CHAPTER 4

DETERMINANTS OF INVENTORY INVESTMENT BEHAVIOUR

In this chapter, the determinants of inventory investment behaviour are examined in four sections. In section one, conceptual framework is presented and in section two framework of the analysis is incorporated. Section three deals with results and discussion and in the last section conclusions are presented.

4.1 RELEVANT CONCEPTS:

Inventory, which forms a part of current assets, comprises of three components, viz (i) raw materials, (ii) goods in process, semi-finished, secondary and joint products and (iii) finished products. Raw material and goods in process constitute two thirds of the aggregate inventory holding for the sugar industry in India. Inventory investment is defined as a change in the stock of inventories, or the net addition to stock of inventories. Inventory investment is usually perceived as a sum of intended and unintended investment.

Intended investment is the difference between intended or desired stock of inventories and the current stock of inventories. Unintended inventory investment results from unanticipated timing in the receipt of material used in
production as well as from unanticipated sales or output. Firms hold inventories for mainly four reasons. They are (i) Transaction motive (ii) Speculative motive(iii) to maintain buffer stocks and (iv) to meet the backlog of demand.

In a growing economy like India, inventory investment is also required to grow so as to sustain and maintain the flow of production process on a continuing basis, and for fuller utilization of existing capacity. It becomes highly important for analysis of fluctuations in economic activity because of its considerable volatile nature. The standard deviation of inventory investment over time, as opposed to its mean, is comparable to that of capital expenditures.

4.2 FORMULATION OF MODEL:

Inventory investment behaviour is analysed in the present study, in the framework of flexible accelerator model, since, the naive accelerator model is unrealistic, as it assumes no lags in the adjustment process. But in reality, there will be procurement lags between orders and deliveries and their length depends on the source of supply and availability. Another factor influencing the speed of adjustment is uncertainty in the market for raw material, and in the demand for final product.

The sales change variables both current and lagged ones are included in the model to represent the accelerator effects.
Lagged sales change variable accounts partly for expectations of net sales changes (proxy to expectational-accelerator hypothesis) and partly for partial adjustment process (proxy to flexible accelerator hypothesis). Stock of inventories at the beginning of the period is included to represent the lag in achieving desired level of inventories.

The financial variables considered in the model are flow of net debt and retained earnings or alternatively profits. Flow of net debt represents external finance and, retained earnings or profits represent the internal source of finance. The flow of net debt is one of the major external finance variables, which serves for both short term and long term funding. There will be lags in inventories of imported, domestic materials and components due to procurement procedures and delivery lags etc. Since, retained earnings or alternatively profits are an important source of internal funds for inventory investment, they are included in the model. In order to get a correct appraisal of the effect of flow of funds, both internal and external, there is a practice to include fixed investment also in the model of inventory investment. The other variables considered are cost of funds and stock-sale ratio.

A distinguishing feature of this study is that, a finite distributed lag structure is considered for the financial variables also in addition to the sales change variables. Three sales change variables including one current and two lagged ones
are considered as explanatory variables in specifications of step-wise regressions.

All the variables are in current prices. Three cases viz., time series, cross section and pooled are considered. All the financial variables are deflated by capital stock of previous year, except the sales change variables, which are deflated by sales of previous year. These ratio measures of variables are independent of units of measurements and of scale and it helps to correct for heteroscedasticity.

In the case of cross section study, cross section regressions for every year are computed. But, results of the estimated regressions with $R^2$ more than 0.3 only are being reported. Time series estimation was carried out for four cases. In case one, there are 23 companies and the data runs from 1965-66 to 1986-87. There are 27 companies with data from 1965-66 to 1985-86, in case two. In case three, there are 34 companies, having data from 1965-66 to 1982-83. In case four, 45 companies have data ranging from 1965-66 to 1980-81.

Both linear and log-linear forms of the models are estimated for time series and cross section study. Since the results obtained for linear and log-linear forms of the models are similar in almost all cases, only results of the linear forms are being reported, to avoid repetition. All the tables of this chapter are presented in appendix III.
The method of estimation was ordinary least squares. The model specifications are as follows.

\[
\frac{\text{IN}(t)}{k(t-1)} = a + \sum_{r=0}^{2} b_r \frac{\Delta S(t-r)}{S(t-r-1)} + \sum_{r=0}^{2} c_r \frac{\text{RENT}(t-r)}{k(t-r-1)} + \sum_{r=0}^{2} d_r \frac{\text{FNDE}(t-r)}{k(t-r-1)} + e \frac{I(t)}{k(t-1)}
\]

(4.1)

\[
\frac{\text{IN}(t)}{k(t-1)} = a + \sum_{r=0}^{2} b_r \frac{\Delta S(t-r)}{S(t-r-1)} + \sum_{r=0}^{2} c_r \frac{\text{RENT}(t-r)}{k(t-r-1)} + \sum_{r=0}^{2} d_r \frac{\text{FNDE}(t-r)}{k(t-r-1)} + e \frac{I(t)}{k(t-1)} + f \frac{\text{INS}(t-1)}{k(t-1)} + g \frac{\text{INS}(t)}{S(t)} + h \text{ACF}
\]

(4.2)

\[
\frac{\text{IN}(t)}{k(t-1)} = a + \sum_{r=0}^{2} b_r \frac{\Delta S(t-r)}{S(t-r-1)} + \sum_{r=0}^{2} c_r \frac{\text{PAT}(t-r)}{k(t-r-1)} + \sum_{r=0}^{2} d_r \frac{\text{FNDE}(t-r)}{k(t-r-1)} + e \frac{I(t)}{k(t-1)}
\]

(4.3)

\[
\frac{\text{IN}(t)}{k(t-1)} = a + \sum_{r=0}^{2} b_r \frac{\Delta S(t-r)}{S(t-r-1)} + \sum_{r=0}^{2} c_r \frac{\text{PAT}(t-r)}{k(t-r-1)} + \sum_{r=0}^{2} d_r \frac{\text{FNDE}(t-r)}{k(t-r-1)} + e \frac{I(t)}{k(t-1)} + f \frac{\text{INS}(t-1)}{k(t-1)} + g \frac{\text{INS}(t)}{S(t)} + h \text{ACF}
\]

(4.4)

Where \( r = 0,1,2 \) are one year lags and \( a, b, c, d, e, f, g \) and \( h \) are regression coefficients of the concerned variables,
and

\[ I = \text{Gross fixed investment} \]
\[ K = \text{Gross fixed assets} \]
\[ \Delta S = \text{Sales Change} \]
\[ IN = \text{Inventory investment} \]
\[ RENT = \text{Gross retained earnings} \]
\[ FNDE = \text{Flow of net debt (external finance)} \]
\[ PAT = \text{Profits net of taxes} \]
\[ IAR = \text{Investment allowance Reserve} \]
\[ INS = \text{Stock of inventories} \]
\[ ACF = \text{Average cost of funds} \]
\[ t = \text{Time subscript} \]

4.3 DISCUSSION OF RESULTS:

4.3.1 Cross Section Study:

The estimated results of inventory investment model (4.1) are presented in table III.1 for \( r = 0 \). The R's range from 0.53 to 0.91. Flow of net debt and retained earnings are statistically significant in all the years. Fixed investment is negatively related to inventory investment, since its coefficients have negative signs. The sales change variable is not statistically significant and its coefficients have negative signs in most of the cross sections.

In table III.2, there is a slight improvement in R's when lagged variables are included in the model. The R's range from 0.56 to 0.88. Only the current financial variables, both flow of net debt and retained earnings are significant. The lagged flow
of net debt variable is even negative in some cases. Similarly, the lagged retained earnings and lagged sales change variables have not been statistically significant.

The results for \( r = 0,1,2 \) are presented in table III.3. The \( R^2 \)'s range from 0.64 to 0.91. Here also, the current variables of flow of net debt and retained earnings are statistically significant. The lagged variables have not shown any influence on inventory investment. The sales change variables both lagged and current are not statistically significant and bear negative signs in many regressions. Fixed investment is negatively related to inventory investment in many regressions.

**Summing up, the specification (4.1) has performed well with high \( R^2 \)'s and many significant explanatory variables. Flow of net debt and retained earnings are statistically significant in all the cases viz., \( r = 0; \ r = 0,1 \) and \( r = 0,1,2 \). Lagged flow of net debt and lagged retained earnings variables have not established any impact on inventory investment. Similarly, sales change variables - both current and lagged - have not registered any influence over inventories. Fixed investment has an inverse relationship with inventory investment.

The results of the specification (4.2) are presented in table III.4. Here \( r = 0 \), which means that the regressions were run for current variables. The \( R^2 \)'s range from 0.52 to 0.90. The financial variables FNDE and RENT are statistically
significant in many regressions. The current stock of inventories and lagged stock of inventories variables are also statistically significant. Fixed investment is negatively related to inventory investment, here also.

In table III.5 the results of specification (4.2) for the case $r=0, 1$ are presented. The $R^2$s here range from 0.64 to 0.91. Here also, as in the previous specification, the financial variables FNDE and RENT are statistically significant in most of the regressions. The lagged variables of FNDE and RENT are not statistically significant and many of their coefficients have negative signs also. Fixed investment is statistically significant in half of the regressions and has negative signs. The sales change variables are not significant and some have negative signs also. The current stock of inventories variable is statistically significant in half of the regressions. This means that there is a direct relationship between stock of inventories and inventory investment.

In table III.6, the results of specification (4.2) for the case $r=0, 1, 2$ are given. The $R^2$s in this case range from 0.66 to 0.93. The results are the same as in the previous case.

To sum up the three cases, there is no significant improvement in the results of this specification over the previous one, even by the addition of stock to sales ratio, average cost of funds and lagged stock of inventories variables.
Only current stock of inventories is significant in some of the regressions.

The estimated results of specification (4.3) are given in table III.7 for the case r= 0. The $R^2$'s in this case range from 0.67 to 0.92. The variables FNDE and PAT are statistically significant. Sales change variable does not seem to show any influence on inventory investment. Fixed investment is inversely related to inventory investment.

Table III.8 gives results for the case r = 0,1. $R^2$ values here are more than 0.52. The highest value of $R^2$ is 0.92. Lagged variables are not statistically significant. The conclusions in this case are similar to the earlier cases.

The results for the case r = 0,1,2 for specification (4.3) are presented in table III.9. $R^2$ values range from 0.62 to 0.92. Lagged variables have not shown any influence over inventory investment, here also. All other findings are similar to earlier cases.

Summarizing all the three cases, the results of this model specification are similar to that of specification (4.1), in which retained earnings was used in lieu of profits. Here profits variable has proved to be statistically significant as was retained earnings in specification (4.1).
The estimated results for specification (4.4) for $r = 0$, are given in table III.10. The $R^2$ values range from 0.52 to 0.97. FNDE, PAT and INS variables are statistically significant in many regressions. Fixed investment is inversely related to inventory investment.

Table III.11 presents results for specification (4.4) for case $r = 0, 1$. R values here range from 0.65 to 0.88. The lagged variables are not statistically significant. Sales change variables have no effect on inventory investment. Other findings are similar as in earlier cases.

The results of specification (4.4) for the case $r = 0, 1, 2$ are presented in table II.12. FNDE, PAT and INS variables are significant in most of the regressions. Current stock of inventories is also statistically significant. The ACF variable is not significant. Lagged stock of inventories is also not significant and has little effect on inventory investment. Lagged variables, both of sales change and financial variables, are not statistically significant.

Summing up, in all the four specifications the financial variables, flow of net debt and retained earnings and alternatively profits have turned out to be statistically significant in determining the inventory investment expenditures. The sales change variables, both current and lagged have no influence on inventories. Fixed investment is
inversely related to inventory investment and is statistically significant too. Thus, the interdependence of inventory and fixed investment is indicated.

4.3.2 Time Series Study:

The time series results of specification (4.1) for cases 1 to 4 are presented in table III.13. The $R^2$s in all the cases are well above 0.9, except in case 1, for $r = 0$ and $r = 0,1$. The FNDE variable is statistically significant in all the cases. The RENT variable is significant in some, but not in all the regressions. Fixed investment is inversely related to inventory investment but is not significant.

The time series results of specification (4.2) are presented in table III.14 for all the cases 1 to 4, for $r = 0$, $r = 0,1$ and $r = 0,1,2$. The $R^2$ values for all the regressions are more than 0.90. The FNDE variable is statistically significant in many regressions. RENT and INS variables are statistically significant in some cases only. Lagged variables are not statistically significant with little quantitative effect on inventory investment.

Table III.15 presents time series results of specification (4.3) for all the cases 1 to 4, for $r = 0$, $r = 0,1$ and $r = 0,1,2$. The $R^2$ values are well over 0.9 in all the cases. FNDE is statistically significant in almost all the regressions. PAT
variable is statistically significant in only some of the regressions. Fixed investment is inversely related to inventory investment and is not significant.

Time series results of specification (4.4) are given in table III.16 for all the cases for $r = 0$, $r = 0.1$ and $r = 0.1,2$. The $R^2$ values are well over 0.95 in all the cases. The same conclusions drawn in the previous case hold good here also.

To sum up, in time series analysis, the $R^2$'s are very high, well over 0.9 in almost all cases, with a few exceptions, indicating the better fit of the models. The financial variable FNDE, is statistically significant in all the estimated regressions. The other financial variables, RENT and PAT are also significant in some cases. Fixed investment is inversely related to inventory investment and is statistically significant in some regressions. The sales change variables, both current and lagged have not shown any effect on inventory investment. The variables, cost of funds and lagged stock of inventories are not significant. Current stock of inventories variable has exerted some influence over inventory expenditures.

4.3.3 Pooled Analysis:

The estimated pooled time series cross section results are presented in table III.17. The $R^2$'s in this case are centered around 0.5. The financial variables FNDE, RENT and PAT are
statistically significant in all the regressions. The lagged variables of these, are negatively and statistically significant in some regressions. Fixed investment is negatively significant in many cases. The sales change variables have not established any influence on inventory investment. Current stock of inventories is significant in many cases, while cost of funds is significant in a few regressions. Lagged stock of inventories is not significant and its coefficients are minute.

4.4. MAIN FINDINGS:

1. External sources of financing have more influence on inventory investment than internal funds.

2. The financial flows, both internal and external have proved to be very important determinants of inventory investment and are statistically significant too.

3. Accelerator has not proved to be an important determinant of inventory investment in Indian sugar industry.

4. Fixed investment has an inverse relationship with inventory investment, suggesting the presence of interdependence between the two.

5. Lagged variables have not established any influence on inventory investment. This implies that there are no long term lags in orders and deliveries of inventories in the sugar industry.
6. cost of funds variable has not exerted any influence on inventories.

7. The results are free from auto-correlation and other econometric problems, as the D.W. statistics in time series analysis are all around 2.1.

1Krishnamurthy, K and D U Sastry (1975), Investment and financing in the corporate sector in India, Tata McGraw Hill, Bombay.


3Ibid.