CHAPTER 3

DETERMINANTS OF FIXED INVESTMENT BEHAVIOUR

In this chapter, the determinants of fixed investment behaviour are examined. The chapter is divided into four sections, section one dealing with introduction of the basic concepts and section two containing the analytical framework. In section three, discussion of results is presented and in the last section conclusions are incorporated. All the tables of this chapter are presented in appendix II.

3.1 INTRODUCTION:

The value of that part of the economy's output at any time, held in the form of (i) new structures, new durable equipment, and (ii) change in inventories together, is called investment, while component (i) is fixed capital and component (ii) is working capital. Investment is further expressed either in gross or net terms. The amount of gross investment that is made up of new structures and new producer's durable equipment is called gross fixed investment. Net investment is the difference between gross investment and depreciation. Gross fixed investment consists of non-residential investment and residential investment. Non-residential investment essentially consists of fixed business investment. Investment undertaken to replace
worn-out and obsolete assets by new ones is known as replacement investment, which is normally drawn from depreciation reserve.

Investment is a flow variable, while capital stock is a stock variable. In other words, fixed investment can be expressed as the addition to capital stock. Thus, if we denote capital stock by $K_t$, gross investment including depreciation is given by,

$$I_t = K_t - K_{t-1} + \lambda K_{t-1}$$

where $0 < \lambda \leq 1$.

3.2 METHODOLOGY:

In the present study the determinants of fixed investment are analysed in the framework of the flexible accelerator model with uniform lag structure for all the relevant variables. The time structure of the investment process is represented by a finite distributed lag function.

The accelerator hypothesis assumes technical relationship between output and capital stock. The flexible accelerator mechanism assumes that, firms achieve desired level of capital stock over a period of time. That is, there will be time lags between changes in demand and adjustment of capital stock to the
desired level. These lags arise on account of technological, institutional and expectational factors. Due to the presence of various kinds of lags, current changes in sales induce investment in future. Similarly, current investment is induced by past changes in sales.

The financial variables, both internal and external finance are important determinants of fixed investment expenditures. Internal finance is represented by profits or retained earnings. The cost of using internal finance is lower than that of external funds. Internal finance is preferred, because of the fear of loosing control through external equity, loan financing and delusion of return on such capital. Also, an amount of risk is involved with borrowed funds. Hence, firms prefer internal finance to external sources of finance.

Thus, in econometric investigations, sales change variable, flow of net debt, retained earnings and alternatively profit after tax and investment allowance reserve are incorporated in the model. Uniform lag structure for four years is assumed for all the variables, except in the case of investment allowance reserve for which only two years lags are considered, as the variable may not influence fixed investment beyond a period of two years. All the variables are in current prices. All the variables except sales change are deflated by capital stock of previous year, to correct for heteroscedasticity. Sales change
variables are deflated by sales of the previous year. Both linear and log-linear forms of the models are estimated. Since, the results in both the cases are similar, only the results of linear forms of the models are being reported.

The models are estimated for cross section, time series and pooled cross section time series data. In the case of cross section analysis, cross sections for each year are estimated. The estimated regressions with $R$ more than 0.3 only are being reported. In the case of time series study, the data are organised into four cases. In case one, there are 23 companies with data 1965-66 to 1986-87. In case two, 27 companies are there, having data from 1965-66 to 1985-86. There are 34 companies in case three, with data ranging from 1965-66 to 1982-83. In case four, 45 companies are there and the data runs from 1965-66 to 1980-81. The model specifications are given below.

$$\frac{I(t)}{k(t-1)} = a + \sum_{r=0}^{4} b_r \frac{\Delta S(t-r)}{S(t-r-1)} + \sum_{r=0}^{4} c_r \frac{RENT(t-r)}{k(t-r-1)}$$

$$+ \sum_{r=0}^{4} d_r \frac{FNDE(t-r)}{k(t-r-1)}$$

(3.2)
\[ I(t) \frac{k(t-1)}{k(t)} = a + \sum_{r=0}^{4} b_r \frac{\Delta S(t-r)}{S(t-r-1)} + \sum_{r=0}^{4} c_r \frac{PAT(t-r)}{k(t-r-1)} \]

\[ + \sum_{r=0}^{4} d_r \frac{FNDE(t-r)}{k(t-r-1)} \]  

(3.3)

\[ I(t) \frac{k(t-1)}{k(t)} = a + \sum_{r=0}^{4} b_r \frac{\Delta S(t-r)}{S(t-r-1)} + \sum_{r=0}^{4} c_r \frac{RENT(t-r)}{k(t-r-1)} \]

\[ + \sum_{r=0}^{2} d_r \frac{FNDE(t-r)}{k(t-r-1)} + \sum_{r=0}^{2} e_r \frac{IAR(t-r)}{k(t-r-1)} \]  

(3.4)

\[ I(t) \frac{k(t-1)}{k(t)} = a + \sum_{r=0}^{4} b_r \frac{\Delta S(t-r)}{S(t-r-1)} + \sum_{r=0}^{4} c_r \frac{PAT(t-r)}{k(t-r-1)} \]

\[ + \sum_{r=0}^{2} d_r \frac{FNDE(t-r)}{k(t-r-1)} + \sum_{r=0}^{2} e_r \frac{IAR(t-r)}{k(t-r-1)} \]  

(3.5)

\[ I(t) \frac{k(t-1)}{k(t)} = a + \sum_{r=0}^{4} b_r \frac{\Delta S(t-r)}{S(t-r-1)} + \sum_{r=0}^{4} c_r \frac{PAT(t-r)}{k(t-r-1)} \]

\[ + \sum_{r=0}^{4} d_r \frac{FNDE(t-r)}{k(t-r-1)} + e \frac{IN(t)}{k(t-1)} \]  

(3.6)

here \( r = 0,1,2,3 \) and 4 are time periods of one year lag for each subsequent ones and \( a,b,c,d \) and \( e \) are regression coefficients of the concerned explanatory variables.
And
\[ I = \text{Gross fixed investment} \]
\[ K = \text{Gross fixed assets} \]
\[ AS = \text{Sales Change} \]
\[ IN = \text{Inventory investment} \]
\[ RENT = \text{Gross retained earnings} \]
\[ FNDE = \text{Flow of net debt (external finance)} \]
\[ PAT = \text{Profits net of taxes} \]
\[ IAR = \text{Investment allowance Reserve} \]
\[ t = \text{Time subscript} \]

3.3 **EMPIRICAL ISSUES AND RESULTS** :

3.3.1 **Cross Section Analysis** :

The estimated equation of the specification (3.1) for the year 1982-83 for \( r = 0 \) is given by

\[
\frac{I(t)}{K(t-1)} = -0.2375^* + 0.0461 \frac{AS(t)}{S(t-1)} + 0.3529 \frac{FNDE(t)}{K(t-1)} \\
-1.2501 \frac{RENT(t)^*}{K(t-1)}, \ R^2 = 0.8659, \ F = 88.2574
\]

The estimated equation for the year 1986-87 is given by

\[
\frac{I(t)}{K(t-1)} = 0.1042 + 0.4367 \frac{AS(t)}{S(t-1)} - 0.0028 \frac{FNDE(t)^*}{K(t-1)} \\
-0.2607 \frac{RENT(t)^*}{K(t-1)}, \ R^2 = 0.3850, \ F = 5.2170
\]

In this case, flow of net debt is statistically significant while retained earnings is also significant but has a negative sign.
Results of the specification (3.1) for $r = 0, 1$ are presented in table II.1. The $R^2$ values range from 0.26 to 0.87, the highest value being in the year 1982-83. Flow of net debt is statistically significant in more than half of the regressions. Flow of net debt with one year lag is significant in five of the estimated regression equations. Retained earnings is not statistically significant. Sales change variable with one year lag has shown to be significant in three of the regressions.

Table II.2 presents the results of the same specification for $r = 0, 1, 2$. The $R^2$ values centre around 0.4, the highest value being 0.88 in 1982-83. In 1986-87 also, the $R$ is high (0.83). Lagged variables in this model have not shown to be statistically significant in this model with the result that the flow of net debt and sales change variables alone depicted statistically significant results to influence the fixed capital investment.

The results of the same specification for $r = 0, 1, 2, 3$ are shown in table II.3. The $R^2$ values have not improved significantly over the previous case. In 1982-83, the $R^2$ value is very high (0.90). Here also, similar inferences of earlier two specifications of investment behaviour models would apply. This shows that no improvement took place by extending the lag structure beyond two years.
To sum up, in the specification (3.1), flow of net debt variables – both current and lagged by two years – have proved to be influencing fixed investment. Retained earnings is not significant in many of the regressions. Lagged retained earnings variables also have shown no impact on the explanatory variable.

The estimated regression equation of specification (2) for \( r = 0 \) for the year 1982-83, is given by,

\[
\frac{I(t)}{K(t-1)} = -0.2256^* + 0.0450 \frac{\Delta S(t)}{K(t-1)} + 0.3583 \frac{FNDE(t)^*}{K(t-1)} - 1.226 \frac{PAT(t)^*}{K(t-1)},
\]

\[R^2 = 0.8635, F = 86.4360\]

The estimated regression equation of specification (2) for \( r = 0,1 \) for the year 1986-87, is given by,

\[
\frac{I(t)}{K(t-1)} = 0.113^* + 0.4341 \frac{\Delta S(t)}{K(t-1)} - 0.0104 \frac{FNDE(t)^*}{K(t-1)} - 0.3053 \frac{PAT(t)^*}{K(t-1)}
\]

\[R^2 = 0.3950, F = 5.4415\]

* indicates that the coefficient is significant at 5% level
The results of the specification (3.2) for \( r = 0,1 \) are presented in table II.4., wherein the \( R^2 \)s range from 0.31 to 0.87. Flow of net debt is significant in most of the years. The same variable with one year lag is significant in four of the regressions. Sales change variable with one year lag is significant in three regressions. The profit variable has not proved to be statistically significant as was the retained earnings variable in specification (3.1).

Table II.5 gives the results of specification (3.2) for \( r=0,1,2 \). \( R^2 \) values here range from 0.33 to 0.88. Flow of net debt, both current and with one year lag have proved to be significant, while all the other variables have not been found to be statistically significant.

The table II.6 gives the results of specification (3.2) for \( r = 0,1,2,3 \). \( R^2 \) values here range from 0.39 to 0.90, but there are no significant changes in statistical significance of the explanatory variables in this case, compared to the earlier cases.

In table II.7 results of specification (3.2) for \( r=0,1,2,3,4 \) are presented. The \( R^2 \) values in this case range from 0.42 to 0.93. Flow of net debt did influence the fixed capital investment and is statistically significant. This variable with one year lag and two years lag is statistically significant in a
few regressions, indicating the influence of external financing activity of previous two years on fixed investment.

Summing up, specification (3.2) has not shown any significant improvement over the specification (3.1). Profits after tax variable which is included in specification (3.2) in place of retained earnings has not proved to be statistically significant in almost all the cases. Flow of net debt is influencing investment positively as in the earlier specifications. Sales change variable has not registered any influence on fixed investment.

Table II.8 gives the results of the specification (3.3) for $r = 0$. In this specification, investment allowance reserve is incorporated, which includes the tax incentives. Inclusion of this variable has improved the efficiency of the model in terms of $R^2$ values and statistical significance of explanatory variables. $R^2$ values in this case range from 0.32 to 0.89. Investment allowance reserve and flow of net debt are statistically significant in the estimated regressions of the model. This shows that tax incentives induce investment in fixed assets.

The results of the same specification for $r = 0.1$ are given in table II.9. $R^2$ values in this case range from 0.31 to 0.91. Flow of net debt and investment allowance reserve, both current
and lagged by one year have turned out to be statistically significant and thereby showing their effectiveness in influencing fixed investment.

Table II.10 presents the results of the specification (3.3) for \( r = 0,1,2 \). \( R^2 \) values range from 0.40 to 0.94. Both investment allowance reserve and flow of net debt with two years lags exerted negative influence on fixed capital investment, while retained earnings is not statistically significant.

The results of the specification (3.3) for \( r = 0,1,2,3 \) are given in table II.11. \( R^2 \) values, in this case range from 0.42 to 0.95. But the explanatory variables of fixed capital investment with and without lags gave similar results as in the above case, suggesting no improvement due to additional lagged variables.

Table II.12 gives the results of the specification (3.3) for \( r = 0,1,2,3,4 \). The \( R^2 \) values range from 0.54 to 0.96. Flow of net debt and investment allowance reserve are statistically significant compared to the earlier two cases. Sales change variables, both current and lagged have failed to show any effect on the fixed capital investment.

Summarizing, the specification (3.3), by the inclusion of investment allowance reserve, has improved significantly over the earlier two specifications, in terms of \( R^2 \) values and
significance of the explanatory variables. Investment allowance reserve both current and lagged by one and two years are influencing fixed capital investment. Flow of net debt continues to be statistically significant as in the earlier cases.

The estimated results of specification (3.4), which includes profits in place of retained earnings, for \( r = 0 \) are presented in table II.13. The \( R^2 \) values in this case range from 0.32 to 0.89. The FNDE and IAR variables are statistically significant, while sales change and profit variables have not proved to be significant.

Table II.14 gives results of specification (3.4) for \( r = 0, 1 \). \( R^2 \) values here range from 0.31 to 0.91. Estimated regression equation of the year 1982–83 has the highest \( R^2 \) value (0.91). Lagged FNDE and IAR variables are also significant in some of the years.

In table II.15 results of the same specification for \( r = 0, 1, 2 \) are given. The lowest \( R^2 \) value is in the year 1984-85 (0.31) and the highest value is in the year 1982-83 (0.94). Flow of net debt is significant in a few of the regressions. Though, this variable with two year lag is also significant in a few years, its coefficients are negative depicting the contrary results.
Results of specification (3.4) for the case \( r = 0,1,2,3 \) are presented in table II.16. In this case, the \( R \) values range from 0.41 to 0.95. Investment allowance reserve and flow of net debt are significant in few regressions. Flow of net debt with three years lag and investment allowance reserve with two years lag are not statistically significant.

Table II.17 gives results of the same specification for \( r = 2, 0,1,2,3,4 \). The \( R \) values range from 0.58 to 0.96. Flow of net debt is the only variable, which influences the fixed capital investment and is statistically significant.

Summing up, this specification has fared well, with flow of net debt and investment allowance reserve variables having shown to be significant in many of the cases, as in the earlier specification. Profits variable has not shown any influence on fixed investment.

Specification (3.5) was estimated to examine the interdependence or otherwise of fixed investment and inventory investment decisions. The results of this specification are given in table II.18. The \( R^2 \) values in this case, ranged from 0.46 to 0.94. Inventory investment as an explanatory variable has negative signs for its coefficients in all but one of the estimated regressions. This shows that fixed and inventory investment have an inverse relationship between them, which means
that the more the fixed investment is, the less will be the inventory investment. It may be concluded that fixed and inventory investment are competitive in nature.

3.3.2 Time Series Study:

The time series results of specification (3.1) for the cases \( r = 0,1 \); \( r = 0,1,2 \); \( r = 0,1,2,3 \) and \( r = 0,1,2,3,4 \) are presented in table II.19. The \( R \) values range from a high of 0.71 to a low of 0.05. None of the explanatory variables are statistically significant.

Table II.20 contains the results pertaining to specification (3.2) for all the cases. The highest \( R \) value is 0.90 and the lowest is 0.12. This specification, with inclusion of profits after tax in lieu of retained earnings proved to be statistically significant compared to specification (3.1). But profits after tax and flow of net debt have not shown to be significant.

The time series results of specification (3.3) for the cases \( r = 0 \); \( r = 0,1 \); \( r = 0,1,2 \); \( r = 0,1,2,3 \) and \( r = 0,1,2,3,4 \) are presented in table II.21. The highest \( R^2 \) value in this case is 0.99 and the lowest value is 0.24. Here case 4, with the lag structure increasing 3 to 4 years, could not be estimated for want of more degrees of freedom. Retained earnings and flow of net debt variables are significant in some cases, involving
lagged variables of two years. Investment allowance reserve variable also is significant in a few regressions. These three variables with one and two lags are statistically significant in a few of the regressions.

Results of specification (3.4) are presented in table II.22. The highest R value is 0.99 and the lowest is 0.23. This specification gave good results compared to the one containing retained earnings. Investment allowance reserve is statistically significant in many cases. Flow of net debt is significant in some regressions. Sales change variable is not significant. Profits after tax is significant only in case 4, involving 47 companies.

To sum up, none of the specifications have fared well in time series study. However the specification with investment allowance reserve gave good results compared to others, which exclude this variables. Flow of net debt, profits after tax and retained earnings are also statistically significant in a few of the regressions. Sales change variables both current and lagged have not shown any influence over fixed investment expenditures. The lagged variables of financial variables also did not perform well.
3.3.3 **Pooled time series cross sections study**:

Pooled time series cross section results for all specifications are given in table II.23. $R^2$ values in these cases are very low. Flow of net debt variable has proved to be significant in all the estimated regressions. Current sales change variable and investment allowance reserve are also significant in many of the regressions. Profits after tax and retained earnings are significant in almost all the equations, a result contrary to the cross section and time series cases.

The $R^2$ values of these equations are very poor. This may be due to the special features of the industry, like price controls on sugarcane and sugar. Another reason for the poor performance of the equations may be due to the deflation of all variables.

**Summing up cross section, time series and pooled analysis**, flow of net debt and investment allowance reserve are statistically significant and their coefficients have a positive sign. This implies that external finance and investment allowance reserve have great impact on fixed capital investment expenditures in the sugar industry. The lagged variables of these variables are also statistically significant in some of the years. Current sales change variable seems to have a positive influence on fixed investment and is found to be significant in some of the regressions. The second lag of sales change variable
is found to be significant in a few of the regressions. Profits after tax and retained earnings variables are significant but their coefficients are negative.

3.4 CONCLUDING REMARKS:

1. External finance is found to be the most important determinant of fixed investment expenditures, followed by investment allowance reserves.

2. Fixed investment and inventory investment are found to be competitive in the short run because of scarce flow of funds.

3. The effect of accelerator and the effects of internal funds and profits or liquidity are weak in explaining fixed investment in Indian sugar industry. This may be due to the extreme form of controls inclusive of price and distribution of sugar.

4. In the cross section analysis, though the R values have increased with the increase in the lag structure, the specifications have not fared well after two lags, with no significant improvement in the explanatory power of the independent variable.

5. In the time series study, though the R values are high compared to cross section results, the explanatory variables have not shown significant improvement over the cross section
results. In pooled analysis also, no significant improvement occurred in the explanatory power of the independent variables.

6. Compared to the time series and pooled analysis, cross section study has given good results in terms of statistical significance of the explanatory variables.

7. The OLS results have shown to be reliable, with no multicollinearity and auto-correlation problem as the D.W statistics in time series analysis are around 2.1 in all the cases.