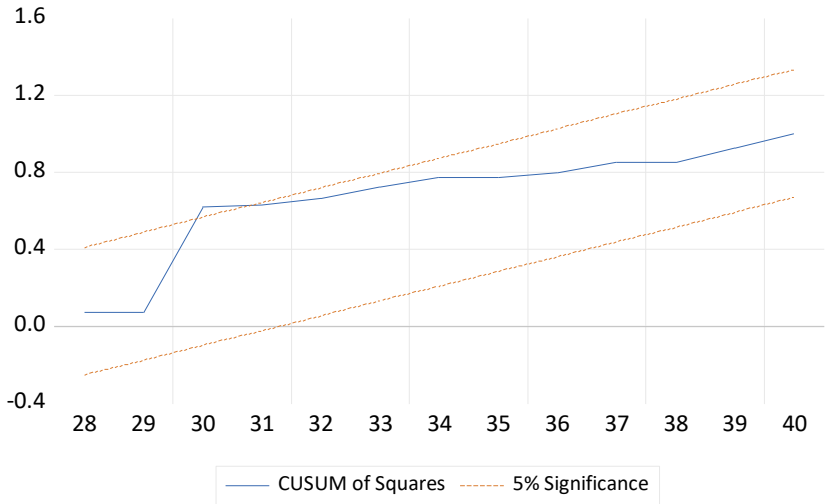
Series: Residuals	
Sample 6 40	
Observations 35	
Mean	-2.78e-18
Median	0.001972
Maximum	0.042789
Minimum	-0.037637
Std. Dev.	0.015605
Skewness	-0.188342
Kurtosis	4.329660
Jarque-Bera	2.785250
Probability	0.248422

Breusch-Godfrey Serial Correlation LM Test:

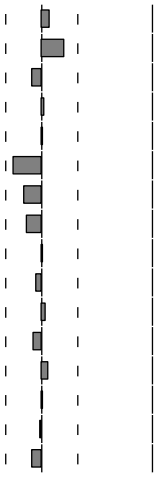
F-statistic	0.646157	Prob. F(4,9)	0.6435
Obs*R-squared	7.808799	Prob. Chi-Square(4)	0.0988

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.821204	Prob. F(21,13)	0.1336
Obs*R-squared	26.12114	Prob. Chi-Square(21)	0.2019
Scaled explained SS	5.999465	Prob. Chi-Square(21)	0.9994



Date: 02/16/25 Time: 21:59
Sample (adjusted): 6 40
Q-statistic probabilities adjusted for 4 dynamic regressors

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.073	0.073	0.2038	0.652
		2	0.216	0.212	2.0399	0.361
		3	-0.096	-0.130	2.4124	0.491
		4	0.024	-0.006	2.4361	0.656
		5	0.006	0.057	2.4375	0.786
		6	-0.255	-0.296	5.3307	0.502
		7	-0.162	-0.146	6.5491	0.477
		8	-0.136	0.020	7.4423	0.490
		9	-0.000	0.002	7.4423	0.591
		10	-0.045	-0.056	7.5487	0.673
		11	0.041	0.076	7.6376	0.745
		12	-0.078	-0.135	7.9775	0.787
		13	0.059	-0.045	8.1793	0.832
		14	-0.003	0.006	8.1800	0.880
		15	-0.012	-0.078	8.1896	0.916
		16	-0.098	-0.136	8.8414	0.920

*Probabilities may not be valid for this equation specification.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	63.32508	(17, 13)	0.0000
Chi-square	1076.526	17	0.0000

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