CHAPTER 6

INVESTMENT, DIVIDENDS AND EXTERNAL FINANCE: A SIMULTANEOUS DETERMINATION

In this chapter, the problem of simultaneous determination of investment, dividends and external financing decisions is examined in the framework of simultaneous equation model.

6.1 THE LOGIC OF INTERDEPENDENCE:

The first attempt to study the three decisions of investment, dividends and external finance was done by Dhrymes and Kurz (1967). The preceding chapters traced the determinants of fixed investment, inventory investment, dividends and external finance and the quantitative significance of those determinants to each separately, in the framework of single linear multiple regression models, estimated by ordinary least squares method. The OLS results brought out the inverse relationship between fixed capital investment and inventory investment, quantitatively each serving as an explanatory variable to the other in their estimated regressions. Further, dividend decisions were autonomous with respect to its determinants in the sense that estimated regressions of dividends did not exhibit any explanatory variable to be statistically significant. Since these explanatory variables form part of investment and external
financing decisions, we require to examine whether external financing and investment decisions and dividends are so mutually dependent or otherwise in estimation of simultaneous linear equation models. Estimation of such simultaneous relationships by ordinary least squares method leads to simultaneous equation bias. Since, it is necessary to make reliable, stable and a correct appraisal of the interdependence among the three decisions and the statistical significance of their determinants, it is appropriate to approach the problem in a simultaneous equation framework. For this purpose, the Two stage least squares method is used.

The simultaneous equation model has four behavioural equations, one each for fixed investment, inventory investment, dividends and external finance. The four endogenous variables of the system are fixed investment \((I(t))\), Inventory Investment \((IN(t))\), Dividends \((DIV(t))\) and External Finance \((FNDE(t))\). The exogenous variables are sales changes \((\Delta st)\), retained earnings \((RENT(t))\), and profits after tax \((PAT(t))\), stock of net debt \((NDE(t-1))\), lagged dividends \((DIV(t-1))\), total investment expenditures \((I(t) + IN(t))\) and investment allowance reserve \((IAR(t))\).

All the variables are at current prices. All the variables except sales change are deflated by capital stock of the previous
year. Sales change variables are deflated by sales of previous year.

The equations of the system are:

\[
\frac{I(t)}{K(t-1)} = a + \sum_{r=0}^{3} b_r \frac{\Delta S(t-r)}{S(t-r-1)} + \sum_{r=0}^{3} c_r \frac{RENT(t-r)}{K(t-r-1)} \\
+ \sum_{r=0}^{2} d_r \frac{FNDE(t-r)}{K(t-r-1)} + \sum_{r=0}^{2} e_r \frac{IAR(t)}{K(t-r-1)}.
\]  

\( (6.1) \)

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

\( (6.2) \)

\[
\frac{FNDE(t)}{K(t-1)} = a + b \frac{RENT(t)}{K(t-1)} + c \frac{IN(t)}{K(t-1)} + d \frac{I(t)}{K(t-1)} \\
+ e \frac{NDE(t-1)}{K(t-1)}
\]  

\( (6.3) \)

\[
\frac{DIV(t)}{K(t-1)} = a + b \frac{PAT(t)}{K(t-1)} + c \frac{FNDE(t)}{K(t-1)} + d \frac{I(t)+IN(t)}{K(t-1)} \\
+ e \frac{DIV(t-1)}{K(t-1)}
\]  

\( (6.4) \)

\[
PAT(t) = DIV(t) + RENT(t)
\]  

\( ... (6.5) \)

This system of equations fulfils the rank and order conditions of identification and is over-identified, and hence it
is estimated by the method of two-stage least squares (2SLS). Equation (6.5) is an identity representing the division of profits between dividends and retained earnings.

6.2 PRESENTATION OF RESULTS:

6.2.1 Cross Section Analysis:

Cross section results estimated by the method of two stage least squares for specification (6.1) are given in the table V.1 for \( r = 0 \). The \( R \) values in this case range from 0.37 to 0.82. The variables flow of net debt and investment allowance reserve are significant in all the regressions. Retained earnings is not significant. The sales change variable is significant in a few of the regressions.

The results of specification (6.1) for \( r = 0,1 \) are presented in table V.2. The \( R \) s here range from 0.65 to 0.94. The same conclusions, drawn in the previous case apply here also. The lagged variables are not statistically significant.

Table V.3 presents results of the same specification for \( r = 0,1,2 \). The \( R \) values in this case range from 0.50 to 0.93. The current sales change variable is significant in some years. The lagged sales change variables also are significant in a few equations. Investment allowance reserve is significant in more
than half of the regressions, while flow of net debt is significant throughout, in all the equations. The lagged variables of the variables concerned are not statistically significant.

The results of specification (6.1) for the case $r = 0, 1, 2, 3$ are given in table V.4. The $R^2$'s here range from 0.58 to 0.94. The conclusions drawn in the earlier case apply here also.

To sum up, in the estimated specification (6.1), of simultaneous system, flow of net debt and investment allowance reserve have performed very well followed by sales change variables both current and lagged ones.

The cross section results of specification (6.2) for $r = 0$ are presented in table V.5. The $R^2$ values in this case have fared extremely well, with more than 0.99 in all the regressions. The reason for this is that the included explanatory variables are adequate, representative and are statistically significant. Retained earnings, sales change and flow of net debt show positive impact on inventory investment. Fixed investment shows negative influence on inventories. Inventory stocks to sales ratio is negatively significant. Stock of inventories at the beginning of the period shows positive influence. The cost of funds variable has not proved to be significant.
The results of the same specification for $r = 0, 1$ and $r = 0, 1, 2$ are presented in tables V.6 and V.7 respectively. The $R$ values in these two cases are well over 0.99 in all the regressions. The conclusions drawn from table V.5 apply here also. The lagged variables are also significant. The lagged variables of retained earnings are negatively significant. The cross section results of specification (6.3) are presented in table V.8. The $R^2$ values in this case are well over 0.99 in all the regressions. Fixed investment, inventory investment and stock of net debt at the end of period $t-1$ are positively significant to influence external finance. Retained earnings is negatively significant. Sales change variable has not exerted any influence on external finance. This suggests that the demand for external finance depends on the level of fixed and inventory investment expenditures and net debt of earlier years. The larger the retained earnings the firm has, the lesser will be the demand for external funds.

The cross section results of the specification (6.4) are presented in table V.9. The $R$ values here range from 0.45 to 0.79. Dividends at the end of period $t-1$ is statistically significant, while profit variable is significant in some of the regressions. Flow of net debt and total investment expenditure variables are not significant. This shows that dividend decisions are autonomous of investment decisions.
6.2.2 Pooled Cross Section Analysis:

The pooled cross section results of specifications (6.1), estimated by the method of 2 SLS are as follows:

\[
\frac{I(t)}{K(t-1)} = -0.0217^* + 0.0655 \frac{\Delta S(t)}{S(t-1)} + 0.0880 \frac{\Delta S(t-1)}{S(t-2)} \\
+ 0.1017 \frac{\Delta S(t-2)}{S(k-3)} - 0.0643 \frac{\text{RENT}(t)}{K(t-1)} \\
+ 0.0292 \frac{\text{RENT}(t-1)}{K(t-2)} - 0.1669 \frac{\text{RENT}(t-2)}{K(t-3)} \\
+ 0.2244 \frac{\text{FNDE}(t)}{K(t-1)} - 0.0014 \frac{\text{FNDE}(t-1)}{K(t-2)} \\
+ 0.0005 \frac{\text{FNDE}(t-2)}{K(t-3)} + 1.5272 \frac{\text{IAR}(t)}{K(t-1)} \\
- 1.2894 \frac{\text{IAR}(t-1)}{K(t-2)} + 0.4177 \frac{\text{IAR}(t-2)}{K(t-3)} \\
\text{[for } r = 0, 1, 2\text{]} R^2 = 0.6949 \\
\frac{F}{180.9375}
\]

The estimated specification (6.2) is given by,

\[
\frac{\text{IN}(t)}{K(t-1)} = 0.0757^* + 0.0669 \frac{\Delta S(t)}{S(t-1)} + 0.0778 \frac{\Delta S(t-1)}{S(t-2)} \\
+ 0.1404 \frac{\Delta S(t-2)}{S(t-3)} + 1.0558 \frac{\text{RENT}(t)}{K(t-1)} \\
- 0.3168 \frac{\text{RENT}(t-1)}{K(t-2)} - 0.4843 \frac{\text{RENT}(t-2)}{K(t-3)} \\
+ 1.2099 \frac{\text{FNDE}(t)}{K(t-1)} - 0.0062 \frac{\text{FNDE}(t-1)}{K(t-2)}
\]
The specification (6.3) estimated for pooled cross section data is given by,

\[
\frac{\text{FNDE}(t)}{K(t-1)} = \frac{0.0104^*}{7.5517} - \frac{1.0010}{-216.8440} \frac{\text{RENT}(t)}{K(t-1)} + \frac{0.3651}{51.6003} \frac{\text{I}(t)^*}{K(t-1)} \\
+ \frac{1.2119}{475.5929} \frac{\text{IN}(t)^*}{K(t-1)} + \frac{0.0221}{27.8312} \frac{\text{NDE}(t-1)^*}{K(t-1)},
\]

\[R^2 = 0.9984, \; F = 378.1818\]

The specification (6.4) estimated for pooled cross section data is given by,

\[
\frac{\text{DIV}(t)}{K(t-1)} = \frac{0.0049^*}{8.5358} - \frac{0.0122}{-2.5589} \frac{\text{FNDE}(t)^*}{K(t-1)} + \frac{0.0111}{2.2728} \frac{\text{I}(t)+\text{IN}(t)^*}{K(t-1)} \\
+ \frac{0.0114}{2.6695} \frac{\text{PAT}(t)^*}{K(t-1)} + \frac{0.7023}{33.5118} \frac{\text{DIV}(t-1)^*}{K(t-1)},
\]

\[R^2 = 0.5671, \; F = 373.1579\]
In the above estimated equations, the financial variables flow of net debt, profits after tax and retained earnings are significantly influencing fixed investment and inventory investment, while sales change variables are weak in influencing them.

6.3 INTERDEPENDENCE OF THE THREE DECISIONS:

The complete interdependence among the three decision variables, investment, retained earnings and external finance is not observed. However, a two-way interaction is observed between fixed and inventory investment decisions. These two decisions are found to be having an inverse relationship. Interdependence between external financing decision and investment decisions is observed. The two-way interaction between dividend policies and investment decisions is absent. Dividend policies are found to be independent of investment decisions and the availability of external finance. The influence of profits on dividend policies is not observed.

6.4 COMPARISON OF 2 SLS RESULTS WITH OLS RESULTS:

A comparison of the 2 SLS results, with the OLS results analysed in the previous chapters shows that more or less both results are concurrent.
The finding, that the effect of accelerator is absent in Indian sugar industry holds good in the case of 2SLS results also. The importance of financial flow variable, external finance in explaining fixed and inventory investment is observed in both OLS and 2SLS results. Investment allowance reserve is found to be an important determinant of fixed investment in both OLS and 2SLS cases. Retained earnings and profit after tax have weak statistical significance and poor impact on fixed investment, whereas they have more influence on inventory investment. This finding is also true with both 2SLS and OLS results.

The finding that fixed and inventory investment are inversely related is also true in both 2SLS and OLS cases. The observation that dividend decisions are autonomous of fixed and inventory investment is also true in both the cases.

6.5 CONCLUSIONS:

1. The simultaneous equation model is over-identified and hence 2 SLS method of estimation was adopted.

2. Complete interdependence among all the three decisions variables, investment, dividends and external finance is found to be absent, mostly on account of autonomous dividend decisions, independent of all of its explanatory variables which influence the other dependent variables.
3. Inverse relationship between fixed and inventory investment is present in the sugar industry.

4. Interdependence between investment and external financing decisions is observed.

5. Investment and dividend policies are not directly dependent but are so, as a residual of profits minus retained earnings.

6. The effects of accelerators in explaining both fixed and inventory investment are not serious in sugar industry in terms of their statistical significance.

7. The results are free from econometric estimation problems like multicollinearity, heteroscedasticity and auto-correlation.

Order Condition for Identification:

In a model of M simultaneous equations, in order for an equation to be identified, the number of pre-determined variables excluded from the equations must not be less than the number of endogenous variables included in that equation, less one.

Rank Condition:

In a model containing M equations in M endogenous variables, an equation is identified if and only if there exists at least one non-zero determinant of order M-1, from the coefficients of the variables excluded in one particular equation but included in the other equations of the model.