CHAPTER 5

ANALYSIS AT THE FIRM LEVEL

5.1 The Sample

In this chapter, the industry level analysis carried out in the previous chapter has been extended to the level of the firm. As investment behaviour may be expected to be different for macro and micro relations, the behaviour of the firm is expected to differ from that undertaken by the industry. In order to bring out this aspect of the problem of linear aggregation, the analysis has been extended to a sample of fourteen firms.

The list of firms included in this study is given in Table 5.1. The summary statistics and measures of predictive capacity obtained for the alternative specifications (listed in Table 5.0), using data pertaining to the above firms, are presented in Tables 5.2 to 5.15. Appendix C contains Tables 5.0 to 5.15. Appendix D contains Tables 5.16 to 5.24, which present the ordinary least squares estimates obtained for the alternative specifications listed in Table 5.0.

5.2 The Bombay Dyeing and Manufacturing Company Limited

The Ordinary Least Squares (OLS) estimates obtained from the analysis of the data for the Bombay Dyeing and Manufacturing Company Ltd., are presented in Appendix D. The summary measures ($R^2$, SEE, and DW), along with the exante forecast measures, are presented in Table 5.2.
An examination of the first two lines of Table 5.2 reveals that of the two alternative specifications that have been taken to represent the accelerator theory, the specific form that approximates desired sales with the constant change, offers better explanation. While 5.2 (ii) accounts for 92 per cent explanation of investment, the alternative 5.2 (i) accounts for only 78 per cent explanation, their respective SSE estimates being of the order of 3094.54 and 4876.72. The DW statistic of the two equation 5.2 (i) and 5.2 (ii) are of the orders of 2.477 and 1.665 respectively, implying the absence of serial correlation of the error terms of equation 5.2 (ii). In terms of their predictive capacities, while 5.2 (ii) tracks four of the nine turning points correctly, 5.2 (i) tracks five turning points correctly.

Line 3 in Table 5.2 represents the estimates obtained by the application of the residual funds specification. Compared to 5.2 (ii), this specification offers a lower explanation of investment. While 5.2 (ii) accounts for 92 percent explanation, 5.2 (iii) accounts for only 87.9 per cent explanation. The superior nature of 5.2 (ii) is further indicated by its lower SSE estimate, which is of the order of 3094.54. The DW statistic in the case of the two equations 5.2 (ii) and 5.2 (iii) is of the order of 1.665 and 2.105 respectively, implying the absence of serial correlation of the error terms, in both
cases. Regarding their predictive capacities, 5.2.(iii) tracks only one turning point correctly, whereas 5.2.(ii) tracks four of the nine turning points correctly.

The next two lines in this table indicate the estimates obtained by the application of the relative price specification to the data. Relative prices in these two equations have been estimated excluding capital gains. The insignificant difference in the $R^2$ values and SEE estimates, and in the magnitude of the DW statistic makes it difficult to choose between the two specifications. Compared to both these specifications, 5.2.(ii) gives better explanation. This equation accounts for 92 per cent explanation of investment, whereas 5.2.(iv) and 5.2.(v) account for only 53 per cent and 54 per cent respectively. The superior nature of 5.2.(ii) is, further indicated by their respective SEE estimates, which are of the order of 3094.54, 7140.34, and 7313.29. While the error terms of 5.2.(ii) are free of the problem of serial correlation, as is apparent from the DW statistic of 1.665, the two alternatives 5.2(iv) and 5.2.(v) have DW statistics of the order of 1.426 and 1.469 respectively, implying that the error terms are serially correlated. Regarding their predictive capacities, while 5.2.(ii) tracks four of the nine turning points correctly, 5.2.(iv) and 5.2.(v) track only zero and one turning point respectively.
The last four lines of this table represent the estimates obtained by the application of the theory wherein the speed of adjustment is taken to be a function of finance variables. The two equations 5.2.(vi) and 5.2.(vii) gives a better explanation compared to 5.2.(viii) and 5.2.(ix). Due to insignificant differences in their respective $R^2$ and SEE estimates, and in the dimension of the DW statistic, it is difficult to choose between 5.2.(vi) and 5.2.(vii). Compared to these two equations, 5.2.(ii) gives better explanation of investment for the sample period. While 5.2.(ii) accounts for 92 percent explanation, 5.2.(vi) and 5.2.(vii) account for 78 percent and 78.2 percent respectively. Their respective SEE estimates are of the order of 3094.54, 5020.95 and 5009.39. Regarding the error terms, the error terms of all three equations are not serially correlated. Turning to their predictive capacities, while 5.2.(ii) tracks four turning points correctly, 5.2.(vi) and 5.2.(vii) track four and five turning points respectively.

A cross comparison of the results discussed so far indicates that of the alternative specifications attempted herein, specification 5.2.(ii) can be considered as the one with the highest explanatory as well as predictive capacity. Such a comparison also reveals that for this particular firm, the alternate theoretical frameworks
can be ranked in the following order:

1) The Accelerator Theory

2) The theory under which the speed of adjustment is taken to be a function of finance variables, and sales determine the desired level of capital stock.

3) The Residual Funds Theory, and

4) The Relative Price Theory.

The OLS estimates obtained for the parameter coefficients of the specification that has been identified as the best, namely, the one labelled as 5.2.(ii), are presented below.

\[ I_t = -1675.6907 + 0.3369 S_{t-1} - 0.2385 \Delta S_{t-1} - 0.2467 K_{t-1} \]

\[ (0.5917) \quad (8.3559) \quad (4.9755) \quad (5.4477) \]

\[ R^2 = 0.9167 ; \quad SSE = 3094.54 ; \quad DW = 1.6655 \]

The signs of the estimates presented herewith indicate that with the exception of the sales change variable, the remaining coefficients have obtained the expected signs. With the exception of the constant term, the other three included variables prove to be significant determinants of investment behaviour, at the 10 per cent level.
5.3 The Arvind Mills

The OLS estimates, along with the summary measures, and measures of predictive capacity, obtained for each one of the alternatives for data on the Arvind Mills, are presented in Table 5.3.

An examination of the first two lines of the Table 5.3 indicates that 5.3.(ii) gives a better performance. This equation accounts for 45.9 percent explanation compared to 5.3.(i) which accounts for only 38.3 percent explanation. The respective SEE estimates of the two equations are of the order of 2410.93 and 2492.66, which is a further indication of the superior nature of 5.3.(ii). The error terms of both specifications 5.3.(i) and 5.3.(ii) are not serially correlated. Turning to their respective predictive capacities, 5.3.(ii) tracks six of the eleven turning points correctly, whereas 5.3.(i) tracks only two turning points.

Line 3 represents the estimates obtained through the application of the residual funds theory to the sample data. Compared to this specification, 5.3.(ii) offers better explanation. While 5.3.(ii) accounts for 45.9 per cent explanation, the alternative 5.3.(iii) accounts for 32.8 per cent explanation, their respective SEE estimates are of the order of 2410.93 and 2602.29. The error terms of both equations are not serially correlated. Regarding their
predictive capacities, while 5.3.(ii) tracks six out of eleven turning points correctly, 5.3.(iii) does not track even one turning points correctly.

The estimates obtained through the application of the relative price theory are presented in the next two lines of this table. Insignificant differences in their respective $R^2$ values, and in the magnitudes of their DW statistics makes it difficult to choose between the two alternatives. In comparison, 5.3.(ii) gives a better explanation of investment for the sample period. 5.3.(ii) accounts for 45.9 per cent explanation, while 5.3.(iv) and 5.3.(v) account for only 31.2 per cent and 34.7 per cent respectively. The superior nature of 5.3.(ii) is further indicated by their respective SEE estimates, which are of the order of 2410.93, 2632.15 and 2648.32. The magnitude of the DW statistic of the three specifications is of the order of 2.1643, 2.0310 and 1.897 respectively, implying that the error terms of all three equations are not serially correlated. Regarding their predictive capacities, 5.3.(iv) and 5.3.(v) track only two and four turning points respectively, whereas 5.3.(ii) tracks six of the eleven turning points correctly.
The last four rows represent the results obtained by assuming the speed of adjustment to be a function of finance variables. Of the four alternatives considered, 5.3.(vi) gives the best explanation. This specification accounts for 39.9 per cent explanation and has an SEE of the order of 2541.07. The three alternatives 5.3.(vii), 5.3.(viii) and 5.3.(ix) account for 38.8 per cent, 33 per cent and 31.5 per cent respectively, and their respective SEE estimates are of the order of 2564.40, 2683.31 and 2711.92. The DW statistics of the four equations are 2.423, 2.203 and 2.113 respectively. Turning to their predictive capacities, 5.3.(vi) tracks one of the eleven turning points correctly, whereas the three alternatives track two, zero and one turning point respectively. Compared to 5.3.(vi), a better explanation is offered by 5.3.(ii). 5.3.(vi) accounts for 39.9 per cent explanation, whereas 5.3.(ii) accounts for 45.9 per cent explanation of investment. In terms of predictions too, 5.3.(ii) gives a better quality of predictions. This equation tracks six of the eleven turning points correctly compared to 5.3.(vi), which tracks only one turning point correctly.

A cross comparison of the results discussed so far indicates that of the four alternate theories compared, specification 5.3.(ii) gives the best explanation of investment for the sample period. Such a comparison also reveals that for the Arvind Mills, the
alternative theoretical frameworks can be ranked in the following manner.

1) The Accelerator Theory, with the specific form wherein expected sales are approximated by constant change.

2) The theory under/which the speed of adjustment is assumed to be a function of finance variables, and desired level of capital stock is determined by sales.

3) Both the Residual Funds Theory, and the Relative Price Theory.

The OLS estimates obtained for the parameter coefficients of the specification that has been chosen as the best, namely 5.3.(ii), are presented below:

\[ I_t = 1338.5973 + 0.2040 S_{t-1} - 0.2404 \Delta S_{t-1} - 0.1081 K_{t-1} \]

\[ (0.4085) \quad (2.0310) \quad (1.4502) \quad (0.9305) \]

\[ R^2 = 0.4569; \quad SEE = 2410.93; \quad DW = 2.1643. \]

The sign of the coefficients presented herewith indicates that with the exception of the sales change variable, the remaining coefficients have attained the expected signs. Lagged sales is the only significant determinant of investment behaviour, being significant at the 10 per cent level.
5.4 The Ahmedabad Manufacturing and Calico Printing Company Limited

The OLS estimates obtained for the alternate specifications for the data representing the behaviour of the Ahmedabad Manufacturing and Calico Printing Company Limited, are presented in Table 5.4. This table also presents the summary measures obtained by each of the alternate specifications along with measures of their respective predictive capacities.

An examination of the first two lines of Table 5.4 indicates that both the specifications give a very poor explanation of investment for the sample period. They account for only 2 per cent and 7 per cent explanation respectively, and their respective SEE estimates are of the order of 10194.1 and 10259.4. The error terms of both the equations are serially correlated. Turning to their predictive capacities, 5.4.(ii) tracks three turning points correctly whereas 5.4.(i) tracks only one of the six turning points correctly.

Specification 5.4.(iii) does not explain the investment for the sample period. It accounts for only 1.7 per cent explanation and the SEE estimate is 10211.6. The magnitude of the DW statistic is 1.199 which implies that the error terms are serially correlated. This specification tracks only one of the six turning points correctly.
The next two lines of this table represent the estimates obtained through the application of the relative price specification to the sample data. 5.4(iv) which approximates the desired level of relative prices by static expectations gives a better explanation. 5.4(iv) accounts for 67 per cent explanation, whereas the alternative 5.4(v) accounts for 19.9 per cent. Their respective SEE estimates are of the order of 9403.5 and 9524.48. The error terms of both specifications are serially correlated. Both equations track two of the six turning points correctly. 5.4(iv) gives a better explanation compared to 5.4(i), 5.4(ii) and 5.4(iii). Its superiority is indicated in terms of both the summary measures, and the statistics indicating their respective predictive capacities.

In the last four lines of this table, the speed of adjustment is assumed to be a function of finance variables, rather than as a constant, implicit in the specifications discussed so far. A comparison of these four alternatives indicates that 5.4(ix) wherein the speed of adjustment is taken as a function of external finance, and relative prices determine the desired level of capital stock, gives the best explanation. This specification 5.4(ix) accounts for 60.5 per cent explanation, and the SEE estimate is 6688.76. The three alternatives 5.4(vi), 5.4(vii) and 5.4(viii) account for 2.1 per cent, 34.8 per cent and 16.8 per cent explanation.
respectively. Their respective $\text{SE}^2$ estimates are 10,527.5, 8593.4, and 9703.62. Only the error terms of 5.4.(ix) are not serially correlated, the $DW$ statistic being 1.668. 5.4.(ix) is able to track five of the six turning points correctly, whereas 5.4.(vi), 5.4.(vii) and 5.4.(viii) track only two, three and two turning points respectively. 5.4.(ix) gives better explanation compared to 5.4.(iv) also. While this specification accounts for 60.5 percent explanation, 5.4.(iv) accounts for only 16.7 percent explanation of investment. The error terms of 5.4.(ix) are not serially correlated, but the error terms of 5.4.(iv) face the problem of serial correlation. Regarding their predictive capacities, 5.4.(ix) tracks five of the six turning points correctly, whereas 5.4.(iv) tracks only two turning points correctly.

A cross comparison of the results discussed so far reveals that for the Ahmedabad Manufacturing and Calico Printing Company Ltd., the alternate theoretical frameworks could be ranked in the following order:

1) The theory wherein the speed of adjustment is taken to be a function of external finance, and relative price determines the desired level of capital stock.

2) The Relative Price Theory, and

3) Both the Accelerator Theory and the Residual Funds Theory.
This ranking is arrived at on the basis of the summary measures and the exante forecast measures. The OLS estimates obtained for specification 5.4.(ix) which has been identified as the best, are presented below:

\[ I_t = 11200.3986 + 0.0856(P_t - Q_{t-1}) + 0.1635 K_{t-1} + 0.3716 \Delta IF_{t-1} \]

\[ (2.3411) \quad (3.2236) \quad (2.9810) \quad (4.0771) \]

\[ R^2 = 0.6048; \quad SEE = 6688.78; \quad DW = 1.6688 \]

The signs of the coefficients presented herewith indicates that all the included coefficients have obtained the right signs. Capital stock, relative prices, and the constant term are the three significant determinants of investment behaviour. The speed of adjustment is influenced by the level of external finance. All the variables are significant at the 10 per cent level.

5.5. The Century Spinning and Manufacturing Company Limited

The OLS estimates obtained for alternate specifications for the data pertaining to the Century Spinning and Manufacturing Company Limited are presented in Table 5.5.

The first two lines of this table consider the accelerator theory. An examination of the estimates given by the two alternatives
indicates that both specifications give a very poor explanation of investment, for the sample period. The two specifications 5.5.(i) and 5.5.(ii) account for only 2.4 per cent and 4.5 per cent explanation respectively, and their respective SEE estimates are of the order of 1990.5 and 2030.4. The DW statistics of the two equations are of the order of 1.401 and 1.535 respectively, implying that the error terms of 5.5.(ii) are not serially correlated, whereas those of 5.5.(i) face the problem of serial correlation. Both equations do not track even one of the nine turning points correctly.

5.5.(iii) also does not give a good explanation of investment, for the sample period. This specification accounts for only 2.6 per cent explanation, and the SEE estimate is 1980.2. The error terms of this equation are serially correlated. 5.5.(iii) tracks only one of the nine turning points correctly.

The next two lines of this table represent the estimates obtained through the application of the relative specification. An examination of the estimates attained by the two alternatives brings out that 5.5.(v) gives a better explanation. 5.5.(v) accounts for 36.9 per cent explanation, while the alternative 5.5.(iv) accounts for only 27.7 per cent explanation. Their respective SEE estimates
are of the order of 16528.7 and 17124.1. The error terms of both the equations are not serially correlated. Regarding predictive capacities, 5.5.(iv) tracks three of the nine turning points correctly, whereas 5.5.(v) does not track even one turning point correctly. Thus, while 5.5.(v) gives better explanation of investment in terms of the summary measures, 5.5.(iv) gives a better quality of predictions. In terms of both the summary measures and the quality of predictions, 5.5.(iv) and 5.5.(v) give a better explanation of investment for the sample period, compared to 5.5.(i), 5.5.(ii), and 5.5.(iii).

Of the last four specifications considered in this table, 5.5.(ix) gives the best explanation. This specification accounts for 29 per cent explanation, and its $\text{SSE}$ estimate is of the order of 17532.4. The three alternative 5.5.(vi), 5.5(vii) and 5.5.(viii) account for 2.6 per cent, 5.4. per cent and 30.2 per cent respectively. Their respective $\text{SSE}$ estimates are of the order of 20533.6, 20231.0 and 17387.0. With the exception of the equation 5.5.(vi), the error terms of the three alternates are not serially correlated. Turning to their predictive capacities, 5.5.(ix) tracks five of the nine turning points correctly, whereas 5.5.(vi), 5.5.(vii) and 5.5.(viii) track one, one, and four turning points respectively. In terms of the summary measures, 5.5.(v) gives a
better explanation, whereas 5.5.(ix) has a better predictive capacity. On this ground, 5.5.(ix) is preferred to 5.5.(v). While 5.5.(ix) tracks five of the nine turning points correctly, 5.5.(v) does not track even one turning point correctly. In terms of the summary measures, 5.5.(ix) accounts for 29 per cent explanation. 5.5.(v) accounts for 37 per cent explanation. The error terms of both equations are not serially correlated.

A cross comparison of the results discussed so far indicates that for the Century Spinning and Manufacturing Company Limited, the alternate theoretical frameworks can be ranked in the following order:

1) The theory wherein the speed of adjustment is a function of finance variables and the desired level of capital stock is determined by relative prices.

2) The Relative Price Theory.

3) Both the Residual Funds Theory and the Accelerator Theory.

This ranking is obtained by the summary measures and the exante forecast measure. The OLS estimates obtained for the parameter coefficients of specification 5.5.(ix), which is identified as the best, are given below:
\[ I_t = -23230.725 + 0.1878 \left( \frac{P_{t-1}C_{t-1}}{C_{t-1}} \right) - 0.0586 K_{t-1} - 0.3036 \Delta EP_{t-1} \]

\[ r^2 = 0.2898 \quad \text{SEW} = 17532.4 \quad \text{DW} = 2.1829 \]

For this firm, relative prices are the only significant determinants of investment expenditure.

Among the four firms considered from the Cotton Textiles Industry, there is no consensus regarding the determinants of investment behaviour. While both Bombay Dyeing and the Arvind Mills exhibit a purely accelerator-like behaviour, with both sales and change in sales being the most important determinants, in the case of the Ahmedabad Manufacturing Company, and Century Spinning, relative prices prove to be the most significant determinants. Finance variables influence the speed of adjustment only in the case of the Ahmedabad Manufacturing Company. Though not significant in itself, the inclusion of external finance in the case of the Century Spinning Company, leads to an improvement in the quality of predictions.
A comparison with the behaviour exhibited by the Cotton Textile industry reveals that Bombay Dyeing and the Arvind Mills, exhibit similar behaviour, with the accelerator variables being the most significant determinants in all three cases. The two other firms namely, Ahmedabad Manufacturing Company and Century Spinning however exhibit dissimilar behaviour vis-a-vis the Cotton Textile industry.

In a study of the applicability of the neo-classical model to industrial corporations in India, Dixit and Prasad\(^1\) include the Century Spinning and Weaving Mills in their sample of fourteen firms. In their analysis, the neo-classical variable proves to be an insignificant determinant of desired capital stock. In the present study however, the neo-classical variable also termed as the relative price variable proves to be the most important determinant of the investment behaviour of the firm. The accelerator and finance variables are second to the relative price variable, in importance.

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5.6 Tata Engineering and Locomotives Limited (TELCO)

The OLS estimates obtained for the alternate specifications for the data representing the behaviour of TELCO, along with the summary measures and measures of predictive capacity are presented in Table 5.6.

A comparison of the first two lines of this table indicates that 5.6.(ii) in which expected sales is approximated by constant change gives a better explanation of investment. This specification 5.6.(ii) accounts for 34.5 per cent explanation, whereas 5.6.(i) accounts for 32.9 per cent explanation. Their respective SEE estimates are 18571.8 and 18198.5. The magnitudes of the respective DW statistics of 5.6.(i) and 5.6.(ii) are of the order of 1.685 and 1.711 implying that in both cases, the error terms are not serially correlated. Regarding their predictive capacities, 5.6.(ii) tracks three of the ten turning points correctly, whereas 5.6.(i) tracks only one turning point.

Compared to 5.6.(iii), 5.6.(ii) gives a better explanation. Though there is insignificant difference in the magnitudes of their respective $R^2$ values and SEE estimates, 5.6.(ii) has better predictive capacity. 5.6.(ii) tracks three of the ten turning points correctly, whereas 5.6.(iii) does not track even one turning point correctly.
Of the four alternative specifications considered, wherein the speed of adjustment is taken to be a function of finance variables, 5.6.(ix) gives the best explanation. This specification accounts for 43.4 percent explanation, while the three alternatives 5.6.(vi), 5.6.(vii) and 5.6.(viii) account for 33.4 per cent, 40.4 per cent, and 38.8 per cent explanation respectively. The superior nature of 5.6.(ix) is further indicated by their respective SEE estimates, which are of the order of 17239.9, 18734.5, 17713.3 and 17958.5. The error terms of all four equations are not serially correlated. 5.6.(ix) tracks one of the ten turning points correctly, whereas the three alternates 5.6.(vi), 5.6.(vii) and 5.6.(viii) track zero, three and one turning point respectively. 5.6.(ix) gives a better explanation in terms of the summary measures, compared to 5.6.(iv). Both the equations track only one turning point correctly.

A cross comparison of the results discussed so far reveals that for the behaviour undertaken by TELCO, the alternate theoretical frameworks could be ranked in the following order:

1) The theory wherein the speed of adjustment is a function of finance variables.

2) The Relative Price Theory

3) The Accelerator Theory, and

4) The Residual Funds Theory.
For this firm, the ranking is not very distinct. The OLS estimates of the parameter coefficients of specification 5.6.(ix) are presented below:

\[ I_t = -1063.9367 + 0.0200 \left( \frac{P_{t-2}/C_{t-1}}{t-1} \right) + 0.0102 K_{t-1} + 0.2670 \Delta E_{t-1} \]

\[ (0.0389) \quad (1.1000) \quad (0.4002) \]

\[ R^2 = 0.4369; \quad SEE = 17223.9; \quad DW = 1.8905 \]

In the above specification, none of the included variables is significant at the 10 percent level. Also the coefficient of the capital stock variable has obtained the opposite sign.

5.7 **Jay Engineering Works Limited**

Table 5.7 presents the OLS estimates obtained for the data pertaining to the Jay Engineering Works Limited. This table also includes the summary measures obtained by each of the alternative specifications, as well as the ex ante forecast measure.

The first two lines represent the estimates obtained through the application of the accelerator theory to the data of the two alternatives considered, 5.7.(ii) gives a better explanation of investment for the sample period. 5.7.(ii) accounts for
37.9 percent explanation, while the alternative 5.7.(i) accounts for only 9.8 percent explanation. The superior nature of 5.7.(ii) is further indicated by their respective SEE estimates which are of the order of 1318.30 and 1539.19. The error terms of both the equations are serially correlated. Turning to their predictive capacities, 5.7.(ii) tracks two of the seven turning points correctly, whereas 5.7.(i) tracks only one turning point correctly.

Compared to 5.7.(iii), 5.7.(ii) gives a better explanation of investment. 5.7.(iii) accounts for only 3 percent explanation, and the SEE estimate is of the order of 1595.60.

The next two lines of this table represent the estimates obtained through the application of the relative price specification, to the data. 5.7.(ii) gives a better explanation compared to both 5.7.(iv) and 5.7.(v). 5.7.(ii) accounts for 37.9 percent explanation, whereas 5.7.(iv) and 5.7(v) account for only 8.3 percent and 9.5 percent explanation respectively. The error terms of all the three equations are serially correlated. 5.7.(ii) tracks two of the seven turning points correctly, whereas 5.7.(iv) and 5.7.(v) do not track even one turning point correctly.
In the last four lines of Table 5.7, the speed of adjustment is assumed to be a function of finance variables. Of the four alternatives considered, 5.7.(vii) gives the best explanation. This specification accounts for 14.5 per cent explanation, while the alternates 5.7.(vi), 5.7.(viii) and 5.7.(ix) account for 9.8 per cent, 9.2 per cent and 12.3 per cent explanation respectively. The magnitudes of their respective DW statistic indicates that the error terms of all the four alternatives are serially correlated. 5.7.(vii) tracks two of the seven turning points correctly, each of the three alternates track one turning point. Compared to 5.7.(vi), 5.7.(ii) gives a better explanation. 5.7.(ii) accounts for 37.9 per cent explanation, whereas 5.7.(vii) accounts for only 14.5 per cent explanation. In both the specifications, the error terms are serially correlated. Turning to their predictive capacities, both equations track two of the seven turning points correctly.

For Jay Engineering Works Limited, on the basis of the results discussed so far, the alternative theoretical frameworks of investment behaviour could be ranked in the following manner:

1) The Accelerator Theory, with the specific form which approximates sales expectations with constant change.
2) The theory wherein the speed of investment is assumed to be a function of finance variables.

3) Both the Residual Funds Theory, and the Relative Price Theory.

This ranking is obtained on the basis of the summary measures, and the ex ante forecast measure. The OLS estimates obtained for the parameter coefficients of equation 5.7.(ii) are presented below:

\[
I_t = -9775.6154 + 0.0918 S_{t-1} - 0.0535 \Delta S_{t-1} + 0.0608 K_{t-1}
\]

\[
(2.0630) \quad (2.5758) \quad (2.6098) \quad (1.8241)
\]

\[ R^2 = 0.3794; \; \text{SEE} = 1318.30; \; \text{DW} = 1.0540 \]

All the four variables included in the above specification are significant at the 10 per cent level, and therefore prove to be significant determinants of the investment expenditure. Both the sales change and the capital stock variable have obtained coefficients with the opposite sign.

5.8 **Larsen and Tubro Limited**

Table 5.8 represents the OLS estimates obtained for the data representing the investment behaviour of Larsen and Tubro. This table also presents the summary measures and ex ante forecast measures of the alternate specifications.
The first two lines in this table present the estimates obtained through the application of the accelerator specification, to the data. The insignificant differences in the magnitudes of $R^2$, SEE estimates and in the dimensions of the DW statistics, makes it difficult to choose between the two alternates. The two alternates 5.8.(i) and 5.8.(ii) account for 63.5 per cent and 63.6 percent explanation respectively. Their respective SEE estimates are of the order of 2681.03 and 2764.33. In both the equations, the error terms are not serially correlated, which is apparent from their respective DW statistics. Both equations do not track even one of the eleven turning points correctly.

There is insignificant difference in the magnitudes of $R^2$ and SEE estimates of equations 5.8.(i), 5.8.(ii) and 5.8.(iii). The error terms of 5.8.(iii) however, are serially correlated. This equation tracks one of the eleven turning points correctly.

Lines 4 and 5 represent the estimates obtained through the application of the relative price specification to the data. In this case too, there is insignificant difference in the $R^2$ values and SEE estimates of the two specifications. The error terms of 5.8.(iv) are not serially correlated, the DW statistic being of the order of 1.639. However, the DW statistic in the case of 5.8.(v)
is 1.479, implying that the error terms are serially correlated. Turning to their predictive capacities, 5.8.(v) tracks two of the eleven turning points correctly, whereas 5.8.(iv) does not track even out turning point correctly.

In the last four lines of this table, the speed of adjustment is assumed to be a function of finance variables. The inclusion of the external finance variable leads to a distinct improvement in both the summary measures, and the exante forecast measure. Both equations 5.8.(vii) and 5.8.(ix) wherein the speed of adjustment is taken as a function of external finance, have similar magnitudes of $R^2$ and SEE estimates. The error terms of both the specifications are not serially correlated. Both equations track eight of the eleven turning points correctly.

A cross comparison of the results obtained by the alternate specifications clearly brings out that none of the alternate theories is of any importance for this firm. The inclusion of the external finance variable in the specification of the speed of adjustment, is clearly the best theoretical framework. Such a comparison therefore reveals that for the investment behaviour exhibited by Larsen and Tubro, the alternative theoretical frameworks could be ranked in the following manner:
1) The theory under which the speed of adjustment is assumed to be a function of external finance.

2) The three alternative frameworks, namely, the Accelerator Theory, the Residual Funds Theory, and the Relative Price Theory. For this firm, no clear cut distinction can be made between these three alternative theories of investment behaviour.

5.9 Hindustan Motors Limited

The OLS estimates obtained for alternative specifications for the data representing the behaviour of the Hindustan Motors Limited are presented in Table 5.9, along with the summary measures and exante forecast measures.

An examination of the first two lines of Table 5.9 reveals that of the two alternative specifications that have been taken to represent the accelerator theory, equation 5.9.(ii) gives a better explanation. This equation accounts for 28.3 per cent explanation, whereas 5.9.(i) accounts for 22.8 per cent explanation. The superiority of 5.9.(ii) is further indicated by their respective SEE estimates, which are of the order of 29398.1 and 29528.6. The error terms of both equations are serially correlated. Regarding their predictive capacities, 5.9.(ii) tracks three of the ten turning points correctly, whereas 5.9.(i) does not track even one turning point correctly.
5.9.(iii) gives a better explanation compared to 5.9.(ii). This equation accounts for 46.6 per cent explanation, and the SEE estimate is of the order of 24553.7. Also, the error terms of 5.9.(iii) are not serially correlated, the DW statistic being of the order of 1.933. Equation 5.9.(iii) tracks two of the ten turning points correctly.

Equation 5.9.(iii) also gives a better explanation compared to 5.9.(iv) and 5.9.(v). Due to insignificant difference in the magnitudes of their respective $R^2$ and SEE estimates, it is difficult to choose between 5.9.(iv) and 5.9.(v). Compared to both these equations, 5.9.(iii) however gives a better explanation. 5.9.(iii) accounts for 46.6 per cent explanation, whereas both 5.9.(iv) and 5.9.(v) account for only 22 per cent explanation. Both equations 5.9.(iv) 5.9.(v) have serially correlated error terms. Turning to their predictive capacities, 5.9.(iii) tracks two of the ten turning points correctly, whereas 5.9.(iv) and 5.9.(v) track only one turning point respectively.

Of the last four lines considered in table 5.9, 5.9.(vi) and 5.9.(viii) which assume the speed of adjustment to be a function of internal finance, give a better explanation. It is difficult to choose between 5.9.(vi) and 5.9.(viii) due to the insignificant difference in the magnitudes of their respective $R^2$ values and SEE
estimates, and also in the dimension of their DW statistics. In comparison to these two specifications, 5.9.(iii) gives a better explanation of investment, for the sample period.

A cross comparison of the results discussed so far indicates that of the alternative theoretical basis that have been identified as the plausible explanations of the observed behaviour, 5.9.(iii) is considered to be the best. This comparison also reveals that for the investment behaviour undertaken by Hindustan Motors, the alternate theoretical frameworks could be ranked in the following order:

1) The Residual Funds Theory
2) The theory wherein the speed of adjustment is taken to be a function of retained earnings.
3) Both the Accelerator Theory and the Relative Price Theory.

The OLS estimates obtained for the parameter coefficients of specification 5.9.(iii) which has been identified as the best, are presented below:
\[ I_t = 29954.6757 + 2.0393 \, r_{t-1} - 0.0369 \, k_{t-1} \]
\[ (1.7640) \quad (2.7177) \quad (0.9557) \]

\[ R^2 = 0.4661 \; \text{SEE} = 24553.7, \; DW = 1.9328 \]

In the above specification, retained earnings and the constant term are the two significant determinants of investment, both variables being significant at the 10 per cent level. All the included variables have obtained the right sign.

The four firms chosen from the engineering industry show diverse investment behaviour between themselves and also when compared to the behaviour exhibited by the engineering industry. In the case of THDC, relative prices are the most important determinant, whereas in the case of Jay Engineering works, the accelerator variable plays the significant role in investment behaviour. In the case of Larsen and Tubro, it is difficult to rank the alternate theories, and external finance is clearly the significant determinant of the speed of adjustment. Residual funds determine investment behaviour in the case of Hindustan Motors. With the exception of Larsen and Tubro, finance variables do not influence the speed of adjustment in the case of the three remaining firms. Of the four firms from the engineering industry considered in this study, no two firms exhibit similar investment behaviour.
Compared to the behaviour of the engineering industry, the four firms exhibit diverse investment behaviour. In the case of the engineering industry, relative prices are the most important determinant of investment behaviour, with the speed of adjustment being influenced by both the finance variables. None of the four firms considered, exhibits a similar behaviour.

In their study, Dixit and Prasad have also included Larsen and Tubro and TELCO in their sample. Their results are similar to those obtained in the present study in that relative prices play a significant role in the case of TELCO. However, in their analysis, relative prices play a significant role in the case of Larsen and Tubro also, which is not the conclusion arrived at in the present study.

5.10 **Tata Chemicals Limited**

The OLS estimates obtained for the alternate specifications for Tata Chemicals along with their respective summary measures and exante forecast measures are presented in Table 5.10.

It is difficult to choose between the first two alternatives, which are based on the accelerator theory due to insignificant difference in the magnitude of their respective $R^2$ and SEE estimates. The two

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2 Ibid
specification 5.10.1 and 5.10.2 account for 73.1 per cent and 73.9 per cent explanation respectively and their respective SEE estimates are of the order of 4445.5 and 4522.6. The error terms of both the equations are not serially correlated as is indicated by their respective DW statistics, 1.747 and 2.070. 5.10.(ii) tracks one of the twelve turning points correctly whereas 5.10.(i) does not track even one turning point. Compared to both 5.10.(i) and 5.10.(ii), the equation 5.10.(iii) gives a better explanation of investment of the sample period. This specification accounts for 77.4 per cent explanation and the SEE estimate is 4073.27. The DW statistic is 1.843 implying the absence of serial correlation in the error terms. This specification tracks seven of the twelve turning points correctly.

The next two lines of the table give the estimates obtained through the application of the relative price specifications to the data. Though it is difficult to choose between the two alternatives on the basis of their respective summary measures, 5.10.(v) gives a better quality of prediction. It tracks four of the twelve turning points correctly, while 5.10.(iv) does not track even one turning point correctly. Compared to 5.10.(v), the equation 5.10.(iii) provides a better explanation. 5.10.(iii) accounts for 77.4 per cent explanation compared to 71.2 per cent accounted for by 5.10.(v). The error terms in both the equations are not serially correlated.
Regarding their predictive capacities, 5.10.(iii) tracks seven of the twelve turning points correctly compared to four turning points correctly tracked by 5.10.(v).

The last four lines in this table give the estimates obtained when the speed of adjustment is taken to be a function of finance variables. Equation 5.10.(vi) and 5.10.(viii) which assume the speed of adjustment to be a function of retained earnings give a better explanation compared to 5.10.(vii) and 5.10.(ix) which take the speed of adjustment to be a function of external finance. There is however insignificant difference in the magnitudes of their respective $R^2$ and SEE estimates, which makes it difficult to choose between 5.10.(vi) and 5.10.(viii). Both the specifications track seven of the twelve turning points correctly. In comparison to 5.10.(vi) and 5.10.(viii), the equation 5.10.(iii) is better. An examination of the parameter coefficients of 5.10.(vi) and 5.10.(viii) reveals that retained earnings is the only variable significant at the 10 per cent level in both the specifications. In this context, 5.10.(iii) wherein retained earnings determine the desired level of capital stock is preferred.

A cross comparison of the results discussed so far reveals that for the behaviour undertaken by Tata Chemicals, the alternative theoretical frameworks can be ranked in the following order:
1) The Residual Funds Theory.

2) The theory where the speed of adjustment is a function of retained earnings.

3) Both the Accelerator Theory and the Relative Price Theory.

The OLS estimates obtained for the parameter coefficients of the specification that has been identified as the best, i.e. 5.10.(iii) are presented below:

\[
I_t = -1653.7601 + 1.7050 r_{t-1} + 0.0446 K_{t-1}
\]

\[
(0.7144) \quad (2.4178) \quad (1.9754)
\]

\[R^2 = 0.7738, \quad \text{SEE} = 4073.27, \quad DW = 1.8429\]

The above specification reveals that retained earnings and capital stock are the two significant determinants of the investment expenditure of Tata Chemicals.

5.11 The Alkali and Chemicals Corporation of India Limited

Table 5.11 represents the summary measures and the predictive capacity measures obtained by the alternative specifications for the data representing the behaviour of the Alkali and Chemical Corporation of India Limited.
For this firm, none of the considered alternatives gives a satisfactory explanation of investment for the sample period. With a few exceptions, most of the specifications account for less than 10 per cent explanation and in no case is the explanation more than 17 per cent. The error terms of all the specifications are serially correlated.

Of the two firms considered from the chemical industry, the results obtained for the Alkali and Chemical Corporation of India, are very poor. In the case of Tata Chemicals, the interval liquidity variable, namely retained earnings is the best determinant of investment behaviour.

In comparison, for the chemical industry as a whole, relative prices prove to be the significant determinant of investment behaviour, with the speed of adjustment being influenced by the availability of external finance. In the case of this industry too, there exists differences in the investment behaviour between the firms themselves, and between the firms and the industry.

Both the firms included in the present study form part of the sample in the study by Dixit and Prasad. In both studies, relative prices do not play a significant role in the case of the Alkali and Chemicals Corporation. In the case of Tata Chemicals, the results

3 Ibid.
obtained by the two studies are contradictory. In the present study, relative prices are not found to be significant, whereas in their analysis, Dixit and Prasad find relative prices to be the significant determinant of investment behaviour.

5.12 Straw Products Limited

The OLS estimates obtained for alternative specifications for the data pertaining to the Straw Products Limited, are presented in Table 5.12. This table also present the summary measures obtained by each of the alternate specifications, along with the exante forecast measure.

Insignificant difference in the magnitude of their respective $R^2$ and $SSE$ estimates, and in the dimension of their DW statistics, makes it difficult to choose between the first five lines of the table. In terms of their predictive capacities, while 5.12.(iii) tracks one of the ten turning points correctly, the remaining four alternative specifications do not track even one turning point correctly.

In the last four lines of this table, the speed of adjustment is assumed to be a function of finance variables. Equation 5.12.(vii) and 5.12.(ix) which take the speed of adjustment to be function of
external finance clearly give better results compared to 5.12.(vi) and 5.12.(viii) in which the speed of adjustment is assumed to be determined by internal finance. It is however difficult to choose between 5.12.(vii) and 5.12.(ix) due to the insignificant difference in their respective $R^2$ and SEE estimates, as also in the dimension of their DW statistics. Both specifications track one of the ten turning points correctly. In both specifications, external finance and capital stock are the only two significant variables. This implies that for this firm Straw Products Limited, external finance along with capital stock, is the determining parameter. The alternate theoretical frameworks of investment behaviour can be ranked in the following order, for Straw Products Limited:

1) The theory wherein the speed of adjustment is assumed to be a function of external finance.

2) The three alternates, namely, the Accelerator Theory, the Residual Funds Theory, and the Relative Price Theory.

5.13 Orissa Cement Limited

Table 5.13 present the summary measures and the exante forecast measures obtained by the alternate specifications, for data pertaining to the Orissa Cement Limited.
An examination of the first two lines of Table 5.13 reveals that while 5.13.(i) accounts for 44.2 per cent explanation of investment for the sample period, 5.13.(ii) accounts for 45.7 per cent explanation. Their respective $R^2$ estimates are of the order of 3561.11 and 3628.41. In both equations the error terms are serially correlated with their respective DW statistics being of the order of 1.148 and 1.132. 5.13.(i) tracks two of the six turning points correctly, whereas 5.13.(ii) tracks three turning points correctly. It is therefore difficult to choose between the two alternatives.

Line 3 represents the estimates obtained by the application of the residual funds application to the data. Both 5.13.(i) and 5.13.(ii) give a better explanation compared to 5.13.(iii). 5.13.(iii) accounts for 36.2 percent explanation, and the $R^2$ estimate is of the order of 3807.57. The error terms of this specification are serially correlated, and it does not track even one turning point correctly.

The next two lines of this table present the estimates given by the application of the relative price theory to the data. Of the two alternatives considered, 5.13.(v) gives a better explanation. Equation 5.13.(v) accounts for 61 per cent explanation, whereas 5.13.(iv) accounts for only 46.1 percent explanation. The error
terms of both specifications are serially correlated. Both equations track two of the six turning points correctly. 5.13.(v) also gives a better explanation compared to both equations 5.13.(i) and 5.13.(ii). These two specifications account for 44.2 percent and 45.7 percent explanation respectively.

Of the next four specifications considered, 5.13.(viii) in which the speed of adjustment is taken as a function of retained earnings, and relative prices determine the desired level of capital, gives the best explanation. 5.13.(viii) accounts for 54.7 percent explanation, whereas the three alternates 5.13.(vi), 5.13.(vii) and 5.13.(ix) account for 46.4 percent, 48.4 percent and 48.2 percent explanation respectively. Their respective SEE estimates are of the order of 3313.08, 3603.80, 3535.50 and 3542.46. The error terms of all the four equations are serially correlated. Compared to 5.13.(viii), 5.13.(v) gives a better explanation of investment. 5.13.(v) accounts for 61 percent explanation, and the SEE estimate is of the order of 3075.47, whereas 5.13.(viii) accounts for 54.7 percent explanation, and in this case, the SEE estimate is 3313.08. Regarding their predictive capacities, 5.13.(v) tracks two of the six turning points correctly, whereas 5.13.(viii) tracks only one turning point correctly.
A cross comparison of the results discussed so far indicates that
5.13.(v) is the best explanator of investment behaviour for the
Orissa Cement Limited. The alternative theoretical frameworks can
be ranked in the following order:

1) The Relative Price Theory with the specific form wherein
   expectations are approximated by constant change.

2) The theory wherein the speed of adjustment is taken to be
   a function of finance variables, and the desired level of
   capital stock is determined by relative prices.

3) The Accelerator Theory, and

4) The Residual Funds Theory.

The OLS estimates obtained for the parameter coefficients of
equation 5.13.(v) are presented below:

\[ I_t = -3575.9530 - 0.0211 \left( \frac{P_t Q_t}{C_{t1}} \right)_{t-1} + 0.0826 \Delta \left( \frac{P_t Q_t}{C_{t1}} \right)_{t-1} + 0.1098 K_{t-1} \]

\[ (0.4720) \quad (0.4273) \quad (2.3931) \quad (2.3671) \]

\[ R^2 = 0.6098 ; \quad \text{SEE} = 3075.47 ; \quad \text{DW} = 1.3338 \]
In the above specification, change in relative prices and capital stock are the two significant determinants of investment behaviour. Both variables are significant at the 10% level. All the included variables (except change in relative prices) have attained coefficients with opposite signs. This could be attributed to the problem of multicollinearity.

5.14 The Associated Cement Company Limited

In the case of this firm, it is difficult to identify any one particular specification as the best. All equations have very insignificant differences in the magnitudes of their respective $R^2$ and SEE estimates. Also, none of the equations have serially correlated error terms. For this firm, capital stock is the only variable significant in all the specifications. None of the other considered variables prove to be significant determinants of investment expenditure.

5.15 Shree Digvijay Cement Company Limited

Like the Associated Cement Company, in the case of this firm too, it is not possible to rank the alternative explanations of investment behaviour. For this firm too, capital stock is the only consistently significant variable. None of the alternative variables used to denote desired capital stock, prove to be
Of the three firms included from the cement industry, a clear ranking of the alternate theories of investment behaviour is possible only in the case of Orissa Cement Limited. For this firm, relative prices are the significant determinant of investment behaviour, and neither of the 'finance variables influences the speed of adjustment. In the case of the Associated Cement Company and Shree Digvijay, capital stock is the only significant determinant, implying the significance of the trend variable.

In the aggregate analysis of the cement industry, sales is the most important determinant of investment behaviour, and the availability of external finance influences the speed of adjustment. None of the firms considered in the present study shows an investment behaviour similar to the cement industry.

Dixit and Prasad include the Associated Cement Company in their sample. In their study too relative prices do not determine the investment behaviour of this firm.

4 Ibid.
5.16 **Some Inferences**

The empirical analysis carried out in this chapter clearly reascertains the conclusion arrived at in the previous chapter that there exist differences in investment behaviour at the aggregate level and at the disaggregated level. The difference in investment behaviour between the aggregate manufacturing sector, and the industries which compose it, is further brought out in the present chapter. The firm level analysis carried out in this chapter clearly indicates that there exist differences in the investment behaviour between firms from the same industry. This analysis proves the hypothesis that macrotheory need not have an exact correspondence with some accepted microtheory. This conclusion is of particular relevance when the alternative theories are to be tested using econometric methods, as was done in this chapter. The ranking of variables according to their importance in the explanation of investment behaviour may well be different for macro and micro explanations.