

## AN EMPIRICAL ANALYSIS OF DETERMINANTS OF INVESTMENT IN INDIA: AN ARDL APPROACH

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### Abstract

The present study attempts to analyze the most debated present issue whether the traditional factors or the economic policy variables play a crucial role in determining the investment behavior in India over the period 1978-2011 or not. ADF test as a test for unit root and CUSUM test for stability test were conducted. To test for both the short run and long run effects among the variables, ARDL procedure was also employed. DOMCR, TED and RER were found to be statistically significant determinants of GFCAF both in the long run and in the short run. GROWTH was significant only in long run but in short run it is not significant. Cost of capital was also found to be significant both in the short run and long run. Importantly, the economic policy variables play a crucial role in determining the behavior of investment in India as compared to the traditional factors.

**Key Words:** Gross Domestic Fixed Capital formation, Gross Domestic Product & ARDL.

**JEL Codes:** E2, E1, C5

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## I. Introduction

India like many developing countries, in 1991, as a part of the structural adjustment and macroeconomic stabilization programmes, implemented various macroeconomic, trade and financial sector policies to support output growth through greater savings and investment. In place of an old controlled regime, a liberal financial policy regime has been replaced. These policy initiations were expected to affect significantly to the investment performance of the economy. But, the traditional theories like acceleration theory of investment, profit theory of investment and flexible acceleration principle of Jorgenson explain about the traditional factors such as output growth, increase in profit and cost of capital are the major factors that affect the investment.

The accelerator theory of investment i.e. acceleration principle was the simplest among all and the base of the majority of these approaches. According to this principle, other things being constant, in order to increase output, firms are required a proportionate rise in the stock of capital investment. The key inference of the acceleration principle is that the changes in aggregate demand or the level of output determines the investment or the changes in capital stock. This theory is based on a number of assumptions such as constant sales –output ratio, full utilization capacity, permanent character for sales change, etc. The main shortcoming of this accelerator theory is that it assumes the supply of financial resources to a firm to be perfectly elastic so that financial factors do not influence the real capital formation in a productive unit.

There are also theories that explain that the current profits i.e. the amount of retained profits or by other variables like output, price and sales which reflects profit, affects the investment. Therefore, the profit theory states that “greater the gross profits or greater will be the level of internally generated funds and in turn greater will be the rate of investment”.

Jorgenson (1967) developed a neo classical flexible accelerator model in against of the accelerator model. In order to explain the investment behavior, the flexible accelerator model incorporates the user cost or the rental cost of capital by taking into account interest rate, depreciation and price of capital goods and accelerator effect as well. This flexible accelerator model of Jorgenson is basically relied on theory of optimal capital allocation. The theory of a profit maximizing of firm is subject to a production function which basically explains a technical

association between input and output get defined is central in neo classical model. Jorgenson's basic assumptions for a firm to maximize its present value are:-a) the rate of change of the input of capital services is equal to the rate of investment; b) the relationship between levels of output and inputs of labor and capital services are constrained by a production function. The demand for capital is a derived demand as the firm supplies capital services to itself through the acquisition of investment goods and it is positively related to the expected rental cost of capital. Therefore, the neo classical theory suggests that high interest rates raise the cost of capital which reduces the investment rate.

Although, the neoclassical flexible accelerator model is successful in developed countries but its application in developing countries is uncertain because of the inherent assumptions of the model and the inadequacy or non-availability of data for certain variables. Therefore, research on investment has moved in different directions with the objective of identifying the proper economic variables that might be expected to affect investment.

Hence, the present study attempts to analyze the most debated present issue whether the traditional factors or the economic policy variable play a crucial role in determining the investment behavior in India over the period 1978-2011 or not.

The present paper proceeds as follows. In section II, we discuss the literature review. The section III contains theoretical and conceptual framework. The section IV includes a detailed discussion on data and methodology. Similarly, in section V, we report on the ARDL model to determine the variables that affect gross fixed capital formation both in short run and long run. Section VI contains a detailed discussion of the empirical analysis in nutshell and the Section VII includes conclusion of the study.

## II. Review of Literature

Some of the reviews of literature relating to determinants of investment are given.

Athukorala (1998)<sup>1</sup> conducted a study to analyze the interest rate-saving-investment nexus in India using data for the period 1955-95. The study formulated three functions that were

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<sup>1</sup> Athukorala, P. "Interest rates, Saving and investment: Evidence from India". Oxford Development Studies, vol.. 26, No-2, 1998.

(1) domestic saving function (2) private investment function and (3) bank lending behavior function for the empirical analysis purpose. F test for the long run income homogeneity restriction, lagrange multiplier test for residual serial correlation, Sargan's test for the correct specification of instrument, Jarque-Bera test for normality of residuals, Ramsey test for functional form mis-specification, Engle's autoregressive conditional heteroscedasticity test, Chow test for parameter stability were conducted by splitting the sample period into 1956-79 and 1980-95. The coefficient of the real bank credit variable in the investment function was significant which suggested that increase in real bank credit positively affected the private investment. His study also supported the MaKinnon-Shaw's hypothesis that higher real deposit interest rate could promote investment through facilitating self-financed capital accumulation.

Taking into account the importance of saving, investment and their association with GDP growth and welfare, Agrawal (2000)<sup>2</sup> made a study on the saving and investment behavior in five South Asian countries such as India, Pakistan, Nepal, Bangladesh and Sri Lanka. He econometrically analyzed the determinants of total and private investment rates in South Asia using panel data from the five South Asian countries. The estimation results showed that net FDI inflows to GDP (FDI/Y) was the most important determinant of the investment rate. The impact of total foreign borrowing as share of GDP was positive and significant but much smaller than that of FDI inflows. Another important determinant of investment rate was the total domestic credit to GDP ratio. Its coefficient was found to be positive and significant both in the short run and in the long run.

Nair (2005)<sup>3</sup> analyzed the determinants of fixed investment in the private corporate manufacturing sector in India in the context of the policy reforms. He used the time series data of manufacturing sector covering the period 1973-74 to 2001-02. He employed unconstrained Vector Auto Regression (VAR) model of Johansen and Juselius Cointegration tests to know the long run relationship among different variables that affect the private corporate investment. The Augmented Engle Granger test for cointegration was also carried out to validate the hypothesis

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<sup>2</sup> Agrawal, P. "Saving, Investment and Growth in India", June 2000, IGIDR.

<sup>3</sup> Nair, V.R. "Determinants of Fixed Investment: A Study of Indian Private Corporate Manufacturing sector", WP-369, march 2005.

that the direction of the cointegrating vector obtained in all the cases was the intended one or not. The empirical results suggested that macro economic variables such as real bank credit to the private sector, change in user cost of capital, index of current account liberalization and index of capital account liberalization did not have any significant impact on corporate investment.

Verma and Wilson (2005)<sup>4</sup> made a study to explore the interdependencies between foreign capital inflows and real GDP, sectoral savings and investment for the Indian economy during the period from 1950 to 2001. Johansen's FIML estimation was employed by them to study the long run cointegrating relationships and short run adjustments for the non-stationary time series data which includes endogenously detected structural breaks in 1989 and 1993. The empirical results stated that household saving per worker positively affects household investment in the short run at one percent level of significance. There exists a missing link from investment to output. Private corporate investment and household investment per worker does not affect GDP both in the short run and in the long run which are necessary conditions for the validation of Solow and endogenous growth models. Per worker public investment adversely affects per worker output both in the short and long run. Thus, it does not support Barron's hypothesis of the benefits of the public provision of capital.

Therefore, the present study attempts to know whether there exists a long run relationship among the variables or not and to see how the external factors and traditional factors are affecting to the investment in India.

### III. Theoretical and conceptual framework

The general functional form of the gross domestic fixed investment is as follows

$$GFCAF/Y = a_0 + a_1GROWTH + a_2DOMCR/Y + a_3FDI/Y + a_4TED/Y + a_5RER + a_6COC \quad 2$$

Where GFCAF/Y is gross domestic fixed capital formation as percentage of GDP, GROWTH refers growth of output, DOMCR/Y is Domestic credit to private sector as percentage of GDP, similarly, FDI/Y is the foreign direct investment as percentage of GDP, TED/Y is the total

<sup>4</sup> Verma. R and E.J.wilson: "A Multivariate Analysis of Savings, Investment and Growth in India", working paper 05-24, 2005, Department of Economics, University of Wollongong, Australia.

external debt as percentage of GDP, RER is the real exchange rate and COC is the cost of capital.

In the accelerator model, the desired capital stock  $K^*$  is proportional to real GDP,  $Y$ . that is

$$K^* = f(Y) \quad 3$$

This can also be expressed in terms of a desired investment  $(GFCAF/Y)^*$  that is

$$(GFCAF/Y)^* = f(GROWTH) \quad 4$$

Therefore, growth was taken as the independent variable in the model. When income increases, the demand for consumer goods will increase which in turn raises the demand for capital goods to produce more consumer goods to meet the increased demand, thus the rise in demand for capital increases the total investment. In this case investment is induced by income; therefore, it is called as induced investment.

The availability of institutional credit is also one of the most important determinants of investment in developing nations. The quantity of credit is likely to be important in a credit market where the interest rates were controlled at below market clearing levels. A credit squeeze rations out some bank borrowers who may be unable to find loans elsewhere and so be unable to finance their investment projects. Therefore, the investment rate is influenced by the ratio of total domestic credit to GDP.

Another source of funds for invest is the inflow of foreign direct investment. The use of this source of funds depends on the various policies towards FDI. The FDI through backward and forward linkages with the industries can promote domestic investment. Hence, it is included in the model.

Foreign borrowing is also another source of investment. In one hand external debt permits a country to invest more and can be the main source of capital formation and economic growth if it will be used in a productive way. In other hand, if the external debt will not be used in productive way and also if the domestic currency value will decline then the burden of external debt will be very high which will affect negatively to domestic investment and thereby economic growth. Therefore, we include it in the model as an explanatory variable.

Investment demand can also be affected by the real exchange rate. An increase in real exchange rate would increase the price of imported capital and intermediate goods and result in contraction of investment. Real exchange rate (RER) is defined as:

$$\text{RER} = \text{NER} \cdot P^f / P$$

Where NER stands for number of domestic currency per dollar,  $P^f$  is the foreign price level proxied by the US GDP deflator and P is the GDP deflator (domestic price level).

Cost of capital is also another major factor that affects investment. We have taken cost of capital as the explanatory variable in the model as suggested by Jorgenson (1967) that is

$$\text{COC} = (\text{RL} + d) P_k / P$$

Where, RL stands for real interest rate, d is the depreciation rate,  $P_k$  is the price of capital goods which is proxied by the implicit price deflator of investment and P is the general price level of output proxied by the GDP deflator.

#### IV. Data and Methodology

The study is purely based on secondary data. The data has been collected from different sources such as world bank's report on world development, RBI hand book of statistics, CMIE etc. for the period from 1978-2011.

#### Unit Root Test

Augmented Dicky-Fuller test has been conducted to test the stationarity of the variables. From the test it is found that GROWTH, DOMCR and COC are stationary at level. But, other variables such as GFCAF, FDI, TED and RER are stationary in first difference. (for details see the following table which is given in the Appendix).

<Insert Table-1>

#### ARDL (Auto Regressive Distributed Lag) Cointegration Approach

From the results of the Table 1, it is clear that all the seven variables are of a mixed order of integration, a combination of I(0) and I(1) regressor. Therefore, we test for cointegration using

Auto Regressive Distributed Lag (ARDL) modeling approach. The main advantage of the ARDL model is that while other cointegration techniques such as Engle and Granger (1987), Phillips and Hansen (1990), Johansen (1988) and Johansen and Juselius (1990) require all variables to be of equal degree of integration i.e. I(1), ARDL model can be applied with the mixed order of integration. Another beauty of this technique is that when the sample size is small, it is more statistically significant approach for determining cointegrating relationships. Hence, we have constructed the error correction representation of the ARDL model which is as follows:

$$\Delta GFCAF = a_0 + a_1 LGFCAF_{t-1} + a_2 LGROWTH_{t-1} + a_3 LDOMCR_{t-1} + a_4 LFDI_{t-1} + \beta_5 LTED_{t-1} + a_6 LRER_{t-1} + a_7 LCOC_{t-1} + \sum_{j=1}^n b_j \Delta LGFCAF_{t-j} + \sum_{j=0}^n c_j \Delta LGROWTH_{t-j} + \sum_{j=0}^n d_j \Delta LDOMCR_{t-j} + \sum_{j=0}^n e_j \Delta LFDI_{t-j} + \sum_{j=0}^n f_j \Delta LTED_{t-j} + \sum_{j=0}^n g_j \Delta LRER_{t-j} + \sum_{j=0}^n h_j \Delta LCOC_{t-j} + \theta_t \dots \dots \dots (1)$$

The parameters  $a_i$  where  $i = 1-7$  are the corresponding long run multipliers and the short run dynamic co-efficients of the underlying ARDL approach are the parameters  $b_j - h_j$ . we first test the null of no cointegration (i.e  $H_0 : a_1 = a_2 = a_3 = \dots a_7 = 0$ ) against the alternative using the F test with critical values tabulated Pesaran et al (2001) in the ARDL model. Pasaran et al (2001) provided two sets of asymptotic critical values. The first set assumes that all variables are I(0) while the second set assumes that all variables are I(1). If the calculated F statistics is greater than the upper bound critical value the null hypothesis of no cointegration will be rejected and vice versa.

For estimating the long-run relationship among the variables the ARDL approach involves two steps. The first step involves establishing an existence of long run relationships among the variables in question. If a long run cointegrating relationship exists, the second step estimates both the short run and long run elasticities. The estimated error correction term also provides valuable information regarding the short adjustment to its long run equilibrium.

As the F (4.58) statistics of the whole model is greater than Pesaran et al (2001) critical tabular value without intercept and trend that is LB = 2.66 and UB = 4.05, we reject the null hypothesis that there is no cointegration at 1 per cent level of significant and we conclude by accepting the alternative hypothesis that is there is cointegration or long run relationships among the variables. The maximum lag of two is chosen since we have 34 annual observations from the period 1978 to 2011.



To estimate the long run and short run coefficients of the ARDL model all the seven variables are normalized thereafter. As we have 34 annual observations, Akaike Information Criteria (AIC) method with the maximum lag of two was chosen. CUSUM test was conducted as a test for the stability (for details see figure-1 in appendix).

## V. Data Analysis

(Insert table-2)<sup>♦</sup>

The result of the empirical study suggests that the long run coefficient of growth is found to be positive and significant at 5 % level. 1 unit increase in growth of real GDP leads to 0.46 unit change in gross domestic fixed capital formation in the long run. But the coefficients of Domestic credit to private sector as percentage of GDP and cost of capital are found to be significant at 10 % level and they also possess their expected signs. 1 unit increase in cost of capital will be accompanied by 0.2 unit reduction in gross domestic capital investment rate. Although the coefficient of foreign direct investment is positive but it is not significant. A positive and highly significant long run coefficient of real exchange rate suggests that 1 unit increase in real exchange rate affects fixed investment by 0.37 units.

(Insert table-3)<sup>♦</sup>

In the short run, GFCAF being the dependent variable, two statistically and highly positive significant effects of the variables such as domestic credit to private sector as percentage of GDP (DOMCR) and real exchange rate (RER) and one negative significant effect of the variable i.e. total external debt (TED) are found. 1 unit increase in DOMCR and RER lead to 0.38 and 0.37 unit increases in GFCAF respectively. But, the coefficient of foreign direct investment is not found to be significant. DOMCR, RER and TED are found to be significant at 1% level. A statistically significant at 10% level of coefficient of cost of capital is also obtained. The coefficient of growth is found to be significant at 5% level in first difference with lag two

<sup>♦</sup> Table-2, Table-3 results are given in Appendix.

which suggests that it has a very short period effect on GFCAF. Therefore, from the short run elasticities of the coefficients of the variable it is clear that the effect of economic policy variables such as DOMCR, TED and RER outweighs the effects of the traditional factors such as GROWTH and COC.

The short run error correction term,  $ecm(-1)$  shows the short run adjustment of gross domestic fixed capital formation to its own deviation from long run. This is of the correct sign and statistically significant, indicating that deviation from the long run rate of gross domestic fixed capital formation is corrected by 99% in the next period. Moreover, a significant error correction confirms the existence of a stable long-run relationship between the dependent variable i.e. gross domestic fixed capital formation and the significant regressor.

The diagnostic tests indicate that the model has no problem of serial auto correlation and heteroscedasticity problem and does not violate the normality condition and has a good functional form. The  $R^2$  is also high for the ARDL model which shows that the overall goodness of fit is extremely high. The joint significance of all regressors in the model measured by F-statistics is also found to be significant at 1 percent level. The Durbin-Watson statistics is more than two. By using the cumulative sum (CUSUM)<sup>♦</sup> test, the stability of the regression coefficients is also evaluated. The plots of the CUSUM are found to be within the boundaries which confirm the stability of the regression coefficients of the model.

## VI. Discussion

Hence, from the above econometric analysis it is clear that GROWTH has a statistical significant effect on the GFCAF in the long run but it has a very short period effect on GFCAF. Cost of capital is found to be statistically significant and negative at 10% level both in the short run and in the long run. That confirms that the traditional factors have less effect on investment both in the short run and long run. On the other hand, the short run and long run coefficients of domestic credit as percentage of GDP, real exchange rate and total external debt are found to be significant at 1% level in both the short run and the long run. Despite the coefficient of total external debt is highly significant but it is negative. The coefficient of the FDI is not found to be

<sup>♦</sup> CUSUM test (Fig-1) result is given in Appendix.

significant although it is positive both in the short run and in the long run. Importantly, the effects of the policy variables seem to be stronger than the traditional factors.

## VII. Conclusion

From the above analysis, it is clear that the economic policy variables such as DOMCR, RER and TED play a crucial role in India as compared to the traditional factors like GROWTH and COC. Domestic credit to private sector (DOMCR), real exchange rate (RER) and the total external debt (TED) are found to be significant determinants of investment and have stronger effect than the traditional factors such as growth rate of real GDP (GROWTH) and the cost of capital (COC). But, the total external debt has a negative and highly significant effect on the gross domestic fixed capital formation in India. Therefore, instead of going for the foreign borrowings, the government of India should try for alternative domestic sources such as increasing internal funds through enhancing gross domestic saving and especially encouraging small savings of the household and savings of private corporate and public sector.

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Appendix

**Table 1: Augmented Dicky-Fuller test as a test for Unit Root**

t values & P-Values		
Variables	Level	First Diff.
<b>GFCAF</b>	-1.03 (0.73)	-5.41(0.00)*
<b>GROWTH</b>	-4.43(0.00)*	-----
<b>DOMCR</b>	-4.46(0.00)*	-----
<b>FDI</b>	-1.32(0.60)	-5.18(0.00)*
<b>TED</b>	-0.68(0.83)	-4.82(0.00)*
<b>RER</b>	-1.22(0.65)	-4.72(0.00)*
<b>COC</b>	-4.29 (0.00)*	-----

\*Significant at 1 per cent level

**Table-2: Estimated Long Run Coefficients using the ARDL Approach:**

ARDL (0,2,1,0,2,0,0) selected based on Schwarz Bayesian Criterion  
Dependent variable is GFCAF, 32 observations used for estimation from 1980 to 2011

Regressor	Coefficient	P-Value
GROWTH	0.45**	[0.01]
DOMCR	0.13***	[0.05]
FDI	0.19	[0.65]
TED	-0.004*	[0.00]
RER	0.37*	[0.00]
COC	-0.20***	[0.09]
INPT	6.55**	[0.03]
T	0.62*	[0.00]

\*Significant at 1 per cent level, \*\*significant at 5 per cent level, \*\*\*Significant at 10 per cent level

**Table-3: Error Correction Representation for the Selected ARDL Model**

ARDL (0, 2, 1, 0, 2, 0, 0) selected based on Schwarz Bayesian Criterion  
Dependent variable is GFCAF, 32 observations used for estimation from 1980 to 2011

Regressor	Coefficient	P-Value
dGROWTH	0.13	[0.14]
dGROWTH1	-0.21**	[0.04]
dDOMCR	0.38*	[0.00]
dFDI	0.19	[0.65]
dTED	-0.004*	[0.00]
dTED1	-0.003*	[0.00]
dRER	0.37*	[0.00]
dCOC	-0.20***	[0.09]
INPT	6.56**	[0.03]
T	0.63*	[0.00]
ecm(-1)	-0.99*	[0.00]

\*Significant at 1 per cent level, \*\*significant at 5 per cent level, \*\*\*Significant at 10 per cent level

**Figure 1: CUSUM Test: As a test for stability.**

